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Increasing Young Children's Contact With Print During Shared Reading: Longitudinal Effects on Literacy Achievement

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Longitudinal results for a randomized-controlled trial (RCT) assessing the impact of increasing preschoolers' attention to print during reading are reported. Four-year-old children (N = 550) in 85 classrooms experienced a 30-week shared reading program implemented by their teachers. Children in experimental classrooms experienced shared-book readings 2 or 4 times per week during which their teachers verbally and nonverbally referenced print. Children in comparison classrooms experienced their teachers' typical book reading style. Longitudinal results (n = 356, 366) showed that use of print references had significant impacts on children's early literacy skills (reading, spelling, comprehension) for 2 years following the RCT's conclusion. Results indicate a causal relation between early print knowledge and later literacy skills and have important implications concerning the primary prevention of reading difficulties.

In 1998, the National Academy of Sciences released the consensus report, *Preventing Reading Difficulties in Young Children* (PRD; Snow, Burns, & Griffin, 1998). This report articulated a national agenda for reducing the prevalence of reading difficulties among American school children. A predominant theme of PRD was its emphasis on primary prevention, conceptualized as providing early support for young children's skills and competencies in areas most closely linked to later literacy achievement. These skills and competencies are commonly referred to as prereading or emergent literacy skills.

One set of emergent literacy skills receiving considerable attention in PRD and subsequent research syntheses (e.g., Hammill, 2004; National Early Literacy Panel [NELP], 2008; Piasta & Wagner, 2010) is print knowledge. Print knowledge is an umbrella term describing young children's emerging knowledge of the specific forms and functions of written language. This includes understanding letters, rules governing print organization (e.g., left-to-right directionality of print in English orthography), and concept of word (i.e., words as being meaningful, discrete units that map to spoken words). It seems intuitive that children's print knowledge would be a critical determinant to their success in formal literacy instruction, particularly when learning to "crack the code" of letters and sounds. Thus, explicitly teaching preschool children about print should be a key ingredient in supporting their literacy success. However, very little research has systematically addressed ways to increase preschoolers' print knowledge and whether, in turn, this might lead to long-term literacy advantages.

In the last decade, an emerging body of research has explored using the shared-book reading context to increase preschoolers' print knowledge. The motivation to increase children's attention to print during storybook readings is based on evidence indicating that preschool-aged children very rarely look at or talk about the print during adult–child

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shared reading, even when the storybooks contain very ''print-salient'' design features (font changes, character speech bubbles, print embedded within illustrations; Evans & Saint-Aubin, 2005; Evans, Saint-Aubin, & Landry, 2009). Similarly, adults—whether parents, teachers, or day-care providers—seldom use any overt means to evoke children's visual or verbal attention to print within storybooks. Adults rarely produce comments or questions about print and only seldom point to or track print (Ezell & Justice, 2000; Hammett, Van Kleeck, & Huberty, 2003). The lack of attention to print is surprising given the relation between the amount of time preschoolers spend looking at print in storybooks and children's level of print knowledge (e.g., Evans, Williamson, & Pursoo, 2008). Together, these data suggest that increasing the amount of time and attention to print during storybook reading is one way to improve children's print knowledge.

Notably, adults can make simple adjustments to increase children's attention to print during shared storybook reading. These simple adjustments are typically referred to as making verbal and nonverbal print references (i.e., talking about or pointing to print within the text; Evans et al., 2008; Ezell & Justice, 2000; Justice, Kaderavek, Fan, Sofka, & Hunt, 2009). For instance, adults can ask children questions and comments about print, such as ''Where should I read on this page?'' ''Do you know this letter?'' and ''This word is ''danger.'' They can also track words in text and point to print embedded within illustrations. In high-quality reading sessions, such print referencing is additive. In other words, print referencing occurs in addition to other facilitative practices to encourage children's learning, language, and engagement during shared reading.

From an educational perspective, it is important to know if children who have more contact with print during shared reading show corresponding gains in print knowledge and later literacy achievement. Several studies have addressed the question of short-term impact, finding that children experience significant gains on print knowledge measures when adults utilize print references (Justice & Ezell, 2000, 2002; Lovelace & Stewart, 2007). For example, Justice and Ezell (2000) found that preschool children whose parents incorporated print references during reading experienced significant gains on three of five print knowledge measures compared to children of untrained parents reading the same books. Such positive short-term impacts of print referencing have been replicated in a number of settings (e.g., preschools, clinics) and for diverse populations of children (e.g., children with disabilities, children from low-income homes; Justice & Ezell, 2002; Lovelace & Stewart, 2007; van Bysterveldt, Gillon, & Moran, 2006). The theorized mechanisms underlying these effects are twofold (Adams, 1990; Rayner, 1985). First, adults' references to print, whether verbal, nonverbal, or a combination of both, directly increase the sheer volume of time children spend attending to and presumably processing the specific forms and functions of print in books. Second, adults' references to print provide explicit (vs. implicit) encoding of information about the forms and functions of print, resulting in immediate learning as well as long-term retention.

