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Bilingual mothers and children gesture differently across native and second languages

Sirada Rochanavibhata
Northwestern University, United States
Corresponding Author
Email: sirada.rochanavibhata@northwestern.edu

Jessica Yung-Chieh Chuang
Northwestern University, United States

Viorica Marian
Northwestern University, United States

Abstract

Children from bilingual families are typically exposed to more diverse communication practices compared to those from monolingual households. Characterizing bilinguals' gesture use can provide insight into children's developmental trajectory in their two languages and the cross-linguistic effects of scaffolding from adults. Gestural patterns of Thai-English bilingual mothers and their preschool-age children were examined in three communicative tasks (prompted reminiscing, book sharing, and toy play) during two sessions (one in Thai and one in English). Gestures were categorized into representational, deictic, conventional, beat, and all. The results revealed that, as early as preschool, bilinguals gesticulate differently in their two languages. The findings highlight the importance of evaluating bilinguals' nonverbal communication in both languages for a comprehensive picture of their linguistic profiles, especially among speakers of understudied languages. Our understanding of how gestures and speech function as an integrated communicative system would be incomplete without the inclusion of linguistic populations that are underrepresented in research.

Keywords: gesture; mother-child dyads; bilingual; preschoolers; cross-linguistic

1. Introduction

Children's language development progresses along with their gesture use (Gullberg et al., 2008). The development of early bilingualism is no exception (Gullberg, 2012). A gesture is a nonverbal communicative act involving movements of the arm, hand, or head. The onset of the gesture-speech combination predicts future language development (Capobianco et al., 2017), and gesture continues to influence speech (e.g., content, rate) throughout adulthood (Bernardis & Gentilucci, 2006). In adult-child interactions across different cultures, adults scaffold children's early language development through gestures and speech (Iverson et al., 1999). Despite the

universality of gesture use, the nature of gestural communication varies across cultures and languages (e.g., Hickmann et al., 2011; Iverson et al., 2008; Marian, 2023; Nicoladis, 2002). In the present study, we aimed to investigate the difference in gestural communication of Thai-English bilingual mother-child dyads when speaking their first and second languages (L1 and L2), as well as to explore how bilingual mothers' and children's gesture use in their L1 and L2 differ as a function of communicative tasks. Understanding the variability in gesture use of bilingual parents and preschoolers informs educators and clinicians in providing appropriate verbal and nonverbal scaffolding for linguistically and culturally diverse children, to maximize learning and speech-language intervention outcomes.

1.1. Different types of gesture and their communicative purposes

Previous research has revealed that speakers tend to use gestures that are semantically connected to the verbal content when attempting to describe images to their conversation partner (Graham & Argyle, 1975). Notably, gestures have been shown to increase the effectiveness of message conveyance when they are related to the speech content. For example, speech accompanied by representational gestures (i.e., gestures bearing close semantic connections with the co-occurring speech, such as holding hands formed as circles in front of the eyes for 'binoculars'; also referred to as iconic gestures) is perceived as more persuasive, as listeners consider utterances with semantically related gestures to contain important information (Maricchiolo et al., 2009). Despite not being directly related to the content of speech, beat gestures (i.e., manual movements characterized by repetitive bi- or multi-directional strokes that correspond to the rhythm of speech) also enhance communication effectiveness. Listeners perceive information presented with beat gestures as more pertinent compared to information presented without them (Krahmer & Swerts, 2007).

1.2. Cross-linguistic and cross-cultural differences in gestural communication

Gestural communication varies across different cultures and languages (e.g., Hickmann et al., 2011; Iverson et al., 2008; Marian, 2023; Nicoladis, 2002). For instance, while both American and Italian monolingual children produce deictic gestures (used to direct attention to an object, location, or individual) more than iconic gestures (used to convey physical expressions of the referent's semantic content) when interacting with their mothers, Italian children exhibit a larger repertoire of iconic gestures than American children (Iverson et al., 2008). These results are likely reflective of the greater use of iconic gestures associated with the Italian language and culture to which young Italian children are exposed. Cross-cultural differences in gesture use could also reflect the distinct values and norms that parents hope to pass on to the next generation (Kita, 2009). For example, Taiwanese monolingual mothers use up to three times more gestures compared to American monolingual mothers when interacting with their preschoolers (Goldin-Meadow & Saltzman, 2000). These patterns of maternal gesture use may be explained by culture-specific child-rearing philosophy. Chinese culture places greater value on parents effecting change in their children than American culture, which places greater importance on children's inherent talents and strengths (Bornstein et al., 1991). As a result, Taiwanese parents often focus on instructing their children, employing gestures as a supplemental mode of communication to emphasize their teaching and scaffolding, while American parents tend to focus less on training their children and more on letting children take the lead (Goldin-Meadow & Saltzman, 2000).

Bilinguals also exhibit cross-linguistic variation in their gesture use. Differences in the frequency of different gestures across a bilingual's two languages may be due to proficiency. For instance, cross-linguistic differences in gestural patterns, especially the use of iconic, deictic, conventional, and beat gestures, have been found in French-English bilingual preschoolers with unequal proficiency in their two languages. Bilingual children produced more iconic and beat gestures in their more dominant and proficient language (Nicoladis, 2002; Nicoladis et al., 1999), and produced more deictic (such as pointing) and conventional gestures (i.e., a group of culturally bound, arbitrary gestures, such as thumbs-up for expressing affirmation) during interactions in their less proficient language (Nicoladis, 2002). However, considering that bilinguals speak two languages associated with different cultures, it is also possible that cross-linguistic differences in gestural communication may be accounted for by unique cultural norms. The present study aimed to test the hypothesis that each of a bilingual's two languages can cue distinct cultural frames, resulting in different gestural patterns across languages.

