



PAPER

Ethnic differences in mother–infant language and gestural communications are associated with specific skills in infants

Catherine S. Tamis-LeMonda,¹ Lulu Song,¹ Ashley Smith Leavell,¹ Ronit Kahana-Kalman¹ and Hirokazu Yoshikawa²

1. Department of Applied Psychology, New York University, USA

2. Harvard Graduate School of Education, Harvard University, USA

Abstract

We examined gestural and verbal interactions in 226 mother–infant pairs from Mexican, Dominican, and African American backgrounds when infants were 14 months and 2 years of age, and related these interactions to infants' emerging skills. At both ages, dyads were video-recorded as they shared a wordless number book, a wordless emotion book, and beads and string. We coded mothers' and infants' gestures and language/vocalizations. Each maternal utterance was coded as referential (e.g. 'That's a bead') or regulatory (e.g. 'Put it there'). Mothers reported on infants' gestural, receptive, and productive vocabularies at 14 months, and infants were assessed on receptive language, expressive language, and action sequencing and imitation at 2 years of age. Mothers of the three ethnicities differed in their gesturing, distributions of the two types of language, and coupling of language and gestures. Mothers' ethnicity, language, and gestures were differentially associated with infants' 2-year skills. Mother–infant communicative interactions are foundational to infant learning and development, and ethnic differences in modes of early communication portend divergent pathways in the development of specific skills.

Introduction

Parent–infant interactions are a core conduit for infants' learning about their worlds. Consequently decades of scholarship have been dedicated to understanding the nature and developmental significance of parent–infant interactions for infants' emerging skills. Three overarching tenets characterize this body of work, and provide a framework to the present study. First, social interactions are 'multimodal' in that parents use different communicative modalities (e.g. gestures, vocalizations) to engage their infants for different purposes, and respond to multimodal signals from their infants to gauge babies' needs (Hsu & Fogel, 2003). Second, parent–infant interactions are both shaped by and a reflection of *culture*. Parents from all backgrounds interact with their infants in ways that promote universally relevant skills, while also providing infants with unique social experiences that portend culture-specific patterns of development (Adolph, Karasik & Tamis-LeMonda, 2010; Bornstein, 2010; Keller, Borke, Staufienbiel, Yovsi, Abels, Papaligoura, Jensen, Lohaus, Chaudhary, Lo & Su, 2009; Rogoff, 2003; Super & Harkness, 1986; Whiting & Whiting, 1975). Finally, parent–infant interactions are *dynamic* in that parents and infants adapt their communicative behaviors from moment-to-moment to meet

changing task demands, as well as across developmental time as infants acquire new skills (Hirsh-Pasek & Burchinal, 2006; Tamis-LeMonda, Way, Hughes, Yoshikawa, Kalman & Niwa, 2008).

What is of particular interest is whether and how early patterns of parent–infant interactions come to be reflected in infants' emerging skills. Infants from different backgrounds may develop communicative styles that mirror their everyday experiences with parents, such as how often they use gestures or vocalizations to convey their intentions. In turn, infants' early practice with different forms of communication might reinforce specific skills (e.g. expressive language, action imitation). If so, early behaviors observed in everyday mother–infant interactions might offer meaningful insight into divergent developmental pathways.

Ethnic differences in mother–infant interactions

Our first aim was to contrast language/vocalizations and gestures in mothers and infants from diverse ethnicities. Language/vocalizations and gestures were examined because of their developmental and social significance. Infant vocalizations are a major form of expression, and maternal vocalizations are the chief mode of response to infants. Individual differences in infants' vocalization

Address for correspondence: Catherine S. Tamis-LeMonda, New York University, Steinhardt School of Culture, Education and Human Development, Department of Applied Psychology, 246 Greene Street, 410W, New York, NY 10003, USA; e-mail: catherine.tamis-lemonda@nyu.edu

frequency and quality predict early language development (e.g. Goldstein & Schwade, 2008), and mothers' verbal responses to infant vocalizations predict infants' vocabulary growth and the timing of emerging language skills (Goldstein, Schwade & Bornstein, 2009; Smith, Landry & Swank, 2006; Huttenlocher, Vasilyeva, Waterfall, Vevea & Hedges, 2007; Tamis-LeMonda, Bornstein & Baumwell, 2001).

Gestures are also a primary means for communicating and regulating others' actions. Infants use gestures to request adult assistance and/or direct adult attention (Bigelow, MacLean & Proctor, 2004). Mothers use gestures to elicit attention and mark referents for infants, who learn new actions by observing adults' actions (Rowe & Goldin-Meadow, 2009a, 2009b). The coupling of gestures with verbalizations is more effective in eliciting infant attention than maternal verbalizations alone (e.g. Stack & Muir, 1992), and gestures facilitate infants' word learning (Matatyaho & Gogate, 2008; Zukow-Goldring & Arbib, 2007).

Nonetheless, despite the universal significance of language/vocalizations and gestures, mothers and infants from different backgrounds may differ in their relative emphases on the two forms of communication. For example, both parents and children from higher socioeconomic status (SES) backgrounds produce greater diversity in their gestures than their counterparts of lower SES backgrounds (Rowe & Goldin-Meadow, 2009a). However, studies of *ethnic* variation in mother–infant interactions are scarce. Typically, researchers contrast middle-income, White mother–child pairs with Latino and/or Black dyads, which risks confounding socioeconomic or minority status with ethnicity. Moreover, Latinos have generally been studied as a pan-ethnic group without distinctions among Latino ethnicities.

We examined gestural and verbal modes of communication in mother–infant dyads from Mexican, Dominican, and African American backgrounds. These groups differ in their cultural backgrounds, immigrant status, and parenting views and practices, and were therefore expected to differ in their relative emphases on gestures versus language during interactions, and possibly their coupling of gestures with different forms of language.

Mexicans are a recent Latino immigrant group to the Northeast United States (the study location), mostly first generation, with relatively low levels of education, and few years of education completed in the United States (Smith, 2006). Lower levels of schooling and exposure to mainstream US practices might result in greater emphasis on gestures relative to language in mother–infant interactions. For example, in one study of Guatemalan Mayan mothers and their 12- to 24-month-old children, Mayan mothers often communicated through gestures, gaze, touch, and posture, while conversing fluently with other adults (Chavajay & Rogoff, 1999; Rogoff, Mistry, Goncu & Mosier, 1993). In another study, first- to third-graders' observation of adults' demonstration of paper folding was compared in

children of Mexican heritage whose mothers had basic or more schooling and children of European American heritage whose mothers had extensive schooling (Mejía-Arauz, Rogoff & Paradise, 2005). European American heritage children were more likely to request extra information, whereas the Mexican heritage children whose mothers had only basic schooling were more likely to observe quietly. When they did request information, the European heritage children were more likely to do so verbally, whereas the Mexican heritage children whose mothers had basic schooling more often requested information nonverbally, through gesture, touch, and facial expressions. When the three groups of children were asked to fold paper in triads, the Mexican heritage children whose mothers had basic schooling often used nonverbal conversation involving actions and gestures, whereas the European heritage children often talked. Mexican heritage children whose mothers had more schooling were intermediate on all comparisons (Mejía-Arauz, Rogoff, Dexter & Najafi, 2007). Mexican mothers of infants also emphasize nonverbal forms of interaction such as touch (Beckwith & Cohen, 1984; Richman, Miller & LeVine, 1992).

