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Lulu Song, Catherine S. Tamis-LeMonda, Hirokazu Yoshikawa, Ronit Kahana-Kalman, and Irene Wu

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Language Experiences and Vocabulary Development in Dominican and Mexican Infants Across the First 2 Years

Lulu Song and Catherine S. Tamis-LeMonda
New York University

Hirokazu Yoshikawa
Harvard University

Ronit Kahana-Kalman
New York Institute of Technology

Irene Wu
New York University

We longitudinally investigated parental language context and infants' language experiences in relation to Dominican American and Mexican American infants' vocabularies. Mothers provided information on parental language context, comprising measures of parents' language background (i.e., childhood language) and current language use during interviews at infants' birth. Infants' language experiences were measured at ages 14 months and 2 years through mothers' reports of mothers' and fathers' engagement in English and Spanish literacy activities with infants and mothers' English and Spanish utterances during videotaped mother–infant interactions. Infants' vocabulary development at 14 months and 2 years was examined using standardized vocabulary checklists in English and Spanish. Both parental language context and infants' language experiences predicted infants' vocabularies in each language at both ages. Furthermore, language experiences mediated associations between parental language context and infants' vocabularies. However, the specific mediation mechanisms varied by language.

Keywords: Latino infants, vocabulary, language development, literacy activity, language exposure

The bioecological model of development (Bronfenbrenner, 1979, 1986; Bronfenbrenner & Morris, 1998) asserts that development is embedded in a nested system of social contexts. For infants and young children, experiences in the proximal setting of the home are primary sources for learning about the world. Sociocultural theories of language development highlight infants' interactions with parents as foundational to developing language skills (e.g., Bruner, 1983; Hoff, 2006). Further, substantial evidence

suggests that experiences and development in infancy predict later outcomes (Bornstein et al., 2006; Marchman & Fernald, 2008). In particular, early experiences in language-rich contexts promote infants' vocabulary and language development (e.g., Hart & Risley, 1995), which in turn relate to early reading achievement (Snow, Burns, & Griffin, 1998) through relations with grammatical development (Bates & Goodman, 1997; Dionne, Dale, Boivin, & Plomin, 2003; Marchman, Martínez-Sussmann, & Dale, 2004), phonological awareness (Metsala, 1999; Sénéchal, Ouellette, & Rodney, 2006), and listening comprehension (Sénéchal et al., 2006). Longitudinal studies on the association between language experiences and vocabulary in infancy and later achievement are scarce. However, one study that followed a group of Caucasian children from infancy to school age demonstrated that vocabulary at 25 months of age accounted for unique variance in children's language and cognitive skills at age 8 years (Marchman & Fernald, 2008).

Research on children's early language experiences and development has typically focused on the White middle-class monolingual English-speaking population. However, over the next decade, U.S.-born children of Latino immigrant parents (i.e., second generation) are expected to make up the largest component of the Latino population in the United States, and about one in seven new students enrolling in U.S. schools will be a second-generation Latino (Suro & Passel, 2003). Many of these children confront the challenge of navigating two cultural worlds, which typically includes learning two languages. However, most studies on the language skills of Latino children are based on assessments in the preschool and school-age years (but see Hurtado, Marchman, & Fernald, 2008, and Rodriguez et al., 2009), rendering a paucity of

Lulu Song and Catherine S. Tamis-LeMonda, Center for Research on Culture, Development, and Education, Department of Applied Psychology, Steinhardt School of Culture, Education, and Human Development, New York University; Hirokazu Yoshikawa, Graduate School of Education, Harvard University; Ronit Kahana-Kalman, Department of Behavioral Sciences, New York Institute of Technology; Irene Wu, Center for Research on Culture, Development, and Education, New York University. Irene Wu is now at the Department of Psychology, University of Michigan.

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Correspondence concerning this article should be addressed to Lulu Song or Catherine S. Tamis-LeMonda, 246 Greene Street, Floor 5E, New York, NY 10003. E-mail: lulusong@nyu.edu or catherine.tamis-lemonda@nyu.edu

data on the early language experience and development of Latino infants (0–2 years).

Moreover, previous research on children's early experience and development has largely treated the Latino population in the United States as a homogeneous group. Pan-ethnic characterizations fail to capture the unique developmental stories of different Latino ethnic groups. The diverse Latino population originates from a variety of nations and regions (e.g., Mexicans, Dominicans, Cubans, Puerto Ricans) and differs in socioeconomic status (SES), immigration histories, cultural values, and language skills (Tienda & Mitchell, 2006; Yoshikawa, 2011). Thus, the study of different Latino ethnicities has both theoretical and practical significance.

Theoretically, differences found among Latino ethnic groups challenge pan-ethnic generalizations about Latino infants' language experience and development. Language development is a complex social and cognitive phenomenon that is shaped by multiple forces. For example, depending on the sociocultural context (e.g., parents' language and literacy activities), Latino infants may be monolingual English or Spanish speakers, may be dominant in one language with some knowledge of the other, or may be relatively balanced in both languages. A better understanding of the characteristics of Latino infants' language development requires attention to the sociocultural context of children's lives. Practically, many Latino children from various ethnic groups are targets of intervention programs that aim to boost school readiness. However, a one-size-fits-all strategy may not benefit all children. Interventions or educational programs may need to be fine tuned based on the characteristics of different Latino ethnic groups, as infants from different backgrounds may be presented with dramatically different language experiences.

In response to these gaps, we asked three questions. First, are there differences in the vocabulary development in English and Spanish between Dominican and Mexican American infants at two ages (14 months and 2 years)? Second, are there differences in infants' language context and language experiences between the two groups? Third, what are the contributions of language context and language experiences to individual differences in infants' vocabularies in English and Spanish? In addressing these questions, beyond describing between-group differences, we highlight individual differences in infants' language experiences and vocabulary. Even if group differences exist between Mexican and Dominican children, enormous variation likely exists within each Latino group as well and, consequently, across the full range of children—in terms of both English and Spanish language skills and experiences.

Vocabulary Development in Latino Infants

Virtually no studies have systematically compared children from different Latino backgrounds on their early language development. However, children from different Latino backgrounds have been shown to differ in their English language proficiency and academic skills. For example, census data in 2005 showed that, among Latino residents in New York City who were ages 5 years and older, Mexicans as the most recent immigrant group had the lowest percentage (56.8%) of people reporting that they spoke English *only*, *very well*, and *well*, whereas Dominicans with a longer immigration history in the city had a higher percentage (67.4%; Barrera-Tobón, 2008). Other researchers have found con-

siderable variation in the average math skills during elementary school among Latino subgroups, with first- and second-generation Latinos, those from poorer backgrounds, and those with less English exposure and proficiency in kindergarten exhibiting lower math skills than their third-generation, English-proficient Latino peers from more resourced backgrounds (Reardon & Galindo, 2007).

However, these studies focused on English proficiency only or on academic skills tested in English. This may provide a distorted picture of the language skills per se of different Latino groups. How children are faring in Spanish or on total conceptual vocabulary (if Spanish and English were both credited) is open to question. Additionally, later disparities among different Latino groups may exist in the absence of earlier differences. It has yet to be determined whether there is early divergence in language skills among Latino ethnic groups and, if so, where those divergences lie and how soon in development they emerge. Finally, there is a lack of attention to within-group variation, as individual differences are treated as random noise in comparative studies, rather than as sources of meaningful information. Group averages mask the huge overlap between Latino subgroups and may lead to simplistic ethnic characterizations.

Context and Experiences of Latino Infants

Parental Language Context

Mothers and fathers are core contributors to infants' early language development. A recent diary study of Latino bilingual 25-month-olds showed that mothers and fathers were the major conversational partners in infants' daily activities, accounting for 77% of their total conversational time with people in the environment (Place & Hoff, in press). Thus, mothers' and fathers' language background and language use at home represent a primary language context for young children. Among Latino parents, both their English and Spanish skills and language use at home can vary significantly depending on their generational status, years in the United States, as well as education (Hakimzadeh & Cohn, 2007; Suro & Passel, 2003). Specifically, Latino parents who were born in the United States and those who have been in the United States longer tend to have better English skills and are more likely to speak English than first-generation immigrant parents, who have been in the United States for a shorter time. Further, with increased education, Latino immigrants are more likely to speak English well and use it often. Similarly, Latino parents' Spanish-language skills and production could vary with parents' education levels or SES, as has been observed among English-speaking caregivers (e.g., Hart & Risley, 1995).

Language Experiences

Young children's language experiences refer to the actual interactions children have with speakers of a certain language. Latino infants could differ in the language they hear during interactions with their parents as a result of parental language context. Here, focus is on two measures of Latino infants' language experiences: (a) infants' participation in literacy activities in English and Spanish with their mothers and fathers and (b) infants' exposure to each language during interactions with mothers.

Literacy activities, such as book reading and storytelling, are important language experiences for children and vary by SES, ethnicity, and home language use. Low-income parents read less frequently to their infants and toddlers than parents with higher incomes (e.g., Bradley, Corwyn, McAdoo, & García Coll, 2001), although wide variation exists within low-income households (Raikes et al., 2006). Latino and African American mothers are less likely to read to their children than White, non-Latino mothers across social classes (e.g., Bradley et al., 2001; National Center for Education Statistics, 1999; Raikes et al., 2006). Mothers who do not speak English read to their children less frequently than English-speaking mothers in the United States (National Center for Education Statistics, 1999). Maternal education and maternal beliefs about the importance of literacy activities are also associated with the frequency of book reading (Lyytinen, Laasko, & Poikkeus, 1998; Raikes et al., 2006; Scarborough & Dobrich, 1994). Although in general low-income, Spanish-speaking Latino parents tend to read less often than mainstream groups, little is known about differences among Latino ethnic groups.

