

## Research Report

# Gesture and speech in maternal input to children with Down's syndrome

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(Received January 2005; accepted August 2005)

### Abstract

*Background:* Despite recent interest in relationships between maternal gesture and speech and communicative development in typically developing (TD) children, little work has examined either speech or gesture in mothers of children with Down's syndrome (DS).

*Aims:* To compare aspects of speech and gesture production by mothers of children with DS with that of mothers of TD children.

*Methods & Procedures:* Participants were five mothers of children with DS (mean chronological age (CA)=47.6 months; mean mental age (MA)=22.4 months) and five mothers of TD children. To equate for expressive language ability, children in the TD and DS groups were individually matched on the basis of: (1) gender; (2) correspondence between the TD child's chronological age and the DS child's language age; and (3) observed expressive vocabulary size. Each mother–child dyad was videotaped for approximately 30 min during free play. Data analyses focused on: (1) the number and types (speech only, gesture only, mixed) of maternal utterances; (2) the gesture types (deictic, iconic, conventional, emphatic); and (3) for mixed utterances, the structure and the temporal patterning of spoken and gestured components.

*Outcomes & Results:* Relative to mothers of TD children, mothers of children with DS produced significantly fewer utterances overall, but the distribution of utterance types did not differ between the two groups. Relative to mothers of TD children, mothers of children with DS used proportionately more deictic gestures and made more frequent use of SHOWING. Mothers of TD children produced more POINTING gestures. Finally, mothers of children with DS

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produced a significantly higher proportion of utterances consisting of a single gesture and a single verbal utterance; in contrast to mothers of TD children, more complex structures (one gesture with multiple verbal utterances, one verbal utterance with multiple gestures) were never observed. Within the category of utterances consisting of a gesture and a single verbal utterance, mothers of children with DS tended to produce gestures that were held throughout the complete verbal utterance, while the gestures of mothers of TD children tended to co-occur with only a portion of the utterance.

*Conclusions:* The findings suggest that mothers of children with DS adjust their communication to the developmental status of their child. Results are discussed in terms of the role of gesture in maternal communication and in the regulation of mother–child interaction.

*Keywords:* Gesture, maternal communication, early development, Down's syndrome.

## Introduction

In almost all cultures studied, parents alter their communication patterns when talking to young typically developing (TD) children. Speech directed toward infants and children in the earliest stages of language acquisition is generally characterized by relatively short, syntactically simplified utterances with frequent repetitions and exaggerated intonational contours (for a review, see, for example, Snow 1995). As children begin to become more competent linguistically, parents may increase the number of utterances directed to the child, decrease affect-salient (i.e. expressive, non-propositional statements such as greetings and endearments), and increase information-salient speech (i.e. fully propositional statements, questions or reports about the parent or infant; Bornstein *et al.* 1992). Didactic utterances directed at the child have also been shown to increase between 16 and 20 months when children make substantial gains in expressive language (Longobardi 1995).

Communication to young children is, of course, not only verbal, it also involves gesture. And just as parents modify their speech in communication to young children, they also alter their patterns of gesture production. Gestures produced by parents during parent–toddler conversations tend to be relatively infrequent, conceptually simple, refer to present, concrete referents and reinforce the message conveyed in speech (Bekken 1989, Iverson *et al.* 1999, O'Neill *et al.* 2005). This 'gestural motherese' contrasts with patterns of gesture use observed in adult interactions, in which gestures tend to be more abstract and provide information that is not explicitly communicated in speech (Bekken 1989).

These modified patterns of communication to young children are presumed to reflect parental sensitivity to children's limited comprehension; the use of simplified, more affectively oriented speech and relatively simple pointing gestures to reinforce verbal communication may provide children with linguistic and contextual cues that support language comprehension. That patterns of parental communication change as children develop suggests that parents adapt their communications to the perceived ability of the growing child to participate in and comprehend an ongoing communicative interaction.

While alterations in parental speech and gesture to young TD children have been relatively well-studied, less is known about the nature of parental communication to

children with developmental disorders. The present study addresses this gap in the literature by focusing on communicative input to young children with Down's syndrome (DS). As has been well documented, children with DS demonstrate significant delays in cognitive and language development. Research to date suggests that speech to children with DS differs from that directed to TD children and to children with mental retardation of other aetiologies (but for contrasting evidence, see Rondal 1988). In comparison with mothers of chronological age-matched TD children, mothers of children with DS produce utterances with reduced syntactic complexity (Buium *et al.* 1974, Mahoney 1988), use fewer nouns, and make reduced use of verbal deixis (Cardoso-Martins and Mervis 1985). In addition, parents of older individuals with DS (aged 5–20 years) raise their overall pitch and increase pitch variation when talking to their child compared with an adult, modifications similar to those observed in speech directed to young children (Fidler 2003).

