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The cross-racial/ethnic gesture production of young autistic children and their parents

Adrienne De Froy and **Pamela Rosenthal Rollins**
School of Behavioral and Brain Sciences, The University of Texas at Dallas, Callier Center for Communication Disorders, Dallas, TX, USA

Abstract

Background & Aims: Early gesture plays an important role in prelinguistic/emerging linguistic communication and may provide insight into a child's social communication skills before the emergence of spoken language. Social interactionist theories suggest children learn to gesture through daily interactions with their social environment (e.g., their parents). As such, it is important to understand how parents gesture within interactions with their children when studying child gesture. Parents of typically developing (TD) children exhibit cross-racial/ethnic differences in gesture rate. Correlations between parent and child gesture rates arise prior to the first birthday, although TD children at this developmental level do not yet consistently exhibit the same cross-racial/ethnic differences as their parents. While these relationships have been explored in TD children, less is known about the gesture production of young autistic children and their parents. Further, studies of autistic children have historically been conducted with predominantly White, English-speaking participants. As a result, there is little data regarding the gesture production of young autistic children and their parents from diverse racial/ethnic backgrounds. In the present study, we examined the gesture rates of racially/ethnically diverse autistic children and their parents. Specifically, we explored (1) cross-racial/ethnic differences in the gesture rate of parents of autistic children, (2) the correlation between parent and child gesture rates, and (3) cross-racial/ethnic differences in the gesture rates of autistic children.

Methods: Participants were 77 racially/ethnically diverse cognitively and linguistically impaired autistic children (age 18 to 57 months) and a parent who participated in one of two larger intervention studies. Naturalistic parent–child and structured clinician–child interactions were video recorded at baseline. Parent and child gesture rate (number of gestures produced per 10 min) were extracted from these recordings.

Results: (1) Parents exhibited cross-racial/ethnic differences in gesture rate such that Hispanic parents gestured more frequently than Black/African American parents, replicating previous findings in parents of TD children. Further, South Asian parents gestured more than Black/African American parents. (2) The gesture rate of autistic children was not correlated with parent gesture, a finding that differs from TD children of a similar developmental level. (3) Autistic children did not exhibit the same cross-racial/ethnic differences in gesture rate as their parents, a result consistent with findings from TD children.

Conclusions: Parents of autistic children—like parents of TD children—exhibit cross-racial/ethnic differences in gesture rate. However, parent and child gesture rates were not related in the present study. Thus, while parents of autistic children from different ethnic/racial backgrounds appear to be conveying differences in gestural communication to their children, these differences are not yet evident in child gesture.

Implications: Our findings enhance our understanding of the early gesture production of racially/ethnically diverse autistic children in the prelinguistic/emerging linguistic stage of development, as well as the role of parent gesture. More research is needed with developmentally more advanced autistic children, as these relationships may change with development.

Keywords

Autism, gesture, race/ethnicity, parent–child interaction

Corresponding author:
Adrienne De Froy, School of Behavioral and Brain Sciences, The University of Texas at Dallas, Callier Center for Communication Disorders, 1966 Inwood Road, Dallas, TX 75235, USA.
Email: adrienne.defroy@utdallas.edu

Introduction

Autism spectrum disorder (autism) is a complex neurodevelopmental condition characterized by disruptions in social communication in the presence of restricted/repetitive interests or behavior (American Psychiatric Association, 2022). Delays in spoken language are also common, resulting in a prolonged prelinguistic/emerging linguistic period for many autistic children (Coonrod & Stone, 2004; Landa & Garrett-Mayer, 2006).[1] Gesture—symbolic movement that serves a communicative function—generally appears before spoken language, allowing young children to communicate with others before they acquire speech (Crais et al., 2004; Iverson & Goldin-Meadow, 2005). Cross-culturally, typically developing (TD) children begin to gesture around 9 months of age (Blake et al., 2007; Crais et al., 2004, Guidetti & Nicoladis, 2008; Iverson & Goldin-Meadow, 2005). Comparatively, the gesture of autistic children follows a similar developmental trajectory as in typical development (Sowden et al., 2008; Talbott et al., 2020) but is characterized by slower growth (Iverson et al., 2018; Watson et al., 2013). For both groups of children, early gesture facilitates spoken language development, as evidenced by strong parallels between early gestural and later verbal communication (Capone & McGregor, 2004; Goodwyn et al., 2000; Iverson & Goldin-Meadow, 2005; Özçalişkan et al., 2016). Early gesture therefore plays an important role in prelinguistic/emerging linguistic communication and may provide insight into a child's social communication skills before the onset of more developmentally advanced skills, such as speech.

Parenting beliefs/practices and possible implications for parent gesture

Social interactionist and transactional theories of language (Bruner, 1983; Sameroff, 2009; Vygotsky, 1978) posit that children learn to communicate through continuous dynamic interactions with their social environment. The construction of a child's communication (including gesture) is influenced by caregiver input. This input varies cross-culturally because gestures are, at least in part, culturally defined actions (Cartmill et al., 2012; Iverson et al., 1994). Further, cultural differences in parenting beliefs/practices may manifest as differences in gesture production within parent–child interactions (Fagan, 2000; Tamis-LeMonda et al., 2020; Tuli, 2012). For example, Hispanic mothers routinely identify *respeto* (child respectful obedience) as central to their parenting (Calzada et al., 2010; Tamis-LeMonda et al., 2020). To elicit this desired behavior from children, Hispanic parents often display calm authority, characterized by the parent confidently and gently guiding the child (Tamis-LeMonda et al., 2020). Hispanic mothers have been found to gesture more frequently when interacting with their young children than Black/African American mothers, particularly when regulating their child's behavior (Tamis-LeMonda et al., 2012). Because gestures can aid a child's understanding of parent directions, the authors proposed that this difference could be one way the Hispanic mothers encouraged their cultural value of *respeto* (i.e., a child is more likely to follow a direction they understand). Similarly, studies of Black/African American and South Asian parenting beliefs also indicate an emphasis on child obedience and respect (Jambunathan & Counselman, 2002; Tamis-LeMonda et al., 2020; Thomas, 2000; Tuli, 2012). However, to our knowledge, no studies have analyzed how the Hispanic cultural value of *respeto* compares to the cultural values of child obedience reported in Black/African American and South Asian parenting (e.g., do parents from one racial/ethnic background have higher expectations for child obedience compared to others?) or how these values are conveyed in parent gesture.