To gauge Latino children's language exposure, parents are typically asked to estimate the amount of time children spend with speakers of particular languages (e.g., Pearson, Fernández, Lewedeg, & Oller, 1997). However, these reports may not always accurately reflect children's language exposure. For example, parents who think they are using one language may be mixing two languages (Goodz, 1989). Furthermore, even when children are exposed to one language for the same amount of time, how much speech they actually hear shows enormous variability (Hart & Risley, 1995; Hoff, 2006). Therefore, observational data can effectively augment parental report as an additional and critical window onto language exposure.

Parental Language Context and Language Experiences in Relation to Vocabulary Development

Our third question was about origins of individual differences in infants' vocabulary development. Specifically, our conceptual model posits that parental language context predicts Latino infants' vocabularies in English and Spanish and that this relation-

ship is mediated by infants' literacy activities and exposure to the two languages (see Figure 1). Bilingual research with older children has shown a relationship between parental language context and children's language use and proficiency. For example, the language or languages parents speak at home are related to the home language use of bilingual children living in the Netherlands (De Houwer, 2007). Mothers' proficiency in the second language (here English) also predicts Mandarin–English bilinguals' English proficiency (Jia, Aaronson, & Wu, 2002).

Early literacy activities (especially book reading) also play an important role in fostering language and literacy development (Bus, van IJzendoorn, & Pellegrini, 1995; Duursma et al., 2007; Patterson, 2002; Payne, Whitehurst, & Angell, 1994; Raikes et al., 2006; Rodriguez et al., 2009; Scarborough & Dobrich, 1994; Sénéchal, & LeFevre, 2002; Whitehurst et al., 1994). For example, the frequency of book reading was related concurrently to parent-reported infants' vocabulary at ages 14 and 24 months among English-speaking families. In addition, for Spanish-speaking children, daily reading at 36 months was significantly associated with children's Spanish skills at the same age (Raikes et al., 2006). A causal effect of book reading on vocabulary growth has also been established in experimental studies (Whitehurst et al., 1994; see E. Reese, Sparks, & Leyva, 2010, for a review).

However, studies on children's home literacy activities have mostly focused on a single language. Only a few studies, to our knowledge, have examined how Latino children's vocabularies relate to the home literacy and language environment in both languages children were learning (e.g., Duursma et al., 2007; Patterson, 2002; L. Reese, Garnier, Gallimore, & Goldenberg, 2000). For example, one study indicated that language exposure (percentage of time the child was spoken to) and literacy experience (frequency of book reading with parents) in each language predicted vocabulary in English and Spanish of bilingual 21- to 27-month-olds living in New Mexico, whereas TV viewing did not (Patterson, 2002).

Finally, infants who are exposed to more language—that is, whose primary caregivers, usually mothers, speak more—tend to have larger vocabularies (Hart & Risley, 1995; Huttenlocher,

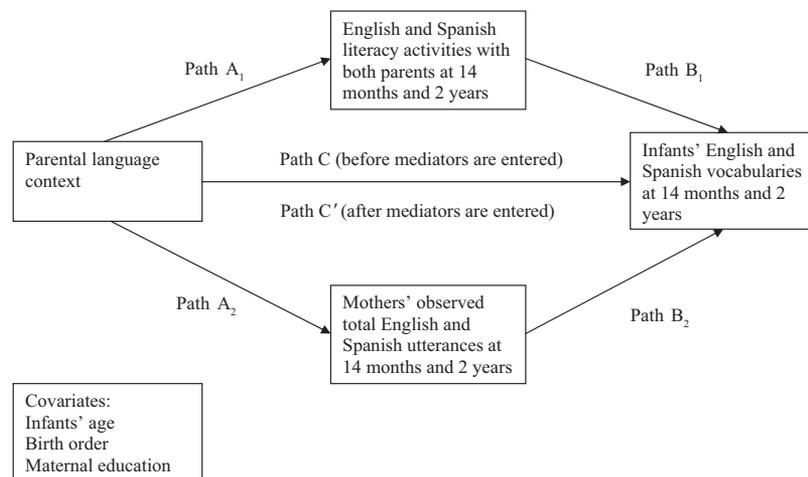


Figure 1. Conceptual map of predictors of Latino infants' early vocabulary in English and Spanish.

Haight, Bryk, Seltzer, & Lyons, 1991). Thus, bilingual infants' vocabulary in each language should be directly related to the amount of exposure they have to each language. Researchers asked parents to report English- and Spanish-learning bilingual infants' productive vocabulary and to estimate the amount of time the infants spent with speakers of each language (Pearson et al., 1997; Place & Hoff, in press). Infants' vocabulary levels in each language were significantly associated with the exposure to the same language. Further, there is also evidence that language exposure mediates the effect of parents' language background on bilingual Latino infants' vocabulary (Place & Hoff, in press).

Current Study

To answer our research questions, we conducted a longitudinal study of Dominican American and Mexican American infants from low-SES families from birth to 2 years of age. Mothers supplied information on parental language context during birth interviews. Infants' vocabularies in English and Spanish were measured using standard parental checklists at ages 14 months and 2 years. Language experience data were obtained from mother interviews and videotaped observations of mother–infant interactions at both 14 months and 2 years. From these data, we analyzed between-group differences and within-group variation in infants' vocabulary, parental language context, and language experiences. We then examined covariation among context, experience, and vocabulary development and tested for the mediation effect of language experience. On the basis of census data findings of greater English proficiency in Dominican versus Mexican older children (Barrera-Tobón, 2008), we expected to see greater English skills among Dominicans emerging already in infancy. We also expected Dominican infants to be more likely to have parents speaking English and to be more likely to have literacy activities and maternal production in English than Mexican infants. In contrast, Mexican infants were expected to display greater Spanish-

speaking skills. As for individual differences, we hypothesized that in the context of mean-level differences, there would exist huge overlap and similar variability among the Dominican and Mexican infants in their vocabulary, parental language context, and language experiences. Finally, we hypothesized that parental language context and infants' language experiences would predict vocabularies (in English and Spanish) and that the effect of parental language context on infants' vocabulary would be mediated by infants' language experiences in the respective language.

Method

Participants

A total of 212 Dominican ($N = 115$) and Mexican ($N = 97$) mothers were recruited shortly after giving birth to the focal infants at hospital maternity wards in New York City. To participate, mothers had to (a) be at least 18 years of age, (b) reside in the city but not in a shelter, (c) have given birth to a healthy, full-term infant (birth weight > 2,500 grams), and (d) identify themselves as Dominican or Mexican. Although low household income was not an inclusionary criterion, the average household income of the participating families turned out to be close to the local poverty line (\$26,138) of New York City (Leviton, Koolwal, Krampner, & Seidel, 2008; see Table 1), in line with the population profile in this area.

Of the 212 baseline families, 155 (82 Dominican and 73 Mexican; 73% of the original sample) with infant assessment data for at least one of the two data collection points—ages 14 months and 2 years—were included in the current study. Three families were excluded because the focal infants were later found to have disabilities. The other 54 families could not be located or moved out of the 100-mile catchment area after baseline. Baseline family characteristics, such as mothers' and fathers' age, racial/ethnic

Table 1
Descriptive Statistics of Demographic Variables by Ethnic Group

| Demographic variable | Dominican | Mexican |
|---|-------------------------|-------------------------|
| <i>N</i> | 82 | 73 |
| Female | 54% | 59% |
| Firstborn | 43% | 29% |
| Infants' age at 14 months | 14.78 (1.07) | 14.87 (1.08) |
| Infants' age at 2 years | 25.27 (1.33) | 25.31 (1.45) |
| Baseline (infants' birth) | | |
| Mothers' age | 25.91 (5.25) | 27.04 (5.46) |
| First-generation mothers | 79% | 96% |
| First-generation fathers | 72% | 97% |
| Mothers' years in the United States | 13.14 (8.38) | 8.26 (5.77) |
| Fathers' years in the United States | 15.80 (11.32) | 10.87 (7.61) |
| Mothers' years of education | 12.27 (2.18) | 8.21 (3.43) |
| Fathers' years of education | 11.85 (2.03) | 8.15 (2.55) |
| Mothers' dominant childhood language was Spanish | 96% | 99% |
| Fathers' dominant childhood language was Spanish | 71% | 97% |
| Mothers' dominant home language was Spanish at baseline | 76% | 93% |
| Fathers' dominant home language was Spanish at baseline | 66% | 86% |
| 2 years | | |
| Mothers who had worked since 14 months | 64% | 46% |
| Fathers currently employed | 84% | 98% |
| Household earning from 14 months to 2 years | \$28,469.77 (17,782.58) | \$23,237.55 (12,313.27) |

group, marital/cohabiting status, number of children, immigrant status, years in the United States, education, employment, and family income, were compared between families with and without data at 14 months and 2 years. None of the 13 contrasts yielded significant differences, suggesting that the attrition was not systematic.

Demographics for the two groups are presented in Table 1. There were no significant differences in the proportions of girls or firstborns or in the mean ages at two visits between the two ethnic groups. Information on mothers' age, mothers' and fathers' generational status, years in the United States, years of education, dominant language in childhood, and current dominant language at home was gathered at baseline. The majority of the Dominican and Mexican parents were foreign born. However, whereas one fifth of the Dominican mothers and one fourth of the Dominican fathers were born in the United States, almost all Mexican parents had migrated to the United States themselves: $\chi^2(1, N = 155) = 9.50, p = .002$, for mothers; $\chi^2(1, N = 152) = 15.62, p < .001$, for fathers. Within immigrant mothers, Dominicans had lived in the United States for 9.60 years ($SD = 6.48$), and Mexican mothers had lived in the United States for 7.66 years ($SD = 5.04$), $t(125) = 1.85, p = .067$.¹ Dominican first-generation mothers came mostly from Santo Domingo, the capital of the Dominican Republic, and Mexican mothers came mostly from Puebla, one of the poorer states of Mexico (Yoshikawa, 2011). Mothers and fathers within an ethnic group had similar levels of education, but Dominican parents had more years of education than Mexican parents: $t(149) = 8.59, p < .001$, for mothers and $t(131) = 9.22, p < .001$, for fathers. Parents' language background and current home language are reported in the Results section.

