

Differential Effects of the Targeted Reading Intervention for Students With Low Phonological Awareness and/or Vocabulary

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Abstract

Students most at risk for reading-related disabilities frequently struggle with word recognition and oral language, including, in the earliest grades, specific skills related to phonological awareness and vocabulary. Classroom teachers' delivery of high-quality differentiated supplemental instruction may promote reading acquisition for these students. The current study examined whether the Targeted Reading Intervention, a webcam-coaching literacy professional development program for kindergarten and first grade classroom teachers, was more effective in producing reading gains for students who had the lowest scores on fall measures of phonological awareness and/or vocabulary as compared with students with higher scores. Findings revealed that students who participated in the Targeted Reading Intervention and who scored lowest on the fall vocabulary measure had the highest scores on spring decoding measures.

Keywords

professional development, literacy instruction, phonological awareness, vocabulary

Children with or at risk for reading-related disabilities in early elementary school frequently fall below grade level if they do not receive supplemental instruction or intervention (Foorman & Torgesen, 2001). Results from National Assessment of Education Progress (NAEP) have shown that 40% of fourth graders without a disability read at or above a *proficient* level, compared with 12% of their peers with a disability. Furthermore, only 27% of students without a disability scored at a *below basic* level, compared with 68% of students with a disability (National Center for Education Statistics, 2017). A variety of factors are associated with poorer reading outcomes for early elementary students with or at risk for reading-related disabilities, including lower phonological awareness and vocabulary knowledge (Kilpatrick, 2015; Nation & Snowling, 1998). In addition, classroom teachers' reading instruction does not always emphasize differentiated instruction that might help these students become competent readers (Vaughn & Wanzek, 2014). The focus of the current study was a literacy professional development program, the Targeted Reading Intervention (TRI), which trained kindergarten and first grade classroom teachers to differentiate their instruction to promote rapid reading gains for students who struggled with reading. A series of randomized controlled trials studies have shown the TRI to be effective in improving

students' reading skills (Amendum, Vernon-Feagans, & Ginsberg, 2011; Vernon-Feagans, Bratsch-Hines, Varghese, Cutrer, & Garwood, 2018; Vernon-Feagans, Kainz, Hedrick, Ginsberg, & Amendum, 2013) but less is known about the effectiveness of the TRI for students who may be at highest risk of having reading-related disabilities. The current study examined the degree to which the TRI was differentially associated with improved decoding, spelling, and reading comprehension outcomes based on students' fall scores on measures of phonological awareness and vocabulary, which were each dichotomized to represent highest risk (bottom quartile) and lower risk (top three quartiles).

Essential Skills for Reading Acquisition

Researchers have emphasized the need to accurately identify the particular skills with which children struggle when

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learning to read so that teachers can provide differentiated instruction to help children become successful readers (Boscardin, Muthén, Francis, & Baker, 2008; Catts, Adlof, & Weismer, 2006). Teachers' ability to differentiate their reading instruction is particularly important for students with the lowest initial skills, as children's ability to make gains in reading is likely a factor of how his or her initial skills interact with the classroom teachers' instruction (Connor et al., 2009). Targeting the essential skills needed for reading is particularly important in the earliest grades to provide children with a strong foundation in reading. Yet, kindergarten and first grade teachers frequently need support in understanding which skills are most related to reading acquisition, identifying when children are missing those skills, and providing children with differentiated approaches that target essential skills (Bratsch-Hines, Vernon-Feagans, Garwood, & Varghese, 2017; Tobin, 2008).

The Simple View of Reading is a widely supported framework positing that the essential skills leading to reading comprehension are decoding and linguistic comprehension, which can be conceptualized more broadly as word recognition and oral language (Adlof, Catts, & Little, 2006; Braze et al., 2016; Gough & Tunmer, 1986; Hoover & Gough, 1990; Ouellette & Beers, 2010). Word recognition includes skills such as letter-sound correspondence, print awareness, and phonological awareness. Oral language includes skills such as narrative discourse, semantic knowledge, and vocabulary (NICHD Early Child Care Research Network, 2005). In the current article, we selected two particular skills, phonological awareness and vocabulary, because they have been shown to be related to reading comprehension (Joshi, 2005; Kilpatrick, 2015; Nation & Snowling, 1998; Ouellette & Beers, 2010) and amenable to change through intervention support (Beck & McKeown, 2007; Oudeans, 2003). Specifically, we sought to understand whether the provision of professional development supports for early elementary teachers to provide differentiated reading instruction would be especially beneficial for children with the lowest initial skills in these area(s).

Phonological awareness skills. Phonological awareness includes identifying and manipulating units of oral language such as words, syllables, onsets, rimes, and phonemes. Children with lower phonological awareness skills have difficulty with contrasting and segmenting sounds within words (Bishop & Snowling, 2004), thereby compromising their ability to decode and read written words and text (Boscardin et al., 2008; Carlson, Jenkins, Li, & Brownell, 2013; Juel, 1988) and contributing to a higher likelihood of future learning disabilities (McNamara, Scissons, & Gutknecht, 2011). In an observational study, kindergarteners who scored below the 25th percentile on a phonological

awareness composite demonstrated less growth in word identification, decoding, and reading fluency from kindergarten through third grades as compared with kindergarteners with higher phonological awareness skills (McNamara et al., 2011).

Interventions for students with low phonological awareness. A limited number of studies have explored intervention effects specifically for students with low phonological awareness skills. Interventions often combined phonological awareness and phonics training, which led to positive impacts on word reading (Foorman et al., 2003). Oudeans (2003) found that for children who started kindergarten with low phoneme segmentation skills, integrated alphabetic and phonological awareness training versus training that taught alphabetic and phonological awareness as separate activities resulted in higher phoneme segmentation, letter-sound fluency, and word reading skills. In another study, children with low phonological manipulation skills who received either of two treatments (phonological training with a small versus large amount of letter-sound correspondence training) improved in their phonological abilities as well as word-level reading skills as compared with children with low phonological manipulation skills in a control group (O'Connor, Jenkins, & Slocum, 1995).