Dominicans have a longer history in the Northeast than Mexicans and therefore tend to be more acculturated, with higher proportions of multi-generational households (Yoshikawa, 2011). As parents reside in the United States for longer periods, they increasingly adopt the language and customs of the host society, and likewise change in their views and practices around teaching (Cabrera, Shannon, West & Brooks-Gunn, 2006; Tamis-LeMonda *et al.*, 2008). Consequently, Dominicans may be more likely than Mexicans to use language as a core channel for communicating with infants.

African Americans differ from both Mexicans¹ and Dominicans in that although they are of minority status, they may be more likely to adopt mainstream US practices in rearing their infants. US-born African American mothers will have experienced US schooling for their entire childhoods, which may result in internalization of consistent messages about the value of language interactions in the early years. And census data indicate that their educational attainment is higher than that of first-generation immigrants from Mexico or the Dominican Republic (Crissey, 2009). On this account, African American mothers might be more likely to use distal forms of communication (language) and rely less on gesture than Latinos.

Beyond the sheer amount of language, mothers of the three groups might differ on functional aspects of language use. Mexican and Dominican mothers might be more likely to use language to regulate or direct their infants' actions (e.g. 'Put it there') than as a tool of

¹For simplicity, we use the term 'Mexican' and 'Dominican' rather than 'Mexican American' and 'Dominican American' to refer to these US immigrant groups.

reference (e.g. 'That's a blue ball'). Mexican parents of older children are less likely to teach school-related skills to their children than European American parents (Heath, 1986) and some view teaching to be the responsibility of teachers (Fuligni & Fuligni, 2007). Studies of immigrant Dominican mothers indicate a strong emphasis on teaching, but with high parental control (Laosa, 1980; Planos, Zayas & Busch-Rossnagel, 1997). Differences in mothers' functional use of language might again be due to educational differences across the groups. Working- and lower-class mothers and those with fewer years of education more frequently use language to direct their children's behavior compared to upper middle-class mothers; in contrast, upper middle-class mothers are more likely to respond to children's utterances, display more diverse lexicons and longer utterances, and use speech to elicit conversations from children compared to working- and lower-class mothers (Heath, 1986; Hoff-Ginsberg, 1991; Rowe, 2008). These social class differences are more pronounced in certain settings (mealtime) than others (bookreading) (Hoff-Ginsberg, 1991).

Ethnic differences might also be seen in mothers' coupling of language and gestures. If Mexican mothers (and perhaps Dominican mothers) gesture more and use more regulatory language than referential language when compared to African American mothers, their gestures may be more likely to be paired with the more dominant mode of language, functioning to direct children's actions or attention. African American mothers might use gestures more with referential language, as a tool for learning.

Finally, infants and mothers might vary in their use of gestures and language across different tasks or situations. In one study, mothers and their 13- and 21-month-old infants used more vocabulary during play than mealtime (Bornstein, Tamis-LeMonda & Haynes, 1999). Mothers also direct more speech toward their toddlers during book-sharing than toy play (Ninio & Bruner, 1978; Fletcher & Reese, 2005). Mexican American and Anglo mothers of 4-year-olds differed in the use of commands, labels and descriptors when engaged in school-related (categorization) versus everyday (shoelace tying) tasks (Moreno, 2000).

Differential skills

A second aim was to examine specificity of associations between early patterns of mother–infant interaction and infants' emerging skills. We postulated that variation in mothers' language and gestures would be associated with cognitive skills in infants that were specifically supported by these different behavioral forms – such as expressive language, receptive language, and infants' action sequencing and imitation.

Studies of parent–infant interactions indicate that infants exposed to more language have larger vocabularies (Hart & Risley, 1995; Huttenlocher, Haight, Bryk,

Seltzer & Lyons, 1991). The amount of maternal speech at 16 months predicts infants' vocabulary growth up to 26 months (Huttenlocher *et al.*, 1991). In addition, children from high-SES families have larger vocabularies than children from mid- or low-SES families, and children's exposure to maternal speech accounts for these differences (Hoff, 2003).

Parent and child gesture may also support children's language skills. Parent gesture is related to infant gesture, which in turn predicts children's vocabulary development in preschool (Rowe & Goldin-Meadow, 2009a; Rowe, Özçaliskan & Goldin-Meadow, 2008). For example, gestural combinations in both Italian and American infants predict the age of onset of two-word speech (Iverson, Capirci, Volterra & Goldin-Meadow, 2008), and different aspects of 18-month-olds' gestures predict later lexicon and sentence complexity (Rowe & Goldin-Meadow, 2009b).

Parents who use more gestures have infants who produce more gestures. In Italy, children are exposed to a gesture-rich culture during interactions with others (Kendon, 2004); in turn, Italian children display a greater repertoire of conventional gestures (e.g. bringing empty hand to lips for *eat*) compared to American children, yet smaller expressive vocabularies (Iverson *et al.*, 2008). In US families of diverse SES backgrounds mothers' gestures relate to children's gestures at 14 months after controlling for parent talk (Rowe *et al.*, 2008).

Gestural communications may also promote infants' skills at sequencing and imitating actions. Gestural communications require infants to keenly observe and decipher the meanings conveyed by others' hand movements, and to use their own hands and actions to communicate intentions to others. Action sequencing and the imitation of actions – such as copying how someone folds an origami figure, inserts a peg into a board, or uses a crayon to draw a circle – also call upon keen visual attention and the interpretation and replication of action. Thus, these specific cognitive skills may be rooted in infants' early experiences with gestural forms of communication. Indeed, developmental neuropsychology conceptualizes gestural skills along multiple dimensions, including the use of nonverbal behaviors to convey meaning (e.g. waving bye-bye) and skilled sequences in which children string together gestures to complete an action in response to verbal commands and/or in imitation (Dewey, 1995; Dewey, Cantell & Crawford, 2007).

Current study

We examined ethnic similarities and differences in mother and infant communicative behaviors during different tasks when infants were 14 months and 2 years of age, and asked whether within- and between-group variation in these behaviors would relate to infants' emerging skills at the two ages. We expected certain aspects of mother–infant interactions to yield similar patterns across ethnicities. For example, mothers were

expected to use more referential language when sharing books and more regulatory language when stringing beads. In terms of ethnic differences, Mexican mothers, followed by Dominicans, were expected to use more gestures and regulatory language than African American mothers, who were expected to use more referential language. The two Latino groups were expected to be more likely to couple gestures with regulatory language than African American mothers; instead, African American mothers were expected to be more likely to couple gestures with referential language.

In turn, Mexican infants were expected to show stronger gestural and receptive language skills but lower expressive language skills than infants of the other groups, Dominican infants were expected to display stronger expressive language skills than Mexican infants and stronger gestural skills than African American infants. African American infants were expected to display greater expressive language skills relative to both groups of Latino infants. Finally, individual differences in mothers' and infants' observed gestures at the two ages were expected to relate to infants' action sequencing and imitations specifically, whereas mothers' and infants' language/vocalizations were expected to relate to 2-year receptive and expressive language skills.

Methods

Participants

Three hundred and twenty-four (324) mothers (self identified as Dominican, Mexican, or African American) were recruited from maternity wards after giving birth to their full-term, healthy focal children (163 boys and 161 girls). Dominican mothers were 79% first-generation and 20% second-generation. Mexican mothers were 96% first-generation. All African American mothers were US-born, and their mothers had been born in the US as well.