These findings raise the possibility that modifications observed in parental speech to children with DS exceed those exhibited in speech to TD children, even to TD children who are at roughly the same level of linguistic ability as the child with DS. If so, this too could reflect parental sensitivity to children's developmental level, in this case to the cognitive delays and specific difficulties with linguistic processing associated with DS. To the extent that gesture and speech form a unified system of communication (for an argument to this effect, see McNeill 1992), one might then also expect parents of children with DS to modify their gestures when communicating with their child, and perhaps even to modify just those aspects of gesture that would support children's comprehension of an ongoing conversation.

The overarching goal of the present study was to examine the relationship between gesture and speech in maternal input to young children with DS. We asked whether mothers of children with DS make use of the 'gestural motherese' observed among mothers of TD children, and whether the tendency to produce concrete, conceptually simpler gestures that are redundant with the verbal message is related to developmental characteristics of the child. To this end, gestures and speech produced by mothers of children with DS were compared with those of mothers whose TD children were matched to the children with DS based on expressive language. By holding children's expressive abilities constant, it was ensured that any additional modifications made by mothers of children with DS are not simply a function of differences in children's elicitation of maternal communication.

In sum, the aim of the present study was threefold: (1) to examine the frequency of gesture production, types of gestures produced, and the informational relationship between gesture and speech in mothers of children with DS; (2) to compare aspects of gesture and speech produced by mothers of children with DS to those observed in mothers of TD children matched on the basis of expressive language abilities; and (3) to determine whether any variation in the tendency to simplify communication to children with DS is related to the degree of developmental delay exhibited by the child.

## **Methods**

### *Participants*

Participants were five mothers of children with DS and five mothers of TD children. All mothers of children with DS were upper-middle class and were native speakers

of Italian living in the Rome area. Their children (three boys and two girls) ranged in age from 37 to 56 months (mean=47.6, SD=7.96) and had mental ages between 18 and 27 months (mean=22.4, SD=4.16). Mental age assessment employed the Brunet–Lézine Scale (Brunet and Lézine 1955/67). This scale is the most widely used instrument in Italy for assessing young children's developmental functioning (for further discussion, see Vicari and Caselli 2002 and Vicari 2004). All the children had been receiving regular therapy focusing exclusively on cognitive and motor abilities since the age of 2 years. Neither children's language abilities nor parental communication strategies were targeted by the therapists, and none of the children with DS received speech/language therapy or had any exposure to sign language or gesture training. Information about the children with DS is summarized in table 1. Three of the children were firstborn, one was secondborn and one was thirdborn.

The five mothers of TD children were selected from a larger sample of upper-middle class, native Italian-speaking mothers described in previous work on maternal communication to children at 16 and 20 months of age (Iverson *et al.* 1999). Three mothers participated with boys and two with girls. One child was firstborn, three children were secondborn and one was thirdborn. The 16-month observation was used for two mothers; data from the 20-month observation were used for the other three mothers.

To ensure that any differences in maternal communication were not simply due to group variation in language skills among children with DS and TD children, mothers of TD children were individually matched to mothers of children with DS on the basis of their *children's* level of expressive language ability. Because no data on mental age were available for the TD children, and to maximize comparability, children with DS were individually matched to TD children using the following four-step procedure (for further details, see Iverson *et al.* 2003). First, parents of children with DS completed the Primo Vocabolario del Bambino (PVB, the Italian adaptation of the MacArthur Communicative Development Inventory; for a detailed description, see Caselli and Casadio 1995), and a total vocabulary score (total number of words produced, as reported by parents) was calculated for each child with DS (for information regarding the validity of this instrument for use with parents of children with DS, see Miller *et al.* 1992 and Caselli *et al.* 1998). Second, each child's vocabulary score was compared with the PVB standardization data and the child assigned a language age equal to that at which 50% of children in the normative sample attained that score. Third, subgroups of TD children whose gender and *chronological age* generally corresponded to the gender and *language age* of

**Table 1. Characteristics of children with Down's syndrome**

Child	Sex	Chronological age (months)	Mental age (months)	Language age (months)	Lag between chronological and language ages (months)
A	male	37	18	16	21
C	male	56	24	20	36
G	female	44	27	20	24
I	female	55	25	17	38
V	male	46	18	17	29
Mean		47.6	22.4	18.0	29.6
SD		7.95	4.16	1.87	7.37

each child with DS were identified. Finally, from within each of these subgroups of TD children, the child whose observed vocabulary size (i.e. the number of *different* words, excluding repetitions, produced in the course of the observation) matched that of the child with DS as closely as possible (within six words) was identified as the child's individual match. Observed vocabulary size was chosen as the final matching criterion because it has been shown to be highly correlated with children's total scores on parental vocabulary checklists (e.g. the MacArthur CDI; Fenson *et al.* 1994).

In sum, the two groups of mothers who are the focus of the present study had children who were individually matched on the basis of: (1) gender; (2) correspondence between the TD child's chronological age and the DS child's language age; and (3) observed vocabulary size. The groups of children were not significantly different either on chronological/language age (Mann-Whitney  $U$ -test=12, n.s.) or observed vocabulary size ( $U$ =10.5, n.s.).

