8-13-2019

Effect of Child Sex and Sibling Composition on Parental Verbal and Nonverbal Input

Ebru Pinar

EFFECT OF CHILD SEX AND SIBLING COMPOSITION ON PARENTAL VERBAL AND NONVERBAL INPUT

by

EBRU PINAR

Under the Direction of Şeyda Özçalışkan, PhD

ABSTRACT

Children show differences in the way they speak and gesture. Parents also show variability in the way they produce speech when interacting with their singleton sons vs. daughters—a pattern that we do not yet know extend to boy-boy vs. girl-girl twins. In this study, we ask whether there is evidence of sex (girls vs. boys) or group (singletons vs. twins) differences in parents' speech and gesture production, and whether these differences also become evident in different twin dyads (girl-girl, boy-boy, girl-boy) difference? Our results largely showed no evidence of a sex or dyad-composition difference in either parent speech or gesture, but evidence of a group difference in gesture, with the parents of singletons providing greater amount, diversity, and complexity of gestures than parents of twins in one-on-one interactions. These results suggest that differences in parent input to singletons vs. twins might become evident initially in gesture.

INDEX WORDS: Parent speech, Parent gesture, Twin children, Sex Differences

EFFECT OF CHILD SEX AND SIBLING COMPOSITION ON PARENTAL VERBAL AND NONVERBAL INPUT

by

EBRU PINAR

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2019

EFFECT OF CHILD SEX AND SIBLING COMPOSITION ON PARENTAL VERBAL AND NONVERBAL INPUT

By

EBRU PINAR

Committee Chair: Şeyda Özçalışkan

Committee: Rose Sevcik

Nihan Ketrez

Electronic version approved:

Office of Graduate Studies

College of Arts and Sciences

Georgia State University

August 2019

DEDICATION

I would like to dedicate this work to my parents, Dr. Tevfik Pınar and Dr. Gül Pınar, and my brother, Refik Tuğrul Pınar, who supported and encouraged me fully throughout this process. Thank you for being the greatest examples I had and thank you for always guiding me in the best possible way.

ACKNOWLEDGEMENTS

I would like to first thank my advisor Dr. Şeyda Özçalışkan for her invaluable support, motivation, and help. I also would like to thank my committee members Dr. Rose Sevcik and Dr. Nihan Ketrez for their precious guidance, advice, and assistance. I am truly thankful for the grant from the Scientific and Technological Research Council of Turkey (111K270; Ketrez Sözmen, PI), which the data collection for this project was supported from. Additionally, I am grateful for the determination and enthusiasm that my research assistants, Melis Çiftçi and Fatih Şahinkayası, showed in this process. Lastly, I would like to thank my lab friends – Hatice Sümeyra Öztürk, Stephanie Baumann, Valery Lima, Kübra Şengül, and Murat Şengül for their feedback and support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Singleton children show sex differences in early speech development. Girls produce a greater number and diversity of words at an earlier age than boys (Berglund, Eriksson, & Westerlund, 2005). There is some evidence suggesting that this pattern is also true for their gestures: girls typically produce their first gesture at an earlier age than boys (Butterworth & Morrisetta, 1996). The pattern of sex differences in language development also becomes evident in twin children (Day, 1932). Boy-boy twin dyads lag behind both girl-girl twin dyads and singletons—boy or girl— in early vocabulary development, producing fewer number and diversity of words (Garitte, Almodovar, Benjamin & Canhao, 2002). Previous work shows us that there are sex and dyad composition differences in the way children speak and gesture. One possible explanation for the sex and dyad composition differences could be the parental input that children receive.

Research on parental speech input presents inconclusive results: some studies show greater amount, complexity, and variety of speech addressed to singleton girls than to singleton boys (Cherry & Lewis, 1976; Leaper et al., 1998), while others suggest either no sex differences in parent speech input (Brundin, Rodholm, & Larsson, 1988; Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991) or more greater amount of talk addressed to boys (Laflamme et al., 2002). However, there are no studies that examine patterns of parent speech input to different twin dyads or twins compared to singletons. Research on parental nonverbal (i.e., gesture) input to singletons as well as to twins also remains sparse. There is some evidence that suggests that parents of singletons might be comparable in the amount of co-speech gestures that they produce when speaking to their daughters vs. sons, but only for gestures that convey additional information not found in speech (e.g., “look what I have” + point at toy; Özçalışkan & Goldin-Meadow, 2010). Though, we still do not know about the overall amount, diversity, or complexity

of gestures parents produce when talking to their singleton boys vs. singleton girls or to their boy-boy, girl-boy, or girl-girl twins.

In this study, we focus on the gestures and speech produced by parents of three groups of 1- to 2-year-old fraternal twins (boy-boy, girl-boy, girl-girl), comparing them to the gestures and speech produced by parents of 1- to 2-year-old boy vs. girl singletons—all native Turkish speakers. We ask whether we can find evidence of sex (boy vs. girl) and dyad composition (boy-boy, girl-boy, and girl-girl) differences in the speech and gestures parents provide to their children. These findings will expand our understanding of the importance of parental verbal and nonverbal input that can help boost language and gesture development in singleton and twin children.

1.1 Sex differences in singleton and twin children's early speech and gesture production

1.1.1 Speech

The speech production of singletons shows sex differences at the early ages, with an advantage for girls (Hyde & Linn, 1988; Kimura, 1998). Girls are known to produce their first words (Maccoby, 1966) and first sentences (Ramer, 1976) earlier than boys. Girls also develop larger vocabularies (Eriksson, Marschik, Tulviste, Almgren, Perez Pereira, Wehberg & Gallego, 2012; Huttenlocher et al., 1991) and produce more complex and more diverse set of sentences (Tse, Chan, Li, & Kwong, 2002) compared to boys of the same age.

Turning to twin children, we know that twins lag behind singletons—with an average lag time of 3 months—in their early speech development (Conway, Lytton, & Psyh, 1980; Day, 1932; Gucuyener et al., 2011; Hay, Prior, Collett, & Williams, 1987; Rutter & Redshaw, 1991; Rutter, Thorpe, Greenwood, Northstone, & Golding, 2003; Savic, 1980), and this gap increases

by child's age (Day, 1932; Rutter et al., 2003). Research also suggests that twin children start to produce their first sentences later than singleton children (Rice et al., 2014); and these differences between singletons and twins become evident across a number of speech abilities from articulation (Hay et al., 1987) to expressive and comprehensive language skills (Stafford, 1987).

Importantly, twins also show differences in terms of their dyad composition, with girl-girl twins exceeding boy-boy twins in their spoken language development (Day, 1932). In an earlier longitudinal study of play activities (Symbolic Play Test & Reynell Developmental Language Scales (1977 Revision), Hay et al. (1987) showed that 30-month-old boy-boy twins lag behind girl-girl twins, showing a 6-to-8-month difference in their expressive and receptive language development. Similarly, another study that focused on 24-month-old twins and singletons showed that twins had lower language scores on average compared to singletons, and boy-boy twins had lower scores compared to girl-girl twins, all assessed by parental report (CDI; Fenson, Pethick, Renda, Cox, Dale, & Reznick, 2000; Galsworthy, Dionne, Dale, & Plomin, 2000; Rice et al., 2014). Similar pattern was also seen in a study that included Turkish twin children at the age of 5 years old and concluded that boy-boy twins performed more poorly than girl-girl twins on vocabulary, using the Turkish version of the Peabody Picture Vocabulary Tests (Gucuyener et al., 2011).

Compared to several studies that showed a female advantage in same-sex twin dyads, there were only a few studies that examined mixed-sex twin dyads, with largely inconclusive results. Galsworthy et al. (2000) found that 2-year-old girl-girl twins had significantly higher language scores than boy-boy and girl-boy twins of the same age. On the contrary, some other

studies showed no evidence of a difference between girl-girl and girl-boy twins in spoken language abilities (Garitte et al., 2002; Gucuyener et al., 2011).

1.1.2 Gesture

Children do not only communicate with speech; they also communicate with gestures. Previous work, largely based on singleton samples, suggests a strong link between early gesture and speech. Children gesture before they produce their first words to communicate about referents (Acredolo & Goodwyn, 1985, 1989; Bates, 1976; Bates, Bretherton, Camaioni, & Volterra, 1979), and these gestures predict emerging spoken language abilities (Butcher & Goldin-Meadow, 2000; Goldin-Meadow, 1998, 2003; Goldin-Meadow & Butcher, 2003; Özçalışkan & Goldin-Meadow, 2005[a], 2009, 2010). Although limited, the existing research suggests a female advantage in early gesture production among singletons. For example, girls tend to produce more gestures than boys at the early ages (8-30 months; Eriksson & Berglund, 1999; Fenson, Dale, Reznick, Bates, Thal, & Pethick, 1994); girls also produce their first gestures about a month earlier than boys (Butterworth & Morisette, 1996)—all assessed by parent report.

