Exceptional Children

Vol. 78, No. 1, pp. 73-87.

Efficacy of a Reading Intervention for Middle School Students With Learning Disabilities

JEANNE WANZEK
Florida State University

SHARON VAUGHN

GREG ROBERTS
The University of Texas at Austin

JACK M. FLETCHER
University of Houston

ABSTRACT: *This experimental study reports findings on the effects from a year-long reading intervention providing daily 50-min sessions to middle school students with identified learning disabilities (n = 65) compared with similar students who did not receive the reading intervention (n = 55). All students continued to receive their special education services as provided by the school. Statistically significant results favored the treatment group for sight word reading fluency following intervention. Small effects were found for phonemic decoding fluency and passage comprehension. No other statistically significant differences were noted between groups. The findings suggest that although gains on word reading fluency resulted from the additional reading treatment, accelerating the reading performance of students identified with learning disabilities may be unlikely to result from a 1-year daily intervention provided in groups of 10 to 15 students.*

Over the past 2 decades, considerable attention has focused on beginning reading instruction, including an emphasis on designing and implementing effective interventions to prevent reading problems in young children (Fletcher, Lyon, Fuchs, & Barnes, 2007; Torgesen, Rose, Lindamood, Conway, & Garvan, 1999; Vellutino, Scanlon, Small, & Fanuele, 2006; Wanzek & Vaughn, 2011). Findings from these studies have provided a foundation for designing appropriate instruction for students with reading difficulties and disabilities with an aim toward preventing reading problems. Despite their documented effectiveness, these interventions have either been

inadequately implemented or are insufficient to prevent reading difficulties in older students. To illustrate, although recent *National Assessment of Educational Progress* (National Center for Education Statistics, 2007) data showed a slight gain in fourth- and eighth-grade reading comprehension scores since 1992, 26% of students still read below basic—which means that they cannot understand grade-level text.

Remediation of reading difficulties in older students may require considerable intensity and differentiation of instruction. A significant problem is that intensive, small-group instruction provided by highly skilled teachers is an expensive and infrequently applied instructional practice within most educational settings (Vaughn, Levy, Coleman, & Bos, 2002; Vaughn, Moody, & Schumm, 1998). Therefore, it is perhaps not surprising that the few available studies of students who receive special education services show flat levels of growth and little evidence that interventions through special education actually close the achievement gap (Bentum & Aaron, 2003; Foorman et al., 1997; Hanushek, Kain, & Rivkin, 1998; Torgesen et al., 2001).

Beyond inclusion, resource rooms, and other standard special education practices, there is relatively little research on reading interventions for middle school students with reading disabilities. In 2007, Scammacca and colleagues conducted a meta-analysis of reading intervention studies with older students with reading disabilities. There were 17 studies examining interventions for students with learning disabilities (LD) that met criteria for the meta-analysis. The interventions in these studies were brief (all but one was conducted for less than 15 hr of intervention) and 15 of the studies used researcher-developed measures that were associated with higher effects than the standardized measures. The majority of the interventions addressed the reading components of vocabulary and comprehension. Overall, the authors identified several key findings from their analyses about reading interventions for older students with LD:

- Students demonstrated gains from the interventions with large effect sizes reported for reading comprehension on researcher-developed outcome measures; however, it was not possible to determine the extent to which these gains actually resulted in overall advancement—meaning that students were closing the gap with typical readers—or merely making gains relative to comparison but not actual normative progress.
- Students benefited from a range of intervention types including word- and text-level interventions as well as vocabulary and comprehension interventions.
- There were an inadequate number of experimental studies, conducted over extensive time (> 10 hr of intervention) and utilizing standardized measures as outcomes.

Recently, a practice guide (Kamil et al., 2008) provided a summary of effective practices for adolescent literacy broadly, not specifically for students with LD or reading difficulties. They identified three practices that had strong research evidence: (a) providing explicit vocabulary instruction, (b) providing direct and explicit comprehension instruction, and (c) providing intensive and individualized interventions by trained specialists. The recommendation for providing intensive interventions was derived from approximately 12 small-scale studies, many of which were not focused specifically on students with LD. The practice guide indicated a strong need for a more comprehensive investigation into the efficacy of interventions for older students with reading difficulties.

THE PRESENT STUDY

Conceptual Framework

The conceptual framework that guided the development and implementation of this study is a response-to-intervention (RTI) approach to preventing and remediating learning and behavior problems. The RTI framework is broadly defined as providing universal screening, ongoing progress monitoring, and/or curriculum-based measurements with research-based classroom instruction (Tier 1), and increasingly layering more intensive interventions to meet students' instructional or behavioral needs (Fletcher & Vaughn, 2009; Vaughn & Fuchs, 2003). After students with per-

sistent learning or behavior problems are identified, research-based interventions are implemented to address the problem, and students' responses are monitored. RTI frameworks provide a schoolwide model for addressing students' problems, evaluating the efficacy of interventions at the child level, and then determining whether additional interventions or alternative approaches are needed. These models have been influenced by public health models of disease prevention that consider primary health needs through a prevention model (e.g., regular check-ups, exercise, appropriate monitoring of blood pressure) and then secondary and tertiary levels of health support that increase in cost and intensity depending upon the initial needs or response to treatment (Vaughn, Wanzek, & Fletcher, 2007). There are many iterations on these models and although a few have been implemented at the secondary level, the vast majority are elementary-focused (Fuchs & Deshler, 2007; Mastropieri & Scruggs, 2005). Although RTI has achieved recognition as a recommended practice for elementary students, considerably less is known about the efficacy of RTI-type frameworks for secondary students, particularly students with learning disabilities. This study was designed to further enhance the knowledge about the use of an RTI-type framework for middle school students with learning disabilities.

Although RTI has achieved recognition as a recommended practice for elementary students, considerably less is known about the efficacy of RTI-type frameworks for secondary students, particularly students with learning disabilities.