### *Procedure*

Mothers in both groups were videotaped with their children for 30 min during free play with toys. Mothers were encouraged to play with the child as they normally would. Sessions for the mothers of children with DS took place in the clinic room where their twice-a-week therapy sessions took place; this setting was familiar and comfortable for both participants. Sessions for mothers of TD children took place in their homes. Before viewing the tapes for coding purposes, they were previewed to ensure that the interaction had proceeded smoothly and that both the parent and the child had been active participants in the session.

### *Coding*

#### *Utterances in speech and gesture*

All intelligible spoken and gestured utterances produced by the mothers were transcribed from the videotapes. Utterances were identified using criteria outlined by Devescovi and Pizzuto (1995). Specifically, an utterance was defined as any sequence of words and/or gestures (that may or may not be grammatically structured) that is preceded and followed by a silence, a change of conversational turns, or a change in intonational patterns.

All utterances were then grouped into one of three categories according to whether they consisted of speech only, gesture only, or speech with co-occurring gesture. *Speech only* utterances were produced with no accompanying gesture; *gesture only* utterances were produced with no accompanying speech. All utterances in which a gesture co-occurred in time with speech were included in the *speech with gesture* category.

#### *Gesture types*

All gestures occurring in speech+gesture or gesture only utterances were classified into one of four categories following a coding system described by Iverson *et al.*

(1999) and employed in other studies of maternal gesture (O'Neill *et al.* 2005, also McNeill 1992). *Deictic gestures* single out specific events or objects from other referents present in the context. They express communicative intent by drawing another's attention to an object. Two types of deictic gestures were coded: SHOWING and POINTING.<sup>1</sup> SHOWING gestures consisted of holding an object up and orienting it toward the communicative partner in the centre of the gesture space. Gestures were classified as POINTING when a finger (usually the index) or flat hand was extended toward a specific person, object, location, or event.

*Conventional gestures* have forms and meanings that are culturally determined. Some conventional gestures are specific to the Italian repertoire (e.g. rotating the index finger on the cheek for GOOD; opening and closing the fingers repeatedly with thumb extended and palm facing the body for CIAO), while others are less culturally specific (e.g. shaking the head NO; clapping the hands for BRAVO; holding an index finger to the lips for QUIET).

*Representational gestures* (also referred to as iconic gestures; McNeill 1992) refer to objects, persons, or events through hand, body, or facial movements. Such gestures represent attributes of or actions performed by or with specific referents, and their referent does not vary across different contexts (e.g. opening and closing the thumb and fingers for BIRD; holding the fist to the mouth for TRUMPET).

Finally, all non-representational gestures that do not have specific semantic content, do not refer to precise referents, and are not linked to specific handshapes were classified as *emphatic gestures*. Such gestures highlight aspects of discourse structure and/or new content introduced into the interaction (e.g. moving a flat hand downward; extending the arms outward) and are often rhythmically timed with speech (McNeill 1992).

### *Informational relationship, structure, and timing*

All utterances consisting of speech with gesture were further classified according to the informational relationship between the spoken and gestured elements, the structure of the verbal and gestured portions of the utterance, and the extent to which the spoken and gestured portions of the utterance overlapped in time.

The informational relationship between gesture and speech was coded based on the contribution made by the gestured portion of the utterance to the overall message conveyed in speech. Utterances in speech and gesture were thus classified into one of three categories. In the first category, gesture *reinforced* the message conveyed in speech, by either emphasizing or conveying the same information as elements in the verbal portion of the utterance. Included in this category were all instances of utterances with an emphatic gesture, utterances containing a conventional gesture and its verbal equivalent (e.g. YES+'yes'), and utterances in which a referent was labelled in speech and indicated with a deictic gesture (SHOWING or POINTING; e.g. SHOWING an apple+'apple').

In the second category, gesture *disambiguated* the message contained in speech. In these utterances, gesture identified the precise referent of the spoken portion of the utterance. Included in this category were utterances including a deictic gesture and a demonstrative or locative expression (e.g. 'this', 'that', 'here', 'there'), personal or possessive pronoun (e.g. 'your', 'yours'), or attention-directing expressions (e.g. 'Look!', 'See!').

The third category consisted of utterances in which gesture *added* information to the message that was not explicitly conveyed in speech. In a majority of utterances in this category, the gestured portion of the utterance (usually a deictic gesture) identified the referent, while the spoken portion described an attribute of the referent.

With regard to structure, mothers' utterances in speech with gesture were classified into four major categories: (1) one gesture+one word; (2) one gesture+one multiword utterance; (3) one gesture+two or more multiword utterances; and (4) two or more gestures+one multiword utterances (Iverson *et al.* 1999). Finally, with regard to the temporal overlap between speech and gesture within an utterance, utterances were categorized according to whether the gesture co-occurred with *part* of the spoken utterance (i.e. the gesture was executed with a word or a subset of the words in the utterance and completed prior to utterance completion), or with the *complete* utterance (i.e. the gesture was executed as the verbal utterance began and was held until it ended).

