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Do parents lead their children by the hand?*

ŞEYDA ÖZÇALIŞKAN AND SUSAN GOLDIN-MEADOW
University of Chicago

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ABSTRACT

The types of gesture + speech combinations children produce during the early stages of language development change over time. This change, in turn, predicts the onset of two-word speech and thus might reflect a cognitive transition that the child is undergoing. An alternative, however, is that the change merely reflects changes in the types of gesture + speech combinations that their caregivers produce. To explore this possibility, we videotaped 40 American child–caregiver dyads in their homes for 90 minutes when the children were 1;2, 1;6, and 1;10. Each gesture was classified according to type (deictic, conventional, representational) and the relation it held to speech (reinforcing, disambiguating, supplementary). Children and their caregivers produced the same types of gestures and in approximately the same distribution. However, the children differed from their caregivers in the way they used gesture in relation to speech. Over time, children produced many more REINFORCING (*bike* + point at bike), DISAMBIGUATING (*that one* + point at bike), and SUPPLEMENTARY combinations (*ride* + point at bike). In contrast, the frequency and distribution of caregivers' gesture + speech combinations remained constant over time. Thus, the changing relation between gesture and speech observed in the children cannot be traced back to the gestural input the children receive. Rather, it appears to reflect changes in the children's own skills, illustrating once again gesture's ability to shed light on developing cognitive and linguistic processes.

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INTRODUCTION

Most of the research on input to children during the early stages of language development has focused on adult speech, with relatively little attention paid to other aspects of adults' communications with young children. But people gesture when they talk. Even children at the earliest stages of language learning use their hands while speaking, as do their parents. A considerable amount of research has made it clear that gesture is integrated both temporally and semantically with the speech it accompanies (Kendon, 1980; McNeill, 1992). Moreover, gesture can convey substantive information that is related, but not identical, to the information conveyed in the speech that it accompanies (Goldin-Meadow, Alibali & Church, 1993; Goldin-Meadow, 2003). As such, gesture has the potential to offer insight into speakers' unspoken thoughts, whether those speakers are children or adults. The goal of this study is to explore the gestures adults produce when they talk to young children. We ask, in particular, whether changes in children's use of gesture during the transition from one- to two-word speech can be traced back to changes in the gestures children receive as input from their parents.

Development of gesture and speech as an integrated system

At a time when children are limited in what they can say, there is another avenue of expression open to them, one that can extend the range of ideas they are able to express. In addition to speaking, children can also gesture (e.g. Bates, 1976; Bates, Benigni, Bretherton, Camaioni & Volterra, 1979). Earlier work has shown that at young ages (1;2 to 1;4) children's communicative repertoire includes more different types of referential meanings conveyed in gesture than in words, with minimal overlap between the lexicons in the two modalities (Iverson, Capirci & Caselli, 1994).

The earliest gestures children use, typically beginning around 0;10, are DEICTICS – gestures whose referential meaning is given entirely by the context and not by the form of the gesture (e.g. pointing at a doll to indicate a doll, holding up a bottle to draw another's attention to that object). At this early stage, deictic gestures offer children a tool to refer to objects before they have words for those objects and, as shown in earlier work, children often produce a deictic gesture for a particular object (point at dog) approximately three months before they produce the verbal label for that object *dog* (Iverson & Goldin-Meadow, 2005). In addition to deictics, children also use a second type of gesture – ICONIC or REPRESENTATIONAL gestures. Unlike deictics, the form of a representational gesture captures aspects of its intended referent and its meaning is therefore less dependent on context (e.g. flapping hands with the arms out to represent bird, holding a fist-shaped hand by the ear to represent telephone; Acredolo & Goodwyn,

1988; Iverson *et al.*, 1994). Importantly, Acredolo & Goodwyn (1988) found that the more representational gestures children had in their communicative repertoires at 1;7, the larger their verbal vocabularies would be at 2;0, suggesting that there is a tight link between early gesture use and word learning.[1]

After the onset of their first words, children continue to use gesture to extend their communicative range, but now in combination with speech. The earliest gesture + speech combinations young children produce contain gestures that convey information that REINFORCES the information conveyed in speech; for example pointing at an object while naming it (e.g. *juice* + point to bottle of juice; Leopold, 1949; Greenfield & Smith, 1976). Several months later, children begin to produce gesture + speech combinations in which gesture conveys information that SUPPLEMENTS the information conveyed in speech; for example gesturing at an object while describing the action to be performed on the object (e.g. *open* + point to drawer), or gesturing at an object while describing the owner of that object (e.g. *daddy* + point to father's car; Greenfield & Smith, 1976; Masur, 1983; Goldin-Meadow & Morford, 1985; Zinober & Martlew, 1985; Morford & Goldin-Meadow, 1992). This second type of gesture + speech combination (called SUPPLEMENTARY combinations) allows a child to express two elements of a sentence (one in gesture and one in speech) at a time when the child may not be able to express those elements within a single spoken utterance.

Children begin producing gesture + speech combinations prior to their first two-word utterances. More impressive is the fact that the age at which children first produce supplementary combinations (in which gesture and speech convey different information, e.g. *open* + point to drawer) predicts the age at which they produce their first word + word combinations (*open drawer*; Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). Thus the child's ability to convey sentence-like meanings ACROSS gesture and speech is a signal that the child will soon be able to convey these meanings entirely WITHIN speech (see also Capirci, Iverson, Pizzuto & Volterra, 1996; Goodwyn & Acredolo, 1998).

What might underlie this phenomenon? One possibility is that the changes in children's gesture + speech combinations reflect internal development, namely cognitive and communicative growth within the child. An equally plausible alternative, however, is that the changes in the child's gesture system reflect parallel changes in the child's external environment, that is, increasingly sophisticated use of gesture by the child's parents.

[1] The remaining types of gestures outlined by McNeill (1992) – METAPHORICS, BEATS, and ABSTRACT DEICTICS – are not routinely produced by children until ages 5;0 or 6;0 (McNeill, 1992), and are rarely used by adults when they talk to their young children (Iverson *et al.*, 1999).

