
RESEARCH ARTICLE

Relations between Preschool Teachers' Language and Gains in Low Income English Language Learners' and English Speakers' Vocabulary, Early Literacy and Math Skills

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This study explores whether the quality of Head Start teachers' language fosters gains in children's vocabulary, literacy, and math skills, and whether the pattern is similar for low income English language learners and English speakers. Children (N=191) attended two urban Head Start Centers. The CLASS (language modeling scale) was used to observe the quality of teachers' language. Children's skills were assessed in the fall and spring on measures of expressive and receptive vocabulary, early literacy, and math skills. The pattern of results differed for English language learners and English speakers and across outcome measures. The quality of teachers' language predicted gains in English language learners' receptive and expressive vocabulary, but not that of English speakers. In addition, the receptive vocabulary of the English language learners predicted gains in their phonological awareness and math skills. The relation between teachers' language and children's print knowledge was moderated by their receptive vocabulary. That is, the quality of teachers' language predicted gains in print knowledge only among those children who had higher vocabulary scores. These results underscore the role that teachers' language can play and the importance of children's vocabulary for their early academic development.

Preschool is considered an important context for developing young children's early literacy and math skills (Barnett, 2008; Bowman, Donovan, & Burns, 2001; Pianta, Barnett, Burchinal, & Thornsburg, 2009; Snow, Burns, & Griffin, 1998). Attending preschool is beneficial for all children; however, it is arguably more important for low income children and nonnative English speakers (Dearing et al., 2009; Garcia & Miller, 2008; Hamre & Pianta, 2005). Head Start children begin preschool generally one standard deviation below the national average on measures of literacy and math skills, and low income Hispanic English language learners display skills about one third of a standard deviation below their English speaking peers (Hindman, Skibbe, Miller, & Zimmerman, 2010).

Much attention has been given to what characterizes effective preschool instruction (e.g., Barnett, 2008; Early et al., 2006; Mashburn et al., 2008). Relevant factors include the

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curriculum, the type and quality of teachers' interactions with children, and teachers' social-emotional support of children (Pianta et al., 2009). One important component of teachers' interactions with children is the nature of the language teachers use. Although research shows that teachers' language is related to children's early academic skills, our knowledge of the processes through which teachers' language fosters the skills of children from different backgrounds is still fairly limited (Dickinson & Porche, 2011).

This study investigates how the quality of the language used by preschool teachers fosters gains in low income children's vocabulary, early literacy, and math skills. Of particular interest are potential differences in effects for English language learners and English speakers, given research showing that the effectiveness of specific types of teacher interactions varies with characteristics of the children (Connor, Morrison, & Slominski, 2006).

Preschool Teachers' Language

The nature of the language preschool teachers use is related to children's early academic skills (e.g., Connor et al., 2006; Dickinson, McCabe, & Essex, 2006; Dickinson & Tabors, 1991). Teachers' use of rare and challenging vocabulary, extended discourse, and dialogic reading techniques when speaking or reading to children accounts for significant variance in children's early language and literacy skills (see Dickinson et al., 2006; Neuman, 2006 for reviews).

One important predictor of children's early literacy development is their vocabulary (Biemiller, 2006). Research by Wasik and colleagues (Wasik, Bond, & Hindman, 2006; Wasik & Hindman, 2011) shows the importance of the language used by teachers for children's vocabulary development. Children in classrooms where teachers received training to increase the quality of their language interactions and instruction earned higher receptive vocabulary scores, as well as phonological awareness scores, than children in control classrooms. The investigators tested only direct relations between teachers' language usage and children's outcomes, but it is possible that the relation is better conceptualized as one where children's vocabulary mediates the relation between teachers' language and children's early literacy skills. That is, research shows that teachers' language predicts gains in children's vocabulary (e.g., Wasik et al., 2006; Wasik & Hindman, 2011) and children's vocabulary is related to their early literacy skills (Biemiller, 2006). Accordingly, in the present study, we examined whether children's vocabulary was a mediator between teacher's language and gains in children's early literacy.

Classroom interactions that foster growth in vocabulary (as well as other aspects of language and early literacy) include teachers conversing with children, asking them open-ended questions that require more than a yes-no response, and introducing new vocabulary and concepts to children (Neuman & Dickinson, 2003). Without specific instruction, teachers do not spend much time engaging in such interactions; even with instruction, it can be difficult to accomplish growth in children's vocabulary (Wasik & Hindman, 2011).

Teachers of English language learners face additional challenges because the English skills these children bring with them to school is highly variable, and there is still little consensus on what are best practices to foster their English language and literacy competencies (Goldenberg, 2008). Many teachers of preschool English language learners report not being sufficiently informed of effective strategies and techniques to use (Worthington et al., 2011).

Children's Vocabulary

Growing up in a home where parents talk with children using a rich and varied vocabulary predicts children's own vocabulary development (Hoff, 2006). Hart and Risley (1995) found that the number of different words children hear at home during the first few years of life predicts their subsequent vocabulary and IQ (see also Hoff, 2003). And, as other researchers have shown (Dickinson et al., 2003; Kendeou, van den Broek, White, & Lynch, 2009; Storch & Whitehurst, 2002), young children's vocabulary is related to their phonological awareness and print knowledge. However, children from low income families hear far fewer words and a more limited range of different types of words than their middle income peers (Hart & Risley, 1995; Hoff, 2003; Pan, Rowe, Singer, & Snow, 2005). They also engage less frequently with printed matter or in interactions that can foster phonological awareness or knowledge of print (Adams, 1990; Serpell, Baker, & Sonnenschein, 2005). The relatively limited experience low income children have at home with such forms of language and literacy interactions highlights the need for careful consideration of what occurs at school.

Low income English language learners are particularly dependent upon what goes on at school for their English language development (Hammer, Miccio, & Wagstaff, 2003; Hammer, Lawrence, & Miccio, 2007). These children are less likely to hear English at home (Hammer et al., 2003) or engage in literacy-related interactions with parents (Brooks-Gunn & Markman, 2005; Raikes et al., 2006).

The consequences of entering kindergarten without being fluent in English are long-lasting (Kieffer, 2008). English language learners who are not fluent in English or have limited English vocabularies are likely to have long-term difficulties with reading comprehension and other aspects of reading (Mancilla-Martinez & Lesaux, 2011; Snow et al., 1998).

Research documents the relation between preschool children's vocabulary knowledge and their early literacy (e.g., Kendeou et al., 2009; Storch & Whitehurst, 2002) and math skills (e.g., Hindman et al., 2010). Hindman et al. (2010) found that Head Start children's vocabulary at the start of preschool was one of the strongest predictors of gains in literacy and math skills. Similarly, Kendeou et al. (2009) found that preschoolers' early language skills, indexed by receptive vocabulary, listening and television comprehension, predicted their decoding skills, indexed by phonological awareness, and word and letter identification. Hindman et al. (2010) explained their findings by noting that children need to have sufficient vocabulary to understand instruction in literacy and math. Similarly, Jordan, Huttenlocher and Levine (1992) noted that children need to be able to understand the wording used in math problems.

Children's Math Skills

Far less research has focused on children's math development than on their language and literacy development (Cross, Woods, & Schweingruber, 2009). Low income children have fewer math-relevant experiences at home than middle income peers (Tudge & Doucet, 2004). Moreover, parents feel less competent to assist children with math than literacy development (Brenneman, Stevenson-Boyd, & Frede, 2009; Cannon & Ginsburg, 2008).

Partially in response to the limited home-based math experiences of many children, a recent report by the National Research Council on math learning in early childhood stressed the need for more high quality math instruction in preschool (Cross et al., 2009; see also

Ginsburg, Lee, & Boyd, 2008). In addition, as noted previously, children need to be able to understand what teachers are saying to benefit from instruction in math (Hindman et al., 2010). They need to have sufficient vocabulary to understand math terms (e.g., the words for numbers and operations) and math word problems.

Several researchers have shown the relation between English speaking children's vocabulary and math skills (e.g., Cowan et al., 2011; Hindman et al., 2010; Jordan et al., 1992; Levine, Jordan & Huttenlocher, 1992; Romano, Babchiishin, Pagani, & Kohen, 2010). For example, Cowan et al. (2011) found that second graders' oral language skills (grammar and receptive vocabulary) predicted their third grade math skills. Jordan and colleagues (Jordan et al., 1992; Levine et al., 1992) found that although middle income children did better than low income ones on math tasks involving verbal reasoning skills, the income-related differences were not evident on nonverbal math tasks. They attributed the differential patterns on the two types of tasks, at least in part, to differences in children's vocabulary.