Focus

We are particularly concerned about determining effective reading interventions for students with LD with reading problems in the middle grades. There are few experimental studies examining the efficacy of comprehensive multicomponent reading interventions for older students with identified LD who demonstrate reading problems. The purpose of this experimental study was to determine whether students who are identified with LD and exhibiting reading problems benefit from a supplemental, remedial intervention in addition to their typical instruction for general and special education when compared with students with LD who do not receive the remedial intervention.

We recognize that education leaders are promoting interventions for adolescents with reading problems and that the differential performance of students with LD has been inadequately studied (Biancarosa & Snow, 2004). One of the reasons there are few large-scale experimental studies examining the efficacy of interventions with older students with LD is the complexity of randomizing students with LD to treatment and comparison conditions, particularly in target areas such as reading where the vast majority of students with LD demonstrate learning difficulties and it is not allowable to discontinue special education services. To accommodate this challenge, all students in this study continued in their typical general and special education classes. We provided students assigned to the treatment condition a supplemental, remedial reading intervention class for one period a day, 5 days a week for the entire school year. Students assigned to the comparison condition were provided with an elective such as art or band. This design allowed us to determine the relative effects of additional reading intervention support for students with identified LD and reading problems. We hypothesized that students who were randomized to a supplemental reading intervention would outperform students who participated in nonreading elective classes, on both word reading and comprehension outcomes.

METHOD

Participants

This study included sixth- to eighth-grade students identified with LD who participated in a larger study of middle school reading intervention for students struggling with reading (Vaughn, Cirino, et al., 2010; Vaughn, Wanzek, et al., 2010). The study was conducted in seven middle schools (Grades 6–8) in three school districts in two large urban cities in Texas. Three schools from a large urban district in one city

and four schools from two medium-size districts participated.

We used the state accountability test results, Texas Assessment of Knowledge and Skills (TAKS; Texas Education Agency, 2004), administered in the spring of the year prior to intervention, to identify struggling readers in the LD population. Students were included in the study if they were identified by the school district with LD and either (a) failed the TAKS reading achievement test, (b) obtained a score on the TAKS reading test that fell within one half of a standard error of measurement above the passing score (a 95% confidence interval of their observed score suggesting that their true score would fall substantially below the passing standard), or (c) took the School Determined Alternative Assessment in lieu of TAKS.

A total of 135 students with LD were included in the sample for the present study. As part of the larger study, 76 of these students were randomly assigned to receive a supplemental reading intervention in addition to their general and special education classes and 59 students with LD were randomly assigned to the school comparison group (i.e., did not receive the supplemental intervention but continued to receive the same special education and general education classes). In the larger study, treatment students were assigned randomly two for every one comparison to adequately power the study. A total of 120 (65 treatment and 55 comparison) completed the intervention and had posttest data. A total of 46 students (35 treatment and 11 comparison) were available at follow-up 4 months later.

Fifty-eight percent of the treatment students were African American, 12% were Caucasian, and 26% were Hispanic. In the comparison group the distribution was 51%, 20%, and 27%, respectively. Sixty-four percent of the students in the study qualified for free or reduced-price lunch programs during the intervention year (68% in treatment and 58% in comparison).

Description of Instruction

Typical Classroom Instruction. All students in the study continued to receive their usual content-area instruction and special education instruction. General education classes, including English language arts, math, science, and social studies, were typically held daily from 45 to 50 min each (one class period) with class sizes of about 20 to 25 students. To enhance the overall reading instruction for all students in the middle schools, all content area teachers (i.e., general education, remedial, and special education) were provided professional development on evidence-based practices for teaching vocabulary and comprehension by the research team (Denton, Bryan, Wexler, Reed, & Vaughn, 2007). Teachers attended a 6-hr professional development session at the beginning of the school year, then met in study groups at their respective schools approximately once a month throughout the school year. In six of the schools, study groups consisted of interdisciplinary teams, whereas one school framed study groups by department area. In-classroom coaching was also provided by request.

Teachers attended a 6-hr professional development session at the beginning of the school year, then met in study groups at their respective schools approximately once a month throughout the school year.

We coached teachers in vocabulary and comprehension strategies using an instructional routine consisting of explicit modeling, demonstration, or description, followed by guided and independent practice. We provided guidance for selecting appropriate academic and content-specific vocabulary words, assisting students in decoding the words with word parts, and introducing new word meanings with student-friendly definitions and the use of examples and nonexamples to help students understand word meaning. We also taught teachers to use graphic organizers to provide a framework for vocabulary instruction. In addition, this professional development included guidance in implementing comprehension strategies such as teaching students to generate different types of questions, using main idea and summarizing strategies to complete note-taking guides and identify text structures, and use of graphic organizers to understand connections in text. During the monthly study group sessions teachers worked with a facilitator to apply these

strategies while planning lessons in their own content areas.

Special Education and Remedial Instruction. We collected data on the reading instruction students received as part of their special education program. Just under half of the students with LD in the study (47%; n = 64 students) participated in all general education classes with special education support as designated by their individualized education programs (IEPs). These students did not receive any reading instruction outside of general education. The other 71 students (53%) participated in remedial or special education reading classes in place of one or more general education classes in their class schedule. Of these 71 students, 33 students were in the treatment group (43% of the treatment group) and 38 students were in the comparison group (64% of the comparison group). Schools may have considered the supplemental reading intervention provided by the research team as an existing remedial class and, therefore, provided fewer typical remedial classes for the students in the treatment group while allocating more resources to students in the comparison group. However, we do not have any systematic evidence to confirm this possibility and schools continued to implement all services as designated by student IEPs. Thus, the designated special education for students was not affected by the study, although it appears students in the comparison group may have received more of the remedial classes offered to struggling readers in the schools. Eleven students (four in treatment; seven in comparison) participated in two remedial reading classes during the school day and two treatment students participated in three remedial reading classes in place of general education classes during the school day.