Do changes in children's early gestures relate to changes in their caregivers' gestures?

A great deal of research has shown that adults modify their speech when they interact with their young children (e.g. Snow & Ferguson, 1977; Hart & Risley, 1995). Mothers use shorter phrases with relatively simple words, talk more slowly, and use more variable patterns of intonation with children than with adults. However, speakers routinely produce gesture as they talk, and adults talking to children are no exception. In contrast to the considerable amount of information we have about the speech that language-learning children hear, much less is known about the gestures that children see (but see Shatz, 1982; Bekken, 1989; Iverson, Capirci, Longobardi & Caselli, 1999). Bekken (1989) examined the gestures mothers produced when talking to their eighteen-month-old daughters and compared them to the gestures the mothers produced when talking to an adult. She found that the mothers gestured less frequently and used conceptually simpler gestures (i.e. more deictic gestures indicating concrete referents) when they addressed their child than when they addressed the adult. These results hint at a motherese in gesture comparable to motherese in speech. Iverson *et al.* (1999) extended these findings by analysing maternal gestures at two age points (when the child was 1;4 and 1;8) in Italian-speaking mother–child dyads. They found that Italian mothers often produced deictic and conventional gestures but produced few representational gestures when interacting with their young children. Thus, in comparison to the gestures they produce when talking to adults, parents seem to modify their gestures when talking to children.

But is parental gesture responsible for the changes that we see in child gesture during the early stages of language development? Namy, Acredolo & Goodwyn (2000) found that the number of gestures parents produced during a book reading task with their children aged 1;3 was highly correlated with the number of gestures the children themselves produced. Acredolo & Goodwyn (1988; Goodwyn & Acredolo, 1993) found that the majority of gestures young children acquire can be traced back to the gestural or motor routines that their parents engage in with their children, either deliberately (e.g. the itsy-bitsy spider song which is routinely accompanied by a finger gesture depicting a spider crawling motion) or unwittingly (e.g. sniffing a flower).

Although these studies suggest that parental gesture can influence child gesture, they do not tell us whether parental gesture is able to account for the changes we see in children's gesture+speech combinations, changes that herald the onset of two-word speech. To address this question, we need to know not only how often parents gesture, but also how those gestures are used in relation to speech – whether they reinforce, or add to, the information conveyed in speech. We therefore examined the gestures that a relatively large ($N=40$) and heterogeneous sample of children and their caregivers

TABLE 1. *Sample distribution by ethnicity and income*

	Family ethnicity					
Household income	African-American	Asian	Caucasian	Hispanic	Mixed	Total
Less than $15,000	1	0	1	0	0	2
$15,000–$34,999	2	1	2	2	1	8
$35,000–$49,999	2	0	3	0	1	6
$50,000–$74,999	2	1	6	0	0	9
$75,000–$99,999	1	0	5	1	0	7
$100,000 or more	0	0	7	0	1	8
Total	8	2	24	3	3	40

Mixed: two or more ethnic groups.

produced when interacting in a natural setting at home. The dyads were observed at three time periods during the early stages of language learning. We explored, first, whether our data replicate previous studies showing changes in children's gestures during the transition from one- to two-word speech. Having found such changes, we then asked whether those changes could be traced back to changes in the parents' gestures. If not, it becomes increasingly likely that the changes found in child gesture during this time period reflect changes in the child's own cognitive and/or communicative skills.

METHOD

Sample

The sample included 40 English-speaking child–caregiver dyads living in Chicago; the families were representative of the broader Chicago area in terms of both ethnic composition and income distribution. All child participants were exposed from birth only to English as their native language and were being raised as monolingual English speakers. Of the 40 children, 22 were females and 18 were males. The mother was the primary caregiver in 35 of the 40 families; the father was the primary caregiver in 2 families, and both parents shared the caregiver role in another 3 families. A summary of the sample described in terms of ethnicity and income is provided in Table 1.

Procedure for data collection

Data collection involved naturalistic observations of spontaneous interaction between children and their caregivers in their homes by a female experimenter. Three video recorded observations were made for each dyad when the child was 1;2, 1;6, and 1;10. Each session lasted approximately

90 minutes, and caregivers were told to interact with their children as they normally would and ignore the presence of the experimenter. The sessions typically involved free play with toys, book reading, and a meal or snack time, but varied according to the preferences of the caregivers. The families were paid for their participation in the study.

Procedure for data analysis

All communicative gestures and meaningful sounds in the video-recorded interactions were transcribed for child and caregiver. A behaviour was considered communicative if the child or the caregiver used their voices or hands to direct the listener's attention. Only hand movements that did not involve direct manipulation of objects (e.g. hammering a peg) and were not part of a ritualized game (e.g. itsy-bitsy spider) were counted as gestures. The only exception was when the child or the caregiver held up an object to bring to the other's attention; these acts served the same function as the pointing gesture, and thus were treated as deictic gestures. Sounds that were used reliably to refer to entities, properties or events (e.g. words such as *doggie*, *open*, *broken*, *there*, *it*), along with onomatopoeic (e.g. *meow*, *oink-oink*, *choo-choo*) and conventionalized evaluative sounds (e.g. *oopsie*, *wow*, *uh-oh*) were considered meaningful, and thus were transcribed as speech and counted as words. Transcripts were divided into communicative acts, which were defined as a sequence of words and/or gestures that was preceded and followed by a pause, a change in conversational turn, or a change in intonational pattern. Only communicative acts directed to the target child were included in the analysis. Communicative acts were further divided into three categories: gesture only (utterances in which gestures were produced without speech, e.g. point at dog), speech only (utterances in which speech was produced without gesture, e.g. *dog*, *I open it*), or gesture+speech combinations (utterances in which a gesture was produced along with speech, e.g. *see dog*+point at dog, *eat*+point at muffin). We did not code the order in which gesture and speech were produced in gesture+speech combinations; all of these combinations are marked with a '+' sign, with the word arbitrarily listed first and the gesture second.