To date, it is unknown whether adults' use of print references during shared reading has any long-term benefit to young children. The present research represents the first study investigating long-term impacts of this approach. Longitudinal data were collected from children who participated in Project STAR (Sit Together and Read), a 30-week program during which preschool teachers systematically referenced print during shared reading. Elsewhere, we have reported the positive preschool gains experienced by children of Project STAR as compared to children in comparison classrooms, in which teachers read with a typical reading style (Justice, McGinty, Piasta, Kaderavek, & Fan, 2010). We found that Project STAR significantly benefited children's print knowledge (average effect size of .21) with no positive or negative effects on children's language skills as measured by the Clinical Evaluation of Language Fundamentals (Wiig, Secord, & Semel, 2004). The present study addressed whether children in Project STAR also demonstrate an advantage in their formal literacy achievements 1 and 2 years postintervention. Postintervention assessors were blind to children's history of intervention (i.e., whether they were in Project STAR or comparison classrooms), providing a rigorous test of long-term causally interpretable effects of the intervention.

Method

Participants

The multisite, multicohort evaluation of Project STAR involved children enrolled in 85 preschool classrooms randomly assigned to study conditions at the start of the 2004–2005 or 2005–2006 academic years. Teachers were invited to volunteer for a study of shared reading practices. All teachers taught in classrooms prioritizing enrollment for

children considered at risk for future reading difficulties due to socioeconomic disadvantage (e.g., Head Start, targeted-enrollment state prekindergarten). Parent consent forms were distributed to all children in these classrooms. For children returning consent forms, an average of 6 (N = 550) were randomly selected per classroom to complete the four assessment sessions over a 3-year period. The children were assessed in the fall and spring of preschool and then each spring for 2 years (1-year and 2-year postintervention assessments, respectively). Between the first two assessment points, children were exposed to one of three study conditions (high-dose STAR, low-dose STAR, or comparison) each of which featured their classroom teachers' implementation of a 30-week shared-reading program. Children's experiences differed in terms of the amount of explicit print referencing embedded within shared reading, as described in the Procedure section.

The focus of this report concerns those children who experienced one of the three assigned shared-reading conditions in preschool and subsequently completed the 1- and 2-year postintervention assessments. In total, data were available for 356 children and 366 children who could be located at 1 and 2 years postintervention, respectively. Characteristics of these children are presented in Table 1, and exact sample sizes per outcome measure are presented in Table 2. Over half of participating children's families reported incomes of less than $25,000 (57%), and most of the children's mothers had high school diplomas as their highest earned degree (67.5%). Children's language abilities at the fall of preschool were below average (M = 88.31, SD = 15.22 and M = 91.52, SD = 14.61) on the Clinical Evaluation of Language Fundamentals–Preschool:2 (Wiig et al., 2004) and Peabody Picture Vocabulary Test–IV (Dunn & Dunn, 2007), respectively. Attrition was not differential across the three study conditions, $\chi(2, N = 550) = 2.25$, $p = .324$ and $\chi(2, N = 550) = 0.87$, $p = .352$ for 1 and 2 years postintervention. Child age, gender, level of maternal education, and family income also did not differ across conditions (ps > .234), nor did the proportion of children who completed an extra year of preschool postintervention, $\chi(2, N = 398) = 2.71$, $p = .259$.

Table 1
Descriptive Information for Participating Children

	Study condition		
	HD STAR	LD STAR	HD comparison
Age in months			
M	52.84	52.84	52.24
SD	4.65	4.65	4.47
% female	46.62	54.10	43.85
% speaking English at home	97.73	99.13	99.19
Race–ethnicity			
% White, non-Hispanic	43.92	40.98	42.31
% African American	33.78	42.62	39.23
% Hispanic–Latino	8.11	4.10	4.62
% Multiracial	9.46	6.56	11.54
% Other	1.35	3.28	2.31
Maternal education (highest degree attained)			
% no high school diploma	15.54	16.39	22.31
% high school diploma	17.57	15.57	23.08
% high school diploma plus some college or technical training	36.49	50.00	30.00
% associate's degree	8.11	4.10	12.31
% bachelor's degree	8.11	6.56	4.62
% graduate degree	1.35	1.64	1.54
Family income			
% $0 to $15,000	24.32	35.25	33.08
% $15,001 to $30,000	29.73	23.77	21.54
% $30,001 to $45,000	15.54	11.48	16.15
% $45,001 to $60,000	8.11	6.56	10.00
% > $60,000	7.86	13.93	6.92

Note. This information pertains to those children whose data were included in any 1- or 2-year postintervention analysis. Percentages may not sum to 100% due to rounding. HD = high dose; LD = low dose.