1.3. Variability in gestural patterns across different communicative contexts

Parent and child gesture use also differs depending on the nature of the dyadic task. For example, mothers use gestures more frequently when sharing a wordless number book compared to when playing with beads and strings with their infants (Tamis-LeMonda et al., 2012). Different communicative demands not only contribute to the differences in overall gestural frequency, but also influence the number of unique gestures the speakers produce. Mothers of toddlers and preschoolers produce more deictic gestures (i.e., pointing) in toy manipulation tasks, but use more iconic gestures during storytelling, as well as in object and event description tasks (Gutmann & Turnure, 1979). Parents of school-age children also use predominantly iconic gestures in narrative tasks (e.g., story retelling), while producing a greater proportion of deictic gestures in referential tasks, during which mothers and children take turns describing or locating a target item. The aforementioned findings likely also reflect distinct purposes served by different types of gesture. For instance, iconic gestures may facilitate children's semantic understanding of a word by reinforcing the verbal message and providing more complex, comprehensive information regarding the referent (McNeill, 1992), whereas deictic gestures foster children's language development through the joint attention of referents in conjunction with parent's verbal labeling (McGregor, 2008). Therefore, parents may utilize gestures that are the most appropriate in a given moment to maximize the effectiveness of communication and learning according to the task demands and complexity. Despite the generally consistent findings showing that mothers modify their language and gesture use to meet the communicative demands of the child and the dyadic task, relatively less is known about how cross-linguistic differences in bilingual mothers' and children's gesture use are moderated by the demands of the communicative contexts.

1.4. Relationship between maternal gesture use and child communicative development

Children begin to demonstrate gestural patterns similar to their mothers' as early as infancy (Talbott et al., 2015). By preschool, children use gestures at the same rate as adults (e.g., Nicoladis et al., 1999). Specifically, bilingual children use representational, deictic, conventional, and beat gestures in their spontaneous conversation. This pattern persists into adolescence (Özçalışkan & Goldin-Meadow, 2005). Maternal gesture use not only predicts child gesture use during dyadic interactions (e.g., Liszkowski et al., 2012; Talbott et al., 2015), but also children's later language skills (e.g., Goldin-Meadow, 2015; Goodwyn et al., 2000; Rowe & Goldin-Meadow, 2009; Talbott et al., 2015). Specifically, caregivers' use of representational and deictic

gestures has been associated with children's higher language scores and word learning outcomes (Booth et al., 2008; Goodwyn et al., 2000; McGregor, 2008).

1.5. The present study

Although there is a growing body of literature that investigates cross-linguistic differences in the gestural patterns of bilingual speakers, less is known about gesture use in speakers of languages other than the well-studied Indo-European languages such as English, French, and Spanish. Considering that gestures and spoken language form an integrated communicative system, our understanding of how the system develops is incomplete without the inclusion of underrepresented linguistic populations (Kidd & Garcia, 2022; Rochanavibhata & Marian, 2022b). The current study investigated the gestural communication of Thai-English bilingual mother-child dyads in Thailand when speaking in Thai and English across three naturalistic communicative settings (prompted reminiscing, book sharing, and toy play), particularly examining how their gesture use differed as a function of the language spoken and the communicative task. Specifically, we focused on representational, deictic, conventional, and beat gestures due to evidence that these four types of gestures are linked to bilingual children's emerging language skills (Nicoladis, 2002; Nicoladis et al., 1999), and are typically used to enhance communicative effectiveness (Graham & Argyle, 1975; Krahmer & Swerts, 2007; Maricchiolo et al., 2009).

We hypothesized that the gestural communication of the mother-child dyads would differ depending on the language spoken (Thai or English) during the interaction, because of 1) how cultural differences are manifested in maternal gesture use; and 2) the differences in children's emerging L1 and L2 proficiency. We predicted that gestural differences between the bilingual mothers' two languages would reflect the social values of the cultures (Thai versus American) in which each language is predominantly spoken. Previous research has shown that Thai mothers take an adult-centered approach that places an emphasis on teaching vocabulary, whereas American mothers take a child-centered approach that focuses more on encouraging child narrative contributions (Rochanavibhata & Marian, 2022a). Thus, in line with cross-cultural research showing that Taiwanese mothers exhibit a higher gesture rate than American mothers due to their focus on providing instruction to their children (Goldin-Meadow & Saltzman, 2000), we predicted that the Thai-English bilingual mothers would use more gestures overall when speaking in Thai compared to English. Based on previous findings on gestural patterns in bilingual children (Nicoladis, 2002; Nicoladis et al., 1999), we expected that the Thai-English bilingual children would use gestures differently as a function of their proficiency in each of the two languages. Specifically, we predicted that the bilingual children would use more representational and beat gestures in their more proficient language (in this case, English) and more deictic and conventional gestures in their less proficient language (in this case, Thai).

We also hypothesized that mother-child gesture use would differ depending on the nature of the communicative setting. Based on previous research showing that mothers use iconic gestures during storytelling and event description tasks more than during toy manipulation (Gutmann & Turnure, 1979), we predicted that the bilingual mothers and children in the present study would use more representational gestures during the reminiscing task compared to the toy play task. Additionally, considering the evidence that mothers use gestures more frequently when sharing a wordless book compared to when playing with beads and strings with their children (Tamis-LeMonda et al., 2012), we predicted that the mothers and children in our sample would produce more representational, deictic, conventional, and beat gestures during book sharing than during toy play. It is less clear how cross-linguistic differences in maternal and child gesture use might be moderated by task-specific gestural patterns. However, because the toy play task involved object manipulation, which inherently decreases the likelihood of spontaneous hand movement co-occurring with speech, we expected maternal and child nonverbal communication to differ in Thai and English during the reminiscing and book sharing tasks, but not during the toy play task.