Analysis of speech. Communicative acts that contained speech were coded for complexity and assigned to one of three categories: (1) SIMPLE SENTENCES were speech strings containing a single verb (e.g. *look*, *come up*, *give me the ball*). (2) COMPLEX SENTENCES were speech strings containing two or more verbs (e.g. *let me wipe your face*, *sit down and play with your toys*, *hear the birds chirping on the trees*). For certain forms, categorization of sentences as simple or complex was not obvious. We included as simple sentences utterances with a single verb even if it was modified by a modal auxiliary (e.g. *can*, *would*, *should*, *must*), marginal modal (e.g. *used to*+V, *would*

rather+V, *need to*+V, *have to*+V), or a quasi modal (e.g. *going to*+V, *wanna*+V, *to be able to*+V, *let's*+V, *got to*+V), following Huttenlocher, Vasilyeva, Cymerman & Levine (2002). The tag in a tag question (e.g. *You like it, don't you?*) was NOT counted as a second predicate. Similarly, sentences with a conjoined subject (e.g. *Mommy and daddy can't play now*) or a conjoined object (e.g. *Do you want to play with blocks or legos?*) were NOT counted as complex sentences. However, sentences containing coordinated clauses or a subordinate clause were considered complex if they contained more than one verb (e.g. *Pick up your crayons and put them in the box*, *You can have lunch after I cook the beans*). (3) NON-CLAUSAL UTTERANCES referred to speech strings that lacked verbs; these included nouns and noun phrases (e.g. *cookie*, *the doggie*, *nice baby*), particles and prepositional phrases (e.g. *up*, *down*, *over there*, *on the table*), fillers (e.g. *yeah*, *no*, *bye bye*, *hello*), and various conventionalized evaluative and onomatopoeic sounds (e.g. *wow*, *oopsie*, *uh-oh*, *peek-a-boo*, *meow*, *oink-oink*, *choo-choo*).

The speech of the children and the caregivers was analysed further for type and token frequency of different words. Morphologically inflected variants of words (e.g. *run* and *running*, *bike* and *bikes*) were counted as a single type, but alternate forms of words (e.g. *bike* and *bicycle*) were counted as two word types. All words in each transcript were examined to ensure that word counts were not artificially inflated due to inconsistencies in spelling or transcription. Only words produced in a given observation session were counted as types for that session; in other words, we did not automatically give a child credit for a word at a later session simply because the child had produced the word in an earlier session.

Analysis of gesture. Each gesture was classified into one of four categories: (1) CONVENTIONAL GESTURES included hand and body movements that had conventional meanings associated with conventional gesture forms (e.g. nodding the head to mean yes, turning and raising the palms upward to mean don't know). (2) DEICTIC GESTURES were gestures that indicated concrete objects or locations in order to refer to those objects/locations (e.g. pointing to a dog to indicate dog, pointing downward to indicate down, holding up a bottle to indicate bottle). (3) REPRESENTATIONAL GESTURES were gestures that depicted attributes or actions of concrete or abstract referents via hand or body movements (e.g. moving the index finger in circles to convey a ball's rolling). (4) BEAT GESTURES were formless hand movements that conveyed no semantic information but moved in rhythmic relationship with speech to highlight aspects of discourse structure (e.g. flicking the hand or the fingers up and down or back and forth; McNeill, 1992). The incidence of beat gestures was extremely rare in both the child and caregiver data; this category was therefore excluded from the analyses.

Analysis of the relation between gesture and speech. All communicative acts containing both gesture and speech were categorized into three types

according to the relation between the information conveyed in gesture and speech: (1) A REINFORCING RELATION was coded when gesture conveyed the same information as speech (e.g. *dog* + point at a dog, *no* + shake head sideways, *bottle* + hold-up milk bottle). (2) A DISAMBIGUATING RELATION was coded when gesture clarified a proform in speech (e.g. *there* + point to table, *that one* + point to doll). Disambiguating gestures were typically used to clarify pronominal (e.g. *he*, *she*), demonstrative (e.g. *this*, *that*) or deictic (e.g. *here*, *there*) references in speech. (3) A SUPPLEMENTARY RELATION was coded when gesture added semantic information to the message conveyed in speech (e.g. *push* + point to couch, *I want more* + hold-up empty juice cup). Gesture + speech combinations in which gesture and speech conveyed apparently conflicting information (e.g. *doggie* + point at cow) were also included in this category.

The total number of words and gestures were computed and analysed separately for children and caregivers using one-way ANOVAs with age as the single factor. In addition, for each child and caregiver, the total number of different types of communicative acts (speech only, gesture only, gesture + speech), speech (simple, complex, non-clausal), gesture (conventional, deictic, representational), and gesture + speech combinations (reinforcing, disambiguating, supplementary) were computed; these measures were analysed separately for children and caregivers using two-way ANOVA comparisons with age as one factor and type of communication as the other.

Reliability. An independent observer transcribed and coded a subset of the videotaped sessions to assess reliability. The Cohen's kappa scores for agreement between coders were 0·88 ($N = 6148$) for identifying gestures, 0·85 ($N = 795$) for assigning meaning to the identified gestures, 1·0 ($N = 247$) for identifying gesture types, and 0·94 ($N = 247$) for classifying combinations according to the relation between gesture and speech.