Procedure

Prior to the fall of the preschool year, children's classrooms were randomly assigned to one of three study conditions: high-dose Project STAR, low-dose Project STAR, or regular reading program. The preschool classroom was thus the unit of assignment, and all children enrolled in the same classroom experienced the same reading program. Regardless of condition, all children experienced a 30-week shared reading program implemented by their classroom teachers. Each teacher was provided with a set of 30 commercially available children's storybooks and was asked to read one book per week as a whole-class shared-reading session. These whole-class reading sessions involved an average of 17 children (SD = 4.13). Books were selected so that they included print-salient features. All books were read in the same prescribed order. To monitor fidelity of implementation, teachers submitted twice-monthly videotapes of whole-class reading sessions that were coded by research staff to document the frequency and instructional targets of teachers' verbal print referencing (see Piasta, Dynia, Justice,

Table 2
Descriptive Statistics for Preschool and Postintervention Literacy Measures

		HD STAR			LD STAR			HD comparison		
Measure	n[a]	*M*	*SD*	Range	*M*	*SD*	Range	*M*	*SD*	Range
Preschool entry										
Phonological awareness	400	2.21	3.26	0–14	2.87	3.93	0–17	3.21	4.59	0–19
Alphabet knowledge	400	7.82	8.63	0–26	10.68	10.29	0–26	9.38	9.24	0–26
Vocabulary, standard score	396	92.77	15.24	36–124	92.54	13.84	38–121	89.08	14.29	34–135
1 year postintervention										
Reading, raw score	355	20.19	6.26	3–41	21.19	7.17	4–56	19.32	5.24	5–43
Reading, standard score	355	108.21	12.48	65–149	108.93	13.54	68–154	106.62	10.56	71–137
Spelling, raw score	355	15.13	3.47	5–27	15.5	3.29	3–28	14.58	2.95	5–24
Spelling, standard score	355	108.54	13.27	72–150	109.03	14.18	30–137	106.69	11.9	57–131
Comprehension, raw score	351	8.68	3.74	2–19	8.54	4.08	0–29	8.11	2.91	3–19
Comprehension, standard score	351	102.29	12.83	67–136	100.59	14.51	40–143	100.95	10.96	75–129
Vocabulary, standard score	398	98.74	10.81	58–122	98.96	10.50	72–139	97.84	13.70	20–137
2 years postintervention										
Reading, raw score	365	32.8	8.94	5–51	32.09	8.3	12–56	31.21	8.45	12–56
Reading, standard score	365	109.72	13.34	51–137	108.4	12.58	71–139	108.19	12.58	73–135
Spelling, raw score	363	21.23	5.02	8–35	21.17	4.76	12–34	19.99	4.62	10–31
Spelling, standard score	363	108.59	14.38	61–148	108.48	13.45	72–140	105.69	13.08	67–139
Comprehension, raw score	364	15.84	5.21	2–26	15.64	4.88	4–28	14.93	5.58	4–28
Comprehension, standard score	364	100.11	13.089	44–128	99.53	12.23	43–124	98.96	13.37	55–134
Vocabulary, standard score	367	97.21	11.11	71–136	96.85	10.17	72–129	95.48	11.27	66–130

Note. HD = high dose; LD = low dose.
[a]Sample size reflects those children whose data were included in any 1- or 2-year postintervention analysis. Of the 550 children in the original sample, 33 did not complete preschool pretest measures, 117 unenrolled or could not be located upon Year 1 postintervention assessments, and 35 more children unenrolled or could not be located upon Year 2 postintervention assessments. An additional 48 children participated in Year 2 but not Year 1 assessments; at the time of Year 1 assessments, these children remained in preschool and were not capable of completing follow-up assessment tasks. Finally, 7 children completed only a portion of follow-up assessments due to participation refusal, high distractibility, or experimenter error on the day of assessment. Neither attrition nor remaining in preschool for an extra year was differential across conditions (ps > .259).

Pentimonti, & Schatschneider, 2009 for an in-depth description of the coding scheme). Teachers also submitted written logs recording all reading taking place in their classrooms. This monitoring ensured that children's shared reading experiences varied only in the amount and manner in which books were read by their teachers over the 30-week period. Note that the average duration of book reading sessions did not significantly differ among conditions, $F(2, 82) = 2.17$, $p = .120$.