The problem of limited vocabulary can be even greater for English language learners (Kempert, Saalback, & Hardy, 2011). Attending a preschool program that fosters vocabulary skills should increase low income Hispanic children's math skills, through the increase in vocabulary.

Present Study

As the prior review indicates, the quality of teachers' language usage is related to children's vocabulary and early literacy skills (Wasik et al., 2006; Wasik & Hindman, 2011). And, children's vocabulary is related to their early literacy and math development (Collins, 2010; Hindman et al., 2010). There are still, however, important gaps in our knowledge of the relations between teachers' language usage and low income children's early academic skills, some of which are addressed by this study.

We investigate whether the relation between teachers' language usage and low income children's early academic skills is direct or indirect, that is, one mediated by children's vocabulary. We extend work on the relation between teachers' language usage and children's early literacy skills to children's math development by exploring the relations between teachers' language, children's receptive vocabulary, and math skills. We also consider whether the relation between teachers' language usage and children's academic skills is similar for English speakers and English language learners. We hypothesize that the quality of teachers' language usage will predict gains in children's receptive and expressive vocabulary. We also hypothesize that children's receptive vocabulary will predict gains in their early literacy and math skills. Thus, we hypothesize that the relation between teachers' language usage and children's early literacy and math skills is mediated by children's receptive vocabulary. Receptive rather than expressive vocabulary is used in the mediation analyses because understanding what the teachers are saying is what is important in this context (e.g., Hindman et al., 2010).

These results have implications for improving our understanding of how teachers' language facilitates young children's academic development. The results will have particular relevance for understanding English vocabulary development in low income English language learners (Goldenberg, 2008).

METHOD

Overview

Children in this study were participants in a larger project designed to evaluate the effectiveness of the Core Knowledge Preschool Sequence (<http://www.coreknowledge.org>) being implemented in several Head Start Centers in Baltimore, MD. The Core Knowledge Preschool Sequence is based on E.D. Hirsch's views about the importance of conceptual knowledge for facilitating children's learning (www.coreknowledge.org). The program includes three overarching areas: language and literacy development, knowledge acquisition and cognitive development, and physical well-being and motor development. The authors of this paper conducted the evaluation but played no role in the implementation of the Core Knowledge Preschool Sequence or the training of the teachers. All children attending the focal Head Start centers received this curriculum. However, only children whose parents gave them permission to participate in the evaluation were tested by project personnel.

More than half of the children attending the focal Head Start centers spoke Spanish at home as their primary language. However, none of the teachers was fluent in Spanish; most knew no Spanish or only a few words. Note that the Core Knowledge Preschool Sequence is an English language curriculum.

Participants

Participants were preschool-aged children attending two urban Head Start centers. The centers were located within close proximity of each other, were run by the same director, and had the same policies and curriculum. Children were recruited for this study in two waves over a two year period. Data from both waves were combined into one set for analyses.¹ Recruitment took place in the fall of each of two consecutive years.

Consent forms requesting parental permission for children to participate in the evaluation were sent home to all children attending the focal Head Start centers. The consent forms were printed in English and Spanish. Consent to participate in the study was received for 71% of the children enrolled in the centers in the fall of Wave 1 and 75% of the children enrolled in the fall of Wave 2. Of the children whose families gave permission for them to participate in the study, complete data were available for 79%. Those with missing data were excluded from analyses. Data from 25 children were not included due to not meeting our selection criteria (13 children were bilingual; 12 children provided data in both waves. This is discussed further below).

There were 191 children in this study (mean age = 4.03 years, $SD = .56$). They attended one of 25 classes (Wave 1: 11 classes, Wave 2: 14 classes). Classes had a mean of 18.48 students (range 12-20). The number of children per classroom who participated in this study

¹ Mixed ANOVA's were used to determine whether there were differences in growth patterns between the two waves of children on the various language, early literacy and math measures. Wave was the between-subjects factor, fall and spring test scores were repeated measures. Neither main effects comparing waves 1 and 2 nor interactions involving wave were statistically significant ($p > .10$). Accordingly, data from the two waves were combined in all analyses.

ranged from 3 to 12. Three classrooms had five or fewer participating children; 16 classrooms had between six and nine participants, and five classrooms had between 10 and 12 participants. Each classroom had one teacher and one teacher's assistant.

All of the teachers were female and had completed college. Six of the teachers were new to the centers during Wave 2, eight taught there during Waves 1 and 2. However, all teachers in the study received ongoing training in the Core Knowledge Preschool Sequence, a curriculum that emphasized the nature of language used with the children. No additional information about teachers' background was available to the evaluation team.

Of the 191 children, 108 were Spanish monolingual (henceforth called English language learners) and 83 English monolingual (henceforth called English speakers). Ninety-one of the children were from Wave 1 (59 English language learners, 32 English speakers); 100 were from Wave 2 (49 English language learners, 51 English speakers). Twelve of the 191 children participated in both Waves 1 and 2; however, only their Wave 1 data are included here. See Table 1 for additional demographic information about the participants.

TABLE 1
Number of Participants by Wave, Gender, and Language Status

	Wave 1		Wave 2		Total
	Boys	Girls	Boys	Girls	
English Language Learners	32	27	30	19	108
English Speakers	16	16	26	25	83
Total	48	43	56	44	191

All English language learners were Hispanic. English speakers were African-American with the exception of one Hispanic boy and one girl whose ethnicity was not specified. As is apparent, ethnicity was conflated with English fluency. Such a conflation is not uncommon with Hispanic families, many of whom are immigrants and not fluent in English (Garcia & Jensen, 2009; Garcia & Miller, 2008).

Children's English language fluency was determined through parent report and school records. Parents indicated on a three-point scale how well their child spoke and understood English and Spanish; options included 'a little', 'okay', and 'well'. Children who spoke and understood English "well", but Spanish "a little" were categorized as English monolingual. Conversely, children who spoke and understood Spanish "well" but English "a little" were categorized as Spanish monolingual. Thirteen children spoke and understood English and Spanish well; they were classified as bilingual. The number was too small to permit analysis as a separate group; therefore, they were not included in this study. Assignment to classrooms was not based on degree of fluency in either language.

Measures

Receptive vocabulary. The Receptive One-Word Picture Vocabulary Test (ROWPVT; Brownell, 2000) was used to assess children's receptive language skills. Children were shown a series of four pictures and a word was read aloud by the tester. The child was asked to identify the picture associated with the word. A child received a score of 1 for a correctly identified picture and 0 for an incorrectly identified picture. Scores for each item were summed.

Internal consistency reliability for children between ages 3 and 5 in the normative sample was excellent, as indicated by a Cronbach's alpha of .96. Cronbach's alpha in the present study was also excellent, .97² in both the fall and spring.

Expressive vocabulary. The Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, & Torgesen, 2007) Definitional Vocabulary subtest assessed children's expressive vocabulary. There were 35 items in this subtest. Children were shown a series of pictures and were asked to name each picture and explain how it was used or to describe one of its important features or attributes. For example, a child was shown a picture of a sun and asked "What is this?" After responding, the child was asked "Is it yellow or blue?" Separate scores were given for being able to name the picture (define) and describe its function or attributes (function). A score of 1 indicated a correct response and 0 indicated an incorrect response. Scores on the define and function aspects of each item were combined, in keeping with the publisher's directions, and scores across items were summed for a total score.

Reliability in the normative sample was excellent (Cronbach's alpha of .94), as it was in the present study, with a Cronbach's alpha of .98 in both the fall and spring.

Early literacy skills. Two aspects of early literacy, phonological awareness and print knowledge, were assessed using the TOPEL (Lonigan et al., 2007).

The Phonological Awareness subtest consisted of 27 items that assessed children's elision and blending abilities for sounds and words. For elision items, the child was asked to say a word and then asked to say the word without specific sounds (e.g., "Say backyard without back"). For blending tasks, the child was asked to listen to different sounds and combine them to form a new word (e.g., "What word do these make: gum (pause) drop?). Approximately half of the elision and blending tasks included pictures of the relevant words, half did not have pictures. A score of 1 was given for correct responses and 0 for incorrect responses. Scores were summed.

The Print Knowledge subtest assessed children's knowledge of conventions of print and alphabet knowledge. This subtest consisted of 36 items. Children were shown a series of pictures and asked to identify letters or words, point to specific aspects of print, say letter sounds, or identify letters associated with specific sounds. For example, a child was shown a picture containing three numbers and one letter and asked "Which is a letter?" A score of 1 was given for correct responses and a score of 0 for incorrect responses. Scores were summed.