### *Reliability*

Intercoder reliability was assessed by having a second trained coder independently transcribe maternal gestures produced in a total of five randomly selected sessions (two mothers of children with DS, three mothers of TD children). Mean intercoder agreement for identifying maternal gestures was 0.92 ( $n=112$ ) and 1.0 (104) for identifying maternal gesture types (i.e. classifying gestures as either deictic, conventional, representational or emphatic).

## **Results**

The aim of this study was to describe the relationship between maternal speech and gesture in the context of interactions between mothers and young children with DS and compare it with that observed among mothers of TD children at comparable levels of expressive language development. We begin by briefly describing overall communication patterns and amount of gesture produced by both groups of mothers. The relationship between maternal speech and gesture production was then examined by focusing on the types of gestures produced by the two groups, the informational relationship between maternal gestures and speech, the composition of utterances with gesture, and the relative duration of gestures co-produced with speech.

### *Overall communication and amount of gesture*

Mothers' overall communication was first examined by totalling the number of utterances produced by each mother during the observation and averaging them across mothers in the two groups. Mothers of children with DS produced significantly fewer utterances than mothers of TD children with comparable expressive language abilities (mean<sub>DS</sub>=275.8, SD=36.41; mean<sub>TD</sub>=537.8, SD=112.8,  $U=0$ ,  $p<0.005$ ). Indeed, the distributions for the two groups were completely non-overlapping. In order to explore this relationship further, we looked within the group of mothers of children with DS at the relationship between

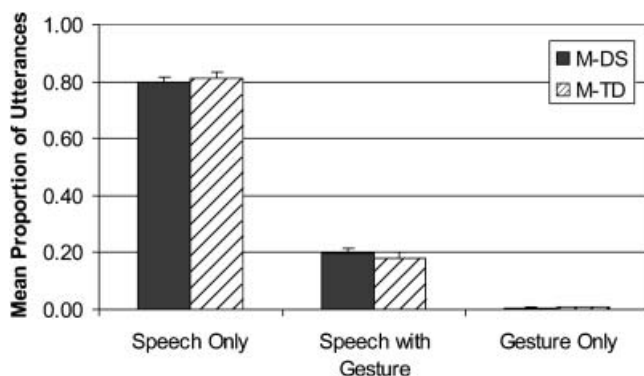


Figure 1. Utterance types.

number of utterances and the relative degree of developmental delay exhibited by the children. To index developmental delay, the lag between children's chronological and expressive language ages was calculated (table 1). Although the relationship did not reach conventional levels of significance, there was a tendency for mothers of children exhibiting a larger lag to produce fewer utterances (Spearman  $r = -0.70$ ,  $p = 0.18$ ).

The proportions of utterances consisting of speech only, speech with gesture, and gesture only were next compared. These data are shown in figure 1.

As is evident, the distributions of utterances across categories were remarkably similar across groups. For both groups of mothers, a majority of utterances consisted of speech alone (mean<sub>DS</sub> = 0.80, SD = 0.03; mean<sub>TD</sub> = 0.81, SD = 0.04, n.s.). Utterances in speech with gesture were the next most frequent (mean<sub>DS</sub> = 0.20, SD = 0.03; mean<sub>TD</sub> = 0.18, SD = 0.04, n.s.), while utterances in gesture only were relatively uncommon (mean<sub>DS</sub> = 0.005, SD = 0.006; mean<sub>TD</sub> = 0.007, SD = 0.003, n.s.). Approximately 21 and 19% of utterances produced by mothers of children with DS and mothers of TD children respectively were accompanied by gesture. Despite the overall similarity of means and variability between the two groups, examination of the relationship between extent of lag between chronological and expressive language age in the children with DS and their mothers' use of gesture revealed a strong tendency for mothers of children with a larger lag to produce a higher proportion of utterances in speech with gesture ( $r = 0.90$ ,  $p < 0.05$ ).

### *Gesture types*

As described above, gestures were classified as deictic (SHOWING and POINTING), conventional (e.g. nodding the head YES), representational (e.g. circling an index finger oriented downward for SPIN), or emphatic (e.g. moving the hand up and down rhythmically in time with accompanying speech). The distributions for gesture types for the two groups of mothers are shown in figure 2.

As is apparent, the majority of gestures produced by mothers in both groups were deictic. However, relative to mothers of TD children, mothers of children with DS produced a significantly higher proportion of deictic gestures (mean<sub>DS</sub> = 0.73, SD = 0.12; mean<sub>TD</sub> = 0.47, SD = 0.19,  $U = 3.5$ ,  $p < 0.05$ ). Within the deictic gesture category, pointing was most frequent for both groups of mothers. However,



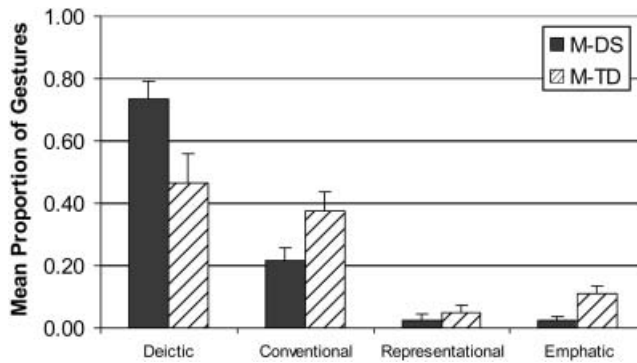


Figure 2. Gesture types.