After children produce their first gestures followed by their first words, they continue using gestures in combination with words (i.e., gesture + speech). First, children start producing gesture-speech combinations where the information conveyed in gesture is the same as the information in speech (e.g., complementary gesture+speech; “bird” + point at bird; Goldin-Meadow & Morford, 1985; Greenfield & Smith, 1976; Masur, 1983; Morford & Goldin-Meadow, 1992; Zinober & Martlew, 1985). Shortly later, they start using gesture-speech combinations where gesture conveys unique information that is not given in speech (supplementary gesture+speech; “fly” + point at bird). Similar to the findings on gesture, girls

produce gesture-speech combinations that convey sentence-like meanings (e.g., ride +point at bike) earlier than boys—a difference that predicts the onset of first sentences in speech (Özçalışkan & Goldin-Meadow, 2010). There is, however, no research that has yet examined whether these patterns extend to twin-children.

In summary, girls exceed boys in their speech development, developing more varied and more complex speech at an earlier age—a pattern that largely becomes evident in their gestures. Twin dyads also show similar sex differences in speech, with an advantage for girl-girl twins, particularly compared to boy-boy twins. At the same time, twins lag behind singletons in their early speech development, a pattern that might be true for their gestures.

1.2 Sex differences in the speech and gestures produced by parents of singleton and twin children

1.2.1 Speech

One of the best predictors of the typical range of variability in children's vocabulary in speech is the verbal input that they receive from their parents (e.g., Ambridge, Kidd, Rowland, & Theakston, 2015; Hoff, 2006; Huttenlocher et al., 1991; 2002; 2010; Liu, 2014). More specifically children who are exposed to a greater amount and variety of words from their parents show not only faster vocabulary growth, but also develop larger vocabularies than children who hear fewer words from their parents (Conway et al., 1980; Hart & Risley, 1995; Huttenlocher et al., 1991; Pan, Rowe, Singer, & Snow, 2005). Research shows that parents modify their speech when they are speaking with their children (Hart & Risley, 1995; Snow & Ferguson, 1977). When compared to adults, parents tend to use shorter phrases with simpler syntax and lexicon (Furrow, Nelson, & Beneict, 1979), exaggerated intonation (Cooper,

Abraham, Berkman, & Staska, 1997), and more imperatives, interrogatives, and repetitions (Ninio, 1983; Ninio, 1984; Snow, 1995). Therefore, parents use simpler speech when addressing their children compared to adults; parents also gradually increase the complexity of the speech that they produce as their children grow older (Gleitman et al., 1984; Huttenlocher et al., 2007; Phillips, 1973; Rondal, 1980; Snow, 1972). Thus, parental verbal input is both sensitive to changes in the child's developing language system and also exerts an important influence on their children's language development trajectories.

Parents also differ in the amount and diversity of the speech that they target to their sons vs. daughters. Some studies suggest an advantage for girls: In an earlier meta-analysis, Leaper et al., (1998) examined the amount of different types of talk (e.g., supportive vs. directive) mothers addressed to their daughters vs. sons across 41 studies covering an age span of 0;1-11;0; they found that mothers produced more of each type of talk when interacting with their daughters compared to their sons. Similar results were reported for younger children (ages 1;8-2;0): mothers talked more and used more complex speech with their daughters than with their sons in interactive play contexts (Cherry & Lewis, 1976; Schaffer & Crook, 1979). However, a few other studies, focusing mostly on younger children (ages 0;6-2;2) present contradictory evidence. For example, Laflamme et al. (2002), examining parent input to boys vs. girls (age 0;9) by free-play, showed that parents used more words with their sons than with their daughters, while these differences disappeared by the time children were 1;3 years old. Huttenlocher et al., 1991 also found no evidence if a sex difference in maternal talk to girls vs. boys (ages 1;2-2;2) in parent child interactions.

Earlier research focused on sex differences largely in the amount and complexity of speech parents of singletons produce, leaving the diversity of their speech largely unexamined.

There is also scant research that examined differences in parent speech input to different dyads of twin children or to twin children compared to singleton children. The only two existing studies (ages 2;5; Lytton et al., 1977; ages 1;3-1;9; Tomasello et al., 1986), both focusing on the relation between amount of parent talk and child vocabulary in twin children during parent-child interaction, suggests that maternal speech serves as a key predictor of vocabulary development in twin children—but neither study provides reports on sex differences.

1.2.2 Gesture

Apart from speech, parents also gesture towards their children. However, we know very little about their nonverbal input when compared to the literature on their verbal input. We know that parents modify their gesture input for the communicative needs of their children (Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005; 2006; Shatz, 1982), just like they do in their speech. Research suggests that mothers tend to produce simpler gestures (i.e., pointing) when they are interacting with children (Bekken, 1989; Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005). Almost all of these gestures that parents use are accompanied with speech (i.e., gesture+speech combinations). There are differences on how parents use gesture+speech combination. For instance, parents mostly use the simpler types of gesture-speech combinations, namely complementary gesture-speech combinations (“look at the bird” + point at the bird), at the early ages (Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005).

Research suggests that parents’ use of gesture might facilitate children’s use of gestures, which, in turn, help children learn new words. For example, parents who gesture more tend to have children who gesture more as well, showing a tight link between child and parent gesture (Iverson et al., 1999; Namy, Acredolo, & Goodwyn, 2000; Rowe, 2000). In an earlier longitudinal study following children from 14 to 34 months of age, it was shown that parents’

gesture use at 14 months of age was related to child gesture use at 14 months of age, which, in turn, predicted child vocabulary at 34 months of age (Rowe, Özçalışkan, & Goldin-Meadow, 2008). The positive relation between parent gesture and child vocabulary has been shown in other studies, with parent gesture predicting the size (age 1;4; Iverson et al. 1999) or the rate of vocabulary acquisition of young children (ages 1;0-3;0; Pan et al., 2005). Similarly, when parents were explicitly asked to use symbolic gestures in addition to words when communicating with their young children, children used more gestures at 1;0 and also showed greater vocabulary gains in speech at age 2;0 (Acredolo & Goodwyn, 1989).

Compared to numerous studies examining parent speech and gesture input to singletons, there is little research that examines sex differences in gesture input to singletons or twins. There are, however, studies that show differences in coordinated joint engagement with mothers of singleton vs. twin children. Gesture plays an important role in coordinated joint engagement—with pointing and showing gestures showing positive correlations with coordinated joint engagement and subsequent language development (Brooks & Meltzoff, 2008; Butterworth, 2003; Colonnesi et al., 2010; Lock 1978; Tomasello et al., 2007). It is also found that gestures are more likely to occur when children are involved in coordinated joint engagement (Bakeman & Adamson, 1986).

There are a few studies that specifically examined joint attention patterns in twin vs. singleton children. According to Thorpe et al. (2003) twin children typically receive less joint attention, and directed speech, and engage in shorter conversations with their mother when compared to singleton children. As a result, twin parents are found to be less interactive, responsive (Stafford, 1987) encouraging, and involved (Thorpe et al., 2003; Thorpe et al., 1991) while communicating with their children. There are also more interruptions during mother-child

interactions among twins compared to singletons (Clark & Dickman, 1984), which may result in less amount and complexity of speech input from the parents (Conway et al., 1980; Lytton, Conway, & Sauve, 1977).

In sum, research shows that parental verbal and nonverbal input plays an important role in both singleton and twin children's language development. However, research remains largely inconclusive about sex differences in parents' speech towards their daughters vs. sons; and there is no work that examines patterns of parent verbal input to twin children. Research in gesture is even sparser, with no studies examining either sex or dyad composition differences in parental gesture input to children at the early ages.

1.3 Current Study

Previous research, based largely on singletons, suggests that parents' speech and gesture input play an important role on children's spoken development. While some studies show inconclusive findings on sex differences that parents provide towards their singleton children (e.g., Leaper et al., 1998; Huttenlocher et al., 1991), there is no work exploring these patterns in twin children. At the same time, even though we know the importance of parental gesture input in children (e.g., see Özçalışkan & Dimitrova, 2013 for review), we do not yet know whether parents show sex differences in the input they provide to singleton and twin children. Therefore, in this study, we take these findings one step further by examining differences in both speech and gesture input that parents provide, based on child sex and dyad composition. We have two questions: First, we focus on sex differences and ask whether parents differ in the way they gesture and speak to their boys vs. girls and whether these patterns extend to parents of boy-boy vs. girl-girl twins. Based on inconclusive findings on sex differences in the way parents speak to

their daughters and sons (e.g., Cherry & Lewis, 1976; Huttenlocher et al., 1991), we predict that parents of girls—singleton or twin— will either produce greater or similar amount, diversity, and complexity of speech as parents of boys. Looking at group differences, we know that singleton children outperform twin children in their overall language (e.g., Garitte et al., 2002); we also know that child speech and parent speech is positively related (Conway et al., 1980). Based on these findings, we predict that parents of singletons will produce greater amount, diversity, and complexity of speech than parents of twins. We expect gestures to follow the patterns observed in speech, based on earlier work that show close integration between parent gesture and speech (Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005).