Vocabulary skills. Vocabulary skills provide a foundation for subsequent reading comprehension (Beck & McKeown, 2007; Ouellette & Beers, 2010), with low comprehenders generally having weak vocabulary skills (Catts et al., 2006; Ricketts, Nation, & Bishop, 2007). Young children must be able to understand word meanings and analyze the coherence of meanings among words to comprehend written text (Gärdenfors, 2017).

Interventions for students with low vocabulary skills. Interventions designed to help students with low vocabulary skills have shown mixed results, with studies generally predicting to vocabulary outcomes rather than broader literacy and reading comprehension outcomes. In one study, kindergarten students who had lower receptive vocabulary scores at pretest and who received both small-group vocabulary instruction and whole-group lessons had word-learning gains that were nearly equivalent to their peers with higher receptive vocabulary skills who only received whole-group lessons (Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010). In another study, kindergarteners with lower receptive vocabulary skills who received explicit vocabulary instruction during a storybook intervention had greater gains in taught vocabulary than control students with lower receptive vocabulary skills who did not receive the intervention. Furthermore, intervention students with lower receptive vocabulary skills made similar gains in both taught and untaught words when compared with intervention students

with higher receptive vocabulary skills. In contrast, control students with lower receptive vocabulary skills made lower gains in both taught and untaught words when compared with control students with higher receptive vocabulary skills (Coyne, Simmons, Kame'enui, & Stoolmiller, 2004).

TRI Description and Targeted Skills

The TRI is a professional development program for kindergarten and first grade classroom teachers, which integrates activities in fluency, phonological awareness, decoding, oral language, and comprehension in 15-min sessions, ideally implemented each day with individual students with or at risk for reading-related disabilities. Each classroom teacher is asked to work with three selected students over the course of the academic year, one at a time for 6 to 8 weeks, until the student begins to make rapid progress. TRI activities and strategies are always situated within words and texts (rather than introducing sounds or letters independent of context), and emphasize basic decoding skills, vocabulary skills, and higher-order reading skills, such as being able to read connected texts and engage in inferential comprehension (Spear-Swerling & Sternberg, 1996). All activities are designed to assist the teacher in providing diagnostic reading instruction for each individual student. Professional development supports initial teacher training and ongoing weekly webcam literacy coaching. Coaches watch classroom teachers implement the TRI with a student struggling in reading and give the teacher real-time feedback and email summaries based on their instruction.

TRI instructional levels. The TRI contains four progressively more difficult levels of reading complexity, with the goal that most students will reach the upper levels within the target 6- to 8-week period. At the lowest level, the TRI *Pink* level, the student participates in activities that promote phonological awareness, semantic, and decoding skills, including generating phonemes and producing definitions orally as well as segmenting, blending, and writing two- and three-sound words that contain short vowels (and potentially digraphs, two letters that represent one sound, such as *th* or *ck*). Importantly, the student also practices fluent reading and engages in guided oral reading activities using connected texts. As the student progresses rapidly in learning skills through *Pink* activities, the coach and teacher work together to determine when the student should move to the *Blue* level, where the teacher introduces four- to six-sound words. Moving to the *Green* level, the teacher introduces the different spelling patterns for long vowel sounds as well as for diphthongs (the combination of two vowels in a single syllable, such as *oi* and *oy*) and r-controlled words (the distinct sound of a vowel followed by an /r/, such as *ar* and *er*). Although children at each level have exposure to multisyllabic words, it is at the highest *Purple* level where the

teacher introduces how to orally identify “chunks” of sounds and segment, blend, and write two-, three-, and four-syllable words. At all four levels, the student and teacher have a brief language interaction about the meaning of each new word. The teacher provides progressive instructional scaffolding within the context of words and texts.

TRI activities. Each 15-min TRI session is composed of four activities: *Re-Reading for Fluency*, *Word Work*, *Guided Oral Reading*, and *Pocket Phrases*. In *Re-Reading for Fluency*, the teacher asks the student to re-read a selection of text read previously during *Guided Oral Reading* to develop the student's reading fluency. In *Word Work*, the teacher uses multisensory instructional games to help the student identify and manipulate sounds within words, and to decode and write words (Clay, 1993; Moats, 1998; Morris, Tyner, & Perney, 2000). During *Word Work* activities, the teacher helps the student understand the meaning of words (vocabulary); prompts the student to listen to words and identify beginning, middle, and ending sounds at lower TRI levels or identify chunks of sounds at upper TRI levels (phonological awareness); has the student match sounds to letters or letter combinations (letter-sound correspondence); and has the student segment and blend words (decoding). In *Guided Oral Reading*, the teacher uses a text that incorporates *Word Work* words and is at the student's instructional reading level. The teacher scaffolds the student's ability to understand word meanings to enhance comprehension. In addition, the student is asked to summarize, expand upon, answer explanatory questions, and make inferences about the text. Finally, in *Pocket Phrases*, which helps support sight word reading and fluency, the teacher writes a sentence or phrase from the *Guided Oral Reading* text and tells the students to read the phrase to other adults (e.g., teachers, principals, parents). This activity helps adults support the student, providing both repeated exposure and motivation to the student, who is encouraged to keep reading all day.