When infants were 2 years old, significantly more Dominican than Mexican mothers had worked since the 14-month visit, $\chi^2(1, N = 135) = 9.69, p = .008$, whereas significantly more Mexican than Dominican fathers were employed at the 2-year visit, $\chi^2(1, N = 123) = 8.25, p = .004$. During the 14-month to 2-year period, Dominican and Mexican families had similar household earnings (Mann-Whitney Test, $Z = -1.36, p = .175$).

Procedure

Data were collected in three forms: Vocabulary checklists of the focal infants, mother interviews, and mother-infant interactions.

Vocabulary in English and Spanish. Various researchers have pointed to the importance of assessing children's language skills in both languages by crediting infants, for example, with words known in either language (Parra, Hoff, & Core, 2011; Patterson, 2002; Pearson et al., 1997; Pearson, Fernández, & Oller, 1993; Umbel, Pearson, Fernández, & Oller, 1992). In addition, a total conceptual vocabulary can be calculated by counting translation equivalents (cross-language synonyms, e.g., *dog* and *perro* [dog]) only once when summing the total vocabulary across the two languages (Pearson et al., 1993).

Thus, we used the MacArthur Communicative Development Inventory (MCDI; Fenson et al., 2004) in English and its Spanish version, the MacArthur Inventario del Desarrollo de Habilidades Comunicativas (IDHC; Jackson-Maldonado et al., 2003). These inventories are parental checklists of infants' and toddlers' vocabulary with established validity and reliability with monolingual and bilingual infants (Marchman & Martínez-Sussmann, 2002).

The infant form at 14 months asked for a report of words the focal infants understood and produced. The toddler form at 2 years asked only for words produced, as it is too difficult for mothers to reliably keep track of infants' receptive vocabulary at this age.

Unlike previous research in which mothers were asked to fill out the vocabulary checklist on their own, a bilingual interviewer read each word on the MCDI and/or the IDHC to mothers and asked whether the infant understood (at 14 months) or said each word (14 months and 2 years). Thus, mothers' literacy in English or Spanish did not affect reports of infants' vocabulary.

Before the probing for individual words began, the interviewer determined which version of the checklist to use on the basis of questions to the mother regarding her infant's skills in the two languages. Guidelines for determining which checklist to use were as follows: (a) if the mother indicated that her infant understood and spoke English or Spanish only, the MCDI or IDHC was used; (b) if the mother indicated that her infant understood and spoke primarily English with some Spanish or primarily Spanish with some English, the MCDI or IDHC was used based on the infant's dominant language; and (c) in instances where the mother indicated her infant was using both languages, both checklists were used. However, in cases where the examiner used the MCDI or IDHC only, mothers were always asked for infants' vocabularies in the nondominant language. Questions on infants' vocabularies in the nondominant language were asked at the end of each group of words (e.g., toys, food items, action words). For example, a mother who reported a child as dominant in Spanish but as producing a few English words would be asked, "For the list of food items we just reviewed, are there any food words your child says in English, such as *apple*? Can you tell me which food items she/he says in English?" Infants were then credited with any words understood or produced in both English and Spanish, regardless of the choice of MCDI or IDHC.

At 14 months, 45% of the Dominican and 9% of the Mexican infants received the MCDI (English dominant), and the rest received the IDHC (Spanish dominant). At 2 years, 29% of the Dominican infants and 5% of the Mexican infants received the MCDI, and 59% of the Dominican infants and 81% of the Mexican infants received the IDHC. An additional 17 infants (eight Dominican and nine Mexican) received both the MCDI and the IDHC because mothers indicated that they had a relatively balanced production in English and Spanish by this age. Of these infants, six were English dominant (based on having more English words than Spanish words in their vocabulary), and 11 were Spanish dominant (based on having more Spanish than English words). Thus, by 2 years, 37% of the Dominican infants and 6% of the Mexican infants were English dominant. The differences in the proportions of English-dominant infants between the two groups were significant at both ages: $\chi^2(1, N = 135) = 21.78, p < .001$, at 14 months; $\chi^2(1, N = 134) = 15.69, p < .001$, at 2 years. The majority of the Dominican and Mexican infants (84% and 95%, respectively) maintained their language dominance from ages 14 months to 2 years. The few infants who unexpectedly changed from English dominant to Spanish dominant between 14 months and 2 years ($N = 8$) had only a receptive vocabulary in English and

¹ We evaluated t values against null distributions that are adjusted to take into account whatever distributional anomalies might exist.

did not produce any words in either language at 14 months but produced more Spanish than English words at 2 years.

Although the IDHC contains more items than the MCDI (428 vs. 396, respectively) at 14 months, the two checklists both contain 680 items at 2 years. Because proportions of these totals and raw scores yielded the same results, we used raw scores to represent infants' vocabulary size. Receptive and productive vocabulary scores were derived for English and Spanish, respectively. Following Pearson et al. (1993), total conceptual vocabulary was calculated for infants' production by summing the words infants produced in English only, in Spanish only, and in both English and Spanish.

To check the accuracy of mothers' reports of infants' language skills, we correlated reported scores of infants' productive vocabulary at 2 years with independent assessments of infants' expressive language skills based on the Mullen Scales of Early Learning (Mullen, 1995).² During the Mullen assessment (conducted at the same home visits), infants were presented with objects or pictures and asked to name them (e.g., the researcher points to a picture and asks, "What is this?"). We ran correlations for the entire sample and within subgroups of children on the basis of children's gender and birth order, mothers' ethnicity, mothers' immigration status and current dominant language at home, and the language version of the vocabulary checklist. These checks were conducted to ensure that accuracy of report was maintained across these different subgroups. In the full sample, mothers' reports of children's productive vocabulary correlated with children's scores on the Mullen Expressive Language scale ($r = .54$), and associations were likewise strong in all subgroup analyses. Specifically, associations between maternal report measures and independent assessments of infant expressive language were significant for boys ($r = .62$), girls ($r = .47$), firstborns ($r = .59$), later borns ($r = .52$), Dominicans ($r = .49$), Mexicans ($r = .55$), immigrant mothers ($r = .52$), nonimmigrant mothers ($r = .67$), mothers who currently spoke English ($r = .67$) or Spanish ($r = .54$) at home, and when the vocabulary checklist was in English ($r = .73$) or Spanish ($r = .56$; all $ps < .01$).

Parental language context. At baseline, mothers were interviewed by fluent speakers of their language. Mothers were asked, "What was the most common language you spoke at home growing up?" and "What is the most common language you speak at home now?" Mothers also answered the same questions about the language or languages spoken by infants' fathers. These questions yielded four language context variables: mothers' and fathers' dominant language in their childhood and mothers' and fathers' primary home language at infants' birth.

To reduce the number of language context variables for regression analyses, we performed a principal component analysis (PCA) with varimax rotation. All parental language context variables demonstrated appreciable loadings on a single factor. The factor loadings for mothers' most common language in childhood and current language at home and for fathers' most common language in childhood and current language at home were .53, .72, .83, and .88, respectively, generally indicating excellent loadings (Comrey & Lee, 1992). The factor accounted for 56% of the variance among the four variables (Cronbach's $\alpha = .73$).

Literacy activities. When the focal infants turned 14 months old and 2 years old, home visits were conducted. During interviews, mothers reported on three early literacy activities in which

they and the fathers engaged their infants: Singing songs, reading books, and telling stories. Mothers indicated the frequency of each activity as *every day*, *a few times a week* (both coded as 1), *a few times a month*, or *rarely or not at all* (both coded as 0). Mothers also indicated in which language (English or Spanish or both) these activities occurred.

Literacy activity scores in English and Spanish were derived by summing the frequency scores of activities in each language, respectively. Separate scores were obtained for mothers and fathers. Activities that parents engaged in with infants in both languages were included in both English and Spanish sum scores. The potential range of literacy activity scores in each language for each parent was 0 to 3. To illustrate, if a mother reported engaging the infant in singing songs and storytelling a few times a week (scoring 1) in both English and Spanish and engaging in book reading a few times a month (scoring 0) in Spanish only, the infant would receive a mother literacy activity score of 2 in English and 2 in Spanish.

Observed language exposure. At each of the home visits at 14 months and 2 years, we videotaped mothers and infants for a total of 7 min during three tasks: (a) sharing a wordless number book (2 min); (b) sharing a wordless emotion book (2 min); and (c) stringing beads together (3 min). Video clips were transcribed by bilingual speakers of English and Spanish. Each utterance by the mother was coded as English, Spanish, or other. The categories of English and Spanish utterances referred to those containing words and phrases found only in the English or Spanish language, including meaningful sounds in each language (e.g., *pio pio*, which is the sound a chicken makes in Spanish, and *chu chu*, which is the sound a train makes in English). The remaining utterances (13% of all utterances) contained phrases in which both English and Spanish words were used (e.g., *Mira el truck* or *Ven aca please*), Anglicisms (i.e., *okay*, *wow*, and *bye*) that had been assimilated into the Spanish language, utterances that did not fall into the previous categories, such as sounds that existed in both English and Spanish (e.g., *mhm*) or infants' names, and words and phrases that were incomprehensible because of low audio quality or background noise. We counted mothers' total English and Spanish utterances during the 7-min interaction. Of all the transcripts at the two ages, 20% were recoded by a second trained coder. The correlations between the two coders were .97 on average.

Results

Among the 155 families, 134 and 133 families had infant assessment data at 14 months and 2 years, respectively. The incomplete rate was similar across ages and ethnic groups. Missing values were imputed using the multiple imputation method (Schafer, 1997) with SPSS. Results of each imputed data set generally did not differ from analyses based on original data. Thus, findings are reported on the full sample ($N = 155$) with imputed values. Preliminary analyses showed no effect of gender on infants' vocabulary size, literacy activities, or observed language exposure. Thus, analyses were collapsed across boys and girls.