Studies of South Asian parenting also suggest the dominance of the importance of child achievement, with South Asian parents expressing a preference for directly teaching their children concepts rather than encouraging independent exploration in play (Jambunathan & Counselman, 2002; Tuli, 2012). In contrast, in White, western cultures, child autonomy and assertiveness are often valued over interdependence and obedience (Calzada et al., 2010). This difference could result in South Asian parents gesturing more than their White counterparts (e.g., teaching a child object names by showing or pointing to a toy while labeling it).

Cross racial/ethnic differences in parent gesture

There is a significant gap in our understanding of how parenting beliefs/practices compare among various cultures and racial/ethnic groups and how these differences might translate to differences in parent gesture production. However, findings indicate cross-racial/ethnic differences in parent gesture rate (e.g., Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012).[2] In a study of dyads living in the United States, Mexican mothers of 14-month-olds gestured more frequently than Dominican and Black/African American mothers, while both Mexican and Dominican mothers of two-year-olds gestured more frequently than Black/African American mothers (Tamis-LeMonda et al., 2012). Similarly, in a study of 8- to 15-month-old children, Salomo and Liszkowski (2013) found Chinese communication partners gestured more than their Dutch counterparts who gestured more than their Yucatec Mayan counterparts.

Relationship between the gesture rates of TD children and their parents

In typical development, infant and parent gesture rates are interconnected around the first birthday. Correlations between parent and child gesture have been reported in 8- to 15-month-olds (Salomo & Liszkowski, 2013) and 14-month-olds (Tamis-LeMonda et al., 2012). At this age, results are inconsistent whether this relationship results in children exhibiting the same cross-racial/ethnic differences in gesture as their parents (Cameron-Faulkner et al., 2021; Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012). However, by 22 months of age, TD children more consistently gesture like their parents, a pattern that holds until at least 34 months of age (Rowe et al., 2008). Taken together, these data suggest the gesture of young TD children is influenced by their social environment by around their first birthday and is closely reflecting parent gesture by their second birthday.

Relationship between the gesture rates of autistic children and their parents

In contrast with the research on the cross-racial/ethnic differences in gesture for TD children and their parents, there is a paucity of research for autistic children and their parents. Studies of autistic children have historically been conducted with predominantly White participants (Steinbrenner et al., 2022). As a result, there is a dearth of data regarding the gesture production of young autistic children and their parents from diverse racial/ethnic backgrounds. Further, to our knowledge, no studies have analyzed if the gesture rate of autistic children is related to that of their parents. As stated above, parents from different racial/ethnic groups differ in their use of gesture, and children learn to gesture in part through interactions with their parents. It is therefore valuable to examine how parents from various racial/ethnic groups gesture within interactions with their children when studying the gesture of autistic children. Additionally, because gesture use varies cross-culturally, it is important to explore if and to what extent child race/ethnicity influences gesture production in young autistic children.

Current study

The purpose of the present study was to explore potential cross-racial/ethnic differences in the gesture rates of young autistic children and their parents and to examine the relationship between parent and child gesture rates.[3] To this end, the following research questions (RQs) guided this study:

RQ 1: Does the gesture rate of parents of young autistic children vary by race/ethnicity?
RQ 2: Does parent gesture rate predict the gesture rate of their young autistic children?
RQ 3: Does the gesture rate of young autistic children vary by race/ethnicity?

We hypothesize (RQ 1) that the gesture rates of parents of young autistic children will vary by race/ethnicity, as observed in studies of parents of young non-autistic children (Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012). We predict young cognitively and linguistically impaired autistic children may not be benefiting from their social environment in the same way as TD children at similar developmental levels and will not yet reflect their parents' gesture. As such, we hypothesize (RQ 2) parent gesture rate will not predict child gesture. Finally, like TD children at similar cognitive/linguistic levels, we hypothesize (RQ 3) young autistic children will gesture at similar rates across race/ethnicity. Although we anticipate finding no statistically significant relationships with child gesture rate (RQs 2 and 3), such a result would be important as it would inform our understanding of the early developmental trajectory of gesture in autistic children in the prelinguistic/emerging linguistic stage of development. This is a developmental period in which TD children are beginning to imitate the gesture rates of their parents and is thus an important first step in understanding the developmental unfolding of gesture production in autistic children.

Methods

Participants

Participants for this study were 77 culturally and socioeconomically diverse young autistic children and a parent who took part in one of two more extensive studies assessing Pathways Early Autism Intervention (Pathways) in Dallas, TX. For both studies, families were recruited through local infant-toddler programs, community centers, advocacy groups, physicians' offices, social media, and word of mouth. The inclusion criteria for the original studies were identical except for the age range of the children at baseline (i.e., <40 months for children in Rollins et al., 2021 and <60 months for children in Rollins & De Froy, 2022). The other inclusion criteria for the original studies were (1) receiving an "autism spectrum" classification on the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2, Lord et al., 2012) administered by research reliable study personnel; (2) having no other known medical, neurological, or genetic concerns as reported by the caregiver; and (3) having a primary home language of English or Spanish. For the present analyses, four additional inclusion criteria were imposed (Figure 1): (1) a video recorded administration of the Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP; Wetherby & Prizant, 2002); (2) a standard score of <85 on the Mullen Scales of Early Learning (MSEL; Mullen, 1995) Early Learning Composite; (3) a Total Calibrated Severity Score ≥ 5 on the ADOS-2; and (4) shared racial/ethnic identity with at least one other dyad.

