Experimental Evaluation of a Preschool Language Curriculum: Influence on Children's Expressive Language Skills

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Purpose: The primary purpose of this study was to investigate child impacts following implementation of a comprehensive language curriculum, the Language-Focused Curriculum (LFC; Bunce, 1995), within their preschool classrooms. As part of this larger purpose, this study identified child-level predictors of expressive language outcomes for children attending at-risk preschool programs as well as main effects for children's exposure to the language curriculum and its active ingredients—namely, teacher use of language stimulation techniques (LSTs; e.g., open questions, recasts, models).
Method: Fourteen preschool teachers were randomly assigned to 2 conditions. Treatment teachers implemented the experimental curriculum for an academic year; a total of 100 children were enrolled in their classrooms. Comparison teachers maintained their prevailing curriculum; a total of 96 children were enrolled in these classrooms. Teachers' fidelity of implementation was monitored using structured observations conducted 3 times during the academic year. Children's growth in expressive language was assessed using measures derived from language samples in the fall and spring, specifically percent complex utterances, rate of noun use, number of different words, and upper bound index.
Results: Children's language skill in the fall, socioeconomic status (household income), and daily attendance served as significant, positive predictors of their language skill in the spring. The impact of the language curriculum and LST exposure was moderated by children's classroom attendance, in that the language curriculum accelerated language growth for children who attended preschool regularly; a similar effect was seen for LST exposure.
Conclusions: Adoption of a comprehensive language curriculum may provide a value-added benefit only under highly specific circumstances. Findings suggest that at-risk children who receive relatively large doses of a curriculum (as measured in days of attendance during the academic year) that emphasizes quality language instruction may experience accelerated expressive language growth during pre-kindergarten.

KEY WORDS: preschool curriculum, poverty, language acquisition

Well over 1 million children in the United States attend publicly funded preschool and pre-kindergarten (preK) programs, and many of these youngsters face elevated risks for academic challenges due to environmental disadvantage (Clifford, Early, & Hills, 1999). The public's multi-billion-dollar investments in preK education are largely based on the presumption that its positive returns (e.g., increased educational attainment and income status for its participants) outweigh the initial economic investment, with cost-benefit analyses lending support to this point (Lynch, 2004). Nonetheless, scrutiny concerning the overall quality of preK learning environments is unabated, and, as Meisels

(2006) points out, policymakers are pressing for evidence showing that children who attend preK programs are indeed learning and that public funds are being used wisely. Of additional interest in light of contemporary educational policies is ensuring that the curricula used within public schooling are "scientifically based" (*No Child Left Behind Act of 2001,* P. L. 107-110).

Determining the Effectiveness of Preschool Curricula

Although researchers have used a variety of research methodologies to address questions concerning what and how much children learn within preschool programs (e.g., National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 2000, 2002; Peisner-Feinberg & Burchinal, 1997; Vandell, 2004), the use of experimental methods to address causal questions is currently a priority in the research agenda of the U.S. Department of Education (Raudenbush, 2005). Consistent with this agenda, the U.S. Department of Education's National Center for Education Research (NCER) established the Preschool Curriculum Evaluation Research (PCER) Consortium in 2002 to conduct a rigorous multisite investigation of commercial preschool curricula. A total of 14 curricula were studied by 12 research teams (we comprised one such team), each team using randomized experimental procedures to study effects for one curriculum (or, in some cases, two curricula) against comparison conditions. Independent contractors commissioned by NCER conducted a cross-site intent-to-treat multisite evaluation using a set of standardized measures of child outcomes to provide comparative estimates of curriculum effects; results of this evaluation are forthcoming in a report commissioned by NCER (PCER Consortium, 2007). Individual research sites are also reporting their own experimental findings based on site-specific measures, which often were selected to be particularly sensitive to anticipated effects of specific curricula. In this article, we present findings from our experimental evaluation of the language-focused curriculum (LFC; Bunce, 1995) conducted as part of the PCER Consortium. The findings reported here are derived from site-specific measures used to estimate impacts on children's expressive language skills; the measures we selected were closely aligned to the LFC and its anticipated impacts and thus provide an important complement to the results of the multisite evaluation.

Designing Language-Focused Preschool Curricula: Theoretical Framework

The curriculum under investigation—the LFC—was designed to improve children's expressive language abilities by enhancing the language-learning environment of preschool classrooms (Bunce, 1995). The need for both is supported by research showing (a) considerable variability in the quality of language-learning opportunities within the classrooms of America's preschools (see Farran, Aydogan, Kang, & Lipsey, 2006) and (b) that preschool children's achievements in expressive language provide unique and complementary contributions to later higher-level language and literacy achievements, including reading comprehension, decontextualized language skill, and metalinguistic awareness (e.g., Chaney, 1998; Speece, Roth, Cooper, & de la Paz, 1999; Walker, Greenwood, Hart, & Carta, 1994). Perhaps the most well-established risk factor associated with the quality and timing of children's expressive language growth is poverty, with children reared in low socioeconomic status (SES) homes consistently exhibiting less developed expressive language skills compared with children reared in more advantaged circumstances (e.g., Bowey, 1995; Chaney, 1994; Fazio, Naremore, & Connell,1996; Hart & Risley, 1995; Whitehurst, 1997). Whitehurst, for instance, found the vocabulary and complex syntax skills of low-SES preschoolers to be 15 and 10 standard score points, respectively, below those of more advantaged children (see also Justice, Meier, & Walpole, 2005; Rush, 1999; Washington & Craig, 1999).

The comparative differences in expressive language observed for children of low-SES backgrounds are most appropriately viewed as language differences arising from contextual features of children's language-learning environments, such as the lexical diversity of caregiver utterances (e.g., Hart & Risley, 1995; Hoff-Ginsberg, 1998). Nevertheless, preschoolers' oral language achievements exhibit critical integrative linkages with their short- and long-term reading, academic, and social/relational achievements, and oral language difficulties can undermine healthy outcomes in each of these areas (e.g., Bowey, 1995; Catts, Fey, Tomblin, & Zhang, 2002; Chaney, 1994; Fazio et al., 1996; Fujiki, Brinton, Morgan, & Hart, 1999; Hart & Risley, 1995). The remarkable continuity between early and later school performance in oral and written language achievements (see Storch & Whitehurst, 2002) stresses the importance of interventions that effectively accelerate children's language accomplishments during the preschool years of development to circumvent or at least diminish risk for later problems.

Many research-based approaches to early language intervention (cf. Cronan, Cruz, Arriaga, & Sarkin, 1996; Schuele, Rice, & Wilcox, 1995; Valdez-Menchaca & Whitehurst, 1992) reflect social-interactionist theories of how children acquire language. Origins of this theory reside, in part, on Bruner's (1966) seminal writings that view language (as well as other aspects of "intellectual development") as emerging from "systematic and contingent interactions between adults and children" (p. 6). More recent interpretations of social-interactionist theories

situate language acquisition as a psychobiological process to which "frequent, relatively well-tuned affectively positive verbal interactions" are critical for supporting language growth in early childhood (Chapman, 2000, p. 43). Such theories, including the learning-from-input hypothesis (see Hoff, 2004), emphasize the importance of children's socially embedded, mediated interactions with more knowledgeable conversational partners as critical developmental mechanisms that provide children with linguistic input associated with accelerated outcomes (Bruner, 1983; Chapman, 2000; Justice & Ezell, 1999).

Basic research drawing from social-interactionist perspectives of language development provides a rich source of scientific knowledge that applied researchers can draw upon to design preschool language interventions. Rush (1999), for instance, studied mother–child interactions for 39 preschoolers of poverty, finding a strong negative correlation between the amount of time children spent playing alone and their expressive and receptive vocabulary skills; reciprocally, strong positive correlations were observed between children's vocabulary skills and maternal verbal responsiveness. This finding of a strong positive correlation between language gains and caregiver behaviors suggests the importance of designing preschool classrooms that afford frequent opportunities for children to engage in one-on-one conversational interactions with teachers as well as peers. Hoff (2003) more recently reported that characteristics of the language used by upper- and middle-SES mothers in conversations with their toddlers fully mediated the relationship between household income and children's short-term growth in expressive vocabulary and syntax. Characteristics of maternal language associated with children's language growth included use of a more diverse vocabulary and a higher mean length of utterance (MLU), with the latter measure (MLU) explaining 22% of the variance in children's expressive vocabulary skills. Hoff (2003) concluded that "children who heard longer utterances built productive vocabularies at faster rates than children who heard shorter utterances" (p. 1374). Similar findings by Huttenlocher, Vasilyeva, Cymerman, and Levine (2002) found that preschoolers' comprehension of complex syntax (viz., elaborated nouns, clausal structures) becomes more strongly associated with their teachers' use of complex syntax over an academic year of instruction. Such findings suggest the importance of designing preschool classrooms in which children are exposed to diverse vocabulary and varied syntax, including complex syntax, within their interactions with teachers.