TOPEL developers reported good reliability for the Phonological Awareness subtest (Cronbach's alpha of .87). The alphas in this study were .82 (fall) and .85 (spring). The

² Cronbach's alpha statistics for each measure were computed by combining Wave 1 and 2 scores.

developers noted excellent reliability for the Print Knowledge subtest (Cronbach's alpha of .95). In the present sample the alphas were .94 (fall) and .96 (spring).

Math skills. The Woodcock-Johnson Tests of Achievement III, Applied Problems subtest (WJ-III; Woodcock, McGrew, & Mather, 2001) was used to assess children's math skills. Children were shown pictures and asked questions that assessed various math skills, including cardinality, discriminating quantities, addition, subtraction, and understanding number symbols. The child scored a 1 for a correct response and a 0 for an incorrect response. Scores were summed.

Test developers noted excellent reliability, with Cronbach's alphas ranging from .92 to .94 for children age 2 to 5. Cronbach's alphas in this study in the fall and spring ranged from .84 to .88 for the two comparable forms A and B.

Teachers' language. The Classroom Assessment Scoring System (CLASS; Pianta, LaParo, & Hamre, 2007) was used to examine the quality of teachers' language. The CLASS is a commonly used measure for assessing classroom quality. It assesses three domains (based on 9 individual scales) of classroom quality: emotional support, classroom management, and instructional support.

Factor analyses conducted by researchers who use the CLASS reliably produce two factors, emotional climate (includes scales for positive and negative climate) and instructional climate (includes scales for concept development and quality of feedback, two of the three scales comprising the instructional support domain; Howes et al., 2008; Pianta et al., 2005). However, according to the publishers, one can use individual scale scores in analyses. For example, the language modeling scale, one of the scales in the instructional support domain, was used in recent research by Justice, Mashburn, Hamre, and Pianta (2008).

In the present study, we also focus on the language modeling scale. The scale examines the amount and quality of teachers' use of language stimulation and language facilitation during interactions with children through open-ended questions, repetition and extension, self- and parallel talk, and advanced language. These characteristics of language interactions have been shown to predict children's growth in vocabulary (e.g., Wasik & Hindman, 2011).

Ratings are done in the classroom for a minimum of four 30-minute cycles. Each cycle consists of 20 minutes of observation followed by 10 minutes of record keeping. During the 20 minute observation the observer watches everything that is happening in the classroom with particular attention paid to the teacher's instructional interactions and behaviors. The observer also takes notes during this time period. Immediately following the observation period, the observer provides numerical ratings on each of the scales within each domain.

Ratings on the language modeling scale range from 1 through 7, with a score of 1-2 representing low quality (teacher does not converse much with children, few child-initiated conversations, majority of teacher's questions are close-ended, little repetition or expansion of children's remarks by teacher, teacher uses little advanced language), 3-5 representing mid-level quality (teacher's behaviors are intermediate between that of ratings for low quality and high quality: teacher sometimes converses with children, some of conversations are child-initiated, teacher asks a mix of open-ended and close-ended questions, teacher sometimes repeats or extends students' responses, teacher sometimes maps her remarks to that of child, teacher sometimes uses advanced language), and 6-7 representing high quality (teacher often converses with children, clear effort by teacher to engage children in conversation, teacher asks

many open-ended questions, teacher repeats or extends children's responses, teacher makes remarks contingent on children's remarks, teacher uses advanced language). Ratings for each scale within a domain are averaged across observation cycles.

Language practices for English language learners (Language practices). This measure, which was developed by the researchers, documents teacher practices useful with English language learners (August, Carlo, Dressler, & Snow, 2005; Espinosa, 2005; Goldenberg, 2008). Four teacher practices were assessed: using visual aids, speaking slowly/using repetition, explaining meaning of key words, and incorporating Spanish words into daily vocabulary. Observers rated the frequency of occurrence of each of the four behaviors on a 7-point scale (1=not at all, 7= most of the time). Ratings were done at the end of each cycle of CLASS ratings. Ratings for each item were averaged across observation cycles. Cronbach's alphas for the four-item scale were .79 in the fall and the spring.

Procedure

Assessment of children's skills. Children were individually administered the ROWPVT, WJ-III Applied Problems, and the three subtests from the TOPEL in the fall and spring by trained research assistants. Each child was tested during two separate testing sessions in a quiet room in his or her school. Testing took place in English. During the first session, children completed the ROWPVT and WJ-III Applied Problems subtest. During the second session, children completed the three subtests (Print Knowledge, Definitional Vocabulary, and Phonological Awareness) from the TOPEL. Administration of WJ-III Applied Problems was counterbalanced, such that half of the children received form A in the fall and B in the spring, and half received form B in the fall and A in the spring. The length of time between the first and second testing sessions ranged from 1 day to 3 weeks; the typical time between sessions was about one week.

Teachers' language. Classroom quality was assessed using the CLASS (Pianta et al., 2007) in the fall and spring. During the summer prior to Wave 1 data collection, a research assistant satisfactorily completed a training program conducted by CLASS developers. The research assistant then trained the observers who would conduct classroom observations and served as one of the observers of classroom quality herself.

Observers were trained using the three master videos provided by the CLASS developers. Training continued until the observers achieved ratings within one point of the master coders on 80% of the codes on the videos. Mean percentage agreement with the master code for language modeling was 81%. Disagreements were discussed and resolved.

After achieving the required level of agreement with the master videos, the observers worked in pairs in a classroom. The average level of agreement was 94% on the language modeling scale. This procedure for determining reliability is similar to that used by Justice et al. (2008) and others using the CLASS.

Once reliability was achieved, observers worked individually in classrooms. There were four observers, two advanced undergraduates and two graduate students, in Wave 1. The two graduate students served as observers during Wave 2.

Each classroom was observed one morning in the fall and spring for four 20-minute cycles; language modeling scores were averaged across the four cycles (see Pianta et al., 2007). The fall and spring data were averaged to compute the average yearly language modeling score for each classroom.

Language practices. After making ratings on the CLASS observation forms, observers completed the Language Practices form. As with scores on the CLASS, scores on language practices were averaged across the four cycles. Fall and spring scores were combined to compute a yearly average.

Inter-rater agreement was established by having observers perform ratings in the same classroom. Overall agreement (ratings within one point of each other, consistent with how CLASS reliabilities were calculated) was very high (fall: 93%, spring: 96%).

RESULTS

Although both raw scores and standard scores were available for all academic measures, only raw scores were used in the analyses reported in this paper because the floor of some measures was too high. That is, children earned raw scores too low to convert to standard scores or the standard scores did not differentiate well among children who earned low raw scores.

We first present preliminary analyses to validate the data analytic strategies used in the study. We then present results of the assessments of children's academic skills, followed by data on the quality of the teachers' language. The final section addresses the central hypotheses of the study, that children's vocabulary mediates the relations between the quality of teachers' language and children's academic outcomes.

Preliminary Analyses

Because children were nested within 25 classrooms, it was important to determine whether such nesting needed to be considered through multilevel modeling. Multilevel modeling allows researchers to calculate regression coefficients that take nesting or clustering effects into account. Unconditional means models and intraclass correlations (ICC) were used to determine whether a significant proportion of the variance in the outcomes was due to clustering within classrooms. Unconditional means models using the Mixed procedure to fit a cross-sectional model as described by Peugh and Enders (2005) were tested in IBM SPSS version 19. ICCs were also calculated using SPSS.

Ideally, less than five percent of the variance in outcome scores should be attributed to classroom clustering ($ICC \leq .05$; Krull & MacKinnon, 2010). However, an acceptable guideline for these ICC values is .05-.15 (Hedges & Hedberg, 2007).

There was no evidence to suggest that clustering by classroom was a factor in the present study for receptive vocabulary, $Z = 1.00$, $p = .32$, $ICC = .060$, print knowledge $Z = 0.63$, $p = .53$, $ICC = .003$, or math skills, $Z = 0.49$, $p = .62$, $ICC = .024$. Test statistics could not be calculated for phonological awareness because the Hessian matrix was not positive definite, an

indication that for this outcome, multilevel modeling procedures would not result in reliable coefficient estimates.

In contrast to findings with the other outcomes, there was some evidence to suggest that clustering by classroom may impact regression coefficients for expressive vocabulary, $Z=2.05$, $p=.04$, $ICC=.20$. Therefore, we estimated the regression of expressive vocabulary on teachers' language interactions using multilevel modeling and found that the pattern of results was the same as with OLS regression (see Appendix A for both sets of coefficients).