Participant characteristics are summarized in Table 1. Chronologically, the children ranged in age from 18 to 57 months. However, their mean receptive and expressive

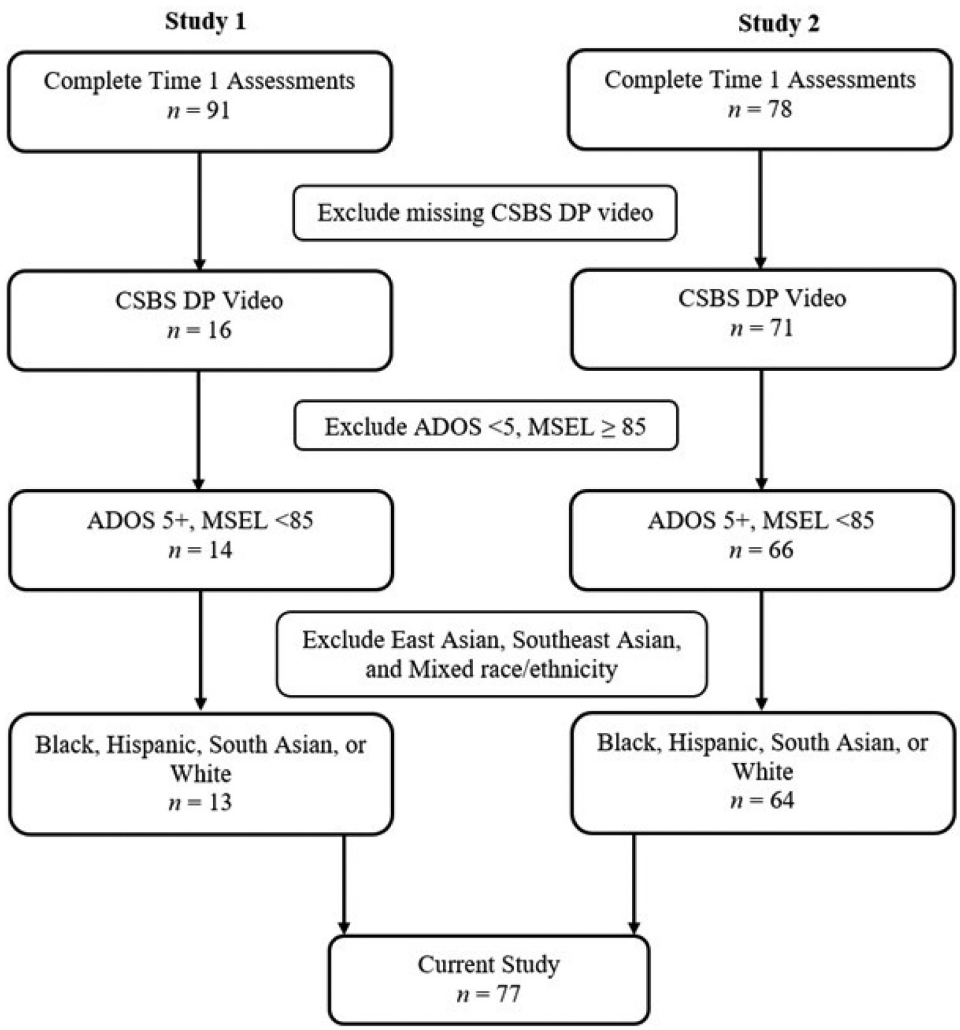

Figure 1. Study flow: participants from studies 1 and 2 included in the present study. *Note*. ADOS = Autism Diagnostic Observation Schedule, 2nd Edition, Total Calibrated Severity Score; MSEL = Mullen Scales of Early Learning, Early Learning Composite (standard score with $M = 100$, $SD = 15$).

language age on the MSEL was commensurate with 12- to 13-month-old children, and all children performed at or below the level of a three-year-old child on these measures. Further, average developmental skills, as measured by the MSEL, fell approximately three standard deviations below the mean on this assessment. The demographics of the sample were broadly representative of that of Dallas County, except that our sample contained a larger percentage of Asian and a lower percentage of Black/African American participants (United States Census Bureau, n.d.). Of note, our sample of Black/African American participants was small ($n = 8$). All parents consented to one of the larger studies using an informed consent procedure approved by the university's Institutional Review Board.

Comparisons of participant characteristics by racial/ethnic group are presented in Table 2. There were no significant differences in terms of child characteristics. Average maternal education was significantly higher for South Asian than Hispanic families (mean difference = 2.7 years, Hedges's $g = 1.15$, $p < .001$) and White families (mean difference = 2.3 years, $g = 0.98$, $p = .042$). Further, proportions differed significantly between Hispanic and South Asian families for annual family income. Specifically, 68% of Hispanic families and 6% of South Asian families fell in the <$50,000 bracket. Conversely, 56% of South Asian families and 16% of Hispanic families fell in the $50,001–100,000 bracket.

Study design

As noted above, the present study is a secondary analysis of data from autistic children and a parent who participated in one of two more extensive intervention studies on the efficacy of Pathways. Study 1 (Rollins et al., 2021) took place from 2016 to 2018 and Study 2 (Rollins & De Froy, 2022)

Table 1. Baseline participant characteristics (n = 77).