Description of the LFC

Application of contemporary social-interactionist approaches to the design of preschool language-learning presumes that teacher–child interactions matter greatly to young children and that these interactions are crucial contexts for enhancing children's language skills through the provision of high-quality linguistic input. The curriculum selected for investigation at this PCER site, the LFC (Bunce, 1995), adheres to social-interactionist principles, in which enhancement of the verbal interactions among teachers and children is an integral component. The LFC was developed by the University of Kansas with funding from the U.S. Department of Education to design a Language Acquisition Preschool (LAP) serving 3- to 5-year-old children with language limitations, including children with clinically depressed language skills (i.e., language impairment), children from poverty backgrounds, and children acquiring English as a second language (Bunce, 1995). The LFC manual (Bunce, 1995) provides a detailed description for implementing a half-day, 4-day, or 5-day curriculum emphasizing a rotation of child-centered (e.g., center time, sharing time) and teacher-directed (e.g., story time, group time) activities. Each week's plan is organized around a particular theme (e.g., places in the community), and daily lesson plans elaborate this theme (e.g., grocery store, doctor's office). For each daily lesson plan, a comprehensive set of language targets focusing on form and content (i.e., vocabulary) are identified, and these targets are to be addressed in activities across the day. Within the area of form, a repeated goal throughout the curriculum is for children to "learn new, and employ a variety of, syntactic constructions" (Bunce, 1995, p. 100). These syntactic constructions encompass verb phrase structures (e.g., "is landing"), adjective/object descriptions (e.g., "large plane"), pronouns (e.g., "I, you"), and prepositions (e.g., "in, on, under"). Complementing these language targets are social-skill (e.g., negotiating with peers for toys) and cognitive-skill objectives (e.g., classifying objects) that are also to be addressed in the daily plan (see Table 1).

Beyond these procedural features of the curriculum, in which specific linguistic targets are identified, the LFC emphasizes relational processes of language intervention by instructing teachers to use a set of *language stimulation techniques* (LSTs) in group and one-on-one interactions with children. Teachers' use of LSTs is designed to foster their delivery of linguistically responsive conversations with children that simultaneously increase children's exposure to key linguistic concepts (e.g., verb phrase structures, pronouns, prepositions) and cognitive concepts within LFC lesson plans. Teachers who adopt the LFC are encouraged to use eight types of LSTs when conversing with children: (a) focused contrasts (highlight contrasts among language targets); (b) models (emphasize language targets that the child does not yet use independently); (c) event casts (provide ongoing description of an activity); (d) open questions (ask questions that have many possible answers); (e) expansions (repeat child's utterance with varied vocabulary); (f) recasts (repeat child's

Table 1. Sample concepts addressed in the Language-Focused Curriculum (LFC). Source: Bunce, 1995.

Theme: Discovering places: Beauty/barber shop		
Objectives	**Specific skills**	**Example(s)**
Linguistic		
	Vocabulary	comb, curl
	Verb phrase structures	is curling, dries
	Noun phrase structures	the hair dryer
	Adjectives/object descriptions	set hair, dry hair
	Prepositions	under the dryer
Cognitive		
	Problem solving	how to fix hair
	Classifying	things that are wet vs. dry
	Sequencing	steps to cutting hair
Social		
	Initiating with peers	responding to requests
	Group cooperation	waiting for a turn

utterance using varied syntax); (g) prompted initiations (prompt child to initiate with a peer); and (h) scripted play (provide verbal descriptions of familiar events). Readers are referred to the LFC manual for in-depth discussion and examples of each LST.

The available evidence concerning the potential impact of the LFC rests primarily on studies that have examined the relations between one or more of its active ingredients—the LSTs—and children's language abilities. Studies of the facilitating effects of parent or teacher use of specific LSTs have included both correlational and experimental studies (e.g., Baker & Nelson, 1984; Bradshaw, Hoffman, & Norris, 1998; Fey, Cleave, & Long, 1997; Fey & Loeb, 2002; Girolametto, Hoaken, Weitzman, & van Lieshout, 2000; Girolametto & Weitzman, 2002; Schuele et al., 1995). For instance, Girolametto and Weitzman (2002) reported correlations of .51, .41, and .48 between day care providers' use of three LST strategies (models, expansions, and recasts) and children's verbal productivity, syntactic complexity, and lexical diversity. However, to our knowledge, the LFC as a curricular package has been examined in one nonexperimental pretest–posttest study by Rice and Hadley (1995). Rice and Hadley presented outcomes from LFC participation for 65 children in the University of Kansas' LAP classrooms, 36 children of whom exhibited language impairment (LI); most children received the curriculum for a 10-month period. Four language measures were collected at entrance and exit from the LAP: receptive vocabulary, general receptive language, general expressive language, and expressive syntax. The former three measures were derived from standardized measures of language, whereas the fourth was based on MLU calculated from spontaneous language samples. Results showed that children with LI gained an average of 10 standard score points on each of the four measures from entry to exit, whereas children with typical language skills gained an average of 7 points. The authors noted that the children who participated in the LAP classrooms (considered as a group) "either matched or exceeded the expected normative rate of language learning across at least three of the four outcome measures" (Rice & Hadley, 1995, p. 168).

Goals and Hypotheses of the Present Study

The present study was designed to determine whether exposure to the LFC accelerated the expressive language skills of children participating in at-risk preschool programs compared with prevailing practices, which in this study were equivalent to a single widely used curriculum (discussed subsequently). As noted previously, the present work was conducted as part of the Institute of Education Sciences PCER Consortium and provides an important complement to the larger "what works" multistudy evaluation conducted by NCER contractors that uses a set of standardized cross-site measures collected at each site (e.g., Peabody Picture Vocabulary Test-III; Dunn & Dunn, 1997). It is complementary in that the present study examined child impacts using site-specific measures of expressive language skills selected for their close alignment to the content of the curriculum. Additionally, the present study sought to determine not only whether the curriculum was effective but also under what conditions and for whom it exerted its effects. We addressed four specific aims. The first aim was to determine the extent to which four child characteristics (fall language skill, gender, SES, preschool attendance) were correlated with children's expressive language abilities in the spring of preK. Previous reports have shown all four variables to have a significant influence on the rate of language acquisition in preschool-aged children (e.g., for language, see Gray, 2004; for gender, see Bornstein, Hahn, & Haynes, 2004; for SES, see Whitehurst, 1997; for attendance, see Hubbs-Tait et al., 2002).

The second aim was to determine the causal impact of LFC exposure on preschoolers' expressive language skills, primarily their use of complex syntax and diverse vocabulary as measured within spontaneous language samples. Measures of both represent a critical focus of basic and applied research concerned with preschool language attainment (e.g., Hoff-Ginsberg, 1998; Huttenlocher et al., 2002; Jackson & Roberts, 2001), and preschoolers' achievements in these areas are associated with features of the environment, including the language-learning characteristics of the classroom (Girolametto & Weitzman,

2002; Huttenlocher et al., 2002). Although numerous studies have investigated impacts of classroom-based language interventions on children's vocabulary skills (e.g., Girolametto & Weitzman, 2002; Wasik & Bond, 2001; Whitehurst et al., 1994), for the most part, such studies have focused on single-word vocabulary gains. Likewise, at-scale effectiveness studies typically do not use refined measures of expressive syntax, such as use of elaborated noun phrases or density of syntactically complex utterances. However, such measures exhibit sensitivity to features of the environment (e.g., Girolametto & Weitzman, 2002; Huttenlocher et al., 2002), can identify specific areas of linguistic weakness among children with language impairment (see Liles, Duffy, Merritt, & Purcell, 1995; Scott & Windsor, 2000), and are viewed by experts to provide a more culturally valid representation of the language skills of at-risk children compared to standardized tools (see Craig & Washington, 2000).