Second, we focus on twin dyads, and ask whether parental gesture and speech are influenced by the dyad composition of the twin children (boy-boy, girl-boy, girl-girl). Given the lack of previous work on parent input to twins, we rely on previous results in singletons. Accordingly, we expect that parents of girl-girl twins will use either greater or similar amount, diversity, and complexity of speech compared to parents of girl-boy or boy-boy twins. We expect gestures to follow the same patterns as speech; based on earlier work that shows close integration between parent gesture and speech (Özçalışkan & Goldin-Meadow, 2005).

2 METHOD

2.1 Sample

The participants include the parents of 35 singletons (19 boys and 16 girls) and 31 fraternal twins (10 boy-boy, 9 girl-boy, 12 girl-girl), all native Turkish speakers. All but 6 of the

parents were mothers. The six remaining parents included both the mother and father (n=5)[1], or only the grandmother (n=1). The sample of the study comes from an already collected larger study that examines morpho-syntactic development of children learning Turkish (Ketrez, 2011). The children in this study were selected so that they were comparable in age: there were no reliable age differences between the two groups of singletons and two groups of same sex twins ($F(3,51)=1.39$, $p=.25$) or three groups of twins ($F(2,29)=.48$, $p=.62$) at the time of our observations. Parents were also comparable in age (range= 30;4- 32;8; see Table 1)[2] and education: most of the participants in each group had either a university (56-100%), or a high school degree (10-37%). Participants for the original study were recruited through web platforms and foundations serving twin and singleton families in the greater metropolitan Istanbul area. The sample size is similar to an earlier study, comparing speech and gesture use in parents of children with autism spectrum disorder (ASD) and parents of typically developing (TD) children along the same set of variables (Özçalışkan, Adamson, Dimitrova, & Baumann, 2018), which indicated that 23 subjects per group were adequate to detect reliable effects at $p < .001$ ($\eta 2 = .90$).

Table 1 The mean age (SD) distribution of children and their parents

	Singletons		**Twins**		
	Boy	**Girl**	**Boy-Boy**	**Girl-Boy**	**Girl-Girl**
Child	1;6 (0.4)	1;6 (0.5)	1;9 (0.7)	2;0 (0.6)	1;8 (0.7)
Parent	30;7 (3.3)	30;4 (2.2)	30;8 (3.7)	32;8 (3.5)	32;4 (5.4)

[1] In the recordings where both mother and father were present, they took turns while interacting with their children; we therefore included input across the two parents.
[2] The age of the grandmother was not recorded.

Table 2 Age range of children and their parents

	Singletons		Twins		
	Boy	**Girl**	**Boy-Boy**	**Girl-Boy**	**Girl-Girl**
Child	1;0 – 2;1	0;10 – 2;5	1;1 – 3;4	1;4 – 2;10	1;1 – 3;0
Parent	26 – 41	27 – 33	24 – 35	28 – 39	3 – 42

2.2 Data collection

Each family was visited in their homes by a female experimenter. Parents were provided with several toys (i.e., farmhouse toy, puzzle) and asked to play with their children as they would in their everyday interactions. The mean interaction time was 13 minutes but varied slightly across families (range=5-25). All interactions were video-recorded.

2.3 Data Transcription and Coding

2.3.1 Speech

All parent speech was transcribed, using Codes for Human Analysis Transcript (CHAT) system (CHILDES; MacWhinney, 2000) from video-records by native Turkish speakers. Sounds that are used to refer to an object, property of an object, or an event (e.g., 'kedi'=cat, 'güzel'=pretty), onomatopoetic (e.g., 'hav hav'=woof woof), or conventionalized evaluative sounds (e.g., 'hı-hı'=uh-uh) were treated as words, following earlier work (Özçalışkan et al., 2017). Speech transcripts were divided into utterances, defined as a sequence of words that are preceded and followed by a change in conversational turn, intonation or pause, following the CHAT system guidelines (MacWhinney, 2000). Video recordings were transcribed and coded for morphemes in speech, following Ketrez and Aksu-Koç (2019).

2.3.2 Gesture

All gestures produced by each parent was coded. Gesture was defined as a communicative hand movement that does not involve direct manipulation of an object (e.g., moving a toy truck back and forth) or a ritualized game (e.g., patty cake), following earlier work (Özçalışkan & Goldin-Meadow, 2005[a]). The gestures produced by each parent were further coded for gesture diversity and complexity. Gesture diversity referred to the diversity of parent's vocabulary in gesture, namely the number of different referents each parent indicates in gesture (e.g., point at cat vs. point at dog). Gesture complexity referred to the complexity of the (1) gesture type, including *deictic gestures* that indicate referents (e.g., point at cat), *conventional* gestures that convey culturally-prescribed meanings (e.g., headshake), and iconic gestures that convey characteristic actions and features associated with objects (e.g., flapping arms to show flying), and the complexity of the (2) gesture-speech relation, including complementary gesture-speech combinations (i.e., gesture coveys the same information as speech; "see the cat" + point at cat) and supplementary gesture-speech combinations (i.e., gesture clarifies or adds new information to speech; e.g., "what do you want?"+point at cat' "look over there" + point at top of cabinet).

2.3.3 Reliability

We assessed reliability for gesture coding by two trained independent coders blind to the hypotheses of the study, who each coded a randomly selected 20% of the video-records for gesture detection, gesture meaning, gesture type and gesture-speech relation type, separately in each of the five groups. For the parents, the agreement between coders was 89%, κ=.96 ($Parents_{GIRL}$ = 92%, $Parents_{BOY}$ = 91%, $Parents_{BOY\text{-}BOY}$ = 83%, $Parents_{GIRL\text{-}GIRL}$ = 95%,

$Parents_{GIRL-BOY}$ = 86%) for the identification of the gestures; 95%, κ=.95 ($Parents_{GIRL}$ = 95%, $Parents_{BOY}$ = 100%, $Parents_{BOY-BOY}$ = 92%, $Parents_{GIRL-GIRL}$ = 95%, $Parents_{GIRL-BOY}$ = 92%) for assigning *gesture gloss*; 98%, κ=.98 ($Parents_{GIRL}$ = 99%, $Parents_{BOY}$ = 100%, $Parents_{BOY-BOY}$ = 95%, $Parents_{GIRL-GIRL}$ = 100%, $Parents_{GIRL-BOY}$ = 97%) for the classification gestures into types; and 95%, κ=.94 ($Parents_{GIRL}$ = 91%, $Parents_{BOY}$ = 95%, $Parents_{BOY-BOY}$ = 90%, $Parents_{GIRL-GIRL}$ = 100%, $Parents_{GIRL-BOY}$ = 97%) for the classification gesture-speech combinations into types.

2.4 Scoring

2.4.1 Speech

We assessed the number of words and number of different words each parent produced.[3] We used number of words as a measure of *amount*, number of different types of words (e.g., 'cat' vs. 'dog') as a measure of *diversity*, and the mean length of utterance in morphemes (i.e., MLU) as a measure of *complexity* for speech production. We treated words

with the same stem but with derivational morphemes (e.g., "sing" vs. "singer" as two word types), as well as words with the same stem but with inflectional morphemes (e.g., "sing", "singing", "sings" as three word types) as different words.

2.4.2 Gesture

We assessed the number of gestures, number of different gesture referents produced by each parent. We used the number of gestures as a measure of *amount* and the number of different referents conveyed in gesture (e.g., point at cat *vs.* point at dog) as a measure of *diversity* for gesture production. We also used the type of gesture (deictic, conventional, iconic) and gesture-

[3] For the one twin dyad where both parents were present, we tabulated speech production across the two parents.

speech combination (complementary, supplementary) as a measure of *complexity* of gesture production: iconic and conventional gestures and supplementary gesture-speech combinations were considered as more complex than deictic gestures and complementary gesture-speech combinations, following earlier work (Özçalışkan & Goldin-Meadow, 2005[b]).[4]

Parents produced very few iconic gestures (2 iconic gestures per minute in total); we therefore excluded all iconic gestures from the analysis.