RESULTS

Speech

Not surprisingly, children produced more speech over time (Table 2). They produced more communicative acts containing speech ($F(2, 78) = 51{\cdot}58$, $p < 0{\cdot}001$), more different types of words ($F(2, 78) = 70{\cdot}90$, $p < 0{\cdot}001$), and more words overall (i.e. tokens; $F(2, 78) = 40{\cdot}04$, $p < 0{\cdot}001$) with age. There was a significant increase in all three speech production measures between 1;2 and 1;6 (Scheffé, $p < 0{\cdot}05$), and between 1;6 and 1;10 (Scheffé, $p < 0{\cdot}001$). Children's speech lexicons showed a steady increase from a mean number of 11 word types and 43 word tokens at 1;2 to a mean number of 95 word types and 479 word tokens at 1;10. The majority of the children were producing one-word speech at 1;2 (36/40), and more

TABLE 2. *Summary of children's and caregivers' speech production**

	Child's age		
	1;2	1;6	1;10
CHILDREN			
Mean number of communicative acts containing speech (*S.D.*)	38 (44)	150 (120)	350 (249)
Mean number of word types (*S.D.*)	11 (12)	37 (26)	95 (63)
Mean number of word tokens (*S.D.*)	43 (53)	180 (143)	479 (402)
Number of children who produced at least one one-word utterance	36	40	40
Number of children who produced at least one two-word utterance	10	25	37
CAREGIVERS			
Mean number of communicative acts containing speech (*S.D.*)	897 (479)	958 (521)	904 (492)
Mean number of word types (*S.D.*)	361 (145)	383 (150)	389 (149)
Mean number of word tokens (*S.D.*)	3087 (1938)	3365 (2120)	3326 (1979)

S.D.: standard deviation.
* The figures for means and standard deviations are rounded to the nearest whole number.

than half of the children were producing two-word combinations by 1;6 (25/40).

The caregivers, on the other hand, remained relatively stable in their speech, showing no significant differences across the three data points in their use of communicative acts containing speech ($F(2, 78) = 0{\cdot}94$, *ns*), word tokens ($F(2, 78) = 1{\cdot}43$, *ns*), or word types ($F(2, 78) = 0{\cdot}16$, *ns*). As shown in Table 2, caregivers produced an average of 377 word types and 3260 word tokens over the three time periods, with only slight variations across the observations.

We next looked at the types of speech the children and their caregivers produced (see Table 3). The children produced no utterances with two clauses (i.e. complex sentences) during the observations, but did produce the other two types of utterances. The children's non-clausal utterances included nouns (e.g. *mommy*, *the doggie*, *there*), particles (e.g. *up*, *down*, *on*), fillers (e.g. *yeah*, *bye*, *thank you*), and various evaluative and onomatopoeic sounds (e.g. *oopsie!*, *uh-oh!*, *meow*, *ruff-ruff*, *choo-choo*). Their simple sentences typically involved verbs alone (e.g. *look*, *go*, *hop*) or verbs with one or two arguments (e.g. *I want*, *daddy go*, *roll it*, *mommy do it*, *I cooking eggs*). Looking only at the speech types that the children did produce (i.e. simple sentences, non-clausal sentences), we found an effect of type ($F(1, 39) = 127{\cdot}32$, $p < 0{\cdot}001$) – children produced more non-clausal sentences than simple sentences (Scheffé, $p < 0{\cdot}01$). There was also an effect of age ($F(2, 78) = 51{\cdot}60$, $p < 0{\cdot}001$), which interacted with speech type

TABLE 3. *Summary of types of speech produced by children and their caregivers**

	Child's age		
	1;2	1;6	1;10
CHILDREN			
Mean number of complex sentences (*S.D.*)	0	0	0
Mean number of simple sentences (*S.D.*)	1 (3)	10 (19)	61 (91)
Mean number of non-clausal sentences (*S.D.*)	37 (42)	140 (109)	290 (178)
CAREGIVERS			
Mean number of complex sentences (*S.D.*)	51 (37)	59 (46)	69 (45)
Mean number of simple sentences (*S.D.*)	481 (275)	510 (309)	486 (277)
Mean number of non-clausal sentences (*S.D.*)	365 (200)	388 (201)	349 (191)

S.D.: standard deviation.
* The figures for means and standard deviations are rounded to the nearest whole number.

($F(2, 78) = 53{\cdot}96$, $p < 0{\cdot}001$). The children increased their use of simple sentences between 1;6 and 1;10 (Scheffé, $p < 0{\cdot}01$) and non-clausal sentences between 1;2 and 1;6 and between 1;6 and 1;10 (Scheffé, p's $< 0{\cdot}001$).

The caregivers produced complex sentences, as well as simple and non-clausal sentences. Like the children, they too displayed an effect of speech type ($F(2, 78) = 115{\cdot}97$, $p < 0{\cdot}001$) – caregivers produced more simple sentences than non-clausal sentences (Scheffé, $p < 0{\cdot}01$) and more non-clausal sentences than complex sentences (Scheffé, $p < 0{\cdot}001$). There was, however, no effect of time for the caregivers ($F(2, 78) = 0{\cdot}94$, *ns*) and no interaction with speech type ($F(4, 156) = 1{\cdot}36$, *ns*). Caregivers produced large numbers of simple sentences and non-clausal sentences throughout the study, and rarely used complex sentences. Indeed, at each observation session, complex sentences accounted for only 6% of the caregivers' total speech, and most occurred while the parents were reading books to their children.

The children's speech changed considerably from 1;2 to 1;10 in terms of amount, diversity, and complexity, whereas the caregivers' speech remained essentially unchanged. It is possible, however, that the caregivers used differing numbers and types of gestures during this period. The next section addresses this possibility.