Our third aim was to determine the association between exposure to teacher use of LSTs and children's expressive language gains. Whereas the previous aim examines the main effects of curriculum on children's language gains during preschool, we recognize that treatment status (i.e., experimental, comparison) may not serve as a reliable proxy for characterizing children's exposure to the main ingredients of the curriculum, namely the LSTs. That is, we presumed that some LFC teachers would use LSTs at moderate or low rates even when trained to use the LFC; we also presumed that some comparison teachers may naturally use LSTs at moderate to high rates. Given that LSTs are seen as an active ingredient of the LFC (Bunce, 1995), we examined the relationship between LST exposure and children's expressive language gains.

The fourth aim was to examine whether LFC and/or LST exposure moderated the associations between specific child characteristics and their expressive language gains during preschool. Specifically, we determined whether exposure to a heightened language-learning environment had value-added impacts for children as a function of entering language skill, gender, SES, and attendance. Here, our intent was to determine for whom and under what conditions the experimental curriculum may have exerted its effects by considering whether exposure to the LFC or, alternatively, its main ingredients (the LSTs), was influential only under certain circumstances. Determining whether a curriculum is effective within specific circumstances is an important consideration in evaluations conducted within business-as-usual settings that involve heterogeneous implementers and recipients. Several preschool curriculum evaluations, particularly those that have studied one curriculum against another curriculum, have failed to show consistent main effects; rather, such studies typically find moderated effects in which characteristics of classrooms, teachers, or children (or all of the above) must be taken into consideration to identify specific conditions under which a particular curriculum is able to exert its effects (see Assel, Landry, Swank, & Gunnewig, 2007; Landry, Swank, Smith, Assel, & Gunnewig, 2006).

Method

Participants

Participants included 14 teachers working in three public preschool programs serving children deemed at risk. A total of 196 four-year-olds were enrolled in these classrooms at the beginning of the academic year. Six classrooms were funded through Title I (n = 100), six classrooms were affiliated with Head Start (n = 70), and two classrooms were funded by a state preK initiative (n = 26). All classrooms were located in a single state. Eight were located in a rural and Appalachian region of the state and for which the median household income as reported by the 2000 U.S. Census was $26,149. The remaining six classrooms were located mid-centrally in a light industrial and farming region of the state and for which the median household income was $45,290 (U.S. Bureau of the Census, 2000). All programs required children to meet specific risk factors to determine eligibility; residing in a low-income household was the primary factor for which children established eligibility. The Title I and state preK programs were designed to provide greater participation in preschool for 4-year-olds residing in lower income households but whose income was too high to qualify for Head Start.

All teachers in the sample were White, non-Hispanic females, ranging in age from 24 to 53 years (M = 41.9; SD = 9.1). The majority of teachers had a bachelor's or graduate degree (78%). Teachers reported that their experience in the classroom with children of any age ranged from 3 to 27 years, with a mean of 11.4 years (SD = 8.3). Each classroom had a teaching assistant to provide full-time instructional and management support.

The children enrolled in these classrooms (102 males, 94 females) ranged in age from 4;0 (years;months) to 4;11 at the start of the study (M = 4.54, SD = .3). In terms of race and ethnicity, 143 children were White (73%), 36 children were Black (18%), 8 were Hispanic/Latino (4%), and 6 were classified as mixed or an unspecified race or ethnicity (3%). Race/ethnicity information was unavailable for 3 children. Ninety-seven percent of children resided in homes in which English was the primary language spoken (n = 190); six children spoke Spanish at home (3%). About one-fifth of the children's mothers (18%; n = 35) had not graduated from high school, 41% held a high school diploma or equivalent (n = 80), and 32% had attended some college or held a college degree

(n = 63; information on maternal education unavailable for 18 mothers).

Random Assignment

Classrooms were randomly assigned to treatment (n = 7) and comparison (n = 7) conditions by the NCER-contracted evaluators in the summer that preceded the academic year. One hundred children (51% male, 49% female) were enrolled in treatment classrooms, and 96 (54% male, 46% female) were enrolled in comparison classrooms. The ethnic/racial composition of children in the two sets of classrooms was fairly similar: 75% of children in the treatment classrooms were White, 16% were Black, and 5% were Hispanic (4% were an other or unreported ethnicity or race); in the comparison classrooms, 71% of children were White, 21% were Black, and 3% were Hispanic (5% were an other or unreported ethnicity or race). A comprehensive set of statistical comparisons made by the evaluation contractors for teacher (e.g., educational level, teaching experience), child (e.g., age, gender), and child caregiver characteristics (e.g., educational attainment, employment status) found no significant differences between the two groups on any variable for the full sample (PCER Consortium, 2007).

Procedures

Teacher and child participation in this study spanned an entire academic year. In the month prior to the start of the academic year, both treatment and comparison teachers received professional development (PD) over 3 days (approximately 15 hr total). An additional 2.5-hr follow-up/refresher training was conducted for treatment teachers in January of the academic year. At the first PD session, teachers provided informed consent and were fully briefed concerning the intent of the study (i.e., to conduct a curriculum evaluation). At this time, teachers also committed to fully implementing the curriculum to which they were assigned (either a new experimental curriculum or the curriculum already used within their programs, which in all cases was High/Scope; Hohmann & Weikart, 1995). All teachers received a set of incentives to participate in the study, including instructional materials (e.g., books, art supplies), an allowance to use for PD opportunities, and a small account to draw on over the year for educational supplies. Treatment and comparison teachers received similar incentives.

Over the course of the year, teachers were observed in their classrooms on three occasions to study their classroom instruction and to monitor implementation fidelity for the LFC teachers. Children within the 14 classrooms participated in the curriculum assigned to their classrooms and were assessed in the fall and spring of the academic year.

Curriculum Implementation

Experimental condition. The LFC teachers completed an intensive 3-day workshop designed by the authors of this study to provide background information on language development in young children and the use of the LFC to accelerate language-learning opportunities within the preschool classroom. The trainers included three of the four authors of this study (excepting Mashburn), all of whom have graduate degrees in education and considerable experience working with teachers. Additionally, the author of the LFC, Betty Bunce, delivered some portions of the workshop. The workshop was developed based on core content within the LFC manual. Day 1 provided a tutorial on language development, including key terms (e.g., syntax, vocabulary), an overview of language-development milestones, and a general synopsis of language-development theory, particularly social-interactionist approaches. Days 2 and 3 focused on LFC implementation to include use of the eight LSTs (e.g., event casts, open questions), features of a model classroom, and an outline of curriculum objectives and sample activities. The workshop included didactic instruction as well as a variety of interactive activities and role play. For example, teachers received a prop box and were asked to illustrate how they would implement a particular theme in their classroom and how they would embed LSTs in their instruction.

At the training workshop, treatment teachers also received a comprehensive set of curriculum materials to facilitate their implementation of the treatment curriculum. Specifically, they received a binder of all lesson plans that specified daily objectives and curriculum activities. They received materials required for implementing activities, including storybooks, art materials, and dramatic play costumes and props. Teachers also received an extra set of lesson plan copies on which to mark implementation notes, including any modifications and changes to use of lesson plans.

In January of the academic year, a 2.5-hr refresher training was conducted for treatment teachers, led by one or two of the authors of this study. This refresher focused exclusively on teacher use of LSTs. The training provided a didactic overview of each LST (e.g., open questions), and then teachers watched videotapes of themselves at individual computer monitors and evaluated their own use of LSTs. Teachers received individual feedback on LSTs on which they should focus for the remainder of the academic year. Although the refresher training had been scheduled and planned at the start of the study, its intensive focus on teacher use of LSTs was based on the fall fidelity observations in the LFC classrooms. Specifically, the results of classroom observations

conducted in October of the academic year indicated that teachers were implementing LFC lesson plans to a high degree of fidelity but were not exhibiting high levels of LST use (see Pence, Justice, & Wiggins, in press). Research findings presented elsewhere showed that LFC teachers significantly increased their use of LSTs after this refresher training (Pence et al., in press).