² We focused on infants' 2-year productive vocabulary—the key outcome in this study—as there is little variability in infants' productive vocabulary at 14 months.

Vocabulary Development of Dominican and Mexican Infants

Group differences in infants' vocabulary at ages 14 months and 2 years. Infants' vocabulary size was examined in three 2 (language: English vs. Spanish) \times 2 (ethnicity: Dominican vs. Mexican) analyses of variance (ANOVAs) conducted on infants' receptive and productive vocabulary at 14 months and productive vocabulary at 2 years, respectively.

Infants' receptive and productive vocabulary scores at 14 months are shown in Figure 2, Panels A and B. On average, infants comprehended more Spanish ($M = 85.80$) than English ($M = 20.52$) words. However, the English–Spanish difference was much greater among Mexican infants than Dominican infants. For every English word comprehended, Dominican infants comprehended 1.61 Spanish words, whereas Mexican infants comprehended 13.04 Spanish words. The stronger Spanish receptive vocabulary translated to a larger total receptive vocabulary for Mexican infants relative to Dominican infants ($M_s = 64.80$ and 41.52 , respectively). These results were indicated by significant main effects of language, $F(1, 153) = 53.81, p < .001$, and ethnicity, $F(1, 153) = 10.36, p = .002$, and by a significant Language \times Ethnicity, $F(1, 153) = 26.56, p < .001$, interaction. Dominican infants comprehended more English words, $t(153) = 2.86, p = .005$, but fewer Spanish words, $t(153) = -4.92, p < .001$, than Mexican infants.

At 14 months, both Dominican and Mexican infants produced more Spanish than English words, as indicated by a main effect of language, $F(1, 153) = 15.84, p < .001$. The main effect of ethnicity and the Language \times Ethnicity interaction were not significant. Dominican infants produced more English words, $t(153) = 2.13, p = .036$, than Mexican infants. The two groups produced similar numbers of Spanish words.

At 2 years, infants continued to produce more Spanish than English words. Dominican infants were on par with Mexican infants in Spanish productive vocabulary but produced more English words than Mexican infants, $t(153) = 3.59, p < .001$ (see Figure 2, Panel C). Dominican infants' larger total vocabulary was not due to translation equivalents (e.g., *dog* and *perro*). Rather, the vast majority of their words represented unique concepts; their total conceptual vocabulary accounted for 98% of the total vocabulary across languages. Findings were supported by significant main effects for language, $F(1, 153) = 44.15, p < .001$, and ethnicity, $F(1, 153) = 7.16, p = .008$, of the ANOVA. The Language \times Ethnicity interaction did not reach significance.

Infants' total conceptual vocabulary scores at 14 months and 2 years are shown in Figure 2, Panel D. A 2 (age) \times 2 (ethnicity) ANOVA was performed on infants' total conceptual vocabulary scores at the two ages. Dominican infants had larger total conceptual vocabularies than Mexican infants, but the difference arose mostly at 2 years. These results were supported by the significant main effects of age, $F(1, 153) = 337.99, p < .001$, and ethnicity, $F(1, 153) = 6.91, p = .009$, and a significant Age \times Ethnicity interaction, $F(1, 153) = 6.43, p = .012$. The two groups did not differ in their total conceptual vocabulary at 14 months, but Dominican infants had larger total conceptual vocabulary than Mexican infants by 2 years, $t(153) = 2.60, p < .01$.

For both Dominicans and Mexicans, infants who had larger vocabularies in one language at 14 months tended to have larger vocabularies in the same language at 2 years (r_s ranged from .34 to .82). However, vocabulary in one language was either negatively related or unrelated to vocabulary in the other language across time, which aligns with the findings that language skills of bilingual children are correlated within a language but not across

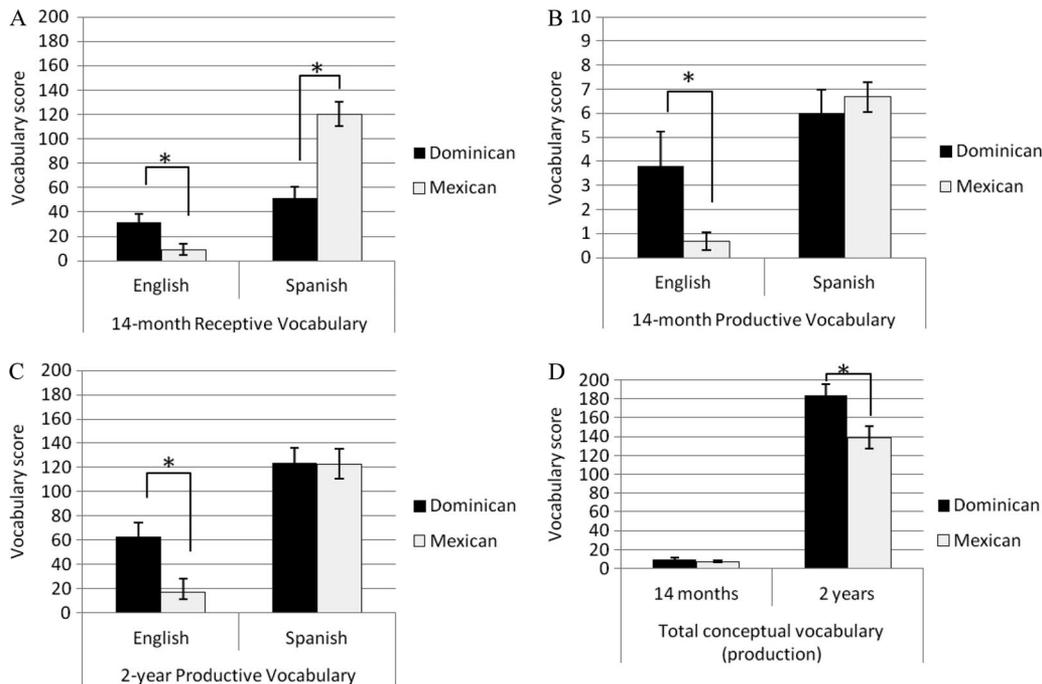


Figure 2. Infants' vocabulary scores at ages 14 months and 2 years. Error bars represent standard errors. * $p < .05$.

languages (Conboy & Thal, 2006; Marchman et al., 2004; Parra et al., 2011).

Individual differences in infants' vocabulary. Group means in the vocabulary of Dominican and Mexican infants mask the vast individual differences within each group in both the size of vocabulary in each language and the relative proportion of English and Spanish in infants' vocabulary at both ages. For example, at 2 years of age, infants of both groups varied from producing 0 to over 400 English or Spanish words. Even within the Spanish-dominant infants (76% of the sample), English vocabularies ranged from 0 to over 50 words, and Spanish vocabularies ranged from 0 to over 400 words in both ethnic groups (see Figure 3).

In terms of composition, 10 (12%) Dominican and two (3%) Mexican infants produced only English words, whereas 23 (28%) Dominican and 23 (32%) Mexican infants produced only Spanish words. Among the 59% of Dominican (one infant produced no words at all) and 65% of Mexican infants who produced both English and Spanish words, the ratio of English-to-Spanish vocabulary showed a larger range for Dominicans (from 0.01 to 134.00) than for Mexicans (from 0.01 to 5.50). As shown in Figure 3, although the majority of these bilingual infants produced more Spanish than English words, there were more Dominican infants who were balanced in their vocabularies in the two languages or produced more English than Spanish words compared with Mexican infants. Similar individual variability was also observed at 14 months.

Summary. Several results emerged from the group-level comparisons of Dominican and Mexican infants' vocabulary development. First, although both Dominican and Mexican infants had larger vocabularies in Spanish than in English, the Dominican infants comprehended more English words at 14 months and produced more English words at both 14 months and 2 years than Mexican infants. Second, although Mexican infants had larger receptive vocabularies in Spanish than Dominican infants at 14 months, the two groups did not differ in their Spanish vocabulary at 2 years. Finally, the vocabulary development of the two ethnic groups showed both stability and language independence. Infants' vocabulary size at 14 months was a strong predictor of vocabulary size at 2 years but only in the same language.

Within both groups, we found similarly large individual differences in infants' vocabulary in both English and Spanish. Furthermore, the individual data revealed that the English vocabulary was not contributed solely by the monolingual English-speaking infants; rather, close to two thirds of both ethnic groups produced words in both languages. Finally, Dominican infants' larger mean English vocabulary was due to both the larger number of infants who produced only English words and the larger number of infants who were relatively balanced in their production in both languages compared with Mexican infants.

Language Context and Experiences of Dominican and Mexican Infants

Parental language context. Although virtually all Dominican and Mexican mothers grew up speaking primarily Spanish, fewer Mexican mothers spoke English as the most common language at home when the infants were born, $\chi^2(1, N = 155) = 8.78, p = .002$. Compared with Mexican fathers (3%), more Dominican fathers (29%) grew up speaking primarily English, $\chi^2(1, N = 155) = 18.29, p < .001$, and spoke English (14% vs. 34%, respectively) as the most common language at home when infants were born, $\chi^2(1, N = 155) = 7.02, p = .006$ (see Table 1). Results were maintained when focusing exclusively on immigrant parents (those not born in the United States).