Of the initial sample, 226 mother–infant dyads (70%) are included here (75 African American, 80 Dominican, 71 Mexican; 105 boys and 118 girls) based on mother–infant pairs who participated in at least one home visit. The 98 (30%) families who dropped from the study were those who were unable to be located, moved beyond a 100-mile catchment area, did not have interaction data, declined further participation, or had children later diagnosed with disability. Attrition analyses indicated no differences between mothers with and without data. Missing values were imputed (Graham, 2009).

Mothers ranged from 18 to 46 years old ($M = 26.24$ years, $SD = 6.20$). African American and Dominican mothers and fathers averaged about 12 years of education. Mexican mothers and fathers had about 8 years of education which was lower than the other two groups, $ps < .001$. All African American mothers were fully schooled in the United States, compared to only 26% of Dominicans and 7% of Mexicans.

Procedures

Data for the current study are based on interviews with mothers, video-recorded mother–infant interactions at the 14-month and 2-year visits, and assessments of children's cognitive skills at 2 years. At the 14-month assessment, mothers reported on their infants' gestural, receptive, and productive vocabularies based on the MacArthur Communicative Development Inventory (MCDI; Fenson, Dale, Reznick, Thal, Bates, Hartung, Pethick & Reilly, 2004) in English or the MacArthur Inventario del Desarrollo de Habilidades Comunicativas in Spanish (IDHC; Jackson-Maldonado, Thal, Fenson, Marchman, Newton & Conboy, 2003). At the 2-year visit, three sets of skills were assessed in infants: Expressive Language, Receptive Language, and Action Sequencing and Imitation. These were based on mothers' report of infants' productive vocabulary on the 2-year MCDI or IDHC and direct testing of infants using the Mullen Scales of Early Learning (Mullen, 1995). Native Spanish speakers, fluent in English, translated the Mullen Scales into Spanish with back-translations. Associations among subscales and relations to MCDI and IDHC did not differ across the three ethnicities or language of assessment.

Mothers were interviewed in their primary language by native speakers. All African Americans, 25% of Dominican mothers, and 9% of Mexican mothers spoke English, and the rest Spanish. Families were given \$75 at each visit.

Mother–infant interactions

At each age, mothers and infants were videotaped sharing: (1) a wordless number book; (2) a wordless emotion book; and (3) beads and string. The wordless number book included pictures of everyday objects of varying numbers (e.g. five cookies), sometimes with numerals. The emotion book featured photographs of infants expressing various emotions (e.g. crying, smiling). The beads were colorful wooden shapes including spheres and squares, with plastic strings for threading. During the video-recorded protocols (lasting 2–3 minutes each), mothers were told: '*We would like to videotape you and (CHILD) playing with some of the toys we brought*'. When mothers were handed the number book and the emotion book, they were told: '*Please share this book with your child*'. For the bead stringing task, they were told: '*Please play with these with your child*'.

These tasks were selected to present different demands to mothers and infants. Book-sharing might elicit more referential language, as mothers label and describe objects, whereas beads might elicit more regulatory language and behaviors as mothers guide actions. Additionally, the content of books might result in different use of gestures (e.g. heightened pointing for the number book when counting).

Mother and infant gestures and language/vocalizations were coded using Interact Software (Mangold, 2008); the frequencies of mothers' gestures, referential utterances, and regulatory utterances, and infants' gestures and vocalizations were exported for further analyses.

Mothers' and infants' *gestures* were coded as: (1) point at object (index finger extended); (2) show object (object is held up or waved); (3) object give (object is handed to the other person); (4) conventional (gesturing meaning; e.g. waving; opening/closing fist to request object). *Referential language* was reflected in utterances that provided or elicited information about objects or activities (e.g. 'That's blue'; 'Eso es azul') and questions ('What color is this?' 'Que color es este?'). *Regulatory language* included utterances that directed infants' attention or directed or corrected infants' actions ('Look!' 'Mira!'; 'Put it there!' 'Ponlo ahí!'). Infant vocalizations included non-distress vocalizations only.

Infant gestural, receptive, and productive vocabularies at 14 months

Mothers were asked about their infants' gestural, receptive, and productive vocabularies using the MCDI or IDHC based on the following guidelines: (1) If the mother indicated that her infant understood and spoke English or Spanish *only*, the MCDI or IDHC *only* was used; (2) 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 (3) in instances where the mother indicated her infant was using both languages, both checklists were used. All African American mothers received the MCDI; 55% of the Dominican mothers and 81% of the Mexican mothers received the IDHC, whereas the remaining Latino mothers received the MCDI. For Latino infants, regardless of language version, mothers were *always* asked for infants' vocabularies in the non-dominant language.

A bilingual interviewer read each word on the MCDI and/or the IDHC to mothers and asked whether the infant understood or said the word. In addition, questions on infants' vocabularies in the non-dominant language were asked at the end of each word grouping (e.g. toys, foods). For example, a mother reporting on the IDHC would be asked 'for the list of food items we just reviewed, are there any that your child says in English, such as apple, etc.? Can you tell me which food items she/he says in English?' Infants were credited with any words understood or produced in either English or Spanish.

Infants' *receptive vocabulary scores* were the sum of words infants understood but had not yet produced and the words infants had both understood and produced. Infants' *productive vocabulary scores* were the words infants produced. Receptive and productive vocabulary scores included English and Spanish words. Translation equivalents (words with the same meaning in the two

languages) were counted only once in the total productive vocabulary scores for Latino infants (see Pearson, Fernández & Oller, 1993).

Mothers also reported on infants' communicative gestures using the MCDI or the IDHC. They were asked about the 12 items on the MCDI which matched corresponding items on the IDHC (e.g. showing, pointing, giving an object, head shake for 'no', lip smacking for 'yummy'). For each item mothers responded whether the infant produced the gesture: 'Not yet', 'sometimes', or 'often'. A gesture score was calculated by summing the gestures that infants produced 'sometimes' or 'often' (range = 0–12).

Infants' expressive language at 2 years

Infants' expressive language at age 2 was based on a composite score summing standardized *z*-scores of the 2-year MCDI or IDHC productive vocabulary and infants' scores on the Mullen scale of Expressive Language ($r = .69, p < .001$).

The procedure for the MCDI or IDHC interview was identical to that at 14 months, except that mothers were only asked for words infants *produced*. At 2 years, 57% of the Dominican mothers and 81% of the Mexican mothers received the IDHC, 31% of the Dominican mothers and 5% of the Mexican mothers received the MCDI, and 12% of the Dominican mothers and 14% of the Mexican mothers received both language versions. All African American mothers received the MCDI. Again, regardless of the language version, infants were credited for producing a word in either English or Spanish.

For the Mullen scale of Expressive Language, examiners tested infants' ability to use language productively in response to oral information. For example, infants received points if they correctly named objects or labeled pictures. The Mullen scales produced normalized *T*-scores which were standardized for analyses. Infants were credited with an item if they correctly responded in Spanish or English.

Receptive language at 2 years

Infants' receptive language was tested with the Mullen Receptive Language scale. Items assess infants' ability to understand words or simple phrases. For example, infants were credited if they successfully identified body parts or objects in pictures by pointing to them after hearing prompts (e.g. 'Show me dolly's eyes').