Comparison condition. Comparison teachers were informed at the start of PD that they were involved in a study designed to characterize the effects of preschool curricula on children's development. All comparison teachers reported use of High/Scope (Hohmann & Weikart, 1995) as their primary curriculum and had received training in its use. High/Scope is one of the most widely used classroom curricula within publicly funded preschool programs today, and it is particularly well-known for its longitudinal association with improved child outcomes as demonstrated within the High/Scope Perry Preschool Study of Ypsilanti, Michigan, conducted in the 1960s (see Schweinhart, Barnes, & Weikart, 1993; Schweinhart et al., 2005). The High/Scope curriculum is grounded in the use of *active participatory learning* (i.e., children learn by doing) to guide children's development, and its curricular materials emphasize teachers' use of practices that foster active learning by children, carefully designed learning environments, and children's daily participation in plan-do-review cycles that help them develop self-regulation and independence in learning (see Vogel, 2001). It is important to note that the extent to which comparison-group teachers implemented the core features of High/Scope was not assessed as part of this study.

The participation of the comparison teachers largely modeled that of the treatment teachers in an effort to control for Hawthorne effects (i.e., change that occurs as a result of increased attention rather than an intervention, per se). Comparison teachers received 15 hr of professional development on the same 3 days as the treatment teachers prior to the start of the academic year; this training focused on topics that the research team felt would not compromise the integrity of the curriculum implementation (e.g., creative music and movement activities; behavior management techniques). Local experts were recruited for these sessions (e.g., a clinical psychologist who consulted with one of the participating preschool programs on behavioral management). Only two distinctions differentiated participation in the study for treatment versus comparison teachers beyond treatment teachers' use of a new curriculum. First, comparison teachers did not receive training in January of the academic year (whereas the treatment teachers completed a 2.5-hr workshop), and second, comparison teachers were not asked to submit lesson plans to research personnel.

Distinctiveness of interventions. The two curricula evaluated in this study share many similarities in their approach to instruction. Both curricula (a) emphasize the importance of teacher–child interactions as a means for teaching children, (b) highlight the need to intentionally organize the classroom environment so that it facilitates a range of learning experiences (e.g., art, dramatic play, music) and meaningful social contexts, and (c) privilege children's active exploration and self-guided learning over rote drill and direct instruction activities. Moreover, the developmental domains identified within the two curricula almost completely overlap, with both domains addressing children's growth across the five key indicators of school readiness (i.e., approaches to learning; language, literacy, and communication; social and emotional development; physical development, health, and well-being; and arts and science; see Bunce, 1995; High/Scope Educational Foundation, n.d.). The key distinction between the two curricula is the heightened emphasis on language facilitation within the LFC, as addressed in two ways. First, the LFC provides guidance on identifying and addressing highly specific linguistic objectives within daily and weekly lessons plans (e.g., specific verbal phrase structures, specific pronouns). Second, the LFC identifies specific strategies and behaviors (e.g., recasts) that teachers should use to stimulate language during interactions with children. The High/Scope curriculum, by comparison, is much less explicit regarding specific linguistic objectives and language stimulation techniques, and attention to language development is balanced with other developmental domains.

Fidelity of implementation. Adherence to implementation of the LFC was carefully monitored and measured for the seven LFC teachers. Two approaches were used. First, each LFC teacher faxed her completed weekly lesson plan to project personnel at the end of each week; teachers noted any modifications to the plan, which were then reviewed by project staff. Project staff contacted teachers periodically by phone or site visits to discuss any modifications to the plans that seemed to pose threats to integrity of implementation, although these were generally avoided by a priori discussions between teachers and research staff on whether a modification would be acceptable. Fidelity to the submission process was high: The number of submitted plans (out of a possible 40) for each teacher ranged from 37 to 40, with a mean of 39.

Second, classroom observations were conducted in fall, winter, and spring of the academic year by research personnel. Trained observers spent approximately 2 hr in each classroom, during which they completed a fidelity checklist while also collecting a 50-min video sample of the instructional day to assess instructional quality more generally. The fidelity checklist was developed for this study and included 45 checklist items selected for inclusion based on analysis of key curriculum features described in the LFC manual (Bunce, 1995). The

checklist contained 7 items that addressed teachers' use of the LSTs (the LST section) and 38 items that addressed implementation of specific daily activities, such as dramatic play, storytime, and group lesson (the Activity section). For the LST section, frequency of use was recorded for 7 LSTs (focused contrasts, models, event casts, open questions, recasts, expansions, redirects) on a scale of 0 to 3 (0 = *no use,* 1 = *one use,* 2 = *two or three uses,* 3 = *four or more uses*) as calculated during an approximate 50-min period of continuous observation across a range of different classroom activities. Although it would seem that the teachers would receive ceiling scores given the scale used, the rate of occurrence for LSTs (particularly at the fall observations) was remarkably low (see Pence et al., in press). A total of 21 points were possible at each observation, and a single LST score was calculated for each teacher by dividing the total number of points earned by the number of points possible. Averaged across the three observations, the average LST score was .45 (*SD* = .18, range = .17–.79). The average LST score for LFC teachers was .57 (*SD* = .15, range = .36–.79), compared with .32 for comparison teachers (*SD* = .12, range = .17–.56), a difference that was statistically significant, $F(1, 12) = 11.83$, $p = .005$ ($d = 1.71$).

Measures

This study involved two sets of measures: cross-site measures implemented by the national evaluation team and site-specific measures implemented by a specific site's research team. The battery of measures used by the PCER Consortium are detailed elsewhere (PCER Consortium, 2007) and are not used in the present research. Rather, this study used site-specific measures of teacher LST use and four child characteristics: (a) gender, (b) SES, (c) preschool attendance, and (d) expressive language skill. Child gender and household income (serving as a proxy for SES) was provided by parents on a demographic questionnaire collected in the fall of the year. Children's attendance was recorded by teachers in this study for each child participant; these were submitted monthly to project staff. We calculated the percentage of days in attendance for a child by dividing the days in attendance by the total number of school days. Days for which children were recorded as tardy were coded as being in attendance. The fourth measure, expressive language skill, is described next.

Children's *expressive language skills.* All children were individually assessed with a battery of language and literacy measures during a 6-week assessment window in the fall and spring of the academic year. On average, 7 months spanned the two assessments for individual children. At the time of this assessment, children provided a 10-min spontaneous language sample during a one-on-one interaction with an examiner, which served as our site-specific measure of expressive language ability. All examiners were undergraduate or graduate students in the first author's research laboratory at the University of Virginia; all had prior experience working with children and completed a training session on how to collect language samples. Language samples were either videotaped or audiotaped (depending on parental consent) and were timed to ensure that they were exactly 10 min in length. Researchers used Play-Doh and a variety of other props (e.g., a picnic basket with plastic food, a farm set with animals, stuffed animals) as a springboard for discussion following conventional guidelines for eliciting child language samples (e.g., Paul, Tetnowski, & Reuler, 2002); an identical set of materials was used with each child. In collecting these samples, assessors used a balance of open-ended questions and comments in order to elicit as much child language as possible, with a goal of eliciting at least 50 utterances per child. On average, 77 utterances (fall samples) and 85 utterances (spring samples) were collected from each child; fifty or more utterances were elicited from 83% and 84% of children, respectively, at the fall and spring time points. Although the duration of the spontaneous language sample was less than desirable, the 10-min (50-utterance) criterion was established given (a) constraints associated with the number of samples collected (196 children × 2 samples) within a relatively short duration of time and (b) the context of the study in which children were tested within their preschool programs (and the resultant concerns by program administrators of loss of instructional time due to testing).

After the language samples were collected, standardized procedures were used for their transcription and coding by trained research assistants. Research assistants were undergraduate and graduate students with educational training in speech and hearing sciences, linguistics, or education. For both transcription and coding, the standardized procedures in the research lab involved research assistants completing a comprehensive training protocol that involved (a) studying relevant materials (e.g., transcription guidelines, a grammar refresher), (b) completing a set of three to five practice sessions with accuracy checks, and (c) completing reliability sessions until the assistant achieved 90% or better reliability against at least five consecutive gold-standard (i.e., master-coded) transcripts. After the third step was achieved, an assistant could then work independently as a transcriber/coder. All transcripts were checked for accuracy (for accuracy of words and for segmenting utterances) following transcription and then again after coding (see subsequent paragraph) by trained research assistants to protect against drift. Reliability of transcribing and coding procedures in this study exceeded 90% based on the

level of agreement exhibited by each transcriber/coder against master codes that had been carefully developed through consensus by reliable transcribers/coders for a set of practice and reliability transcripts. Agreement percentages were calculated as number of agreements/number of agreements + disagreements. Research assistants were blind to study conditions when transcribing and coding child language samples.