In sum, nesting was not a significant factor for most of the outcomes. The pattern of findings for the one measure where nesting was a factor was comparable using multilevel modeling and OLS regressions. Therefore OLS regressions were used in all analyses to facilitate comprehension of the results among readers who are unfamiliar with multi-level modeling.

We also correlated children's gender with their vocabulary, literacy and math scores to see if we needed to consider gender a covariate. We computed separate zero order correlations for the English speakers and English language learners and obtained correlations ranging from .026 to .125. Because none of the values was statistically significant (all $ps>.10$), gender was not used as a covariate.

Gains in Children's Vocabulary, Literacy and Math Skills

Mixed ANOVAs were used to determine whether there were gains in children's achievement scores from fall to spring and whether there were differences in achievement patterns between English language learners and English speakers. The repeated variable was fall/spring test score; the between subject variable was language group.

Means and standard deviations are provided in Table 2. Analyses revealed significant overall gains in children's raw scores from fall to spring on receptive vocabulary, $F(1,177)=147.79$, $p<.001$, $\eta_p^2=.455$, expressive vocabulary, $F(1,176)=173.14$, $p<.001$, $\eta_p^2=.496$, phonological awareness, $F(1,176)=93.30$, $p<.001$, $\eta_p^2=.344$, print knowledge, $F(1,178)=125.73$, $p<.001$, $\eta_p^2=.414$, and math skills, $F(1,182)=153.84$, $p<.001$, $\eta_p^2=.458$. Also revealed were main effects of children's language group, such that English speakers scored higher than English language learners on four of the five measures: receptive vocabulary $F(1,177)=153.13$, $p<.001$, $\eta_p^2=.464$, expressive vocabulary, $F(1,176)=200.54$, $p<.001$, $\eta_p^2=.533$, phonological awareness, $F(1,176)=52.18$, $p<.001$, $\eta_p^2=.229$, and math skills, $F(1,182)=62.86$, $p<.001$, $\eta_p^2=.257$. The main effect of language group was not significant for print knowledge, $F(1,178)=0.01$, $p=.93$.

The English language learners and English speakers also showed significantly different patterns of gains for receptive vocabulary, $F(1,177)=12.22$, $p=.001$, $\eta_p^2=.065$. Both groups of children displayed a significant increase from fall to spring in receptive vocabulary scores (English language learners $F(1,99)=162.30$, $p<.001$, $\eta_p^2=.62$; English speakers, $F(1,78)=28.36$, $p<.001$, $\eta_p^2=.267$), but English language learners showed a greater increase in scores than English speakers (see Table 2). In light of these differences and in order to retain the ability to detect different patterns of performance, analyses were done separately for English language learners and English speakers, unless otherwise specified.

TABLE 2
Means and Standard Deviations of Raw Scores on Children's Vocabulary,
Early Literacy and Math Tests

	Fall			Spring	
	N	M	SD	M	SD
Receptive Vocabulary					
English Language Learners	101	12.73	10.29	23.00	12.25
English Speakers	79	35.47	12.73	41.15	12.09
Analyses					
Gain from Fall to Spring	$F(1, 177) = 147.79$			$p < .001$	$\eta_p^2 = .455$
Language Group	$F(1, 177) = 153.13$			$p < .001$	$\eta_p^2 = .464$
Gain x Language Group	$F(1, 177) = 12.22$			$p = .001$	$\eta_p^2 = .065$
Expressive Vocabulary					
English Language Learners	101	6.09	9.73	15.28	14.54
English Speakers	77	32.64	15.13	42.00	13.60
Analyses					
Gain from Fall to Spring	$F(1, 176) = 173.14$			$p < .001$	$\eta_p^2 = .496$
Language Group	$F(1, 176) = 200.54$			$p < .001$	$\eta_p^2 = .533$
Gain x Language Group	$F(1, 176) = 0.02$			$p = .901$	$\eta_p^2 = .000$
Phonological Awareness					
English Language Learners	102	4.93	3.47	7.72	3.76
English Speakers	76	8.75	3.91	11.45	4.69
Analyses					
Gain from Fall to Spring	$F(1, 176) = 93.30$			$p < .001$	$\eta_p^2 = .344$
Language Group	$F(1, 176) = 52.18$			$p < .001$	$\eta_p^2 = .229$
Gain x Language Group	$F(1, 176) = 0.02$			$p = .879$	$\eta_p^2 = .000$
Print Knowledge					
English Language Learners	101	6.86	7.13	11.97	10.21
English Speakers	79	6.72	7.60	12.34	10.26
Analyses					
Gain from Fall to Spring	$F(1, 178) = 125.73$			$p < .001$	$\eta_p^2 = .414$
Language Group	$F(1, 178) = 0.01$			$p = .930$	$\eta_p^2 = .000$
Gain x Language Group	$F(1, 178) = 0.29$			$p = .594$	$\eta_p^2 = .002$
Math Skills					
English Language Learners	104	2.20	3.06	4.73	3.87
English Speakers	80	6.29	4.04	8.86	4.10
Analyses					
Gain from Fall to Spring	$F(1, 182) = 153.84$			$p < .001$	$\eta_p^2 = .458$
Language Group	$F(1, 182) = 62.86$			$p < .001$	$\eta_p^2 = .257$
Gain x Language Group	$F(1, 182) = 0.01$			$p = .911$	$\eta_p^2 = .000$

Note: Language group refers to English language learners and English speakers. Receptive Vocabulary was assessed with the Receptive One Word Picture Vocabulary Test. The TOPEL was used to assess Expressive Vocabulary (Definitional Vocabulary subtest), Phonological Awareness, and Print Knowledge. Math Skills were assessed with the Woodcock Johnson-III Applied Problems subtest.

Quality of Teachers' Language with Children

CLASS ratings for teachers' language ranged from 1.75 to 6.00 (maximum =7) with an average of 3.52 ($SD=1.06$). About 60% of the ratings fell between 3 and 5, which the developers categorized as mid-level quality (see Pianta et al., 2007). About 7% fell in the high range and 33% fell in the low range. Descriptively, teachers frequently conversed with children but less frequently extended children's remarks, used advanced vocabulary, or used open-ended questions. Such findings are consistent with those found by Justice et al. (2008).

Ratings from the Language Practices measure provide additional information about the nature of the language used by teachers in the classroom. The mean rating for using visual aids to supplement oral language was 3.93 ($SD = 1.28$) out of 7, a mid-level rating. About 64% of the ratings fell between 3 and 5. The mean rating for repeating directions or speaking more slowly was 3.46 ($SD=1.28$). Field notes indicated that almost all the language practices scored in this category involved the teacher repeating directions to the children. The mean rating for explaining the meanings of key words was 2.62 ($SD=1.24$). About 40% of the scores fell in the 3-5 range; the remaining 60% were below 3. The mean rating for incorporating Spanish was 1.87 ($SD=.92$); 84% of the ratings were below 3. These low ratings likely reflect the fact that the teachers and aides were very limited in their knowledge of Spanish.

Relations between Teachers' Language and Children's Academic Outcomes

We first present tests of the relations between teachers' language and gains in children's receptive and expressive vocabulary. We next present tests of the relations between teachers' language and children's early literacy and math skills with children's receptive vocabulary as a mediator. Because children's receptive vocabulary did not mediate gains in print knowledge, we decided post-hoc to test whether children's receptive vocabulary was instead a moderator of the relation between teachers' language and gains in children's print knowledge.

Relations between teachers' language and gains in children's receptive and expressive vocabulary. Regression analyses were conducted with teachers' language scores as the predictor and children's spring vocabulary scores as the outcome. Each child received a teacher language score based on the score his or her teacher received. The child's fall vocabulary score served as a covariate. Separate regressions were conducted for children's receptive and expressive vocabulary.

Teachers' language scores significantly predicted gains in English language learners' receptive vocabulary, $\beta=.207$, $t(97)=3.26$, $p=.002$, and expressive vocabulary, $\beta=.291$, $t(98)=4.77$, $p<.001$ (see Tables 3 and 4). Teachers' language uniquely accounted for 4% of the variance in gains in English language learners' receptive language skills and 8% in their expressive language skills. In contrast to findings with English language learners, teachers' language was *not* a significant predictor of gains in English speakers' receptive, $\beta=.069$, $t(76)=0.85$, $p=.40$, or expressive language skills, $\beta=.008$, $t(74)=0.12$, $p=.91$.