Remedial reading classes provided to students by the school were generally held daily (89% of students in remedial classes participated daily) for 45 to 50 min (one class period). About 10% of the students participated in a remedial reading class scheduled for 90 min daily. Group sizes for the remedial classes were generally smaller than typical general education classes. About 56% of the students participated in classes with 10 to 15 students. Another 21% of students in remedial classes were in class sizes of five to 10 students. Fifteen percent had smaller classes (2–5 students) and 9% were in classes larger than 15 students.

Supplemental Intervention (Treatment). The students with LD who were randomly assigned to the treatment condition were provided an additional reading intervention for one class period per day (45–50 min per day). The supplemental intervention took the place of an elective class in the student's schedule and did not replace any of the typical instruction in content areas or special education. Students in the comparison group continued to receive the elective class (e.g., art, band) they had in their schedule. The intervention combined vocabulary and comprehension techniques with opportunities for guided discussion to address student needs in understanding the words and text (Baumann, Edwards, Bolnad, Olejnik, & Kame'enui, 2003; Beck, McKeown, & Kucan, 2002; Gersten, Fuchs, Williams, & Baker, 2001; Mastropieri, Scruggs, & Graetz, 2003). Given that many older students with reading problems continue to struggle with decoding words (Paulesu et al., 2001) and reading less phonetically regular words with automaticity (Goswami, 1993), we also included explicit instruction in English phonology, recognizing high-frequency words accurately and quickly, and a strategy for applying phonics elements to reading multisyllable words.

The students were placed in small class sizes of 10 to 15 students for the supplemental intervention with other students with reading difficulties that were participating in the larger study. The intervention groups were formed based on student class schedules and their TAKS (Texas Education Agency, 2004) score from the previous year. Groups were homogeneous to the extent possible based on class schedule.

The intervention included three phases of instruction. Students needed to be able to respond to each aspect of the lesson automatically without prompts prior to the teacher moving to the next skill or lesson. If only one or two students in the class did not demonstrate mastery, the teacher moved onto the next skill or lesson to meet the needs of the other students in the class and then provided review activities to the students who needed additional opportunities for practice.

Phase 1 of the intervention emphasized word recognition and fluency, with additional instruc-

tion in vocabulary and comprehension. Phase 1 consisted of approximately 25 lessons taught over 7 to 8 weeks. Word recognition was promoted using the lessons in REWARDS Intermediate (Archer, Gleason, & Vachon, 2005a) to teach phonological elements and advanced strategies for decoding multisyllabic words. Progression through lessons was dependent on students' mastery of sounds and word reading. Students received daily instruction and practice with individual letter sounds, letter combinations, and affixes as well as application of a strategy to use word parts to decode and spell multisyllabic words. Fluency was promoted by using oral reading fluency data and pairing higher and lower readers for partner reading. Students engaged in repeated reading daily with their partner with the goal of increasing accuracy and rate (approximately 10 min daily). Vocabulary was addressed by teaching the meaning of words through basic definitions and providing examples and nonexamples (pictures, sentences, demonstrations, etc., as appropriate) of how to use the words. Newly introduced vocabulary words were then reviewed daily, with students matching words to appropriate definitions or examples of word usage. During Phase 1, students read connected text consisting of narrative and expository passages for application of the word recognition and vocabulary instruction (approximately 20 min daily). Intervention teachers provided instruction in locating information in text and rereading text to monitor comprehension. Students used these strategies to answer comprehension questions following each reading.

Phase 2 of the intervention emphasized vocabulary and comprehension, with additional instruction and practice provided for applying the word recognition and fluency elements learned in Phase 1. Phase 2 lessons occurred over a period of 17 to 18 weeks, depending on students' progress. The word recognition skills and strategies taught in Phase 1 were reviewed daily in Phase 2 with explicit application of the phonic elements and decoding strategies to reading and spelling of new vocabulary words. After reading words, vocabulary instruction continued with students being provided basic definitions for each word (orally and in writing), followed by engagement in activities to practice word meaning, including identifying the appropriate word to match various scenarios, examples, or descriptions. In addition, students were introduced to word relatives and parts of speech (e.g., *politics*, *politician*, *politically*). Vocabulary words for instruction were chosen from the text read in the fluency and comprehension component. Three days a week, teachers used REWARDS Plus Social Studies lessons and materials (Archer, Gleason, & Vachon, 2005b). Two days a week, teachers used novels with lessons developed by the research team. Students were taught strategies for understanding each type of text (i.e., expository and narrative) including identifying the structural features of the text and identifying questions to be answered in various sections of the text. Each day, students read the text at least twice for fluency. Connected text reading occurred between 20 and 40 min each day depending on the designated lesson. Students worked with partners to increase their accuracy and rate of reading. Intervention teachers provided feedback. Students also received explicit instruction in comprehension and understanding text. Comprehension elements covered generating questions of varying levels of complexity and abstraction while reading (e.g., literal questions, questions requiring students to synthesize information from text, and questions requiring students to apply background knowledge to information in text); identifying main idea; summarizing text; and using strategies to answer multiple-choice, short-answer, and essay questions. These skills were practiced both orally and through writing with explicit instruction on forming written responses.

Phase 3 continued the instructional emphasis on vocabulary and comprehension, with more time spent on independent student application of the skills and strategies introduced in Phase 2. Phase 3 occurred over approximately 8 to 10 weeks. Fluency and comprehension were taught through application of strategies for reading and understanding text to both expository science and social studies content and narrative text (novels), with a focus on applying the strategies to independent reading. Students read passages twice for fluency, generated questions while reading, and addressed comprehension questions related to all the skills and strategies learned (e.g., multiple choice, main idea, summarizing, literal information, synthesizing questions, background knowl-

edge) independently before discussing. Review of word recognition strategies and introduction of new vocabulary was provided daily with words selected from the text.

