

Relation Between Language Experiences in Preschool Classrooms and Children's Kindergarten and Fourth-Grade Language and Reading Abilities

David K. Dickinson
Vanderbilt University

Michelle V. Porche
Wellesley Centers for Women, Wellesley College

Indirect effects of preschool classroom indexes of teacher talk were tested on fourth-grade outcomes for 57 students from low-income families in a longitudinal study of classroom and home influences on reading. Detailed observations and audiotaped teacher and child language data were coded to measure content and quantity of verbal interactions in preschool classrooms. Preschool teachers' use of sophisticated vocabulary during free play predicted fourth-grade reading comprehension and word recognition (mean age = 9; 7), with effects mediated by kindergarten child language measures (mean age = 5; 6). In large group preschool settings, teachers' attention-getting utterances were directly related to later comprehension. Preschool teachers' correcting utterances and analytic talk about books, and early support in the home for literacy predicted fourth-grade vocabulary, as mediated by kindergarten receptive vocabulary.

Language ability is widely recognized as central to reading comprehension. High-quality preschool experiences are known to foster language and early reading, and early reading skill heavily determines children's later success. But relatively little is known about the specific features of preschool classrooms that contribute to language acquisition. This article reports results of a longitudinal study that was designed to identify features of teacher-child interactions in preschool that relate to the language and literacy development of children from low-income families. It tests the hypothesis that the dynamics of teacher support for language in the classroom are similar to those found in homes; therefore, use of strategies found to be useful in homes will be associated with enhanced language learning in classrooms. Furthermore, we hypothesize that support for language in preschool results

in improved language and reading and that examination of direct and indirect effects will reveal lasting effects of preschool classroom experiences on fourth-grade language and reading competencies.

We address these hypotheses using new research tools that allow us to analyze existing data from a study that examined home and classroom contributions to language and literacy development of children from low-income families (Dickinson & Tabors, 2001; Snow & Dickinson, 1991). Using multiple simultaneous mediation analyses (Preacher & Hayes, 2008), we examine direct and indirect associations between variables describing children's preschool classroom experiences and language and reading skills in kindergarten and fourth grade, taking into account home and child variables.

Language and Reading Comprehension

Central to the design of this study was the hypothesis that the support that children receive for language in the preschool years has lasting effects on later reading comprehension (Snow & Dickinson, 1991). Considerable evidence now bolsters this assumption.

Longitudinal studies. Language plays a pivotal role in supporting reading development (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, &

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Correspondence concerning this article should be addressed to David K. Dickinson, Vanderbilt University, Department of Teaching and Learning Peabody #330230, Appleton Place, Nashville, TN 37203-5721. Electronic mail may be sent to David. Dickinson@Vanderbilt.Edu.

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Poe, 2003), and a recent meta-analysis found associations between early language and reading at the end of first and second grades (National Early Literacy Panel, 2009). Vocabulary in the primary grades is associated with later reading skills (Muter, Hulme, Snowling, & Stevenson, 2004; Spira, Bracken, & Fischel, 2005), and language in preschool predicts reading in later elementary to middle school years (NICHD Early Child Care Research Network, 2005a; Storch & Whitehurst, 2002; Walker, Greenwood, Hart, & Carta, 1994).

Full understanding of the importance of early language to later reading requires consideration of indirect pathways through which early language fosters later reading. During the preschool years, language and code-related competencies are correlated and mutually facilitative (Dickinson, McCabe, Anastasopoulos, Peisner-Feinberg, et al., 2003; NICHD Early Child Care Research Network, 2005b). Indirect effects of language on reading have been demonstrated for phonemic awareness, because growth in vocabulary has been found to result in changes in the mental representation of language, which supports improved phonemic awareness (Metsala, 1999). This facilitative effect of language on phonological awareness begins early as indicated by a study of Finnish-speaking children that found that language at ages 1 and 2 contributes to early reading, with the contribution being mediated through phonological awareness (Silven, Poskiparta, Niemi, & Voeten, 2007).

Storch and Whitehurst (2002) found that age 4 language skills had a large indirect effect on comprehension in Grades 3 and 4. Likewise, the NICHD Child Care study (2005b) found indirect effects of age 3 language on Grade 3 reading that were mediated through earlier code-related competencies. Thus, converging evidence suggests that language contributes to reading in Grades 3 and 4, especially when measures of extended language are included along with vocabulary.

Reading comprehension. Theoretical accounts of reading comprehension stress the importance of language skills (Hoover & Gough, 1990; Vellutino, Tunmer, Jaccard, & Chen, 2007). Longitudinal evidence comes from Catts, Adlof, and Weismer's (2006) finding that second- to fourth-grade language predicts eighth-grade reading comprehension for children with and without specific language impairment. Similarly, Vellutino et al. (2007) found that semantic knowledge supports spelling, which, in turn predicts decoding. Semantic and syntactic knowledge predict language comprehension, which is correlated with reading comprehension.

Studies of online processing reveal that vocabulary enhances comprehension by supporting inferential processes that require word-level semantic knowledge (Cain, Oakhill, & Bryant, 2004; Nation, Clarke, Marshall, & Durand, 2004). The ability to read words that cannot be decoded easily also has been linked to vocabulary size among 8- and 9-year-old children (Ricketts, Nation, & Bishop, 2007), and vocabulary is an area of significant weakness for poor comprehenders. Ouellette (2006) found that among fourth-grade readers, receptive vocabulary is related to decoding and depth of word knowledge relates to comprehension.

Language Development

To become proficient readers, children must learn tens of thousands of words by middle school (Biemiller, 2006) including many Graeco-Latin words with abstract meanings (Corson, 1997). Children also must acquire complex grammatical structures, differentiate genres and modalities, and learn to use language for metalinguistic and analytic purposes (Berman & Nir-Sagiv, 2004; Ravid & Tolchinsky, 2002).

The role of experience in fostering children's acquisition of language is described by the emergentist coalition model (ECM; Hirsh-Pasek, Golinkoff, Hennon, & Maguire, 2004). It argues that children first attend to salient perceptual features, then use knowledge of the speaker's focus of attention and intentions, and later employ linguistic cues (e.g., parts of speech). In preschool classrooms ECM predicts that individualized teacher-child conversations would be most conducive to language learning because all three sets of cues can be used optimally. In one-on-one conversations, adults adjust the information they provide about words according to form class (Hall, Burns, & Pawluski, 2003) and their estimation of the likelihood that the child knows a word (Weizman & Snow, 2001). Semantically contingent (Nelson, 1989) and responsive (Landry, Smith, & Swank, 2006) interactions support learning. Thus, language acquisition is fostered when adults are *tuned in and responsive* to what children are saying.

