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The Impacts of a Scalable Intervention on the Language and Literacy Development of Rural Pre-Kindergartners

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Read It Again (RIA) is a curriculum for pre-kindergarten (pre-K) classrooms that targets children's development of language and literacy skills. A cluster randomized trial was conducted in which 104 pre-K classrooms in the Appalachian region of the United States were randomly assigned to one of three study conditions: Control ($n = 30$), RIA only ($n = 35$), or RIA with expanded professional development components ($n = 39$). This study tested the impacts of RIA on six measures of children's ($n = 506$) language and literacy development. There was a significant positive impact of RIA on print concepts, and the impacts of RIA on print knowledge and alphabet knowledge were significantly stronger in classrooms with lower-quality literacy instruction. There were no impacts of RIA on children's language development and no impacts of the professional development components. Implications of the findings for implementing scalable, effective strategies to improve key school readiness outcomes for children from economically-disadvantaged backgrounds are discussed.

This study was conducted to determine the impacts of *Read It Again!* (RIA; Justice & McGinty, 2009), a low-cost, preschool language and literacy curriculum designed for scalability, such that it could be used with large numbers of teachers at very low costs and with minimal intensive training in its implementation. For the present purposes, RIA impacts were examined among 506 pre-kindergartners attending early childhood programs in rural, Appalachian communities; the programs served children considered to be at-risk for future academic challenges due to socio-economic disadvantages. As a potential means to reduce these risks, RIA provides teachers with a 30-week, whole-class curriculum that targets children's development of vocabulary, narrative expression, print knowledge, and phonological awareness skills; each of which is consistently linked to children's later development of word recognition and reading comprehension skills (average correlation > 0.40; National Early Literacy Panel, 2008).

These four skills are often under-developed among children experiencing socio-economic risks during the preschool years (e.g., Cabell, Justice, Konold, & McGinty, 2011), yet these skills are amenable to change through the use of systematic and explicit instructional practices and programs (e.g., Justice & Ezell, 2002; Ukrainetz, Cooney, Dyer, Kysar, & Harris, 2000; van Kleeck, Gillam, & McFadden, 1998; Whitehurst et al., 1994). Furthermore, causally interpretable research designs show that improvements in these skills,

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particularly in the areas of print knowledge and phonological awareness, can lead to longer-term improvements in reading (e.g., Byrne & Fielding-Barnsley, 1991; Lundberg, Frost, & Petersen, 1988; Piasta, Justice, McGinty, & Kaderavek, 2012). In light of the achievement gaps in these early language and literacy skills, the malleability of these skills, and their positive associations with later reading outcomes, there have been numerous efforts to provide the early-childhood community with interventions that are effective in promoting these skills.

INTERVENTIONS TO IMPROVE PRESCHOOLERS' LANGUAGE AND LITERACY SKILLS

Children from low socio-economic backgrounds lag behind their advantaged counterparts in development of language and literacy skills during early childhood (Noble, Houston, Kan, & Sowell, 2012). Importantly, the effects of low socioeconomic status (SES) on young children are not only seen on behavioral indices of early language and literacy skills (e.g., how many alphabet letters children can identify or how well they can write their own names; Cabell et al., 2011), but also on neurobiological indices reflecting language-supporting regions of the brain, namely the left temporal, temporo-occipital, and frontal cortices (see Noble, Wolmetz, Ochs, Farah, & McCandliss, 2006). Studies show marked differences in these language-supporting regions of the brain as a function of SES, and that these differences are magnified over time as children age (Noble et al., 2006). In addition, the effects of SES on young children's brains are relatively specific, affecting language-supporting regions of the brain more so than those affecting memory, social-emotional processing, and cognitive control/self-regulation (Noble, McCandliss, & Farah, 2007). This suggests that targeting early language and literacy interventions to low-SES children may serve a key preventive mechanism for reducing the incidence of reading difficulty and academic under-achievement.

Scientific interest in estimating the impacts of early language and literacy interventions, some in the commercial market but also some generated from within the research community, has increased substantially in the last decade, such that early childhood educators have a plethora of options from which to choose (e.g., Assel, Landry, Swank, & Gunnewig, 2007; Fischel et al., 2007; Hamre et al., 2010; Justice, Mashburn, Pence, & Wiggins, 2008; Justice, McGinty, Cabell, Kilday, Knighton, & Huffman, 2010; Lonigan, Farver, Phillips, & Clancy-Menchetti, 2011; Preschool Curriculum Evaluation Research Consortium, 2008; Wilcox, Gray, Guimond, & Lafferty, 2011). The effects of many of these programs have been tested specifically among children from low-SES backgrounds. Interventions to improve the language and literacy skills of low-SES preschoolers often times include general *practices* that teachers might embed within the curriculum, such as the use of interactive storybook reading (see Mol, Bus, & de Jong, 2009). This practice can positively improve children's language and literacy skills, especially when educators adopt techniques that promote the explicitness and/or interactivity of their reading sessions with children (e.g., Justice, Kaderavek, Fan, Sofka, & Hunt, 2009; Wasik, Bond, & Hindman, 2006). Interventions being investigated also include *programs*; programs differ from practices as they seek to manualize general practices, such as interactive reading, often to improve the systematicity of early language and literacy instruction so that it follows a scope and sequence over time.

Some language and literacy programs involve the use of a single curriculum, whereas others involve the compilation of various curricula and practices into a larger whole. Examples of the former include *Let's Begin with the Letter People* (Abrams & Company, 2000) and *Doors to Discovery* (Wright Group, 2001), each of which was evaluated for its impacts among a sample of 603 preschoolers in programs with enrollment based on risk (Assel et al., 2007), as well as the *Literacy Express Preschool Curriculum* (Lonigan, Clancy-Menchetti, Phillips, McDowell, & Farver, 2005), recently investigated with 808 children exhibiting risk (Lonigan et al., 2011). Examples of the latter include the Evidence-Based Program for the Integration of Curricula (EPIC; Fantuzzo, Gadsden, & McDermott, 2011) and the Head Start Research-Based Developmentally Informed intervention (REDI; Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008), both involving compilations of a variety of practices and programs, usually targeting skills beyond language and literacy, into a larger structure. The REDI intervention, for instance, comprises a social-emotional curriculum, interactive storybook reading, a phonological awareness curriculum, and literacy-focused center-time activities.

The accumulated literature to date on the impacts of language and literacy intervention programs, particularly those representing a single curriculum, shows two clear points of coherence. First, there is strong evidence that these programs can have positive impacts on children's skills in key areas. For instance, Lonigan et al. (2011) evaluation of the impacts of the *Literacy Express Preschool Curriculum* (Lonigan et al., 2005) relative to business-as-usual preschool curricula showed positive impacts on three of four primary outcome measures representing language expression ($d = 0.27$), phonological awareness ($d = 0.36$), and print knowledge ($d = 0.32$). Assel et al. (2007) earlier evaluation of the impacts of *Let's Begin with the Letter People* (Abrams & Company, 2000) and *Doors to Discovery* (Wright

Group, 2001) compared to control conditions yielded similarly sized effects (*d*s = 0.18, 0.26, and 0.28 for measures of language comprehension, phonological awareness, and print knowledge, respectively). In general, impacts on literacy skills (phonological awareness, print knowledge) are stronger than impacts on language skills (vocabulary, language expression and comprehension) (Justice et al., 2010; Lonigan et al., 2011).

It is difficult to know for certain the extent to which these small-to-medium-sized impacts on children's short-term language and literacy skills are robust with respect to their longitudinal significance for improving children's future reading performance, as few studies of such programs have followed children longitudinally. However, a recent follow-up of high-risk children who had received a literacy intervention during preschool, for which estimated impacts were modest in size at the end of preschool ($d = 0.21$; Justice, McGinty, Piasta, Kaderavek, & Fan, 2010), found that these children had significantly better reading skills at first grade than controls (*d*s = 0.26–0.31; Piasta et al., 2012). Such findings, coupled with a large literature showing positive correlations between preschoolers' language and literacy skills and their future reading outcomes (see National Early Literacy Panel, 2008), imply that even modest effect sizes associated with language and literacy program exposure, particularly for high-risk preschoolers, may have practical value.