TABLE 3
Teachers' Language Predicting Gains in Children's Receptive Vocabulary

	<i>B</i>	<i>SE B</i>	β
English Language Learners (N=101)			
Fall Receptive Vocabulary Scores	0.87***	0.08	.73
Language Modeling	2.45**	0.75	.21
English Speakers (N=79)			
Fall Receptive Vocabulary Scores	0.67***	0.08	.71
Language Modeling	0.76	0.90	.07

Note: $R^2 = .62$, $F(2, 97)=77.72$, $p<.001$ for English language learners. $R^2 = .51$, $F(2, 76)=39.14$, $p<.001$ for English speaking children.

* $p < .05$. ** $p < .01$. *** $p < .001$

TABLE 4
Teachers' Language Predicting Gains in Children's Expressive Vocabulary

	<i>B</i>	<i>SE B</i>	β
English Language Learners (N=101)			
Fall Expressive Vocabulary Scores	1.08***	0.09	.72
Language Modeling	4.11***	0.86	.29
English Speakers (N=77)			
Fall Expressive Vocabulary Scores	0.74***	0.06	.82
Language Modeling	0.10	0.86	.01

Note: $R^2 = .64$, $F(2, 98)=86.57$, $p<.001$ for English language learners. $R^2 = .68$, $F(2, 74)=77.00$, $p<.001$ for English speaking children.

* $p < .05$. ** $p < .01$. *** $p < .001$

Relation between teachers' language and gains in children's early literacy skills.

We first tested for direct effects of teachers' language on gains in children's early literacy skills using teachers' language as the predictor and children's scores on spring phonological awareness and print knowledge as the outcomes. Fall phonological awareness (or print knowledge) scores were entered as covariates. Separate regressions were conducted for phonological awareness and print knowledge. After testing direct effects of teachers' language, we tested whether children's receptive vocabulary mediated the relation between teachers' language and gains in children's early literacy. As noted earlier, receptive vocabulary was used in these analyses rather than expressive vocabulary because children first need to understand what their teachers are telling them. Tests of mediation were conducted using regressions to test the relation between teachers' language and gains in children's phonological awareness and print knowledge, the relation between teachers' language and gains in children's receptive vocabulary skills, and the relation between gains in children's vocabulary skills and gains in early literacy skills, controlling for the effects of teachers' language (MacKinnon, 2008).

Phonological awareness. The quality of teachers' language did not significantly predict gains in English language learners' phonological awareness, $\beta = -.001$, $t(99) = -0.02$, $p = .99$ (Table 5), but a significant direct effect between two variables is not necessary to test for mediating effects of a third variable (MacKinnon, 2008). As presented earlier, teachers' language was a significant predictor of gains in receptive vocabulary for English language

learners, $\beta=.207$, $t(97)=3.26$, $p=.002$. After we controlled for fall phonological awareness scores, receptive vocabulary was a significant predictor of English language learners' spring phonological awareness scores, $\beta=.524$, $t(99)=5.92$, $p<.001$. It accounted for 16% of the variance in the gains in phonological awareness.

Table 5
Teachers' Language Predicting Gains in Children's Phonological Awareness

	<i>B</i>	<i>SE B</i>	β
English Language Learners (N=102)			
Fall Phonological Awareness Scores	0.66***	0.09	.61
Language Modeling	-0.01	0.31	-.001
English Speakers (N=76)			
Fall Phonological Awareness Scores	0.65***	0.12	.54
Language Modeling	1.17**	0.43	.27

Note: $R^2 = .31$, $F(2, 73)=16.34$, $p<.001$ for English speaking children. $R^2 = .37$, $F(2, 99)=28.56$, $p<.001$ for English language learners.

* $p < .05$. ** $p < .01$. *** $p < .001$

Using the method discussed by MacKinnon (2008), we calculated the mediated effect by multiplying the unstandardized regression coefficients for the relations between teachers' language and vocabulary skills ($B=2.453$) and the relation between vocabulary skills and phonological awareness ($B=.161$). The standard error of the mediated effect was calculated using the standard errors of each effect, .75 and .03, respectively. The estimated mediated effect is approximately 0.39, and the estimated standard error of this effect is approximately 0.14. The test statistic is then calculated by dividing the mediated effect by the standard error of the mediated effect, $Z=2.86$, $p=.004$. The 95% confidence interval associated with the mediated effect, (0.12, 0.67) does not include zero, which also indicates that the mediated effect is statistically significant.

In contrast to the pattern with English language learners, teachers' language predicted gains in English speakers' phonological awareness, $\beta=.268$, $t(73)=2.71$, $p=.008$. Teachers' language accounted for 7% of the variance in the spring phonological awareness scores of the English speakers. Given that teachers' language did not predict significant gains in English speakers' receptive vocabulary, mediation analyses were not appropriate.

Print Knowledge. Teachers' language did not significantly predict gains in English language learners' print knowledge, $\beta = -.026$, $t(98) = -.42$, $p=.68$ (Table 6). We again used the MacKinnon (2008) method to test the mediated effect of teachers' language on gains in English speakers' print knowledge through gains in their receptive vocabulary. Direct relations between teachers' language and gains in print knowledge skills were not present, but it was still possible to test for a mediated effect (MacKinnon, 2008). After we controlled for fall print knowledge scores, receptive vocabulary was not a significant predictor of English language learners' spring print knowledge scores, $\beta=.062$, $t(96)=0.89$, $p=.378$. The mediated effect was calculated by multiplying the unstandardized regression coefficients for the relations between language modeling and vocabulary skills ($B=2.453$) and the relation between vocabulary skills and print knowledge skills ($B=.050$). The standard error of the mediated effect was calculated using the standard errors of each effect, .75 and .06, respectively. The estimated mediated

effect was 0.12, and the estimated standard error of this effect was 0.14. The mediated effect was not significant, $Z=0.85$, $p=.397$.

TABLE 6
Teachers' Language Predicting Gains in Children's Print Knowledge

	<i>B</i>	<i>SE B</i>	β
English Language Learners (N=101)			
Fall Print Knowledge Scores	1.13***	0.09	.79
Language Modeling	-0.27	0.63	-.03
English Speakers (N=79)			
Fall Print Knowledge Scores	1.08***	0.10	.80
Language Modeling	1.67*	0.67	.18

Note: $R^2 = .63$, $F(2, 98)=83.64$, $p<.001$ for English language learners. $R^2 = .63$, $F(2, 76)=65.59$, $p<.001$ for English speaking children.

* $p < .05$. ** $p < .01$. *** $p < .001$

As with findings for phonological awareness, teachers' language did predict gains in English speakers' print knowledge, $\beta=.175$, $t(76)=2.51$, $p=.01$. Teachers' language uniquely accounted for 3% of variance in these children's print knowledge. Again, given that teachers' language did not predict gains in English speakers' receptive vocabulary, mediation analyses were not appropriate.

We conducted additional post-hoc analyses to determine why the mediated effect for gains in children's print knowledge was not significant. Perhaps one needs a certain fund of vocabulary knowledge for teachers' emphasis on language during class interactions to predict gains in children's print knowledge. Research shows that children's vocabulary scores can moderate relations between other language and literacy scores. For example, Dickinson et al. (2003) found that the relation between phonological sensitivity and print knowledge varied with the vocabulary knowledge displayed by children. Research reviewed by Goldenberg (2008) indicated that children who started the school year with higher English proficiency scores showed greater gains on language measures than children who started with lower scores. Connor et al. (2006) found that different patterns of teacher interactions were effective depending upon the child's vocabulary skills.

With these findings in mind, we conducted regression analyses to test whether the effect of teachers' language on children's print knowledge varied with children's vocabulary knowledge. We used children's receptive vocabulary scores averaged across fall and spring as a moderator variable. Unlike in prior analyses, this analysis combined data from English language learners and English speakers because it was not the home language that mattered but the amount of English the child knew.

The relation between teachers' language and gains in children's print knowledge was in fact moderated by children's receptive vocabulary, $\beta=.102$, $t(168)=2.12$, $p=.04$ (Figure 1). When children's receptive vocabulary was high (one standard deviation above the mean of this sample), teachers' language significantly predicted gains in children's print knowledge, $\beta=.150$, $t(168)=2.04$, $p=.04$. In contrast, when children's receptive vocabulary was low (one standard deviation below the mean of this sample), teachers' language did not significantly predict gains in children's print knowledge, $\beta= -.078$, $t(168) = -1.06$, $p=.29$. Similarly, when

children had mean levels of receptive vocabulary, teachers' language did not predict gains in children's print knowledge, $\beta=.036$, $t(168)=.710$, $p=.48$. In short, teachers' language directly predicted gains in children's print knowledge only when children had better vocabulary skills.