Gesture

Children produced more and more gestures over time. They produced more communicative acts containing gesture ($F(2, 78) = 17{\cdot}52$, $p < 0{\cdot}001$), more gesture tokens ($F(2, 78) = 17{\cdot}80$, $p < 0{\cdot}001$), and more gesture + speech combinations ($F(2, 78) = 44{\cdot}09$, $p < 0{\cdot}001$) with age. There was a significant

TABLE 4. *Summary table for caregivers' and children's gesture production**

	Child's age		
	1;2	1;6	1;10
CHILDREN			
Mean number of communicative acts containing gesture (*S.D.*)	53 (36)	89 (62)	116 (72)
Mean number of gesture tokens (*S.D.*)	54 (36)	90 (64)	119 (75)
Mean number of gesture+speech combinations (*S.D.*)	6 (8)	27 (29)	64 (47)
Number of children who produced at least one gesture+speech combination	21	39	39
CAREGIVERS			
Mean number of communicative acts containing gesture (*S.D.*)	97 (76)	88 (58)	101 (93)
Mean number of gesture tokens (*S.D.*)	103 (81)	97 (72)	104 (94)
Mean number of gesture+speech combinations (*S.D.*)	88 (75)	86 (66)	95 (87)

S.D.: standard deviation.
* The figures for means and standard deviations are rounded to the nearest whole number.

increase in all three gesture measures between 1;2 and 1;6 (Scheffé, $p < 0{\cdot}01$) and between 1;6 and 1;10 (Scheffé, $p < 0{\cdot}05$). As shown in Table 4, children increased their gesture production from a mean number of 54 gestures at 1;2 to a mean number of 119 gestures at 1;10. Moreover, at 1;2 only 21 of the 40 children were producing gesture+speech combinations, and by 18 months all but one child were combining gesture with speech.

The caregivers, on the other hand, remained essentially unchanged in their gesture production, with no significant differences across the three data points in their use of communicative acts containing gesture ($F(2, 78) = 0{\cdot}58$, *ns*), gesture tokens ($F(2, 78) = 0{\cdot}19$, *ns*), or gesture+speech combinations ($F(2, 78) = 0{\cdot}28$, *ns*). As can be seen in Table 4, caregivers produced an average of about 100 gestures over the three time periods, and most of these gestures were produced in combination with speech.

We next looked at the types of gestures produced by the children and their caregivers. As can be seen in Figure 1, children and caregivers used the same three types of gestures (deictic, conventional, representational). There was an effect of gesture type for both children ($F(2, 78) = 76{\cdot}75$, $p < 0{\cdot}001$) and caregivers ($F(2, 78) = 63{\cdot}64$, $p < 0{\cdot}001$) – both produced significantly more deictic than conventional gestures, and more conventional than representational gestures over the three time periods (Scheffé, p's $< 0{\cdot}05$).[2]

[2] 'Baby signs,' gestures that have taken on word-like status within a particular parent–child dyad (Acredolo & Goodwyn, 1988; Goodwyn & Acredolo, 1993, 1998), were used

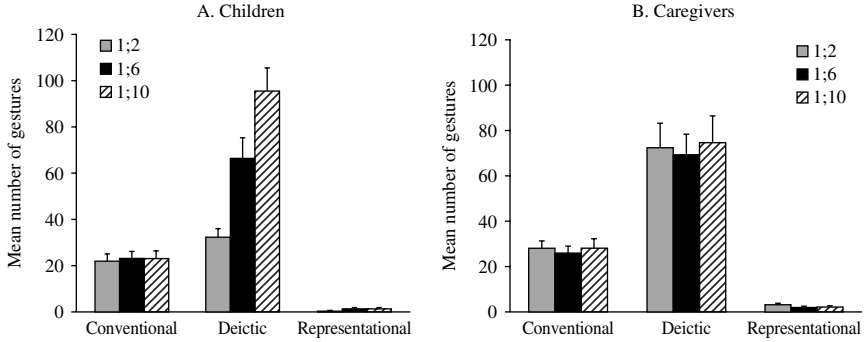

Fig. 1. The mean number of conventional, deictic, and representational gestures that children (left graph) and their caregivers (right graph) produced when the children were 1;2 (grey bars), 1;6 (black bars), and 1;10 (hatched bars).

For the children, there was also an effect of age ($F(2, 78) = 76{\cdot}75$, $p < 0{\cdot}001$), which interacted with type of gesture ($F(4, 156) = 22{\cdot}25$, $p < 0{\cdot}001$). The children's use of conventional and representational gestures remained stable over time, but their use of deictic gestures increased between 1;2 and 1;6 and between 1;6 and 1;10 (Scheffé, p's $< 0{\cdot}0001$); they produced a mean number of 31 diectic gestures at 1;2, but 95 at 1;10. In contrast, there was no effect of time for the caregivers ($F(2, 78) = 0{\cdot}20$, *ns*) and no interaction ($F(4, 156) = 0{\cdot}08$, *ns*). Caregivers used the same numbers of deictic, conventional, and representational gestures at each time period.

The relation between gesture and speech

We turn next to utterances containing both gesture and speech. Our goal is to explore the semantic relation between gesture and speech in these combinations, and to determine whether the children's gesture + speech combinations resembled those of their caregivers. As can be seen in Figure 2, children and caregivers produced communicative acts containing only speech, only gesture, and gesture + speech. There was a main effect of type of communicative act for both children ($F(2, 78) = 52{\cdot}32$, $p < 0{\cdot}001$) and caregivers ($F(2, 78) = 159{\cdot}59$, $p < 0{\cdot}001$) – both produced significantly more communicative acts containing only speech than either gesture + speech or only gesture (Scheffé, p's $< 0{\cdot}001$). However, gesture (with or without

infrequently by both children and caregivers in our sample. At 1;2, there was only one child who produced 3 baby signs ($M = 0{\cdot}08$, *S.D.* $= 0{\cdot}47$) and two caregivers who produced a total of 7 baby signs ($M = 0{\cdot}18$, *S.D.* $= 0{\cdot}84$). At 1;6, four children produced a total of 12 baby signs ($M = 0{\cdot}30$, *S.D.* $= 1{\cdot}44$), and none of their caregivers produced any baby signs. At 1;10, neither the children nor the caregivers produced any baby signs. We included baby signs under the category of representational gestures.