Literacy activities. Infants' literacy activity scores are presented in Figure 4. A 2 (language) \times 2 (parent) \times 2 (age) \times 2 (ethnicity) ANOVA was conducted with language, parent, and age as the within-subject variables and ethnicity as the between-subjects variable. On average, parents engaged infants in literacy activities more frequently at 2 years than at 14 months. Across ethnic groups and ages, parents engaged infants in more Spanish than English literacy activities ($M_s = 1.41$ and 0.93, respectively). However, Dominican parents engaged their infants in both English and Spanish literacy activities ($M_s = 1.19$ and 1.33, respectively), whereas Mexican parents were more likely to engage infants in Spanish than English literacy activities ($M_s = 1.50$ and 0.67, respectively). These findings were supported by significant main effects of language, $F(1, 153) = 30.29, p < .001$, and age, $F(1, 153) = 5.54, p = .02$, and a significant Language \times Ethnicity

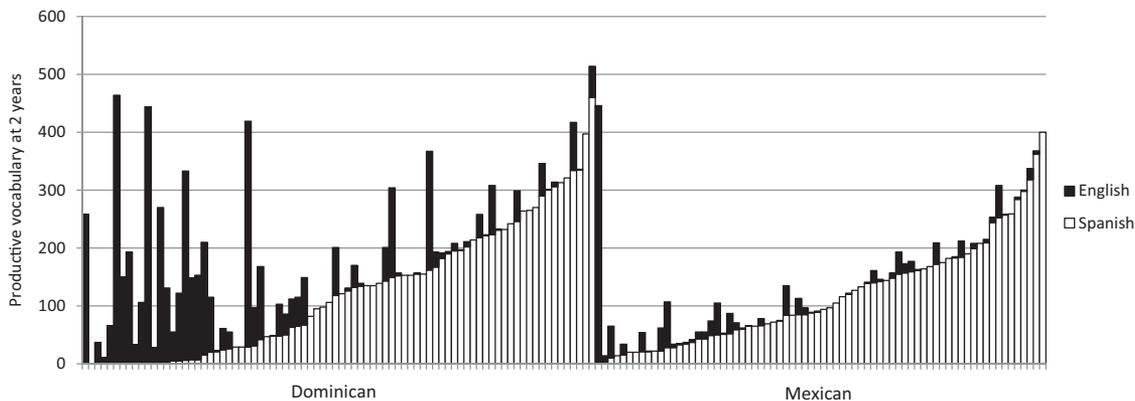


Figure 3. Individual vocabulary scores in English and Spanish of Dominican and Mexican infants at age 2 years.

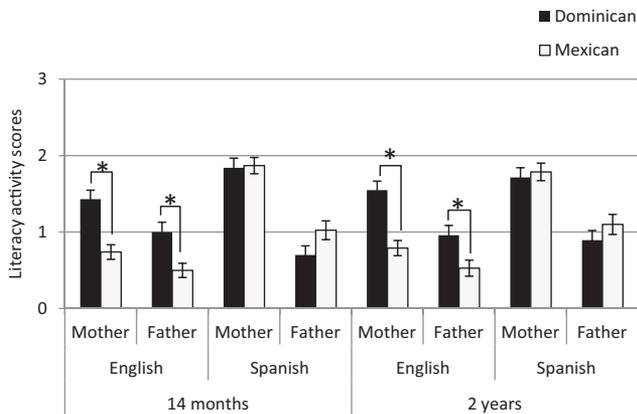


Figure 4. Mothers' and fathers' literacy activity scores in English and Spanish when children were ages 14 months and 2 years. Error bars represent standard errors. * $p < .05$.

interaction, $F(1, 153) = 15.66, p < .001$. The main effect of ethnicity was not significant. Both Dominican mothers and fathers engaged their infants in English literacy activities more than Mexican mothers and fathers at 14 months—mothers, $t(153) = 3.63, p < .001$; fathers, $t(153) = 2.38, p = .018$ —and at 2 years—mothers, $t(153) = 4.87, p < .001$; fathers, $t(153) = 2.40, p = .017$. The two ethnic groups did not differ in their Spanish literacy activities at either age.

Regardless of language, age, or ethnicity, mothers were more likely than fathers to engage their infants in literacy activities ($M_s = 1.46$ and 0.88 , respectively). Although both mothers and fathers were more likely to engage infants in Spanish than English activities, the difference was greater among mothers than fathers. Finally, the difference between the scores of mothers' English and Spanish activities decreased, whereas that of fathers increased, across the ages. This suggested that mothers' engagement in English literacy activities increased from 14 months to 2 years, whereas their engagement in Spanish literacy activities stayed at a relatively high level. In contrast, fathers who engaged in low levels of literacy activities at 14 months regardless of language began to engage the infants in more literacy activities in Spanish (the stronger language of most fathers) at 2 years. These findings were indicated by a significant main effect of parent, $F(1, 153) = 123.74, p < .001$, a significant Language \times Parent interaction, $F(1, 153) = 26.79, p < .001$, and a significant Language \times Parent \times Age interaction, $F(1, 153) = 8.45, p = .004$.

Finally, at both ages and across ethnic groups, infants who engaged in more literacy activities in one language with mothers also tended to engage in more literacy activities with fathers in the same language (r_s ranged from $.44$ to $.59, p_s < .01$), and the engagement of both mothers' and fathers' in literacy activities was stable (r_s ranged from $.42$ to $.55, p_s < .001$). In addition, one parent's engagement in literacy activities at 14 months also predicted the other parent's engagement in literacy activities at 2 years in the same language (r_s ranged from $.30$ to $.39, p_s < .05$). Finally, in all but one case, the concurrent and the predictive relations showed language specificity, with cross-language relations being negative or nonsignificant. These results held when examining Dominican and Mexican families separately.

Observed language exposure. Coding of the videotaped mother–infant interactions indicated that Dominican and Mexican mothers did not differ in their overall talkativeness at either age (at 14 months, $M_s = 157.95$ and 175.18 , respectively; at 2 years, $M_s = 172.21$ and 166.39 , respectively). Mothers' total English and Spanish utterances are shown in Figure 5. A 2 (language) \times 2 (age) \times 2 (ethnicity) ANOVA was conducted on mothers' English and Spanish utterances. Across both ethnic groups, mothers produced more Spanish than English utterances ($M_s = 121.71$ and 24.42 , respectively), as shown by a main effect of language, $F(1, 153) = 179.51, p < .001$. Thus, mothers' language use in these interactions reflected their language background as being predominantly Spanish speakers. However, we also found a significant Language \times Ethnicity interaction, $F(1, 153) = 33.11, p < .001$. Dominican mothers produced more English utterances but fewer Spanish utterances than Mexican mothers at 14 months—English, $t(153) = 5.46, p < .001$; Spanish, $t(153) = -4.82, p < .001$ —and 2 years—English, $t(153) = 5.19, p < .001$; Spanish, $t(153) = -3.93, p < .001$. Compared with 14 months, Dominican mothers produced more total utterances at 2 years, whereas Mexican mothers produced fewer total utterances, as suggested by a significant Age \times Ethnicity interaction, $F(1, 153) = 5.21, p = .024$.

Individual differences in literacy activities and language exposure. Literacy activities also varied substantially for both groups of infants. Whereas some infants rarely engaged in any type of literacy activity with either parent, others frequently engaged in all three types of literacy activities with both parents (i.e., daily or several times per week). The two ethnic groups showed similar distributions in their Spanish literacy experiences, spanning the full range for activities with mothers and fathers. Similarly, Dominican and Mexican infants varied in their English literacy experiences across the full range; however, many more Mexican infants received scores of 0 or 1 for English literacy activities than Dominican infants. Nevertheless, 15% of Mexican infants frequently engaged in two or three types of literacy activities in English with their parents.

Besides the group-level patterns in mothers' production, there was also individual variability in mothers' total utterances and mixing of two languages within each ethnic group. For example, some mothers produced over 200 utterances at the 2-year assess-

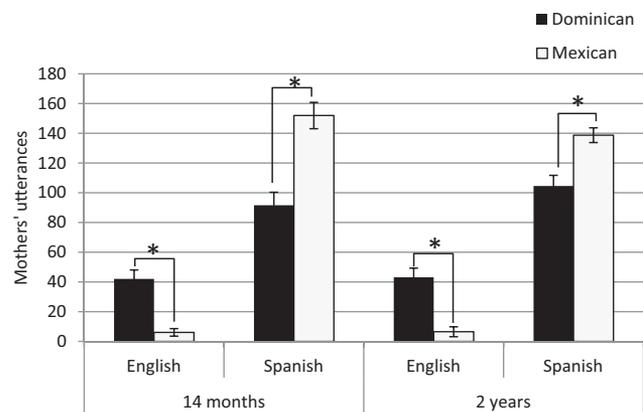


Figure 5. Mothers' English and Spanish utterances when children were ages 14 months and 2 years. Error bars represent standard errors. * $p < .05$.

ment, whether solely in one language or in two languages, during the 7-min interaction, whereas others produced 12 utterances (see Figure 6). For those mothers who spoke both languages during the interaction, 79% of Dominican and 73% of Mexican mothers produced at least one English and one Spanish utterance. Among these mothers, the ratio of English-to-Spanish utterances ranged from 0 to 139 for Dominican mothers ($M = 4.86$, $Mdn = 0.12$), and from 0 to 40 for Mexican mothers ($M = 0.94$, $Mdn = 0$). Similar variability was seen at 14 months. Thus, the greater number of English utterances produced by Dominican mothers was not solely due to more monolingual English-speaking mothers; Dominican mothers who used both Spanish and English during the sessions spoke more English than did Mexican mothers who used both languages.

Summary. In terms of language context and experiences, Dominican parents were more likely to speak English at home when their infants were born and to engage their infants in English literacy activities than Mexican parents. Dominican and Mexican mothers also provided qualitatively different verbal input to their infants in terms of the amount of English and Spanish they spoke and these differences were not due to mothers' overall talkativeness. Thus, although both groups of infants were exposed to Spanish predominantly, Dominican infants had more experiences with English.

Nonetheless, the individual data revealed large variability in both ethnic groups in infants' literacy activities and observed language exposure. Regardless of ethnicity or language, some infants experienced frequent literacy activities and a large amount of language exposure, and others experienced few literacy activities and very little language exposure. Differences in literacy experiences and language exposure in English at the individual level corroborated the mean-level comparison.