mothers of children with DS produced proportionately fewer points and made relatively greater use of showing than mothers of TD children (for pointing,  $\text{mean}_{\text{DS}}=0.73$ ,  $\text{SD}=0.16$ ;  $\text{mean}_{\text{TD}}=0.87$ ,  $\text{SD}=0.12$ ,  $U=4$ ,  $p<0.05$ ; for showing,  $\text{mean}_{\text{DS}}=0.27$ ,  $\text{SD}=0.16$ ;  $\text{mean}_{\text{TD}}=0.13$ ,  $\text{SD}=0.12$ ,  $U=4.5$ ,  $p<0.05$ ). Mothers of children with DS used proportionately fewer conventional gestures than mothers of TD children, a difference that tended toward significance ( $\text{mean}_{\text{DS}}=0.22$ ,  $\text{SD}=0.08$ ;  $\text{mean}_{\text{TD}}=0.37$ ,  $\text{SD}=0.13$ ,  $U=5.5$ ,  $p<0.08$ ). While representational gestures were infrequently produced by mothers in both groups, mothers of children with DS produced fewer representational gestures than their counterparts with TD children, although the difference was not statistically significant ( $\text{mean}_{\text{DS}}=0.02$ ,  $\text{SD}=0.04$ ;  $\text{mean}_{\text{TD}}=0.05$ ,  $\text{SD}=0.04$ , n.s.). Finally, emphatic gestures, which accounted for approximately 10% of the gesture types produced mothers of TD children, were rarely observed among mothers of children with DS ( $\text{mean}_{\text{DS}}=0.02$ ,  $\text{SD}=0.03$ ;  $\text{mean}_{\text{TD}}=0.11$ ,  $\text{SD}=0.05$ ,  $U=1.5$ ,  $p<0.03$ ).

#### *Informational relationship between gesture and speech*

The informational relationship between speech and gesture was next examined by calculating the mean proportions of utterances in speech with gesture that were classified as *reinforce* (e.g. SHOW an apple+'mela' <apple>),<sup>2</sup> *disambiguate* (e.g. POINT to a toy tractor+'questo cos'è' <what's this?>), and *add* (e.g. POINT to a picture of a musical instrument in a book+'cosa sta suonando?' <what is he playing?>) on the basis of the informational role played by gesture with respect to co-occurring speech. These data are shown in figure 3.

As is evident, these distributions exhibited a comparable overall pattern across the two groups of mothers. A majority of gestures served to reinforce the message conveyed verbally, while utterances in which gesture disambiguated the verbal message were less frequent. There was a tendency for mothers of children with DS to produce fewer reinforce and more disambiguate utterances compared with mothers of TD children, but neither of these differences were statistically reliable (for reinforce,  $\text{mean}_{\text{DS}}=0.56$ ,  $\text{SD}=0.22$ ;  $\text{mean}_{\text{TD}}=0.74$ ,  $\text{SD}=0.09$ , n.s.; for disambiguate,  $\text{mean}_{\text{DS}}=0.37$ ,  $\text{SD}=0.22$ ;  $\text{mean}_{\text{TD}}=0.23$ ,  $\text{SD}=0.10$ , n.s.). Utterances in which gesture added information to speech were relatively uncommon ( $\text{mean}_{\text{DS}}=0.07$ ,  $\text{SD}=0.05$ ;  $\text{mean}_{\text{TD}}=0.03$ ,  $\text{SD}=0.03$ , n.s.).

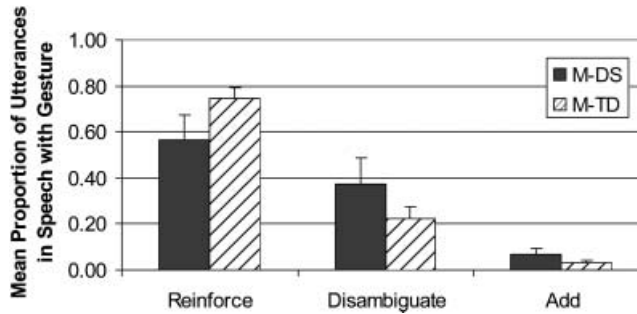


Figure 3. Informational relationship between gesture and speech.

#### *Composition of utterances with gesture*

To examine the composition of utterances in speech with gesture, these utterances were classified according to the length of the verbal utterance (a single word vs. a multiword utterance) and the number of gestures that were co-produced with the verbal utterance (one or more). This yielded four categories of utterances: a single word utterance with a gesture (SHOW a puzzle piece+‘ecco’ <here>), a multiword utterance with a gesture (POINT to toy basket+‘li devo rimettere?’ <I need to put them back?>), multiple multiword utterances with a single gesture (ALL GONE+‘l’altra macchina? Io la vedo. Dov’è?’ <The other car? I see it. Where is it?>), and a multiword utterance with multiple gestures (POINT to drawing of child+POINT to his cap+‘il bimbo col cappello’ <the little boy with the hat>). The proportions of utterances in speech with gesture in these four categories were calculated and averaged across mothers in the two groups. These distributions are shown in figure 4.