A second point emerging from the accumulated literature on the impacts of language and literacy intervention programs is that teachers may require considerable professional development to achieve fidelity of implementation, particularly to the more dynamic, process-oriented features of a language and literacy program (Justice, Mashburn, Hamre, & Pianta, 2008). In contrast to the procedural features of a curriculum, such as adherence to a sequence of activities in a lesson plan, dynamic features involve teachers manipulating the way they interact with and respond to children. For instance, implementation of the *Language-Focused Curriculum* (Bunce, 1995) involves teachers' use of seven specific language-facilitating techniques (e.g., open-ended questions) when delivering structured lessons (Pence, Justice, & Wiggins, 2008); teachers tend to show only gradual increases in their use of these process-oriented features of curricula (Pence et al.).

A number of studies have thus featured provision of extensive professional development (PD) to teachers, including in-class coaching as well as technology-mediated consultation (e.g., Assel et al., 2007; Bierman et al., 2008; Hamre et al., 2010; Lonigan et al., 2011). Interestingly, however, several controlled comparisons of more intensive forms of PD relative to less intensive forms of PD, such as in-class coaching versus minimal workshops, have not supported the role of more intensive PD in elevating children's outcomes (see Assel et al.; Lonigan et al., 2011). Thus, although intensive PD may promote aspects of teachers' implementation fidelity (Hamre et al.; Landry, Anthony, Swank, & Monseque-Bailey, 2009), it is not, as yet, clear that it serves to improve the more desirable outcome of enhancing the benefits of a program with respect to children's gains in language and literacy skills. Given that provision of PD can have very high costs for the provider (e.g., coach, consultant) and the recipient (the teacher), and may not decisively lead to its desired impacts, there remains a need for further research that determines the added-value of PD with respect to targeted child outcomes.

SCALABILITY OF LANGUAGE AND LITERACY INTERVENTIONS

Taken together, the extant literature suggests that language and literacy programs for preschoolers may have significant developmental value, at the least for improving children's short-term growth in language and literacy skills but perhaps also for their longer-term reading achievement. Indeed, this literature provides educators with a large array of empirically-supported programs from which to select, and the collective evidence suggests that programs are likely to yield comparable effect sizes based on empirical reports, typically in the range of 0.20 to 0.35, corresponding to an improvement of about one-fifth to one-third of a standard-deviation unit on targeted language and literacy skills. However, a critical barrier to the dissemination and diffusion of such programs into the everyday milieu of preschool programs is that many intervention programs were not developed to be *scalable*. Instead, they often require the purchase of expensive materials or kits for each classroom and/or intensive coaching provided by early-childhood professionals. For instance, intervention implementation described in Assel et al. (2007) involved a $3,000-per-classroom commercial curriculum coupled with PD comprising a four-day workshop and 1.5-hour monthly in-class mentoring for each teacher. Intervention implementation described in DeBaryshe and Gorecki (2007) was similarly intensive: the language and literacy curriculum investigated cost $3000 per classroom, and teachers received weekly individual coaching for implementation.

Scalability as a construct concerns issues related to diffusion and dissemination; a scalable intervention is one that not only has positive impacts on the targeted outcome, but also is one that can be rolled out and utilized by a large number of stakeholders (Milat, King, Bauman, & Redman, 2012). For our purposes, the stakeholders of interest are early childhood educators, including those working in settings serving high-risk children. The design of scalable language and literacy

intervention programs must take into consideration significant issues related to technical and organizational capacities that affect stakeholders, and costs of accessing and implementing the program. To date, there is minimal evidence that any of the intervention programs described in the language and literacy literature were designed with scalability in mind. Indeed, many of the potential end-users of such programs, or the organizations in which they work, may not have the resources to adopt such programs and to secure the PD supports that appear necessary for educators to implement with fidelity. For instance, programs located in rural areas often have limited resources for purchasing empirically-validated programs, and limited access to staff development opportunities, including qualified mentors who work directly with teachers in their classrooms (Cady, Taylor, & Hodges, 2007).

Read It Again-PreK! (RIA), the language and literacy program under investigation in the present study was designed over a three-year collaborative process among practitioners, policy-makers, and researchers working within the state of West Virginia (see Justice et al., 2010). The goal of this collaboration was to generate an intervention that would be comparable in its impacts to other empirically-supported interventions, and that would be scalable for young children attending pre-k classrooms located in rural settings. To guide the design process, *a priori* decisions were made regarding what would constitute a scalable intervention in these settings; namely, the team determined that the resultant program would: (a) be available at very little cost, (b) require few if any specialized materials for implementation, (c) could be used with fidelity with minimal PD, and (d) could "fit" within a variety of early-childhood program structures (e.g., half- and full-day programs, home- and center-based programs). Read It Again, the intervention that resulted from this process, met all of these criteria.

READ IT AGAIN

RIA is available as a free manualized download (http://ccec.ehe.osu.edu/). It requires few materials for implementation beyond a set of 15 commercially purchased storybooks (a one-time investment of approximately $125), and it can be implemented with high levels of fidelity with modest amounts of PD (and self-study modules are available online at no cost) (Piasta, Justice, McGinty, Mashburn, & Slocum, 2013). To ensure that the program readily fit within a variety of program structures, it involved implementation of only two brief intervention sessions each week; these sessions are implemented as a whole-class lesson, consistent within a "Tier 1" intervention approach from a response-to-intervention perspective. The use of a whole-class framework for implementation was important from a scalability perspective, as some preschool programs meet for only several hours and implementing multiple small-group lessons is not feasible.

The RIA program comprises 60 individual lesson plans. The program follows a systematic scope and sequence of instruction designed to target four areas of language and literacy development: vocabulary, narrative, print knowledge, and phonological awareness. Each lesson includes a static sequence of instructional activities that are framed around the reading of a storybook, thus comprising a before-, during-, and after-reading activity. Accompanying each lesson is a guide describing how teachers can differentiate delivery of the lesson through use of specific scaffolding strategies, as well as a notes page for tracking implementation and individual children's performance during the lesson. See the Appendix for an example RIA lesson.

The theory of change for RIA specifies three active ingredients: (a) a systematic scope and sequence of instructional objectives, (b) explicit instruction aligned to these objectives embedded within an authentic literacy context (i.e., whole-class read-alouds), and (c) monitoring of children's progress toward these objectives and differentiating instruction accordingly. With respect to the first active ingredient, RIA addresses 23 learning objectives for building children's competencies in the domains of vocabulary, narrative, print knowledge, and phonological awareness; these are addressed systematically (progressing from easiest to most difficult) and repeatedly over the duration of the program. For the second active ingredient, the 60 RIA lesson plans are soft-scripted, identifying two targeted objectives as well as a sequence of activities with *suggested language* for the teacher to use. The suggested language for teachers provides a mechanism for using explicit instruction to bring about change in children's skills, as aligned to the instructional objectives. Explicit instruction involves directly supporting children's learning via use of clear explanations and demonstrations. Finally, for the third active ingredient, RIA includes an informal progress monitoring tool (Pupil Progress Checklist) that teachers complete for each child at three points during the program. Teachers rate each child's competencies on the 23 learning objectives. To support teachers' use of differentiated instruction, RIA lessons provide teachers with guidance on how to use scaffolding to differentiate instruction based on data from the Pupil Progress Checklist. Pilot research (Justice et al., 2010) involving a quasi-experimental design suggested that impacts achieved were similar in magnitude (range of 0.20 to 0.35) to interventions not designed for scalability, referenced previously. However, more intensive investigation is warranted,

particularly given the quasi-experimental nature of the prior pilot study.

PRESENT STUDY

Situated exclusively within communities meeting the federal designation of Appalachia and considered to be rural, this study was designed to test the impacts of RIA on children's language and literacy development. This study addressed three research questions. First, to what extent does RIA have positive impacts on children's development of language and literacy skills during pre-kindergarten (pre-K)? To address this primary research question, an experimental study was conducted in which we compared the development of language and literacy skills for children ($n = 361$) enrolled in the 74 classrooms in which teachers implemented RIA with the skills of children ($n = 145$) enrolled in 30 classrooms in the Control condition. We hypothesized that children in RIA classrooms would exhibit greater language and literacy skills at the end of pre-K, controlling for fall skills, compared to children in the Control classrooms.

Second, to what extent do the impacts of RIA on children's development of language and literacy skills depend upon the quality of language and literacy instruction in the classroom? We hypothesized that the impacts of RIA on children's literacy development would be relatively stronger in classrooms that were observed to have lower-quality literacy instruction; similarly, we hypothesized that the impacts of RIA on children's language development would be relatively stronger in classrooms that were observed to have lower-quality language instruction. Both hypotheses support a *compensatory effect* of RIA, whereby RIA has stronger positive impacts on children's development within classrooms having otherwise lower levels of support for children's language and literacy development. This compensatory effect has been shown in prior studies of early-literacy intervention (McGinty, Justice, Piasta, Kaderavek, & Fan, 2012).