Associations Among Context, Experiences, and Vocabulary Development

We next examined associations among parental language context, language experiences, and infants' vocabulary development (see Table 2). Parental language context was associated with all four vocabulary scores in the expected directions, with stronger

effects for English than Spanish vocabulary. Parental language context was also associated with all language experience variables in the expected directions. In terms of language experiences, infants' engagement in literacy activities with parents was positively associated with vocabulary in the same language but was negatively or not related with vocabulary in the other language both within and across developmental time. Similarly, mothers' English and Spanish utterances were positively associated with infants' vocabulary in the respective language and negatively associated with infants' vocabulary in the other language both within and across developmental time.

We next examined the role of ethnicity in the associations just discussed (i.e., parental language context and infants' language experiences; infants' language experiences and vocabulary). We first asked whether ethnicity moderated associations between parental language context and infants' language experiences. In separate regressions, English and Spanish literacy activities and observed English and Spanish exposure at 14 months and 2 years served as dependent variables. Step 1 of the regressions included ethnicity and the parental language context factor; Step 2 tested the interaction between ethnicity and parental language context (i.e., moderation) on the specific language experience variable. In a second set of regressions, we asked whether ethnicity moderated associations between infants' language experiences and infants' vocabularies. In these regressions, infants' English and Spanish vocabularies at 14 months and 2 years served as dependent variables. Step 1 of regressions included ethnicity and infants' language experiences (literacy activities or observed exposure); Step 2 tested the interaction between ethnicity and the specific language experience.

Findings from both sets of regressions indicated that ethnicity did not moderate any associations (i.e., neither the Ethnicity \times Parental Language Context interaction nor the Ethnicity \times Language Experiences interactions were significant in any models). However, consistent with bivariate findings reported earlier, regression results for the parental language context and language experiences were all significant (B s ranged from .183 to .645, all p s $< .05$). The ethnicity contrast was significant for English literacy activities at both ages, observed English and Spanish

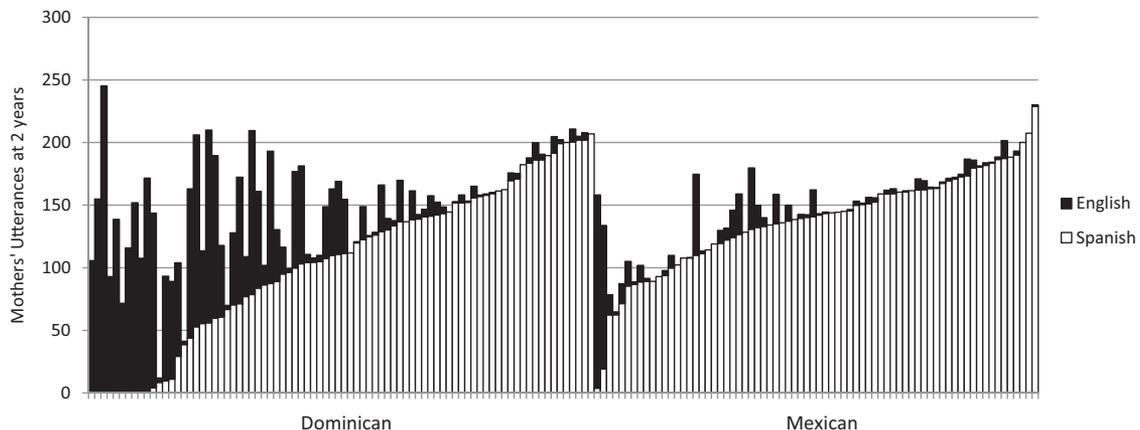


Figure 6. Utterances in English and Spanish of individual mothers when children were age 2 years.

Table 2
Correlations Among Parental Language Context, Language Experiences, and Vocabulary Size

| Context and experiences | 14 months | | 2 years | | Parental language context factor |
|--|---------------|---------------|---------------|---------------|----------------------------------|
| | Total English | Total Spanish | Total English | Total Spanish | |
| Language context | | | | | |
| Parental language context factor ^a | .58*** | -.32*** | .60*** | -.37*** | — |
| Literacy activities | | | | | |
| 14 months | | | | | |
| English activities | .36*** | -.25** | .38*** | -.18* | .39*** |
| Spanish activities | -.24** | .40*** | -.24** | .28*** | -.28*** |
| 2 years | | | | | |
| English activities | .23** | -.12 | .26** | -.09 | .24** |
| Spanish activities | -.29*** | .44*** | -.27** | .36*** | -.39*** |
| Observed language exposure (mothers' utterances) | | | | | |
| 14 months | | | | | |
| English | .68*** | -.41*** | .59*** | -.33*** | .44*** |
| Spanish | -.41*** | .40*** | -.46*** | .33*** | -.36*** |
| 2 years | | | | | |
| English | .64*** | -.39*** | .60*** | -.45*** | .60*** |
| Spanish | -.48*** | .49*** | -.52*** | .43*** | -.55*** |

^a Higher scores on the parental language context factor reflect higher likelihoods of parents speaking English (past or present).

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

exposure at both ages (in different directions), total Spanish vocabulary at 14 months, and total English vocabulary at 2 years (B s ranged from .145 to .353, all $ps < .05$). However, the ethnicity contrast was not significant for total English vocabulary at 14 months after controlling for the English literacy activities or observed English exposure at the same age in these regressions. All overall regression models were significant (F s > 4.95 , $p < .003$). Together, these results indicate that although infants of the two ethnic groups differed in their parental language contexts, language experiences, and vocabulary development when averages were considered, the patterns of association among variables did not differ. Thus, subsequent regression analyses that included all variables were conducted for the full group of infants.

Mediating Pathways

In the final set of analyses, we tested whether parental language context related to infants' vocabulary development through the mediators of language experiences. Four models were examined for infants' English and Spanish vocabularies at 14 months and 2 years, respectively. The predictor in each model was the parental language context factor score. The two measures of language experiences—literacy activities and observed language exposure—served as mediators. Mothers' and father's literacy activity scores were summed to obtain a total English score and a total Spanish score at 14 months and 2 years. Dependent variables were total English and total Spanish vocabularies at 14 months (receptive and productive) and total English and total Spanish vocabulary at 2 years (productive only).

The mediation effects were assessed with the bootstrapping technique (Hayes, 2009; Preacher & Hayes, 2004; see Preacher & Hayes, 2008, and <http://www.people.ku.edu/~preacher/> for the SPSS syntax for the multiple mediator analysis). Whether or not the indirect (mediating) effect was significant can be tested by examining the bias corrected confidence intervals of the indirect effect (Hayes, 2009; Preacher & Hayes, 2004, 2008). If the con-

fidence intervals do not include 0, the indirect effect is significant, suggesting that Path C is significantly reduced to Path C' (see Figure 1); otherwise, the indirect effect is not significant.

Each model assessed whether literacy activities and observed language exposure mediated the relationship between parental language context and infants' vocabulary in the respective language at a particular age. Variables of age, birth order (i.e., firstborn or not), and maternal education (in years, indicating SES; Bornstein & Bradley, 2003) that have established effects on infants' vocabulary were included as covariates in each model. Infants' age at 14 months, birth order, and maternal education were entered in Models 1 and 2. In Models 3 and 4, infants' age at 2 years was entered instead. Models 3 and 4 also controlled for infants' previous vocabulary levels by including their vocabulary score at 14 months as one of the covariates. A summary of the four models is presented in Table 3, and the results are shown in Table 4. For each model, unstandardized coefficients and their standard errors are presented for Paths A, B, C, and C' as well as confidence intervals for testing of mediation and the R^2 totals. Not shown are coefficients for three controls (infants' age, birth order, and maternal education), which were generally not significant with the exception of associations between infants' age and 14-month and 2-year Spanish vocabularies ($ps < .05$). The partial effect of infants' 14-month vocabulary is included in Models 3 and 4, as it indicates the strong stability of child language over this early period in development.

English vocabulary at 14 months. As shown in Model 1, parental language context predicted both mediators of English literacy activities and mothers' observed English utterances (Path A). This extends bivariate findings by showing unique prediction to each mediator in the presence of the second mediator, as well as continued prediction in the presence of covariates (infant age, birth order, and maternal education). Second, mothers' observed English utterances predicted infants' English vocabulary (Path B; as was the case at the bivariate level) after controlling for parental

Table 3

Summary of the Mediation Models of Language Context, Literacy Activities, Observed Language Exposure, and Vocabulary Size

| Model | Predictor | Mediator 1 | Mediator 2 | Outcome | Covariates |
|-------|---------------------------|---|---|---------------------------------|---|
| 1 | Parental language context | English activities with both parents at 14 months | Mothers' observed total English utterances at 14 months | English vocabulary at 14 months | Infant's age at 14 months, birth order, and maternal education |
| 2 | Parental language context | Spanish activities with both parents at 14 months | Mothers' observed total Spanish utterances at 14 months | Spanish vocabulary at 14 months | Infant's age at 14 months, birth order, and maternal education |
| 3 | Parental language context | English activities with both parents at 2 years | Mothers' observed total English utterances at 2 years | English vocabulary at 2 years | Infant's age at 2 years, birth order, maternal education, and English vocabulary at 14 months |
| 4 | Parental language context | Spanish activities with both parents at 2 years | Mothers' observed total Spanish utterances at 2 years | Spanish vocabulary at 2 years | Infant's age at 2 years, birth order, maternal education, and Spanish vocabulary at 14 months |

language context, the mediator of English literacy activities, and the covariates. However, English literacy activities no longer predicted English vocabulary in the presence of other variables.