Regarding transcription, the child language samples were transcribed and segmented at the utterance level using the Systematic Analysis of Language Transcripts (SALT; Research Version 8.0) software program; utterances were identified based on SALT conventions, which use pauses and pitch changes to identify utterances. After the transcripts were created, a coding system was applied to each, based on the work of Huttenlocher and colleagues (2002). To apply this coding system, transcripts were coded for complex utterances and nouns (detailed descriptions follow in subsequent subsections). From the codes applied, four dependent measures were derived from each transcript. The measures represented areas of language skill that were aligned to the curriculum's goals either implicitly or explicitly (Bunce, 1995), have been shown to be influenced by measurable features of the environment (e.g., teacher language use, quality of instruction) within classroom contexts (Huttenlocher et al., 2002), and are positively associated with standardized measures of language skill both concurrently and predictively (e.g., Pankratz, Plante, Vance, & Insalaco, 2007).

Measure 1: Percent Complex Utterances (complex variable). The percentage of complex utterances was calculated using a coding system derived from Huttenlocher et al. (2002) applied at the level of the utterance. Research by Huttenlocher and colleagues has shown that children's performance on this measure is strongly associated with features of their language-learning environments (e.g., parental use of multiclause utterances), and we therefore anticipated that such a measure may provide a sensitive indicator of the effects of the LFC, particularly given its emphasis on helping children to "learn new and employ a variety of syntactic constructions" (Bunce, 1995, p. 66). For our purposes, utterances were considered to be complex if they contained more than one clause and took one of the following six forms, based on Huttenlocher et al.'s (2002) scheme: (a) contained an infinitival form with an additional verb (e.g., Dad knows how to play chess); (b) contained a "let" verb followed by a pronoun and another predication (e.g., Let her do it); (c) contained a gerund form with an additional verb (e.g., Swimming is really hard); (d) contained a conjunction between two clauses (e.g., Put the toys down or you will go to time out); (e) contained a dependent noun clause (e.g., Tell me what you did in school today), relative clause (e.g., The boy who owns the red convertible drives fast), comparative clause (e.g., They picked as many apples as they could carry), or adverb clause (e.g., You will find it where you left it); or (f) contained one or more independent clauses and one or more dependent clauses that were not captured by the previous items (e.g., I wanna go to the store where they have candy). For each child, the percentage of complex utterances was calculated by dividing the child's raw frequency of complex utterances by the total number of utterances he or she produced.

Measure 2: Rate of Noun Use (noun variable). Also adapted from Huttenlocher et al. (2002) to provide a second measure of grammatical complexity, children's noun use (including single nouns, pronouns, and elaborated noun/pronoun phrases) was also coded. This measure was selected based on its demonstrated sensitivity to features of preschoolers' language-learning environments (Huttenlocher et al., 2002) but also based on the clear attention to promoting children's use and comprehension of pronouns, nouns, and noun phrases within the LFC. Within each daily planning guide, teachers are provided a list of nouns to target (e.g., airplane, pilot, flight attendant) as well as pronouns and adjective/object descriptions (e.g., large plane, small plane, big suitcase; Bunce, 1995, p. 110). In each transcript, each noun (e.g., frog, boy), pronoun (he, they), and elaborated noun phrase (this button, red light) was identified, such that multiple codes for nouns, pronouns, and noun/pronoun phrases could be applied to each utterance. The rate of noun use was calculated by dividing the total number of nouns, pronouns, and elaborated nouns per transcript by the total number of utterances.

Measure 3: Number of Different Words (NDW variable). NDW provides a general estimate of lexical diversity. This measure was included based on its demonstrated sensitivity to characteristics of language instruction (e.g., teachers' linguistic responsiveness) within preschool settings (see Girolametto & Weitzman, 2002) and the clear emphasis on promoting vocabulary skill within the LFC. Within the LFC, teachers expose children to a comprehensive set of (presumably) novel words within a range of activity settings, including art and dramatic play. When calculated on preschool children's language samples of 12-min duration, test–retest reliability for NDW is adequate ($r = .53$; Gavin & Giles, 1996), as is also the case when samples comprise at least 25 utterances ($r = .55$). The total number of unique word roots present in each language sample was calculated by the SALT software for each transcript.

Measure 4: Upper Bound Index (index variable). As suggested by Brown (1983), a child's most syntactically complex utterances within a language sample may provide the best estimate of language competence. Following

McCartney, Robeson, Jordan, and Mouradian's (1991) procedures, we calculated the upper bound index by determining the median upper bound of the five most grammatically complex utterances (greatest number of morphemes) produced by each child. This metric is similar to the Length measure used by Pankratz et al. (2007) in their study of the predictive relations between language measures collected when children were 5 and 6 years of age and their reading and language outcomes approximately 3 years later. Participants were children with specific language impairment. For each child, researchers calculated a Length measure for transcribed narratives (elicited with *The Renfrew Bus Story*; Cowley & Glasgow, 1994) that represented the average length (in words) of the five longest utterances for each child. Concurrent relations between the Length measure and concurrent standardized measures of language were moderate to strong (r = .30–.57). Importantly, the Length measure exhibited uniformly strong predictive relations with standardized measures of oral language (r = .786), receptive vocabulary (r = .689), and word recognition/decoding (r = .610) collected several years later. Such findings support the concurrent and predictive validity of this measure as an index of preschoolers' spoken language skills.

Analytical Approach

This study involved a nested design that included between 8 and 17 children within each of 14 preschool classrooms. Hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) provided the conceptual framework for specifying two-level models to account for variance both within and between preschool classrooms for four measures of expressive language ability. The first research question examined the extent to which child characteristics (fall language ability, gender, SES, attendance) were associated with children's expressive language ability in the spring. In the first level of the two-level models, associations between spring expressive language ability and child-level predictors were specified (see Equation 1). A spring language score (Y) for a child (i) who is in classroom (j) is a function of the mean spring score for children in this class (β_{00}) after adjusting for fall language scores (β_{01}), gender (β_{02}), SES (β_{03}), attendance (β_{04}), and the error term associated with this estimated mean (r_{ij}).

$$Y_{ij} = \beta_{00} + \beta_{01}(\text{fall score}) + \beta_{02}(\text{gender}) + \beta_{03}(\text{SES}) + \beta_{04}(\text{attendance}) + r_{ij} \quad (1)$$

The second research question examined the extent to which exposure to the LFC was associated with children's expressive language ability. In the second level model, treatment condition (LFC/comparison) was entered as a classroom-level predictor to examine the extent to which between-classroom differences in spring expressive language ability was related to the LFC. In Equation 2, the adjusted mean spring score for children in each classroom (β_{00}) resulting from the Level 1 model in Equation 1 is a function of the grand mean spring score (γ_{00}), use of the LFC (γ_{01}), and the error term associated with this estimated mean (u_{0j}).

$$\beta_{00} = \gamma_{00} + \gamma_{01}(\text{LFC}) + u_{0j} \quad (2)$$

The coefficient γ_{01} provides an estimate of the extent to which children's expressive language ability is different in LFC classrooms as compared with comparison classrooms, thus providing an unbiased estimate of the impacts of LFC exposure.

The third research question examined the extent to which children's exposure to teacher use of LSTs within treatment and comparison classrooms was associated with expressive language ability. In Equation 3, teacher use of LSTs (based on average fidelity ratings over three observations) replaced treatment condition (LFC/control) to estimate whether greater exposure to LSTs related to higher spring expressive language ability after accounting for children's fall language ability, gender, income, and attendance.

$$\beta_{00} = \gamma_{00} + \gamma_{01}(\text{LST}) + u_{0j} \quad (3)$$

The fourth research question examined whether two measures of children's classroom-based preschool language experiences—LFC exposure and LST exposure—moderated the associations between specific child characteristics and expressive language ability. In these analyses, a coefficient from the Level 1 model indicating the extent to which spring language scores were associated with fall language ability, gender, SES, and attendance was included as an outcome in a Level 2 equation. In this Level 2 model, either LFC or LST use (see Equation 4) and the resulting coefficient γ_{11} determined the extent to which the magnitude of the associations between spring language ability and four child characteristics—fall language ability, gender, SES, or attendance—varied as a function of exposure to LFC or LSTs:

$$\beta_{01} = \gamma_{00} + \gamma_{11}(\text{LFC or usage of LST}) + u_{1j} \quad (4)$$

There were some missing data for fall and spring expressive language scores, SES, and days of attendance (see Table 2). Missing data were estimated using multiple imputation procedures in SAS, which created five complete data files. Multilevel analyses were conducted in SAS using PROC MIXED on each of the five imputed data files, and coefficients and standard errors resulting

Table 2. Child (n = 196) and classroom (n = 14) characteristics.