Additionally, the associations between maternal gestures, child gestures, and child language proficiency in each language were examined. We had three predictions. Based on previous findings that mothers' gesture use influences children's gesture use (Liszkowski et al., 2012; Talbott et al., 2015; Wray & Norbury, 2018), we expected 1) maternal and child gesture rates to be positively correlated. Because maternal representational and deictic gestures are associated with better language outcomes (Booth et al., 2008; Goodwyn et al., 2000; McGregor, 2008), we expected 2) maternal representational and deictic gesture rates in each language to be positively correlated with child receptive and expressive vocabulary in each language. We also hypothesized that the bilingual children's representational, deictic, conventional, and beat gesture productions would be linked to their emerging language skills. Specifically, previous research suggests that bilinguals produce more representational and beat gestures in their stronger

language (Nicoladis, 2002; Nicoladis et al., 1999). Thus, we expected 3a) child representational and beat gesture rates in each language to be positively correlated with their receptive and expressive vocabulary in each language. Conversely, because bilinguals have been shown to produce more deictic and conventional gestures in their weaker language (Nicoladis, 2002), we expected 3b) child deictic and conventional gesture rates in each language to be negatively correlated with their receptive and expressive vocabulary in each language.

Bilinguals' gesture use reflects their distinct socio-cognitive and cognitive-linguistic profile (Yow, 2015). Examining the gesture use of parents and children from understudied bilingual populations will contribute to our understanding of how mothers' and children's nonverbal communicative behaviors may differ as a function of the languages they speak and the task demands, as well as how maternal and child gesture use relates to linguistic skills during preschool. Findings from the present study will help caregivers, teachers, and paraprofessionals (e.g., speech-language pathologists, psychologists) to support children's communication in order to maximize their learning and intervention outcome (e.g., McGregor, 2008).

2. Method

2.1. Design

The present study followed a within-subjects repeated measures (language: English, Thai; task: prompted reminiscing, book sharing, toy play) design. The dependent variables in this study were maternal and child gesture use (representational, deictic, conventional, beat, and all gestures).

2.2. Participants

The participants were 26 Thai-English bilingual mother-child dyads living in Thailand. The inclusionary criteria for the dyads were: a) mothers' and children's exposure to each language was at least 20% on average per day; and b) mothers' and children's proficiency in each of the two languages was at least five on the 0-to-10 Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, et al., 2007) scale. Children were mostly 4-year-old preschool children, with age ranging from 3;11 to 5;0 (years;months). This age group was selected for the study because speech-gesture integration was found to emerge and develop between approximately 2 and 5 years of age (Capone & McGregor, 2004).

The researchers obtained the mothers' background information using the LEAP-Q (Marian et al., 2007), which assesses mothers' language proficiency in speaking, understanding, and reading in their first and second languages. Information regarding the children's language background and experience was obtained through an adapted child version of the LEAP-Q, completed by the mothers. In addition, information on the dyads' socioeconomic background was collected using the LEAP-Q. Based on the LEAP-Q data, there was variability in the sources from which the children were exposed to English. All mothers in our sample spoke both Thai and English at home, to varying degrees. On average, the mothers reported speaking English to their children 44.23% (*SD* = 17.70) of the day. The fathers were reported as speaking English to their children at a similar rate: *M* = 46.73% (*SD* = 35.30) of the day. Although rarer, some families reported siblings and extended family (e.g., grandparents, aunts, uncles) as children's sources of English exposure. Extended family members were reported as speaking English to the children on average 13.66% (*SD* = 21.75) of the time. Siblings were reported as using English with the target

child on average 62.50% (*SD* = 35.94) of the time. All of the children attended bilingual preschools. On average, the children were reported as speaking English 54% (*SD* = 27.68) and hearing English 51.54% (*SD* = 30.46) of the time each day at school.

Standardized vocabulary tests were administered to assess the dyads' expressive and receptive language skills in English and Thai. The mothers and children were given the Peabody Picture Vocabulary Test-Third Edition (PPVT-III; Dunn & Dunn, 1997) and the Expressive Vocabulary Test (EVT; Williams, 1997), both of which assess English receptive and expressive vocabulary. The translated Thai versions of the two standardized tests were also administered, to assess the dyads' Thai expressive and receptive vocabulary. Because the Thai translations of the two tests have not been standardized, raw scores are reported for both the English and Thai tests. The PPVT and EVT scores revealed that the bilingual mothers had higher receptive and expressive vocabulary scores in Thai compared to English. On the other hand, the bilingual children had higher expressive vocabulary scores in English relative to Thai. Detailed information regarding the participants' language and demographic background is shown in Table 1. Paired-samples *t*-tests were run to compare Thai and English means.

	Thai Mean (*SD*)	English Mean (*SD*)	*p* value
Children			
Total number	26		-
Age (months)	54.42 (4.34)		-
Exposure[a] (%)	52.30 (15.76)	46.63 (16.09)	.37
Mother-reported proficiency[b]	7.56 (1.26)	7.29 (1.01)	.39
Receptive vocabulary (PPVT)	67.19 (19.05)	63.00 (18.02)	.35
Expressive vocabulary (EVT)	36.15 (5.96)	48.38 (9.14)	< .001
Mothers			
Total number	26		-
Age (years)	36.72 (3.74)		-
Education (years)	19.77 (2.05)		
Exposure[a] (%)	64.81 (15.90)	35.00 (16.06)	< .001
Self-reported proficiency[b]	9.32 (0.96)	7.08 (1.12)	< .001
Receptive vocabulary (PPVT)	198.46 (2.55)	153.04 (23.21)	< .001
Expressive vocabulary (EVT)	125.73 (14.93)	109.50 (16.58)	< .001

Table 1. Language background and demographics of bilingual mothers and children. Note: [a]Exposure was reported in terms of percentage per day. [b]Proficiency was averaged across speaking, understanding, and reading domains, measured using the LEAP-Q, on a 0-10 scale.

2.3. Procedure

In the preliminary session, the mothers filled out the LEAP-Questionnaires to provide information regarding their and their child's language experience and socioeconomic background, specifically maternal levels of education. The fathers also filled out the LEAP-Q, which provided information on paternal levels of education. Following the completion of the LEAP-Q, the PPVT-III (10-15 min) and the EVT (10-20 min) were administered, to assess the mothers' and children's expressive and receptive language skills in English and Thai.