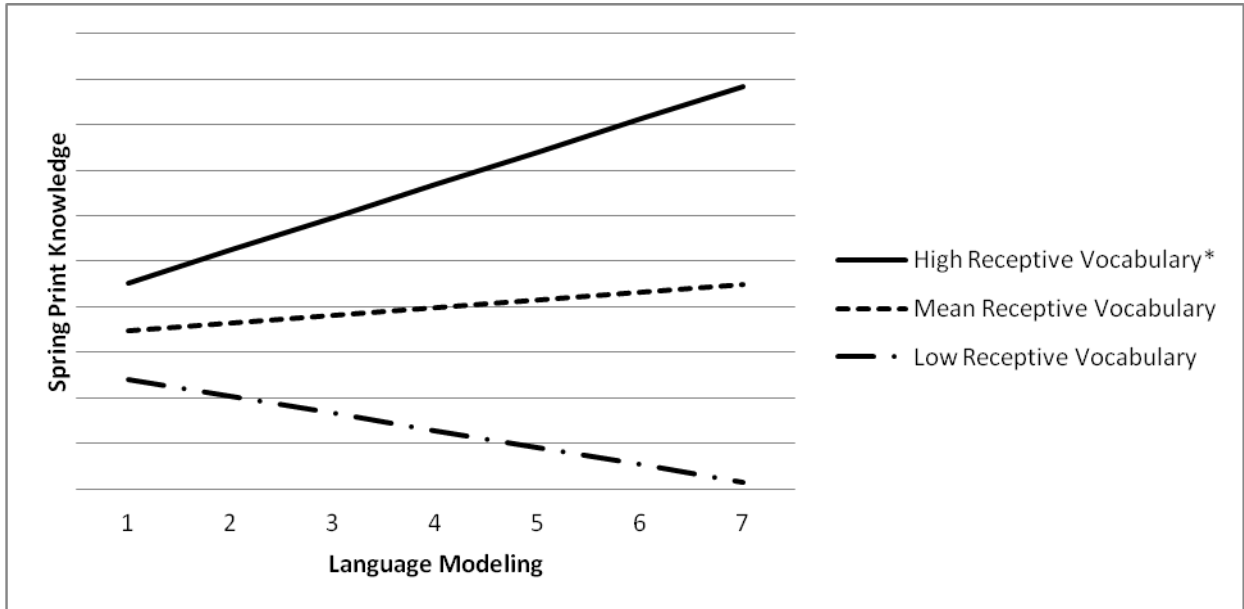


Figure 1. Teachers' language predicting children's spring print knowledge scores, controlling for fall print knowledge scores, at different levels (mean, \pm one standard deviation) of receptive vocabulary averaged over the year.

* $p=.04$.

Relation between teachers' language and gains in children's math skills.

Regression analyses were conducted with teachers' language as the predictor and children's spring math scores as the outcome variable. Children's fall math scores served as a covariate.

Teachers' language did not directly predict gains in English language learners' math skills, $\beta=.034$, $t(101)=0.48$, $p=.63$ (Table 7). However, as previously discussed, we would not necessarily expect teachers' language to be a direct predictor of gains in children's math skills. Instead, it is more likely that receptive vocabulary is a mediator between teachers' language and gains in children's math skills. Tests of mediation were conducted following MacKinnon (2008).

TABLE 7
Teachers' Language Predicting Gains in Children's Math Skills

	<i>B</i>	<i>SE B</i>	β
English Language Learners (N=104)			
Fall Applied Problems Scores	0.89***	0.09	.71
Language Modeling	0.13	0.27	.03
English Speakers (N=80)			
Fall Applied Problems Scores	0.76***	0.08	.75
Language Modeling	0.30	0.28	.08

Note: $R^2 = .51$, $F(2, 76)=52.56$, $p<.001$ for English language learners. $R^2 = .58$, $F(2, 77)=53.91$, $p<.001$ for English speaking children.

* $p < .05$. ** $p < .01$. *** $p < .001$

As presented earlier, teachers' language was a significant predictor of English language learners' gains in receptive vocabulary, $\beta=.207$, $t(97)=3.26$, $p=.002$. After we controlled for fall math scores, receptive vocabulary was a significant predictor of English language learners' spring math scores, $\beta=.306$, $t(99)=3.48$, $p=.001$. It accounted for 5% of the variance in the gains in English language learners' math skills.

The mediated effect was calculated by multiplying the unstandardized regression coefficients for the relations between teachers' language and English language learners' receptive vocabulary skills ($B=2.453$) and the relation between receptive vocabulary and math skills ($B=.099$). The standard error of the mediated effect was calculated using the standard errors of each effect, .75 and .03, respectively. The estimated mediated effect was 0.24, and the estimated standard error of this effect was 0.10. The mediated effect of teachers' language on gains in English language learners math skills through their receptive vocabulary was significant, $Z=2.40$, $p=.02$. The 95% confidence interval associated with the mediated effect, (0.04, 0.44) does not include zero, which also indicates that the mediated effect is statistically significant.

Teachers' language did not predict English speakers' gains in math skills, $\beta=.079$, $t(77)=1.06$, $p=.29$. Given that teachers' language also did not predict gains in English speakers' receptive vocabulary, mediation analyses were not appropriate. However, after we controlled for fall math scores, receptive vocabulary was a significant predictor of English speakers' spring math scores, $\beta=.316$, $t(76)=3.83$, $p<.001$, accounting for 7% of the variance.

DISCUSSION

This study explored the relations between the quality of Head Start teachers' language and low income English language learners' and English speakers' gains in vocabulary, literacy, and math skills. Our primary hypothesis was that teachers' language would predict children's receptive vocabulary which, in turn, would predict gains in children's early literacy and math skills. Novel aspects of this study included testing whether children's vocabulary mediated the relation between teachers' language and children's early literacy outcomes, and extending the inquiry to include children's math skills. Of particular interest was whether the pattern of results would be similar for low income English language learners and English speakers.

The relations between teachers' language and children's receptive and expressive vocabulary differed for English language learners and English speakers and across outcome measures. These findings show the important role that the language used by teachers plays, and the significance of children's vocabulary for early literacy and math development. There were four particularly noteworthy findings.

One, both English language learners and English speakers displayed significant increases from fall to spring in their receptive and expressive vocabulary. However, English language learners earned lower receptive and expressive vocabulary scores than English speakers. Although the English language learners did not close the gap between themselves and their English speaking peers after a year attending Head Start, the gap in their receptive vocabulary skills did narrow. It is important to find effective means of instruction to close the gap and improve all children's vocabulary (Pianta et al., 2009). As shown in this study and in others (e.g., Biemiller, 2006; Kendou et al., 2009), children's vocabulary predicts their early academic skills. Research by Duncan et al. (2007) underscores the importance of children's early academic skills for later school success.

Two, the quality of teachers' language with English language learners predicted gains in these children's receptive and expressive vocabulary. As hypothesized, teachers' language predicted the receptive vocabulary of English language learners, which in turn predicted gains in their phonological awareness and math skills. In other words, the receptive vocabulary skills of children who were learning English mediated the relation between teachers' language interactions and children's phonological awareness and math skills. (Based on theoretical grounds, expressive vocabulary was not considered to be a potential mediator.) This pattern of findings extends related research by Dickinson and colleagues (Dickinson & Tabors, 1991; Dickinson & Porche, 2011), and Wasik and Hindman (2011), among others, by showing that the relation between teachers' language and English language learners' early academic skills may be better conceptualized as an indirect one, mediated by children's vocabulary.

Three, the relations among teachers' language, children's receptive vocabulary, and gains in early literacy differed for phonological awareness and print knowledge. Unlike patterns with phonological awareness, the relation between teachers' language and gains in children's print knowledge was moderated by children's receptive vocabulary. Teachers' language predicted gains in children's print knowledge when children displayed higher vocabulary levels; such children typically were English speakers. The quality of teachers' language did not predict gains for children with lower vocabulary scores, typically English language learners. Such a pattern of differential benefit related to the level of children's vocabulary skills is consistent with research reviewed by Goldenberg (2008) and research conducted by Connor et al. (2006).

Four, the relation between teachers' language and English speakers' gains in vocabulary was different from the parallel relation involving English language learners. Although English speakers' receptive vocabulary predicted gains in their phonological awareness, print knowledge, and math skills, the quality of teachers' language did not predict vocabulary gains.