2.5 Analysis

We investigated sex and group differences in the amount, diversity, and complexity of speech and gestures parents produce when interacting with their singleton (boys, girls) and twin (boy-boy and girl-girl) children, using two-way ANOVA with child sex (boy *vs.* girl) and group (singleton *vs.* twin) as between subjects factors, separately for the amount, diversity, and complexity of speech and gesture production. We then investigated dyad composition differences in the amount, diversity, and complexity of the speech and gestures parents produce when addressing their twin children with a set of one-way ANOVAs—with the type of twin-dyad (boy-boy, girl-boy, girl-girl) as a between-subject factor, separately for the amount, diversity, and complexity of speech and gesture production. In all analyses – except for MLU – we used parent's production of speech and gesture per minute of interaction to control for variability in the duration of parent-child play interaction across different child-parent pairs. The only exception was the MLU, which we computed by dividing the number of morphemes per utterance by the total number of spoken utterances for each parent. We transformed gesture and

[4] For the one twin dyad where both parents are present, we tabulated gesture production across the two parents.

speech scores that were not normally distributed using log10 or square root transformation, as appropriate, and used transformed scores in our analysis.

3 RESULTS

3.1 Do parents of singletons and same-sex twins talk and gesture differently to their sons and daughters?

3.1.1 Speech

Parents did not show an effect of sex for either the amount ($F(1, 50) = 1.80$, $p = .19$), diversity ($F(1, 50) = 3.70$, $p = .06$), or complexity ($F(1, 50) = 3.81$, $p = .06$) of their speech production. Similarly, parents' speech did not differ by group either for amount ($F(1, 50) = .29$, $p = .60$), diversity ($F(1, 50) = 1.64$, $p = .21$), or complexity ($F(1, 50) = .17$, $p = .06$). There was also no interaction between sex and group for either the amount ($F(1, 50) = .75$, $p = .79$), diversity ($F(1, 50) = .26$, $p = .61$), or complexity ($F(1, 50) = .01$, $p = .93$) of parents' speech production. (See Table 3.1.1).

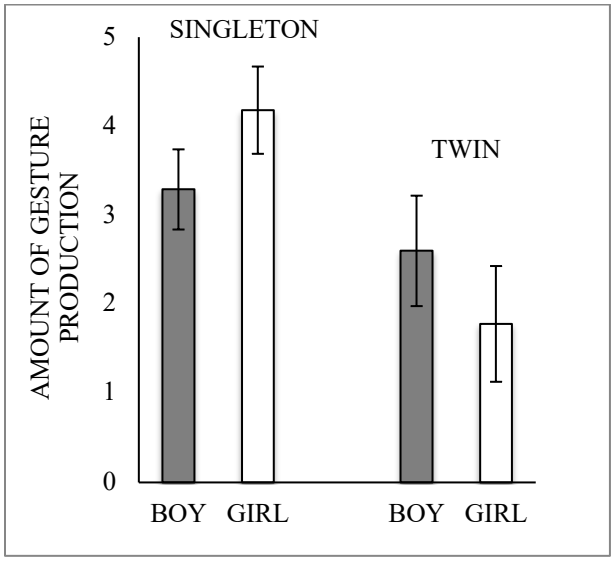
Table 3 Speech production by parents of singleton and same-sex twin dyads

	Singletons		**Twins**	
	Girl	**Boy**	**Girl-Girl**	**Boy-Boy**
$M_{\text{word amount per minute}}$ (SD)	46.56 (13.66)	54.39 (19.72)	45.26 (14.67)	50.46 (18.18)
$M_{\text{word diversity per minute}}$ (SD)	17.03 (5.21)	21.67 (8.21)	15.56 (4.69)	18.25 (6.93)
$M_{\text{complexity}}$ (SD)	4.61 (1.34)	5.39 (1.40)	4.80 (0.83)	5.17 (1.28)

3.1.2 Gesture

Turning next to gesture, we found that parents showed no effect of sex for amount of gesture production ($F(1, 50) = .004$, $p = .95$). However, they showed an effect of sex for the diversity of meanings they conveyed in gesture ($F(1, 50) = 5.27$, $p = .03$, $\eta p^2 = .10$), with parents of boys producing a greater diversity of meanings in their gestures than parents of girls. Parents also showed an effect of group for both the amount ($F(1, 50) = 7.68$, $p = .01$, $\eta p^2 = .13$) and diversity ($F(1, 50) = 4.85$, $p = .03$, $\eta p^2 = .09$) of gesture production. Overall, parents of singletons produced a greater amount and diversity of gestures than parents of twins (See Fig. 1). However, there was no interaction between sex and group for either amount ($F(1, 50) = 2.37$, $p = .13$) or diversity ($F(1, 50) = 1.03$, $p = .31$) of gesture use (See Figs. 1A-1B)

1A. GESTURE AMOUNT



1B. GESTURE DIVERSITY

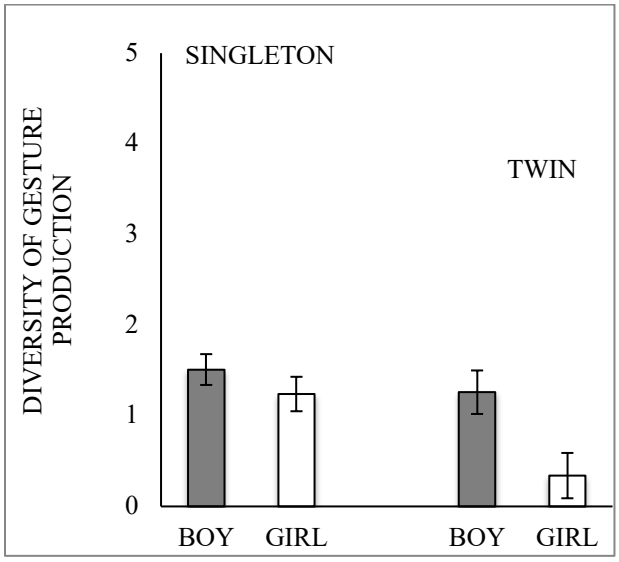


Figure 1 Mean amount (1A) and diversity of gestures (1B) produced per minute by boys and girls in singletons and twin dyads

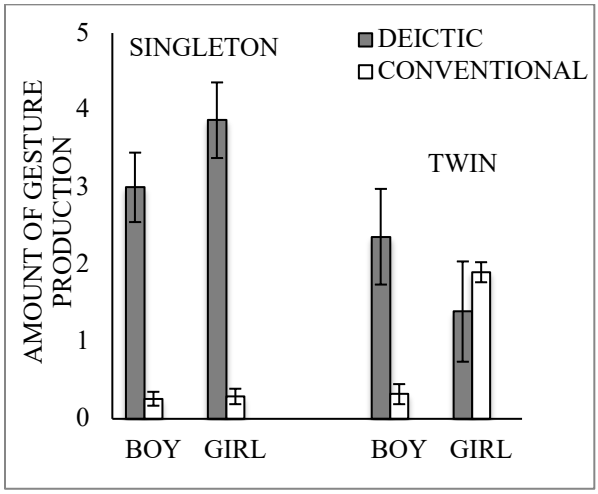
Turning next to complexity of gesture, and beginning with gesture types, we found an effect of gesture type ($F(1, 50) = 121.47$, $p < .001$, $\eta p^2 = .57$) and group ($F(1, 50) = .12$, $p = .01$, $\eta p^2 = .13$), *but* no effect of sex ($F(1, 50) = .03$, $p = .73$). Parents produced greater number of deictic than conventional gestures; and parents of singletons produced more of each type of gesture than parents of twins (See Fig. 2A). There was also an interaction between gesture type and group ($F(1, 50) = 7.81$, $p = .01$, $\eta p^2 = .14$). By comparing means of the groups with each gesture type, we found significant group difference in deictic ($F(1, 52) = 9.83$, $p < .05$), *but* not in conventional ($F(1, 52) = .08$, $p = .78$) gestures that parents used. This suggests that the interaction is caused by the group differences in deictic gestures, showing greater production of deictic gestures among singletons than in twins. There was *no interaction* between gesture type and sex ($F(1, 50) = .09$, $p = .77$), or between gesture type, sex, and group ($F(1, 50) = .97$, $p = .33$).

Next looking at gesture-speech combinations, we found no effect of gesture+speech combination type ($F(1, 50) = 3.87$, $p = .06$) or sex ($F(1, 50) = .03$, $p = .87$), *but* we found an effect of group ($F(1, 50) = 5.97$, $p = .02$, $\eta p^2 = .11$), with singletons producing more gesture+speech than twins. None of the two way interactions (gesture-speech type x sex, $F(1, 50) = 1.30$, $p = .26$; gesture-speech type x group, $F(1, 50) = 1.31$, $p = .26$) or three-way interactions (gesture-speech type, sex, and group, $F(1, 50) = .50$, $p = .48$) was significant (See Fig. 3.1.2B).