Third, to what extent do RIA PD enhancements have positive impacts on children's development of language and literacy skills during pre-K? As noted previously, a number of interventions targeting language and literacy skills described in the literature were coupled with PD supports provided to teachers (e.g., Bierman et al., 2008; Hamre et al., 2010; Pence et al., 2008). It is not clear that more extensive PD is necessary for interventions to achieve positive impacts on children's development, as suggested by several controlled comparisons of the benefits of enhanced PD (e.g., coaching, consultation) to minimal PD (traditional workshop; see Lonigan et al., 2011). To address this question about the added-value of RIA professional development components, we compared the development of language and literacy skills for children ($n = 191$) enrolled in the 39 RIA classrooms in which teachers had access to the professional development enhancements to the skills of children ($n = 160$) enrolled in the 35 RIA classrooms in which teachers did not have access to these resources. Given mixed results in the literature regarding the benefits of providing enhanced PD to teachers with respect to children's outcomes, we did not advance an *a priori* hypothesis; intuitively, however, one might anticipate that providing teachers with access to enhanced PD would have a positive impact on children's development of language and literacy skills.

METHOD

Participants

Participants in this study were 104 lead teachers and 506 children enrolled in pre-kindergarten (pre-K) classrooms that served four-year olds in rural counties within Ohio, Virginia, or West Virginia. All classrooms were located within counties that are part of the Appalachian geographic and cultural region of the eastern United States, as defined by the Appalachian Regional Commission (2013). To recruit classrooms to participate, district or regional program directors that led pre-K programs within eligible counties were first contacted by research staff to introduce them to the study. Program directors who expressed potential interest in participating were then visited by members of the research staff who provided more details about the RIA program, the demands that the program and research study would place on teachers and children, the benefits and any risks of participating, and requirements of the study design, including the need to conduct random assignment of classrooms to study conditions. Within districts or regions in which program directors expressed interest in participating, pre-K classrooms were identified that met the following eligibility requirements: (a) served at least 75% of children from low-income households according to 2008 Federal Poverty Guidelines; (b) expected a minimum of six children enrolled in the classroom who would meet the age requirement to be eligible to enroll in kindergarten during the following school year according to local eligibility requirements; and (c) had high stability as defined by high rates of child attendance, low rates of child mobility, and low rates of staff turnover.

The lead teacher in each pre-K classroom that met the above inclusion criteria was then contacted by a research staff member who provided details about the study and arranged a time to meet face-to-face with the teacher to determine her or his interest in participating. These meetings lasted 20–30 minutes and consisted

of a presentation describing details of the study, along with a question-and-answer opportunity. For teachers who then expressed interest in participating, research staff provided a consent form and instructions for how to contact the director of the research study to get any additional information, formally register to participate in the study, and submit their signed consent forms. A total of 104 teachers participated in the study, and Table 1 presents characteristics of these teachers and their classrooms. In five of these classrooms, there was either teacher turnover or extended absences by the lead teacher for medical reasons, and the demographic characteristics in this table are reported for the teacher who spent the majority of time with the children during the school year. This table illustrates the wide variation in teachers' demographic background characteristics with regard to their years of teaching experience, level of education, and type of pre-K programs within which they worked.

At the beginning of the school year, the lead teacher in each participating classroom sent home with each a letter describing the study, a brief child demographic questionnaire, and a parent/guardian consent form; the consent form sought permission for children to participate. Of 1,849 consent forms returned (averaging about 18 children per classroom), 1,424 parent/guardians provided consent for their children to participate (77% consent rate, with an average of about 14 children per classroom). Five children per classroom were randomly selected to participate from among those who met the following inclusion criteria: the parent/guardian provided consent, the child was expected to enroll in kindergarten the following year, the child had no known disability, and the child spoke English as their primary language. In classrooms in which only three or four children met the above criteria, all eligible children were included in the study.

Table 2 presents demographic characteristics of the participating children and their families. Approximately half of the children in the study (47%) were boys, and 89% of children were White. There were high levels of social and economic risk among children in the sample. With regard to maternal education, 42% of mothers did not have a high school diploma or had a high school diploma or equivalent as their highest degree; less than 20% had a degree beyond high school. The average yearly family income was \$26,922 (SD = \$22,692), and over one-half of the children resided in homes in which the total family income was less than \$20,000 per year.

TABLE 1
Characteristics of Teachers and Classrooms (n = 104)

	Missing	n	%	M	SD
Study condition	0				
Control		30	29		
RIA-Traditional		35	34		
RIA-Enhanced		39	38		
Teacher highest level of education	1				
Less than BA		44	43		
BA		38	37		
Graduate		21	20		
Program type	2				
Head Start		60	59		
State PK		32	31		
Other		10	10		
Teaching experience	1			10.00	8.07
Quality of language modeling	0			3.12	0.62
Quality of literacy focus	0			1.73	0.45

Note. Teaching Experience = teachers' report of experience as lead teachers in pre-K and kindergarten settings; Quality of Language Modeling and Quality of Literacy Focus from *Classroom Assessment Scoring System* (Pianta, La Paro, & Hamre, 2004).

Study Design

This study featured a multi-cohort, multi-site, cluster randomized trial design with three conditions.

TABLE 2
Characteristics of Children and Families (n = 506)

	Missing	n	%	M	SD
Gender	0				
Boy		239	47		
Girl		267	53		
Race/ethnicity	52				
White		414	89		
Other		52	11		
Maternal education	46				
Less than high school		45	10		
High school or equivalent		145	32		
Some college, no degree		114	25		
High school + technical training		66	14		
Associate's degree		43	9		
Bachelor's degree or more		47	10		
Family income	56				
\$10,000 or less		107	24		
\$10,001–\$20,000		123	27		
\$20,001–\$30,000		64	14		
\$30,001–\$40,000		56	12		
\$40,001–\$50,000		31	7		
More than \$50,000		69	15		
Child's age (months)	2			52.9	3.18
Days between assessments	79			202.0	13.80
Fall assessments					
Print knowledge (TOPEL)	23			91.4	12.30
Alphabet knowledge (PALS)	20			12.5	14.40
Print concepts (PWPA)	19			95.1	13.00
Definitional vocabulary (TOPEL)	29			99.6	10.50
Phonological awareness (TOPEL)	44			91.3	13.90
Narrative language (NAP)	50			18.2	6.74
Spring assessments					
Print knowledge (TOPEL)	77			99.6	14.10
Alphabet knowledge (PALS)	78			30.1	16.90
Print concepts (PWPA)	77			110.0	14.50
Definitional vocabulary (TOPEL)	80			101.2	9.47
Phonological awareness (TOPEL)	80			95.4	15.60
Narrative language (NAP)	88			20.7	5.52

Specifically, the study used a *multi-cohort* design involving three independent cohorts of classrooms and children who entered pre-K in either fall 2008, 2009, or 2010. The research was conducted using a *multi-site* design, such that research teams at The Ohio State University and the University of Virginia followed identical research protocols for classrooms located in Ohio ($n = 58$) and Virginia and West Virginia ($n = 46$), respectively. The research featured a *cluster randomized trial* in which classrooms were randomly assigned, within cohort and site blocks, to one of three study conditions: (1) Read It Again-Enhanced (RIA-E), in which teachers implemented RIA for a 30-week period and received enhanced professional development supports; (2) Read It Again-Traditional (RIA-T), in which teachers implemented RIA for a 30-week period and participated in workshops to support their implementation of RIA; and (3) Control, in which teachers were instructed to conduct "business as usual" instruction in their classrooms. At the end of their study year, classrooms assigned to the Control group received the Read It Again materials and activities, including access to the professional development supports provided to the RIA-E teachers.

Classrooms' placements into study conditions were conducted using *free random assignment procedures*, such that each classroom had an equal probability of being assigned to each of the three study conditions without regard to the assignment of other classrooms. As a result, there were unequal numbers of classrooms in each study condition ($n_{ria\text{-}e} = 39$; $n_{\text{ria-t}} = 35$; $n_{\text{control}} = 30$). All teachers who participated in the study were aware that there were multiple study conditions and that random assignment would determine their study condition. As part of their orientation to the study, teachers received information about how experiments work, the effects of contamination, and the value of their role in participating in an experiment and protecting against contamination. Teachers assigned to the RIA conditions were asked not to share any materials or RIA details with other teachers until the study was over. Regardless of condition, all teachers received various incentives for participating in the study, including gift cards at each classroom observation and each time questionnaires were collected (usually \$50 per occasion) and a completion incentive (total incentive of \$300/teacher).