Adults also support language by remaining on a topic and encouraging children to elaborate their ideas (Hoff-Ginsberg, 1991; Nelson, 1989). Topic elaboration may encourage children to draw on their grammatical and lexical knowledge to produce more complex structures and create opportunities for adults to provide tailored support. Also, Weizman and Snow (2001) found

that the length of interactions between parents and children was correlated with the number of sophisticated words used. Thus, talk that *extends a topic* fosters language learning.

Group settings in preschool also might foster language learning. Density of exposure to novel vocabulary is associated with vocabulary growth (Hoff, 2003; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Pan, Rowe, Singer, & Snow, 2005). Exposure to relatively low-frequency or sophisticated vocabulary may be especially important because later reading comprehension requires knowledge of abstract and complex word meanings (Corson, 1997; Ravid & Tolchinsky, 2002). Books are a rich source of such vocabulary, and book reading also is a context that is conducive to analytic discussions about words and the meaning of text that have been found to be correlated with improved vocabulary (Dickinson & Smith, 1994). Thus, the *frequency of use of sophisticated vocabulary* predicts language learning, and lexical richness might be provided as books are read and discussed. *Analytic talk* during book reading also may predict language learning.

Describing Classroom Support for Development

Most studies of the effects of child care on development have used global rating scales (Harms & Clifford, 1980; La Paro, Pianta, & Stuhlman, 2004). Our approach was to focus on verbal interactions as other researchers have done. The Bermuda child care study examined the function and amount of verbal interaction between caretakers and children and found it was predictive of vocabulary and comprehensive language growth controlling for parent factors (McCartney, 1984). Connor, Morrison, and Slominski (2006) videotaped interactions in 34 preschool classrooms and coded for activity and teacher-child interactions. They found that only 4 min per day were spent reading books, and another minute was divided among varied language and literacy topics. Differences in time use were associated with growth in vocabulary and code-related skills. Huttenlocher, Vasilyeva, Cymerman, and Levine (2002) found that the complexity of syntax used by teachers of 4-year-old children predicted growth in grammatical comprehension.

The Current Study

We hypothesized that the quantity and content of preschool children's classroom interactions with teachers would predict language when the children

were in kindergarten and that kindergarten language ability would predict Grade 4 language and reading comprehension. We also anticipated that preschool classroom experiences would support kindergarten print-related competencies and that these would indirectly support Grade 4 decoding and reading comprehension. The following were hypothesized as likely to be associated with enhanced language growth: teachers who were *tuned in and responsive*, had *extended topics of the conversation*, and used *sophisticated vocabulary*. In group settings we anticipated that *sophisticated vocabulary* and *analytic discussions of books* would be associated with greater language growth. Additionally, we hypothesized that children would benefit from group activities with an instructional focus as indicated by being *orderly* as indicated by utterances that *requested attention* and that were concerned with accuracy of information as indicated by *corrections* of the incorrect content.

Method

These data are part of a larger study, the Home-School Study of Language and Literacy Development (Dickinson & Tabors, 2001; Snow & Dickinson, 1991; Weizman & Snow, 2001) that was designed to gather descriptive information about home and classroom experiences of children living in low-income homes during the preschool years and the long-term consequences of variability in early support for language on later reading. The current report focuses on data collected in classrooms and uses information collected in the homes as control variables.

Sample

Participants were recruited from preschool programs in Eastern Massachusetts that served children from low-income homes, defined as being eligible for Head Start or state vouchers. Preschool teachers sent home letters describing the study to families who met our income requirements. Families were given a \$25 stipend and a children's book; teachers received classroom materials. When they were 4 years old, the 83 children in our sample were dispersed across 65 classrooms, with no more than 2 children selected from the same classroom. We were not able to randomly select participants because of low response rates. Although those who responded might have been more stable, educationally oriented families, such a bias likely would be

evenly distributed across classrooms; therefore, differential effects of teachers would still reflect classroom-based differences. The original sample, which consisted of 83 children, was not significantly different from the analytic samples used to predict kindergarten ($n = 74$) and fourth-grade ($n = 57$) outcomes for this article, which were reduced because of attrition. For example, there was no difference in maternal education for kindergarten, $d = -.31$, *ns*, or Grade 4 attrition, $d = .05$, *ns*; child gender at kindergarten, $d = .21$, *ns*, or Grade 4, $d = .07$, *ns*; race or ethnicity at the two time points, $d = .29$, *ns*, and $d = .10$, respectively; or by income level at the start of the study for kindergarten, $d = .16$, *ns*, or Grade 4 attrition, $d = .37$, *ns*. Tests of early child language and home language environment showed no differences for the reduced kindergarten, $d = .41$, $p < .10$ and $d = .10$, *ns*, each with only one comparison case, or Grade 4 samples, $d = .31$, *ns*, and $d = .23$, *ns*, respectively.

The sample, with preschool, kindergarten, and Grade 4 demographics shown respectively, was primarily White (64%, 64%, 66%) but also included children of African American/African descent (23%, 22%, 20%), Latinos (7% across waves), and mixed race or ethnicity (6%, 7%, 7%). Boys and girls were evenly matched (49% and 51%, respectively, at preschool and kindergarten; 47% and 53% at Grade 4). Using baseline data collected at the start of the study, the highest level of maternal education was a high school diploma (62%, 61%, 58%) and ranged down to 6 years of formal education. Almost half of the sample (46%, 43%, 41%) had household incomes of less than \$10,000 per year and the rest ranged to upward of just over \$25,000 per year.

Observations were conducted in Head Start classrooms ($n = 33$) and private preschool programs ($n = 32$) that served children who received state vouchers for low-income families. Early analyses of our data set compared private and Head Start classrooms with respect to teacher education, time use, and patterns of teacher-child interaction; the only difference for two settings was that Head Start students spent more time in transitions (Dickinson & Tabors, 2001).

This study was designed prior to the development of statistical methods now used to control for the nesting of students within classrooms. Therefore, we adopted a sampling methodology of recruiting individual students from different preschools to address these problems of nonindependence. Unfortunately, this design has the potential to reduce the stability of measurement of classroom

impacts, thereby attenuating the chances of finding consistent results across classrooms that did not reflect robust associations. Drawing children from many different communities and schools reduced the chances that long-term stability in language and literacy skills was the result of similar instruction at shared schools.

Classrooms and settings. The classrooms had similar general environments and schedules, with the space in each divided into distinct areas (e.g., blocks, dramatic play, and books). The classroom day included distinct activity periods (e.g., free play, large group, and meal time). There was variability in the emphasis placed on different areas and activities, but the general atmosphere and scheduling were similar.

Teacher interviews. Teachers were interviewed to gather information about their professional histories (for details, see Dickinson & Tabors, 2001).