Action sequencing and imitation at 2 years

Infants' skills at action sequencing and imitation were reflected in a composite score based on summing the standardized *z*-scores on the Visual Reception and Fine Motor scales of the Mullen ($r = .66, p < .001$). Items on both scales assess infants' abilities to carry

out and/or imitate sequences of actions to complete a task in response to visual information (e.g. modeling) and simple commands. For example, one set of items ask infants to select and then place different shapes (circle, square, triangle) into correct holes on a form-board after the examiner (a) points to the holes and places the shapes in their respective holes ('Watch me put them in their holes'); (b) removes the shapes from holes ('Watch me take them out'), and then (c) asks the child to re-place the shapes in their holes ('Now, you put them in'). Other sequences include nesting cups, sorting and placing objects into containers, etc. Similarly, the Fine Motor scale items assess infants' skills at carrying out various actions after a demonstration and simple verbal instructions. These include imitating crayon lines of different orientations ('Now we go this way'), placing pennies into slots of different orientations ('See we put them in'), stacking blocks and building towers ('You make one too'), screwing and unscrewing nuts and bolts ('You do it. You take it off'; 'Now, let's turn it on'), and stringing beads ('Watch while I string the beads'; 'It's your turn').

Results

The overarching study goals were to describe ethnic similarities and differences in mother and infant communicative behaviors across tasks and infant age, and examine whether individual variation in these behaviors relates to specific emerging skills in infants. To address the first goal, we conducted repeated-measures ANOVAs in which mother ethnicity (Mexican, Dominican, African American) and child gender served as between-subjects factors, and infant age (14 months and 2 years) and task (number book, emotion book, beads) served as within-subjects factors. Mother gestures, infant gestures, mother language (referential, regulatory) and infant vocalizations were dependent measures in separate models. Similarly, infants' gestures, receptive vocabulary, and productive vocabulary based on the 14-month MCDI or IDHC were evaluated as dependent measures in ANOVAs, with ethnicity and child gender serving as between-subjects factors.

Next, we examined ethnic differences in mothers' coordination of language and gestures, in terms of proportions of utterances that were augmented with gestures. We also conducted regression analyses to test ethnic similarities and/or differences in *associations* between mothers' use of gestures and language. Mothers' language type (referential or regulatory) served as dependent variables, and ethnicity, gestures and the ethnicity \times gesture interaction were predictors.

To address the second goal, we tested the unique contributions of infant and mother communicative language/vocalizations and gestures at 14 months and 2 years to infants' 2-year skills in regressions. Separate regressions were conducted for each of the three infant

skills at 2 years (action sequencing and imitations, receptive language, and expressive language). The first step of regressions included contrasts for Mexican and Dominican ethnicity (African Americans as referent group) and demographic controls of infant gender, mothers' years education, and father residency. The second step included 14-month mother and infant gestures and vocalizations/language. The third step included mothers' and infants' gestures and language/vocalizations at 2 years.

Mother–infant communicative behaviors

Mother gestures

Mothers of all ethnicities gestured (see Table 1). Of the four gesture types, *points* were most prevalent, constituting 72% and 68% of mothers' gestures at the two ages. Mothers' *object shows* and *gives* accounted for 10% to 16% of gestures at the two ages, and *conventional gestures* were least frequent, 3% and 4% of gestures.

Mothers gestured most frequently when sharing the number book followed by beads and emotion book, as indicated by a main effect for task, $F(2, 440) = 139.25$, $p < .001$. They increased gestures over infant age, $F(1, 220) = 54.19$, $p < .001$, with increases seen for points, conventional, and give gestures (all $ps < .001$). Age changes in mothers' gesturing primarily occurred during sharing of the number book, as indicated in a significant interaction between task and child age, $F(2, 440) = 5.68$, $p < .01$.

As hypothesized, Mexican and Dominican mothers gestured more frequently than African American mothers, $F(2, 220) = 5.98$, $p < .005$. However, ethnic differences in mothers' gestures were qualified by children's age, $F(2, 220) = 7.87$, $p = .001$ (see Figure 1). At the 14-month assessment, Mexican mothers gestured the most, but by the 2-year assessment, Dominicans caught up in their frequency of gesturing. African American mothers were low in their gesturing compared Mexicans at 14 months and both Latino groups at 2 years. Ethnic differences in gesturing were seen for *points*, *gives*, and *shows* at 14 months and *points* at 24 months, indicating more frequent gesturing by Mexicans and Dominicans relative to African Americans (all $ps < .05$). Ethnicity \times task and ethnicity \times task \times age interactions were not significant, and no gender differences emerged.

Mother language

Mothers' referential and regulatory language accounted for 92% of mothers' total utterances across the three ethnicities (range 89% to 94%). Although the overall amount of talk did not differ among the ethnic groups, ethnic differences emerged across language type and task. Specifically, a significant ethnicity \times language type interaction, $F(2, 220) = 17.92$, $p < .001$, indicated that

Table 1 *Infant and mother behaviors by age, task, and ethnicity*

| Infant behaviors | Mexican | | Dominican | | African American | |
|-------------------------|---------------|---------------|---------------|---------------|------------------|---------------|
| | 14 Months | 2 Years | 14 Months | 2 Years | 14 Months | 2 Years |
| <i>Number Book</i> | | | | | | |
| Vocalize | 9.30 (7.62) | 20.32 (13.21) | 11.74 (9.21) | 24.30 (14.10) | 9.33 (8.87) | 24.71 (13.11) |
| Gesture | 6.52 (6.79) | 10.17 (8.56) | 4.31 (6.12) | 11.57 (11.27) | 3.09 (5.12) | 9.10 (10.01) |
| <i>Emotion Book</i> | | | | | | |
| Vocalize | 8.21 (6.17) | 14.06 (10.55) | 10.11 (8.57) | 18.11 (11.17) | 9.24 (7.11) | 14.06 (10.51) |
| Gesture | 2.75 (3.69) | 5.09 (5.54) | 2.76 (5.16) | 4.55 (5.45) | 2.70 (5.00) | 3.80 (5.15) |
| <i>Beads</i> | | | | | | |
| Vocalize | 6.12 (6.89) | 15.21 (14.00) | 9.40 (8.43) | 20.29 (14.44) | 5.84 (7.86) | 16.41 (12.50) |
| Gesture | 2.57 (3.91) | 2.49 (2.51) | 2.88 (3.80) | 4.05 (4.28) | 2.98 (4.04) | 3.88 (3.74) |
| <i>Mother behaviors</i> | | | | | | |
| <i>Number Book</i> | | | | | | |
| Gesture | 14.48 (11.03) | 19.24 (11.78) | 11.81 (10.08) | 21.02 (13.60) | 12.58 (8.61) | 15.31 (11.34) |
| Referential | 24.96 (13.10) | 30.26 (12.69) | 25.01 (15.52) | 30.94 (12.83) | 28.07 (13.33) | 32.27 (13.65) |
| Regulatory | 16.31 (9.95) | 14.95 (8.84) | 12.40 (9.46) | 14.29 (8.01) | 12.52 (7.82) | 8.85 (7.76) |
| <i>Emotion Book</i> | | | | | | |
| Gesture | 7.30 (5.88) | 9.00 (6.75) | 5.74 (5.52) | 10.38 (6.39) | 5.04 (5.03) | 6.64 (8.02) |
| Referential | 18.05 (9.46) | 23.56 (10.53) | 16.61 (11.33) | 24.00 (10.44) | 19.53 (11.57) | 23.01 (10.08) |
| Regulatory | 16.87 (9.18) | 18.38 (10.87) | 17.40 (11.18) | 15.14 (9.39) | 13.65 (7.91) | 12.19 (10.08) |
| <i>Beads</i> | | | | | | |
| Gesture | 12.50 (8.57) | 11.37 (5.57) | 8.40 (8.08) | 13.18 (6.36) | 8.46 (6.52) | 11.84 (5.88) |
| Referential | 6.36 (6.85) | 7.86 (10.00) | 8.40 (8.78) | 13.83 (11.27) | 7.12 (8.17) | 14.97 (10.37) |
| Regulatory | 36.48 (21.29) | 39.68 (18.43) | 35.41 (20.17) | 42.43 (16.71) | 29.47 (21.26) | 30.93 (18.00) |

Note: Standard deviations are shown in parentheses.