As is apparent, the vast majority of maternal utterances in speech with gesture for mothers in both groups consisted of a multiword utterance with a single gesture. However, relative to mothers of TD children, mothers of children with DS produced a greater proportion of utterances in this category, a difference that was statistically reliable (mean<sub>DS</sub>=0.85, SD=0.06; mean<sub>TD</sub>=0.76, SD=0.06,  $U=3$ ,  $p<0.03$ ). Utterances consisting of a single word with a gesture were next most frequent and did not differ significantly between the groups (mean<sub>DS</sub>=0.15,

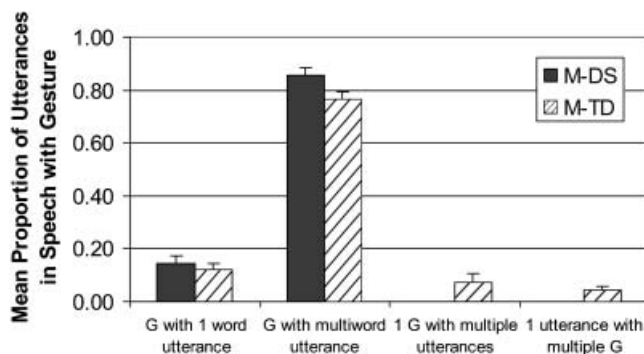


Figure 4. Utterance structures.

SD=0.06; mean<sub>TD</sub>=0.12, SD=0.04, n.s.). Instances of utterances in the final two categories (multiple multiword utterances with a single gesture, a single multiword utterance with multiple gestures), which were observed (albeit relatively infrequently) in the production of mothers of TD children, were never observed among mothers of children with DS (for multiple utterances with a single gesture, mean<sub>DS</sub>=0, SD=0; mean<sub>TD</sub>=0.07, SD=0.07,  $U=0$ ,  $p<0.005$ ; for single utterance with multiple gestures, mean<sub>DS</sub>=0, SD=0; mean<sub>TD</sub>=0.05, SD=0.03,  $U=0$ ,  $p<0.005$ ).

*Relative duration of gestures co-produced with speech*

Finally, the extent of temporal overlap between the verbal and gestured components of utterances in speech with gesture was analysed. This was done by classifying utterances according to whether the gesture co-occurred with a portion of the verbal utterance (e.g. POINT to toy + 'ce l'hai a scuola questo pupazzo<sup>13</sup> <you have this doll at school>) or with the complete utterance (e.g. SHOW toy cars + 'come si chiamano queste' <what are these called?>). The proportion of multiword utterances<sup>4</sup> with gesture in each category was calculated and averaged across mothers in each group. These data are shown in figure 5.

As is apparent, the two groups of mothers differed sharply in the relative timing patterns of speech and gesture in co-produced utterances. Whereas the gestures of mothers of TD children were about equally likely to overlap either with a portion of vs. a complete utterance (mean<sub>part</sub>=0.45, SD=0.19; mean<sub>complete</sub>=0.55, SD=0.19), mothers of children with DS were far more likely to hold a gesture for the duration of a complete utterance (mean<sub>part</sub>=0.21, SD=0.16; mean<sub>complete</sub>=0.79, SD=0.16,  $U=3$ ,  $p<0.03$ ). In addition, examination of the relationship between extent of lag in the children with DS and temporal duration of mothers' gestures revealed a strong tendency for mothers of children with a larger lag to produce a higher proportion of gestures that were held throughout the verbal utterance ( $r=0.90$ ,  $p<0.05$ ).

**Discussion**

This study examined the relationship between speech and gesture in maternal input to young children with DS and TD children. The goal was to compare the relative

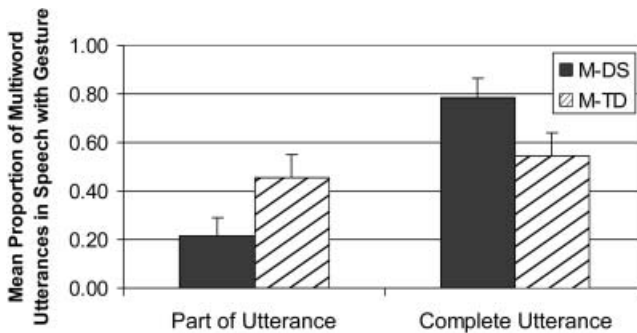


Figure 5. Duration of gesture with respect to utterance.

use of gesture and speech and the relationship between gestural and verbal communication in mothers' communication to children with DS with that of a group of mothers of TD children matched on the basis of productive language to preclude the possibility that differences in maternal communication patterns were simply a reflection of differences in children's eliciting expressiveness. Results indicated that mothers of children with DS and mothers of TD children were generally similar in the overall frequency with which they produced gesture and in the informational relationship between their gestures and their speech. However, despite the fact that their children had highly comparable levels of expressive language, the two groups differed in a number of specific and significant ways.