Characteristics	*n*	Missing	*M*	*SD*
Child characteristics				
Fall average utterances sampled	180	18	76.8	29.0
Spring average utterances sampled	173	23	85.3	31.9
Fall percent complex utterances*	179	17	12.2	8.29
Spring percent complex utterance*	173	23	13.8	7.62
Fall rate of noun use*	179	17	1.28	0.41
Spring rate of noun use*	173	23	1.37	0.32
Fall number of different words*	182	14	92.8	38.0
Spring number of different words*	173	23	112.5	40.9
Fall medium upper bound*	182	14	8.84	2.90
Spring medium upper bound*	173	23	9.64	2.78
Gender				
Male	102			
Female	93			
Family income (in 10s of thousands)	159	37	2.65	1.79
Days attended	193	3	130	20.17
Classroom characteristics				
Language-focused curriculum				
Treatment	7	0		
Control	7	0		
Average rating of LSTs	14	0	0.45	0.19

Note. LST = language stimulation technique.

*Dependent measures used in this study.

from each analysis were averaged to provide coefficient estimates.

Results

Table 3 presents means and standard deviations on the four assessments of children's language skills at the beginning and end of preK for children in the treatment and comparison classrooms. Paired-samples t tests were conducted for each of the four expressive language measures for the entire sample, using a Bonferroni adjusted alpha of .0125 (.05/4) to control for Type I error. Results of four paired-samples t tests indicated that the children, considered collectively as a single group, made significant gains in their expressive language abilities from fall to spring of the year: Complex, $t(161) = 2.55$, $p = .012$ ($d = 0.2$); Noun, $t(161) = .295$, $p = .004$ ($d = 0.24$); NDW, $t(164) = 6.3$, $p < .001$ ($d = 0.5$); and Index, $t(164) = 3.56$, $p = .001$ ($d = 0.28$). This finding shows that the four aspects of child language skill sampled are in an active state of growth during the later preschool years, although the effect-size estimates show the gains to be relatively modest in size. The largest amount of growth was seen for NDW.

Table 3. Fall and spring scores for children in LFC and comparison group on expressive language measures.

	LFC (n = 100)		Comparison (n = 96)	
Measure	**Fall**	**Spring**	**Fall**	**Spring**
Complex	0.12 (0.1)	0.14 (0.1)	0.13 (0.1)	0.14 (0.1)
Noun	1.29 (0.4)	1.37 (0.3)	1.28 (0.4)	1.38 (0.3)
NDW	95.03 (38.1)	109.29 (39.5)	90.42 (35.9)	115.6 (42.1)
Index	8.89 (3.1)	9.54 (2.8)	8.77 (2.7)	9.75 (2.7)

Note. Standard deviations are in parentheses. Complex = percent complex utterances; Noun = rate of noun use; NDW = number of different words; Index = upper bound Index.

Table 4 presents results from an HLM that examined the extent to which child characteristics, exposure to the LFC, and exposure to LSTs were associated with children's expressive language abilities. In the first block in the analysis, fall language scores, gender, SES (family income), and attendance were included as predictors for each of the four measures of spring expressive language ability (see Equation 1). Results indicated that fall language scores and family income were associated positively with each of the four measures of expressive language ability in spring. Attendance was also significantly and positively associated with one of the spring expressive language skills, namely the Upper Bound Index measure.

In Model 2, the classroom-level measure indicating whether the LFC curriculum was implemented (1 = *treatment,* 0 = *comparison*) was included as a predictor in

Table 4. Associations between attendance, LFC exposure, LST exposure, and expressive language abilities.

Model	Complex		Noun		NDW		Index	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Model 1: Child characteristics								
Intercept	.139		1.37		112.6		9.66	
Fall language scores	0.29***	0.06	0.23***	0.06	0.51***	0.07	0.41***	0.06
Male (1)/Female (0)	−0.31	1.10	0.04	0.04	10.1	5.28	0.09	0.36
Family income (in 10s of thousands)	0.10**	0.03	0.01***	0.00	0.43**	0.15	0.03***	0.01
Days attended	0.19	0.24	0.01	0.01	0.88	1.23	0.19*	0.08
Model 2: LFC								
Treatment (1)/Control (0)	0.64	1.43	0.02	0.06	−5.29	5.88	0.01	0.51
Model 3: LST								
Average rating over three observations	−0.03	0.04	−0.00	0.00	−0.21	0.15	−0.02	0.01

*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

the Level 2 equation. There were no systematic differences in spring expressive language ability when contrasting the LFC and comparison classrooms when controlling for fall expressive language ability, gender, SES, and attendance.

In Model 3, the classroom-level measure representing child exposure to LST replaced the measure of whether classrooms implemented the LFC curriculum. Results indicated that across LFC and comparison classrooms, child exposure to LSTs was not significantly related to children's expressive language abilities when controlling for fall expressive language ability, gender, SES, and attendance.

Table 5 presents the moderating effects of children's classroom-based language experiences (LFC exposure and LST exposure) on the associations between child characteristics and spring expressive language skills. For each of the analyses, fall language scores, gender, SES (family income), and attendance were included as child-level covariates. To examine interactions between LFC exposure and child characteristics, LFC (treatment, comparison) was included as a Level 2 predictor, and the interaction between LFC and each child characteristic was tested separately. Likewise, to examine interactions between LST exposure and child characteristics, LST (average rate of use in each classroom) was included as a Level 2 predictor, and the interaction between LST and each child characteristic was tested separately. There was a significant and positive moderating influence of LFC exposure for boys on the complex variable; there was also a significant, positive moderating influence of LFC exposure on the associations between attendance and the noun (rate of noun use) and index variables

Table 5. Moderating effects of classroom conditions (exposure to LFC, exposure to LST) on associations between child characteristics and expressive language ability.

Variable	Complex		Noun		NDW		Index	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
LFC*child characteristics								
LFC*fall language	0.15	0.13	0.03	0.11	0.08	0.14	0.10	0.12
LFC*male	4.04*	2.04	−0.02	0.09	−5.32	11.0	0.27	0.70
LFC*family income	0.10	0.06	.000	.002	−0.16	0.30	−0.01	0.02
LFC*days attended	0.82	0.50	0.05*	0.02	3.76	2.51	0.37*	0.17
LST*child characteristics								
LST*fall language	.000	.004	−.000	.003	−.000	.004	.002	.003
LST*male	0.09	0.05	.000	.002	−.004	.276	.000	.019
LST*family income	.002	.001	.000	.000	−.001	.008	.000	.001
LST*days attended	0.03*	0.01	.001*	.000	0.10	0.07	0.01**	0.00

*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

(upper bound index). In addition, there was a significant moderating influence of LST exposure on the associations between attendance and the complex (percent complex utterances), noun (rate of noun use), and index variables (upper bound index).

Figures 1 and 2 present these LFC Exposure × Attendance interactions by plotting the estimated expressive language scores for children in the LFC and comparison classrooms for the median number of days (135 days) and the maximum number of days (156 days). Figures 3, 4, and 5 present the estimated mean expressive language scores for children who attended classrooms receiving the median LST scores (44%) and the maximum LST scores (79%) for the median number of days (135 days) and the maximum number of days (156 days). Results indicate that being in attendance regularly had a stronger positive influence on children's expressive language ability in LFC classrooms compared with comparison classrooms and in classrooms exhibiting high rates of LST use compared with classrooms exhibiting moderate rates of LST use.