The Project STAR shared reading program. Children assigned to the high- or low-dose STAR conditions experienced a shared reading program in which their teachers used explicit print references during reading so as to increase children's contact with print. In the high-dose condition, children experienced four reading sessions per week for 30 weeks (120 sessions total); in the low-dose condition, children experienced two sessions per week (60 sessions total). In all other ways, the two STAR conditions were identical, thus providing a planned comparison of whether the intensity of the STAR program was influential to children's literacy achievement.

Teachers implementing the STAR program received training in how to make general verbal print references, such as questions about print (e.g., ''Do you know this letter?''), and nonverbal print references (such as tracking the print with one's finger) during shared reading. Training was accomplished via an 8-hr fall workshop, a 3-hr winter ''refresher'' workshop, and two written feedback letters from project staff. In the workshops, teachers received information about four print ''domains'' that they can explicitly reference during shared reading: print meaning, book and print organization, letters, and words. The teachers also learned about specific references that link to each of these domains (see Table 3 for both print domains and sample print references). To support use of print references as aligned to these specific domains, an insert was placed into each of the 30 books provided

Table 3
Print Knowledge Domains, Targets, and Sample Print References

Print targets	Sample print references
Instructional Domain 1: Print meaning	
1. Print function: Understands the relation between meaning and print	Here are the penguin's words. He says, ''thank you''
2. Environmental print: Knows the purpose of print embedded within the environment	This is a box of cereal. It says, ''Corn Flakes''
3. Concept of reading: Understands the meaning behind reading and the contexts in which reading occurs	We're going to read these words; what will these words tell us?
Instructional Domain 2: Book and print organization	
1. Page order: Knows the order in which pages are read in a book	I am going to read this page first and then this page over here next
2. Author: Knows the role of the author	The author, Eric Carle, wrote all the words in this book
3. Page organization: Knows that reading occurs from the top of the page to the bottom of the page	This is the top of the page. This is where I begin reading
4. Title of book: Knows the role of the title of the book	This is the title of the book. It tells us the name of the book
5. Print direction: Knows that reading must occur from left to right	I start reading here and I read this way
Instructional Domain 3: Letters	
1. Upper- and lowercase letters: Knows that letters come in two forms, one of which is the uppercase letter	This M in the red block is an uppercase letter. See how this uppercase letter is bigger than these lowercase letters?
2. Names of letters: Knows the names of the majority of uppercase letters	What is this letter?
3. Concept of letter: Knows that letters are a symbol used in written language	Do you see a letter that is in your own name?
Instructional Domain 4: Words	
1. Word identification: Identifies some written words in familiar contexts	This word is ''the.'' This word is in this book all the time, can you help me find it?
2. Short vs. long words: Knows that the number of letters in words can vary from many to few	This word is lollapaloosh. It is a long word. It has a lot of letters in it! Let's count all the letters
3. Letters vs. words: Knows that letters are different from words	This is the letter K. K is in the words kangaroo and kick
4. Concept of word in print: Represents the systematic relation between spoken works and written words	Let's point to each word as I read it. Ready?

Note. Adapted from Justice, Kaderavek, Fan, Sofka, and Hunt (2009) and reprinted with permission.

to these teachers. The insert listed two recommended print targets for the given book and suggestions on how to reference these targets when reading. Teachers were asked to reference each print target at least twice. As an example, when reading the book *I Stink!* (Mcmullan, 2002) during Week 16 of the intervention, the insert prompted teachers to make at least two references calling children's attention to the concept of a letter and at least two references calling attention to page order. The two feedback letters provided to teachers noted whether or not attention was brought to the recommended print targets. Fidelity in hitting these targets was high, averaging 82% and 89% in the high-dose and low-dose STAR conditions respectively. Moreover, teachers implementing the STAR program made significantly more print references per reading session (high-dose STAR: $M = 31.12$, $SD = 18.71$; low-dose STAR: $M = 35.84$, $SD = 16.36$) than teachers in the comparison condition described next ($M = 8.50$, $SD = 9.08$), ps $< .001$, with no reliable differences in the amount of print referencing per reading session between the two STAR conditions, $p = .251$. Justice et al. (2010) and Piasta et al. (2009) provide additional details concerning teacher training, fidelity, and implementation.

Regular reading program. The comparison condition for the study involved teachers implementing a regular reading program typical of preschool classrooms. Children assigned to these classrooms experienced a 30-week shared reading program that was identical to Project STAR high-dose classrooms with respect to the books, schedule, and intensity of reading. Specifically, teachers in the

comparison classrooms received the same 30 children's books and were instructed to read these four times per week using their normal style of reading (120 sessions total).