TRI efficacy in previous studies. In a series of randomized controlled trials, the TRI has been found to be effective in improving literacy skills for students at risk for reading-related disabilities. Three previous articles (Amendum et al., 2011; Vernon-Feagans et al., 2012, 2013) reported results for students in up to 15 schools that were randomized to TRI treatment or control conditions. Findings suggested that students at risk for reading-related disabilities in treatment schools who received the TRI in kindergarten and first grade had significantly higher decoding, word reading, and reading comprehension spring scores, controlling for fall scores, as compared with students at risk for reading-related disabilities in control schools. Effect sizes ranged from 0.30 to 0.70. These data were also examined for differential effects based on initial student skill levels. In one study, moderation of treatment condition by receptive

vocabulary skills was not predictive of decoding, spelling, or reading comprehension tests (Amendum et al., 2011). In another study, students at risk for reading-related disabilities who had higher fall phonological awareness scores had higher decoding gains when they were in treatment versus control schools (Vernon-Feagans et al., 2012). A recent study reported results for the same students used in the current study, finding that treatment students at risk for reading-related disabilities gained more than control students at risk for reading-related disabilities, with effect sizes ranging from 0.16 to 0.28 (Vernon-Feagans et al., 2018).

The Current Study

The TRI is unique in that it combines phonological awareness, decoding, fluency, vocabulary, and comprehension skills rather than just focusing on one set of skills. Given the multifaceted focus of the TRI, we sought to determine whether the intervention would particularly help children who scored lowest on fall measures of phonological awareness and/or vocabulary. Our research questions were as follows:

Research Question 1: Was the TRI treatment effect moderated by students' phonological awareness or vocabulary skills on measures that were dichotomized to represent students with the lowest skills versus students with higher skills?

Research Question 2: Did a three-way interaction emerge, such that phonological awareness by vocabulary skills moderated the treatment effect of the TRI?

Method

Research Design and Participants

School sites. Data from this study were drawn from a randomized controlled trial of the TRI conducted in 10 schools from three high-poverty rural school districts located in the Southeastern United States. Each of the 10 schools received Title I funding, with 64% to 87% of students eligible for free or reduced-priced lunch.

Research design. Randomization occurred at the classroom level within each school site, with all kindergarten and first grade classrooms randomly assigned as either treatment or control classrooms. The randomization process led to a higher number of treatment classrooms than control classrooms over the course of the 3-year study because we did not constrain the number of treatment and control classrooms to be equal. If schools added kindergarten or first grade classrooms during the second or third year of study implementation (e.g., because of fluctuating grade-level class sizes), these classrooms were also randomized

to participate in the study. In total, across all 3 years, the randomization process resulted in 50 kindergarten (26 treatment, 24 control) and 50 first grade (29 treatment, 21 control) participating classrooms.

Classroom teachers were asked to participate in the study for 2 years. Once classrooms were randomized to treatment or control, teachers were not able to opt out of the study during the 2-year intervention window if they remained at the school and continued to teach kindergarten or first grade. Some teacher attrition occurred when teachers left the school or grade level. In these cases, we fully trained his or her replacement teacher on the TRI, who was then involved in treatment study activities. We also enrolled replacement control teachers. In total, across all 3 years, the study included 119 teachers (67 treatment, 52 control). Teacher attrition from the first year to the second year of study participation was 18.5% (22.0% for treatment teachers, 15.0% for control teachers). Differential attrition was at a low level of 7% (What Works Clearinghouse [WWC], 2017). We followed students for 1 year (not 2 years), and the number of students at risk for reading-related disabilities was 556 (305 treatment, 251 control). Student attrition over 1 year of participation in the study was 7.2% (6.6% for treatment students and 8.0% for control students). Differential attrition was at a low level of 1.4% (WWC, 2017).

Teacher participants. Treatment teachers participated in a 3-day TRI training institute at the beginning of the year, were provided with laptops for use during the intervention, and received ongoing weekly webcam coaching and up to four TRI continuing professional development sessions during the school year. Control teachers were also provided with laptops at the beginning of the year and received an evidence-based math software program (Building Blocks; Clements & Sarama, 2012). Teachers in control classrooms taught reading in any way they deemed to be appropriate for students and served as a "business as usual" counterfactual.

Student participants. To determine eligibility as a *student at risk for reading-related disabilities*, kindergarten and first grade students were screened using grade-level subtests from AimsWeb (Shinn & Shinn, 2002) and the *Dynamic Indicators of Basic Early Literacy Skills—Sixth Edition* (DIBELS; Good & Kaminski, 2002). Kindergarten students were administered AimsWeb *Letter Sound Fluency* and DIBELS *First Sound Fluency* subtests. First grade students were administered DIBELS *Phoneme Segmentation Fluency* and *Nonsense Word Fluency* subtests. We used fall grade-level AimsWeb/DIBELS benchmarks to categorize all students as being at *high risk*, *some risk*, or *low risk* for reading difficulties. In classrooms with more than three consented students from the *high-risk* group (or *some risk*

group in classrooms with insufficient numbers of consented *high-risk* students), we placed students on a list in a random order to receive additional assessments from the third edition of the *Woodcock Johnson* (WJ; *Word Attack* and *Letter-Word Identification*; Woodcock, Mather, & Schrank, 2004). Students had to score below 35% on the grade percentile score for one or both WJ subtests to participate in the TRI. Three students were included from each classroom each year.

TRI Teacher Training and Professional Development

TRI teacher training consisted of several elements. All teachers randomized to treatment classrooms and additional school personnel (e.g., principals) attended an annual 3-day training, during which they received TRI materials and learned about TRI activities and strategies aimed to help students at risk for reading-related disabilities. Teachers watched video examples of TRI activities and sessions, modeled the activities and strategies with other teachers and coaches, and practiced independently with children. Teachers were given access to an interactive TRI website, which included resources for continued professional development, TRI materials (e.g., TRI Diagnostic Map, TRI Reference Tool), and TRI training videos.