In two subsequent sessions, the same Thai-English bilingual researcher visited the mother-child dyads' homes and video-recorded interactions between the mother and the child throughout three naturalistic tasks, including 1) prompted reminiscing; 2) book reading; and 3) toy play. Each mother-child dyad completed the three tasks over one day in Thai and one day in English. The order of languages was counterbalanced across participants. The two sessions took place two weeks apart. At the beginning of each session, the researcher instructed the mothers and children to speak only in the designated language. Although the bilingual mother-child dyads were asked to converse exclusively in one language per session, many participants unintentionally code-switched at some point, to varying degrees.

2.3.1. Task 1: Prompted reminiscing

In this task, word prompts were provided to elicit mother-child reminiscing. Previous research has shown the effectiveness of prompts in eliciting autobiographical memories (e.g., Marian & Neisser, 2000; Rochanavibhata & Marian, 2020). The mothers were given a deck of cards (n = 11), with each card showing a one word prompt. Two sets of word prompts were used. Set 1: *airplane*, *birthday*, *blanket*, *blood*, *boat*, *butterfly*, *cat*, *holiday*, *laughing*, *lunch*, and *school*; Set 2: *car*, *dinner*, *doctor*, *dog*, *friend*, *kitchen*, *party*, *spider*, *summer*, *year*, and *zoo*. The respective Thai translations of the words are: *เครื่องบิน*, *วันเกิด*, *ผ้าห่ม*, *เลือด*, *เรือ*, *ผีเสื้อ*, *แมว*, *วันหยุด*, *การหัวเราะ*, *อาหารเที่ยง*, and *โรงเรียน* (Set 1); and *รถ*, *อาหารเย็น*, *หมอ*, *หมา*, *เพื่อน*, *ครัว*, *งานเลี้ยง*, *แมงมุม*, *ฤดูร้อน*, *สนาม*, and *สวนสัตว์* (Set 2). The mothers were given one set of the word prompts in English and another set in Thai. The mothers were then instructed to help the child recount memories related to each word. To elicit narratives from the children, the mothers were also instructed to ask their child, *What else do you remember?* and *Can you tell me more?* before continuing to the next word prompt.

2.3.2. Task 2: Book reading

Two wordless picture books, *Frog, Where are You?* (Mayer, 1969) and *Frog Goes to Dinner* (Mayer, 1974), were assigned to each dyad. These two books do not differ in narrative length or complexity (Gutiérrez-Clellen, 2002), and have been widely used by researchers for narrative elicitation from children and adults of diverse linguistic and cultural backgrounds (e.g., Melzi et al., 2011; Rochanavibhata & Marian, 2021). The mother was instructed to tell the story and elicit contributions from the child as they typically would using a picture book, for as long as they would like. Half of the dyads shared *Frog, Where are You?* (Mayer, 1969) in Thai and *Frog Goes to Dinner* (Mayer, 1974) in English, while the other half shared *Frog Goes to Dinner* (Mayer, 1969) in Thai and *Frog, Where are You?* (Mayer, 1974) in English.

2.3.3. Task 3: Toy play

The dyads were given a set of gender- and culturally-neutral farm-themed toys, including a pig, chicken, cow, horse, duck, sheep, and goat. The mothers were instructed to play with the child using these toys as they typically would and for as long as they would like. The same set of toys were used in both the English and Thai sessions.

2.4. Coding and analysis

Video recordings were transcribed using the Child Language Analysis program (MacWhinney, 2000). Behavioral communication codes for types of gestures were developed based on the taxonomy used by previous researchers (e.g., Iverson et al., 1999; McNeill, 1992), and research assistants were trained using a coding manual. Coding for gestures involved reviewing the video

recordings and inserting the type of gesture in the corresponding positions in each utterance on the transcripts. Four types of gestures were coded: 1) representational; 2) deictic; 3) conventional; and 4) beat. 1) Representational gestures refer to gestures that bear semantic association with speech, and symbolically depict aspects of the narrative. Iconic and metaphoric gestures are both considered representational – one is concrete and the other abstract, therefore we coded for both types and counted them as representational gestures. An example of an iconic gesture includes flapping one's hands to show a bird flying, whereas moving one's arms in a circular motion to represent the concept of 'entirety' or 'all' is an example of a metaphoric gesture. 2) Deictic gestures are used to direct attention to an object, location, or individual, including showing gestures (holding an object up), indicating gestures (touching something with the whole hand), and pointing gestures (extending the index finger). 3) Conventional gestures' form and meaning are typically culturally defined, and can usually be recognized without co-occurring speech. Examples of conventional gestures include shaking one's head for 'no' and nodding one's head for 'yes'. 4) Beat gestures are repeating manual strokes occurring along with the rhythm of speech to highlight the part of the discourse that the speaker wants to emphasize.

Each gesture was coded based on the speaker's body movement and the utterance context in which it occurred in all three tasks. Instances of code-switching into the other language (e.g., switching to Thai during the English session) were excluded from coding and analysis. After the coders had been trained, inter-rater reliability was established between the coders on 20% of the transcripts. Reliability was calculated by tallying the total number of agreements and disagreements between coders on each of the gesture types coded for, while accounting for the expected frequencies of agreement by chance. For example, every time the two coders agreed that the event in question was a beat gesture, it was counted as an agreement. All agreements and disagreements were then tallied for beat gestures. The same process was repeated for the other types of gestures. Any disagreements among the coders were discussed until an agreement was reached. Reliability was $\kappa = 0.86$. Both the mother's and children's gestures were coded for the same two types. Table 2 provides additional examples of each type of gesture, with corresponding illustrations (Figures 1-7).

Gesture Type	Examples
Representational	Forming a dome shape by putting two reverse-cupped hands together above the head for 'hat'. [Insert Figure 1 here] Moving one's arms in a circular motion to represent the concept of 'all'. [Insert Figure 2 here]
Deictic	Holding up a toy in the center of the gesture space, oriented toward the child. [Insert Figure 3 here] Tapping on the floor. [Insert Figure 4 here] Extending the index finger toward an object. [Insert Figure 5 here]
Conventional	Flipping both hands for 'I don't know'. [Insert Figure 6 here]
Beat	Flicking the fingers rapidly when reminiscing. Vertical or horizontal hand movements that co-occur with spoken clauses.

