

Rationale

In Response to Intervention (RTI) and Multi-Tiered Systems of Support (MTSS) frameworks, the general education teacher is expected to learn and deliver supplemental interventions to accelerate students' learning (Wanzek, Al Otaiba, & Gatlin, 2016). Teachers' implementation efforts are a critical aspect of intervention effectiveness, and some research has demonstrated that students make limited gains when teachers implement interventions with low fidelity (Greenberg, Domitrovich, Graczyk, & Zins, 2007). Understanding relations among key intervention elements, implementation fidelity, and children's early learning outcomes has remained elusive despite decades of research. Focusing on implementation of specific intervention elements and exploring which elements promote children's academic gains is important to understand how and why programs produce effects for individual students.

In the current study, we focused on the implementation fidelity of a program that consists of a Tier 2 reading intervention and embedded professional development (PD). Tier 2 reading interventions are frequently comprised of core activities and specific strategies that are implemented with individual students. This can introduce variability in how teachers implement interventions, and means interventions are more likely to vary in fidelity at the student level (Wanzek et al., 2016). Capturing specific elements of fidelity at an individual student level may lead to improved understanding of intervention effectiveness. Additionally, multi-year participation in these types of programs may have important implications for improving the impact of interventions for students. Teachers may have greater competency in implementing the intervention during the second year of training, helping teachers to develop more internalized and automated instruction that allows them to differentiate instruction.

Study Aims

The current study focused on how kindergarten and first grade classroom teachers' implementation fidelity to a Tier 2 PD program was related to students' early reading outcomes. Prior efficacy studies have primarily focused on *if* the intervention produced gains for students (Vernon-Feagans et al., 2018). In contrast, the current study examined associations among treatment teachers' fidelity of implementation (exposure, adherence, and quality of delivery) and students' reading and vocabulary outcomes, with years of program participation (one versus two years) as a moderator, to begin to unpack *how* the intervention produced gains for students.

Setting and Sample

Kindergarten and first grade classrooms ($N = 100$) were randomized in ten Title I schools across three rural school districts, with approximately half randomized as treatment and half as control. In the current study, we only included teachers who taught in classrooms randomized to the treatment condition and their students. A total of 67 treatment teachers participated in the study. All teachers were recruited to participate in the study for two years, although some attrition occurred (Author, 2018). A total of 305 students, approximately three per treatment classroom, participated in the study during one school year.

Key Measures

Implementation fidelity. Fidelity of implementation was measured at the student-level rather than teacher-level to capture every student's experience with his or her teacher's implementation of the intervention. We focused on three aspects of fidelity: (1) student exposure to the intervention, which was the number of sessions student received; (2) teacher adherence to

intervention strategies and activities, which was the proportion of adherence items coded as *present* during all overarching intervention activities; (3) teacher quality of scaffolding, which was the proportion of scaffolding items that were coded as *present* during intervention activities; and (4) teacher quality of comprehension during lessons, which was measured by a three-point Likert-type global indicator across intervention activities. Exposure was reported by teachers, whereas adherence and quality were coded using video-recorded coaching sessions. Two video sessions for each student and his/her teacher were randomly selected to be coded for adherence and quality.

Reading/Vocabulary Outcomes. Two subtests from the Woodcock Johnson Diagnostic Reading Battery (Woodcock, Mather, & Schrank, 2004), Letter-Word Identification (LW) and Passage Comprehension (PC), and one subtest from the Test of Language Development (Newcomer & Hammill, 2008), Oral Vocabulary (OV), were used.

Covariates. Covariates included student grade level, student demographics (gender, race, and socioeconomic status), and teacher qualifications (education and years of experience).

Moderators. Year of participation in the Tier 2 PD program was used as a moderator of the relationship between teacher implementation fidelity variables and children's reading outcomes.

Analytic Plan

We analyzed two-level hierarchical linear models (HLM). Significant interactions were probed by testing simple slopes at the moderator (year of participation) values of 0 and 1. Effect sizes were calculated using Hedge's g .

Findings

As shown in Table 1, main effects of implementation fidelity variables were not significantly associated with Letter-Word Identification (LW) scores. An interaction between teachers' year of participation and exposure was significant ($B = 0.54, p = .008$) in association with students' spring LW scores. This interaction (Figure 1a) indicated that the relation between intervention exposure and students' decoding skills varied by teachers' year of participation in the study ($g = .17$).