Teachers were also provided ongoing support via weekly webcam-coaching sessions. As described above, teachers worked with three selected students over the course of the year, one at a time, for 6 to 8 weeks. Each TRI coach met individually with his or her assigned classroom teacher each week to observe the teacher's TRI session with an individual student. The coach provided live feedback to the teacher during the session. At the beginning and end of each coaching session, the coach and teacher discussed the student's most pressing need and the TRI activities, strategies, level, and texts that would most effectively meet that need. Through ongoing modeling and support, the coach helped the teacher reflect on each student's progress to determine the student's current level of phonological awareness, decoding, oral language, vocabulary, fluency, and comprehension skills and to set goals to help the student progress in his or her skills at a rapid pace. As follow-up to each webcam-coaching session, coaches e-mailed feedback and answers to teacher questions.

Coach Training

Seven coaches worked with the classroom teachers across the study. All coaches held master's degrees and had substantial early elementary teaching and/or coaching experience specific to literacy instruction. Prior to coaching teachers in this study, all coaches participated in a 5-day coach-training institute, which focused on TRI content, coaching pedagogy, and fidelity to the core coaching

components of the TRI. Coaches were then required to submit video recordings of themselves implementing the TRI at all levels of the intervention, and to receive certification feedback on their fidelity of implementation before beginning coaching. Ongoing weekly meetings were held for the intervention director to discuss feedback on quality and fidelity of coaching implementation with coaches.

TRI Implementation Fidelity

Treatment teachers' fidelity to the TRI intervention was captured through a combination of coded video-recorded teacher-coach sessions, teacher report, and coach report. We captured fidelity at the student level, such that fidelity differed for each student, even when students received the TRI from the same classroom teacher. For *TRI student exposure*, teachers reported the number of TRI sessions they completed with each individual student every week, which were summed across the total number of weeks the teachers worked with the student. Treatment students, on average, received 17 TRI sessions across 8 weeks. For *TRI teacher exposure*, coaches reported the number of TRI coaching sessions they completed with each teacher for each individual student over the year. Treatment teachers, on average, received four coaching sessions when working with each student, or 12 over the course of each year. To capture each teacher's *adherence* to and *quality* of TRI implementation, we coded coach-teacher video-recorded TRI sessions. *Adherence* to TRI activities was the proportion of key tasks and strategies within each activity that a teacher completed during the TRI session. Treatment teachers, on average, implemented the TRI with adherence across 84% of the coded sessions. *Quality* was coded as the combination of teacher quality of both *scaffolding* and *context*. Quality of *scaffolding* represented the proportion of activities during which the teacher engaged in scaffolding the child. Quality of *context* represented the proportion of activities during which the teacher situated words within context (e.g., emphasized semantic and comprehension skills). Treatment teachers, on average, implemented the TRI with quality across 61% of the coded sessions.

Data Collection Procedures

Parents or primary caregivers returned questionnaires in the fall, which included information about child and family demographic characteristics and consent to participate in the study. Teachers completed questionnaires in the fall and spring, which included items about their professional background and classroom characteristics. Student assessments were administered in the fall and spring. TRI research assistants, who were mainly former teachers or graduate students, participated in two 8-hr training sessions led by a TRI assessment trainer to become certified to collect data for the

project. To be deemed reliable, research assistant completed the full battery of assessments with nonparticipating children.

Measures

Phonological awareness skills. To assess students' phonological awareness skills, research assistants administered subtests from the first edition of the *Comprehensive Test of Phonological Processing* (CTOPP; Wagner, Torgesen, & Rashotte, 1999). Per the manual, the CTOPP Phonological Awareness composite comprised *Blending Words*, *Elision*, and *Sound Matching* subtests for 5- and 6-year-old children and of *Blending Words* and *Elision* subtests for 7- and 8-year-old children. *Blending Words* measured the child's ability to combine sounds to form words. *Elision* measured the extent to which the child could say a word and then say the remaining part of the word after dropping out a designated sound. *Sound Matching* measured the child's ability to match and compare sounds in words. Based on the normed sample, reliability estimates were .84 for *Blending Words*, .89 for *Elision*, and .93 for *Sound Matching* (Wagner et al., 1999). For each subtest, the CTOPP scaled score produced values of 0 to 20. For the variable used in inferential analyses, we dichotomized the fall composite scaled score as falling at or below the 25th quartile, which had a value of 6.67 for both kindergarten (0 = *top three quartiles*, $n = 209$ or 72%; 1 = *bottom quartile*, $n = 82$ or 28%) and first grade students (0 = *top three quartiles*, $n = 188$ or 74%; 1 = *bottom quartile*, $n = 66$ or 26%).

Vocabulary skills. To assess students' vocabulary skills, research assistants administered the *Oral Vocabulary* subtest of the *Test of Language Development—Fourth Edition* (TOLD; Newcomer & Hammill, 2008). The *Oral Vocabulary* subtest measured the child's ability to recall and explain word meanings by giving oral definitions for common English words that were spoken by the research assistant without the use of pictures. Based on the normed sample, test-retest reliability was 0.82 for children aged 4 to 8 years (Newcomer & Hammill, 2008). The TOLD scaled score produced values of 0 to 20. To calculate the final variable of *vocabulary skills* that was used in inferential analyses, we dichotomized the fall scaled score as falling at or below the 25th quartile separately for each grade level. Thus, we dichotomized kindergarten students based on the 25th quartile value of 4 (0 = *top three quartiles*, $n = 202$ or 69%; 1 = *bottom quartile*, $n = 89$ or 31%). We dichotomized first grade students based on the 25th quartile value of 6 (0 = *top three quartiles*, $n = 153$ or 60%; 1 = *bottom quartile*, $n = 101$ or 40%).

Condition. We created a binary dummy variable to represent *condition* (0 = *control*, 1 = *treatment*). Elsewhere, we

reported the treatment main effects of the TRI for the current sample (Vernon-Feagans et al., 2018). In this study, we moderated *condition* by *vocabulary skills* and/or *phonological awareness skills* to determine whether differential treatment effects existed.