[Insert Figure 7 here]

Table 2. Types of gestures and corresponding examples.

3. Results

3.1. Task duration, speech quantity, gesture quantity, and gesture rate

3.1.1. Task duration

See Table 3 for the average task duration (in minutes) across languages. There were no significant differences across languages in the average durations of the sessions (*p*s > .05).

Task	English	Thai	*p* value
Prompted Reminiscing	23.08 (9.99)	21.75 (9.10)	.45
Book Sharing	7.79 (2.50)	6.98 (2.88)	.09
Toy Play	15.11 (6.96)	18.21 (10.14)	.06

Table 3. Mean task duration in minutes (standard deviations) across languages.

3.1.2. Speech quantity

See Table 4 for the average number of words produced by the mothers and children by task and language. The bilingual mothers and children produced more words in Thai than in English on all three tasks (*p*s < .05). Book sharing was the only task in which the number of words produced by the bilingual children did not differ across languages.

Task	English	Thai	*p* value
Mothers			
Prompted Reminiscing	1243.85 (707.12)	1968.115 (874.35)	< .001
Book Sharing	473.92 (202.39)	919.27 (457.74)	< .001
Toy Play	599.00 (314.36)	1271.19 (875.57)	< .001
Children			
Prompted Reminiscing	636.62 (308.59)	808.38 (434.576)	.01
Book Sharing	110.35 (86.62)	103.38 (107.12)	.70
Toy Play	435.31 (286.53)	727.96 (595.74)	.005

Table 4. Mean number of words (standard deviations) produced by the mothers and children in each task and language.

3.1.3. Gesture quantity

See Table 5 for the mean raw frequencies of each gesture type produced by the mothers and children by task and language.

	Prompted Reminiscing		Book Sharing		Toy Play	
Gesture Type	English	Thai	English	Thai	English	Thai
Maternal	3.08 (2.54)	5.92 (6.57)	1.38 (2.37)	1.65 (2.10)	0.35 (0.69)	3.12 (8.05)
Representational						
Deictic	6.46 (6.67)	7.77 (11.22)	15.69 (11.90)	16.96 (14.01)	9.12 (9.46)	22.73 (18.26)
Conventional	33.42 (22.32)	42.96 (24.29)	3.38 (2.99)	4.38 (4.81)	5.92 (5.31)	15.35 (24.71)

Beat	1.62 (2.43)	2.04 (3.32)	0.65 (1.20)	0.19 (0.49)	0.42 (0.86)	1.27 (4.05)
All	44.58 (26.94)	58.69 (34.47)	21.12 (14.66)	23.19 (16.63)	15.81 (12.80)	42.46 (47.34)
Child						
Representational	4.62 (4.86)	13.12 (10.14)	0.50 (1.07)	0.65 (2.76)	0.38 (0.57)	2.38 (4.84)
Deictic	4.46 (4.44)	5.69 (5.30)	6.04 (5.20)	5.77 (9.37)	5.77 (4.53)	23.46 (22.55)
Conventional	13.23 (10.92)	17.42 (13.59)	2.38 (2.23)	2.23 (3.23)	2.08 (2.04)	4.12 (6.89)
Beat	3.23 (4.47)	2.65 (3.98)	0.31 (0.62)	0.19 (0.49)	0.38 (0.85)	0.62 (1.58)
All	25.54 (18.03)	38.96 (19.50)	9.23 (7.28)	8.85 (13.07)	8.62 (6.62)	30.58 (28.77)

Table 5. Mean raw frequencies (standard deviations) of maternal and child gesture use across tasks and languages.

3.1.4. Gesture rate

Gesture rate was calculated by dividing the raw frequencies of gestures (all, representational, deictic, conventional, and beat) that participants produced in English and Thai by the number of words participants produced in English and Thai, respectively. The values were then multiplied by 100. The decision to calculate gesture rate using the total number of words as the denominator was based on previous cross-linguistic studies (e.g., Laurent et al., 2015; Molnar et al., 2022; Pika et al., 2006; Sherman & Nicoladis, 2004). See Table 6 for the mothers' and children's gesture rates for each type of gesture across communicative tasks and languages.

	Prompted Reminiscing		Book Sharing		Toy Play	
Gesture Type	English	Thai	English	Thai	English	Thai
Maternal						
Representational	0.27 (0.24)	0.30 (0.31)	0.23 (0.30)	0.16 (0.23)	0.05 (0.11)	0.18 (0.26)
Deictic	0.60 (0.82)	0.38 (0.51)	3.25 (2.26)	1.94 (1.62)	1.77 (1.70)	1.85 (1.15)
Conventional	2.91 (1.94)	2.30 (0.51)	0.70 (0.60)	0.43 (0.42)	1.09 (0.97)	0.99 (0.86)
Beat	0.14 (0.24)	0.09 (0.13)	0.16 (0.34)	0.02 (0.05)	0.11 (0.29)	0.05 (0.17)
All	3.93 (2.61)	3.07 (1.53)	4.34 (2.52)	2.55 (1.80)	3.03 (2.33)	3.07 (1.72)
Child						
Representational	0.78 (0.80)	1.75 (1.43)	0.35 (0.78)	0.21 (0.73)	0.10 (0.18)	0.26 (0.34)
Deictic	0.74 (0.85)	0.81 (1.05)	8.47 (12.59)	4.85 (6.30)	1.90 (1.77)	3.76 (3.02)
Conventional	2.17 (1.42)	2.56 (1.95)	2.87 (3.39)	2.41 (3.42)	0.76 (0.80)	0.50 (0.47)
Beat	0.47	0.26	0.21 (0.43)	0.09	0.07	0.05

	(0.64)	(0.33)		(0.25)	(0.13)	(0.14)
All	4.16	5.38	11.89	7.56	2.83	4.57
	(2.31)	(2.67)	(14.42)	(7.95)	(2.38)	(3.22)

Table 6. Mean gesture rates (standard deviations) of the mothers and children across tasks and languages.