Audiotape data. We audiotaped each child in large group, book reading, small group, meal time, and free play. Teachers wore small backpacks that contained a tape recorder equipped with a microphone clipped to their collar. Data collectors observed classroom interactions and made notes that supplemented the audiotapes, which were transcribed using the Codes for the Human Analysis of Transcripts (CHAT) conventions for analysis by the Child Language Analysis (CLAN; MacWhinney, 1991). We returned a second day if a key setting was not observed the first day. This was necessary for less than 10% of the classrooms and almost all data used in our analyses came from settings observed on Day 1. We transcribed and analyzed 15 min of conversations from free play ($n = 74$), large group time ($n = 62$), and book reading ($n = 62$), with our corpus including approximately 50 hr. No variables were used from meal times and small groups because missing data would have unacceptably reduced our sample size.

Tapes were transcribed within weeks of the observations and were then verified and corrected by a second research assistant in a two-step process. Utterance breaks were noted by attending to phrase-final intonation. Prior to analysis, the tapes were checked for accuracy of CHAT conventions using automated procedures.

In coding setting, we identified the point on the tape both when the classroom observation and the audio data indicated an activity setting was established, often marked by the teacher announcing that it was "time for" the next activity (time stamps were indicated on transcripts). Children and teach-

ers assembled in the required location and began to engage in behaviors that typified an activity. Transcription began when the event was well established and continued until it ended or until we reached the 15 min time allocation, a typical length of book reading.

To determine how often children heard or used low-frequency words we developed a word list that acted as a filter to screen out common words. The updated Dale–Chall list of 3,000 words known by fourth graders (Chall & Dale, 1995) was the starting point and was expanded by adding all linguistic forms of the base words. The derivationally inflected forms included *'s, s, es, ies, d, ed, ied, ing, r, est, ier, iest* to create a list of 7,875 common word forms. Lists of words used in each classroom were run against the list of common words and the identified common words were deleted. Further pruning of the words subjected to analysis was performed by identifying common nouns, high-frequency spoken words, and slang (e.g., *tummy, mommy, cubby*), and all forms of address (e.g., *honey, miss*). The resulting list of nearly 8,000 words was then used to analyze talk across all classrooms. The list of words that remained after being subjected to this common word “filter” was the list of “sophisticated” vocabulary used for analysis. The CLAN program *FREQ* was used to generate comprehensive lists of word tokens and types, both for the unfiltered list of words used in classrooms and for the list of sophisticated words.

Each transcript was coded for specific kinds of talk. During book reading we coded all talk that was not a direct reading of text. Our unit of coding was the utterance, with both teacher and child utterances being coded. Distinctions between individual children’s contributions were not made; thus, we describe the overall nature of teacher–child interactions rather than specific interactions between a teacher and our target child (or other specific individual children). Each utterance was coded by classroom context and for the relation between one comment and another that preceded or followed it (e.g., “initiation” and “evaluation”). Research assistants were trained in use of the CHAT conventions by the first author who was trained by one of the developers of CHILDES. Coders had to achieve a Cohen’s Kappa level of .85 or better for all categories on five training transcripts prior to analytic coding. Procedures protected against rater drift, and interrater reliability checks were conducted on 10% of the data. Across all categories a Cohen’s Kappa statistic of .79 was maintained, reflecting “very substantial” agreement

(Landis & Koch, 1977, p. 165). Rates of agreement per coding category ranged from 61% to 97%, with the lowest levels of reliability for the categories of requesting attention and requests for clarification. Disagreements were resolved through a process of discussion and consensus.

Because exposure to a greater variety of words (quality) is more predictive of language growth than simply the quantity of exposure to words (Huttenlocher et al., 1991; Pan et al., 2005; Weizman & Snow, 2001), teacher talk variables were expressed as the percentage of teacher talk during a setting. To calculate density measures we used the *FREQ* routine in CLAN to count words used and to count codes assigned to utterances by directing the program to attend to different tiers in the transcript—to the transcribed text or to codes assigned to an utterance. Thus, to calculate the percentage of teacher utterances that were coded as “explaining,” *FREQ* was run on the coding tier and directed to count instances of explanations. *FREQ* also counted the total number of coded utterances. By dividing the number of explanatory utterances by the total, we obtained a measure of the relative frequency of use of the type of comment by teachers. Similarly, to obtain a measure of the relative amount of teacher versus child talk we determined the number of words used by teachers in a given setting and the number of words used by children, and divided child words by teacher words. For determining the relative number of rare words used we divided a count of rare word use by the total number of words used in a setting.

Because of the number of variables and the fact that this was an early effort to relate details of classroom conversation from across the day to child outcomes, we conducted exploratory analyses by setting to identify variables that were related to each other and those that were associated with measures of children’s language and literacy skills (reported in Dickinson & Tabors, 2001). We used the variables listed next to describe utterances (see Table 1).

Types of Teacher Utterances During Free Play (See Supporting Information Table S1)

Percentage of teacher extending utterances during free play described teachers’ efforts to keep the conversation going by encouraging further talk. The proportion is calculated by dividing the number of teacher utterances extending by the total number of teacher utterances during free play. Such comments typically included comments in which the teacher

encouraged the child to remain on the same topic and provide additional information.

Percentage of sophisticated vocabulary used by teachers during free play was the number of low-frequency or "sophisticated" words used by teachers relative to the total number of words used by the teachers during free play. Examples of such words are provided by the first 10 root words on the list: *able, aboard, about, above, absent, accept, accident, account, ache, and acid.*

The ratio of teacher talk relative to child talk during free play evaluated responsiveness, with a lower ratio indicating less talk by teachers relative to that of the children. The proportion is calculated by dividing the number of teacher utterances by the total number of child utterances during free play.

Types of Teacher Utterances During Large Groups and Book Reading

Percentage of teacher attention-related utterances determined the density of comments made by a teacher indicating she was striving to gain or hold attention. The proportion is calculated by dividing the number of teacher attention utterances by the total number of teacher utterances during large group time.

Percentage of teacher correcting utterances included corrections of the accuracy of what children said. The proportion is calculated by dividing the number of teacher utterances correcting by the total number of teacher utterances during large group time.

The percentage of analytic utterances during book reading was analytic talk that explored reasons for characters' actions or events in the story or dis-

cussed the meanings of words. Utterances could be contributed by children or teachers. The proportion is calculated by dividing the number of combined teacher and child analytic utterances by the total number of utterances.

Measures of Student Literacy Skills

When children were in kindergarten and again in Grade 4 they were given a battery of tests that examined growth in language and literacy skills (descriptive statistics and intercorrelations are shown in Table 1).

Narrative production. In this kindergarten task children were shown a series of three pictures of a toy bear family on a picnic flying a kite and asked to tell a story about what was happening. Narratives were audiotaped, transcribed, coded, and scored for structure, story elements, and syntactic complexity (see Snow, Tabors, Nicholson, & Kurland, 1995). Structure included the presence of clauses that described a complicating action, such as "The kite got stuck in the tree." Story elements included openings and closings, mentioning of the kite, evaluative elements, statement of problem, proposed resolution, mention of a climax, and material that provided a conclusion. The number of words produced by the child was divided by the number of clauses to yield a word per clause measure of syntactic complexity. Structure (number of complicating action clauses: 0-4), story elements (number of elements present: 0-7), and syntactic complexity (words per clause: 0-4) were added together to create a total score.