Student outcomes. Research assistants administered four WJ subtests to measure student literacy skills: *Word Attack*, *Letter-Word Identification*, *Spelling of Sounds*, and *Passage Comprehension* (Woodcock et al., 2004). We added all of the correct responses to get a total raw score and then calculated and used w scores (a metric derived from the transformation of the Rasch model) from the raw scores. Below, we present subtest reliability estimates for children aged 5 to 7 years, as reported by McGrew, Schrank, and Woodcock (2007). *Word Attack* measured the child's skill in applying phonic and structural analysis skills to the pronunciation of unfamiliar printed sounds and words and had a reliability of .93. *Letter-Word Identification* measured the child's word-identification skills and had a reliability of .98. *Spelling of Sounds* measured the child's spelling ability and had a reliability of .81. *Passage Comprehension* measured the child's reading skills and had a reliability of .96.

Control variables. We included student demographics, grade level, and year in study as control variables in inferential models. Child *gender* was included as dummy variable (0 = *girl*, 1 = *boy*), as was child *race* (0 = *non-White*, 1 = *White*). We used family income and maternal education to create a variable capturing children's family *socioeconomic status* (SES). Family income levels were coded categorically, representing five increments of US\$20,000. Maternal education was coded as a continuous variable representing the highest number of years of attained education. Family income and maternal education were standardized and averaged to form *socioeconomic status*. A binary dummy variable represented *grade* (0 = *kindergarten*, 1 = *first grade*). Finally, given that our study spanned 2 years each in kindergarten and first grade classrooms, teachers participated in the study for 1 or 2 years. A binary dummy variable represented *year in study* (0 = *first year*, 1 = *second year*).

Analysis Strategy

Separate analyses were conducted for each outcome (*Word Attack*, *Letter-Word Identification*, *Spelling of Sounds*, *Passage Comprehension*) using three-level hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002), with Level 3 representing schools, Level 2 representing teachers, and Level 1 representing students. Analyses accounted for nesting of teachers within schools and students within

Table 1. Teacher Descriptive Information.

Variable	Treatment		Control	
	<i>n</i>	% or <i>M</i> (<i>SD</i>)	<i>n</i>	% or <i>M</i> (<i>SD</i>)
Gender				
Male	1	1.54	0	0.00
Female	64	98.46	52	100.00
Race				
Black	10	15.87	11	21.15
Hispanic	0	0.00	0	0.00
White	53	84.13	39	75.00
Other	0	0.00	2	3.84
Certification level				
Elementary education certified	58	90.63	42	80.77
Master's degree or higher	20	31.25	14	26.92
Experience				
Total years teaching	64	9.38 (8.14)	52	9.25 (8.12)
Years in current grade	64	4.82 (5.42)	52	5.33 (6.14)
Grade				
Kindergarten	31	46.27	29	55.77
First grade	36	53.73	23	44.23

teachers; students' fall scores on selected outcomes; and student gender, student race, SES, grade level, and year in study as control variables. To aid in moderation interpretation, all predictors were grand-mean centered prior to analyses. For our RQ1 (Model 1 in Table 3), we performed two-way moderation analyses to understand if the significant effects of TRI treatment (Vernon-Feagans et al., 2018) had differential impacts for students who scored lowest on fall measures of phonological awareness *or* vocabulary, after controlling for fall scores and other control variables. For our RQ2 (Model 2 in Table 2), we performed three-way moderation analyses to determine whether the significant effects of TRI treatment had differential impacts for students who scored lowest on fall measures of phonological awareness *and* vocabulary. Significant moderation findings were probed using least squares means in HLM models, where the estimates and standard errors of spring scores on the relevant outcomes were calculated for each group (control group, bottom quartile; control group, top three quartiles; treatment group, bottom quartile; and treatment group, top three quartiles). Values accounted for fall scores, other control variables, and nesting of teachers within schools and students within teachers.

For treatment students, 0% to 2.2% of predictor data were missing and 6.6% of spring outcome data were missing. For control students, 0% to 2.4% of predictor data were missing and 8.0% of spring outcome data were missing. To avoid imprecise estimation of models due to these missing data, we created multiple imputed datasets in SAS 9.3. Following recommendations from WWC (2017), data for treatment versus control students were imputed separately and

combined for analyses. Multiple imputation procedures used an iterative method to estimate the multivariate relations among study variables for cases with available data. These observed relations among study variables were then used to estimate plausible values for missing data (Schafer & Graham, 2002). Analyses were run on each of 20 imputed datasets, with model parameters aggregated across datasets.

Results

Descriptive Findings

As shown in Table 1, the treatment and control teachers who participated in the study were predominately females and White. Approximately a quarter of teachers in both groups had a master's degree or higher and averaged 9 years of total teaching experience. No significant differences existed between teachers in the treatment and control groups on demographic characteristics or teacher qualifications. As shown in Table 2, less than half of the treatment students and more than half of the control students were males. Approximately half of students in both groups were Black, one quarter was White, and one sixth was Hispanic. Socioeconomic status across both groups was similar, with 83% of incomes falling below US\$40,000 and an average maternal education level of 12 years (high school diploma or equivalent). On the phonological awareness measure, 25% of treatment students and 30% of control students scored in the bottom quartile. On the vocabulary measure, 31% of treatment and 40% of control students scored in the bottom quartile.

Table 2. Student Descriptive Information.