Linear mixed effects models were run individually by type of gesture and speaker using the lme4 package (Bates et al., 2015) in *R* (R Core Team, 2022). Each model included fixed effects of language (English, Thai), task (prompted reminiscing, book sharing, toy play), and their interaction, as well as a random effect of participant. Language was simple coded: English [-0.5] versus Thai [+0.5]. Task was sum coded: prompted reminiscing [+1], book sharing [0], and toy play [-1] to compare prompted reminiscing to the grand mean; and prompted reminiscing [0], book sharing [+1], and toy play [-1] to compare book sharing to the grand mean. The significance of fixed effect estimates was evaluated using the Satterthwaite approximation for degrees of freedom, using lmerTest (Kuznetsova et al. 2017). Follow-up comparisons, with the Satterthwaite approximation for degrees of freedom and the Tukey correction for multiple comparisons, were run using the emmeans package (Lenth, 2022). See Tables S1-S10 in the online supplementary materials for the model outputs, and Figures 8-10 for the boxplots.

[Insert Figures 8, 9 and 10 about here]

3.2. Maternal gesture use across languages and tasks

3.2.1. All gestures

There was a main effect of language on the bilingual mothers' overall gesture rate ($F(1,125) = 8.76$, $p = .004$), and a significant interaction between language and task ($F(2,125) = 3.27$, $p = .041$). Tukey-adjusted pairwise comparisons revealed that the mothers' overall gesture rate was higher in English than in Thai during prompted reminiscing (Estimate = 0.61, $SE = 0.27$, $t = 2.30$, $p = .023$), but not during book sharing (Estimate = 0.27, $SE = 0.27$, $t = 1.00$, $p = .320$) or toy play (Estimate = 0.10, $SE = 0.27$, $t = 0.36$, $p = .720$).

3.2.2. Representational gestures

Maternal use of representational gestures differed across tasks ($F(2,125) = 8.45$, $p < .001$). Tukey-adjusted pairwise comparisons revealed that the mothers used more representational gestures during prompted reminiscing than toy play (Estimate = 0.17, $SE = 0.04$, $t = 4.11$, $p < .001$). The effect of language ($F(1,125) = 0.57$, $p = .452$) and interaction between language and task ($F(2,125) = 2.67$, $p = .073$) were not significant.

3.2.3. Deictic gestures

There were significant effects of language ($F(1,125) = 5.21$, $p = .024$) and task ($F(2,125) = 33.55$, $p < .001$) on the maternal use of deictic gestures, as well as a significant interaction between language and task ($F(2,125) = 3.99$, $p = .021$). Tukey-adjusted pairwise comparisons revealed that the mothers used more deictic gestures in English than in Thai during book sharing (Estimate = 1.31, $SE = 0.37$, $t = 3.58$, $p < .001$), but not during prompted reminiscing (Estimate = 0.22, $SE = 0.37$, $t = 0.59$, $p = .557$) or toy play (Estimate = -0.08, $SE = 0.37$, $t = -0.21$, $p = .832$).

3.2.4. Conventional gestures

The bilingual mothers used more conventional gestures in English (M = 1.57, SD = 1.61) than in Thai (M = 1.24, SD = 1.20; F(1,125) = 4.46, p = .037). Maternal conventional gesture use also differed across tasks (F(2,125) = 63.98, p < .001). Tukey-adjusted pairwise comparisons revealed that the mothers used more conventional gestures during prompted reminiscing relative to book sharing (Estimate = 2.04, SE = 0.19, t = 10.81, p < .001) and toy play (Estimate = 1.57, SE = 0.19, t = 8.30, p < .001). Additionally, the mothers used more conventional gestures during toy play than book sharing (Estimate = -0.47, SE = 0.19, t = -2.51, p = .035). There was no significant interaction between language and task (F(2,125) = 0.98, p = .379).

3.2.5. Beat gestures

The mothers used more beat gestures in English (M = 0.14, SD = 0.29) than in Thai (M = 0.05, SD = 0.13; F(1,125) = 5.84, p = .017). There was no significant effect of task (F(2,125) = 0.34, p = .713) or interaction between language and task (F(2,125) = 0.65, p = .525).

3.3. Child gesture use Across languages and tasks

3.3.1. All gestures

The bilingual children's overall gesture rate differed across tasks (F(2,125) = 10.77, p < .001). Tukey-adjusted pairwise comparisons revealed that the children's overall gesture rate was higher during book sharing relative to prompted reminiscing (Estimate = -4.95, SE = 1.39, t = -3.58, p = .001) and toy play (Estimate = 6.03, SE = 1.39, t = 4.35, p < .001). There was no significant main effect of language (F(1,125) = 0.16, p = .689) or interaction between language and task (F(2,125) = 2.95, p = .055).

3.3.2. Representational gestures

There were main effects of language (F(1,125) = 6.75, p = .010) and task on the bilingual children's use of representational gestures (F(2,125) = 29.98, p < .001). There was also a significant interaction between language and task (F(2,125) = 6.87, p = .001). Tukey-adjusted pairwise comparisons revealed that the bilingual children used more representational gestures in Thai than in English during prompted reminiscing (Estimate = -0.97, SE = 0.22, t = -4.42, p < .001). There were no cross-linguistic differences in representational gesture use during book sharing (Estimate = 0.14, SE = 0.22, t = 0.65, p = .516) or toy play (Estimate = -0.16, SE = 0.22, t = -0.73, p = .465).

3.3.3. Deictic gestures

The bilingual children's deictic gesture rate differed across tasks (F(2,125) = 13.11, p < .001). Tukey-adjusted pairwise comparisons revealed that the children used more deictic gestures during book sharing relative to prompted reminiscing (Estimate = -5.88, SE = 1.17, t = -5.04, p < .001) and toy play (Estimate = 3.83, SE = 1.17, t = 3.28, p = .004). There was no significant effect of language (F(1,125) = 0.35, p = .557) or significant interaction between language and task (F(2,125) = 2.87, p = .060).