Emergent literacy. At kindergarten we used five subscales of the Early Childhood Diagnostic

Table 1
Descriptive Statistics and Intercorrelations for Classroom Variables (n = 74) and Kindergarten (n = 74) and Fourth-Grade (n = 57) Outcomes

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Teacher extending topic utterances, free play	0.45	0.11	1.0											
2. Teacher sophisticated vocabulary, free play	0.01	0.01	.11	1.0										
3. Ratio of teacher-child talk, free play	2.85	1.60	-.40***	-.16	1.0									
4. Teacher attention utterances, large group	0.01	0.02	.21 [†]	-.09	-.17	1.0								
5. Teacher correcting utterances, large group	0.01	0.01	.11	-.06	-.28*	.22*	1.0							
6. Analytic utterances during book reading	0.12	0.09	.19	.11	-.03	-.21 [†]	-.12	1.0						
7. Kindergarten narrative production	5.43	3.07	.26*	.07	-.29*	.30**	.30**	-.08	1.0					
8. Kindergarten emergent literacy	0	4.01	.29*	.28*	-.36**	.15	.42***	.16	.33**	1.0				
9. Kindergarten receptive vocabulary	93.86	15.49	.38***	.22 [†]	-.29*	.08	.25*	.39**	.47***	.60***	1.0			
10. Grade 4 reading comprehension	46.25	24.58	.29*	.34*	-.34**	.28*	.19	.18	.46***	.64***	.62***	1.0		
11. Grade 4 receptive vocabulary	100.75	15.98	.34**	.32*	-.40**	.08	.27*	.31*	.28*	.60***	.77***	.71***	1.0	
12. Grade 4 word recognition	100.54	15.86	.30*	.39**	-.40**	.21	.22 [†]	.06	.34**	.61***	.56***	.81***	.64***	1.0

[†]p < .10. *p < .05. **p < .01. ***p < .001.

Instrument: The Comprehensive Assessment Program (Mason & Stewart, 1989). Subtests included Writing Concepts (e.g., directionality, print vs. picture; $M = 8.54$, $SD = 4.39$), Letter Recognition ($M = 32.93$, $SD = 11.34$), Story and Print Concepts (e.g., you read left to right; $M = 12.72$, $SD = 6.49$), Sounds in Words (e.g., rhyming, initial sound identification; $M = 7.14$, $SD = 3.64$), and Environmental Print (i.e., "reading" familiar environmentally contextualized print; $M = 7.15$, $SD = 4.76$). Because the five subtests were highly correlated and varied widely in range of scoring, a total score was created by standardizing and adding up subtest scores. This standardized z score ($M = 0$, $SD = 4.01$) was used for the analyses.

Receptive vocabulary. The Peabody Picture Vocabulary Test-Revised (Dunn & Dunn, 1981) was used to assess receptive vocabulary at kindergarten and Grade 4. It was administered at preschool, kindergarten, and fourth grade. The standard score has a mean of 100 with a standard deviation of 15.

Reading comprehension. The Reading Comprehension measure from the California Achievement Test (CTB Macmillan/McGraw-Hill, 1992) was administered in fourth grade. Students read narrative and expository passages silently and had 50 min to answer 50 multiple choice questions. Percentile scores are used for this norm-referenced test.

Word recognition. The Wide Range Achievement Test-Revised (Jastak & Wilkinson, 1984) was administered in fourth grade. This reading subtest asked students to recognize and name letters and to pronounce printed words. The standard score has a mean of 100 with a standard deviation of 15.

Control Variables

Child mean length of utterance. Children's talk during a toy play task at age 3 that was conducted in the home was analyzed to provide the child's mean length of utterance, which is calculated by compiling the number of words used by the child for each turn and then obtaining the average number of words per turn, or utterance. Note that we did not transcribe or analyze at the level of morphemes. The mother played with her child and the conversation was audiotaped and transcribed. Longer utterances indicated more advanced language use.

Home support for literacy (de Temple, 2001). This composite variable consists of responses from maternal interviews when children were ages 3 and 4. A sum score reflects frequency and variety of home literacy practices (e.g., reading frequency,

number of children's books in the home categorized on a 3-point scale, use of libraries and book stores, and exposure to other print forms such as funnies, catalogs, children's magazines, and newspapers.)

Family welfare status. At the first home visit when children were age 3, respondents were asked whether the family was receiving public assistance (which at that time was Aid to Families with Dependent Children [AFDC]). Because all families were eligible for Head Start and the range of family income was narrow, this measure was used to further discern poverty status and risk among the families (43% reported receiving AFDC).

Maternal education level. At the first home visit when children were age 3, mothers were asked to report their years of formal education.

Child gender. Child gender was coded 1 for boys and 0 for girls.

Age at assessment. The decimal age of each child was computed for the kindergarten and fourth-grade assessment batteries.

Teacher education level. The education levels of the preschool teachers were reported on a 5-point categorical scale: 1 = high school diploma and some college courses but not a child development associate (23%), 2 = child development associate (8%), 3 = associates degree (29%), 4 = bachelor's degree (27%), and 5 = master's degree (13%).

Center type. Center type was coded 1 for Head Start and 0 for private voucher programs: Forty-seven percent of children attended Head Start centers and 53% used vouchers to attend private preschools.

Results

Descriptive and inferential analyses were conducted using SAS 9.1 (SAS Institute, Cary, NC). We checked variable distributions for assumptions of normality, and subsequently used a log 10 transformation (Osborne, 2002) for the following variables: percentage teacher attention utterances in large group and large group percentage teacher utterance correcting. Inferential tests (t tests and analysis of variance) showed no association between outcomes and center-based measures (center type and teacher educational level), maternal education, child gender, or the child's age at testing. Additional analyses showed significant correlations among child outcomes at kindergarten and Grade 4. While narrative production was moderately associated with the other outcomes, emergent literacy, receptive vocabulary, reading comprehension, and word

Table 2
 Descriptive Statistics and Intercorrelations for Demographic Variables (n = 74) and Kindergarten (n = 74) and Fourth-Grade (n = 57) Outcomes

	M	SD	1	2	3	4	5	6	7	8	9	10	11
1. Child MLU age 3	2.97	0.65	1.0										
2. Home support for literacy	25.93	4.59	.13	1.0									
3. Years of formal maternal education	11.66	1.87	.03	.05	1.0								
4. Age at kindergarten assessment	5.61	0.25	.05	-.15	.02	1.0							
5. Age at fourth-grade assessment	9.70	0.50	.11	-.10	.01	.35*	1.0						
6. Kindergarten narrative production	5.43	3.07	.18	.39***	.05	-.01	-.04	1.0					
7. Kindergarten emergent literacy	0	4.01	.27*	.35**	.08	.02	.08	.33**	1.0				
8. Kindergarten receptive vocabulary	93.86	15.49	.18	.50***	-.01	-.13	-.01	.47***	.60***	1.0			
9. Grade 4 reading comprehension	46.38	24.78	.23 [†]	.37**	.12	-.07	-.09	.46***	.64***	.62***	1.0		
10. Grade 4 receptive vocabulary	100.71	15.99	.32*	.40**	-.05	-.10	-.05	.28*	.60***	.77***	.71***	1.0	
11. Grade 4 word recognition	100.12	15.77	.28*	.37**	.12	-.21	-.14	.34**	.61***	.56***	.81***	.64***	1.0

Note. MLU = mean length of utterance.
[†]p < .10. *p < .05. **p < .01. ***p < .001.

recognition all showed strong intercorrelations (Table 2).