Main effects of implementation fidelity variables were not significantly associated with PC scores. An interaction (Figure 1b) between teachers' second year of participation and exposure was significant ($B = 0.41, p = .03$) in association with students' spring PC scores ($g = 0.13$).

Adherence to intervention strategies was significantly related to students' spring OV scores ($B = 2.85, p = .02, g = 0.15$). The other implementation fidelity variables were not significantly associated with OV scores. No significant interaction findings emerged.

Implications

The program tested in the current study was specifically developed for classroom teachers and, despite extensive coaching support, not all teachers demonstrated 100% fidelity to the intervention. Our study of the PD program portrayed realistic implementation of the intervention. Our two primary findings included: 1) Teacher adherence to intervention strategies was directly associated with oral vocabulary, and 2) Student exposure to the intervention was related to word reading and reading comprehension, but only when their teachers were in their second year of participation in the program. In line with existing research, *how* teachers'

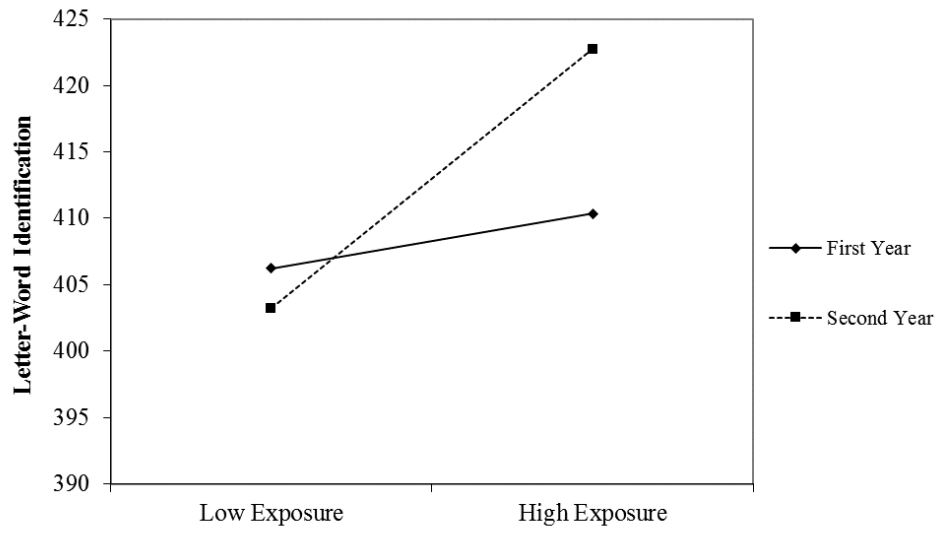
implement reading interventions is an important part of understanding *why* interventions are or are not successful. Ongoing PD for teachers can help teachers implement interventions more effectively, which can thereby improve children's reading outcomes.

Table 1.

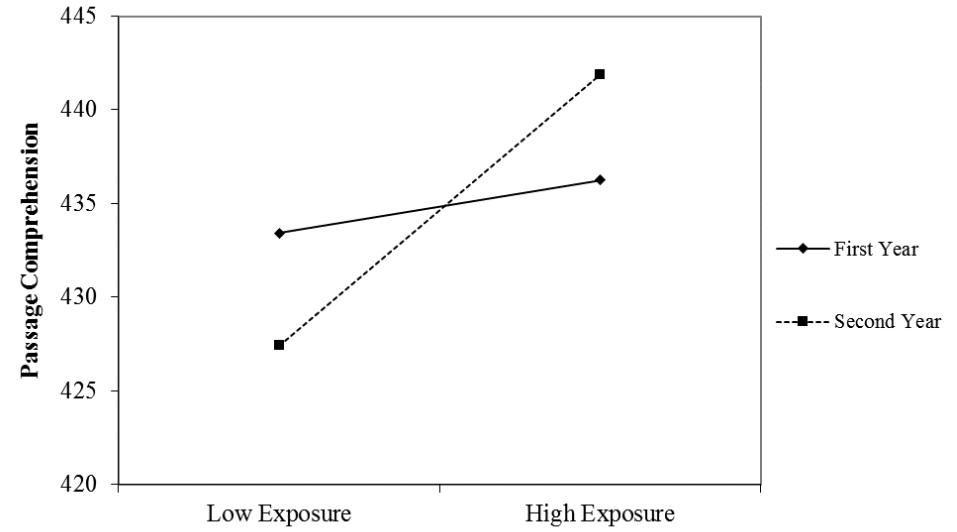
Multilevel Model Main and Moderation Effects (N = 305)