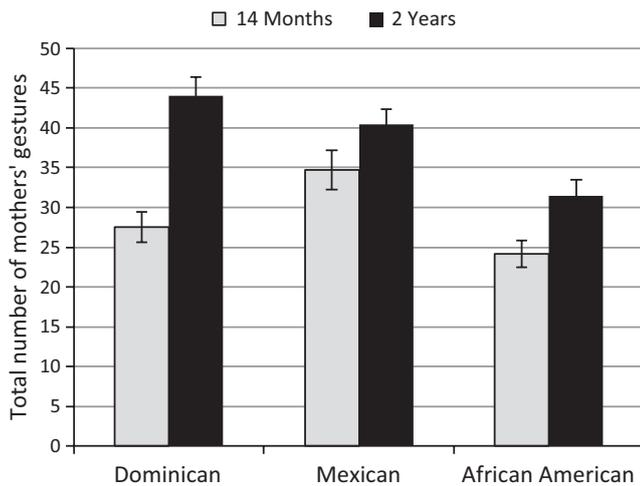


Figure 1 *Ethnic differences in frequencies of mothers' gestures at 14 months and 2 years.*

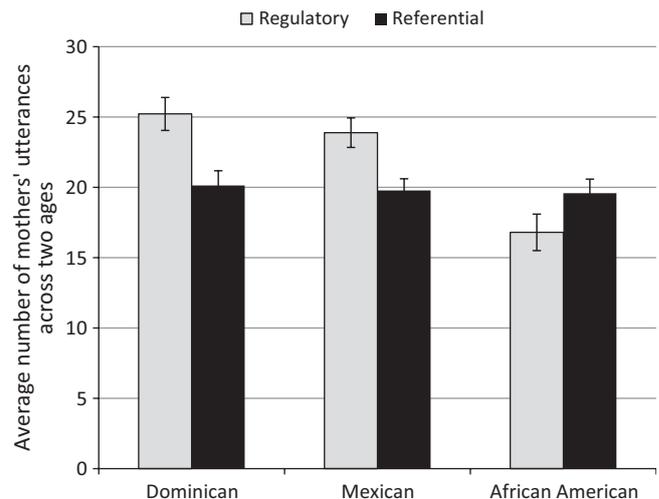


Figure 2 *Ethnic differences in frequencies of mothers' regulatory and referential language.*

African American mothers used more referential than regulatory language, whereas Dominican and Mexican mothers used more regulatory than referential language (see Figure 2). A significant ethnicity \times task interaction, $F(4, 440) = 4.71, p = .001$, indicated that Mexican and Dominican mothers talked more during bead stringing than did African American mothers. This interaction helps explain ethnic differences in mothers' type of language. That is, mothers displayed more regulatory language during bead stringing but more referential language during booksharing, reflected in a significant task \times language type interaction, $F(2, 440) = 749.03, p < .001$.

Mother language and gestures

At 14 months, 20.6% of referential and 14.3% of regulatory vocalizations were followed by a gesture (within a 2 sec window). At 24 months, 22.4% of referential and 16.2% of regulatory vocalizations were followed by a gesture. A 3 (ethnicity) \times 2 (age) \times 2 (vocalization type) ANOVA was conducted, with proportion of vocalizations that contained a gesture serving as a dependent variable. The ANOVA yielded a main effect for vocalization, $F(1, 125) = 97.01, p < .001$, and a main effect for ethnicity, $F(2, 125) = 7.26, p < .001$. A higher proportion of referential vocalizations were accompanied by gestures

compared to regulatory vocalizations, and Mexican mothers were more likely to accompany their vocalizations with a gesture (21.2% of vocalizations) than were African American (15.9%, $p = .001$) or Dominican mothers (17.1%, $p = .004$).

To examine ethnic differences in language–gesture associations, we regressed mothers’ gestures, ethnicity, and the ethnicity \times gesture interaction on the two language types (at each age) (see Figure 3). At the 14-month assessment, mothers’ gestures were associated with mothers’ referential language, b (standardized beta) = .53, $t(219) = 3.98$, $p < .001$, indicating that mothers who gestured more frequently also used more referential language. However, the association was stronger for African American mothers compared to Dominican and Mexican mothers, as supported by a significant interaction between Latino status and gestures, $b = -.44$, $t(219) = -2.40$, $p = .017$. Latino status, child gender, mothers’ years of education, and father residency (also entered in models) did not predict mothers’ referential language.

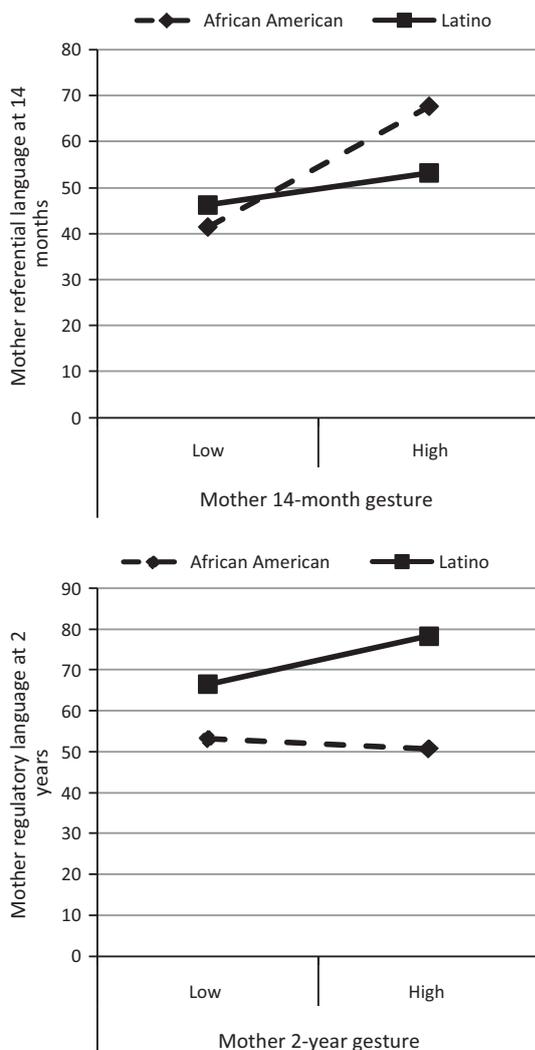


Figure 3 Association between mothers’ gestures and language varies by Latino status.

At the 2-year assessment, mothers’ gestures again related to mothers’ referential language, $b = .27$, $t(219) = 2.32$, $p = .02$, but ethnicity no longer moderated the association between gestures and referential language. Mothers’ years of education was also associated with mothers’ referential language, $b = .19$, $t(219) = 3.00$, $p = .003$, whereas Latino status, child gender, and father residency were not.