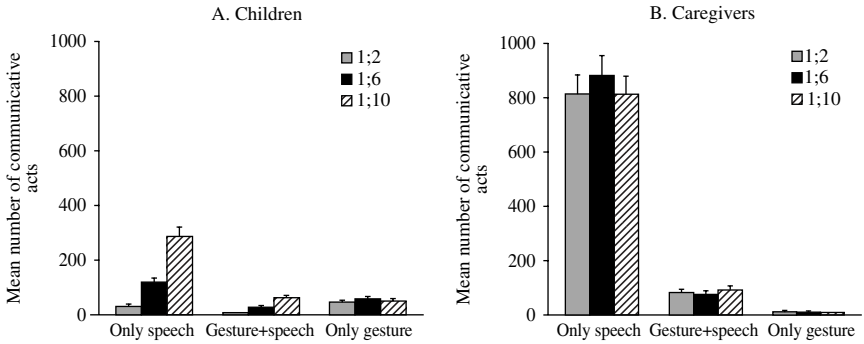

Fig. 2. The mean number of speech only, gesture + speech, and gesture only communicative acts produced by children (left graph) and their caregivers (right graph) when the children were 1;2 (grey bars), 1;6 (black bars), and 1;10 (hatched bars).

speech) accounted for less than 10% of the caregivers' communicative acts throughout the entire observation period, but 50% of the children's communicative acts.

For the children, there was also an effect of age ($F(2, 78) = 60{\cdot}99$, $p < 0{\cdot}001$), which interacted with type of communicative act ($F(4, 156) = 31{\cdot}44$, $p < 0{\cdot}001$). The children produced more only speech communicative acts over time, with significant increases between 1;2 and 1;6 and between 1;6 and 1;10 (Scheffé, *p's* $< 0{\cdot}01$). Their use of communicative acts containing only gesture and gesture + speech remained stable over time. There was no effect of time for the caregivers ($F(2, 78) = 0{\cdot}90$, *ns*) and no interaction with type of communicative act ($F(4, 156) = 0{\cdot}19$, *ns*).

We next asked whether the types of gesture + speech combinations that the children produced changed over time, and if so, whether those changes reflected similar changes in their caregivers' gesture + speech combinations. As can be seen in Figure 3, both children and caregivers used all three types of gesture + speech combinations – combinations in which gesture reinforced (*car* + point to car), disambiguated (*look it* + point to car), or supplemented (*drive* + point to car) the information conveyed in speech. There was an effect of type of combination for both children ($F(2, 78) = 30{\cdot}32$, $p < 0{\cdot}001$) and caregivers ($F(2, 78) = 49{\cdot}13$, $p < 0{\cdot}001$). Both children and caregivers produced significantly more reinforcing combinations than either supplementary or disambiguating combinations (Scheffé, *p's* 0·05). In addition, the children produced significantly more supplementary than disambiguating combinations (Scheffé, $p < 0{\cdot}001$).

For the children, there was also an effect of age ($F(2, 78) = 44{\cdot}09$, $p < 0{\cdot}001$), which interacted with type of combination ($F(4, 156) = 7{\cdot}02$, $p < 0{\cdot}001$). The children significantly increased their production of

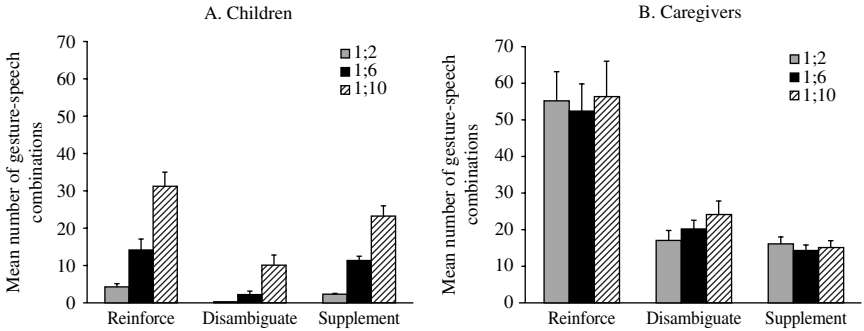

Fig. 3. The mean number of reinforcing, disambiguating, and supplementary gesture + speech combinations that children (left graph) and their caregivers (right graph) produced when the children were 1;2 (grey bars), 1;6 (black bars), and 1;10 (hatched bars).

reinforcing combinations between 1;2 and 1;6 and between 1;6 and 1;10 (Scheffé, p's $< 0{\cdot}01$), disambiguating combinations between 1;2 and 1;10 ($p < 0{\cdot}05$), and supplementary combinations between 1;6 and 1;10 ($p \leqslant 0{\cdot}001$). In contrast, there was no effect of time for the caregivers ($F(2, 78) = 0{\cdot}28$, ns) and no interaction with type of combination ($F(4, 156 = 0{\cdot}41$, ns).

The caregivers thus remained stable over time in the absolute numbers of gesture + speech combinations of each type that they produced – the children did not. Caregivers were also stable over time in the distribution of types of gesture + speech combination they produced: they used reinforcing, disambiguating and supplementary combinations at comparable rates over the three time periods, with mean percent rates of 58% for reinforcing (60% at 1;2, 59% at 1;6, 56% at 1;10), 23% for disambiguating (19% at 1;2, 23% at 1;6, 27% at 1;10) and 19% for supplementary combinations (21% at 1;2, 18% at 1;6, 17% at 1;10). Children, on the other hand, showed changes in their relative use of the three types of gesture + speech combinations: they produced proportionally fewer reinforcing combinations over time (decreasing their production from 71% at 1;2 to 51% at 1;10), and increased their production of disambiguating combinations (from none at 1;2 to 13% at 1;10) and supplementary combinations (from 29% at 1;2 to 36% at 1;10) over the three observation sessions.

Types of supplementary gesture + speech combinations

As noted earlier, supplementary gesture + speech combinations function like sentences in that they convey propositional information. Replicating previous work (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005), we found that the onset of supplementary gesture + speech combination tended to precede the onset of two-word combinations in our sample of

children. Fourteen of the children produced propositional information in a gesture+speech combination before producing it in a two-word combination, compared to 4 who showed the reverse pattern (14 to 4, $\chi^2 = 5{\cdot}81$, df = 1, $p < 0{\cdot}05$). (One child produced neither supplementary nor two-word combinations during our observations, and the remaining 21 produced their first instance of both types of combinations during the same session; since there were four months between each observation session, it is quite likely that we missed the first productions for these children.)