Next, we conducted multiple mediation analyses to examine whether kindergarten assessments of narrative production, emergent literacy, and receptive vocabulary mediate the relation between preschool classroom variables and Grade 4 outcomes (see Supporting Information Figure S1). To infer mediation we needed to establish four criteria: (a) significant relation between preschool classroom measures and Grade 4 outcomes; (b) significant relation between the kindergarten assessments and preschool classroom variables; (c) significant relation between the kindergarten assessments and Grade 4 outcomes, adjusting for preschool classroom measures; and (d) the relation between preschool classroom measures and Grade 4 outcomes weakens after adjusting for the kindergarten assessments (Baron & Kenny, 1986; Preacher & Hayes, 2008). We infer that the relation between preschool classroom variables and Grade 4 outcomes is *completely* mediated by kindergarten assessments if the regression coefficient for the preschool variables is no longer significant after adjusting for kindergarten assessments. These results are presented as sets of hierarchical regression models.

In conjunction with Baron and Kenny's (1986) causal steps method, we also used a more rigorous product-of-coefficients approach that allowed us to test for multiple mediators simultaneously and to identify specific mediating pathways (Preacher & Hayes, 2008). The kindergarten assessments were entered as a *set* of variables in a multiple mediation model and tested as a group, which is useful when considering variables that would be theoretically

correlated with each other; one or all variables could be significant individual mediators in a multiple mediation model (Preacher & Hayes, 2008). The indirect effect of preschool classroom variables on Grade 4 outcomes that is mediated through kindergarten assessments is estimated as the total effect of preschool classroom on Grade 4 outcomes minus the direct effect of preschool classroom on Grade 4 outcomes after adjusting for the kindergarten assessments. We used bias-corrected bootstrap method (overcomes limitations of small sample size and corrects for non-normal distributions that would not be assessed accurately with the Sobel test) for these additional tests of indirect effects using a product-of-coefficients approach. Missing values were multiply imputed (Allison, 2001; Rubin, 1987) using the PROC MI procedure in SAS. Partial correlations were computed from regression models for each variable to assess effect size. Conventions for interpretations of effect size were derived from Cohen (1988) as cited in NICHD Early Child Care Research Network (2006).

Correlations between variables describing classroom talk and kindergarten and fourth-grade outcomes are shown in Table 1. Several variables describing conversations during free play were associated with later assessments. Teacher-to-child speech ratio was negatively related to student literacy skills in kindergarten (range $r = -.29$ to $-.36$) and fourth-grade (range $r = -.34$ to $-.40$), indicating that fourth-grade scores were higher when teachers tended to talk less and children talked more. Teachers' utterances that extended talk were positively related to all student outcomes (kindergarten range $r = .26$ to $.38$; fourth-grade range $r = .29$ to

.34). Teachers' higher proportioned use of more sophisticated vocabulary words was related to higher levels of emergent literacy, $r = .28$, and receptive vocabulary at kindergarten (a trend) $r = .22$, $p < .06$ and at fourth grade, $r = .32$, and fourth-grade comprehension, $r = .34$, and word recognition, $r = .39$.

Associations were also found between kindergarten and Grade 4 student language and literacy skills and teachers' utterances in large group meetings and book reading (Table 1). Higher percentages of attention-related utterances were related to higher scores on narrative production in kindergarten, $r = .30$, and comprehension in fourth grade, $r = .28$. Similarly, the more teachers corrected information, the higher the students' scores were on narrative production, $r = .30$; emergent literacy, $r = .42$; vocabulary in kindergarten, $r = .25$; and vocabulary in fourth grade, $r = .27$. The more teachers and students used analytic talk during preschool book reading (e.g., why characters acted as they did), the higher the students' vocabulary scores were at kindergarten, $r = .39$, and fourth grade, $r = .31$.

Welfare status was negatively related to kindergarten narrative production, $t = 2.49$, $df = 72$, $p < .05$, but not to other outcomes, likely reflecting the restricted demographic range in our sample. Children in Head Start tended to come from families receiving AFDC, $\chi^2 = 10.94$, $df = 1$, $p < .0009$. Maternal education was not associated with outcomes (Table 2). Child mean length of utterance was positively related to kindergarten emergent literacy, $r = .27$, and Grade 4 vocabulary, $r = .32$, and word recognition, $r = .27$. Home support for literacy showed moderate to strong associations with each of the child assessments (range $r = .35$ to $.50$).

For each of our mediation models we tested all free play and group preschool variables. Because kindergarten narrative production did not meet the second criteria as a potential mediating variable across preschool measures of interest, it was not included in the multiple mediation tests. Because of the relatively small sample size, and to maximize our degrees of freedom, we included only language-related control variables in our mediation analyses.

Thus, to examine the indirect effect of preschool classroom measures on Grade 4 reading comprehension we included the six preschool measures and the language-related control variables in our first model (Table 3). Teacher use of sophisticated vocabulary in free play ($r_p = .29$) and teachers' attention-related utterances in large group ($r_p = .25$) were associated with later comprehension when the hypothesized mediator variables were ignored,

whereas the effect of sophisticated teacher vocabulary ($r_p = .17$) was significantly reduced when kindergarten mediator variables were introduced. The control variables were not significant. Both kindergarten child outcomes were significantly associated with Grade 4 reading comprehension, adjusting for preschool variables; emergent literacy showed a medium effect ($r_p = .27$) and receptive vocabulary showed a large effect ($r_p = .41$). Teacher use of attention-related utterances in large group was not mediated by preschool variables but remained a significant covariate ($r_p = .30$). Additional tests using a product-of-coefficients approach (Preacher & Hayes, 2008) were conducted with each of the preschool indexes of teacher talk in free play and structured activities to assess kindergarten outcomes as multiple mediators (Table 4). Bias-corrected confidence intervals (CI) indicated that the total indirect effect of preschool teacher sophisticated vocabulary on Grade 4 comprehension through the set of kindergarten mediators (emergent literacy and receptive vocabulary) was significant, as the 95% CI for the total indirect effect did not contain zero. Second, there were specific effects of emergent literacy: Although kindergarten receptive vocabulary had a significant direct association with Grade 4 comprehension, emergent literacy was the only significant mediator of preschool teacher sophisticated vocabulary to Grade 4 comprehension (Figure 1A) as indicated by its 95% CI that did not contain zero.