Study Conditions

RIA-E

Teachers assigned to the RIA-E condition were offered access to the 30-week RIA program. Teachers in the RIA-E condition also received two types of PD to support their implementation of RIA. First, teachers participated in a full-day workshop, prior to the start of the year, during which they received information about language and literacy development in young children and familiarized themselves with the structure and content of the RIA curriculum. Second, they each completed a technology-mediated 12-module self-study program (Justice, McGinty, Sofka, Slocum, & Pentimonti, 2009) designed to provide deepened instruction on the particular skills targeted in the intervention (e.g., vocabulary, print knowledge) and the ways in which scaffolded instruction can be used to improve these skills. The modules were designed to draw upon theories of effective PD in which teachers have opportunities to apply and then reflect upon specific strategies within the context of their own classrooms. For instance, within each module, teachers were provided video demonstrations of RIA lessons and were asked to identify which strategies were used; they were also asked to reflect on their children's skills and link specific strategies to specific children's needs, based on their skill levels. To ensure that teachers completed the modules as required, their self-study workbooks were routinely submitted to project staff who evaluated their thoroughness of completion utilizing a fidelity checklist.

RIA-T

Teachers in the RIA-T condition were offered access to the 30-week RIA program in the same way as those teachers in the RIA-E condition. To support their implementation of RIA, teachers also participated in the full-day traditional workshop; however, they did not have access to the technology-mediated self-study program.

For teachers in both of the aforementioned RIA conditions, fidelity of implementation for RIA teachers was carefully documented over the course of this study; measures were designed to span the construct of fidelity, to include adherence, exposure, quality of program delivery, and participant responsiveness (O'Donnell, 2008). Findings specific to fidelity are discussed elsewhere (Piasta et al., 2013), and show that fidelity was generally high across all indices. For instance, RIA teachers implemented 44 of the required 60 lessons ($SD = 15$).

Control

Teachers in the Control condition implemented their business-as-usual classroom instruction. To address potential biases that might arise from differential treatment of participating teachers in the different study conditions, the following study procedures were implemented. First, Control teachers received PD of the same intensity as those in the RIA conditions. The only difference was in the content of the PD provided,

which focused not on language and literacy but on social studies in the early childhood classroom, including universal design, citizenship and classroom participation, and students' rights. Second, Control teachers participated in all of the same classroom-based research activities as teachers in the two RIA conditions, such as routine classroom observations and teacher surveys. Third, teachers in the Control condition received the same incentives as those in the RIA groups.

MEASURES

The study measured demographic characteristics of participating children and their families; characteristics of teachers and classrooms; children's language and literacy skills at the beginning and end of the pre-K school year; and the observed quality of language and literacy instruction at three time points during the school year.

Child and Family Characteristics

Parents/guardians of children completed a demographic questionnaire at the start of the study that provided information about characteristics of the child and family, including the child's gender, age, and race/ethnicity, and maternal education and family income.

Teacher and Classroom Characteristics

At the beginning of the school year, teachers completed a questionnaire on which they reported their years of experience teaching pre-K and kindergarten, their highest level of education, and the type of pre-K program within which they were currently teaching (Head Start, state pre-K, or other). Teachers also described the demographic composition of children in their classrooms, including the percentage of boys and the percentage of four-year-olds. Additional classroom composition variables were derived from parent/guardians' responses to the demographic questionnaire; within each classroom, a classroom-level measure of race/ethnicity (percentage of children who were White), average years of maternal education, and average family income was computed. Finally, children's scores on each of the six assessments of language and literacy skills (described in the next sub-section) in fall were averaged for each classroom to create classroom-level measures of children's language and literacy skills upon entering the classroom in fall.

Children's Language and Literacy Skills

One-on-one assessments of children's language and literacy skills were conducted by a team of trained assessors in fall (September–October) and again in spring (April–May) of the pre-K year. Before assessing children, each assessor participated in training that included guided self-study activities (online presentation and video examples), a written quiz, hands-on training (peer practice), and a certification test (graded observation administering the measure to a volunteer participant).

Four instruments, resulting in a total of six measures, were included in the assessment battery. Each measure aligns with one of the four following domains of language and literacy skills targeted by RIA (print knowledge, vocabulary, phonological awareness, and narrative). Instruments included the *Test of Early Preschool Literacy* (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007), the *Phonological Awareness Literacy Screening-PreK* (PALS PreK; Invernizzi, Sullivan, Meier, & Swank, 2004), the *Preschool Word and Print Awareness Assessment* (PWPA; Justice & Ezell, 2001); and the *Narrative Assessment Protocol* (NAP; Pence, Justice, & Gosse, 2007). All of the resulting measures have adequate psychometrics, based on publisher reports or the empirical literature. Table 2 provides descriptive statistics for each measure during fall and spring for the entire sample of children.

Print Knowledge

Three different albeit overlapping areas of knowledge of print—general print knowledge, alphabet knowledge, and print concepts—were assessed using subtests from the TOPEL, PALS PreK, and PWPA. For *general print knowledge*, children were administered the Print Knowledge subtest of the TOPEL on which each child is asked to display his or her knowledge of functions of print, to identify letters and written words, and to identify letters associated with specific sounds. Each correct answer is awarded one point for a possible total score of 36 across three item sets, and raw scores are converted to age-adjusted standardized scores with a mean of 100 and a standard deviation of 15. For *alphabet knowledge*, children were administered the PALS Upper-Case and Lower-Case Alphabet Recognition subtests; children were asked to name all of the individual letters in both upper- and lower-case forms; one point is awarded for each letter that is correctly identified, yielding a possible total raw score of 52. For *print concepts*, children were administered the PWPA, on which children's knowledge of 14 specific print concepts is examined within the context of a read-aloud. Each response is awarded from 0 to 2 points, depending on the accuracy of the response. Points awarded for each question are totaled, yielding trait estimates based on item-response theory (Justice et al., 2006).

Vocabulary

Children's expressive vocabulary skills were assessed using the Definitional Vocabulary subtest of the

TOPEL, on which the child is shown a picture and asked to tell what it is and then to describe one of its important features or attributes. Each correct response is awarded 1 point for a total possible raw score of 70 across 35 pictured items. Raw scores are converted to age-adjusted standard scores with a mean of 100 and a standard deviation of 15.

Phonological Awareness

The Phonological Awareness subtest of the TOPEL was used to assess children's sensitivity to the phonological structure of spoken language. During this subtest, the child is asked to say a word (e.g., *lamp*) and then to say what is left after dropping specific sounds (e.g., "*Lamp without/p/is . . .*" *lamb*) or to listen to separate sounds and combine them into a word. Each correct answer is awarded one point for a possible total score of 27 across four item sets, and raw scores are converted to age-adjusted standardized scores with a mean of 100 and a standard deviation of 15.

Narrative

The NAP assesses children's spoken narrative abilities using a sample elicited using the wordless storybook, *Frog, Where Are You?* (Mayer, 1969). Assessors collected a video- or audio-taped narrative sample from each child by first telling a scripted story using pictures in the book and then asking children to tell their own story. Each narrative was analyzed based on NAP protocols for inclusion of 12 categories of linguistic structures: complex sentences, negative sentences, elaborated noun phrases, prepositional phrases, advanced modifiers, pluralized nouns, tier-two nouns, auxiliary verbs, copular verbs, irregular past tense verbs, regular past tense verbs, and tier-two verbs. Frequency counts of these particular morphological or syntactic constructions provided information regarding a child's microstructural narrative development, and individual scores were added to create a NAP sum score capturing a child's use of language forms as represented in a spoken fictional narrative.

Quality of Language and Literacy Instruction

On three occasions during the pre-K year—in September, January, and April—a research staff member visited each classroom at the beginning of the school day to a conduct a two-hour videotaping of classroom activities, to include a whole group lesson such as Circle Time, a whole group book reading, and free choice/center time. Videotapes were returned to the research site, and they were observed and rated using the following procedures. First, each two-hour videotape was divided into six 20-minute segments. Second, three of these 20-minute segments were randomly selected to be observed and rated. If the videotape was less than two hours long, three of the available segments were randomly selected, and if the last segment was less than 15 minutes long, it was considered incomplete and not selected to be observed and rated.