Characteristic	M or (n)	SD	Mdn	Range
Child Characteristics				
Age (months)	33.8	9.9	32.0	18–57
ADOS-2 Total CSS	8.4	1.6	9.0	5–10
Adaptive Behavior	71.8	10.0	70.0	52–103
MSEL Early Learning Composite	53.9	7.4	49.0	49–79
MSEL Receptive language age (months)	12.2	7.8	11.0	1–33
MSEL Expressive language age (months)	13.6	7.5	12.0	3–36
Gender: male/female	(60/17)			
Participating Parent Characteristics				
Race/Ethnicity				
Black/African American	(8)			
Hispanic	(37)			
South Asian	(18)			
White	(14)			
Family Characteristics				
Maternal education (years)	15.0	2.5	16.0	6–18
Income				
≤$50,000	(35)			
$50,001–$100,000	(21)			
>$100,000	(21)			
Home language				
English	(29)			
Spanish	(19)			
English + Spanish	(14)			
English + other language	(15)			

Note. ADOS-2 Total CSS = Autism Diagnostic Observation Schedule, Second Edition Social Total Calibrated Severity Score (Total CSS 8–10 = high levels of autism symptomatology); Adaptive Behavior = Vineland Adaptive Behavior Scales, Second Edition, Adaptive Behavior Composite (*M* = 100, *SD* = 15); MSEL = Mullen Scales of Early Learning (MSEL Early Learning Composite *M* = 100, *SD* = 15); Receptive and Expressive language age (months) = Mullen Scales of Early Learning Receptive and Expressive Language ages in months, respectively; Black/African American, South Asian, and White participants did not identify as Hispanic.

from 2018 to 2020 (before the COVID-19 pandemic). All participants received a battery of assessments at baseline prior to randomization into intervention groups; therefore, all assessors were blind to group assignment. The assessment batteries included a study-specific demographic interview, standardized parent report interviews, standardized and direct assessments, and a video recorded parent–child interaction. Assessments were conducted in English and/or Spanish, depending on the family's primary language. Six research clinicians were responsible for administering the assessments. Four were certified SLPs, one a board-certified behavior analyst, and one held a bachelor's degree focused on infant/child development with over 30 years of experience working with parents and children birth to 5 years. Two of the SLPs and the bachelor-level clinician were bilingual (English/Spanish). The assessors were trained to fidelity on all assessments (see Rollins et al., 2021 for clinician training, administration, and scoring procedures). Only data from these baseline assessments were used in the present study.

Video data collection. In this secondary analysis, we extracted parent and child gestures from video recordings of naturalistic parent–child interactions (NPCIs). Although a single interaction may not represent the ongoing interactions between a parent and child (Manning, 2019), NPCIs provide insight into how parent and child interact in a natural setting. NPCIs have been used extensively to assess parent and child behaviors (e.g., Crandall et al., 2019; Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012) and are an ecologically valid method of collecting language samples for intervention studies (Tager-Flusberg et al., 2009). To gain a more comprehensive picture of the gesture production of the children in our sample, we also extracted child gestures from a structured clinician child interaction (SCCI). For this interaction, we used the CSBS DP. The CSBS DP is an assessment of a child's communication and symbolic skills with standardized administration procedures. This generalized measure of child gesture production has been used to assess gesture for autistic and non-autistic children (e.g., O'Neill & Chiat, 2015; Talbott et al., 2015). Further, previous studies have used the CSBS DP in combination with an NPCI to evaluate gesture in young autistic children (Manwaring et al., 2019). The two interactions differ on key features such as the primary communication partner and the degree of structure. Combining the two interactions therefore provides a more comprehensive picture of child gesture across different contexts.

Procedures. Ten-minute video recordings of the NPCI were obtained for each child in the families' homes. Before the video-recorded observation began, a research clinician described the purpose of the observation and the recording procedures. Parents were asked to play with their child the way they typically do. For Study 1 (2016–2018), the families used the child's own toys or other items available in the home; for Study 2 (2018–2020), the dyads were provided with a standardized set of developmentally appropriate toys (a drum, farm animal and tractor set, musical piggy bank, blocks, baby doll with accessories, shape sorter, ball, puzzles, snap lock toy, and picture books). Video recordings of the SCCI were obtained for each child during administration of the CSBS DP. Both the NPCI and SCCI were digitally recorded by a research clinician using an iPad2 for a wide-angle view and hidden camera glasses worn by the adult (parent or clinician) to capture child eye gaze.

The recorded NPCI and SCCI assessments were sent to the lab where the two streams of digitized videos (i.e., iPad 2 and

Table 2. Comparison of baseline participant characteristics across racial/ethnic groups (n = 77).

Characteristic	Black/AA M(SD)	Black/AA Range	Hispanic M(SD)	Hispanic Range	South Asian M(SD)	South Asian Range	White M(SD)	White Range	Comparison p
Child Characteristics									
Age (months)	31 (11)	20-47	35 (11)	15–57	36 (7)	27–50	30 (9)	18–50	.243
ADOS-2 Total CSS	9 (1)	7–10	8 (2)	5–10	9 (1)	6–10	9 (1)	5–10	.098
Adaptive Behavior	68 (7)	59–78	71 (11)	52–103	69 (10)	52–91	78 (8)	64–89	.073
MSEL Early Learning Composite	52 (3)	49–56	54 (8)	49–77	53 (8)	49–79	57 (8)	49–70	.337
Receptive language age (months)	10 (7)	4–22	13 (8)	2–33	10 (7)	1–30	14 (9)	3–33	.326
Expressive language age (months)	13 (8)	7–29	14 (7)	3–33	14 (8)	5–31	14 (9)	5–36	.986
Gender: male/female	7/1		30/7		12/6		11/3		.579
Family Characteristics									
Maternal education (years)	15 (3)[ab]	9–18	14 (3)[a]	6–18	17 (7)[b]	16–18	15 (2)[a]	11–18	.002
Income									.002
≤$50,000	3[ab]		25[a]		1[b]		6[ab]		
$50,001–$100,000	2[ab]		6[a]		10[b]		3[ab]		
>$100,000	3[a]		6[a]		7[a]		5[a]		