Supplemental Intervention Implementation

Intervention Teachers. The research team hired 14 intervention teachers (11 female) to provide the supplemental intervention as part of the larger study. All teachers had at least an undergraduate degree, and 10 teachers had a master's degree. Eight of the 14 teachers had teaching certification in a reading or a reading-related area such as English/Language Arts. Two of the teachers were certified in special education.

The intervention teachers participated in 60 hr of professional development prior to the intervention implementation. The research team provided the training including sessions related to the components of the standardized intervention, features of effective instructional delivery (e.g., modeling, teaching in manageable steps), behavior management, and principles of promoting active engagement during lessons. The teachers received an additional 9 hr of professional development related to the intervention throughout the year to review information prior to each phase of instruction. In addition, all the teachers participated in biweekly staff development meetings to discuss student needs and instruction along with ongoing on-site feedback and coaching provided once every 2 to 3 weeks.

Intervention Fidelity. Project coordinators for the research team observed each intervention teacher two to three times each month and provided feedback on implementation. In addition, frequent team meetings were held within sites, and the team held conference calls across sites, to promote consistent implementation. We collected fidelity data throughout the year for each intervention teacher on up to 5 different instructional days (median = 3.5).

Two observers from the research team monitored fidelity and consistency of intervention implementation, rotating each month so that both observers saw every teacher. Prior to formal data collection, we trained the two observers on the fidelity measure and calculated interrater reliability as the number of agreements divided by the sum of the number of agreements and number of disagreements. Interrater reliability was 100% on the first observation, 93% on the second observation, and 94% at mid-year.

We coded fidelity by rating each of the instructional components on a 3-point Likert-type rating scale ranging from 1 (low implementation) to 3 (high implementation). Quality of implementation (e.g., active engagement, frequent opportunity for students' responses, appropriate use of feedback and pacing) was rated on the same 3-point Likert-type scale for each of the instructional components. A score of 3 (excellent) meant the teacher completed all or nearly all of the required elements and procedures. A score of 2 (adequate) indicated that most of the required elements and procedures were completed. A score of 1 meant that less than half of the required elements and procedures were completed for a given component of the lesson. If a teacher did not include a required component a score of zero was given when calculating the mean scores. The mean implementation score for the intervention across components and observations ranged from 2.22 to 3.00. The mean quality score for the intervention across components and observations ranged from 2.10 to 2.93. The mean total fidelity ranking (implementation of components and quality of instruction) ranged from 2.13 to 2.96.

Measures

We assessed all participants on measures of word decoding, word reading, and comprehension at the beginning of the school year prior to intervention (pretest), at the end of the school year immediately following intervention (posttest), and again in the fall of the next school year approximately 4 months after completion of intervention (follow-up).

Woodcock-Johnson III Tests of Achievement (WJ-III; Woodcock, McGrew, & Mather, 2001). The WJ-III is an individually administered, untimed battery of cognitive and achievement tests. We administered the Letter Word Identification, Word Attack, and Passage Comprehension subtests at pretest, posttest, and follow-up to assess word reading accuracy as well as reading comprehension. Letter Word Identification assesses the

ability to read real words. Word Attack measures the ability to decode nonsense words. The Passage Comprehension subtest is a cloze-based assessment in which students read a passage and fill in a missing word. Coefficient alphas in the Grade 6 sample of 327 struggling readers and 249 typical who contributed data to the larger study for Letter Word Identification, Word Attack, and Passage Comprehension subtests at pretest were .97, .93, and .94, respectively, and at posttest .92, .99, and .85, respectively. Coefficient alphas in the Grade 7 to 8 sample of 436 struggling readers and 440 typical who contributed data in the larger sample for Letter Word Identification, Word Attack, and Passage Comprehension subtests at pretest were .98, .94, and .96, respectively, and at posttest .97, .99, and .83, respectively. The criterion related validity of Letter Word Identification with TAKS Reading (Texas Education Agency, 2004) was 0.52, WJ-III Word Attack with TAKS Reading was 0.34, and WJ-III Passage Comprehension with TAKS was 0.61 in a sample of 1,421 middle school students in Grades 6 to 8.

Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner, & Rashotte, 1999). The TOWRE is an individually administered, timed test of single-word reading fluency. The participant is given 45 sec to read a list of words as fast as possible. The number of words read correctly within the time is recorded. We administered the Sight Word Efficiency and Phonemic Decoding Efficiency subtests at pretest, posttest, and follow-up to assess word list fluency for real words and pseudowords. Internal consistency for different forms of this standardized test exceeds .90. The test/retest coefficients range from .83 to .96.

Texas Assessment of Knowledge and Skills (TAKS; Texas Education Agency, 2004). TAKS is a group-administered, untimed test measuring the students' mastery of the Texas state curriculum in Grades 3 through 9. The TAKS reading score from spring of the year prior to intervention was used to select students having reading difficulties. The TAKS reading test consists of multiple-choice questions related to various passages read independently by the student. Passages include narrative, expository, and mixed (both narrative and expository) text. The internal consistency (coefficient alpha) of the Grade 7 test is .89 (Texas Education Agency, 2004). In preliminary latent-variable analyses of the students in Grades 6 through 8 who composed the parent sample of the students reported here, the TAKS measure loaded strongly on a comprehension factor with other measures of reading comprehension, including the WJ-III (Woodcock et al., 2001) Passage Comprehension subtest.