Finally, parental language context predicted infants' English vocabulary before and after considering the mediators of English literacy activities and mothers' observed English utterances (Paths

Table 4

Coefficients and Confidence Intervals of the Mediation Models

| Model | Path A (SE) | Path B (SE) | Path C (SE) | Path C' (SE) | Bias corrected CIs of indirect associations | |
|---|-------------------------------|-----------------------------|-------------------------------|------------------------------|---|-------|
| | | | | | Lower | Upper |
| Model 1: Parental language context ^a and language experiences to 14-month English vocabulary (adjusted $R^2 = .56^{****}$) | | | | | | |
| M ₁ : 14-month English literacy activities | 0.57 ^{****} (0.13) | -1.91 (1.85) | 27.46 ^{****} (3.39) | 18.25 ^{****} (3.15) | -3.62 | 0.95 |
| M ₂ : Mothers' observed English utterances | 17.19 ^{****} (3.25) | 0.60 ^{****} (0.08) | | | 4.46 | 22.08 |
| Total | | | | | 2.76 | 21.50 |
| Model 2: Parental language context and language experiences to 14-month Spanish vocabulary (adjusted $R^2 = .27^{****}$) | | | | | | |
| M ₁ : 14-month Spanish literacy activities | -0.53 ^{***} (0.15) | 12.57 ^{***} (3.70) | -26.72 ^{***} (7.16) | -13.22 (7.23) | -15.13 | -1.71 |
| M ₂ : Mothers' observed Spanish utterances | -27.56 ^{****} (6.42) | 0.25 ^{**} (0.09) | | | -14.62 | -1.99 |
| Total | | | | | -23.59 | -6.07 |
| Model 3: Parental language context and language experiences to 2-year English vocabulary (English vocabulary at 14 months Coeff = .59 ^{****} ; adjusted $R^2 = .49^{****}$) | | | | | | |
| M ₁ : 2-year English literacy activities | 0.25 (0.18) | 0.93 (2.84) | 29.32 ^{****} (6.11) | 23.27 ^{***} (6.44) | -1.12 | 3.72 |
| M ₂ : Mothers' observed English utterances | 16.04 ^{****} (3.44) | 0.36* (0.15) | | | -0.89 | 16.80 |
| Total | | | | | -1.20 | 17.02 |
| Model 4: Parental language context and language experiences to 2-year Spanish vocabulary (Spanish vocabulary at 14 months Coeff = .11; adjusted $R^2 = .25^{****}$) | | | | | | |
| M ₁ : 2-year Spanish literacy activities | -0.53 ^{***} (0.15) | 9.23* (4.46) | -32.34 ^{****} (8.24) | -17.01 (9.31) | -11.88 | -0.76 |
| M ₂ : Mothers' observed Spanish utterances | -25.08 ^{****} (3.89) | 0.42* (0.17) | | | -22.45 | -1.68 |
| Total | | | | | -28.66 | -6.17 |

Note. CI = confidence interval; M₁ = Mediator 1; M₂ = Mediator 2.

^a Higher parental language context factor scores reflect higher likelihoods of parents speaking English.

* $p < .05$. ** $p < .01$. *** $p < .001$. **** $p < .0001$.

C and C'). Mothers' observed English utterances partially mediated the association from parental language context to infants' English vocabulary, as indicated by a reduction in the coefficient from Path C to C', which was significant based on confidence intervals.

Spanish vocabulary at 14 months. As shown in Model 2, parental language context predicted both Spanish literacy activities and mothers' observed Spanish utterances at 14 months, showing unique associations to each mediator in the presence of the other mediator as well as the covariates. Second, both Spanish literacy activities and mothers' observed Spanish utterances predicted infants' Spanish vocabulary in the presence of parental language context as well as the covariates. Finally, parental language context predicted infants' Spanish vocabulary in the presence of the covariates before considering the mediators. However, this relationship was significantly attenuated and became insignificant in the presence of language experience variables. Not only was the total indirect effect significant, each mediator also showed a significant indirect effect, as indicated by the negative confidence intervals.

English vocabulary at 2 years. As shown in Model 3, parental language context significantly predicted mothers' observed English utterances at 2 years in the presence of all covariates including infants' English vocabulary at 14 months. However, it did not predict English literacy activities at 2 years. Second, mothers' observed English utterances predicted infants' English vocabulary at 2 years, over the effects of parental language context, English literacy activities at 2 years, and all covariates, especially infants' 14-month English vocabulary, which was a significant predictor. Finally, parental language context predicted infants' English vocabulary at 2 years before and after introducing the mediators into the model. The slight attenuation to the path between predictor and outcome was not significant. Although both Path A and Path B were significant for mothers' observed English utterances at 2 years, the mediation effect was not significant, as indicated by a confidence interval that included 0.

Similar to the findings of this concurrent model, when cumulative language experience mediators of literacy activities and mothers' observed utterances (averaged across 14 months and 2 years) were entered in the model instead along with parent language context and covariates, both parental language context and mothers' averaged English utterances predicted infants' English vocabulary at 2 years. Again, mediation was not observed (i.e., differences from Path C to C' were not significant), indicating that both parental language context and observed English exposure uniquely contributed to infants' English vocabulary.

Spanish vocabulary at 2 years. As shown in Model 4, the same results found in Model 2 of 14-month Spanish vocabulary were replicated at 2 years. First, parental language context predicted both language experience variables at 2 years after controlling for all covariates, including infants' 14-month Spanish vocabulary. Second, both Spanish literacy activities and mothers' observed Spanish utterances predicted infants' Spanish vocabulary at 2 years over parental language context and covariates including 14-month Spanish vocabulary. Finally, parental language context predicted infants' Spanish vocabulary at 2 years, even after controlling for their early vocabulary, as indicated by the significant Path C. However, this path became insignificant after considering Spanish literacy activities and mothers' observed Spanish utter-

ances as mediators. The individual indirect effect of each mediator was significant, as indicated by the negative confidence intervals. Similar results were observed when averaged Spanish literacy activities and mothers' observed Spanish utterances across 14 months and 2 years were entered as mediators instead.

Summary. Parental language context predicted both mediators (literacy activities and observed language exposure) in virtually all models; additionally, parental language context and language experiences significantly predicted Latino infants' vocabulary development. In most instances, the effects of parental language context on infants' vocabulary development were mediated by infants' language experiences in the respective language. Notably, the mediation mechanisms differed for English and Spanish. Whereas observed English exposure rather than English literacy activities explained much of the effect of parental language context on infants' English vocabulary, both Spanish literacy activities and observed Spanish exposure mediated associations between parental language context and infants' Spanish vocabulary.

Discussion

This longitudinal study of Dominican and Mexican U.S.-born infants' vocabulary development in the first 2 years of life makes several unique contributions to the literature. First, by examining infants' language context and experiences in both English and Spanish during the first 2 years of life, the study advances our understanding of the early language development of Latino American children. To date, most research that has involved low-SES Latino children has focused on their experience and development in English so as to better understand their English skills and identify the barriers to their later achievements in school. However, from early in life, simultaneously experiencing both Spanish and English is the reality for most Latino children in the United States. Further, early language skills in Spanish are related to later English reading achievements of children who are native speakers of Spanish (L. Reese et al., 2000). Therefore, it is necessary that research attend to both languages when studying the early language development of Latino children.

Second, compared with earlier research on the language development of Latino children, the current study incorporated a systematic examination of parents' language background, language use, and indicators of SES, such as household income and maternal education. Third, by adopting a longitudinal approach, this study gained valuable information on Latino infants' language experiences across the first 2 years of life and how these experiences were dynamically related to their emerging vocabularies in the respective languages. Fourth, we included two ethnic groups of Latinos. The findings suggested that there were indeed significant differences between Latino ethnic groups and that these differences emerged as early as 14 months, rendering any general conclusions about the language development of Latino children simplistic. Finally, by using observational data to examine Latino infants' exposure to different languages—the first effort of this kind to our knowledge—the current study made a significant methodological contribution to the investigation of this population's language experiences.

Similarities and Differences in Vocabulary Development

Several similarities were observed in Dominican and Mexican infants' vocabulary development. For example, both groups showed substantial vocabulary growth from 14 months to 2 years as do children in other ethnic groups and social classes (Fenson et al., 2004; Jackson-Maldonado et al., 2003), and for both groups of infants, vocabulary development exhibited stability already from 14 months to 2 years of age.

Nonetheless, significant differences in their vocabulary development were also found. First, Dominican and Mexican infants showed differential strengths in their receptive and productive language. Whereas Mexican infants had larger receptive vocabularies at 14 months, Dominican infants produced more words at 2 years. Although these findings were based on maternal report, similar patterns are seen when direct assessments are made of the language skills of Mexican and Dominican infants; Mexican infants performed better on the Mullen Receptive Language scale but poorer on Mullen Expressive Language scale when compared with Dominican infants (Tamis-LeMonda, Song, Leavell, Kahana-Kalman, & Yoshikawa, 2011). These findings suggest that a focus solely on productive language may paint an overly pessimistic picture of Mexican American infants' language abilities by missing their skills in comprehension. Future research is needed to better understand potential cultural factors in shaping these differences.

Second, as early as 14 months, Dominican infants had larger English vocabularies relative to Mexican infants. Further, their larger English vocabulary was not at the cost of Dominican infants' Spanish language skills, as the two groups produced equivalent numbers of Spanish words at 2 years. Similar findings have been reported in a study that compared phonological awareness, reading, and language production competency of English monolinguals, Spanish-English early bilinguals (i.e., exposed to both languages extensively and systematically during 0 to 3 years), and later bilinguals (i.e., exposed to Spanish from birth but to English after 4 years of age) at Grades 2 and 3 (Kovelman, Baker, & Petitto, 2008). Although the monolingual children came from high-SES families, children of both bilingual groups came from low-SES families. The study showed that the early Spanish-English bilinguals' performance in English was similar to that of the English monolinguals, which was better than that of the later bilinguals, whereas early bilinguals' performance in Spanish was comparable with that of the later bilinguals. These results signify the potential benefits of early exposure to two languages.