Note. ADOS-2 Total CSS = Autism Diagnostic Observation Schedule, Second Edition Social Total Calibrated Severity Score (Total CSS 8–10 = high levels of autism symptomatology); Adaptive Behavior = Vineland Adaptive Behavior Scales, Second Edition, Adaptive Behavior Composite (*M* = 100, *SD* = 15); MSEL = Mullen Scales of Early Learning (MSEL Early Learning Composite *M* = 100, *SD* = 15); Receptive and Expressive language age (months) = Mullen Scales of Early Learning Receptive and Expressive Language ages in months, respectively; Black/African American, South Asian, and White participants did not identify as Hispanic; significant omnibus tests were followed up with post-hoc tests with Bonferroni corrections applied (Maternal education: cells with shared superscripts do not differ significantly from each other; Income: within each row, cells with shared superscripts do not differ significantly from each other).

glasses) were time linked, transcribed for communication (including gesture), and coded for various social and communicative measures using the conventions of the Child Language Data Exchange System (CHILDES; MacWhinney, 2000). Transcription was conducted at the level of the utterance and included all verbal, vocal, and gestural behaviors bounded by a pause or change in conversational turn (Pan et al., 2005). For Spanish-speaking dyads, bilingual (English/Spanish) research assistants transcribed in Spanish and provided English translations on a secondary coding line. Transcription and coding were conducted by trained research assistants who were blind to group assignment. Specifically, research assistants trained on practice videos until they achieved substantial inter-rater agreement measured by obtaining a Cohen's kappa coefficient of .75 or above. Cohen's kappa accounts for agreement that occurs by chance (Yoder et al., 2018). Once reliable, research assistants were allowed to code study videos.

Measures

Race/ethnicity. Parents self-reported their race/ethnicity during a demographic interview. Responses were collapsed into the following categories: Black/African American, non-Hispanic; East Asian, non-Hispanic; South Asian, non-Hispanic; Southeast Asian, non-Hispanic; White, non-Hispanic; and mixed race/ethnicity (more than one of the preceding categories). For brevity, we omit "non-Hispanic" from category names for the duration of the paper. Participants identifying as East Asian, Southeast Asian, or mixed race/ethnicity were not included in the present analyses as there was only one dyad in each of these groups.

Autism classification and symptom severity. The ADOS-2 was administered by a research-reliable clinician to confirm a research diagnosis of autism and to estimate overall symptom severity. The ADOS-2 is a semi-structured evaluation of communication, social interaction, play, and restricted/repetitive behaviors for children suspected of having autism. The ADOS-2 has been used successfully with Spanish-speaking autistic children (Ohashi et al., 2012; Stronach & Wetherby, 2017). The ADOS-2 is available in five versions (modules) selected based on the child's age and expressive language level. The Toddler Module, intended for children 12–30 months of age, was administered to 36 children. Module 1, intended for children aged 31 months and older whose language abilities range from no speech to simple phrases, was administered to 41 children. ADOS-2 scores were converted to Calibrated Severity Scores (CSS) to allow comparisons of symptom severity across modules. Total CSS was used as an estimate of overall autism symptom severity.

Adaptive functioning. The English or Spanish version of the caregiver interview form of the Vineland Adaptive Behavior Scales, Second Edition (Vineland II; Sparrow et al., 2005) was administered to measure child adaptive functioning skills. The Vineland II is a standardized test of adaptive functioning for individuals from birth to age 90 years. This parent report measure yields an adaptive behavior composite score and domain scores for communication, daily living, socialization, and motor development and has good test-retest reliability (.88-.92).

Language skills and developmental level. The MSEL was used to estimate child receptive and expressive language and developmental level. The MSEL is a standardized direct assessment of development for young children ages 0 to 68 months that yields scores for gross and fine motor skills, visual reception, and receptive and expressive language. Of note, while there is not a Spanish version of the MSEL, we found moderate to high correlations for language scores between the MSEL and the Spanish version of the Vineland II for the children whose primary language was Spanish ($r = .55$, $p = .001$ for receptive language, $r = .77$, $p < .001$ for expressive language), thereby increasing the criterion validity of the MSEL scores for these children. Further, we used raw scores rather than standard scores in analyses.

Video-coded gesture measures. For the present study, gesture was defined as a symbolic movement of part of the body that serves a communicative function (Cartmill et al., 2012; Shumway & Wetherby, 2009). Following Wetherby & Prizant (2002), *communicative* behaviors are those that were directed to the parent or clinician. Any behavior that acted on an object (e.g., pulling on parent's shirt) was not considered a gesture unless the child was showing or giving the object (Dimitrova et al., 2016; Wetherby & Prizant, 2002). Of note, eye contact was not required to determine direction to an adult. In addition, child symbolic movements that were not directed to the parent (e.g., pointing to pictures in a book without clear regard for the parent's shared attention) were also coded. These object-directed movements were included because they may be interpreted by parents as communicative and may play an important role in social communication development (Rollins & De Froy, 2022). The gesture measures detailed below were extracted from the coded NPCI and SCCI transcript files using the utilities of the Computerized Language Analysis software package (MacWhinney, 2000). To assess inter-rater reliability for the presence and type of gesture, a second coder independently coded 20% of the finalized baseline videos from Study 1 and 20% from Study 2, chosen at random.

Child gesture rate. For each child, number of child gestures were extracted from the NPCI and SCCI transcripts. To account for differences in task length, Child Gesture Rate was calculated as the number of gestures produced *per 10 min* during the NPCI and SCCI. Final study reliability (Cohen's kappa) for the presence of child gesture was $M = .92$, $SD = .16$.

Parent gesture rate. Parent gestures were coded from the 10-min NPCI videos following the same protocol as child gestures. SCCI videos were not used for this measure as the research clinicians were the child's primary interaction partner. Parent Gesture Rate was calculated as the number of gestures produced during the NPCI (i.e., number of gestures produced in 10 min). Final study reliability (Cohen's kappa) for the presence of parent gesture was $M = .85$, $SD = .08$.