Mothers’ gestures did not relate to regulatory language at 14 months, $b = -.22$, and ethnicity did not moderate associations. However, sequential analyses of the conditional probabilities of mothers’ gesturing following regulatory language indicated that Mexican and Dominican mothers paired regulatory language and gestures in real time ($z_s = 10.78$ and 5.76 , $p_s < .01$), whereas African American mothers did not ($z = 0.02$, ns). By the 2-year assessment, a significant interaction between Latino status and gestures indicated positive associations between gestures and regulatory language in the two Latino groups only, $b = .44$, $t(219) = 2.42$, $p = .016$.

Infant gestures

Infants’ distribution of gesture types mirrored that of mothers. Infant *points* accounted for 63% and 72% of all gestures at the two ages. *Object shows* and *gives* accounted for 8% to 23% of gestures, and *conventional gestures* were least frequent, accounting for 5% to 7% of all gestures.

Infants gestured the most during the number book, $F(2, 440) = 73.99$, $p < .001$, and increased their gestures between the two ages, $F(1, 220) = 72.85$, $p < .001$. Age gains were seen for *points*, *object shows*, and *conventional gestures* ($p_s < .05$ to $.001$). The age \times ethnicity interaction was not significant, indicating similar age-related changes in gesturing across the three groups of infants. An age \times task interaction indicated the greatest gains in gestures during the number book, $F(2, 440) = 28.65$, $p < .001$.

Ethnic differences were not seen in infant gestures and no differences were seen when the four types of gesture were examined separately. However, a significant ethnicity \times task interaction, $F(4, 440) = 2.67$, $p < .05$, indicated that Mexican infants produced more gestures than Dominican or African American infants when sharing the number book but fewer gestures than the other two groups when sharing beads (see Figure 4). Mexican infants’ high rates of gesturing when sharing the number book and reduced rates of gesturing during bead stringing paralleled the task specificity demonstrated in mothers’ gesturing, suggesting that Mexican infants’ gestures are more attuned to task demands than those of the other two groups of infants. The main effect of gender and all interactions involving gender as well as the task \times age \times ethnicity interaction were not significant.

Infant vocalizations

Infants of all ethnicities vocalized most when sharing the number book, $F(2, 440) = 43.63$, $p < .001$, increased their

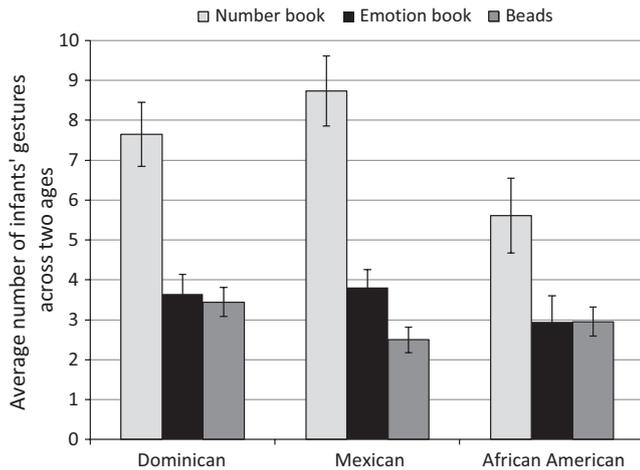


Figure 4 Ethnic differences in frequencies of infants' gestures by task.

vocalizations over age, $F(1, 220) = 204.55, p < .001$, and showed larger gains in vocalizations during the number book and beads compared to the emotion book, as seen in a significant task \times age interaction, $F(2, 440) = 22.37, p < .001$. Ethnic differences were also seen in infant vocalizations, $F(2, 220) = 4.66, p = .01$. Mexican and African American infants displayed fewer vocalizations than Dominican infants. The age \times ethnicity task \times ethnicity, and task \times age \times ethnicity interactions and all analyses by gender were not significant.

Infant gestures and vocalizations

To assess associations between infants' gestures and vocalizations, two regressions were conducted with infants' vocalizations at 14 months and 2 years as dependent variables, and infant gestures, ethnicity, and ethnicity \times gesture interactions as predictors. The regressions models did not yield any significant predic-

tors in the final step. However, sequential analyses indicated that the conditional probabilities of infants' pairing gestures with vocalizations were significant at 14 months ($z_s = 7.65$ for Mexicans, 5.67 for Dominicans, and 5.20 for African Americans, $ps < .01$) and 2 years ($z_s = 11.02$ for Mexicans, 16.11 for Dominicans, and 13.04 for African Americans, $ps < .001$). Thus, although it was not necessarily the case that infants who vocalized more also gestured more (reflected in the regression analyses), when infants vocalized, there was a high likelihood that they would pair the vocalization with a gesture, when base rates of the two behaviors were considered.

Concurrent associations between mother and infant communicative behaviors

Mothers' gestures at 14 months and 2 years was associated with infants' gestures at the two ages ($r_s = .18$ and $.22, ps < .01$ and $.001$) and mothers' gestures at 2 years was associated with infants' vocalizations at 2 years ($r = .19, p < .001$). Mothers' referential language at 2 years was associated with infant vocalizations and gestures at 2 years ($r_s = .36$ and $.32, ps < .001$). Neither mothers' regulatory language at either age nor mothers' referential language at 14 months related to infants' vocalizations or gestures.

Infants' gestural, receptive, and productive vocabularies at 14 months

We next examined whether infants of the three ethnicities differed in the sizes of their gestural, receptive, and productive vocabularies at 14 months based on the MCDI or IDHC.

An ANOVA on infant gestures, with ethnicity and infant gender serving as between-subjects variables and gestural vocabulary size serving as the dependent measure, yielded significant main effects for ethnicity, $F(2,$

Table 2 Hierarchical regression final step prediction of action sequencing and imitation/action skills, receptive, and expressive language at 2 years

| | Action sequencing and imitation | | | Receptive language | | | Expressive language | | |
|----------------------|---------------------------------|------|----------|--------------------|------|-------------------|---------------------|------|-------------------|
| | B | SE B | β | B | SE B | β | B | SE B | β |
| Dominican | 0.62 | 0.28 | 0.17* | 0.54 | 1.57 | 0.03 | -0.41 | 0.27 | -0.11 |
| Mexican | 1.09 | 0.34 | 0.30** | 5.32 | 1.92 | 0.25*** | -0.96 | 0.33 | -0.26** |
| Baby Sex | -0.08 | 0.22 | -0.02 | 0.37 | 1.25 | 0.02 | 0.36 | 0.21 | 0.11 |
| Mother Education | 0.05 | 0.05 | 0.08 | 0.06 | 0.25 | 0.02 | 0.03 | 0.04 | 0.05 |
| Father Residency | -0.34 | 0.25 | -0.10 | -1.11 | 1.39 | -0.05 | -0.09 | 0.24 | -0.03 |
| Mom Referential 14 M | 0.00 | 0.01 | 0.05 | 0.01 | 0.03 | 0.02 | 0.01 | 0.00 | 0.09 ^b |
| Mom Gesture 14 M | 0.03 | 0.01 | 0.24** | 0.09 | 0.04 | 0.16* | 0.01 | 0.01 | 0.06 |
| Infant Vocalize 14 M | 0.01 | 0.01 | 0.12 | 0.06 | 0.04 | 0.11 ^a | 0.00 | 0.01 | 0.04 |
| Infant Gesture 14 M | -0.00 | 0.01 | -0.02 | -0.13 | 0.07 | -0.13 | -0.02 | 0.01 | -0.09 |
| Mom Referential 2 Y | 0.01 | 0.01 | 0.08 | 0.10 | 0.03 | 0.25*** | 0.01 | 0.01 | 0.13 |
| Mom Gesture 2 Y | -0.02 | 0.01 | -0.26*** | -0.12 | 0.04 | -0.23** | -0.01 | 0.01 | -0.09 |
| Infant Vocalize 2 Y | 0.00 | 0.00 | 0.02 | 0.01 | 0.02 | 0.03 | 0.01 | 0.00 | 0.21** |
| Infant Gesture 2 Y | 0.03 | 0.01 | 0.20** | 0.12 | 0.05 | 0.17* | 0.01 | 0.01 | 0.06 |