To control for Hawthorne effects, these teachers received the same amount of training as those implementing the STAR program (8-hr initial workshop, 3-hr refresher workshop, and two instances of written feedback from project staff). The content of the comparison training, however, focused on the general importance of shared-book reading and high-quality reading practices without explicit mention of print references or specific strategies for making such references. For instance, workshop content focused on the use of different genres, particularly information texts, as a means for providing children with quality reading experiences. Teachers learned about information texts, how their use promotes different aspects of development (background knowledge, vocabulary), and how they can be used thematically in relation to dramatic play. Although specific content such as this was emphasized, the overall goal of the comparison-group workshop was to stress the value and importance of shared reading in the classroom so that teachers would have a purpose for reading the researcher-provided texts on a regular basis (one received each week for 30 weeks).

Child Assessments

Children completed up to four assessment sessions over a 3-yr period to assess impacts of the STAR shared reading program. Children's emergent literacy skills were assessed at the beginning and end of their preschool year. Children's literacy achievement was assessed at 1 year postintervention, when most were completing kindergarten, and 2 years postintervention, when most were completing first grade. Children's vocabulary skills, as one measure of language ability, were also assessed at all four timepoints using the Peabody Picture Vocabulary Test–IV (Dunn & Dunn, 2007). All assessments were administered individually by trained research staff. The literacy assessments directly relevant to the present study are described in greater detail next, with descriptive statistics for these and vocabulary scores presented in Table 2.

Emergent literacy skills. The current study included two measures of children's emergent literacy skills: phonological awareness and alphabet knowledge. Both are important early predictors of later reading success (NELP, 2008). Phonological awareness was assessed using the Rhyming subtest from Get It, Got It, Go! (GGG; http://ggg.umn.edu). Children are asked to select, from three alternatives, the word that rhymes with a target given by the assessor. Picture cards are used for each word to reduce memory demands. The score is the number of rhymes correctly identified within a 2-min period (test–retest reliability $r > .83$; Missall & McConnell, 2004). Alphabet knowledge was assessed using the Uppercase Alphabet Recognition subtest of the Phonological Awareness Literacy Screening for Preschool (Invernizzi, Sullivan, Meier, & Swank, 2004). Children are presented with all 26 uppercase letters in a fixed, random order and asked to name each letter. The score is the number of letters correctly named (Cronbach's alpha = .84).

Literacy skills. Children's literacy skills at 1 and 2 years postintervention were assessed using three subtests of the Woodcock–Johnson Tests of Achievement III (Woodcock, McGrew, & Mather, 2001). Early reading skill was assessed using the Letter-Word Identification subtest, in which children are asked to identify letters and read words of increasing difficulty. Early spelling skill was assessed using the Spelling subtest, in which children are asked to write letters and spell words of increasing difficulty. Comprehension skill was assessed using the Passage Comprehension subtest, in which initial items ask children to indicate which of several pictures are related in meaning, and remaining items ask children to select a picture or produce a word that accurately completes a given phrase or passage. Raw scores were used in analyses (split-half reliabilities ranged from $r = .77$ to $r = .99$).

Analytic Strategy

Hierarchical linear models (HLM; Raudenbush & Bryk, 2002) with children nested within preschool classrooms were used to analyze all data. These analyses account for random assignment at the classroom level and significant shared classroom variance (intraclass correlations ranged from .05 to .11 across outcomes). Although cross-classification by preschool and postintervention classrooms was initially considered, the dispersion of children into elementary school classrooms was insufficient to warrant such analyses (i.e., children from the same preschool classroom tended to be distributed among the same elementary classrooms).

Separate HLM analyses were conducted for each of the six outcomes of interest: word reading, spelling, and comprehension at 1 and 2 years postintervention. To control for the emergent literacy skills children possessed at preschool entry, phonological awareness and alphabet knowledge were grand

mean-centered and included as covariates in all analyses. Study condition was treated as a series of dummy codes. Dummy codes representing the two Project STAR conditions were first entered into models in order to specify the contrast between these conditions and the comparison condition, which served as the reference group. Additional models utilizing the dummy codes for the high-dose STAR and comparison conditions were used to specific the high-dose versus low-dose STAR contrast. All variables were entered as fixed effects. Effect sizes (Cohen's *d*) were calculated in a manner consistent with the HLM analyses. For each outcome, the difference between children in two study conditions, as derived from the relevant HLM model, was divided by its pooled standard deviation.

Results

Table 4 presents statistical results and effect sizes contrasting the three study conditions. Results for each postintervention assessment are discussed further next.