Variable	Treatment		Control	
	<i>n</i>	% or <i>M</i> (<i>SD</i>)	<i>n</i>	% or <i>M</i> (<i>SD</i>)
Gender				
Male	167	45.25	141	56.18
Female	138	54.75	110	43.82
Race				
Black	160	53.69	132	53.23
Hispanic	47	15.77	42	16.94
White	74	24.83	53	21.37
Other	17	5.70	21	8.47
Child age (years)	305	6.14 (0.70)	251	6.11 (0.67)
Maternal education (years)	292	12.16 (2.23)	245	12.12 (2.33)
Family income				
US\$0–US\$20,000	179	63.48	141	61.57
US\$20,001–US\$40,000	57	20.21	48	20.96
US\$40,001–US\$60,000	20	7.09	15	6.55
US\$60,001–US\$80,000	16	5.67	12	5.24
US\$80,001 or more	10	3.55	13	5.68
Socioeconomic status	302	–0.02 (0.85)	248	–0.01 (0.93)
Grade				
Kindergarten	149	48.85	144	57.37
First grade	156	51.15	107	42.63
Year in study				
First year	197	64.59	143	56.97
Second year	108	35.41	108	43.03
Academic achievement				
WJ <i>Word Attack</i> , fall	305	410.88 (31.66)	251	407.69 (29.99)
WJ <i>Word Attack</i> , spring	285	451.28 (24.33)	231	443.04 (27.47)
WJ <i>Letter-Word Identification</i> , fall	305	363.10 (33.32)	251	361.01 (34.45)
WJ <i>Letter-Word Identification</i> , spring	285	409.18 (28.08)	231	401.83 (29.22)
WJ <i>Spelling of Sounds</i> , fall	298	455.16 (27.28)	247	453.38 (26.05)
WJ <i>Spelling of Sounds</i> , spring	285	482.03 (13.95)	231	477.58 (15.31)
WJ <i>Passage Comprehension</i> , fall	289	411.82 (20.10)	245	410.10 (21.35)
WJ <i>Passage Comprehension</i> , spring	285	435.40 (25.48)	231	428.95 (25.60)
Phonological awareness (CTOPP)				
Bottom quartile	74	24.83	74	29.96
Top three quartiles	224	75.17	173	70.04
Vocabulary (TOLD)				
Bottom quartile	91	30.54	99	40.08
Top three quartiles	207	69.46	148	59.92

Note. WJ = Woodcock Johnson Tests of Achievement—Third Edition (Woodcock, Mather, & Schrank, 2004); CTOPP = Comprehensive Test of Phonological Processing—First Edition (Wagner, Torgesen, & Rashotte, 1999); TOLD = Test of Language Development—Primary—Fourth Edition (Newcomer & Hammill, 2008).

Multilevel Results

Word Attack. As shown in Table 3, students' decoding skills in the spring as measured by *Word Attack* were higher when they were in the TRI treatment condition versus control condition ($B = 6.53, p = .004$) and lower if they had scored in the bottom quartile of phonological awareness versus the top three quartiles ($B = -8.63, p < .001$). The interaction between these two variables was

not significant ($B = 0.42, p = .922$). However, the interaction between treatment condition and vocabulary skills was significant ($B = 7.95, p = .048$), as displayed in Figure 1. Treatment students who were in the bottom quartile on vocabulary scored 453 points on *Word Attack*, as compared with 441 points (control students in bottom quartile), 445 points (control students in top three quartiles), and 449 points (treatment students in top three

Table 3. Multilevel Moderation Models Predicting to Woodcock Johnson Subtests.

Model	Word Attack		Letter-Word Identification		Spelling of Sounds		Passage Comprehension	
	B	SE	B	SE	B	SE	B	SE
Model 1								
Fixed effects								
Pretest	0.31***	0.05	0.68***	0.05	0.31***	0.04	0.34***	0.05
Male	-0.88	1.85	-2.18	1.62	-0.51	1.01	-2.77	1.56
White	-0.64	2.59	-1.17	2.22	2.80	1.47	-1.54	2.28
Socioeconomic status	1.24	1.28	1.05	1.11	0.34	0.71	2.87**	1.08
First grade	9.59**	3.29	-6.55	3.36	-1.53	2.35	24.64***	2.07
Second year in study	4.58*	1.93	7.13***	1.69	1.09	1.10	2.24	1.68
Treatment	6.53**	2.27	6.99***	1.97	3.50**	1.21	3.81*	1.71
Phonological awareness, bottom quartile	-8.63***	2.18	-6.73***	1.93	-4.70***	1.22	-9.37***	1.87
Vocabulary, bottom quartile	-0.05	2.09	3.09	1.91	-0.74	1.18	0.03	1.80
Phonological awareness × treatment	0.42	4.32	1.16	3.83	-0.43	2.41	2.13	3.70
Vocabulary × treatment	-7.95*	4.02	7.53*	3.60	2.83	2.26	-4.77	3.40
Random effects								
Level 3	21.34	15.80	3.97	6.78	6.20	4.88	9.56	10.45
Level 2	57.38**	21.32	40.25**	15.50	12.34**	5.74	16.94	11.92
Level 1	373.64***	31.64	295.64***	22.83	120.54***	9.04	286.14***	20.69
Model 2								
Fixed effects								
Phonological awareness × vocabulary	4.26	4.22	1.67	3.77	-0.78	2.45	4.66	3.65
Phonological awareness × vocabulary × treatment	10.68	8.61	3.52	7.98	1.35	4.86	0.91	7.31
Random effects								
Level 3	20.51	15.32	3.76	6.65	6.20	4.88	8.96	10.15
Level 2	56.00**	21.26	40.04**	15.51	12.47*	5.79	17.23	12.04
Level 1	374.08***	31.85	296.65***	22.93	120.84***	9.08	286.16***	20.71***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

quartiles). With an overall standard deviation for spring *Word Attack* equal to 26 points, this represented an improvement of 0.29 to 0.44 standard deviations for treatment students who had the lowest (bottom quartile) vocabulary skills versus control students with higher (top three quartiles) or lowest (bottom quartile) vocabulary skills, respectively. No evidence of three-way moderation emerged (Model 2).