Discussion

This research examined the effectiveness of a comprehensive language curriculum designed to promote the quality of children's language-learning experiences within the preschool classroom. Conducted within the framework of the larger multisite PCER study, this study reflects the increased focus within the educational community concerning the use of evidence-based approaches within preschool, elementary, and secondary programs (e.g., Stanovich & Stanovich, 2003). This noted, it is important to recognize that many of the interventions in use currently or that have been shown to be effective in small-scale efficacy and feasibility studies may not effectively scale up, given the many contextual variations seen among preschool programs today and the remarkable heterogeneity among preschool participants. Consequently, researchers must seek to identify not only whether specific programs or curricula are effective but also under what circumstances and for whom value-added impacts are achieved (see McDonald, Keesler, Kauffman, & Schneider, 2006). The results of the present study show that children's participation in a comprehensive preschool language curriculum and exposure to its active ingredients achieves a value-added benefit only under highly specific circumstances.

Figure 1. Moderating effects of LST exposure on the association between Attendance and Percent Complex Utterances at the end of preschool.

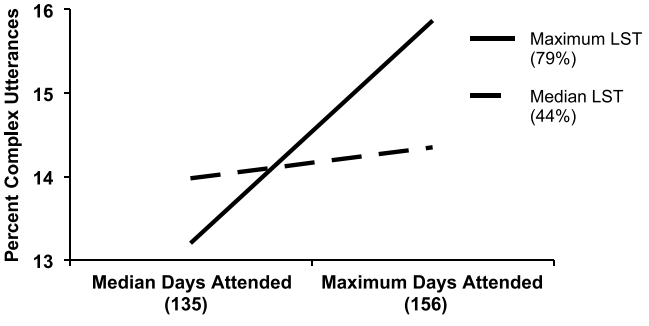
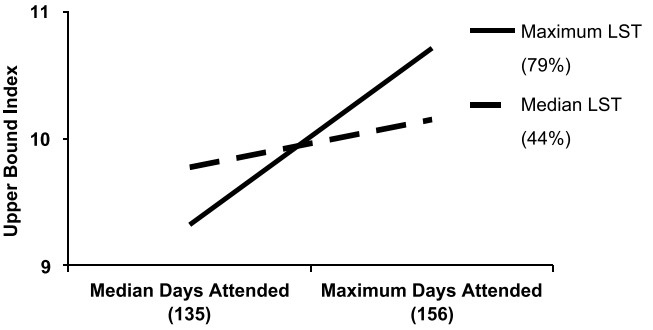


Figure 2. Moderating effects of LST exposure on the association between Attendance and Upper Bound Index at the end of preschool.



Consideration of Major Findings

We addressed four aims in this experimental work. The first aim was to identify specific child characteristics (fall language skill, gender, SES, preschool attendance) predictive of children's expressive language outcomes during preschool. Children's fall expressive language skills and SES (i.e., household income) were the most consistent predictors of spring expressive language skill, explaining substantial portions of variance in all four outcome measures. Such findings are consistent with prior reports in the extant literature and thus were not unexpected. Research has shown that children's language

Figure 3. Moderating effects of LST exposure on the association between Attendance and Rate of Noun Use at the end of preschool.

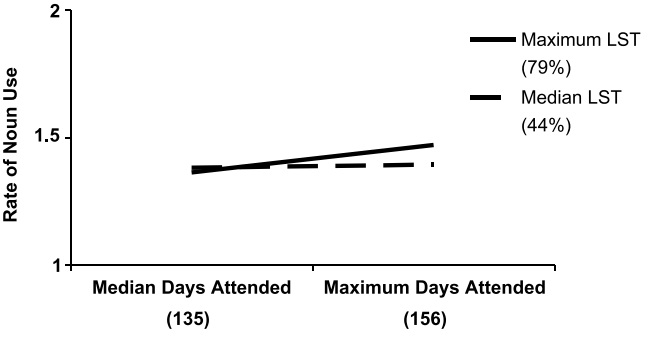
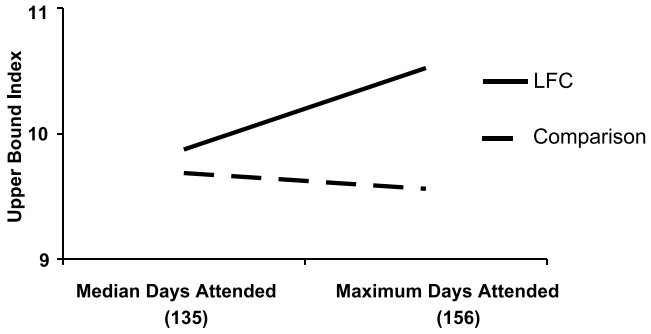
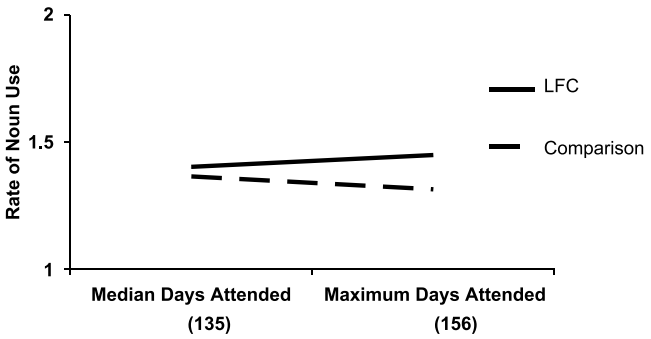


Figure 4. Moderating effects of LFC exposure on the association between Attendance and Upper Bound Index at the end of preschool.



skills are generally stable during the later preschool years (Storch & Whitehurst, 2002), with strong continuity and predictive relations from preschool into kindergarten (see Pankratz et al., 2007). Research has also shown that poverty is one of the most well-established risk factors associated with the quality and timing of children's expressive language achievements (e.g., Fazio et al., 1996; Hart & Risley, 1995; Whitehurst, 1997); estimates show that the expressive language skills of low-SES children, particularly vocabulary, differ by about 1 *SD* from those of their more advantaged peers (Justice et al., 2005; Whitehurst, 1997). In the present study, children's attendance rates were also found to correlate with spring language performance: Children who attended preschool more regularly had higher upper bound indices in the spring relative to those who attended preschool less regularly. This finding was also not surprising, given Hubbs-Tait and colleagues' work (2002) showing positive associations between regular preschool attendance and the receptive vocabulary development of children attending Head Start; this finding was most pronounced for children from homes exhibiting a greater number of indicators of risk (e.g., low household income, low cognitive stimulation, high parental intrusive behavior, high

Figure 5. Moderating effects of LFC exposure on the association between Attendance and Rate of Noun Use at the end of preschool.



maternal depression), indicating that regular "attendance compensated for cumulative family risk" (p. 553).

The second and third aims were related, as both sought to determine the causal impacts of LFC and LST exposure on preschoolers' gains in expressive language skills. We found no main effects for LFC participation on children's expressive language skills, indicating that exposure to LFC was not sufficient to improve children's expressive language skills over and above that seen in the comparison classrooms in which the High/Scope curriculum was reportedly being used. Likewise, we saw no main effects for LST exposure, indicating that heightened exposure to LSTs was insufficient to accelerate language growth. Considering first the null finding for the LFC, this was a somewhat surprising one, given several studies showing that preschool children—even those exhibiting significant developmental risk—make significant gains in language skills when new interventions are implemented within their classrooms (e.g., Girolametto, Weitzman, & Greenberg, 2003; Lonigan, Anthony, Bloomfield, Dyer, & Samwel, 1999; van Kleeck Vander Woude, & Hammett, 2006; Wasik & Bond, 2001). However, if we look closely at this extant body of literature, several possible explanations for why our results diverged from those in the literature are apparent.