Even more interesting, children used supplementary gesture+speech combinations to convey increasingly complex ideas over the three observation sessions. At 1;2, half of the children's supplementary combinations (52%) were either instances where gesture and speech seemed to convey conflicting information (*doggie*+point at squirrel, *truck*+point at bus, *meow*+point at dog), or instances where gesture accompanied a filler expression in speech (*uh-oh!*+point at TV, *please*+point at sibling's cereal, *hi*+point at father).[3] However, by 1;6, the children were using their supplementary combinations to convey two types of sentence-like meanings: (1) gesture added a predicate to speech that did not contain a verb (e.g. *Hair*+move both hands above head in circles as if washing, *Water*+'give' gesture), or (2) gesture added arguments to speech that included one or more arguments and perhaps a predicate (e.g. *Daddy*+point to vacuum cleaner; *All aboard*+point to conductor; *Hop*+point to bunny, *I write*+point to board). Such sentence-like constructions were rarely observed in children's speech before 1;10, but were routinely found in their gesture+speech combinations even at 1;6. Age 1;10 marked yet another shift in the types of supplementary gesture+speech combinations the children produced: gesture added a second predicate to a sentence that already contained a verb (e.g. *I have one*+'give' gesture, *I like it*+'eat' gesture), in effect, turning a simple sentence into a complex sentence. This type of construction was not observed in children's speech even at the final observation session at 1;10, but was found in many children's gesture+speech combinations at this age. Table 5 presents additional examples of the children's supplementary gesture+speech combinations and the ages at which they were produced (see Özçalışkan & Goldin-Meadow, 2005a, for further information on children's early sentence-like constructions in gesture+speech).

[3] In some of the supplementary combinations, gesture and speech conveyed contradictory information and could have been naming errors (e.g. *dog*+point to squirrel, see Gershkoff-Stowe & Smith, 1997). The incidence of these contradictory combinations decreased steadily over time; accounting for 34% of all supplementary combinations at 1;2 ($M = 0{\cdot}65$, $S.D. = 1{\cdot}63$), 25% at 1;6 ($M = 3{\cdot}02$, $S.D. = 5{\cdot}67$), and 13% at 1;10 ($M = 2{\cdot}93$, $S.D. = 3{\cdot}36$).

TABLE 5. *Examples of supplementary combinations produced by children and their caregivers**

Types of gesture–speech combinations	CHILD	CAREGIVER
Gesture adds a second argument to an argument in speech	*Mama* + food on tray (point) [1;2] *Daddy* + camera (point) [1;6] *Hat* + head (point) [1;6]	*In the box* + blocks (point) [1;2] *Girls* + towel (hold-up) [1;6] *Not a horse* + donkey (point) [1;10]
Gesture adds a third argument to two arguments in speech	*Here mom* + bag (hold-up) [1;6] *Mama plate* + trashcan (point) [1;10] *Mommy in kitchen* + child's ear (point)† [1;10]	*Here Peaches* + toy bus (hold-up) [1;2] *Here Sara* + yogurt (hold-up) [1;6] *Here Nikolas* + ball (hold-up) [1;10]
Gesture adds a predicate to an argument in speech	*Mama* + pick-up (conventional) [1;6] *You* + hammer (iconic) [1;6] *More cracker* + give (conventional) [1;6]	*Something* + stir (iconic) [1;2] *Tree* + climb (iconic) [1;6] *No more popcorn* + give (conventional) [1;6]‡
Gesture adds an argument to a predicate in speech	*Read* + book (hold-up) [1;2] *Bounce* + ball (point) [1;6] *Shave* + razor (point) [1;10]	*Blow* + beans (point) [1;2] *Watch* + cartoon (point) [1;6] *Pull more* + zipper (point) [1;10]
Gesture adds a second argument to an argument + predicate combination in speech	*Me touch* + laundry (point) [1;2] *Daddy gone* + outside (point) [1;6] *Drop it* + child's lap (point) [1;10] *Have food* + father (point) [1;10]	*Don't eat the apple* + birds (point) [1;2] *Can you count?* + ladybugs (point) [1;6] *Show me* + drawing (point) [1;10] *Before you hit your head* + radiator (point) [1;10]
Gesture adds a second predicate to a predicate (with or without arguments) in speech	*I like it* + eat (iconic) [1;10] *I paint* + give (conventional)§ [1;10] *All gone* + pick-up (conventional) [1;10]	*Are you making breakfast* + stir (iconic) [1;2] *Want to hear my secret?* + come-here (conventional) [1;6] *What do fish do?* + swim (iconic) [1;10]

* The type of gesture is indicated in the parentheses following the gesture gloss. The age at which each example was produced is given in brackets after the example.
† Child refers to the sound in her ear that comes from the mother.
‡ Mother is asking for the popcorn bag so that the child does not eat anymore.
§ Child is asking for a crayon so that she could paint.

In contrast, the caregivers showed no changes over time in the types of supplementary gesture + speech combinations they produced. At all three time periods, the caregivers used gesture to add additional arguments or an additional predicate to speech that already included one or more arguments and perhaps a predicate (e.g. *Joan* + point to toast; *Like the red fence* + hold-up red crayon; *Finish eating* + point to cup of cheetos; *Rolling away* + point to block; *Go dry them off* + point to towel; *You are supposed to leave it* + point to other room; *Want to go for a ride?* + point to mother's lap; *I will meet you up at the coconut tree* + 'walking gesture'; *Clean up* + 'vacuuming' gesture; see Table 5 for additional examples). The caregivers' supplementary gesture + speech combinations differed from their children's in one other interesting way; the caregivers used supplementary combinations to ask a question in speech and provide an answer in gesture (e.g. *What did he catch?* + point to fish; *What is he driving?* + point to tractor; *Where did the mouse go?* + hold up toy cheese; *Who is eating corn and oats?* + point to sheep; *What do fish do?* + 'swimming' gesture; *What is the baby drinking* + point to bottle of juice). As with other types of supplementary combinations, the caregivers' use of this particular combination type did not vary across the three time periods.