Letter-Word Identification. Students' decoding skills in the spring as measured by *Letter-Word Identification* were higher when they were in the TRI treatment condition versus control condition ($B = 6.99, p < .001$) and lower if they had scored in the bottom quartile of phonological awareness versus the top three quartiles ($B = -6.73, p < .001$). The interaction between these two variables was not significant ($B = 1.16, p = .762$). However, the interaction between treatment condition and vocabulary skills was significant ($B = 7.53, p = .037$), with results similar to what was depicted in Figure 1. Treatment students who were in the bottom quartile on vocabulary scored 413

points on *Letter-Word Identification*, as compared with 401 points (control students in bottom quartile), 402 points (control students in top three quartiles), and 407 points (treatment students in top three quartiles). With an overall standard deviation for spring *Letter-Word Identification* equal to 29 points, this represented an improvement of 0.37 to 0.41 standard deviations for treatment students who had the lowest (bottom quartile) vocabulary skills versus control students with higher (top three quartiles) or lowest (bottom quartile) vocabulary skills, respectively. No evidence of three-way moderation emerged (Model 2).

Spelling of Sounds. Students' spelling skills in the spring as measured by *Spelling of Sounds* were higher when they were in the TRI treatment condition versus control condition ($B = 3.50, p = .004$) and lower if they had scored in the bottom quartile of phonological awareness versus the top three quartiles ($B = -4.70, p < .001$). No evidence of two-way moderation (Model 1) or three-way moderation (Model 2) emerged.

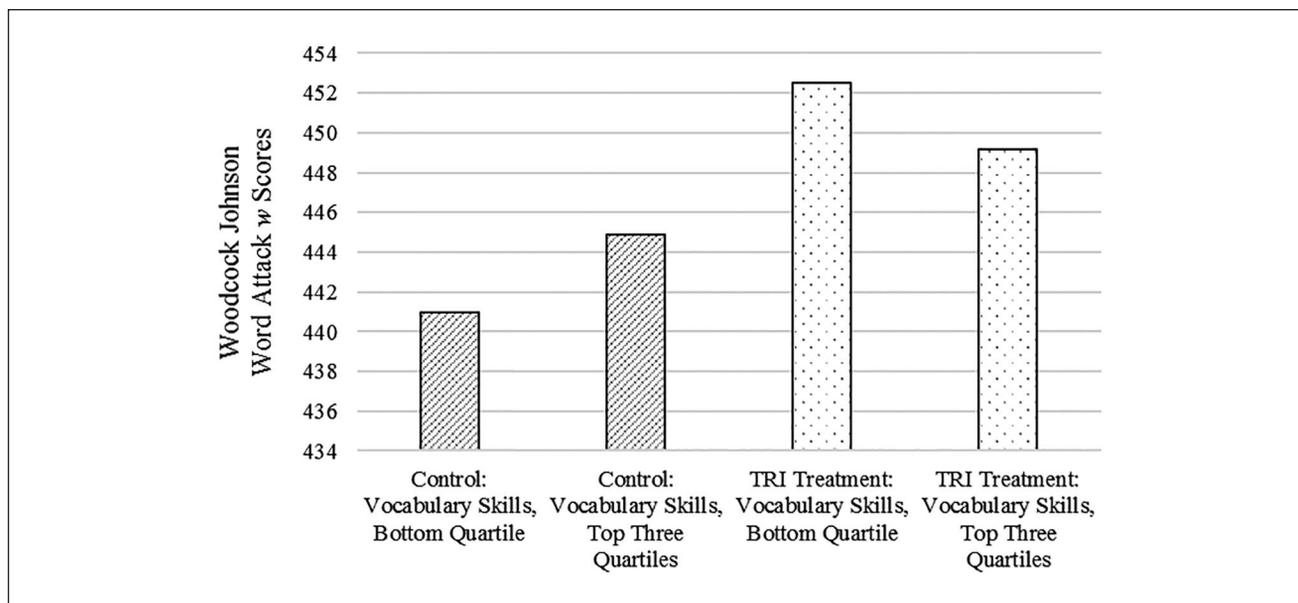


Figure 1. Treatment effect of the TRI moderated by fall vocabulary skills (measured by TOLD-4 *Oral Vocabulary*) predicting to residualized decoding scores (measured by *Woodcock Johnson-III Word Attack*).

Note. TRI = Targeted Reading Intervention; TOLD = Test of Language Development.

Passage Comprehension. Students' reading comprehension skills in the spring as measured by *Passage Comprehension* were higher when they were in the TRI treatment condition versus control condition ($B = 3.81, p = .026$) and lower if they had scored in the bottom quartile of phonological awareness versus the top three quartiles ($B = -9.37, p < .001$). No evidence of two-way moderation (Model 1) or three-way moderation (Model 2) emerged.

Discussion

The purpose of the TRI is to promote rapid reading gains for students who have or who are at risk for a reading-related disability and who tend to fall behind their grade-level peers during early elementary school (Vernon-Feagans et al., 2018). The primary aim of this study was to explore whether the significant effects of the TRI on student decoding, spelling, and comprehension skills differed based on students' fall phonological awareness and/or vocabulary skills. The following results were found: (a) After controlling for fall phonological awareness and vocabulary skills, TRI treatment condition had a positive effect on all student outcomes; (b) scoring in the lowest quartile on vocabulary was not directly related to student outcomes but interacted with TRI treatment condition for the two decoding outcomes; (c) scoring in the lowest quartile on phonological awareness was negatively related to all student outcomes, but did not interact with TRI treatment condition; (d) a three-way interaction among vocabulary, phonological awareness, and TRI treatment condition was not significant. These findings

offer insights into benefits and differential effects of a comprehensive reading intervention such as the TRI and the role of students' initial skills when predicting to gains.

As explored with this sample in a separate study (Vernon-Feagans et al., 2018), as well as a number of other studies (Amendum et al., 2011; Vernon-Feagans et al., 2012, 2013), the TRI has been shown to produce significant gains in decoding, spelling, and reading comprehension skills, unlike other early interventions that produced gains only in decoding (Wanzek, Al Otaiba, & Gatlin, 2016). In this study, TRI effects remained significant after accounting for fall skills of phonological awareness and vocabulary (two important predictors of reading acquisition; Bishop & Snowling, 2004). We speculate that the integrated foci of fluency, phonological awareness, decoding, oral language, word meaning, and comprehension within TRI activities (i.e., reading instruction in both basic and higher-order skills; Spear-Swerling & Sternberg, 1996), as well as the ongoing webcam literacy coaching received by treatment teachers, promoted student gains across literacy domains.