First, most of these studies have focused solely on vocabulary as an outcome measure (expressive and/or receptive) and have used intervention approaches that primarily target word-learning gains. Recent work by Landry and colleagues (2006) suggests that children's vocabulary growth shows greater impacts in classroom-based language interventions compared with syntactic skills, which were largely the focus of the present study and may be harder to influence. Likewise, the available literature is insufficiently clear concerning the effects of classroom-based language intervention on children's discourse-level language skills, which have seldom served as experimental outcomes in large-scale experimental research. Second, the comparison condition in the present study did not approximate the no-treatment control condition used in several studies (e.g., Whitehurst et al., 1994). Rather, the teachers in the comparison condition reported use of a particular curriculum (High/Scope) that has been positively associated with preschoolers' language growth in a recent large-scale professional development study (Landry et al., 2006). When studies have implemented experimental conditions that are closely comparable to comparison conditions (e.g., normal shared reading vs. dialogic shared reading; Lonigan et al., 1999), main effects are greatly attenuated and often fail to achieve statistical significance (see Lonigan et al., 1999; Whitehurst et al., 1994), as was the case in the present study. Third, as a final point, it is also the case that many classroom-based language interventions have used structured small-group instruction—such as

shared-reading activities (e.g., Hargrave & Senechal, 2000; Lonigan et al., 1999; Whitehurst et al., 1994)—as a context for intervention and trained research assistants as intervention agents (e.g., Lonigan et al., 1999; van Kleeck et al., 2006). It is possible that interventions that require teachers to change their instructional practices across a range of diffuse routines are less effective than those that require teachers to modify instruction in only one focal context or activity setting. Researchers conducting a recent evaluation of commercial language and literacy curricula noted that, even with the provision of a training workshop and ongoing weekly coaching, 6 months were required for teachers to successfully use the curricula in their classrooms (Assel et al., 2007).

Turning to the lack of main effects for LST exposure, it is possible that teachers did not achieve use of these techniques at the levels needed to accelerate children's language acquisition. None of our teachers exhibited high rates of LST use: As a group, they received an LST fidelity score of .45 as averaged over three observations. Alternatively, it may be that the level of dosage needed to affect children's language skills was only achieved in the latter months of the academic year; as we discuss elsewhere (Pence et al., in press), teachers' implementation of LSTs showed a gradual increase in use over the academic year. The finding of a null effect is an important one, as prior research has convincingly shown that children's exposure to high-quality language input—including specific LSTs, such as recasts—is associated with accelerated language growth (e.g., Baker & Nelson, 1984; Fey et al., 1997; Fey & Loeb, 2002; Girolametto et al., 2000). Nonetheless, the present work suggests that it may be a challenge to take such findings to scale within the everyday context of the preschool classroom. As research by Girolametto et al. (2003) and Wasik, Bond, and Hindman (2006) has shown, preschool teachers may require intensive and ongoing support, including classroom-based modeling by experts, to infuse high-quality LSTs throughout classroom instruction. It may be tempting to interpret the lack of main effects in this study as showing that the LFC or LSTs are not effective; yet the more accurate interpretation would be that LFC exposure and/or LST exposure did not accelerate children's language acquisition over and above prevailing conditions when applied in everyday preschool settings.

To offer an even more nuanced interpretation of this curriculum evaluation, we now turn to the fourth aim, which was designed to explore whether the gains anticipated from LFC and/or LST exposure might be moderated by specific child characteristics. This aim was designed to explore whether improvements to the classroom language-learning environment might have positive impacts under special circumstances. As the results showed, child attendance emerged as a uniquely important moderating variable, affecting the relationship between LFC exposure and two child language outcomes (noun use and upper bound index), and LST exposure and three child language outcomes (use of complex syntax, noun use, and upper bound index). Precisely, the results showed that children who attend preschool more regularly reap the benefits of a heightened language-learning environment compared with those who attend preschool less frequently. Perhaps the most practical interpretation of this finding is that the percentage of days in attendance represents the child's actual dosage to the curriculum or its active ingredients (the LSTs; see Hubbs-Tait et al., 2002). Although it might seem that teachers' fidelity of implementation would serve as reasonable dosage indicator (as is common in intervention research), when implementing curricula within classrooms in which attendance is highly variable, measures of children's actual exposure to the curriculum as indicated by days in attendance seems a better indicator of their language-learning opportunities. By considering children's actual exposure to the LFC and LSTs as a construct distinct from teachers' fidelity of implementation, the study results showed that both have value-added benefits to children under specific conditions. In the simplest of terms, children seemed unable to experience the benefits of enhanced language-learning opportunities within their preschool classrooms when they were not present to receive them.

Limitations and Conclusions

This study exhibits several important limitations that require discussion and that also present opportunities for future intervention research. First, the number of teachers participating in the two respective conditions was relatively small. The findings of this study raise a number of potentially interesting questions that could have been addressed had the sample been larger. For instance, it would have been desirable to determine whether teachers' pedagogical beliefs, years of teaching experience, or sense of efficacy concerning curriculum implementation influenced children's growth within the experimental condition. Such possibilities should be explored in future research that includes larger numbers of teachers to consider more closely under what conditions a curriculum such as the LFC is most effective.

Second, this study involved evaluation of curriculum effects after only about 9 months of use by implementing teachers. It is plausible that different effects—possibly stronger effects—might have been seen should teachers have had the opportunity to become more practiced in use of the LFC. Landry et al. (2006) recently found that preschoolers experienced greater language and literacy growth when in classrooms of teachers who were in their second year of a professional development study (focused on early language and literacy instruction) compared with first-year teachers. The intensive graduate training that

speech-language pathologists must undergo to become "master" language interventionists suggests that achieving exemplary language stimulation within the preschool classroom requires more rigorous and extensive training than that featured in this study. Quality implementation of the LFC may require providing teachers with ongoing intensive supports that are sustained over time; speech-language pathologists may serve an important consultative role in such activities.

Third, this study investigated treatment fidelity on only three occasions. As an at-scale effectiveness study, the research team's time in the field (observing and supporting teachers) was fairly limited. This is appropriate from a methodological perspective, given our use of a randomized controlled trial (RCT) framework and intent-to-treat analysis. Intent-to-treat analyses within an RCT framework provide the most rigorous tests of causal impacts of an intervention, as all individuals (teachers and children) assigned to a particular condition are maintained in analyses irrespective of compliance or deviations in implementation (Peduzzi, Detre, Wittes, & Holford, 1991); in fact, adherence and fidelity are irrelevant in intent-to-treat analyses. However, in our secondary analysis, in which we conducted "as treated" analyses to address questions of moderation, our lack of in-depth understanding of what actually happened in classrooms during the academic year presents an important limitation. (With as-treated analyses, investigators conduct secondary analyses that consider trial outcomes as a function of how treatment was actually received by recipients—for instance, in relation to adherence to intervention protocols or actual dosage of/participation in intervention; for a recent discussion, see Fontanarosa & DeAngelis, 2008.) Although prior research shows that the characteristics of teacher–child language-focused interactions that are central ingredients in the LFC have positive influences on children's language expression (e.g., Girolametto & Weitzman, 2002), we do not know how often LFC teachers engaged in quality interactions with their pupils and whether such differences contributed to the language achievements of children in their classrooms.

Finally, this study used only measures of children's expressive language skills and relied on spontaneous language sampling for this assessment. Results may have differed with alternative approaches to expressive-language measurement or if other domains of language had been studied (e.g., receptive vocabulary, pragmatics). For instance, the LFC includes a significant focus on facilitating children's pragmatic skills (e.g., turn-taking within conversations, use of conversational initiatives). No measures were applied within this study to ascertain whether the LFC exerted effects on these important functional aspects of language; consequently, its effectiveness for stimulating such areas of language remains unknown. As importantly, we must also raise a cautionary note regarding the measures of children's language skill that were collected. Children's language skills were sampled during a relatively short duration of interaction; sampling outcomes can vary substantially due to the amount of language elicited (see Gavin & Giles, 1996). Perhaps if children's expressive language skills had been sampled in an interaction of 20- or 30-min duration, the study results would have differed.

McDonald and colleagues (2006) recently noted that randomized controlled trials are "a necessary step towards the successful scale-up" of educational interventions (p. 15), and many educators and administrators are eagerly seeking information on "what works" so that they might use the most efficacious approaches with their pupils, particularly those who are most vulnerable for academic challenges. McDonald et al. also point out, however, the need to attend to understanding the constraints imposed by both contextual and individual differences within experimental research, recognizing that not all educational interventions will exert desired effects across all conditions and with all pupils. Nowhere is this likely to be more true than in the arena of preschool education, in which we see remarkable variability among not only the professionals who serve these programs but also the environments in which they work and the children and families they serve. The results of the present study suggest that adoption of a comprehensive curriculum should occur with thoughtful deliberation and that it may not provide a value-added benefit to all children who experience it. Nonetheless, findings suggest that children who receive relatively large doses of a structured curriculum that emphasizes the processes and structures of quality language instruction may experience accelerated expressive language growth during preK.

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