3.3.4. Conventional gestures

The bilingual children's conventional gesture rate differed across tasks (F(2,125) = 13.09, p < .001). Tukey-adjusted pairwise comparisons revealed that relative to the toy play task, the children used more conventional gestures during the prompted reminiscing (Estimate = 1.74, SE = 0.43, t = 4.08, p < .001) and book sharing (Estimate = 2.01, SE = 0.43, t = 4.72, p < .001) tasks.

There was no significant effect of language ($F(1,125) = 0.10$, $p = .757$) or significant interaction between language and task ($F(2,125) = 0.55$, $p = .579$).

3.3.5. Beat gestures

The bilingual children used more beat gestures in English (M = 0.25, *SD* = 0.47) than in Thai (*M* = 0.14, *SD* = 0.26; $F(1,125) = 4.10$, $p = .045$). The children's beat gesture rates also differed across tasks, $F(2,125) = 10.18$, $p < .001$. Tukey-adjusted pairwise comparisons revealed that the bilingual children used more beat gestures during the prompted reminiscing task than in the book sharing (Estimate = 0.21, *SE* = 0.07, $t = 3.08$, $p = .007$) and toy play (Estimate = 0.30, *SE* = 0.07, $t = 4.40$, $p < .001$) tasks. The interaction between language and task was not significant ($F(2,125) = 0.94$, $p = .394$).

3.4. Associations between gesture use and child language skills

Maternal and child representational ($r = 0.27$, $p < .001$) and deictic gesture ($r = 0.33$, $p < .001$) rates were positively correlated. The positive correlation between maternal and child overall gesture rates was marginally significant ($r = 0.14$, $p = .09$), whereas maternal and child conventional and beat gesture rates were not significantly correlated (*p*s > .05). The children's conventional gesture rate in Thai was negatively correlated with their Thai receptive ($r = -0.27$, $p = .02$) and expressive vocabulary scores ($r = -0.23$, $p = .04$). There were no significant positive associations between maternal gesture rate and child vocabulary scores. The correlation results are presented in Tables 13 and 14.

Gesture Type	Pearson's *r*
All	0.14†
Representational	0.27***
Deictic	0.33***
Conventional	0.03
Beat	0.11

Table 13. Pearson's *r* correlations between maternal and child gesture rates. Note: †$p < .10$, ***$p < .001$.

	English		Thai	
Gesture Type	PPVT	EVT	PPVT	EVT
Maternal				
Representational	0.04	-0.03	-0.21†	0.11
Deictic	-0.03	0.08	-0.13	-0.03
Child				
Representational	-0.11	-0.10	-0.22†	-0.02
Deictic	-0.08	-0.03	-0.11	0.06
Conventional	0.08	0.09	-0.27*	-0.23*
Beat	-0.03	0.01	-0.08	-0.05

Table 14. Pearson's *r* correlations between gesture use and child receptive and expressive vocabulary scores. Note: †$p < .10$, *$p < .05$.

4. Discussion

We investigated how the gestural communication of bilingual mothers and children differed as a function of language and task, as well as how maternal and child gestural patterns related to each other. The current results provided evidence for differences in maternal and child gestural patterns across languages and tasks, as well as significant associations between maternal and child gesture use.

Contrary to our predictions, the bilingual mothers used more gestures in English than in Thai. We hypothesized that the bilingual mothers' gesture production in each language would be reflective of culture-specific child-rearing practices. Given the didactic nature of interactions between Thai monolingual mothers and children (Rochanavibhata & Marian, 2022a), the bilingual mothers were expected to resemble their monolingual counterparts when speaking in Thai. Specifically, similar to previous research (Goldin-Meadow & Saltzman, 2000), the mothers' emphasis on teaching was expected to be demonstrated by greater overall use of gestures in Thai. However, we found that the mothers used more conventional and beat gestures when speaking English. These findings could be attributed to the bilingual mothers' unbalanced proficiency; the mothers may have used more gestures in English to compensate for their lower verbal proficiency (e.g., Nicoladis et al., 2007; Sherman & Nicoladis, 2004). It has also been posited that adults view conventional gestures as simple and child-appropriate, which results in greater use of conventional gestures when speaking a weaker language (Nicoladis, 2002; 2007). Thus, although findings in the extant literature have been inconsistent, gestural patterns of the mothers in our sample reinforce the proficiency account of bilingual nonverbal communication.

At the same time, the bilingual children's gestural patterns provided mixed support for the hypothesis that language proficiency influences gesture rate. Although the bilingual children's greater use of beat gestures in English than in Thai was congruent with our prediction, the correlations between their vocabulary scores and gesture rate were not significant in English, their stronger language. While the frequency of the children's deictic gestures did not differ across languages, there was a significant negative correlation between the children's deictic gestures and vocabulary scores in Thai, their weaker language. These inconclusive findings mirror previous research on the relationship between language proficiency and gesture use. On the one hand, gestures are used to compensate for speakers' lower proficiency because they can help with disambiguating unclear verbal messages (So et al., 2010) and supporting word retrieval (Nicoladis et al., 2009). On the other hand, individuals with higher proficiency may use more gestures to increase the complexity of their verbal content (Nicoladis et al., 1999). Therefore, the use of gestures appears to be multipurpose and may not solely be attributed to speakers' language proficiency (Zvaigzne et al., 2019). Other potential factors influencing bilinguals' gesture use include language-specific morphological and syntactical features. For example, Turkish and English have been shown to differ in the ways that path and manner of an action are expressed verbally, resulting in unique gestural patterns in Turkish and English speakers (Özyürek et al., 2008). It is possible that differences in the features of Thai and English contributed to the children's distinct patterns of gestural communication. Although linguists have compared Thai and English syntax (e.g., Chaiyaratana, 1961), the influences of Thai grammatical features on speakers' gestures have not been systematically examined and remain an open question.