	<i>Letter-Word Identification</i>		<i>Passage Comprehension</i>		<i>Oral Vocabulary</i>	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Model 1 – Main associations						
Intercept	408.36 ^{***}	1.48	434.68 ^{***}	1.18	6.90 ^{***}	0.14
Pretest	0.60 ^{***}	0.07	0.28 ^{***}	0.07	0.34 ^{***}	0.06
Grade (0 = kindergarten, 1 = first grade)	-3.14	5.06	25.70 ^{***}	2.82	0.03	0.31
Child gender (0 = female, 1 = male)	-0.29	2.22	-0.43	2.18	0.08	0.23
Child race (0 = Minority, 1 = White)	-0.82	2.91	3.05	2.76	0.10	0.31
SES	2.25	1.64	4.27 [*]	1.47	0.43 [*]	0.18
Teacher education	-0.03	3.37	-3.20	2.62	-0.65 [*]	0.32
Teacher experience	-0.36	0.29	0.24	0.23	0.00	0.03
Exposure	0.07	0.08	0.04	0.08	0.01	0.01
Adherence to TRI activities	7.50	8.40	2.44	8.17	-0.69	0.91
Adherence to TRI strategies	6.96	11.46	6.46	10.63	2.85 [*]	1.25
Quality of scaffolding	-1.81	4.59	2.13	4.33	-0.08	0.47
Quality of comprehension	3.90	2.33	3.04	2.31	0.17	0.26
Year of participation (0 = first year, 1 = second year)	4.74	2.55	-0.41	2.50	-0.33	0.27
Model 2 – Interaction terms						
Exposure x year of participation	0.54 ^{**}	0.20	0.41 [*]	0.19	0.04	0.02
Adherence to TRI activities x year of participation	-24.00	16.79	-4.63	16.05	0.68	1.75
Adherence to TRI strategies x year of participation	39.34	26.00	-5.20	25.25	0.15	2.78
Scaffolding x year of participation	-2.78	9.68	-7.42	8.81	-0.76	0.89
Comprehension x year of participation	-1.11	4.78	2.16	4.54	0.81	0.50
Variance Components						
Level 2 (Classroom)	64.48 [*]	27.37	17.08	18.57	0.46	0.25
Residual	315.09 ^{***}	31.03	316.25 ^{***}	30.30	3.50 ^{***}	0.34

Note. ^{*} $p < .05$, ^{**} $p < .01$, ^{***} $p < .001$.



(a)



(b)

Figure 1. Graph of the interaction between intervention exposure and year of participation as related to (a) Letter-Word Identification scores and (b) Passage Comprehension scores.

References

- Greenberg, M. T., Domitrovich, C. E., Graczyk, P. A., & Zins, J. E. (2005). The study of implementation in school-based preventive interventions: Theory, research, and practice. *Promotion of Mental Health and Prevention of Mental and Behavioral Disorders 2005 Series V3*.
- Newcomer, P. L., & Hammill, D. D. (2008). *Test of Language Development—Intermediate, 4th Edn.* Austin, TX: Pro-Ed.
- Vernon-Feagans, L., Bratsch-Hines, M., Varghese, C., Cutrer, E. A., & Garwood, J. D. (2018). Improving struggling readers' early literacy skills through a Tier 2 professional development program for rural classroom teachers: The targeted reading intervention. *The Elementary School Journal, 118*(4), 525–548.
- Wanzek, J., Al Otaiba, S., & Gatlin, B. (2016). Implementation of tier 2 reading interventions in the primary grades. *Handbook of Response to Intervention, 329–340*. doi:10.1007/978-1-4899-7568-3_19
- Woodcock, R. W., Mather, N., & Schrank, F. (2004). WJ III Diagnostic Reading Battery. Rolling Meadows, IL: Riverside.