The *Classroom Assessment Scoring System-Pre-K* (CLASS; Pianta, La Paro, & Hamre, 2008) was used to assess the quality of instruction for each 20-minute segment. Although this tool assesses ten different dimensions of instruction, for the purposes of this study we were interested in quality with respect to only two specific dimensions: Language Modeling and Literacy Focus. The Language Modeling scale assesses the extent to which the teacher used techniques during instruction that promote children's language growth, including repeating, extending, and recasting children's utterances; using advanced vocabulary; engaging in extended conversations with children; and asking open-ended questions. The Literacy Focus scale assesses the extent to which instruction evidenced systematicity, explicitness, and purposeful integration of literacy concepts (see Justice et al., 2008, for a detailed description of these scales). Raters assigned scores for each 20-minute segment along a 1–7 rating scale, with scores of 1 and 2 representing low quality, 3, 4 and 5 representing medium quality, and 6 and 7 representing high quality. All rated segments for each teacher (three per occasion across three occasions during the year) were averaged to create total scores that represent the level of quality of language instruction and quality of literacy instruction that children experienced in their classroom over the course of the pre-K year.

Standard protocols for conducting rater training were implemented, which included completing an initial training by a CLASS-certified trainer, passing an initial reliability test, and successfully completing re-training on a yearly basis. The 20-minute video segments collected during each of the three occasions for a given cohort were randomly assigned to a trained rater for coding. In addition, 20% of the segments were randomly selected and assigned to two raters in order to assess inter-rater reliability. The intra-class correlations (ICCs) for double-coded video segments using a two-way mixed model across all project time points, cohorts, and sites was 0.74 for Language Modeling and 0.81 for Literacy Focus. Raters were blind to the study condition to which the classroom was randomly assigned. Table 1 indicates that across all participating classrooms, there was, on average, low-to-medium quality language modeling ($M = 3.12$) and low quality literacy instruction ($M = 1.73$) observed within these classrooms.

ANALYSES

Preliminary Analyses

Two sets of preliminary analyses were conducted before addressing the three research questions. The first set of

TABLE 3
Baseline Characteristics of Children in RIA-Enhanced, RIA-Traditional, and Control Classrooms

	RIA-Enhanced (n = *191*)		*RIA-Traditional* (n = *170*)		*Control* (n = *145*)		*RIA v. control*	*RIA-E v. RIA-T*
	M	SD	M	SD	M	SD	t	t
Gender (% Boy)	0.49	0.50	0.46	0.50	0.48	0.51	−0.01	*0.49*
Race/Ethnicity (% White)	0.88	0.32	0.91	0.29	0.87	0.33	0.66	*−0.84*
Age (Months)	52.90	3.13	52.80	3.06	53.10	3.40	−0.72	*0.13*
Maternal education (Years)	12.80	1.63	13.00	1.86	12.70	1.46	1.16	*−0.89*
Family income ($10,000 Dollars)	2.65	2.23	2.93	2.40	2.48	2.16	1.28	*−1.10*
Days between assessments	203.40	14.10	201.80	14.20	201.40	12.80	0.83	*−0.99*
Fall assessments								
Print knowledge (TOPEL)	90.70	10.80	93.50	13.90	89.80	11.90	1.80	*−2.12**
Alphabet knowledge (PALS)	11.80	13.50	14.70	15.70	11.00	13.70	1.51	*−1.80*
Print concepts (PWPA)	94.70	13.30	95.00	12.80	95.80	12.80	−0.76	*−0.18*
Definitional vocabulary (TOPEL)	99.10	10.40	100.30	10.70	99.50	10.50	0.36	*−0.98*
Phonological awareness (TOPEL)	91.30	13.30	92.90	13.60	89.50	14.80	1.78	*−1.10*
Narrative language (NAP)	17.80	6.77	18.60	6.84	18.40	6.58	−0.31	*−1.14*

Note. The last two columns present *t*-statistics from tests of mean differences for RIA (Traditional and Enhanced) compared to Control, and RIA-Enhanced compared to RIA-Traditional, respectively.
*$p \leq .05$.

preliminary analyses involved testing the extent to which there were differences in teacher, classroom, and child characteristics across the study conditions. The expectation following random assignment is that there will be no differences on all measured and unmeasured characteristics prior to the implementation of the intervention. However, the likelihood of achieving equivalence across conditions is diminished under relatively small sub-samples of classrooms, and the addition of statistical controls into the analyses may be needed to

TABLE 4
Baseline Characteristics of Teachers and Classrooms in RIA-Enhanced, RIA-Traditional, and Control Classrooms

	RIA-Enhanced (n = *39*)		*RIA-Traditional* (n = *35*)		*Control* (n = *30*)		*RIA v. control*	*RIA-E v. RIA-T*
	M	SD	M	SD	M	SD	t	t
Teacher characteristics								
Years teaching PK and KG	9.05	7.84	8.28	5.67	13.20	9.84	−2.64*	*0.48*
Highest level of education								
% Less than BA	0.38	0.49	0.38	0.49	0.53	0.51	−1.40	*0.02*
% BA	0.36	0.49	0.44	0.50	0.30	0.47	0.95	*−0.71*
% Graduate	0.26	0.44	0.18	0.39	0.17	0.38	0.60	*0.82*
Classroom characteristics								
Program type								
% Head Start	0.62	0.49	0.45	0.51	0.70	0.47	−1.53	*1.36*
% State PK	0.26	0.45	0.42	0.50	0.27	0.45	0.66	*−1.49*
% Other	0.13	0.34	0.12	0.33	0.03	0.18	1.78	*0.09*
Gender (% Boy)	0.52	0.12	0.51	0.11	0.48	0.13	1.56	*0.23*
Race/Ethnicity (% White)	0.88	0.19	0.92	0.19	0.86	0.25	0.82	*−0.82*
Age (% 4 year olds)	52.90	1.55	52.80	1.32	53.10	1.78	−0.70	*0.22*
Maternal education (Years)	12.90	1.10	13.00	1.19	12.70	0.78	0.96	*−0.71*
Family income ($10,000 Dollars)	2.64	1.44	3.04	1.69	2.49	1.38	1.00	*−1.09*
Average fall assessments								
Print knowledge (TOPEL)	90.60	6.29	93.30	8.35	89.90	7.02	1.24	*−1.57*
Alphabet knowledge (PALS)	11.70	7.26	14.40	8.13	11.20	8.42	1.05	*−1.49*
Print concepts (PWPA)	6.04	1.67	5.99	1.86	6.21	1.64	−0.54	*0.12*
Definitional vocabulary (TOPEL)	99.20	5.68	100.10	6.14	99.60	5.77	0.05	*−0.60*
Phonological awareness (TOPEL)	91.20	6.82	93.00	7.20	89.30	8.98	1.69	*−1.11*
Narrative language (NAP)	17.80	3.58	18.50	3.55	18.40	3.63	−0.43	*−0.80*

Note. The last two columns present *t*-statistics from tests of mean differences for RIA (Traditional and Enhanced) compared to Control, and RIA-Enhanced compared to RIA-Traditional, respectively.
*$p \leq .05$.

better equate the groups at baseline. Table 3 presents descriptive statistics for children in each study condition, and Table 4 presents descriptive statistics for teachers and classrooms in each study condition.

The second-to-last columns in Table 3 and 4 provide a *t*-statistic that represents the magnitude of the difference in means between the groups that are contrasted in Research Question 1 (RIA and Control) and Research Question 2 (RIA-E and RIA-T). These statistics were used to identify variables for which there were meaningful differences across the groups that were being compared. Specifically, we identified teacher and classroom variables that had *t*-values greater than one or less than negative one—a conservative difference in statistical terms but a meaningful difference when comparing the descriptive statistics across the conditions. We included these variables as statistical controls in subsequent analyses in order to strengthen the inferences made about the impacts of the study condition on children's development. For example, for the comparison of the RIA conditions with the Control group, we included teachers' years of experience, level of education, program type, percentage of boys in the classroom, and average classroom level scores on each outcome in the fall. For the comparison of RIA-Enhanced to RIA-Traditional, we included program type, family income, and average classroom level scores on each outcome in the fall.