Plan for Analysis

Analysis of covariance evaluated treatment effects from fall (pretest) to spring (posttest). The nested structure of the data was considered in cases of statistically significant treatment effects. We used latent variable growth modeling (LGM) to estimate group-level parameters and to identify statistically significant differences from pretest through follow-up (i.e., across 3 data points). LGM has several advantages over more traditional analysis strategies (e.g., ANCOVA). First, because LGM belongs to the class of structural equation models, it provides more precise score estimates (Bollen, 1989) by explicitly estimating and adjusting for error due to measurement. LGM generates indices of overall model fit and offers greater flexibility for comparing groups, whether across time or at given points in time. It handles missing data using a direct maximum likelihood estimator to compute a likelihood function for each case using all available data, more efficient than traditional approaches such as list-wise deletion of cases with missing data or imputation of values. Also, because LGM analyzes covariance structures representing different levels of aggregation (e.g., individual and group), it is more appropriate than traditional approaches when data are clustered, whether by design (e.g., stratified sampling strategy) or circumstance (e.g., students in schools). Finally, LGM provides a flexible framework for analyzing the effects of covariates, and the possibility that they differ by group or by level of aggregation.

Multigroup modeling with nested comparisons enabled us to evaluate the statistical significance of group differences at follow-up using the LGM analyses (Bovaird, 2007; Mehta & Neale, 2005). Estimates were adjusted for school-level clustering effects. Difference testing involved constraining the groups as equal on parameters of interest (Time 3 intercept, in this case) and

TABLE 1

Pretest and Posttest Means and Standard Deviations by Study Condition

	Treatment M (SD) (n = 65)		*Comparison M* (SD) (n = 55)		
Measure	*Pretest*	*Posttest*	*Pretest*	*Posttest*	η^2
WJ-III Letter Word Identification	80.89 (11.55)	81.91 (12.76)	79.89 (15.39)	81.22 (14.54)	.000
WJ-III Word Attack	87.09 (9.87)	87.58 (11.31)	86.62 (12.12)	87.80 (10.94)	.002
WJ-III Passage Comprehension	79.86 (11.59)	82.57 (11.03)	78.78 (15.34)	80.11 (12.62)	.017
TOWRE Sight Word	83.38 (9.61)	85.82* (11.01)	80.51 (10.21)	80.62 (10.61)	.054
TOWRE Phonemic Decoding	82.98 (13.36)	85.37 (14.25)	79.84 (11.33)	80.64 (11.41)	.018

Note. WJ-III = Woodcock-Johnson III Tests of Achievement; TOWRE = Test of Word Reading Efficiency; η^2 = eta-squared.
*$p < .01$.

comparing the fit of the constrained and the fully specified models. If groups were comparable on Time 3 performance, the fit for the constrained and full models would not significantly differ. Constraints resulting in less adequate fit suggested significant group differences. Main effects of treatment were estimated as differences between the treatment group and the comparison.

RESULTS

Immediate Effects

Table 1 presents means and standard deviations for observed scores at pretest and posttest. On the TOWRE Sight Word subtest (Torgesen et al., 2001), the adjusted posttest mean difference was a little over 5 standard score points, $F = 6.68$ (1,117), $p = .011$, which was statistically significant and moderately sized ($\eta^2 = .054$). The difference on TOWRE Phonemic Decoding was about 4.5 scale score points, $F = 2.17$ (1,117), $p = .143$, which represented a small-sized effect ($\eta^2 = .018$). There were no statistically significant results on the WJ-III subtests (Woodcock et al., 2001), though the difference on the Passage Comprehension subtest (about 1.7 standard score points) favored the treatment group, but was small in size ($\eta^2 = .017$). Group differences on WJ-III Word Attack and Letter Word Identification were negligible.

Delayed Effects

On the latent variable analysis, we modeled intercept as the end point of the trend (i.e., Time 3) to examine differences 4 months after the intervention ended. Over 90% of the coverage estimates (amount of data present in each cell of the measure by occasion matrix) were at or above .75. There was limited slope variance within the two groups; as such, we modeled slope as a fixed effect. Note that expected growth in the model using standard scores has slope of zero. Note also that nonzero slopes in Table 2 are in a counterintuitive direction, because the slope estimate represents movement from right to left (i.e., from Time 3 to Time 1).

Results in Table 2 reflect fit for the multigroup unconditional model as described previously. Fit was excellent for WJ-III Passage Comprehension (Woodcock et al., 2001); $\chi^2 = 6.53$ (6), $p = .366$; CFI = .99, TLI = .99; RMSEA = .037. For the other measures, fit was acceptable based on χ^2 values and comparative fit index/Tucker-Lewis index indices, though root-mean-square error of approximation values were somewhat outside of the acceptable range. Table 2 also

TABLE 2

Main Effect Estimates at Follow-Up by Treatment Condition

Measure	χ^2/df (p) [a]	*CFI/TLI*	*RMSEA*	*Intercept Estimate* (p)	*Intercept* σ [b]	*Slope Estimate* (p)	Δ_I [b]
WJ-III Letter Word Identification	13.36/6 (.038)	.97/.97	.138				
Treatment				82.86 (< .01)	109.0 (< .01)	–.926 (> .05)	.00
Comparison				82.35 (< .01)	189.8 (< .01)	–1.07 (> .05)	
WJ-III Word Attack	13.89/6 (.031)	.96/.96	.143				
Treatment				87.54 (< .01)	88.15 (< .01)	–.144 (> .05)	.00
Comparison				87.85 (< .01)	99.42 (< .01)	–.318 (> .05)	
WJ-III Passage Comprehension	6.53/6 (.366)	.99/.99	.037				
Treatment				83.12 (< .01)	104.9 (< .01)	–1.05(< .05)	.13
Comparison				81.72 (< .01)	152.2 (< .01)	1.33 (> .05)	
TOWRE Sight Word	12.63/6(.049)	.97/.97	.131				
Treatment				86.46 (< .01)[a]	94.29 (< .01)	–1.27 (< .05)	.49
Comparison				81.75 (< .01)[a]	96.81 (< .01)	–.555 (> .05)	
TOWRE Phonemic Decoding	12.44/6 (.053)	.97/.97	.129				
Treatment				83.62 (< .01)	166.3 (< .01)	–.152 (> .05)	.26
Comparison				80.74 (< .01)	102.5 (< .01)	–.372 (> .05)	

Note. Values sharing a common subscript differ from values without a subscript at $p < .05$. CFI/TLI = comparative fit index/Tucker-Lewis index; RMSEA = root-mean-square error of approximation; WJ-III = Woodcock-Johnson III Tests of Achievement; TOWRE = Test of Word Reading Efficiency.