1 Year PostIntervention

Fitted means (i.e., means adjusted for covariates) for 1-year postintervention data appear in the top panel of Figure 1. Controlling for fall of preschool emergent literacy skills, children in the high-dose STAR condition had higher word reading, spelling, and comprehension outcomes than children in the regular reading comparison condition (ps < .024). Children in the low-dose STAR condition also tended to have higher word reading and spelling outcomes than those in the comparison condition, although these trends fell just short of traditional significance levels (ps < .060). Children in high- and low-dose STAR conditions did not significantly differ in 1-year postintervention outcomes (ps > .113).

2 Years PostIntervention

Fitted means for 2-year postintervention data appear in the bottom panel of Figure 1. Controlling for fall of preschool emergent literacy skills, children in the high-dose STAR condition had higher word reading, spelling, and comprehension outcomes than children in the comparison condition (ps < .025). These children also had significantly higher outcomes than those in the low-dose STAR condition on word reading (p = .034), with a similar trend for comprehension (p = .082). There were no differences between children in the high- versus low-dose STAR conditions on spelling outcomes (p = .123). Children in the low-dose STAR condition had significantly higher spelling outcomes than those in the comparison condition (p = .046) but not word reading or comprehension outcomes (ps > .440).

Post Hoc Analyses

Although previous analyses showed no immediate impact of Project STAR on children's language abilities (see Justice et al., 2010), post hoc analyses investigated whether children in high-dose or low-dose STAR conditions demonstrated longitudinal advantages in language as compared with children in the comparison condition. HLM analyses of children's residualized gains on the Peabody Picture Vocabulary Test–IV showed no significant differences among conditions at either 1 or 2 years postintervention (ps > .302).

Table 4
Statistical Results for Contrasts Among Study Conditions

		HD STAR vs. HD comparison					LD STAR vs. HD comparison					HD STAR v. LD STAR				
Outcome	*n*	Coeff	*t*	*df*	*p*	Effect size	Coeff	*t*	*df*	*p*	Effect size	Coeff	*t*	*df*	*p*	Effect size
1 year postintervention																
Reading	356	1.66	2.34	76	.022	0.26	1.44	1.92	76	.058	0.23	0.21	0.27	76	.787	0.03
Spelling	356	0.89	2.30	76	.024	0.21	0.72	1.91	76	.060	0.22	0.17	0.41	76	.683	0.03
Comprehension	352	0.98	2.72	76	.008	0.21	0.25	0.53	76	.596	0.07	0.74	1.60	76	.113	0.13
2 years postintervention																
Reading	366	2.62	2.34	80	.022	0.27	0.60	0.55	80	.584	0.07	2.02	2.15	80	.034	0.19
Spelling	364	1.83	3.19	80	.002	0.31	1.03	2.02	80	.046	0.21	0.80	1.56	80	.123	0.12
Comprehension	365	1.60	2.28	80	.025	0.26	0.55	0.78	80	.440	0.11	1.05	1.76	80	.082	0.14

Note. Note that the pattern of results remains the same regardless of whether demographic factors such as those indicated in Table 1 were included as controls in analyses. HD = high dose; LD = low dose; Coeff = regression coefficient; Effect size = Cohen's *d*.