The current study showed that the decoding outcomes, but not spelling or reading comprehension, were moderated by initial vocabulary skills. The TRI appeared to be effective in producing decoding gains for children with the lowest fall vocabulary skills, which may have been due to its integrated focus on oral language and vocabulary support and decoding and blending skills throughout the one-on-one teacher-student sessions. Low vocabulary knowledge can lead to problems with decoding and reading words that require vocabulary support (Nation & Snowling, 1998). Without understanding

the meaning of a word before decoding it, a child may think of the word as a nonsense word, rather than a real word with meaning and context. Assessing a student using nonsense words is a useful strategy to determine whether children know how to decode (Spear-Swerling, 2016), but providing meanings for words is a stronger strategy when teaching decoding. Thus, each TRI teacher was trained to assist the student during a TRI session in understanding a word's meaning prior to decoding the word. If a TRI student did not know the meaning of a word, the teacher would show the student a picture of the word in the TRI picture dictionary, act out the word, or provide a definition. The teacher would then make sure the student could use the word in a sentence or provide the definition. Students scoring lowest on the TOLD measure of Oral Vocabulary (Newcomer & Hammill, 2008) may have been the most primed to benefit from TRI teachers' instruction to make the greatest advances in decoding, potentially because teachers provided these students with new and integrated skills of understanding word meaning *in tandem with* decoding words. Given the findings from this study, interventions that integrate vocabulary and scaffolded language support combined with decoding instruction are likely important for students who begin kindergarten or first grade with low vocabulary skills.

As expected given prior research (Al Otaiba & Fuchs, 2002), scoring lowest on fall phonological awareness measures (*Blending Words, Elision, and Sound Matching*) was negatively associated with all of the measured decoding, spelling, and reading comprehension outcomes. Particularly for students in kindergarten and first grade, researchers have found that phonological awareness is an important predictor of how children are able to decode and read words (Hogan, Catts, & Little, 2005). A previous TRI study found that the combination of higher phonological awareness skills and TRI treatment condition led to higher *Word Attack* scores (Vernon-Feagans et al., 2012), but this study did not find that initial phonological awareness moderated the treatment effect. Although TRI teachers worked with students on their phonological skills by prompting them to identify beginning, middle, and ending sounds in words at lower TRI levels and to chunk sounds of words at higher TRI levels, the foci on learning to decode sounds within words, understand the meaning of words, and read with fluency and comprehension were all more strongly emphasized. In this study, the TRI appeared to be equally effective for children regardless of their fall phonological awareness skills.

Finally, a three-way interaction was not significant, as children with the lowest phonological awareness and the lowest vocabulary skills did not experience differential benefits from the TRI. Although this group was likely most at risk for reading-related disabilities, we suspect that a low sample size for this group led to insufficient power to adequately test these relations.

Limitations

The findings from this study need to be interpreted in light of its limitations. The results cannot be assumed to be causal, unlike findings from the intent-to-treat analyses (Vernon-Feagans et al., 2018). Nonetheless, this study was important because it began to unpack questions regarding *for whom* the TRI was most beneficial. Furthermore, we did not collect data from schools about whether the students assessed in this study had an Individualized Education Program (IEP) and thus were receiving services above and beyond those provided by teachers. Future research may want to account for IEP status when exploring differential effects of reading interventions. Finally, broader measures capturing oral language were not collected as part of this study, so the findings were limited to students who had the lowest fall scores on vocabulary. Although knowledge of word meaning is vital to students' ability to comprehend texts, a broader set of oral language measures capturing initial skill status may be beneficial to explore in future work.

Implications for Practice

Findings from this study have practical applications for school practitioners working with children at risk for reading-related disabilities. It may be important to use oral language screeners or assessments prior to or when working concurrently with reading interventions. Findings from our study suggested that when children with lower vocabulary skills had opportunities for additional reading instruction, they made gains in decoding skills. Teachers in our study were trained to not only define words and elaborate on texts but also to provide opportunities for children to talk about the selected words and texts during the TRI sessions. For example, children used words in sentences, received immediate teacher feedback, and talked about personal connections to the guided reading text (e.g., self-to-text connections). Opportunities to independently apply and construct meaning from words and texts may be an important aspect of children's broader reading development. Practitioners can easily embed those opportunities within core reading instruction or reading interventions. Professional development for in-service teachers and elementary teacher preparation programs could highlight concrete ways to integrate oral language, phonological awareness, decoding, and comprehension skills within reading instruction instead of focusing on skills in isolation. A comprehensive focus on foundational literacy skills can optimize the impact of differentiated instruction for children at risk for reading-related disabilities.

Conclusion

Intervention programs such as the TRI that encourage teachers to differentiate instruction for individual learners are

important (Torgesen, 2002). Our study implied that the TRI was effective in producing higher gains for students who began the year with lower versus higher vocabulary skills. Although we did not provide teachers with details about the exact challenges displayed by children in the fall (e.g., related to decoding, oral language, phonological awareness, or comprehension), the TRI's ongoing coaching support for professional development was designed to help teachers correctly identify those weaknesses exhibited by children and target instruction to meet their specific needs. Students who face challenges with reading comprehension in later grades often do not display clinically apparent deficits in their early years of schooling, leading to intervention assistance that may come too late for some students (Catts et al., 2006). Early identification based on oral language skills may be a key strategy to target students most in need of high-quality differentiated instruction from their teachers and available specialists (Gatlin, Wanzek, & Al Otaiba, 2016).

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