In sum, parents of singletons used more gestures conveying a more diverse set of meanings than parents of twins but relying largely on the relatively less complex deictic gestures. In addition, while parents did not differ in the amount and complexity of speech they provide to their girls and boys, they provided greater diversity of meanings in their gestures to their boys.

For gesture+speech combinations we found that parents in both groups produced similar number of supplementary and complementary gesture+speech combinations; though parents of singletons produced greater number of each type of gesture+speech than parents of twins.

2A. GESTURE TYPE



2B. GESTURE-SPEECH TYPE

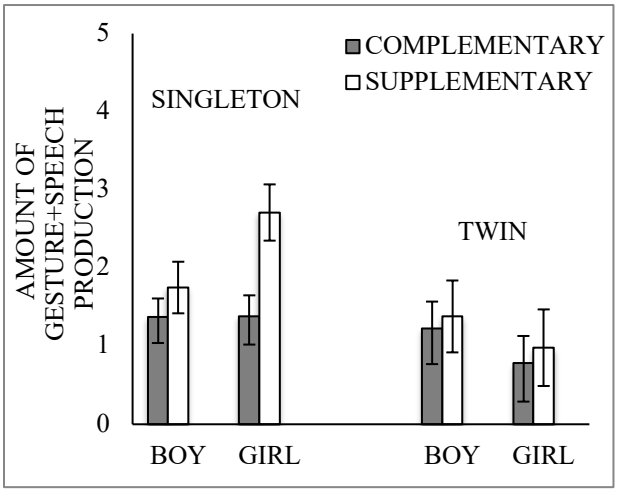


Figure 2 Mean number of different gesture types (2A) and gesture+speech combinations (2B) produced per minute by boys and girls in singletons and twin dyads

3.2 Do parents talk and gesture differently to their twins in different dyads?

3.2.1 Speech

We next examined the patterns of speech and gesture for parents in each of the three twin dyads (boy-boy, girl-girl, boy-girl). First looking at speech, we found that parents did not differ in the amount ($F(2, 28) = .03$, $p = .87$), diversity ($F(2, 28) = .58$, $p = .57$), and complexity ($F(2, 28) = .76$, $p = .48$) of the speech that they provided to their children in the three twin-dyads (See Table 3), thus providing comparable speech input.

Table 4 Speech production by parents of girl-girl, boy-boy, and girl-boy twins

	Girl-Girl	**Boy-Boy**	**Girl-Boy**
$\mathbf{M_{word\ amount\ per\ minute}}$ **(SD)**	45.26 (14.67)	50.46 (18.18)	54.28 (23.25)
$\mathbf{M_{word\ diversity\ per\ minute}}$ **(SD)**	15.56 (4.69)	18.25 (6.93)	16.87 (4.51)
$\mathbf{M_{complexity}}$ **(SD)**	4.80 (0.83)	5.51 (1.54)	4.93 (0.99)

3.2.2 Gesture

The patterns of parent gesture production remained similar to speech. Parents of twins did not differ in either the amount ($F(2, 28) = .42$, $p = .66$) or the diversity ($F(2, 28) = 2.35$, $p = .11$) of the gestures that they produced when interacting with their children in the three different twin dyads (See Figs. 3A-3B).

Next, turning to complexity of gesture, and beginning with gesture types, we found an effect of gesture type ($F(1, 28) = 51.48$, $p < .001$, $\eta p^2 = .65$), but no effect of group $F(2, 28) = .30$, $p = .75$) or gesture type x group interaction ($F(2, 28) = .25$, $p = .54$). Parents produced greater amount of deictic than conventional gestures across the three twin dyads (See Fig. 4A). The pattern was different for gesture-speech combinations. Parents' gesture+speech combinations showed no effect of combination type ($F(1, 28) = 2.32$, $p = .14$), group ($F(2, 28) = .40$, $p = .67$), and no interaction between gesture+speech type and group ($F(2, 28) = .44$, $p = .65$; see Fig. 4B).

In sum, parents of the three twin dyads showed similarities in the amount, diversity, and complexity of speech and gestures that they produced, with no group differences. Parents relied largely on the relatively simpler deictic gestures, regardless of group, and used the different types of gesture-speech combinations at similar rates across the three groups.

3A. GESTURE AMOUNT

3B. GESTURE DIVERSITY

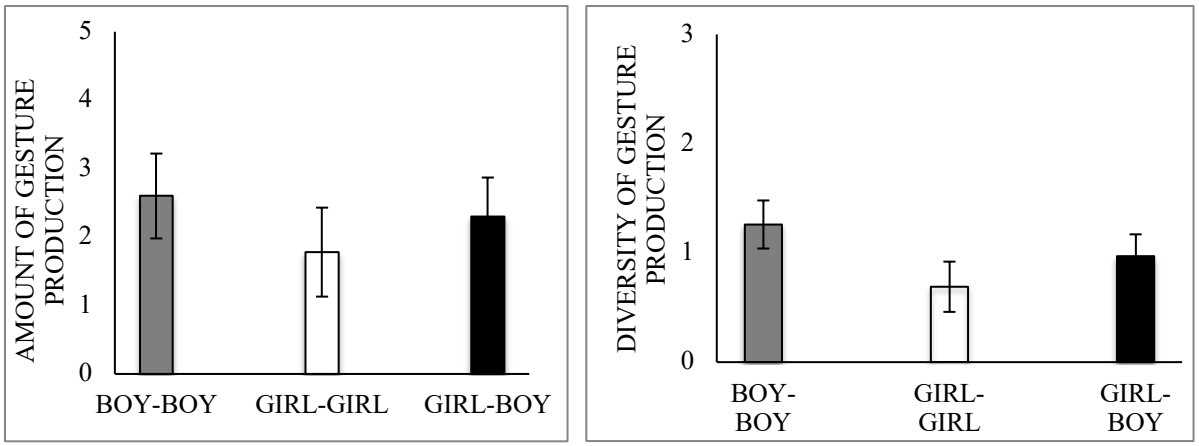


Figure 3 Mean amount (3A) and diversity of gestures (3B) produced per minute by boy-boy, girl-girl, and girl-boy twin dyads

4A. GESTURE TYPE

4B. GESTURE-SPEECH TYPE

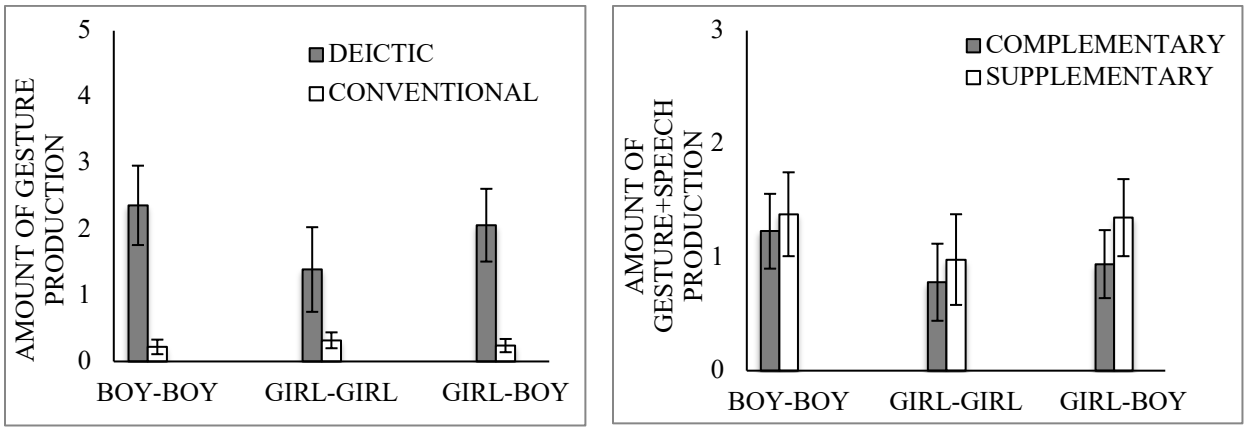


Figure 4 Mean number of different gesture types (4A) and gesture+speech combinations (4B) produced per minute by boy-boy, girl-girl, and girl-boy twin dyads

4 DISCUSSION

This study examined parents' speech and gesture production towards their singleton and twin children. We observed 35 parents of singletons (16 girls, 19 boys) and 32 parents of twins (10 boy-boy, 12 girl-boy, 9 girl-girl) and asked whether parents showed sex, group or dyad composition differences in the way they provided speech and gestures to their children. We

found no sex differences in speech and gesture; except gesture diversity where parents of boys indicated a greater diversity of referents in gesture than parents of girls. Turning to group differences (singleton vs. twin), we found no differences in speech, *but* differences in the amount, diversity, and complexity of gestures parents produced, with an advantage for parents of singletons compared to parents of twins. In addition, we found no dyad-composition differences (boy-boy, girl-boy, girl-girl) in either the amount, diversity, or complexity of speech and gestures parents provided to their children, suggesting that parents of children in each twin dyad used similar amounts and types of speech and gestures.