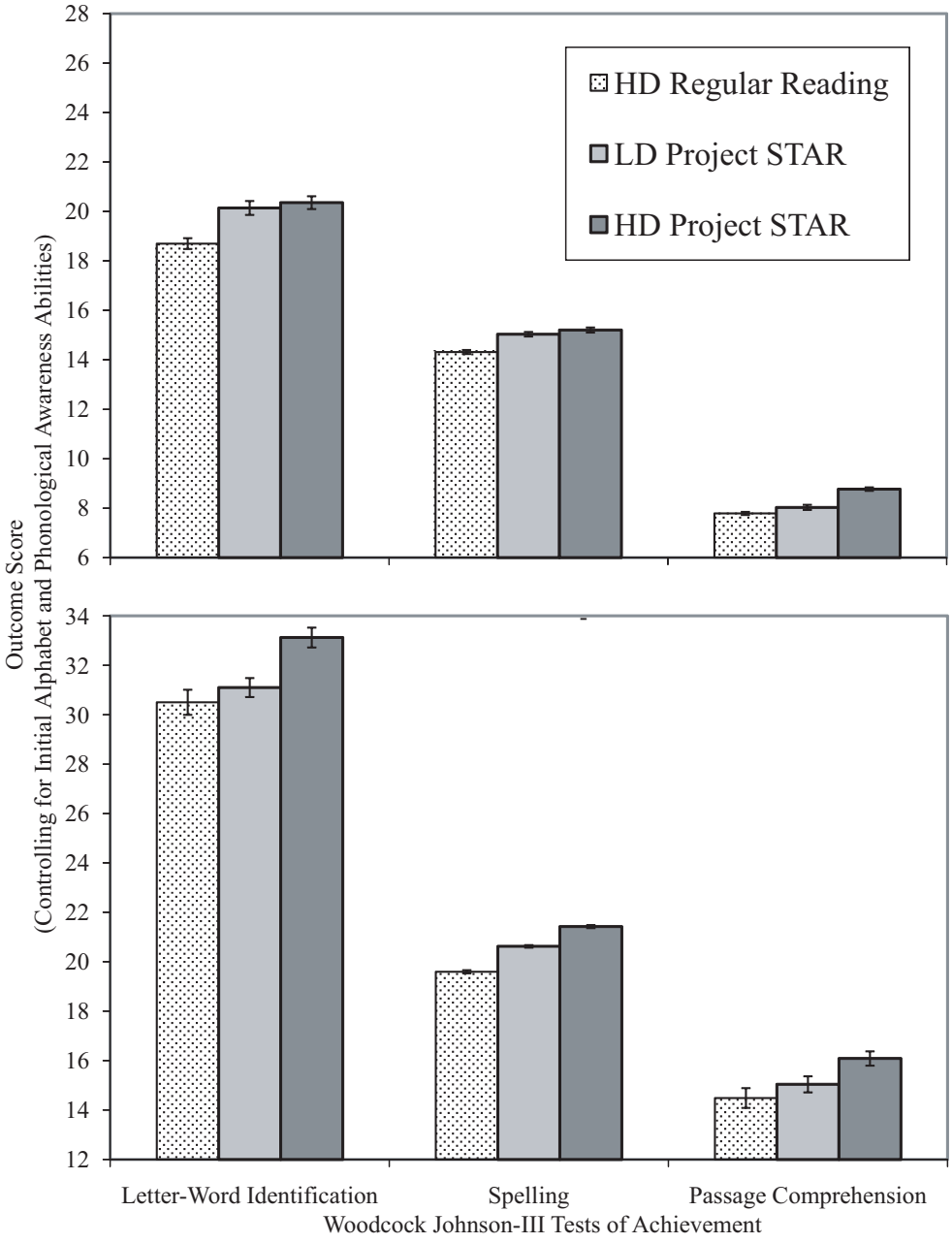

Figure 1. Fitted means and 95% confidence intervals across study conditions for 1-year postintervention data (top panel) and 2-year postintervention data (bottom panel).
Note. HD = high dose; LD = low dose.

Discussion

Nationally crafted consensus reports (e.g., PRD; Snow et al., 1998), state early education standards (see Neuman & Roskos, 2005), and federal education policies (e.g., Head Start Act Program Performance Standards, 45 CFR § 1304 (U.S. Department of Health and Human Services 2007). identify young children's print knowledge as a central component of emergent literacy development and a worthy goal of primary prevention efforts. Increasing young children's contact with print during shared reading represents an empirically validated approach to fostering children's short-term gains in print knowledge. However, the results of the present study are the first to suggest causal links between this practice and later literacy achievement. Specifically, findings indicated that teachers' use of print references during shared

reading 4 times weekly for 30 weeks resulted in long-term increases of approximately 1–3 standard score points in reading, spelling, and comprehension as compared with children whose teachers who used their typical shared reading approach. This reflects an effect size of about one fourth of a standard deviation unit (.26–.31 across skills).

These results have important practical implications for efforts to introduce reading-related interventions early in children's lives, particularly for those children who exhibit risk factors that may compromise later literacy achievement. A vast literature suggests that children from disadvantaged backgrounds, such as those in the present study, begin school with literacy skills significantly below those of their more advantaged peers (e.g., Chernoff, Flanagan, McPhee, & Park, 2007; Lee & Burkam, 2002). This ''achievement gap'' continues to widen throughout the early school years (Chatterji, 2006). By fourth grade, the magnitude of the literacy achievement gap between advantaged and disadvantaged students is .76 of a standard deviation (Hill, Bloom, Black, & Lipsey, 2008). By extension, the .26 to .31 *SD* boost resulting from teachers' use of print references reflects a substantial intervention effect. Of particular note is that the embedding of this intervention within preschool programs—prior to the advent of formal literacy instruction—means that children's literacy skills were boosted early in their school careers, helping to close the achievement gap before it begins widening. By the same token, emergent literacy instruction such as that offered by Project STAR may reduce the numbers of children who experience significant literacy problems later in their school careers, thus offering a potential preventive mechanism for reducing the incidence of reading difficulties. It is important to note, however, that not all children exhibiting risk factors during preschool will develop later literacy problems. As evidenced by the average-range standard scores achieved by the current sample, the majority of such children may go on to develop typical literacy skills in response to early instruction. Further research is necessary to document the extent to which instructional programs such as Project STAR may aid children who do not respond as strongly to preschool emergent literacy instruction.