Power analysis

Sensitivity power analyses were conducted using G*Power version 3.1.9.7 (Faul et al., 2007) to estimate detectable effect sizes given $\alpha = .05$, power $= .80$, and achieved sample sizes. For analysis of covariance (ANCOVA), analyses revealed a medium-to-large main effect ($f = .39$) and very large effects for pairwise comparisons (Cohen's *d*s ranging from 1.03 to 1.69) could be detected. For regression analyses, results indicated small effects could be detected ($f^2 = .10$).

Analytic approach

We first used t-tests (with Hedges's g for effect size estimates) to explore the differences in Parent and Child Gesture Rates between Study 1 and Study 2 to determine if we could combine data from the two studies for the present analyses. Hedges's g was interpreted based on Cohen (1992), with 0.2 indicating a small effect, 0.5 a medium effect, and 0.8 a large effect. Analyses were then conducted among background measures and the outcome variables (Parent and Child Gesture Rate) to identify potential covariates (Pearson correlations for continuous variables, point biserial correlations for dichotomous variables, and analyses of variance [ANOVAs] for categorical variables). To satisfy the linearity assumption of correlation and regression, cube root transformations were applied to Child Gesture Rate. No other model violations were present.

ANCOVA was used to test if Parent and Child Gesture Rate varied by race/ethnicity (RQs 1 and 3). Due to concerns regarding statistical power, we compared results from ANCOVA to hierarchical linear regression and found them to be substantively similar. Therefore, only ANCOVA results are presented. Šidák corrections for multiple comparisons were applied for pairwise comparisons. Effect size estimates were assessed using Hedges's g. We used hierarchical linear regression to test the relationship between Parent and Child Gesture Rates (RQ 2) with identified covariates entered into the model first, followed by Parent Gesture Rate. Partial eta squared (η_p^2) was used to estimate effect size, with .01 indicating a small effect, .09 a medium effect, and .25 a large effect.

Results

Preliminary analyses

There was no statistical difference in Parent or Child Gesture Rates across the two studies (Parent Gesture Rate: $t(75) = -1.96$, $p = .053$; Child Gesture Rate: $t(16) = -1.55$, $p = .141$), indicating we could combine the data from Studies 1 and 2. However, the effect sizes were medium (Parent Gesture Rate: $g = .57$; Child Gesture Rate: $g = .58$). Therefore, we chose a conservative approach and retained the Study variable as a covariate. Of note, the results were substantively similar when the Study variable was omitted from the analyses. Furthermore, we compared the results of the analysis with those obtained using Study 2 data alone (see Supplemental Materials) and found one discrepancy, which we indicate below.

On average, parents produced 39 gestures during the 10-min NPCI ($SD = 20$, $Mdn, = 39$, range: 4–93). Descriptive statistics of Parent Gesture Rate by race/ethnicity suggest a high degree of variability between the groups (Table 3). Correlational analyses revealed no relationships among Parent Gesture Rate and the continuous or dichotomous background variables (Table 4). ANOVAs revealed family income was related to Parent Gesture Rate such that parents in the intermediate income bracket ($50,001-$100,000) gestured more frequently, on average, than parents from the other two income brackets ($p = .028$). Family income was therefore retained as a covariate in subsequent analysis of Parent Gesture Rate (RQ 1).

Mean Child Gesture Rate was 4.46 ($SD = 4.6$, $Mdn = 3.1$, range: 0–25.6). Descriptive statistics of Child Gesture Rate by race/ethnicity suggest little variability between the groups (Table 3). Correlational analyses revealed Child Gesture Rate was correlated with child age, MSEL total raw score, MSEL visual raw score, MSEL receptive language raw score, and Vineland II Adaptive Behavior raw score (Table 4). Because these variables were highly correlated with each other, they could not be entered into statistical models together. We retained MSEL total raw score as a covariate for subsequent analyses of child gesture (RQs 2 and 3) as it is a composite measure of a child's overall developmental level, and it includes the other MSEL measures. Unlike for Parent Gesture Rate, ANOVAs revealed family income was not related to Child Gesture Rate.

Analysis of the research questions

RQ 1: parent gesture rate by race/ethnicity. Controlling for Study and family income, the ANCOVA revealed Parent Gesture Rate varied by race/ethnicity, $F(3,71) = 3.977$, $MSE = 337$, $p = .011$, with a medium effect ($\eta_p^2 = .144$, $p = .011$), while the two covariates were not significant (Study $\eta_p^2 = .036$, $p = .110$; family income $\eta_p^2 = .001$, $p = .757$). Pairwise comparisons (Table 5) found South Asian

Table 3. Descriptive statistics for parent and child gesture rate by participant race/ethnicity category.

		Parent Gesture Rate			Child Gesture Rate		
Race/Ethnicity	*n*	*M(SD)*	*Mdn*	Range	*M(SD)*	*Mdn*	Range
Black/African American	8	23 (13)	23	4–40	4 (4)	3	1–13
Hispanic	37	39 (19)	40	9–91	6 (6)	4	0–23
South Asian	18	50 (21)	49	21–93	3 (2)	2	0–9
White	14	35 (16)	33	10–63	3 (3)	3	0–10

Table 4. Partial correlations controlling for study (1 versus 2) among background variables and parent and child gesture rate (n = 77).

Variable	1	2	3	4	5	6	7	8	9
1. Parent Gesture Rate	–								
2. Child Gesture Rate	−.154	–							
3. Child age	.081	.231	–						
4. Child gender	−.167	.204	.042	–					
5. Maternal Education	.072	−.122	−.124	−.057	–				
6. MSEL total	−.054	.528**	.582**	.096	−.134	–			
7. MSEL visual reception	−.164	.443**	.447**	.134	−.167	.851**	–		
8. MSEL receptive language	−.067	.524**	.473**	.117	−.103	.858**	.635**	–	
9. VABS Comm	.093	.383*	.537**	.046	−.002	.851**	.659**	.707**	–
10. VABS ABC	.140	.423**	.542**	.121	−.019	.769**	.633**	.632**	.883**

Note. Child Gesture Rate = cube root of child gesture rate across the naturalistic parent–child interaction and Communication and Symbolic Behavior Scales Developmental Profile; MSEL = Mullen Scales of Early Learning (raw scores); VABS Comm and ABC = Vineland Adaptive Behavior Scales, Second Edition raw scores of the Communication subscale and Adaptive Behavior Composite, respectively.
*$p < .0011$ (to correct for multiple comparisons, .05/45 comparisons); **$p < .0002$ (.01/45).