[a]Represents the multigroup ($N = 2$) model with slope fixed. [b]Effect for the treatment groups represents intercept differences with the comparison divided by estimated standard deviation pooled across the two groups.

includes estimates for intercept and slope and for variance around intercept; recall that intercept is the model-derived score for performance in fall of 2007. Also, variance is not indicated for slope because it was modeled as a fixed effect. There were no treatment group differences on WJ-III Word Identification or Word Attack. There was a small difference (Δ_I = .13) on WJ-III Passage Comprehension favoring the treatment group, though it was not statistically significant. The difference on TOWRE Sight Word Efficiency (Torgesen et al., 2001; Δ_I = .49) was larger and statistically significant, $\Delta\chi^2 = 5.28(1)$, $p < .05$, whereas the smaller effect on TOWRE Phonemic Decoding Efficiency (Δ_I = .26) was not statistically significant.

DISCUSSION

We examined the effects of a supplemental reading intervention for middle school students with LD. This intervention was conducted within the context of a schoolwide RTI effort to improve reading instruction for all students. We provided all content-area teachers professional development on vocabulary and comprehension practices. Students in both treatment and control groups were equally exposed to this enhanced reading focus and their special education treatment was not altered. We found moderate and statistically significant effects in favor of the students receiving the supplemental intervention on sight word reading fluency, and small effects on phonemic decoding fluency. There were no significant differences between the treatment and comparison groups for the untimed measures of word reading, word attack, or passage comprehension, though a small effect size was reported in favor of the treatment group on passage comprehension. Four months after the intervention was completed, the treatment group still significantly outperformed the comparison group on sight word fluency. In addition, the treatment group maintained standard scores seen at posttest on all measures except phonemic decoding fluency.

These results suggest that the students in the treatment group may have obtained more automatic or fluent word reading skills than students in the comparison group. Although progress in reading words was similar between groups on the untimed word reading measures, the treatment group performed better on timed measures of these skills and continued to do so for sight word fluency at the 4-month follow-up as well. Simple accuracy of reading subskills, such as word reading or decoding, is typically thought to occur prior to the automaticity of these skills, but it is the automaticity of the skills that may be more important in predicting student reading success (Wolf & Katzir-Cohen, 2001). Thus, both groups of students demonstrated similar accuracy in word reading, but the treatment group also demonstrated an ability to read words with more fluency than the comparison group at posttest. However, these increased timed word reading skills were not associated with statistically significantly higher outcomes on comprehension, though there was a small effect size noted in favor of the treatment condition at both posttest and follow-up.

Four months after the intervention was completed, the treatment group still significantly outperformed the comparison group on sight word fluency.

Overall, the differences between groups were smaller in this study than those reported in Scammacca and colleagues' (2007) meta-analysis. Scammacca et al. reported a mean-weighted effect of .51 (moderate) on norm-referenced measures for studies with students with learning disabilities. The effects in the current study were small to moderate. None of the studies reviewed by Scammacca et al. that included a full sample of students with LD administered a norm-referenced comprehension measure so it is not possible to compare the comprehension outcome effects from the current study to the previous LD research.

However, for studies with students with reading difficulties or a mix of students with reading difficulties and LD, Scammacca et al. (2007) reported a mean-weighted effect size of .35 on norm-referenced comprehension measures. Similarly, we found a small effect size for comprehension in this study. Our intervention was provided for a substantially longer amount of time than

any of the studies synthesized by Scammacca et al. The studies with students with LD in Scammacca et al. ranged from two to 20 sessions (50–800 min), with one study providing 90 sessions (4,500 min), whereas the current study provided approximately 165 sessions (7,425-8,250 min). Paradoxically, larger effects have been noted in previous research with shorter intervention periods (Elbaum, Vaughn, Hughes, & Moody, 2000).

We did not deny ongoing special education services to any of the students in the study. About half the sample was receiving one or more remedial reading classes as part of their special education program. Thus, the comparison group in this study provided a rigorous test of the supplemental intervention allowing examination of whether additional time in reading instruction can assist students with LD who struggle with reading. In addition, we provided assistance to the teachers in improving their instruction throughout the content areas and we incorporated several strategies taking place in our intervention in this professional development. This design was the most practical test of the additional intervention, in that schools would want to provide strong remedial intervention in their existing classes before providing an additional intervention to students.

Despite some of the accelerated gains in the treatment group, many students in both treatment and comparison conditions demonstrated reading outcomes well below expected grade levels at posttest. About half of the students in each of the study conditions continued to demonstrate standard scores below 85 on decoding and word reading measures. Similarly, 54% of treatment students and 55% of the comparison students scored below a standard score of 85 on the passage comprehension measure at posttest. Clearly, many of the students participating in this study continued to demonstrate significant difficulties reading and understanding text and will continue to need intervention to successfully read to learn in secondary settings.

We believe that this study provides initial evidence that many of the well-intentioned programs designed to enhance reading outcomes for students with significant reading problems are unlikely to adequately meet the needs of students with LD when provided in standard ways (e.g., one class period per day and with moderate group sizes [10–15]). These findings are consistent with other studies of students with LD who are provided traditional special education services (Bentum & Aaron, 2003; Foorman et al., 1997; Hanushek et al., 1998). Although improved outcomes were realized in a few skill areas, overall gains were small to moderate and did not appreciably close the gap between the treatment and comparison group performance.

Many of the students participating in this study continued to demonstrate significant difficulties reading and understanding text and will continue to need intervention to successfully read to learn in secondary settings.