Our results showed that parents of singletons and twins produced similar amounts, diversity, and complexity of speech while interacting with their singleton and twin children. Why are there no group differences in the way that parents speak? We know from previous research that parents of twins need to divide their attention and speech (Lytton et al., 1977; Thorpe et al., 2003) and that there are more interruptions during parent-child interactions with twins compared to singletons (Clark & Dickman, 1984). Both of these factors were considered as possible reasons as to why parents produce less speech, as well as less complex speech when interacting with their twins (Conway et al., 1980; Lytton et al., 1977). In contrast to most of this earlier work, however, the children in our study were relatively young. As such, they were not producing much speech—singleton or twin, which in turn might have influenced rates of speech production among parents.

We also know from previous work that singleton children lag behind twin children (e.g., Conway et al., 1980) in their language development. Knowing that parents adjust their speech according to the language level of a child, it would be expected for parents of twin children to use less amount and less complex speech than parents of singleton children. However, an

explanation for no difference in their speech could be that children might show no differences on their speech level. Since mothers adapt to language capabilities of their children (Gleitman et al., 1984; Huttenlocher et al., 2007; Rondal, 1980; Snow, 1972), parents might have modified their speech according to children's ability to process complex speech.

Turning to gesture, we found that parents of singletons used a greater amount and diversity of gestures, relying primarily on less complex deictic gestures. We also found that parents of singletons produced more gesture+speech combinations than parents of twins. We know from earlier work that coordinated joint engagement and gesture are positively related (e.g., Brooks & Meltzoff, 2008) and since parents of twins need to divide their attention, there might be less participation of joint engagement (Butler, McMahon, & Ungerer, 2003; Stafford, 1987; Tomasello, Mannle, & Barton, 1989; Tomasello, Mannle, & Kruger, 1986). This in fact affects the quantity and quality of interaction with each child (Rutter et al., 2003). This also is supported by other research, which shows that it is at least five times more likely for a mother to have coordinated joint engagement with one of the twins instead of both (Bakeman & Adamson, 1984). Therefore, the lack of good quality joint engagement in parent-child interaction might result in fewer use of gestures and gesture+speech combinations by the parents in twin dyads. In addition, previous research (Öztürk, 2019) that examined patterns of gesture production in the children of the parents in our study showed that singleton children produced more gestures than twins, which might be the reason why the parents might be providing different amounts of speech input to their children.

Of interest, however, the parents did not differ in either the amount, diversity or complexity of the speech that they used with their children in each of the three twin dyads (girl-girl, boy-boy, girl-boy)—a pattern that also extended to their gestures. Once again, the reason could be the

relatively young age of the children in our study. Parents' production of gesture and speech typically go hand-in-hand with their child's production in each modality (e.g., Conway et al.,1980; Namy, Acredolo, & Goodwyn, 2000). The children in our study, particularly twins, were producing very little speech with limited variability in the amount, diversity, and complexity across the three dyads, which, in turn, might have affected the patterns of speech and consequently gesture production of the parents, resulting in limited variability in parent speech and gesture in the three dyads.

Turning to sex differences, and in contrast to some of the earlier work (Cherry & Lewis, 1976; Shaffer & Crook, 1979), our study found no difference in the way parents provided speech to their daughters vs. sons. Once again, the fact that children in these samples were very young and were mostly communicating through gestures rather than speech or gesture+speech combinations might be one of the reasons to this finding. Therefore, the sex differences in child speech might not have been evident yet, which in turn, could affect parents' speech production.

In gesture production, we also found no sex differences in the amount and complexity *however* we discovered that parents of boys indicated a more diverse set of meanings in gesture than parents of girls. One big factor that might impact parents' speech and gesture could be the child's own speech and gesture production. Using gestures might be an easier way for children to communicate at early ages. There are children who revert to gestural devices to compensate for their difficulties in speech production (Thal & Tobias, 1992). The reason may be that gesture might be easier to produce than speech (Acredolo & Goodwyn, 1989), and/or that gesture might put fewer demands on working memory (Özçalışkan & Goldin-Meadow, 2010). And since we know that boys lag behind girls in their language development (Berglund et al., 2005), boys might turn to gesture more and therefore parents of boys might feel more need to use different

types of gestures to gain attention. Thus, parents might make use of gestures to clarify the message they are conveying while interacting with their sons.

Our findings showed no sex differences in the types of gesture+speech combinations parents used. This finding supports earlier work that found caregivers produced comparable numbers of gesture+speech combinations when addressing to girls and boys (Özçalışkan & Goldin-Meadow, 2005[b]; 2006).

Importantly, parents used simpler gestures when communicating with their children; suggesting agreement with previous work showing that parents produce more deictic gestures than conventional gestures (Özçalışkan & Goldin-Meadow, 2005; Özçalışkan et al., 2018). One other study also found that mothers' gesture less frequently and use simpler gestures when they interact with their children than when they interact with adults (Bekken, 1989). Another reason that parents might dominantly use simpler gestures could be the fact that children also refer to mostly deictic gestures. Children tend to use deictic gestures at early ages because it gives them an opportunity to use these gestures as a tool to refer to an object before they know the word for it (Iverson & Goldin-Meadow, 2005). Deictic gestures are more transparent than conventional gestures because conventional gestures convey relational concept, which might be cognitively more challenging for young children (Özçalışkan, Gentner, & Goldin-Meadow, 2014). In addition, research shows us that more complex representational skills might be necessary to produce conventional gestures, though these abilities usually do not begin to emerge until children are 2 to 3 years old (DeLoache, 2004; Lillard, 1993). Since parents seem to modify their gesture while talking to their children (Iverson et al., 1999), as well as speech, they also might use deictic gestures primarily. In addition, the study design also might have encouraged parents

to produce a greater number of deictic gestures as it involved one-on-one interactions around a set of objects available in the immediate environment.

While we found differences in the complexity of gestures parents used, there was no difference in the gesture+speech type production. Parents of each group and sex produced similar amounts of simpler and more complex gesture+speech combinations. Children at young ages first start producing complementary gestures, which conveys the same information as speech (Leopold, 1949; Greenfield & Smith, 1976) and supplementary gestures come afterwards (e.g., Masur, 1983). Considering the fact that parents' gesture might reflect child gesture, we would expect parents to also produce the simpler gesture+speech combinations, where gesture and speech convey complementary information. At the same time, our findings are also inconclusive with other research findings that showed that both parents and their young children produced greater complementary gesture+speech combinations than supplementary or disambiguating combinations (Özçalışkan & Goldin-Meadow, 2005). One reason that our findings might be different from the literature could be that we treated supplementary gestures as either adding (eat+point at broocoli; 10%) or disambiguating (eat it +point at broccoli; 49%) the information in speech. In fact, if we leave out the combinations parents produced where gesture disambiguates speech, then complementary combinations (broccoli+ point at broccoli) become one of the most commonly used gesture-speech combinations by the parents in interacting with their children in our study as well.

We know from previous work that parents provide models for different types of gestures and gesture+speech combinations, which could help children learn new words and sentence structures and improve their later vocabulary development (see Özçalışkan & Dimitrova, 2013 for review). Inputs that children receive from their parents are critical for them to progress to the

next stage in their language development. Thus, gesture input that parents provide to their children has a significant role in children's language learning. As such, our study, by identifying patterns of gesture and speech input to boys vs. girls as well as twins with different dyad composition, has the potential to provide unique information about the relevance of variability in parent input on children's language development in different twin dyads.

4.1 Limitations

The sample size is relatively small, especially for the different twin dyad groups, which might have affected our power to detect reliable differences; though, we double checked our statistical results, using non-parametric measures, which further confirmed the pattern of results reported in our paper. In addition, the observations showed variability in duration (5-25 minutes), we however, addressed this issue by using per minute production of gesture and speech to make the groups comparable in amount of interaction time.