Examination of Grade 4 receptive vocabulary results (Table 3) showed that teacher correcting-related utterances in large group settings and analytic utterances during book reading were directly associated with Grade 4 receptive vocabulary when the hypothesized mediators of kindergarten language and reading skills were ignored ($r_{ps} = .28$ and $.34$, respectively), whereas the association was significantly reduced when the mediators were included ($r_p = .01$ for each classroom variable). Both control variables, child mean length of utterance and home support for literacy, were also directly related to Grade 4 receptive vocabulary ($r_{ps} = .32$ and $.27$, respectively) when hypothesized mediators were ignored; however, only home support for literacy was reduced ($r_p = .01$) in the full model. The mediation analysis indicated that these reductions were because of indirect paths from preschool indexes of teacher talk and support for literacy at home through kindergarten language and reading skills to Grade 4 vocabulary (Figure 1B). Kindergarten receptive vocabulary ($r_p = .57$) was significantly associated with Grade 4 receptive vocabulary and

Table 3
Regression Models Predicting Grade 4 Comprehension, Receptive Vocabulary, and Word Recognition

	Comprehension				Receptive vocabulary				Word recognition			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Preschool classroom and control variables B (SE) r _p	Adding mediators B (SE) r _p	Preschool classroom and control variables B (SE) r _p	Adding mediators B (SE) r _p	Preschool classroom and control variables B (SE) r _p	Adding mediators B (SE) r _p	Preschool classroom and control variables B (SE) r _p	Adding mediators B (SE) r _p	Preschool classroom and control variables B (SE) r _p	Adding mediators B (SE) r _p		
Preschool teacher classroom measures												
Free play % teacher utterance extending	0.31 (34.36)	-2.45 (28.33)	-1.00 (19.74)	-2.38 (15.98)	2.20 (21.88)	0.98 (19.22)						
Free play % teacher sophisticated vocabulary	-0.01	-0.01	-0.02	-0.01	.01	.03						
Free play % speech ratio teacher/child	1172.51 (636.38)	595.40 (543.48)	396.11 (359.19)	95.52 (300.60)	874.94 (375.80)	468.52 (350.36)						
Large group % teacher utterance attention	0.29*	.17	.18	.04	.33*	.18						
Large group % teacher utterance correcting	-2.27 (2.24)	-1.54 (1.86)	-1.59 (1.30)	-1.44 (1.05)	-1.91 (1.40)	-1.63 (1.25)						
Analytic utterances during book reading	-0.14	-0.13	-0.17	-0.20	-0.19	-0.19						
Language-related controls	425.44 (236.12)	437.91 (207.95)	-105.34 (136.45)	-39.04 (117.10)	189.73 (150.39)	174.06 (139.66)						
Child MLU age 3	0.25†	.30*	-.09	-.08	.17	.19						
Home support for literacy	435.16 (805.61)	-1039.33 (740.11)	964.14 (469.88)	82.96 (426.39)	520.54 (505.18)	-295.92 (499.17)						
Kindergarten child assessments	0.08	-0.20	.28*	.01	.14	-.09						
Emergent literacy	39.01 (33.17)	-18.04 (34.20)	50.66 (19.88)	-2.93 (18.66)	-0.87 (22.82)	-30.11 (23.34)						
Receptive vocabulary	0.16	-0.12	.34*	-.01	-.03	-.24						
Adjusted R ²	4.53 (5.18)	0.74 (4.44)	7.26 (2.97)	4.74 (2.45)	3.48 (3.18)	1.64 (2.87)						
ΔR ²	0.13	.01	.32*	.29*	.13	.11						
F	0.88 (0.70)	0.03 (0.65)	0.82 (0.41)	0.04 (0.36)	0.64 (0.47)	0.12 (0.45)						
	0.23	.01	.27*	.01	.22	.06						
		1.73 (0.89)		0.38 (0.51)		0.93 (0.58)						
		.27*		.11		.23						
		0.68 (0.25)		0.62 (0.13)		0.38 (0.16)						
		.41**		.57***		.35*						
	.25	.47	.38	.60	.27	.43						
	.25	.22	.38	.22	.27	.16						
	3.42	6.06	5.32	9.49	3.54	5.19						

Note. r_p = partial correlation from regression model. MLU = mean length of utterance.
† p < .10. * p < .05. ** p < .01. *** p < .001.

Table 4
 Mediation of Preschool Classroom Variables on Grade 4 Outcomes Through Kindergarten Skills

	Product of coefficients		Bias-corrected bootstrapping	
	Point		Percentile 95% CI	
	Estimate	SE	Lower	Upper
Grade 4 comprehension				
<i>Teacher sophisticated vocabulary</i>				
Kindergarten emergent literacy	438.12	276.93	30.41	1,158.12
Kindergarten receptive vocabulary	314.12	272.31	-144.83	981.36
Total	752.24	377.05	81.30	1,572.20
Grade 4 receptive vocabulary				
<i>Large group % teacher utterance correcting</i>				
Kindergarten emergent literacy	162.40	195.67	-173.46	624.08
Kindergarten receptive vocabulary	675.25	301.22	180.65	1,354.88
Total	837.65	319.29	269.78	1,537.87
<i>Analytic utterances during book reading</i>				
Kindergarten emergent literacy	3.94	6.00	-4.06	24.49
Kindergarten receptive vocabulary	49.37	17.17	17.86	87.51
Total	53.31	17.39	21.26	90.44
<i>Home support for literacy</i>				
Kindergarten emergent literacy	0.04	0.12	-0.16	0.37
Kindergarten receptive vocabulary	0.69	0.31	0.23	1.45
Total	0.73	0.29	0.27	1.42
Grade 4 word recognition				
<i>Teacher sophisticated vocabulary</i>				
Kindergarten emergent literacy	156.71	166.85	-140.40	523.13
Kindergarten receptive vocabulary	302.74	185.53	44.93	866.60
Total	459.46	217.58	78.59	939.00

Note. Bold results indicate statistically significant results.

the final model accounted for 60% of the variation in Grade 4 receptive vocabulary. In additional tests for specific effects of multiple mediation (Table 4) we found that the two preschool classroom variables, teacher correcting utterances and analytic utterances during book reading, and home support for literacy had indirect effects on Grade 4 receptive vocabulary that were completely mediated through kindergarten receptive vocabulary.