Note: * $p < .05$; ** $p < .01$; *** $p < .001$; ^a Predictor of receptive language in step 2 of regression ($p = .011$), but attenuates when other predictors added to model; ^b Predictor of expressive language in step 2 of regression ($p = .019$) but attenuates when other predictors added to model.

220) = 3.13, $p < .05$, and infant gender, $F(1, 220) = 5.98$, $p < .05$. Mexican and Dominican infants had more gestures in their repertoires than African American infants ($ps = .05$ and $.02$), but did not differ from one another. Girls produced more gestures than boys. The ethnicity \times gender interaction was not significant.

Next, ethnic and gender differences in infants' receptive and productive vocabularies were tested in a 3 (ethnicity) \times 2 (language skill – receptive and productive) \times 2 (gender) repeated-measures ANOVA. This analysis yielded a main effect for language skill, $F(1, 220) = 293.70$, $p < .001$, a main effect for ethnicity, $F(2, 220) = 4.81$, $p < .01$, and a significant ethnicity \times language skill interaction, $F(2, 220) = 9.16$, $p < .001$ (see Figure 5). Infants understood more words than they produced. Moreover, Mexican infants displayed an advantage in receptive language, which was also reflected in an overall language advantage (ethnicity main effect), but they had significantly smaller productive vocabularies than African American and Dominican infants. Consequently, their receptive–productive language gap exceeded that of Dominican and African Americans. Analyses involving gender were not significant.

Associations with infants' cognitive skills at 2 years

The second aim was to examine whether mother and infant gestures and language/vocalizations would differentially relate to 2-year-olds' action sequencing and imitation, receptive language, and expressive language. Table 2 presents the final step of regressions for clarity of presentation. Because mothers' regulatory language did not relate to any infant outcomes, it was not included.

As shown in the first column of Table 2, both Mexican and Dominican infants scored higher than African American infants on action sequencing and imitations. Mothers' frequency of gesturing across the three tasks at 14 months related to this outcome as well. By 2 years, infants' observed gestures were associated with higher

action sequencing and imitations. Mothers' gestures at 2 years also related, but by this time more frequent maternal gesturing was associated with *lower* infant action sequencing and imitations. High gesturing by mothers towards their 2-year-olds, after covarying earlier maternal gesturing, might reflect mothers' compensations for lower infant skill. Overall, predictors accounted for 17% of the variance.

Mexican ethnicity was positively associated with infants' *receptive* language skills at 2 years. Mothers' gestures at 14 months related to infants' 2-year receptive language skills. At infant age 2 years, both mothers' referential language and infants' gestures were associated with higher scores. As with infant action sequencing and imitations, mothers' gesture at 2 years was negatively associated with infants' receptive language. Counter to expectations, infants' vocalizations at 2 years was not associated with their receptive language. However, infants' vocalizations at 14 months was associated with receptive language at the second step (Beta = .23, $p = .011$), with the association attenuating to nonsignificance at the final step. Predictors accounted for 18% of the variance.

Finally, Mexican infants displayed lower *expressive* language than African American and Dominican infants. None of the 14-month mother or infant language or gesture variables related to 2-year expressive language in the final step. However, mothers' referential language at 14 months was significantly associated with infant later expressive language at the second step before entering the 2-year concurrent infant vocalizations (Beta = .16, $p = .019$). Bootstrapping analysis confirmed that infant vocalizations at 2 years mediated the association between mothers' referential language at 14 months and infant 2-year expressive language skill, as the bias corrected confidence intervals of the mediator did not include zero (Preacher & Hayes, 2004, 2008). By 2 years, infants' vocalizations (but not gestures) were associated with greater expressive language scores, supporting expectations of specificity of association. This model accounted for 23% of the variance.

Discussion

Our findings highlight the multi-modal, dynamic, and culturally embedded nature of mother–infant communications and infant development. Social interactions provide infants with opportunities to observe and practice different forms of communication, and these early experiences set in motion divergent developmental trajectories.

Mothers' language and gestures

Maternal support of learning may take different forms depending on the situation. Mothers appeared to teach infants 'about the world' when sharing books versus how

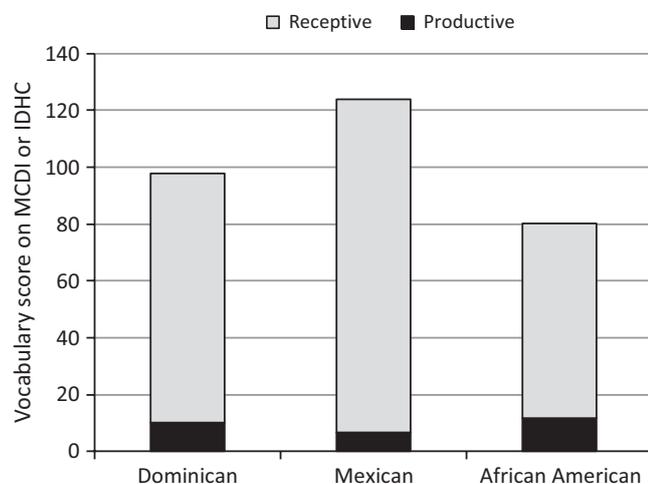


Figure 5 Parental reports of infants' receptive and productive vocabulary on the MCDI or IDHC at 14 months.

to 'act in the world' when sharing beads. These findings highlight the need to attend to situational influences on early communicative patterns when drawing inferences about within- and between-group variation in parenting. In terms of developmental significance, to the extent that individual mothers engage their infants in different activities and routines over the course of a day, infants will experience unique language environments and trajectories of language development. This idea is further supported by ethnic differences in mothers' type of language across the different tasks. Mexican and Dominican mothers talked most during bead stringing and used more regulatory than referential language when compared to African American mothers. Thus, mothers' choices about *when* to talk appeared to shape *how* they talked.

Others have also highlighted contextual influences on the forms of language that mothers use, and noted that such influences might explain cultural differences in infants' language development. For example, in a study of English- and Mandarin-speaking toddlers, regardless of the language spoken, children's vocabularies and mothers' speech to children were characterized by greater noun use during book reading than play (Tardif, Gelman & Xu, 1999). The heightened use of referential language during book-sharing might explain the benefits of such experiences for infants' cognitive development (e.g. Raike, Pan, Luze, Tamis-LeMonda, Brooks-Gunn, Constantine, Tarullo, Raike & Rodriguez, 2006).