4.2 Implications

Boys lag behind girls in many language domains (Hyde & Linn, 1988; Kimura, 1998) and there is some evidence showing these differences become evident in their gestures as well (Butterworth & Morisette, 1996; Özcalışkan & Goldin-Meadow, 2010). In addition, twin children lag behind singletons in their early language abilities (Conway et al., 1980; Day, 1932, Hay et al., 1987; Rutter et al., 2003), with a heightened risk for twin boys (Thorpe, 2006). It is important to understand factors that contribute to these differences, because early difficulties with language have long-term effects on children's academic achievement and emotional well-being (Rutter & Mawhood, 1991). One of the key factors that contribute to children's language

development is the amount of input that they receive from their parents (e.g., Ambridge et al., 2015), which might contribute to differences in language development in both singleton and twin children (Lytton et al., 1977; Thorpe et al., 2003). As such, results from this study can inform parent-focused educational strategies to prevent difficulties particularly twin children might face in language development.

REFERENCES

Acredolo, L. P., & Goodwyn, S. W. (1985). Symbolic gesturing in language development. *Human Development*, 28, 40–49.

Acredolo, L. P., & Goodwyn, S.W. (1989). Symbolic gesturing in normal infants. Child Development, 59, 450–466.

Ambridge, B., Kidd, E., Rowland, C. F., & Theakston, A. L. (2015). The ubiquity of frequency effects in first language acquisition. *Journal of Child Language*, 42, 239–273.

Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development, 55*(4), 1278 – 1289. http://dx.doi.org/10.2307/1129997

Bakeman, R., & Adamson, L. B. (1986). Infants' conventionalized acts: Gestures and words with mothers and peers. *Infant Behavior and Development, 9*(2), 215–230. http://dx.doi.org/10.1016/0163-6383(86)90030-5

Bates, E. (1976). Language and context. New York: Academic Press.

Bates, E., Bretherton, I., Camaioni, L., & Volterra, V. (1979). Cognition and communication from nine to thirteen months: Correlation findings. *The emergence of symbols: Cognition and communication in infancy*, 33-68.

Bekken, K. (1989). Is there motherese in gesture? [Unpublished doctoral dissertation]. Chicago, IL: The University of Chicago.

Berglund, E. V. A., Eriksson, M., & Westerlund, M. (2005). Communicative skills in relation to gender, birth order, childcare and socioeconomic status in 18-month-old children. *Scandinavian Journal of Psychology, 46*(6), 485-491.

Brooks, R., & Meltzoff, A. N. (2008). Infant gaze following and pointing predict accelerated vocabulary growth through two years of age: A longitudinal, growth curve modeling study. *Journal of Child Language, 35*(1), 207 – 220. http://dx.doi.org/10.1017/S030500090700829X

Brundin, K., Rodholm, M., & Larsson, K. (1988). Vocal communication between parents and infants. *Early Human Development*, 16, 35–53.

Butcher, C., & Goldin-Meadow, S. (2000). Gesture and the transition from one- to two-word speech: When hand and mouth come together. In D. McNeill (Ed.), *Language and Gesture* (pp. 235–258). Cambridge: Cambridge University Press.

Butler, S., McMahon, C., & Ungerer, J. A. (2003). Maternal speech style with prelinguistic twin infants. *Infant and Child Development, 12*(2), 129 – 143. http://dx.doi.org/10.1002/icd.272

Butterworth, G. (2003). Pointing is the royal road to language for babies. In S. Kita (Ed.), Pointing: Where language, culture, and cognition meet (pp. 9 – 33). Mahwah, NJ: Lawrance Erlbaum.

Butterworth, G., & Morisette, P. (1996). Onset of pointing and the acquisition of language in infancy. *Journal of Reproductive and Infant Psychology, 14*(3), 219–231.

Cherry, L., & Lewis, M. (1976). Mothers and two-year-olds: A study of sex differentiated aspects of verbal interaction. *Developmental Psychology, 12*, 278–282.

Clark, P.M., & Dickman, Z. (1984). Features of interaction of infant twins. *Acta Geneticae Medicae et Gemellologiae, 33*, 165–171.

Colonnesi, C., Stams, G. M., Koster, I., & Noom, M.J. (2010). The relation between pointing and language development: A meta-analysis. *Developmental Review, 10*(4), 352 – 366. http://dx.doi.org/10.1016/j.dr.2010.10.001

Conway, D., Lytton, H., & Pysh, F. (1980). Twin—singleton language differences. *Can J Behav Sci*, 12, 264–271.

Cooper, R.P., Abraham, J., Berkman, S., & Staska, M. (1997). The development of infants' preference for motherese. *Infant Behav Dev*, 20, 477–488.

Day, E. (1932). The development of language in twins. *Child Dev*, 3, 298–316.

DeLoache, J. S. (2004). Becoming symbol-minded. *Trends in Cognitive Sciences, 8*(2), 66–70. https://doi.org/10.1016/j.tics.2003.12.004.

Eriksson, M., & Berglund, E. (1999). Swedish early communicative development. *First Language*, 19, 55–90.

Eriksson, M., Marschik, P. B., Tulviste, T., Almgren, M., Pérez Pereira, M., Wehberg, S., & Gallego, C. (2012). Differences between girls and boys in emerging language skills: Evidence from 10 language communities. *British Journal of Developmental Psychology, 30*(2), 326-343.

Fenson, L., Dale, P. S., Reznick, J. S., Bates, E., Thal, D., & Pethick, S. J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development,* 59, 1–173.

Fenson, L., Pethick, S., Renda, C., Cox, J. L., Dale, P. S., & Reznick, J. S. (2000). Short form versions of the MacArthur communicative development inventories. *Applied Psycholinguistics*, *21*(1), 95–116.

Furrow, D., Nelson, K., & Benedict, H. (1979) Mothers' speech to children and syntactic development: some simple relationships. *J Child Lang*, 6, 423–442.

Galsworthy, M. J., Dionne, G., Dale, P. S., & Plomin, R. (2000). Sex differences in early verbal and non-verbal cognitive development. *Developmental Science*, *3*(2), 206–215.

Garitte, C., Almodovar, J. P., Benjamin, E., & Canhao, C. (2002). Speech in same-and different-sex twins 4 and 5 years old. *Twin Research and Human Genetics, 5*(6), 538-543.

Gleitman, L. R., Newport, E. L., & Gleitman, H. (1984). The current status of the motherese hypothesis. *Journal of Child Language, 11*(1), 43–79.

Goldin-Meadow, S. (1998). The development of gesture and speech as an integrated system. In J. M. Iverson & S. Goldin-Meadow (Eds.), The nature and functions of gesture in children's communications (pp. 29–42). San Francisco, CA: Jossey–Bass.

Goldin-Meadow, S. (2003). Hearing gesture: How our hands help us think. Cambridge, MA: Harvard University Press.

Goldin-Meadow, S., & Butcher, C. (2003). Pointing toward two-word speech in young children. In S. Kita (Ed.), Pointing: Where language, culture, and cognition meet (pp. 85–107). Hillsdale, NJ: Erlbaum.

Goldin-Meadow, S., & Morford, M. (1985). Gesture in early child language: studies of deaf and hearing children. *Merrill-Palmer q*, 31, 145–176.

Greenfield, P., & Smith, J. (1976). The structure of communication in early language development. New York, NY: Academic Press.

Gucuyener, K., Arhan, E., Soysal, A. S., Ergenekon, E., Turan, O., Onal, E., ... & Atalay, Y. (2011). Language assessment of non-handicapped twins at 5 years of age. *Pediatrics International*, *53*(6), 944–949.

Hart, B., & Risley, T.R. (1995). Meaningful differences in the everyday experience of young american children. Baltimore, MD: Brookes.

Hay, D., Prior, M., Collett, S., & Williams, M. (1987). Speech and language development in pre-school twins. *Acta Genet Med Gemellol,* 36, 239–48.

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review, 26*(1), 55–88.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. Developmental Psychology, 27, 236–248.

Huttenlocher, J., Vasilyeva, M., Waterfall, H. R., Vevea, J. L., & Hedges, L. V. (2007). The varieties of speech to young children. *Developmental Psychology*, 43, 1062–1083.

Hyde, J. S., and Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin*, 104, 53–69.

Iverson, J. M., & Goldin-Meadow, S. (2005). Gesture paves the way for language development. *Psychological Science*, 16, 368–371.

Iverson, J. M., Capirci, O., Longobardi, E., & Caselli, M. C. (1999). Gesturing in mother–child interactions. *Cognitive Development, 14*(1), 57–75.

Ketrez, F. N., & Aksu-Koç, A. (2019). Turkish lexicon for morphosyntactic coding. Manuscript in preparation.

Kimura, D. (1998). Sex and cognition. Cambridge, MA: The MIT Press.

Laflamme, D., Pomerleau, A., & Malcuit, G. (2002). A comparison of fathers' and mothers' involvement in childcare and stimulation behaviors during free-play with their infants at 9 and 15 months. *Sex Roles*, 47, 507–518.