The data in this study have a nested structure such that multiple children ($M = 4.9$) were clustered within each of the 104 pre-K classrooms, and the second set of preliminary analyses involved computing intra-class correlations (ICCs). ICCs represent the proportion of the total variance in each language and literacy outcome assessed in spring (accounting for fall scores on each measure) that is attributable to the classrooms within which children were nested. Because the primary variable of interest in this study—the condition to which classrooms were randomly assigned—is a classroom-level variable, these preliminary analyses determined whether there was significant variability between classrooms in children's development of each language and literacy skill during pre-K that may, in turn, be attributable to the condition to which the classroom was randomly assigned.

Table 5 (Model 1) presents ICCs for each outcome among the full sample of teachers, classrooms, and children included in the test of Research Question 1 and 2. Table 6 (Model 1) presents ICCs for each outcome among the sub-sample of teachers, classrooms, and children in the RIA-E and RIA-T conditions that are included in the test of Research Question 3. In all cases except one (Definitional Vocabulary in Table 6), the between-classroom proportion of the total variability in spring language and literacy skills controlling for fall was significantly different than zero ($p \leq .05$). In addition, measures of literacy development tended to have higher ICCs than measures of language development.

Primary Analyses

To address Research Question 1—To what extent does RIA have positive impacts on children's development of language and literacy skills during pre-K?—we built upon the model from which the ICCs were computed for each outcome (Model 1) by adding the following variables: child and family covariates (gender, maternal education, family income, age, race/ethnicity, days between assessments) to the Level-1 (child) equation, setting covariates (years of teaching PK and KG, teacher level of education, program type, % Boys, and average fall assessment) to the Level-2 (setting) equation, and the study condition to which the classroom was randomly assigned (RIA/Control) to the Level-2 equation. From this analysis (Model 2), the magnitude and direction of the coefficient for the study condition variable represents, for a given outcome, the difference in average classroom level scores in spring, adjusted for fall scores and child and setting covariates, between classrooms randomly assigned to the RIA and Control groups.

We built upon these analyses to examine Research Question 2 concerning the moderated impacts of RIA. Specifically, in Model 3, we entered two continuous variables that serve as potential moderators of the impacts—Language Modeling and Literacy Focus—to the Level-2 equation to examine their direct associations with children's development of each language and literacy outcome. Finally, in Model 4, we added an interaction term for study condition x Language Modeling and study condition *x* Literacy Focus to explore whether the associations between study condition and each outcome were stronger under different levels of each moderator.

To address Research Question 3—To what extent do RIA PD enhancements have positive impacts on children's development of language and literacy skills during pre-K?—we followed the same steps described to address Research Question 1. Specifically, we added to Model 1 from the RIA-E and RIA-T groups only (Table 6), the following variables: child and family covariates (gender, maternal education, family income, age, race/ethnicity, days between assessments) to the Level-1 (child) equation, setting covariates (program type, average family income, and average fall assessments) to the Level-2 (setting) equation, and study condition to which the classroom was randomly assigned (RIA-E/RIA-T) to the Level-2 equation. From this analysis (Model 2), the magnitude and direction of the study condition coefficient represents the difference between the RIA-E and

TABLE 5
Children's Language and Literacy Growth During Pre-K in Read It Again (Enhanced and Traditional) Compared to Control Classrooms

	Print knowledge (TOPEL)		*Alphabet knowledge (PALS)*		*Print concepts (PWPA)*		*Definitional vocabulary (TOPEL)*		*Phonological Awareness (TOPEL)*		*Narrative Language (NAP)*	
Model 1: ICC	*0.19***		*0.25***		*0.19***		*0.08**		*0.11***		*0.09**	
	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p
Model 2: Child + Setting												
RIA/Control	1.01 (1.00)	.314	3.02 (1.76)	.086	3.56 (1.68)	.035	0.44 (0.64)	.485	−0.37 (0.69)	.590	−0.81 (0.65)	.217
Model 3: Moderators												
Language Modeling	0.04 (0.77)	.959	0.73 (1.46)	.615	−1.57 (1.38)	.258	1.59 (0.58)	.008	1.35 (0.53)	.010	−0.35 (0.89)	.529
Literacy Focus	3.89 (1.19)	.001	5.59 (2.23)	.013	5.27 (2.10)	.013	−0.27 (0.76)	.728	1.03 (0.81)	.203	0.22 (0.89)	.805
Model 4: Interactions												
RIA x language modeling	−0.14 (1.62)	.929	−2.17 (3.00)	.470	−2.96 (2.89)	.306	0.21 (1.07)	.844	*0.90 (1.14)*	.431	0.81 (1.15)	.484
RIA x literacy focus	−5.37 (2.05)	.009	−10.6 (3.85)	.006	0.04 (3.90)	.993	−1.56 (1.44)	.278	*−0.60 (1.56)*	.698	1.08 (1.59)	.497

Note. Model 1 includes fall assessment only. Model 2 adds study condition, child covariates (gender, maternal education, family income, age, race/ethnicity, days between assessments), and setting covariates (years of teaching PK and KG, teacher level of education, program type, % Boys, and average fall assessments). Model 3 adds moderator variables (Language Modeling and Literacy Focus). Model 4adds study condition-by-moderator interaction terms.

$^{*}p \leq .05$. $^{**}p \leq .01$.

TABLE 6
Children's Language and Literacy Growth During Pre-K in Read It Again-Enhanced Compared to Read It Again-Traditional

	Print knowledge (TOPEL)		*Alphabet knowledge (PALS)*		*Print concepts (PWPA)*		*Definitional vocabulary (TOPEL)*		*Phonological Awareness (TOPEL)*		*Narrative Language (NAP)*	
Model 1: ICC	*0.15***		*0.19***		*0.26***		*0.07*		*0.11**		*0.16***	
	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p	B (SE)	p
Model 2: Child + Setting												
RIA-E/RIA-T	−0.81 (1.00)	.417	0.19 (1.75)	.912	−2.51 (1.76)	.154	−0.27 (0.71)	.699	1.14 (0.73)	0.116	1.00 (0.73)	0.167

Note. Model 1 includes fall assessment only. Model 2 adds study condition, child covariates (gender, maternal education, family income, age, race/ethnicity, days between assessments) and setting covariates (program type, average family income, and average fall assessments.

$^{*}p \leq .05$. $^{**}p \leq .01$.

RIA-T groups on the mean classroom-level score in spring on each outcome.

All analyses were conducted using the SAS PROC MIXED command (e.g., Singer, 1998). There was a relatively small amount of missing data for teacher and classroom variables (Table 1) and for child and family variables (Table 2), and an examination of the pattern of missingness indicated that the data were missing at random. As a result, multiple imputation procedures were used (10 imputations) that included all variables in the analyses, as well as additional auxiliary variables that are correlated with analysis variables, in order to generate estimates of the missing values. The PROC MIANALYZE command combined the results from the 10 imputed data sets.

RESULTS

Impacts of RIA on Children's Development of Language and Literacy Skills

Table 5 presents results from analyses testing impacts of RIA on children's development of language and literacy skills during pre-K (Research Question 1). Model 2 presents unstandardized coefficients (B) that represent the magnitude of the difference in classroom-level skills in spring of pre-K (controlling for fall scores, child and family characteristics, and teacher and classroom characteristics) between RIA and Control classrooms. Results indicate that there were no statistically significant differences between RIA and Control classrooms for five of the six measures of language or literacy development. There was a statistically significant difference in print concepts ($p = .035$), such that average spring scores in RIA classrooms were 3.56 points higher than in Control classrooms. The difference between RIA and Control classrooms on children's development of alphabet knowledge approached significance ($p = .086$). More specifically, children in RIA classrooms could name, on average, three more letters at the end of pre-K than the average number of letters named by children in Control classrooms.

To describe the magnitude of these differences between RIA and Control classrooms, we also estimated effect sizes by computing Hedges's g that is appropriate for illustrating the size of intervention effects on child (level-1) outcomes that are estimated from HLM analyses in which the assignment to intervention condition are made at the classroom level (level-2) (see What Works Clearing House, 2013). Hedges's g is computed as the coefficient for the adjusted group mean difference between the two intervention conditions (presented in Model 2 of Table 5) divided by the unadjusted pooled within-group standard deviation for the outcome (presented in Table 2 as the SD for each spring assessment). Based on this equation, the effect sizes (g) for the differences between children in RIA and Control classrooms on each outcome are as follows: print knowledge ($g = .07$); alphabet knowledge ($g = .18$); print concepts ($g = .25$); definitional vocabulary ($g = .05$); phonological awareness ($g = -.02$); and narrative language ($g = -0.15$).