Given that the two groups had similar Spanish vocabularies, and the semantic overlap between the Spanish and English vocabularies was small, the extra English words of Dominican children may result in greater general conceptual knowledge over Mexican children as these words were likely to represent unique concepts. One question that arises is why children were acquiring words in the two languages that did not overlap (i.e., over 95% of their vocabulary were not translation equivalents). The reason might be rooted in processing of the input or in the input itself. In terms of processing of input, children might be exposed to the same concept in both languages but tend to pick up only one of the words because of biases such as mutual exclusivity; that is, it is unlikely for young children to map two words to the same object (e.g., Callanan & Sabbagh, 2004; Markman & Wachtel, 1988; also see Golinkoff, Hirsh-Pasek, Bailey, & Wenger,

1992). Alternatively, parents might provide children with different words reflecting different concepts when speaking English versus Spanish with their children. For example, Latino mothers might provide color or number words in English but use Spanish for everyday food names and routines.

Similarities and Differences in Parental Language Context and Language Experiences

Both Dominican and Mexican American infants shared characteristics in their parental language context and language experiences. For both groups, parents' language background and language use were mainly Spanish, especially for mothers. In terms of language experiences, most literacy activities were in Spanish, and infants were predominantly exposed to Spanish when interacting with mothers. Despite their overall low SES, the Latino mothers engaged their infants in almost two of three and Latino fathers in about one of three Spanish literacy activities a few times a week to every day. These early literacy experiences could be extremely important to Latino infants' Spanish acquisition (as suggested by mediation findings).

Across both Latino groups, the engagement of mothers' and fathers' literacy activities were positively associated with each other at both ages and were also stable over time. Thus, if one parent was active in engaging the infant in literacy activities, the infant tended to have rich literacy experiences with the other parent as well. This result accords with prior research, which found that mothers' and fathers' language during mother-child and father-child interactions were strongly associated (Tamis-LeMonda, Baumwell, & Cristofaro, in press). Thus, rather than one parent compensating for the other, infants tend to have similar language experiences with both parents.

However, in the context of these similarities, Dominican and Mexican infants differed in their respective language context and experiences. Although almost all mothers of the two ethnic groups grew up speaking Spanish, more Dominican mothers spoke English at home when their infants were born, suggesting that they had better English skills and/or used more English in their daily communication in the home. The observational data of mother-infant interactions at 14 months and 2 years converged with mothers' self-report of language use. At both ages, Dominican mothers produced more English utterances than Mexican mothers, even when comparing mothers who were first-generation immigrants. There may be several explanations for why Dominican immigrant mothers had better English skills (Yoshikawa, 2011). The Dominican mothers were much more likely to have grown up with relatives who spoke English. Their earlier age of emigration to the United States also suggests that they were more likely to have been exposed to some education in the United States, increasing their English exposure. In addition, their higher levels of education suggest that they may have learned some English in their home country. Further, more of the Dominican than Mexican fathers were native English speakers, creating a need for mothers to use English.

Dominican and Mexican infants also differed in their language experiences with respect to literacy activities with their parents, which also reflected more English exposure of Dominican infants. Although parents of both groups were equally likely to engage their infants in Spanish literacy activities, such as book reading and storytelling, Dominican parents were more likely than Mexican

parents to engage their infants in English literacy activities. This is not to say that Dominican infants engaged in more literacy activities overall. In fact, the two groups did not differ when comparing the engagement in literacy activities regardless of language, suggesting that there was no evidence of a cultural difference in endorsement of learning. Thus, the difference between Dominican and Mexican infants' experiences with literacy activities was not the amount but the language parents used.

Individual Differences Among Latino Infants

Findings also highlight the substantive individual differences found within both ethnic groups in infants' vocabulary, parental language context, and language experiences. All variables examined showed similar and large ranges across the two groups. Further, despite the better English skills among Dominican infants overall, there were Mexican infants who were gaining English skills and experiencing literacy activities and exposure in English at the same level as many Dominican infants. Conversely, there were Dominican infants who did not have parents speaking primarily English or receive any language experience in English and also those who had smaller Spanish vocabularies than many Mexican infants. Thus, although generally corroborating the group-level comparisons, the individual data provided a much richer description of infants' language experience and development.

Contributions of Parental Language Context and Language Experiences to Individual Differences in Vocabulary Development

One of the goals of the current study was to examine how the individual differences in the sociocultural and contextual factors related to the individual differences in infants' vocabulary development regardless of ethnic group. Previous research showed that bilingual infants' simultaneous vocabulary and grammatical development were related within a language but not across languages (Conboy & Thal, 2006; Hoff et al., in press; Parra et al., 2011), suggesting that bilingual infants' linguistic accomplishments in each language are influenced by their experience with the respective language rather than being solely attributable to general individual difference factors, such as IQ or language learning skills (Marchman et al., 2004). Building on these findings, we hypothesized that Latino infants' parental language context (parents' language background and language use) shaped their vocabulary development in English and Spanish through language experiences in each language.

As a first step to testing possible mediating pathways, we asked whether parental language context was associated with infants' language experiences and whether parental language context and infants' language experiences were respectively associated with infants' vocabulary development. Indeed, these associations were seen for the full sample of infants, and ethnicity did not moderate any associations. Thus, although infants of the two ethnic groups differed in their parental language contexts, language experiences, and vocabulary development (described earlier), the patterns of association between these major variables did not differ—mean level differences in infant language experiences and skills do not necessarily imply differences in underlying processes or patterns of association.

Notably, regression analyses indicated that different language experiences mediated Latino infants' vocabulary development in English and Spanish. In Spanish, which was the dominant language for most of the infants in the current study, both early literacy activities and mothers' Spanish utterances in observed interactions mediated pathways to Spanish vocabulary. These results are in line with previous findings indicating that literacy activities have a facilitative effect on children's vocabulary growth (e.g., Bus et al., 1995; Raikes et al., 2006) and that how much mothers talk predicts children's vocabulary size (e.g., Hart & Risley, 1995; Huttenlocher et al., 1991).

Although we did not probe the processes involved in literacy activities that might contribute to vocabulary learning, word learning research may shed light on why literacy activities might facilitate vocabulary development. First, early literacy activities, such as book reading, storytelling, and singing songs, are intense language experiences with a large amount of language data. Second, the language content of these activities is often outside the routines infants are already familiar with. Thus, these activities expose infants to novel, unfamiliar words. Literacy activities encourage parents not only to speak more but also to use a more diverse vocabulary and more advanced syntactic structures when talking to infants than they normally do in daily routines, such as feeding and caretaking. Finally, parents also utilize many effective teaching strategies, such as asking questions, eliciting imitations, expanding on infants' language, providing feedback, and responding to infants' interests during literacy activities, which may support vocabulary development (e.g., Ninio, 1983; Whitehurst et al., 1994). Therefore, early literacy activities may be a key factor in explaining the variability in vocabulary development in infants' native language.

In contrast to the mediational findings with Spanish, in English, mediated pathway was found only for observed English exposure at 14 months. This pathway was weakened at 2 years after controlling for infants' 14-month English vocabulary. It appears that early maternal language may set in motion a pattern of reciprocal influences that snowball to affect later child language (Raikes et al., 2006).

If literacy activities are important, why did English literacy activities not mediate the relationship between parental language context and infants' English vocabulary? Infants' very rudimentary grasp of English may explain this finding. Most infants were Spanish-dominant, with rather small English vocabularies that contained mostly basic words encountered in daily routines (e.g., *candy* and *ball*). Therefore, mothers' direct input in English during various interactions may be the primary source from which these infants learn English words at early stages of language development. However, this result in no way suggests that literacy activities are not important in promoting infants' vocabulary in their second or nondominant language. In fact, as seen in mediation paths for Spanish vocabulary, Latino infants with more comparable exposure to both languages should benefit from literacy activities in both languages. Indeed, experience with reading was a significant predictor of children's vocabulary in English as well as in Spanish in a group of 21- to 27-month-olds exposed to both English and Spanish 25% or more of the time, beyond the time exposed to each language (Patterson, 2002).

Although the current research advances the understanding of Latino infants' vocabulary development in both English and Spanish, it contains several limitations. First, although parents are the primary persons shaping infants' language context, other people who interact with infants regularly may also contribute to the language environment. For example, older siblings who go to schools in the United States may have stronger English skills than parents and influence the overall home language context of their younger siblings. Further, many Latino infants were cared for by persons other than their mothers and fathers, some even for a substantial amount of time if parents were employed. The primary caregivers would have been the ideal persons to report infants' vocabulary. Unfortunately, it was not feasible within the participant burden guidelines (or our resources) to interview multiple respondents. Nevertheless, given that mothers in the current sample resided with the infants at all ages and that many engaged in literacy activities with their infants, mothers' reports of infants' vocabulary were deemed to be valid.

Second, the current parental language context factor captured only the most common language mothers and fathers spoke. Although mothers' use of other languages than their dominant language was reflected in the observed mother–infant interactions, we do not know the extent to which fathers used other languages in the home. Our result indicated that fathers rarely engaged their infants in English literacy activities. However, it is possible that some of the Spanish-dominant fathers did speak English occasionally at home, which may have contributed to their infants' English vocabulary. Related to this, it would be ideal to obtain information directly from fathers on their language use at home and literacy engagement with the infants, and future work should include more information on fathers' contributions to the language development of bilingual children. Finally, the current study examined infants' language experiences in terms of frequency of literacy activities and quantity of mothers' utterances. It remains to be explored how the quality of language experiences relate to Latino infants' vocabulary development.

In closing, the current study demonstrates significant group differences and individual variation in both English and Spanish vocabularies in the first 2 years in Dominican and Mexican infants in the United States. Infants' participation in literacy activities and observed exposure to maternal language mediate pathways from parents' language background and language use to infants' vocabulary development. In ongoing work, we are examining how these early differences predict Latino children's language and cognitive skills at school entry.

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