From a practical standpoint, a particularly welcome finding is that teachers' use of print references during whole-class shared reading has long-term impacts on literacy achievement that are similar to other educational interventions that may be more resource and time intensive (Hill et al., 2008; Konstantopoulos & Hedges, 2008). In fact, this instructional approach only requires a modest adjustment to teachers' typical book reading style. In this regard, the print referencing technique is a constrained intervention that requires only subtle shifts in teacher behavior in a discrete context (i.e., shared reading) rather than global shifts in practice that may require considerable training and material investments. Moreover, teachers' use of this approach as a way to boost children's emergent literacy development does not place any extra demands on their planning and instructional time allocations within the school day. This is a key concern for teachers today who must balance the time and resources they put toward literacy development against their responsibilities for fostering a broad range of child outcomes (e.g., motor skill, social-emotional learning). At the same time, use of this approach does not appear to detract from other foci that are also important within the shared-reading context (e.g., vocabulary discussions; see Zucker, Justice, & Piasta, 2009) nor does it appear to have detrimental effects on children's language growth, which is a developmental domain that seems to benefit from high-quality shared-reading interactions (Justice et al., 2010).

We must note, however, that although teachers in this study showed high fidelity in terms of our print referencing intervention, there was also variability in the total number of print references made (see Piasta et al., 2010). The current findings argue that making approximately 30 print references per reading session was more beneficial than the 8.5 typically made by teachers, but it is unclear whether this extent of print referencing is necessary or ideal. Additional design research is necessary to further investigate dosage to determine whether increasingly greater use of print references leads to greater effects (e.g., McGinty, Breit-Smith, Fan, Justice, & & Kaderavek, 2011; McGinty, Justice, Piasta, Kaderavek, & Fan, 2011) or if the effects eventually plateau.

Beyond the practical appeal of this educational intervention, the data reported here are theoretically intriguing. There is prior evidence within the literature documenting significant cross-time correlations between early indicators of print knowledge and later achievements in word reading, spelling, and reading comprehension (e.g., NELP, 2008). Such correlational evidence does not, however, clarify whether early print knowledge has direct causal relations to later reading achievement, as is made clear in the results of the present study. Moreover, the breadth of long-term effects found in this study suggests that boosting children's early

print knowledge may serve as a gateway to a range of literacy accomplishments in early elementary school. Specifically, early gains in print knowledge attributable to teachers' use of print references extended longitudinally to exert equally strong effects in early reading, spelling, and comprehension at 2 years postintervention. Indeed, this reflects an advantage of building preschool-aged children's print knowledge that is broader and more sustained than suggested by previous correlational data (e.g., Storch & Whitehurst, 2002). We interpret our findings from this study as suggesting that increasing children's contact with print in the language-rich, meaningful, and naturalistic context of shared reading need not result in ''trade-offs'' among reading skill building (i.e., trade-off between comprehension and decoding support; see Justice et al., 2010; Zucker et al., 2009, for further evidence to this end), thus pointing to the power of a primary prevention model that takes an integrated, rather than compartmental, instructional approach (Justice & Ezell, 2004). We caution, however, that further research investigating the effect on comprehension is warranted, given evidence that the particular measure utilized in the present study, along with many other standardized comprehension measures, is highly dependent on word recognition skills (see Keenan, Betjemann, & Olson, 2008). We also acknowledge that the present study included vocabulary as the sole measure of children's language abilities and did not examine differential effects on other aspects of language proficiency.

Conclusion

This research contributes to both the applied and theoretical literature regarding the relations between emergent literacy skills and later literacy achievement. In doing so, it raises the possibility of leveraging these relations to design early interventions that boost young children's skills in those areas most closely linked to later literacy achievement. The long-term impacts of print referencing during preschool shared reading indicated a sizable, positive shift in the literacy trajectories of children for whom social and economic circumstances place them at substantial risk for later reading difficulties. Such impacts suggest the feasibility and power of primary prevention models that subtly enhance existing early childhood routines or activities to bring about meaningful impacts to children's developmental trajectories. Parents, teachers, and other professionals are encouraged to use verbal and nonverbal references to print to increase children's contact with print during shared reading as one means of promoting children's early learning about print and, in turn, their longer term literacy achievement.

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