Ethnic differences also emerged in mothers' use of gestures and their coupling of language and gestures. Mexican mothers gestured most (especially at the 14-month assessment), and were more likely to augment language with gestures than African American and Dominican mothers. Dominicans 'caught up' in their gestures by the 2-year assessment, whereas African American mothers remained relatively low in this form of communication. However, even though African American mothers gestured less frequently than Latino mothers, they tended to use gestures to augment their *referential* statements to infants. In contrast, associations between gestures and *regulatory* language were only seen in Latino mothers, who were also more likely than African American mothers to follow regulatory language with gestures in real time.

The pairing of gestures and speech is thought to reflect a single coupled, communicative system that emerges out of biases towards moving hands and mouth together, which is strengthened over time with experience (Iverson & Thelen, 1999). Our findings suggest universality in the coupling of these communicative forms, yet cultural specificity in the types of utterances most likely to accompany gesture. The finding that Latino mothers specifically – who more frequently expressed regulatory language relative to referential language – were likely to augment this form of speech with gestures reinforces the idea that specific ensembles of action and cognition are reinforced through practice. Notably, because condi-

tional probabilities control for base rates of the behaviors in a sequence, this pairing is not an epiphenomenon of higher frequencies of regulatory language *per se*.

Why might mothers of different ethnic groups vary in their use of language and gestures? Perhaps education accounts for variation in parenting as well as infants' language development (e.g. Hoff, 2003), as mothers from the three groups studied here differed on educational level. However, ethnic differences were maintained after covarying maternal education, indicating that other factors, such as maternal knowledge or cultural belief systems, might be at play (Super & Harkness, 1986; Rowe, 2008). For example, beliefs that babies cannot understand the talk directed to them and that infants learn language on their own are thought to explain the relatively low levels of talking and different forms of speech seen in the Gusii of Kenya, the Kaluli of Papua New Guinea, and African Americans of the Southeastern United States relative to Caucasian parents (Heath, 1989; LeVine, 2004; Schieffelin & Ochs, 1986). Such beliefs might also account for the heightened use of gestures by Latino mothers, as ways of indicating meaning to their infants, especially when regulating infants' actions. Others find that parental knowledge of child development mediates relations between SES and child-directed speech to 30-month-olds (Rowe, 2008). Latino mothers' relatively high regulatory language might also reflect Latino values of proper behavior (Harwood, Miller & Irizarry, 1995) and the importance of children being 'tranquilo' and respectful (Calzada, Fernandez & Cortes, 2010).

Infants' vocalizations and gestures

The hypothesis that infants of the three ethnicities would display differential strengths in specific areas was supported. Mexican infants modified their gestures across tasks by increasing gestures when sharing books but reducing them when sharing beads. These findings align with the unique communicative styles documented in Mayan mothers and Mexican heritage children (Chavajay & Rogoff, 1999; Mejía-Arauz *et al.*, 2005, 2007; Rogoff *et al.*, 1993), and indicate that such patterns are already evident in infancy under controlled conditions in Mexican immigrant families.

Mexican and Dominican infants also had larger gestural vocabularies than African American infants at 14 months. Dominican and Mexican infants had higher scores on action sequencing and imitation assessments than African American infants, but displayed lower scores on their expressive language. Mexican infants were lowest on expressive language measures at both ages and vocalized the least during video-taped interactions. The lower expressiveness of Mexican infants was maintained even though most infants (over 95%) were being reared in monolingual households, dyads interacted and were tested in their native tongue (Spanish), and infants were credited for expressions in either language.

However, Mexicans had the largest receptive vocabularies at 14 months, resulting in a notable receptive–productive language gap at 14 months, and a gap between their expressive language and action skills at 2 years. Thus, Mexican infants appear to understand more than they produce and have specific strengths in following through on action-based commands that may not be captured by measures of expressive language.

Specificity of associations

Variations in mothers' and infants' gestures and language/vocalizations were associated with specific skills at 2 years of age, supporting the idea that early interactions with mothers shape children's developmental trajectories (Sameroff, 1975; Pence, Golinkoff, Brand & Hirsh-Pasek, 2005). Specifically, mothers' referential language at 14 months was associated with infants' expressive language skills at 2 years, although the association attenuated when later infant observed vocalizations was added to the model. In this case, infant observed vocalizations mediated the lagged association from mother to child. The benefits of mothers' referential language for infants' language development might be explained by the semantic richness of this form of language. Referential language offers specific lexical information about objects and events, including color, number and labels ('There are two green apples'), in contrast to regulatory language (which did not relate to any infant measures), which contains a high proportion of pronouns ('Put it there'). Receptive language skills were predicted by both forms of communication (i.e. gestures and language/vocalizations). It is likely that mothers' use of gestures when coupled with referential language supports infants' understanding of words (Rowe & Goldin-Meadow, 2009a, 2009b; Rowe *et al.*, 2008).

Finally, infant and mother gestures were associated with infants' action sequencing and imitation specifically, but did not relate to infants' expressive language skills. What might explain these associations? Gestures during social interactions specify the communicator's intentions – gestures convey meaning via visual modalities and often seek to elicit a desired response from the listener (e.g. the labeling of a picture; turning of a page). Similarly, action sequencing and imitation reflect the successful observation and completion of goal-directed actions, often in response to simple commands. Action sequencing and imitation does not simply reflect motor skill, as dissociations between motor and gestural performance have been documented (Dewey *et al.*, 2007). For example, children with ASD have problems with communicative gestures, which have been attributed to deficits in neural substrates for self–other mapping (Williams, Whiten & Singh, 2004), internal representation of movement (Smith & Bryson, 1994), and the linking of meanings in language to action (Rizzolatti, Fogassi & Gallese, 2001) (see Dewey *et al.*, 2007, for discussion). Infants' early experiences with gestural

communication might be foundational to later, more advanced action skills. Over development, infants might expand their gestural repertoires from simple forms (e.g. pointing to an object to share attention) to more complex action sequences (e.g. imitating a series of object placements). In addition, gestures have been characterized as both spatial tools and skills (e.g. Ehrlich, Levine & Goldin-Meadow, 2006; Hostetter & Alibali, 2008). As such, parents' use of gesture (as a tool) might support infants' enactments in spatial tasks.

Implications

Our findings have implications for work with parents and infants from diverse ethnicities. First, we identified very early onset of divergent developmental paths. Already by 14 months, infants of the three ethnicities showed differences in their communicative skills that were stable over time. Thus, interventions targeted at enhancing parents' use of multiple modalities in communication with very young infants – who are not yet using language themselves – may be most effective. Second, there are implications for the assessment of early communicative development. Measures of expressive language only may not accurately capture children's actual language skills, because some groups may show more dissociation between receptive and productive language, or between gestural expressions and language, as indicated here. Third, our findings speak to the forms of talk that bolster infant language. Whereas mothers' regulatory language did not relate to infant outcomes in any models, mothers' referential language was associated with infants' expressive language skills. Given that mothers are more likely to use referential language during book-sharing, parents should be encouraged to frequently engage young infants in book-sharing already in the first year of life, as a way to foster infants' communicative development. Finally, we reported differences in these ethnically diverse infants' from a *relative* standpoint. This does not mean that these infants were necessarily doing well on the tests we administered. In fact, despite substantial individual variation, infants were delayed on most measures. Family poverty poses risk to infant learning, and early interventions should target early emerging communicative skills to support later school readiness.

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