Moderators of the Impacts of RIA on Children's Development of Language and Literacy Skills

Table 5 presents results from analyses examining Research Question 2 concerning the extent to which the impacts of RIA on children's language and literacy development depended upon the quality of language and literacy instruction in classrooms. Model 3 in Table 5 built upon the Model 2 by adding two additional classroom level predictors in the analyses in their continuous forms—quality of language modeling and quality of literacy instruction—that serve as moderators in subsequent analyses to address Research Question 2. The entry of these variables alone in this stage of the analyses, without the interaction terms, was done to highlight the positive associations that higher-quality instruction has on children's development.

Results indicate that higher-quality language modeling had a statistically significant and positive association with children's development on two sub-tests of the TOPEL. In these cases, a 1-point increase in quality of language modeling was associated with a 1.59-point increase (0.11 standard deviation units) on definitional vocabulary and a 1.35-point increase (0.09 standard deviation units) on phonological awareness. In addition, the quality of literacy instruction had a large and significant positive association with children's development of print knowledge (TOPEL), alphabet knowledge (PALS-PreK), and print concepts (PWPA). In the case of print knowledge, a 1-point increase in quality of literacy instruction resulted in a 3.89-point increase in scores on this subtest of the TOPEL, which represents an increase of 0.26 standard deviation units.

Model 4 in Table 5 builds upon Model 3 by addition two interaction terms that examine the extent to which the impacts of RIA are moderated by the quality of language and literacy instruction in classrooms. Results indicate that there is a large and statistically significant interaction between study condition and quality of literacy focus for print knowledge and alphabet knowledge, indicating that the impacts of RIA on children's development of these literacy outcomes were stronger in classroom with relatively lower quality literacy instruction. For illustrative purposes, we depict these interactions in Figure 1 and Figure 2 using model-based

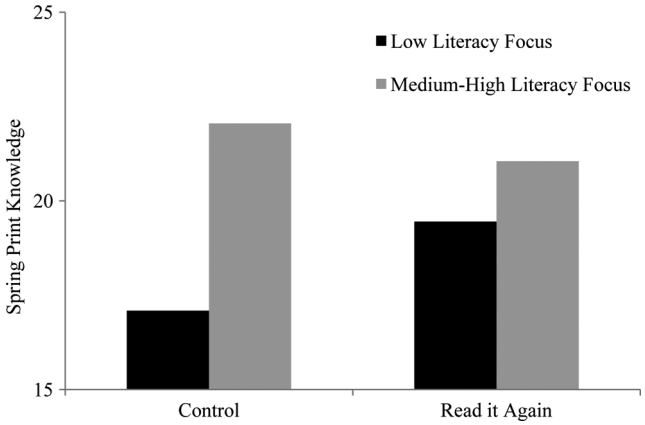

FIGURE 1 Estimated spring print knowledge scores in read it again and control classrooms with low literacy focus and medium-high literacy focus.

estimates to generate mean scores on each outcome for RIA and Control groups at relatively low levels of literacy focus and at relatively medium-and-high levels of literacy focus. The threshold for lower quality literacy instruction was set at less than 1.5; one-third of the sample (34 classrooms) was in the lower quality group and two-thirds of the sample (60 classrooms) was in the medium-and-high quality. Results indicate that under conditions of lower-quality literacy instruction, children in RIA classes had a 2.36 point advantage (Hedge's $g = .17$) on print knowledge and a 5.90 point advantage on alphabet knowledge (Hedges' $g = .35$) in spring compared to their peers in the Control group. Interestingly, under conditions of relatively higher quality literacy instruction, there was a small difference in favor of the Control classrooms compared to the RIA classrooms on print knowledge (Hedges' $g = -0.07$) and alphabet knowledge (Hedges' $g = -0.05$).

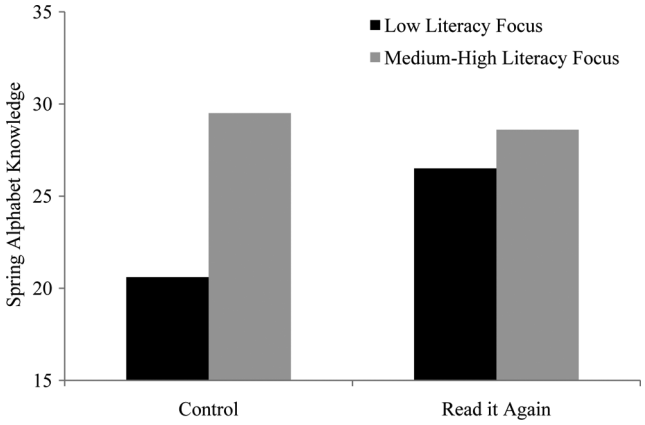

FIGURE 2 Estimated spring alphabet knowledge scores in read it again and control classrooms with low literacy focus and medium-high literacy focus.

We further explored this statistical interaction by splitting the sample into low quality and medium-to-high quality sub-samples using these same criterion, and testing whether there were statistically significant main effects of RIA in each subsample, after controlling for pre-test, child and family, and classroom-level covariates. Results indicated that in relatively higher quality classrooms, the difference between the RIA and control group on children's development of print knowledge ($t = -.59$; $p = .550$) and alphabet naming ($t = -.03$; $p = .975$) was not statistically different than zero. Within the sub-sample of relatively lower quality classrooms, the difference between the RIA and Control group was also not significant for children's development of print knowledge ($t = 1.76$; $p = .082$) or for alphabet naming ($t = 1.36$; $p = .179$).

Impacts of the RIA PD Enhancements on Children's Development of Language and Literacy Skills

To address Research Question 3 regarding the extent to which RIA professional development enhancements had positive impacts on children's development of language and literacy skills, we compared the development of language and literacy skills for children ($n = 191$) enrolled in the 39 RIA-E classrooms with those of children ($n = 160$) enrolled in the 35 RIA-T classrooms. Table 6 presents results pertinent to these comparisons. Across all outcomes, there were no statistically significant differences, thus suggesting there was no added-value of the RIA PD enhancements on children's language and literacy development.

DISCUSSION

The purpose of this study was to determine, in the context of a rigorous study implemented in rural Appalachian preschool classrooms, if a curriculum designed for scalability can achieve positive impacts on children's language and literacy skills. Our particular interest was not only to consider impacts in absolute terms (i.e., does teacher use of this curriculum impact children's development), but also in relative terms. Prior studies of the efficacy of preschool language and literacy interventions typically achieve effects in the range of 0.20 to 0.35, corresponding to an improvement of about one-fifth to one-third of a standard-deviation unit on targeted language and literacy skills (Landry et al., 2009; Lonigan et al., 2011). Should teachers' implementation of RIA in their classrooms over an academic year achieve comparable impacts, RIA would provide the field of early childhood education with a scalable option for bridging

the gap between efficacy research and everyday classroom practices.

Four study findings warrant elaboration. First, results indicated that there was a statistically significant difference in children's development of print knowledge between classrooms that were randomly assigned to RIA for an academic year and classrooms wherein teachers employed their business-as-usual teaching practices. In addition, the difference between RIA and Control group on alphabet knowledge approached statistical significance. Effect sizes of 0.25 for print concepts and of 0.18 for alphabet knowledge are comparable to other studies involving more intensive intervention approaches, such as mentoring/coaching (Landry et al., 2009; Mashburn et al., 2010) and purchase of comprehensive multi-faceted curricular packages coupled with mentoring (Lonigan et al., 2011). Thus, these results provide initial evidence of the efficacy of RIA for improving these two aspects of children's literacy development during pre-K. These short-term impacts on print concepts and alphabet knowledge may well be meaningful with respect to enhancing children's future reading achievement. Recent work by Piasta et al. (2012) reported first-grade outcomes for children who had received a boost in print knowledge during preschool, on the magnitude of 0.21 over children in a comparison condition (see Justice et al., 2010); impacts of the preschool print-knowledge gains at first grade were observed on standardized measures of decoding and reading comprehension and were equivalent to about one-fourth of a standard deviation improvement.