Word recognition in Grade 4 was associated with teacher use of sophisticated vocabulary in free play when the hypothesized kindergarten mediators were ignored ($r_p = .33$) and then significantly reduced when the mediator variables were added ($r_p = .18$; see Table 3). Receptive vocabulary in kindergarten was significantly associated with Grade 4 word recognition adjusting for preschool variables ($r_p = .35$; Figure 1). Additional tests for multiple mediation using products-of-coefficients bias-corrected confidence intervals (Table 4) indicated that these reductions were because of indirect paths

from preschool teacher sophisticated vocabulary through kindergarten receptive vocabulary to Grade 4 word recognition (Figure 1C).

Discussion

We hypothesized that teachers' language in preschool classrooms fosters language development in ways that could be detected at the end of kindergarten and that enhanced language would relate to Grade 4 reading comprehension. We found associations between variables describing conversations in preschool and Grade 4 assessments with our models accounting for substantial variance in reading comprehension, vocabulary, and decoding. Nearly all these effects were mediated by kindergarten measures. Our study is unique in the specificity of the relations we found between teaching practices and learning and the magnitude of the observed associations.

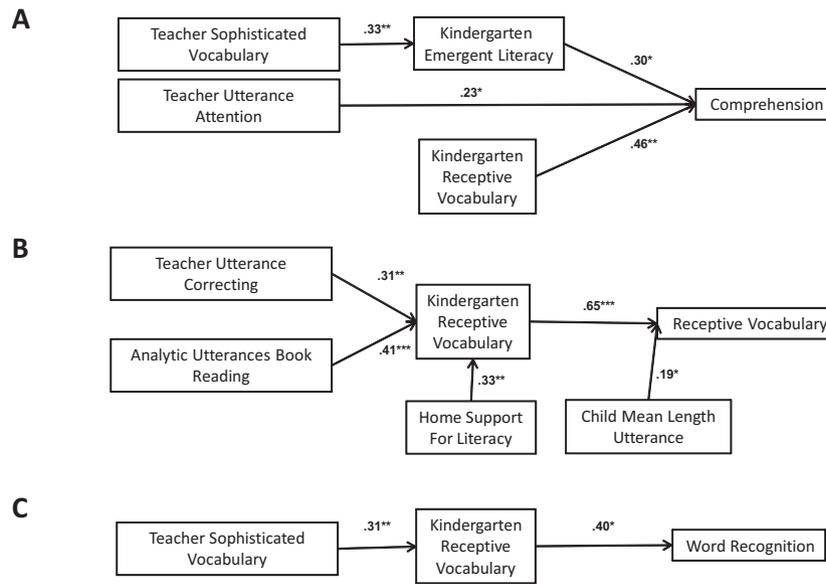


Figure 1. Mediated Grade 4 outcomes showing indirect effects of preschool and home environmental supports for language through kindergarten skills (standardized β shown for significant paths). * $p < .05$. ** $p < .01$. *** $p < .001$.

Relating Grade 4 Language and Literacy to Preschool Classroom Experiences

Our data depict how teachers interacted with all children in the classroom, not just our target child; teacher variables were not driven by the children in our sample. Prior studies have found maternal education, family income, and the quality of home support to be related to language and literacy development (NICHD Early Child Care Research Network, 2000; Zill & Resnick, 2006). We found only limited associations between demographic characteristics and later literacy measures. Sample recruitment strategies narrowed variation in educational and material resources, which allowed us to obtain a clearer understanding of the impact of language and literacy interactions. We chose to focus on quality of home support and the child’s mean length of utterance at age 3 to help control for generational and genetic contributions.

Fourth-grade comprehension was related to teachers’ use of sophisticated vocabulary during free play and attention-related utterances in group settings. Mediation analyses revealed that kindergarten receptive vocabulary and decoding predicted later comprehension, but further examination revealed that only decoding was a unique mediator of the indirect effects of preschool teacher sophisticated vocabulary. Teachers’ efforts to maintain attention had a direct effect on comprehension.

Fourth-grade vocabulary was related to correcting and analytic talk during book reading and kindergarten vocabulary mediated both preschool classroom effects. Home support for literacy had an indirect effect through kindergarten vocabulary skill. The additional direct effect of age 3 mean length of utterance on Grade 4 vocabulary may reflect genetic contributions or enduring parental support factors that contributed to age 3 language growth. Substantial environmental effects have been found for language and reading development (Forget-Dubois, Lemelin, Pérusee, Tremblay, & Boivin, 2009; Harlaar, Haiyou-Thomas, Dale, & Plomin, 2008), so we hypothesize that continued home support was the primary reason for this effect of age 3 mean length of utterance. Fourth-grade decoding also was correlated with teacher use of sophisticated vocabulary in free play, as mediated by kindergarten receptive vocabulary.

Possible Developmental Pathways

Teachers’ talk during free play contributed to children’s emerging language and literacy skills. Teacher use of sophisticated vocabulary contributed to prediction of two of the Grade 4 assessments; it had specific indirect effects on comprehension operating through kindergarten emergent literacy, as well as on decoding operating through kindergarten vocabulary skill. Teachers

who used more varied words provided children more opportunities to learn vocabulary, but it also is possible that use of varied words occurred in the context of relatively sophisticated discussions about books, events, or concepts. Teachers who were inclined to use varied vocabulary also may have been more instructionally oriented, and thus may have engaged children in more talk about print. Thus, our measure of teachers' use of sophisticated vocabulary may have identified teachers who were more verbal and more conceptually and instructionally oriented.

During *free play* the ratio of adult talk relative to child talk was moderately associated with the frequency with which teachers helped children extend their utterances ($r = .40$), and both conversational variables were significantly related to all kindergarten and Grade 4 outcomes. These two strategies may have such similar patterns because teachers who talked less were more responsive and encouraged children to extend their thinking. Teachers who are responsive and engage children in extended personalized conversations may form closer teacher-child relationships, a factor related to later academic success (Birch & Ladd, 1998; Howes et al., 2008; Pianta, 1999). In separate analyses we found that teachers who engaged in more interactions supportive of language growth also were more responsive and emotionally supportive (Densmore, Dickinson, & Smith, 1995).

Analytic talk during group *book reading* was related to Grade 4 vocabulary and had indirect effects mediated through kindergarten vocabulary. Teachers' attention-related utterances also had a direct effect on fourth-grade comprehension. These two strategies were only marginally related and were correlated with different child assessments. Engagement in analytic discussions about books may have directly fostered vocabulary learning. Book reading is a setting in which teachers can focus on and teach vocabulary (Elley, 1989; Hargrave & Senechal, 2000; Wasik & Bond, 2001; Wasik, Bond, & Hindman, 2006) and in which children hear more sophisticated vocabulary as their teacher reads the book and, to a lesser extent, as she discusses it (Dickinson, McCabe, & Anastopoulos, 2003). However, this explanation does not fully account for the fact that analytic discussions in preschool only weakly correlated with kindergarten vocabulary yet had lasting indirect effects on vocabulary. Children in classrooms with teachers who engaged in analytical discussions might have become more attuned to books and more able to engage in and learn from classroom discussions.