Table 5. Unstandardized (mean difference) and standardized (Hedges's g) effect sizes for differences in parent gesture rate (gestures produced per 10 minutes) among race/ethnicity groups (n = 77).

Race/Ethnicity	Comparison Group	Mean Difference	95% CI for Mean Difference	Hedges's *g*	*p*†
South Asian	Hispanic	11.17	−4.47, 26.81	0.61	.298
	White	14.01	−4.14, 32.16	0.76	.218
	Black/African American	26.40**	5.03, 47.76	1.44	.008
Hispanic	White	2.85	−13.21, 18.90	0.15	.998
	Black/African American	15.23	−4.58, 35.03	0.83	.222
White	Black/African American	12.38	−9.66, 34.42	0.67	.575

Note. Race/Ethnicity is presented in descending order of group means; mean difference is calculated as column 1 (Race/Ethnicity) minus column 2 (Comparison Group); for Hedges's *g*, 0.2 is interpreted as a small effect, 0.5 a medium effect, and 0.8 a large effect; †Šidák correction for multiple comparisons applied.
**$p < .01$.

parents gestured significantly more than Black/African American parents, and the effect size was large. There were no significant differences between the gesture rates of South Asian parents and Hispanic parents or South Asian parents and White parents; however, the effect sizes for both comparisons were medium. We also found no significant differences in gesture rate between Hispanic parents and Black/African American parents, but the effect size for this comparison was large. Of note, effect sizes are not dependent on sample size.

RQ 2: parent and child gesture rates. Regression results revealed, controlling for MSEL total raw score and Study, Parent Gesture Rate was not a significant predictor of Child Gesture Rate ($\Delta R^2 = .015$, $p = .203$). Although we were not powered to detect an effect size this small, Parent Gesture Rate explained less than 2% of the variance in the outcome variable, a relationship that is unlikely to be practically significant. Of note, MSEL total raw score alone explained 31% of the variance in Child Gesture Rate ($R^2 = .309$, $p < .001$) while Study was nonsignificant ($\Delta R^2 = .008$, $p = .349$).

RQ 3: child gesture rate by race/ethnicity. Controlling for MSEL total raw score and Study, the ANCOVA revealed no significant differences in Child Gesture Rate by race/ethnicity, $F(3,71) = 2.447$, $MSE = .283$, $p = .071$, although the effect was medium ($\eta_p^2 = .094$). Results of pairwise comparisons (Table 6) revealed no statistically significant comparisons. However, medium to large effect sizes emerged such that Black/African American and Hispanic children gestured more than their White and South Asian peers. Of note, the difference between the Hispanic and South Asian groups reached statistical significance when data from Study 2 were analyzed alone (Supplemental Table 4).

Discussion

Gesture is an early-emerging social communication skill that typically develops prior to spoken language, allowing children to communicate before the onset of more advanced skills. Early gesture also has cascading effects on later language for both TD and autistic children. Social interactionist and transactional theories suggest children learn gesture through interactions with their parents. As such, it is important to understand how parents gesture when interacting with their children and what relationship their gesture has with child gesture production. For young TD children and their parents, the role of race/ethnicity on gesture rate and the relationship between parent and child gesture have been explored. However, there are a paucity of data on these relationships for young autistic children and their parents. In the present study, we explored potential cross-racial/ethnic differences in the gesture rates of young autistic children and their parents and examined the relationship between parent and child gesture rates.

Parent gesture rate by race/ethnicity

As hypothesized, we found differences in Parent Gesture Rate by race/ethnicity. This result is consistent with previous findings that parents of TD children exhibit cross-racial/ethnic differences in gesture rate (Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012). Thus, parents of autistic children appear to be conveying cultural differences in communication like parents of non-autistic children.

Medium to large effect sizes emerged for South Asian parents as compared to all other groups—with the comparison with Black/African American parents reaching statistical significance—a novel finding. Importantly, the sample size for the Black/African American group was very small. As such, these results should be interpreted with caution. However, the effect reached statistical significance despite this group's small sample size and large confidence intervals. The trend of South Asian parents gesturing more than other groups may reflect the South Asian parenting belief that children should be obedient (because children are more likely to follow a direction

Table 6. Unstandardized (mean difference) and standardized (Hedges's g) effect sizes for differences in child gesture rate (gestures produced per 10 minutes) among race/ethnicity groups (n = 77).

Race/Ethnicity	Comparison Group	Mean Difference	95% CI for Mean Difference	Hedges's *g*	$p^{\dagger}$
Black/African American	Hispanic	0.06	−0.40, 0.53	0.16	1.00
	White	0.28	−0.25, 0.81	0.64	.63
	South Asian	0.36	−0.15, 0.86	0.83	.30
Hispanic	White	0.22	−0.15, 0.59	0.50	.53
	South Asian	0.29	−0.05, 0.64	0.67	.13
White	South Asian	0.08	−0.35, 0.50	0.18	1.00

Note. The cube root transformed Child Gesture Rate variable was used; groups are presented in descending order of group mean; mean difference is calculated as column 1 (Race/Ethnicity) minus column 2 (Comparison Group). †Šidák correction for multiple comparisons applied.

that they understand; Tamis-LeMonda et al., 2020) and/or a preference for directly teaching their children concepts rather than encouraging independent exploration (e.g., gesturing toward or with an object when labeling it or to elicit a label from the child; Tuli, 2012).