*Mothers of children with DS simplify their communication*

A number of researchers (Bekken 1989, Iverson *et al.* 1999) have reported that mothers of TD children make use of 'gestural motherese' when talking to their young children. In comparison with their communications with other adults, mothers talking to their TD children simplify their gesture use. They produce proportionately fewer utterances with gesture, and the gestures they produce are much more likely to be deictics (primarily pointing), and used to reinforce rather than to supplement the message conveyed in speech.

Findings from the present study suggest that mothers of children with DS adhere to this overall pattern of communication. Like mothers of TD children, they produced a relatively low proportion of utterances with gesture, made extensive use of deictic gestures, and used gestures to reinforce their verbal message. There are, however, a number of ways in which the communication patterns of mothers of children with DS diverge from the pattern observed in mothers of TD children; and in all cases the observed differences suggest a tendency for mothers of children with DS to adopt an enhanced form of gestural motherese. Mothers of children with DS, in other words, simplify their communication to an even greater degree than mothers with TD children who are at a comparable level of expressive ability.

Thus, for example, mothers of children with DS produced about 50% fewer utterances than did mothers of TD children. Indeed, the distributions for the two groups of mothers were completely non-overlapping, and there was a strong (though not statistically reliable) negative relationship between severity of developmental delay in children with DS and the number of utterances produced by their mothers. This finding is consistent with previous work reporting that relative to mothers of TD children, mothers of young children with DS produce less syntactically complex language (e.g. Buium *et al.* 1974, Mahoney 1988, but see Rondal 1988) and proportionately fewer instances of object labelling (e.g. Cardoso-Martins and Mervis 1985).

At first glance, differences such as these might be interpreted as being indicative of qualitatively 'poorer' input to children with DS. However, child-directed communication characterized by relatively fewer utterances overall may reflect a simplification strategy on the part of mothers. Specifically, mothers of children with DS may provide a reduced rate of communication to avoid overloading the child with information, an adjustment that presumably reflects their awareness of their child's difficulties with language comprehension and processing. Reducing the

number of utterances directed to the child may increase the likelihood that the message is understood.

Given that mothers of children with DS produced many fewer utterances when interacting with their children, one might also have expected the proportion of utterances with gesture to be reduced relative to mothers of TD children. However, this was not the case: the two groups of mothers in this study produced gestures at comparable rates. Why might mothers of children with DS reduce their overall communication but not the relative frequency of gesture production? One possibility, suggested by the finding of a significant positive relationship between the extent of child's developmental delay and maternal production of utterances in speech with gesture, is that gesture enhances the effectiveness of maternal communication to children with DS. When mothers produce gestures with speech, those gestures provide them with an additional means for directing and maintaining their child's attention on the topic of communication. Since gestures are visuospatial in nature and more extended in time relative to the speech stream, they may be particularly accessible to young children with DS.

This interpretation is consistent with research examining the effectiveness of teachers' spoken and gestured communication to older children with DS. Wang *et al.* (2001) found that when classroom teachers provided instruction containing scaffolding in speech with gesture, 7 year olds with DS were more likely to respond to teachers' instructions, focused longer on classroom tasks, and were more successful in accomplishing those tasks than when scaffolding was provided in speech only. They concluded that speech with gesture was more effective than speech alone in facilitating the classroom performance of students with DS because gesture adds concrete, visual, vivid, and informative cues to the information conveyed in speech. Although these findings are from teacher–student interactions involving older children, the gestures observed in the present study may play a similar role in parent–child interactions involving younger children. For mothers communicating with young children with DS, gesture may provide both an additional channel for conveying information and a means for providing that information in a manner that is especially accessible to the child. Using gesture with speech, in other words, may be one way in which mothers adapt their communication to the level of the child.

#### *Mothers of children with DS concretize their communication*

Although previous analyses of maternal *speech* to children with DS have documented reduced use of deictic utterances relative to that of mothers of TD children (e.g. Cardoso-Martins and Mervis 1985), our results suggest that such findings, if interpreted as indicative of an overall reduction in the use of deixis by mothers of children with DS, may be misleading. In this study, mothers of children with DS produced a significantly *higher* proportion of deictic gestures than mothers of TD children. This suggests that rather than restricting their use of deictic reference, mothers of children with DS may simply shift deixis to the gestural modality. Unlike deictic speech, which is ephemeral and linked to referents at an abstract level (e.g. words such as 'this' and 'that' can refer to an infinite number of potential referents), deictic gestures and their referents are both physically present and visible to the child at the moment of communication. Comprehension of gestural deixis, in other

words, may be supported by context in ways that verbal deixis is not; and that context is likely to facilitate the DS child's overall comprehension.