The lasting effect of analytic talk about books could, in part, be the result of children gaining greater ability to learn new words as books are discussed.

Teachers' efforts to help children attend to group discussions had a direct effect on Grade 4 comprehension. By using techniques designed to attract and hold children's attention teachers may have fostered their ability to regulate their attention. Self-regulatory capacities of young children are powerful predictors of later academic success (Blair, 2002; Duncan et al., 2007), and teachers with strong skills managing groups may foster this ability in young children. In our models this preschool variable was not mediated by any kindergarten competencies. It may have been associated with outcomes through self-regulation, which we did not measure, and thus could not detect mediating pathways from preschool to Grade 4. This attention variable was related to Grade 4 comprehension, a competence directly associated with kindergarten emergent literacy. Children who learned to self-regulate attention in groups may have been better equipped to benefit from instruction in kindergarten and beyond. The moderately strong positive correlation between teacher correction of information in group settings and kindergarten print knowledge also points to the potential contribution of instructionally focused groups to children's learning of content and skills.

Limitations and Caveats

Generalizability is limited by the potential of selection bias. For example, our children came only from families where English was spoken, and our population did not include the most severely impoverished or stressed families because they would not have wanted university researchers in their homes. Our study is correlational, so unmeasured variables could account for some results. For example, there was variation in where our families lived so those with the resources to be more supportive of development may have lived in communities with stronger elementary schools. Also, attendance could have been a factor because we have no records of it, but children had to attend sufficiently often for us to test them and no teachers or mothers reported attendance concerns.

The data were collected 20 years ago, when code-focused instruction was rare in preschool. In the intervening years there has been increased attention to code-related knowledge. However, the mechanisms that relate language experience to learning should be the same and the nature of

classroom supports for language may be similar, because recent descriptions of teacher–child conversations continue to find sparse support for language (Dickinson, Darrow, & Tinubu, 2008; Dickinson, Flushman, & Freiberg, 2009).

Implications for Assessing the Quality of Preschool Classrooms

Although our sample was small we found robust relations between variables describing classroom support for language and later language and reading. Our findings are discrepant from those of large studies that have used traditional broad-based measures. For example, the Head Start Family and Child Experiences Survey (FACES) study found no association between fall–spring growth and classroom quality measures (Zill & Resnick, 2006). Efforts to associate measures of classroom quality that included the Classroom Assessment Scoring System (CLASS) and Early Childhood Environment Rating Scale (ECERS) also were unsuccessful in an examination of the Chicago Parent–Child preschools (Ross, Moiduddin, Megher, & Carlson, 2008). Large studies have found associations between measures of quality and child outcomes: NICHD Child Care Study (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002), the Cost-Quality Outcomes Study (Peisner-Feinberg et al., 2001), and an 11-state study of prekindergarten (Howes et al., 2008). But all these studies had large samples and found only modest effects. For example, the 11-state study found effects of the CLASS instruction scale of $d = .06$ for expressive language.

Our finding of substantial associations between detailed description of preschool processes and outcomes is consistent with prior research that carefully examined teacher–child conversations (McCartney, 1984; Connor et al., 2006; Huttenlocher et al., 2002; Wasik & Bond, 2001; Wasik et al., 2006). Studies that examine classrooms in detail have limited observational windows. Huttenlocher et al. (2002) analyzed data from four contexts, 15 min per setting over 2 days, and Connor et al. (2006) observed classrooms for 1 day. All studies that have used this approach have found substantial associations between their measures and children’s growth. Therefore, descriptions of the details of teacher–child interactions may better pinpoint features of classrooms that support children’s learning than do global ratings and may provide greater insight into the mechanisms by which classrooms foster development. If we examine the microstructure of how teachers relate to children (e.g., ratio of sophisticated

words to all words, ratio of adult to child speech), there may be more stability than when observers code in a global manner and describe diverse and complex features of classroom life.

Implications for Understanding Environment Supports for Language Development

The children were in the classrooms of teachers we observed for 1 academic year, and they likely had relatively few opportunities each week to converse with teachers (Layzer, Goodson, & Moss, 1993), yet we observed lasting associations between preschool and later language and literacy. It may be that relatively small amounts of enriched language experiences might bolster aspects of children’s language competencies that are associated with literacy development. This hypothesis is consistent with the fact that Connor et al. (2006) found effects associated with very small differences in classroom experiences and the finding that exposure to syntactically complex language in preschool classrooms is related to syntactic development (Huttenlocher et al., 2002; Vasilyeva, Huttenlocher, & Waterfall, 2006). Neural development is such that the later preschool years are a time when environmental factors may have substantial impact on language and language-related abilities (Huttenlocher et al., 2002).

Our results are consistent with the comprehensive model of early literacy that posits that in the preschool years, multiple language and print-related skills are emerging in a mutually supportive fashion, with growth in one domain fostering development in others (Dickinson, McCabe, Anatasopoulos, Peisner-Feinberg, et al., 2003). In an extension of that model, Dickinson, McCabe, and Essex (2006) hypothesized that the cluster of abilities emerging in preschool and the early primary grades includes interpersonal and self-regulatory abilities, and that language plays a role in establishing a system of language, cognitive, and attention abilities that are recruited for literacy-related activities. Our results suggest that interdependency among developing competencies might flow from cognitive-linguistic interdependencies and social-contextual interdependencies. The former occur when emerging language ability provides children cognitive and linguistic capacity that supports other literacy-related processes. For example, vocabulary can foster later decoding by giving children access to pronunciations of words. As children gain reading skills their decoding skill also can help bolster vocabulary knowledge (Nagy, Herman, & Anderson, 1985).

Social-contextual interdependencies might develop when interactions that foster language also enhance social and self-regulatory skills. Preschool is often children's first exposure to group instruction. Lessons they learn about participating in and attending during groups and forming relationships may have enduring effects. These experiences are all mediated by language. By looking at classrooms through the lens of language we might better understand the beginnings of multiple pathways that lead from preschool to later academic success.

Intervention studies are needed to disentangle the complex correlated web of cognitive, linguistic, and environmental variables. In the meantime, because our results are consistent with prior studies, there is reason to strive to help teachers adopt instructional strategies that build language skills in ways consistent with our results. In addition to maximizing benefits from book reading, attention should be paid to other instructionally focused group times and to settings conducive to individualized conversations such as centers and meal times. Changing teacher practices during informal times may have significant payoff in child learning, but these may be the most challenging situations in which to effect change (Dickinson, Darrow, & Tinubu, 2008; Dickinson et al., 2009; Wasik et al., 2006). The challenges involved in bringing about and sustaining substantial changes in preschool supports for language are enormous. While the challenges are daunting, the increasing importance being accorded to the early childhood years may help make available resources required to make this possible.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Hypothesized multiple mediation of indirect effects of preschool environmental supports for language.

Table S1. Examples of coded variables describing classroom talk.

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