Similarly, a large effect for the difference between Hispanic and Black/African American parents emerged. Although nonsignificant, this result replicates previous findings with mothers of TD children (Tamis-LeMonda et al., 2012). As discussed above, a higher gesture rate may be a way parents aid child comprehension of directions and thus reflect the cultural value of *respeto* (i.e., that children should demonstrate respectful obedience to their caregivers) central to Hispanic parenting (Tamis-LeMonda et al., 2012; Tamis-LeMonda et al., 2020). However, given the lack of data on how the value of child obedience compares across cultures (e.g., if parents from one racial/ethnic background have higher expectations for child obedience than others), we are limited in our ability to fully interpret these findings through a lens of cultural awareness.

Relationship between parent and child gesture rates

We found Child and Parent Gesture Rates were not related. This null relationship contrasts with findings from TD children and their parents for whom gesture production is tightly interconnected from around the first birthday (Salomo & Liszkowski, 2013; Tamis-LeMonda et al., 2012). This discrepancy between populations may be representative of the social difficulties characteristic of autism. For example, the children in our sample may not yet have had the social awareness needed to "pick up" on the social cues of parent gesture. Social difficulties might also manifest as limited social motivation to communicate with others, restricting the overall number of gestures produced. Alternatively, the gesture production of the children in our sample may have been limited by difficulties with motor skill, a common area of difficulty for autistic children (Bhat et al., 2012; Ghaziuddin & Butler, 1998). Additional analyses are needed to explore if social or motor skills are related to the gesture production of the young autistic children in our sample. Regardless of the mechanism, this finding is consistent with our prediction that young autistic children in the pre-linguistic/emerging linguistic stage of spoken language are not benefiting from their social environments in the same way as TD children at a similar developmental level.

Child gesture rate by race/ethnicity

As was foreshadowed by the null relationship between Parent and Child Gesture Rates, Child Gesture Rate did not vary by race/ethnicity. This finding was expected given that TD children at a similar developmental level are not yet consistently exhibiting cross-racial/ethnic differences in gesture (Cameron-Faulkner et al., 2021; Tamis-LeMonda et al., 2012). However, some pairwise comparisons resulted in medium or large standardized effect sizes, suggesting group differences may have emerged given greater statistical power. Notably, the pattern of group differences in child gesture (Black/African American and Hispanic children gestured more than White and South Asian children) was almost opposite of the pattern observed in parent gesture (South Asian parents gestured more than Hispanic and White parents who gestured more than Black/African American parents). Thus, young cognitively and linguistically impaired autistic children do not produce the same pattern of cross-racial/ethnic differences in gesture rate as their parents.

Limitations

A limitation of the present study was statistical power for the pairwise comparisons of gesture rates across race/ethnicity groups (i.e., we could only detect very large effect sizes). However, we found medium and large effect sizes for differences in gesture rate among race/ethnicity groups. Because effect size is not dependent on sample size, the impact of this limitation is reduced. Further, as this was a secondary analysis of data from two intervention studies that were not designed to analyze cross-racial/ethnic differences in parent or child behavior, extensive background information related to culture was not collected. While our sample included participants from diverse racial/ethnic backgrounds, race/ethnicity is not synonymous with culture (Riquelme, 2022), and an analysis that includes race/ethnicity alone cannot be used to draw conclusions about cultural differences. As such, the interpretability of our present findings is limited. Future research should be conducted with a larger sample and include information related to participant culture (e.g., length of residence in the United States, perception of dominant culture/degree of acculturation, parenting beliefs/practices) to allow for an interpretation of results through a lens of cultural awareness (Dickerson, 1995).

Another potential limitation of this study was that parent gestures were gathered from a single parent–child interaction, which may not be representative of the ongoing interactions between a parent and child (Manning, 2019). Social interactions between parent and child occur in various contexts (e.g., meals), and parents may vary their communication style based on the context-dependent needs of a given situation (Flynn & Masur, 2007; Tamis-LeMonda et al., 2012). As such, observing dyads in more than one context may be preferred. However, the structure of the parent–child interaction we employed allowed for a variety of naturalistic activities to occur, as chosen by the dyad.

Future directions

The cognitively and linguistically impaired autistic children in our sample were in the early stages of gesture development and produced few gestures overall. More developmentally advanced autistic children may produce gesture at higher rates, allowing correlations with parent gesture rate and/or differences across racial/ethnic groups to emerge. Therefore, future research should evaluate the role of participant race/ethnicity on gesture production in a more developmentally advanced cohort of autistic children. As noted above, future studies should gather detailed information regarding participant cultural values and parenting beliefs/practices to improve the interpretability of results.

Conclusions

We found that parents of autistic children—like parents of TD children—exhibit cross-racial/ethnic differences in gesture rate. However, parent and child gesture rates were not related in the present study. Further, the cross-racial/ethnic patterns of parent and child gesture differed from each other. Thus, while parents of young autistic children are conveying cultural differences in gestural communication to their children, these differences are not yet evident in their children's gesture. These findings enhance our understanding of the early gesture production of autistic children in the prelinguistic/emerging linguistic stage of development and highlight similarities and differences with TD children and their parents. This work underscores the importance of diversity in autism research and of considering participant race/ethnicity when interpreting results.

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ORCID iDs

Adrienne De Froy https://orcid.org/0000-0003-1537-7727
Pamela Rosenthal Rollins https://orcid.org/0000-0002-8046-2955

Supplemental material

Supplemental material for this article is available online.

Notes

1. We use identity-first language as it has been found to be generally preferred by autistic individuals in the United States (Bottema-Beutel et al., 2021).
2. The interlocutors in Salomo and Liszkowski (2013) extended beyond parents to include all those a child naturally encountered in their day (e.g., grandparents, older siblings).
3. We use the term *parent* to refer to any caregiver participating in the study.

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