Second, findings showed that RIA did not have a statistically significant impact on children's language development. There are analogs in the literature showing null effects of similar interventions. Lonigan and his colleagues (2011) implemented a multi-faceted literacy-focused curriculum (Literacy Express/LE) in a study involving 48 preschool centers. Following workshop training, teachers in 15 centers implemented LE whereas teachers in 18 centers served as controls. (An additional 15 teachers implemented LE and received ongoing coaching to support implementation.) Across four targeted outcome measures, including one measure of expressive language, two measures of phonological awareness, and one measure of print knowledge, children whose teachers implemented LE outperformed children in control classrooms on one measure of phonological awareness. Powell, Diamond, Burchinal, and Koehler (2010) had similar findings in a study of extensive language- and literacy-focused PD offered to 88 teachers. Positive impacts were found on four of seven outcome measures—letter knowledge, print concepts, writing, and a phonological awareness task involving blending—but there were no discernible effects on children's skills in expressive language, letter-word identification, or a phonological awareness task involving initial sound identification.

It is difficult to reconcile why interventions designed to target language and literacy skills broadly, as does RIA as well as other exemplars described above (e.g., Bierman et al., 2008; Landry et al., 2009; Lonigan et al., 2011; Powell et al., 2010;), do not have impacts on both areas of development explicitly targeted. Candidate theories should include consideration of teacher capacity when implementing a multi-dimension curriculum, as well as the nature of children's development across different targeted domains. For instance, it might be that teachers can readily adopt techniques specific to supporting print-related skills compared to those specific to supporting vocabulary-related skills, as has been shown previously (see Pence et al., 2008). Or, it might be that teachers elect to spend more time developing some targeted skills rather than other skills, a point put forth by Powell et al. (2010). It may also be the case that measures of some skills, such as vocabulary growth, are not sensitive to detecting effects of interventions to promote language development. For example, interventions such as RIA, which typically try to promote children's knowledge of a select corpus of words, may not be apparent in distal measures that capture vocabulary breadth. Furthermore, the ICCs reported in Model 1 were lower for language development than literacy development, suggesting that development of language skills is less susceptible to classroom influences than literacy development. Nonetheless, the intervention literature to date seldom has explored why many language and literacy interventions tend to unevenly impact targeted aspects of development, and there is a tendency to dismiss or ignore the presence of uneven effects (to include lack of effects of an intervention on a targeted outcome). However, unevenness in effects appears to be the norm, rather than the exception, and is an important area of future work.

Third, we hypothesized that the impacts of RIA would be relatively stronger in classrooms that had lower-quality language and literacy instruction, suggesting that RIA has a compensatory effect, which has been found in prior studies of early-literacy interventions (McGinty et al., 2012). Results related to literacy, but not language, support this hypothesis: the impacts of RIA on children's development of print knowledge and alphabet knowledge were significantly stronger in classrooms with relatively lower-quality literacy instruction. These findings regarding the moderated impacts of RIA identify two potential mechanisms for improving children's language and literacy development in pre-k settings. First, as indicated in Table 5, measures of the quality of language and literacy instruction entered in Model 3 were shown to have large main effects on children's development on language and literacy outcomes,

respectively. Although classrooms in this sample were rated, on average, as having low to medium-quality language and literacy interactions, these results suggest that intervention strategies than can effectively increase the quality of language and literacy instruction beyond these relatively low levels may also improve children's development of these skills. Second, under conditions when quality of literacy instruction is low, RIA may be a particularly effective strategy in improving children's development on these key indicators of children's school readiness. In contrast, under conditions where literacy instruction is above a very minimal level—in this case above 1.5 on the 1–7 measure—RIA may have no positive impacts on literacy development.

Fourth, results did not provide evidence that the RIA professional development enhancement—a technology-mediated 12-module self-study program—had added-value for children's development of language and literacy skills over the provision of a traditional introductory workshop alone. This does not suggest that professional development, in general, is not beneficial. Instead, it suggests that in the context of this intervention promoting teachers' implementation of a static sequence of instructional activities framed around the reading of a storybook, more professional development was not found to increase children's acquisition of language and literacy skills. This finding speaks further about the scalability of RIA: its impacts on children's development do not depend upon the addition of professional development supports but can be achieved by providing teachers with an introductory workshop and access to 15 books and 60 corresponding instructional activities.

There are some limitations with this study that should be considered when interpreting the results. First, the extent to which results may be generalized outside the context of rural, Appalachian preschool programs is unknown. As children within these communities are seldom the focus of larger-scale investigations of preschool language and literacy curricula, we cannot know whether there are differences specific to these children and the programs that serve them that may limit generalizability. We encourage future investigations of to further study RIA scalability and impacts. Second, the study involved multiple outcome measures and multiple statistical tests, which increases the likelihood of making a Type-I error and incorrectly concluding there is a significant effect or RIA.

A final set of limitations concern the moderator analyses. Results found stronger impacts of RIA on two literacy outcomes under conditions of lower-quality literacy instruction. However, it is important to note that there was a statistically significant difference ($t = 2.17$, $p = .032$) in quality of literacy instruction between the RIA and the Control conditions in favor of the RIA classrooms, which resulted in a disproportionate number of classrooms that were categorized as lower-quality literacy focus in the Control condition (50%) compared to the RIA condition (26%). This suggests that RIA may have improved the quality of literacy-related instructional practices, and the analyses testing questions about moderation did not account for this endogeneity (the association between study condition and quality of instruction). Relatedly, classrooms and children were not randomized into levels of quality, and as a result, there may be differences in the characteristics of children who "sorted" into different levels of quality, which may have influenced these results. Due to these limitations in the moderator analyses, we consider these exploratory analyses and tentative results that are worthy of further investigation in future studies.

In conclusion, many of the recent efforts to develop interventions that improve children's early language and literacy skills require costly materials, intensive training, and/or considerable investments to pay for coaches or consultants that help support implementation. Such interventions have shown modest evidence of success in improving these important developmental skills; however, many early childhood education programs are unlikely to make the on-going investments needed to sustain these programs. In response, RIA was explicitly developed by practitioners, policy makers and researchers with scalability as its primary goal—to be available for very little cost; to require few materials for implementation; to require minimal PD; and to be implemented within the diverse range of early-childhood program structures. This study provides promising evidence that this curriculum has a positive impact on the development of some key early literacy skills for children among the most likely to experience later difficulties in reading: from families with high levels of socio-economic risks, from rural communities with limited resources to support their needs, and from pre-K classrooms that offer lower-quality support for their literacy development.

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APPENDIX: SAMPLE READ IT AGAIN-PREK LESSON SHOWING BEFORE-, DURING-, AND AFTER-READING SEQUENCE

Week 2

Lesson 3: What do these words do?

Book: *Chicka Boom Boom* by Bill Martin, Jr. & John Archambault

Before and During Reading: Print Knowledge

Learning Objective 1: To recognize that print carries meaning and to distinguish print from pictures.

1. Show the children the cover of the book *Chicka Chicka Boom Boom*. Point to the title and ask the children what the title of a book does. You may say: *Here is our title. What does the title tell us?* You may have to *model* the answer. Tell the children: *The title tells us what the story is about.*
2. Read the title while pointing to each word as you say it.
3. Before reading, you could ask children to predict what they think the story will be about. You might say: *The title says 'Boom Boom.' What do you think is going to happen in this book?*
4. Throughout reading, pause and point to specific words and explain that the words help tell the story. For example, you may say: *These words say 'Chicka Chicka Boom Boom'* (pointing to words). You might ask some children to point to some words also, as in: *David, can you come show me where it says 'Chicka Chicka Boom Boom?'*

Don't forget to take a look at the Learners' Ladder for ideas about adapting the **Print Knowledge activity** to diverse learners.

[25]

After Reading: Vocabulary

Learning Objective 2: To understand and use words which describe things and actions (adjectives and adverbs).

1. After reading, tell the children: *Let's talk about all the different colors we saw in the book. Let's see if we can remember all of our color names.* Hold up and name each of the color cards.
2. Give each child a color card. You can explain: *I'm going to give each of you a color. As we go through the book, let's see if we can find everyone's color. Let's look at the letters in the book, and look for letters that are the colors on our cards.*
3. Turn to each page of the book, and name some of the letters on the page. Help children match their color cards to the colors of letters. You could say: *I see lots of red letters on this page. Who has the red card? Amy, your card is red. Come find a letter that is red just like your card.*
4. Continue flipping through the book and calling on children to match their color to the book. Give each child a turn. During this activity, model how colors describe nouns to make phrases, as in: *the purple L, the blue M*, etc.

Materials

- **Book:** *Chicka Chicka Boom Boom*, by Bill Martin, Jr. & John Archambault
- **Color Cards:** blue, green, red, yellow, purple, orange (3 sets)