Additionally, as posited by Limia and colleagues (2019), it may be possible that the bilingual children did not use gestures to offset their weaker proficiency because they mixed their two languages (despite being instructed to speak only one language). Considering that bilingual children have been shown to compensate for lexical gaps by borrowing words from the other language (e.g., Paradis et al., 2000), it is plausible that the bilingual children in our study opted to code-switch instead of using gestures to fill the gap (Limia et al., 2019).

Task comparisons revealed that both the mothers and the children produced higher conventional gesture rates during prompted reminiscing compared to other tasks. Additionally, relative to the other tasks, the mothers used more representational gestures and the children more beat gestures during prompted reminiscing. These findings were expected, as there was no visual referent or objects, other than the cards with the word prompts, for the dyads to refer to when speaking about the specific topics. To facilitate communication, the dyads likely utilized more representational (e.g., flapping the hands for 'flying with wings' when reminiscing about a butterfly) and conventional gestures (e.g., placing the index finger vertically on the lips for 'quiet') to support their speech by visually depicting images that either matched or elaborated upon their narrative content. Congruent with our predictions, we also found that the children produced more deictic (e.g., pointing to the picture of the frog on each page during the reading of *Frog, Where Are You?*) and conventional gestures (e.g., waving hands for 'bye-bye' when the boy leaves with the frog) during book sharing than during toy play. These task-specific differences in gestural patterns aligned with previous findings, which have shown that when contexts or task demands differ, speakers tend to adapt their behaviors and opt for the types of gestures that best facilitate communication (Gampe et al., 2019; Gutmann & Turnure, 1979; Tamis-LeMonda et al., 2012; Wermelinger et al., 2020; Wray & Norbury, 2018).

Additionally, we found that cross-linguistic differences in the bilinguals' gestural patterns were moderated by the communicative task. The mothers' higher overall gesture rates in English and the children's higher representational gesture rates in Thai were found only during prompted reminiscing. For both the mothers and the children, a task without any visual aid or specific referents might have been the most difficult task out of the three. In line with previous research showing that bilinguals use more gestures when engaging in a challenging task (Nicoladis, 2007), it is possible that bilingual mothers and children require gestures to adjust to the complex demands of reminiscing tasks.

Out of the three predictions we had regarding the associations between maternal and child gesture use, as well as between gesture rate and language skills, we found support for two. Maternal and child overall, representational, and deictic gesture rates were positively correlated, which reiterate previous findings (Liszkowski et al., 2012; Talbott et al., 2015; Wray & Norbury, 2018), and suggest that maternal gestural patterns influence children's emerging nonverbal communication. The fact that the children's conventional gesture rate in Thai was negatively correlated with their Thai vocabulary scores potentially highlights the relationship between proficiency and the compensatory nature of conventional gestures (e.g., Nicoladis et al., 2007; Sherman & Nicoladis, 2004). However, contrary to our predictions and previous research (Booth et al., 2008; Goodwyn et al., 2000; McGregor, 2008; Nicoladis 2002; Nicoladis et al., 1999), maternal representational and deictic gesture rates were not significantly correlated with child receptive and expressive vocabulary scores. The children's representational, deictic, and beat

gesture rates were also not correlated with their receptive and expressive vocabulary scores. These results may provide additional support for the hypothesis that language skills may not be the only explanation for the number of gestures speakers produce (Zvaigzne et al., 2019). Furthermore, the incongruent findings from the present study underscore the importance of studying underrepresented languages and populations (Kidd & Garcia, 2022; Rochanavibhata & Marian, 2022b), as gestural patterns found in well-studied languages may not generalize to other, understudied languages.

Understanding the role of gestures in bilingual communication will further support researchers, speech-language pathologists, educators, and early intervention practitioners in developing assessments and treatments tailored to the needs of culturally and linguistically diverse (CLD) populations. When designing classroom curricula, evaluations, and intervention strategies, educators and clinicians should consider a multimodal approach that incorporates both speech and gesture to improve outcomes (e.g., McGregor, 2008). Knowledge of gestural patterns in CLD populations will also allow practitioners to account for factors that influence nonverbal communication, such as cultural background, language proficiency, linguistic features, and task demands.

In sum, the gestural communication of the bilingual mothers and children differed depending on the language in which they spoke and the nature of the task. Cross-linguistic differences in gesture use in the present study suggest that bilingual children interact and utilize nonverbal communication in language-specific ways as early as preschool. To further enhance the effectiveness of message conveyance, the mothers and children modified their gesture use according to the demands of each task. These findings contribute to our theoretical understanding of gestural and speech patterns in languages that are typologically different. However, further research, including qualitative analyses of gesture use and studies focusing on other underrepresented linguistic populations, remains necessary to develop a more complete and accurate understanding of the human communicative system.

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Figure captions

Figure 1. Example of iconic gesture for 'hat'.

Figure 2. Example of metaphoric gesture for 'all'.

Figure 3. Example of showing gesture.

Figure 4. Example of indicating gesture for 'floor'.

Figure 5. Example of pointing gesture.

Figure 6. Example of conventional gesture for 'I don’t know'.

Figure 7. Example of beat gesture: rhythmic hand movement co-occurring with speech.

Figure 8. Boxplots for maternal and child gesture rate during prompted reminiscing. (A) Representational gesture rate by language and speaker. (B) Deictic gesture rate by language and speaker. (C) Conventional gesture rate by language and speaker. (D) Beat gesture rate by language and speaker. (E) All gesture rate by language and speaker.

Figure 9. Boxplots for maternal and child gesture rate during book sharing. (A) Representational gesture rate by language and speaker. (B) Deictic gesture rate by language and speaker. (C) Conventional gesture rate by language and speaker. (D) Beat gesture rate by language and speaker. (E) All gesture rate by language and speaker.

Figure 10. Boxplots for maternal and child gesture rate during toy play. (A) Representational gesture rate by language and speaker. (B) Deictic gesture rate by language and speaker. (C) Conventional gesture rate by language and speaker. (D) Beat gesture rate by language and speaker. (E) All gesture rate by language and speaker.