How can we explain that the quality of language displayed by teachers predicted gains in vocabulary for English language learners but not English speakers? As noted, English language learners' receptive and expressive vocabulary was much more limited than that of English speakers. Therefore, a more basic form of instruction might be sufficient for English language learners to acquire new vocabulary. Results from the CLASS and the Language

Practices protocols indicated that the teachers conversed with the children, but they did not frequently use advanced vocabulary or open-ended questions. They did, however, use visual aids and repetition during half the observations. Such a pattern would enable English language learners to increase their basic knowledge of English but not necessarily promote growth of more advanced language skills.

At first glance, the fact that the quality of the teacher language was not associated with gains in English speakers' vocabulary seems inconsistent with results from Wasik and Hindman (2011), who found that the use of high quality language led to increases in children's vocabulary. The Wasik and Hindman (2011) sample was African American, as was the sample of English speakers in the present study. Although a direct comparison across the two studies is not possible because of differences in the measures used, it appears that the quality of the teachers' language in the Wasik and Hindman (2011) study was higher than in the present study. That is, fewer of the teachers in the former study seemed to demonstrate poor quality language (based on the percentage of teachers who showed low fidelity to the language fostering basis of the intervention). Only 16% of the teachers in the Wasik and Hindman (2011) study could be considered to demonstrate lower quality language compared to 33% of the teachers in the present study. Thus, the difference in results between the Wasik and Hindman (2011) study and the English speakers in the present study could reflect differences in the quality of the teachers' language.

Three important limitations of the study should be noted. The data from this study were correlational, collected at just two time points, thus precluding causal interpretations. Future research should assess children's vocabulary several times during the school year, particularly during mid-year. In addition, all of the English language learners were low income Hispanic children; therefore, findings may not apply to other groups of English language learners. A third limitation is that we did not design the intervention and had no control over the quality of the teachers' language. It could be that any exposure to English, regardless of the quality of the input, might have led to growth in the vocabulary of the English language learners. Future research could use teachers not specifically trained using a curriculum that emphasizes language and compare them to teachers trained to use a curriculum that emphasizes language.

Based on the findings from this study, two additional lines of research, one focusing on teachers and one focusing on children, should be considered. Future research should explore what kinds and amount of training is needed to ensure that all teachers use language in the classroom known to facilitate children's vocabulary. Future research also should follow low income children longitudinally to document their literacy and math skills as they enter elementary school. What skills in preschool best predict academic outcomes for low income English language learners and English speakers?

The results from this study underscore the importance of children's vocabulary development for their academic development (Collins, 2010; Hindman et al., 2010). Low income children routinely enter kindergarten with more limited vocabularies than their middle income peers (Snow et al., 1998), largely because the experiences they have at home do not foster the vocabulary growth needed to support progress in school. Preschool can serve an important function for these children, especially for those who do not hear English at home.

The results from this study also underscore the need to improve the quality of instruction in low income preschool classes (Burchinal, Vandergrift, Pianta, & Marshburn, 2010; Marulis & Neuman, 2010). Although the quality of the language displayed by teachers was associated with gains in the vocabulary of the English language learners, these children

still received much lower scores than their English-speaking peers. As noted by August et al. (2005) and Goldenberg (2008), among others, vocabulary skills are critical to these children's subsequent academic development. The results are particularly pertinent for teachers of English language learners, many of whom believe they lack appropriate strategies for working with those students (Worthington et al., 2011). Professional development for teachers should focus on the importance of children's vocabulary for their early academic development, why the language they use with their students matters, and on ways they can interact with children from different backgrounds to improve their vocabulary. Such preservice or inservice instruction will need to be intensive and ongoing (Barnett, 2008; Wasik & Hindman, 2011). It is important to keep in mind that the teachers in this study were highly qualified; that is, they had earned bachelor degrees and received training in the curriculum. Despite these qualifications, the teachers' language modeling scores fell, on average, in the mid-level range. This highlights the need for more intensive teacher training.

REFERENCES

- Adams, M. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.
- August, D., Carlo, M., Dressler, C., & Snow, C. E. (2005). The critical role of vocabulary development for English language learners. *Learning Disabilities Research and Practice, 20*, 50-57.
- Barnett, W. S. (2008). *Preschool education and its lasting effects: Research and policy implications*. Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit. Retrieved from <http://epicpolicy.org/publication/preschooleducation>
- Biemiller, A. (2006). Vocabulary development and instruction: A prerequisite for school learning. In D.K. Dickinson & S.B. Neuman (Eds.). *Handbook of Early Literacy* (Vol. 2, pp. 41-51). NY: Guilford.
- Bowman, B.T., Donovan, M.S., & Burns, M.S. (Eds.) (2001). *Eager to learn: Educating our preschoolers*. Washington, D.C.: National Academy Press.
- Brenneman, K., Stevenson-Boyd, J., & Frede, E.C. (2009). Math and science in preschool: Policies and practice. *Preschool Policy Brief, 19*. www.nieer.org.
- Brooks-Gunn, J., & Markman, L. B. (2005). The contribution of parenting to ethnic and racial gaps in school readiness. *The Future of Children, 15*, 139-168.
- Brownell, R. A. (2000). *Receptive One-Word Picture Vocabulary Test*. San Antonio, TX: Harcourt.
- Burchinal, M., Vandergrift, N., Pianta, R., & Mashburn, A. (2010). Threshold analysis of association between child care quality and child outcomes for low-income children in prekindergarten programs. *Early Childhood Research Quarterly, 25*, 166-176.
- Cannon, J., & Ginsburg, H.P. (2008). "Doing the math": Maternal beliefs about early mathematics versus language learning. *Early Education and Development, 19*, 238-260.
- Collins, M. F. (2010). ELL preschoolers' English vocabulary acquisition from storybook reading. *Early Childhood Research Quarterly, 25*, 84-97.
- Connor, C.M., Morrison, F.J., & Slominski, L. (2006). Preschool instruction and children's emergent literacy growth. *Journal of Educational Psychology, 98*, 665-689.
- Cowan, R., Donlan, C., Shepherd, D.-L., Cole-Fletcher, R., Saxton, M., & Hurry, J. (2011). Basic calculation proficiency and mathematics achievement in elementary school children. *Journal of Educational Psychology, 103*, 786-803.
- Cross, C.T., Woods, T.A., & Schweingruber, H. (Eds.) (2009). *Mathematics learning in early childhood: Paths towards excellence and equity*. Washington, D.C.: National Academy Press.
- Dearing, E., McCartney, K., & Taylor, B.A. (2009). Does higher quality early child care promote low-income children's math and reading achievement in middle childhood? *Child Development, 80*, 1329-1349.
- Dickinson, D.K., McCabe, A., Anastasopoulos, L., Peisner-Feinberg, E.S., & Poe, M.D. (2003). The Comprehensive Language Approach to early literacy: The interrelationships among vocabulary, phonological sensitivity, and print knowledge among preschool-aged children. *Journal of Educational Psychology, 95*, 465-481.