Limitations

This study examined the effects of a supplemental intervention in comparison to students with LD who did not receive the supplemental intervention. It is not known whether the additional time in intervention or the specific instruction that was provided in the intervention or both are related to the students' improved outcomes. More of the students in the comparison group received supplemental remedial instruction provided by the school than did students in the treatment group. This may have been an artifact of our presence in the school in the sense that the school allocated more resources to students who were not already a part of the treatment group and receiving the researcher-provided supplemental remedial reading class.

Our measure of reading comprehension is limited to word-level inferencing based on context. It is possible that measures of comprehension addressing more complex skills such as identifying main idea, summarizing, or making text connections may have been more sensitive to differences in comprehension between the study groups. However, it is clear from the group means after treatment that even with the gains made by both groups from pretest to posttest, the majority of students were still severely impaired in their reading comprehension abilities.

Implications and Future Research

Our results suggest that a supplemental intervention for students with LD may increase the intensity of intervention for students, allowing them to make additional gains in reading. However, the gains seen were in automaticity of basic reading skills (i.e., word reading fluency); the small effect in comprehension suggests that even more intensity is needed for students to accelerate their reading achievement gains. One possible way to further increase the intensity may be to provide supplemental intervention in smaller groups. The students in this study received the supplemental intervention in class sizes of 10 to 15 students. Using small-group instruction for the supplemental intervention may assist students with LD in making additional gains.

In addition, the intervention we implemented was standardized in nature. Although movement through the lessons was based on student mastery, the overall sequence of instruction and the amount of time spent on each component of the intervention was standardized for all students. It may be possible to achieve more significant gains in student outcomes by providing a more individualized, responsive approach to remediation, with lesson structure and application of instruction designed to respond to the varying needs of the students (Vaughn et al., 2008). This individualization could include emphasizing specific reading strategies over others based on student need including specific language issues. This type of implementation would also require smaller group sizes.

REFERENCES

Archer, A. L., Gleason, M. M., & Vachon, V. (2005a). *REWARDS intermediate: Multisyllabic word reading strategies.* Longmont, CO: Sopris West.

Archer, A. L., Gleason, M., & Vachon, V. (2005b). *REWARDS plus: Reading strategies applied to social studies passages.* Longmont, CO: Sopris West.

Baumann, J. F., Edwards, E. C., Bolnad, E. M., Olejnik, S., & Kame'enui, E. J. (2003). Vocabulary tricks: Effects of instruction in morphology and context on fifth-grade students' ability to derive and infer word meanings. *American Educational Research Journal, 40,* 447–494. doi:10.3102/00028312040002447

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life; Robust vocabulary instruction.* Upper Saddle River, NJ: Pearson.

Bentum, K. E., & Aaron, P. G. (2003). Does reading instruction in learning disability resource rooms really work? A longitudinal study. *Reading Psychology, 24,* 361–382. doi:10.1080/02702710390227387

Biancarosa, G., & Snow, C. E. (2004). *Reading next—A vision for action and research in middle and high school literacy: A report to Carnegie Corporation of New York* (2nd ed.). Washington, DC: Alliance for Excellence in Education. Retrieved from http://www.all4ed.org/files/ReadingNext.pdf

Bollen, K. (1989). *Structural equation models with latent variables.* New York, NY: John Wiley & Sons.

Bovaird, J. A. (2007). Multilevel structural equation models for contextual factors. In T. A. Little & J. A. Bovaird (Eds.), *Modeling contextual effects in longitudinal studies.* Mahwah, NJ: Lawrence Erlbaum.

Denton, C., Bryan, D., Wexler, J., Reed, D., & Vaughn, S. (2007). *Effective instruction for middle school students with reading difficulties: The reading teacher's sourcebook.* Austin, TX: University of Texas System/Texas Education Agency.

Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology, 92,* 605–619. doi:10.1037/0022-0663.92.4.605

Fletcher, J. M., Lyon, G. R., Fuchs, L. S., & Barnes, M. A. (2007). *Learning disabilities: From identification to intervention.* New York, NY: Guilford.

Fletcher, J. M., & Vaughn, S. (2009). Response to intervention: Preventing and remediating academic difficulties. *Child Development Perspectives, 3*(1), 30–37. doi:10.1111/j.1750-8606.2008.00072.x

Foorman, B. R., Francis, D. J., Winikates, D., Mehta, P., Schatschneider, C., & Fletcher, J. M. (1997). Early interventions for children with reading disabilities. *Scientific Studies of Reading, 1,* 255–276. doi:10.1207/s1532799xssr0802_4

Fuchs, D., & Deshler, D. D. (2007). What we need to know about responsiveness to intervention (and shouldn't be afraid to ask). *Learning Disabilities Research and Practice, 22,* 129–136. doi:10.1111/j.1540-5826.2007.00237.x

Gersten, R., Fuchs, L. S., Williams, J. P., & Baker, S. (2001) Teaching reading comprehension strategies to students with learning disabilities: A review of research.

Review of Educational Research, 7, 279–320. doi: 10.3102/00346543071002279

Goswami, U. (1993). Children's use of analogy in learning to read: A developmental study. *Journal of Experimental Child Psychology, 42*, 73–83. doi:10.1016/0022-0965(86)90016-0

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (1998). *Does special education raise academic achievement for students with disabilities?* (Working Paper No. 6690). Cambridge, MA: National Bureau of Economic Research.