Support for this interpretation comes from the finding that mothers of children with DS also made relatively greater use of SHOWING than did mothers of TD children. Since SHOWING gestures and their referents are in physical contact, the link between them is highly concrete and immediately apparent. Mothers can also capitalize on direct gesture-referent contact to enhance the salience of SHOWING gestures (e.g. through movement) and further highlight the gesture-referent link. Other deictic gestures (e.g. POINTING) are often produced at some distance from their referent, which requires the recipient to overcome spatial separation between communicative signal and referent in order to identify the gesture-referent link. SHOWING gestures eliminate the distancing problem, and this may make them more interpretable to young children with DS.

*Mothers of children with DS highlight the link between communication and referent*

Mothers of children with DS produced utterances in speech with gesture that consisted primarily of a single multiword utterance with a single co-occurring gesture. Unlike mothers of TD children, mothers of children with DS never produced utterances that violated this one-to-one correspondence between speech and gesture (e.g. a verbal utterance with multiple gestures, a gesture co-produced with successive multiple utterances).

When an utterance is produced with multiple co-occurring gestures, children must shift their attentional focus each time a new gesture is produced and integrate multiple pieces of gestured information with the verbal message. Successive multiple utterances accompanied by a single gesture present a somewhat different problem: they require the child to hold the referent of the gesture in memory while processing a relatively longer stream of speech. In contrast, utterances that maintain a one-to-one relationship between speech and gesture highlight the correspondence between a gesture and the verbal utterance it accompanies, thereby simplifying the child's task of linking communication and referent.

The increased production of utterances that reflected a consistent, one-to-one relationship between speech and co-occurring gesture was accompanied by a strong tendency to hold gestures across complete verbal utterances, a pattern that was much less evident among mothers of TD children. Maintaining one-to-one correspondence between gestures and verbal utterances and holding co-produced gestures for the duration of the utterance may be another way in which mothers of children with DS reduce the information load placed on their children. Holding gestures for the full duration of an utterance may help maintain the child's attention on the referent as the spoken message is communicated, thereby giving children greater opportunity to recognize the link between the referent and the utterance. Indeed, the tendency to hold gestures throughout complete utterances was strongest in mothers whose children with DS were the most developmentally delayed.

The importance of gestural scaffolding of attention in children with DS is highlighted by studies that have reported difficulty with attention deployment in infants with DS (for reviews, see Zelazo and Stack 1997 and Sigman 1999). Specifically, infants with DS exhibit deficits both in sustained attention (e.g. Krakow

and Kopp 1983, Brown *et al.* 2003) and in the ability to shift attention from one object to another (Krakow and Kopp 1982). Relative to TD infants, infants with DS spend less time engaged in object play (Landry and Chapieski 1989, Legerstee and Weintraub 1997), more time unoccupied (i.e. not attending to toys or to a social partner), and shift their gaze from their play to a person or another object in the environment less frequently (Krakow and Kopp 1983). These early difficulties with attention to objects presumably impact the development of the ability to coordinate attention between an object and a person; and indeed, infants with DS exhibit delays in the development of joint attention (e.g. Mundy *et al.* 1989).

In light of these attentional difficulties, the gestural motherese observed among mothers of children with DS may be a strategy for maintaining the child's attention on the object on which the conversation is focused and therefore facilitates triadic interaction. Deictic gestures provide visible, physical reference to objects and events; and because SHOWING gestures naturally involve manipulation of a referent, mothers can move the object to draw attention to it, and even bring the object directly into the child's visual field. One-to-one correspondence between a gesture and a multiword utterance, in combination with temporally extended gestures, provides a physical instantiation of the link between referent and communication. In short, the 'gestural motherese' produced by mothers of children with DS differs from that of mothers of TD children of comparable verbal expressive ability on precisely those dimensions that may be supportive of attention regulation in young children. The effect of enhanced attention to the referent may then be to enhance the child's opportunity to engage in the communicative interaction and the likelihood that communication will be understood by the child. Work by Legerstee and colleagues suggests that when an adult maintains the child's attention to an object, children with DS are more likely to respond with words and gestures (Legerstee *et al.* 2003, also Landry and Chapieski 1989, Roach *et al.* 1998). Thus, to the extent that mothers of children with DS are successful in maintaining their child's attentional focus, they may well be encouraging production of communicative behaviours.

### Acknowledgements

Research was supported by a CNR Short-term Mobility grant to J. M. I. Portions of this work were presented at the 14th International Conference on Infant Studies, Chicago, IL, USA, May 2004. The authors thank the Ospedale S. Lucia for generously making its facilities available for data collection; M. G. Colombini, P. Gentili, R. Pisaneschi and M. R. Pizzamiglio for their assistance with data collection; R. Wozniak and members of the University of Pittsburgh Infant Communication Lab for comments on previous drafts of the manuscript; and the children and parents who participated in the study.

### Notes

1. Throughout, gestures are indicated in small capitals.
2. In these and all subsequent examples, English glosses for Italian words and phrases are given in brackets.
3. In these examples, the portion of the utterance with which the gesture co-occurred is indicated with double underlining.

4. Single-word utterances with gesture were excluded from this analysis because co-occurring gestures were always held across the complete utterance.

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