- Dickinson, D.K., McCabe, A., & Essex, M.J. (2006). A window of opportunity we must open to all: The case for preschool with high-quality support for language and literacy. In D.K. Dickinson & S.B. Neuman (Eds.). *Handbook of Early Literacy* (Vol. 2, pp. 11-28). NY: Guilford.
- Dickinson, D.K., & Porche, M.V. (2011). Relation between language experiences in preschool classrooms and children's kindergarten and fourth-grade language and reading abilities. *Child Development, 82*, 870-886.
- Dickinson, D.K., & Tabors, P. O. Early literacy: Linkages between home, school and literacy achievement at age five. *Journal of Research in Childhood Education, 6*, 30-46.
- Duncan, G., Dowsett, C., Claessens, A., Magnuson, K., Huston, A., Klebanov, P Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428-1446.
- Early, D.M., Robert C. Pianta, R.C., Clifford, R.M., Burchinal, M.R., Ritchie, S., Howes, C., & Barbarin, O. (2006). Are teachers' education, major, and credentials related to classroom quality and children's academic gains in pre-kindergarten? *Early Childhood Research Quarterly, 21*, 174-195.
- Espinosa, L.M. (2005). Curriculum and assessment considerations for young children from culturally, linguistically, and economically diverse backgrounds. *Psychology in the Schools, 42*, 837-853.
- Garcia, E.E., & Jensen, B. (2009). Early educational opportunities for children of Hispanic origins. *Social Policy Report, XXIII* (no.11).
- Garcia, E.E., & Miller, L.S. (2008). Findings and recommendations of the National Task Force on Early Childhood Education for Hispanics. *Child Development Perspectives, 2*, 53-58.
- Ginsburg, H.P., Lee, J.S., & Boyd, J.S. (2008). Mathematics education for young children: What is it and how to promote it. *Social Policy Report, XXII* (1).
- Goldenberg, C. (2008). Teaching English language learners. *American Educator, 38*, 8-44.
- Hammer, C.S., Miccio, A. W., & Wagstaff, D. A. (2003). Home literacy experiences and their relationship to bilingual preschoolers' developing English literacy abilities: An initial investigation. *Language, Speech and Hearing Services in Schools, 34*, 20-30.
- Hammer, C. S., Lawrence, F. R., & Miccio, A. W. (2007). Bilingual children's language abilities and early reading outcomes in Head Start and kindergarten. *Language, Speech and Hearing Services in Schools, 38*, 237-248.
- Hamre, B. K., & Pianta, R.C. (2005). Can instructional and emotional support in the first-grade classroom make a difference for children at risk of school failure? *Child Development, 76*, 949-967.
- Hart, B., & Risely, T. B. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Paul. H. Brookes Publishing Company.
- Hedges, L. V., & Hedberg, E. C. (2007). Intraclass correlation values for planning group-randomized trials in education. *Educational Evaluation and Policy Analysis, 29*, 60-87.
- Hindman, A. H., Skibbe, L.E., Miller, A., & Zimmerman, M. (2010). Ecological contexts and early learning: Contributions of child, family, and classroom factors during Head Start, to literacy and mathematics growth through first grade. *Early Childhood Research Quarterly, 25*, 235-250.
- Hoff, E. (2003). The specificity of environmental influence: SES affects early vocabulary development via maternal speech. *Child Development, 74*, 1368-1378.
- Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review, 26*, 55-88.
- Howes, C. Burchinal, M., Pianta, R., Bryant, D., Early, D., Clifford, R., and Barbarin, O. (2008). Ready to learn? Children's pre-academic achievement in pre-Kindergarten programs. *Early Childhood Research Quarterly, 23*, 27-50.
- Jordan N. C, Huttenlocher J., & Levine S. C. (1992). Differential calculation abilities in young children from middle- and low-income families. *Developmental Psychology, 28*, 644-653.
- Justice, L.M., Mashburn, A.J., Hamre, B.K., & Pianta, R.C. (2008). Quality of language and literacy instruction in preschool classrooms serving at-risk pupils. *Early Childhood Research Quarterly, 23*, 51-68.
- Kempert, S., Saalback, H., & Hardy, I. (2011). Cognitive benefits and costs of bilingualism in elementary school students: The case of mathematical word problems. *Journal of Educational Psychology, 103*, 547-561.
- Kendeou, P., van den Broek, P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *Journal of Educational Psychology, 101*, 765-778.
- Kieffer, M. J. (2008). Catching up or falling behind? Initial English proficiency, concentrated poverty, and the reading growth of language minority learners in the United States. *Journal of Educational Psychology, 100*, 851-868.
- Krull, J. L., & MacKinnon, D. P. (2010). Multilevel modeling of individual and group mediated effects. *Multivariate Behavioral Research, 36*, 249-277.

- Levine, S.C., Jordan, N.C., & Huttenlocher, J. (1992). Development of calculation abilities in young children. *Journal of Experimental Child Psychology*, *53*, 72-103.
- Lonigan, C.J., Wagner, R. K., & Torgesen, J. K. (2007). *Test of Preschool Early Literacy*. Austin, TX: Pro-Ed.
- MacKinnon, D.P. (2008). Single mediator model. In D.P. MacKinnon (Ed.), *Introduction to Statistical Mediation Analysis* (pp. 47-77). New York: Lawrence Erlbaum Associates.
- Manicilla-Martinez, J., & Lesaux, N. K. (2011). The gap between Spanish speakers' word reading and word-knowledge: A longitudinal study. *Child Development*, *82*, 1544-1560.
- Marulis, L. M., & Neuman, S.B. (2010). The effects of vocabulary interventions on young children's word learning: A meta-analysis. *Review of Educational Research*, *80*, 300-336.
- Mashburn, A.J., Pianta, R.C., Hamre, B., Downer, J.T., Barbarin, O.A., Bryant, D., and Early, D.M. (2008). Measures of classroom quality in prekindergarten and children's development of academic, language, and social skills. *Child Development*, *79*, 732-749.
- Neuman, S. B. (2006). The knowledge gap: Implications for early education. In D.K. Dickinson & S.B. Neuman (Eds.). *Handbook of Early Literacy* (Vol. 2, pp. 29-40). NY: Guilford.
- Neuman, S.,B., & Dickinson, D. K. (2003). Introduction. In S.B. Neuman & D.K. Dickinson (Eds.). *Handbook of Early Literacy Research* (pp.3-29). NY: Guilford.
- Pan, B.A., Rowe, M. L., Singer, J.D., & Snow, C.E. (2005). Maternal correlates of growth in toddler vocabulary in low income families. *Child Development*, *76*, 763-782.
- Pianta, R.C., Barnett, W.S., Burchinal, M., & Thornburg, K.R. (2009). The effects of preschool education: What we know, how public policy is out is not aligned with the evidence base, and what we need to know. *Psychological Science in the Public Interest*, *10*, 49-88.
- Pianta, R.C., Howes, C., Burchinal, M., Bryant, D., Clifford, R., Early, D., & Barbarin, O. (2005). Features of prekindergarten programs, classrooms, and teachers: Do they predict observed classroom quality and child-teacher interactions? *Applied Developmental Science*, *9*, 144-159.
- Pianta, R. C., Le Paro, K. M., & Hamre, B. K. (2007). *Classroom Assessment Scoring System Pre-K*. Baltimore, MD: Brookes.
- Raikes, H., Pan, B. A., Luze, G., Tamis-LeMonda, C., Brooks-Gunn, J., Constantine, J., Tarullo, L. B., Raikes, H. A., & Rodriguez, E. (2006). Mother-child bookreading in low-income families: Correlates and outcomes during the first three years of life. *Child Development*, *77*, 924-953.
- Romano, E., Babchishin, L., Pagani, L.S., & Kohen, D. (2010). School readiness and later achievement: Replication and extension using a nationwide Canadian Survey. *Developmental Psychology*, *46*, 995-1007.
- Serpell, R., Baker, L., & Sonnenschein, S. (2005). *Becoming literate in the City: The Baltimore Early Childhood Project*. NY: Cambridge.
- Snow, C. E., Burns, M. S., & Griffin, P. (Eds.), (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.
- Storch, S. A., & Whitehurst, G. J. (2002). Oral language and code-related precursors to reading: Evidence from a longitudinal structural model. *Developmental Psychology*, *38*, 934-947.
- Tudge, J. R., & Doucet, F. (2008). Early mathematical experiences : observing young Black and White children's everyday activities. *Early Childhood Research Quarterly*, *19*, 21-39.
- Wasik, B.A., Bond, M.A., & Hindman, A. H. (2006). The effects of a language and literacy intervention on Head Start children and teachers. *Journal of Educational Psychology*, *98*, 63-74.
- Wasik, B.A., & Hindman, A. H. (2011). Improving vocabulary and pre-literacy skills of at-risk preschoolers through teacher professional development. *Journal of Educational Psychology*, *103*, 455-469.
- Worthington, E., Maude, S., Hughes, K., Luze, G., Peterson, C., Brotherton, M.J., Luchtel (2011). A qualitative examination of the challenges, resources, and strategies for serving children learning English in Head Start. *Early Childhood Education Journal*, *39*, 51-60.
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock Johnson Tests of Achievement*. Rolling Meadows, IL: Riverside Publishing.

APPENDIX A

TABLE 8
 OLS and Multilevel Modeling Regression Coefficients for Teachers' Language
 Predicting Children's Definitional Vocabulary

English Language Learners (N=101)		
Variable	OLS	Multilevel Modeling
Fall Expressive Vocabulary Scores	1.08 (0.09)***	1.06 (0.91)***
Language Modeling	4.11 (0.86)***	4.12 (0.90)***
English Speakers (N=77)		
Variable	OLS	Multilevel Modeling
Fall Expressive Vocabulary Scores	0.74 (0.06)***	0.76 (0.06)***
Language Modeling	0.10 (0.86)	0.22 (0.99)

Note: Standard errors in parentheses.

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