Kamil, M. L., Borman, G. D., Dole, J., Kral, C. C., Salinger, T., & Torgesen, J. (2008). *Improving adolescent literacy: Effective classroom and intervention practices: A practice guide* (NCEE#2008-4027). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/wwc

Mastropieri, M. A., & Scruggs, T. E. (2005). Feasibility and consequences of response to intervention: Examination of the issues and scientific evidence as a model for the identification of individuals with learning disabilities. *Journal of Learning Disabilities, 38,* 525–531. doi:10.1177/00222194050380060801

Mastropieri, M. A., Scruggs, T. E., & Graetz, J. E. (2003). Reading comprehension instruction for secondary students: Challenges for struggling students and teachers. *Learning Disability Quarterly, 26*, 103–116. doi:10.2307/1593593

Mehta, P., & Neale, M. (2005). People are variables too: Multilevel structural equations models. *Psychological Methods, 10*, 259–284. doi:10.1037/1082-989X.10.3.259

National Center for Education Statistics. (2007). *National assessment of educational progress: The nation's report card.* Washington, DC: U.S. Department of Education.

Paulesu, E., Demonet, J. F., Fazio, F., McCrory, E., Chanoine, V., Brunswick, N., . . . Frith, U. (2001). Dyslexia: Cultural diversity and biological unity. *Science, 291*, 2165–2167. doi:10.1126/science.1057179

Scammacca, N., Roberts, G., Vaughn, S., Edmonds, M., Wexler, J., Reutebuch, C. K., & Torgesen, J. K. (2007). *Intervention for adolescent struggling readers: A meta-analysis with implication for practice.* Portsmouth, NH: RMC Research Corporation, Center on Instruction. Retrieved from http://www.centeroninstruction.org/files/Meta%2Danalysis%20Struggling%20Readers1%2Epdf

Texas Education Agency. (2004). TAKS: *Texas assessment of knowledge and skills information booklet: Reading, grade - revised.* Retrieved from http://www.tea.state.tx.us/student.assessment/taks/booklets/reading/g6e.pdf

Texas Education Agency. (2004). Texas assessment of knowledge and skills. Austin, TX: Author.

Torgesen, J. K., Alexander, A. W., Wagner, R. K., Rashotte, C. A., Voeller, K. K. S., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long-term outcomes from two instructional approaches. *Journal of Learning Disabilities, 34*, 33–58. doi:10.1177/002221940103400104

Torgesen, J. K., Rose, E., Lindamood, P., Conway, T., & Garvan C. (1999). Preventing reading failure in young children with phonological processing disabilities: Group and individual responses to instruction. *Journal of Educational Psychology, 91*, 579–594. doi: 10.1037/0022-0663.91.4.579

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (1999). Test of word reading efficiency. San Antonio, TX: PRO-ED.

Vaughn, S., Cirino, P., Wanzek, J., Wexler, J., Fletcher, J. M., Denton, C., . . . Francis, D. J. (2010). Response to intervention for middle school students with reading difficulties: Effects of a primary and secondary intervention. *School Psychology Review, 39,* 3–21.

Vaughn, S., Fletcher, J. M., Francis. D. J., Denton, C. A., Wanzek, J., Wexler, J., . . . Romain, M. A. (2008). Response to intervention with older students with reading difficulties. *Learning and Individual Differences, 18,* 338–345. doi:10.1016/j.lindif.2008.05.001

Vaughn, S., & Fuchs, L. S. (2003). Redefining learning disabilities as inadequate response to instruction: The promise and potential problems. *Learning Disabilities Research and Practice,* 18, 137–146. doi:10.1111/1540-5826.00070

Vaughn, S., Levy, S., Coleman, M., & Bos, C. S. (2002). Reading instruction for students with LD and EBD: A synthesis of observation studies. *The Journal of Special Education, 36*, 2–13. doi:10.1177/00224669020360010101

Vaughn, S., Moody, S., & Schumm, J. S. (1998). Broken promises: Reading instruction in the resource room. *Exceptional Children, 64*, 211–226.

Vaughn, S., Wanzek, J., & Fletcher, J. M. (2007). Multiple tiers of intervention: A framework for prevention and identification of students with reading/learning disabilities. In B. M. Taylor & J. E. Ysseldyke (Eds.), *Effective instruction for struggling readers, K–6* (pp. 173–195). New York, NY: Teacher's College Press.

Vaughn, S., Wanzek, J., Wexler, J., Barth, A., Cirino, P. T., Fletcher, J. M., . . . Francis, D. J. (2010). The relative effects of group size on reading progress of older students with reading difficulties. *Reading and Writing: An Interdisciplinary Journal, 23,* 931–956. doi:10.1007/s11145-009-9183-9

Vellutino, F. R., Scanlon, D. M., Small, S. G., & Fanuele, D. P. (2006). Response to intervention as a vehicle for distinguishing between children with and without reading disabilities: Evidence for the role of kindergarten and first grade interventions. *Journal of Learning Disabilities, 39,* 157–169. doi:10.1177/00222194060390020401

Wanzek, J., & Vaughn, S. (2011). Is a three-tier reading intervention model associated with reduced placement in special education? *Remedial and Special Education, 32,* 167–175. doi:10.1177/0741932510361267

Wolf, M, & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific Studies of Reading, 5,* 211–239. doi:10.1207/S1532799XSSR0503_2

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). Woodcock-Johnson III tests of achievement. Itasca, IL: Riverside.

ABOUT THE AUTHORS

JEANNE WANZEK (Florida CEC), Assistant Professor, Florida Center for Reading Research and School of Teacher Education, Florida State University, Tallahassee. **SHARON VAUGHN** (Texas CEC), H. E. Hartfelder/Southland Corp. Regents Chair in Human Development and Executive Director; and **GREG ROBERTS,** Associate Director, Meadows Center for Preventing Educational Risk, The University of Texas at Austin. **JACK M. FLETCHER** (Texas CEC), Hugh Roy and Lillie Cranz Cullen Distinguished Professor, Department of Psychology, University of Houston, Texas.

Correspondence concerning this article should be addressed to Jeanne Wanzek, Florida State University, 1107 W. Call St., P.O. Box 306-4304, Tallahassee, FL 32306 (e-mail: jwanzek@fcrr.org).

Manuscript submitted February 2010; accepted June 2010.