Leaper, C., Anderson, K. J., & Sanders, P. (1998). Moderators of gender effects on parents' talk to their children: A meta-analysis. *Developmental Psychology*, 34, 3–27.

Lillard, A. S. (1993). Pretend play skills and the child's theory of mind. *Child Development, 64*(2), 348–371. https://doi.org/10.1111/j.1467-8624.1993.tb02914.x.

Liu, H. M. (2014). Lexical and acoustic features of maternal utterances addressing preverbal infants in picture book reading link to 5-year-old children's language development. *Early Education and Development*, 25, 1103–1117.

Lock, A. E. (Ed.). (1978). Action, gesture and symbol: The emergence of language. New York: Academic Press.

Lytton, H., Conway, D., & Suave, R. (1977). The impact of twinship on parent-child interaction. *Journal of Personality and Social Psychology, 35* (2), 97–107.

Maccoby, E. (1966). The development of sex differences. Stanford, CA: Stanford University Press.

MacWhinney, B. (2000). The CHILDES Project: Tools for Analyzing Talk. 3rd Edition. Mahwah, NJ: Lawrence Erlbaum Associates.

Masur, E.F. (1983). Gestural development, dual-directional signaling, and the transition to words. *J Psycholinguist Res*, 12, 93–109.

Minton, C, Kagan, J., & Levine, J. A. (1971). Maternal control and obedience in the two-year-old. *Child Development*, 42, 1872–1894.

Morford, M., & Goldin-Meadow, S. (1992). Comprehension and production of gesture in combination with speech in one-word speakers. *J Child Lang*, 19, 559–580.

Namy, L. L., Acredolo, L., & Goodwyn, S. (2000). Verbal labels and gestural routines in parental communication with young children. *Journal of Nonverbal Behavior*, 24, 63–80.

Ninio, A. (1983). A pragmatic approach to early language acquisition. Paper presented at: The Study Group on Crosscultural and Crosslinguistic Aspects of Native Language Acquisition. Jerusalem, Israel: Institute for Advanced Studies, Hebrew University.

Ninio, A. (1984). Functions of speech in mother–infant interaction. Final science report to the U.S.-Israel Binational Science Foundation. Jerusalem, Israel.

Özçalişkan, Ş., & Goldin-Meadow, S. (2005[b]). Do parents lead their children by the hand? *Journal of child language*, *32*(3), 481-505.

Özçaliskan, S., Adamson, L. B., Dimitrova, N., & Baumann, S. (2017). Early gesture provides a helping hand to spoken vocabulary development for children with autism, down syndrome, and typical development. *Journal of Cognition and Development*, *18*(3), 325–337.

Özçalışkan, Ş, & Dimitrova, N. (2013). How gesture Input provides a helping hand to language development. *Seminars in Speech and Language, 34*(4), 227–236. https://doi.org/10.1055/s-0033-1353447.

Özçalışkan, Ş., & Goldin-Meadow, S. (2005). Do parents lead their children by the hand? *J Child Lang*, 32, 481–505.

Özçalışkan, Ş., & Goldin-Meadow, S. (2005[a]). Gesture is at the cutting edge of early language development. *Cognition*, 96, B101–B113.

Özçalışkan, Ş., & Goldin-Meadow, S. (2006). Role of gesture in children's early constructions. In: Clark E, Kelly B, eds. Constructions in Acquisition. Stanford, CA: CSLI Publications, 31–58.

Özçalışkan, Ş., & Goldin-Meadow, S. (2009). When gesture–speech combinations do and do not index linguistic change. *Language and Cognitive Processes*, 28, 190–217.

Özçalışkan, Ş., & Goldin-Meadow, S. (2010). Sex differences in language first appear in gesture. *Developmental Science*, *13*(5), 752-760. doi:10.1111/j.1467-7687.2009.00933.x

Özçalışkan, Ş., Adamson, L. B., Dimitrova, N., & Baumann, S. (2018). Do Parents Model Gestures Differently When Children's Gestures Differ? *Journal of Autism and Developmental Disorders*, *48*(5), 1492-1507.

Özçalışkan, Ş., Gentner, D. & Goldin-Meadow, S. (2014). Do iconic gestures pave the way for children's early verbs? *Applied Psycholinguistics,* 35, 1143–1162. doi: 10.1017/S0142716412000720

Pan, B. A., Rowe, M. L., Singer, J. D., & Snow, E. (2005). Maternal correlates of growth in toddler vocabulary production in low-income families. *Child Development,* 76, 763–782.

Phillips, J. R. (1973). Syntax and vocabulary of mothers' speech to young children: Age and sex comparisons. *Child Development*, 44, 182–185.

Ramer, A. L. (1976). Syntactic styles in emerging language. *Journal of Child Language, 3*(1), 49–62.

Rice, M. L., Zubrick, S. R., Taylor, C. L., Gayán, J., & Bontempo, D. E. (2014). Late language emergence in 24-month-old twins: Heritable and increased risk for late language emergence in twins. *Journal of Speech, Language, and Hearing Research, 57*(3), 917-928.

Rondal, J. A. (1980). Fathers' and mothers' speech in early language development. *Journal of Child Language*, 7, 353–369.

Rowe, M. L. (2000). Pointing and talk by low-income mothers and their 14-month-old children. *First Language*, 20, 305–330.

Rutter, M., & Mawhood, L. (1991). The long-term psychological sequelae of specific developmental disorders of speech and language. *Biological risks for psychosocial disorders*. Cambridge7 Cambridge University Press.

Rutter, M., & Redshaw, J. (1991). Growing up as a twin: Twin–singleton differences in psychological development. *Journal of Child Psychology and Psychiatry, 32,* 885–896.

Rutter, M., Thorpe, K., Greenwood, R., Northstone, K., & Golding, J. (2003). Twins as a natural experiment to study the causes of mild language delay: I: design; twin–singleton differences in language, and obstetric risks. *Journal of Child Psychology & Psychiatry & Allied Disciplines*, *44*(3), 326–341.

Savić, S. (1980). How twins learn to talk: A study of the speech development of twins from 1 to 3. Academic Pr.

Schaffer, H. R., & Crook, C. K. (1979). Maternal control techniques in a directed play situation. *Child Development*, 50, 989–996.

Shatz, M. (1982). On mechanisms of language acquisition: can features of the communicative environment account for development? In: Wanner E, Gleitman L, eds. Language Acquisition: The State of the Art. New York, NY: Cambridge University Press, 102–127.

Snow, C. E. (1972). Mothers' speech to children learning language. *Child Development*, 43, 549–565.

Snow, C.E. (1995). Issues in the study of input: fine-tuning, universality, individual and developmental differences, and necessary causes. In: Fletcher PM, ed. The Handbook of Child Language. Oxford, UK: Blackwell, 180–194

Snow, C.E., & Ferguson, C.A. (1977). Talking to children: Language input and acquisition. New York, NY: Cambridge University Press.

Stafford, L. (1987). Maternal input to twin and singleton children: Implications for language acquisition. *Human Communication Research, 13*(4), 429-462.

Thal, D., & Tobias, S. (1992). Communicative gestures in children with delayed onset of oral expressive vocabulary. *Journal of Speech and Hearing Research, 37,* 157–170.

Thorpe, K. (2006). Twin children's language development. *Early Human Development*, 82387–395. doi:10.1016/j.earlhumdev.2006.03.012

Thorpe, K.J., Golding, J., MacGillivray, I., & Greenwood, R. (1991). Comparison of prevalence of depression in mothers of twins and mothers of singletons. *British Medical Journal, 302*, 875–878.

Thorpe, K.J., Greenwood, R., & Rutter, M. (2003). Twins as a natural experiment to study the causes of mild language delay: II. Family interaction risk factors. *J Child Psychol Psychiatry, 44*(3), 342–355.

Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A new look at infant pointing. *Child Development, 78*(3), 705 – 722. http://dx.doi.org/10.1111/j.1467-8624.2007.01025.x

Tomasello, M., Mannie, S., & Barton, M. (1989). The development of communicative competence in twins. *Revue Internationale de Psychologie Sociale, 2*(1), 49 – 59.

Tomasello, M., Mannle, S., & Kruger, A. C. (1986). Linguistic environment of 1-to 2-year-old twins. *Developmental Psychology, 22*(2), 169.

Tse, S. K., Chan, C., Li, H., & Kwong, S. M. (2002). Sex differences in syntactic development: Evidence from Cantonese-speaking preschoolers in Hong Kong. *International Journal of Behavioral Development, 26*(6), 509-517.

Zinober, B., & Martlew, M. (1985). Developmental changes in four types of gesture in relation to acts and vocalizations from 10 to 21 months. *Br J Dev Psychol*, 3, 293–306.