The caregivers, of course, had no difficulty producing spoken sentences that contained multiple arguments or multiple predicates and did not need gesture to produce constructions of this type. At all three observation sessions, all but one of the 40 caregivers produced each of these different types of constructions entirely within speech (see Özçalışkan & Goldin-Meadow, 2005b, for further information on caregivers' sentence-like constructions in gesture + speech and speech alone). Thus, gesture did not function to expand the caregivers' spoken repertoires, as it did for the children.

DISCUSSION

This study examined the gestures that children produce at the early stages of language-learning and compared them to those produced by their caregivers. We observed 40 children during the transitional period between one-word and two-word speech and, not surprisingly, found that the children's speech displayed the developmental changes typically found during this time period (Goldfield & Reznick, 1990; Bloom, 1993). Our question was whether their gestures changed as well.

Changes in children's gesture during the transition from one- to two-word speech

We found that the children's gestures changed in number but not in type as they progressed from producing one word at a time to producing two-word combinations. The children produced conventional and deictic gestures and

a very small number of representational gestures at 1;2 and throughout this eight-month observation period. However, the total number of gestures that the children produced increased during this period, although not as steeply as their words. At 1;2, the children actually produced more communicative acts containing gestures than words (53 vs. 38) but by 1;6, the pattern was reversed (89 vs. 150). By 1;6, speech was becoming the preferred modality and, when gesture was used, it was beginning to be used with speech as often as without it. This finding is consistent with earlier studies showing a preference for the gestural modality over the spoken modality in fourteen- to sixteen-month-olds (Acredolo & Goodwyn, 1988; Goodwyn & Acredolo, 1993; Iverson *et al.*, 1994), a preference that fades with time.

In addition, the absolute number of gesture+speech combinations that the children produced increased during this time period. Although there were increases in all three types of gesture+speech combinations, increases in supplementary combinations (in which gesture adds information to the information conveyed in speech) are particularly interesting because these combinations allow the child to convey propositional information across modalities (e.g. *ride*+point at bike) at a time when that child may have difficulty conveying that information entirely within speech (*ride bike*). Not only did this type of combination increase with age but it also typically preceded, rather than followed, the onset of two-word combinations, replicating earlier findings (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005).

Gesture thus serves as an early device for referring to objects and events and for commenting on the relation between those objects and events. Why are young children able to use gesture, but not words, to serve these functions? One possibility is that children at this age may not yet have developed the complex phonological and articulation mechanisms necessary for the production of comprehensible words (Acredolo & Goodwyn, 1988). Another is that gestures may be easier to recall and thus more accessible than words for the beginning language-learner. Pointing gestures put very little strain on a child's memory, and iconic gestures can be created on the spot by taking advantage of whatever knowledge the child happens to have about an object or action. Thus, gesture allows children to express a thought even if they do not have a particular vocabulary word in their repertoires for that thought. In addition, gesture, when produced while talking, has been found to reduce a speaker's cognitive load. Speakers, both children and adults, when asked to explain their solutions to math problems, remember more items unrelated to the problems if they gesture during their explanations than if they do not gesture (e.g. Goldin-Meadow, Nusbaum, Kelly & Wagner, 2001). Gesturing thus eases the process of speech production, providing speakers – including young speakers at the early stages of language-learning – with extra cognitive resources that could

enable them to encode, and thus communicate more complex ideas than they can convey in speech on its own.

Are the caregiver's gestures responsible for the changes in the children's gestures?

Children use gesture to substitute for words and, later, as building blocks for sentences. Do these changes that we see in the children's gestures reflect changes found in their caregivers' gestures? In short, probably not. Several lines of evidence allow us to elaborate on these conclusions.

The first point to note is that gesture accounted for a very small proportion of the caregivers' communications with their children – only 10% of the caregivers' communicative acts contained gesture, and this percentage remained stable across the three observation sessions. Most of the caregivers' communications throughout the observations consisted of only-speech, as is strikingly apparent in Figure 2 (right graph). Not surprisingly, the children increased the numbers of only-speech utterances they produced during this time, but they also increased their gesture + speech combinations and they continued to communicate using only-gesture. Gesture accounted for a much bigger proportion of total communications for the children than for the caregivers at each observation session (71% vs. 10% at 1;2, 46% vs. 9% at 1;6, 32% vs. 10% at 1;10).

In terms of absolute numbers, however, children and caregivers produced the same numbers of gestures and, over time, the children's distribution of gesture types began to approximate their caregivers' (see Figure 1). The caregivers produced large numbers of deictic gestures, a smaller number of conventional gestures, and a very small number of representational gestures. The children followed suit in the gestures they produced, and, at 1;2, they were already producing approximately the same number of conventional and representational gestures as their caregivers. The salient change in the children during this time period was that they produced more and more deictic gestures. At 1;10, the children produced even more deictics than their caregivers, although the overall distribution of gesture types was the same for child and caregiver (more deictic gestures than conventional and more conventional than representational). Thus, the children may have learned not only the three different types of gestures from their caregivers, but also how often to use them.

It is less clear, however, what kind of influence the caregivers had on their children's gesture + speech combinations. Both the caregivers and the children produced all three types of gesture + speech combinations – reinforcing, disambiguating, and supplementary. The children may therefore have learned to relate gesture to speech in these ways from their caregivers' gesture + speech combinations. Indeed, the caregivers'

supplementary combinations may have been particularly important in providing a model for the expression of propositional information. An utterance in which propositional information is conveyed across modalities, one piece in speech and another in gesture, may be easier for the young child to process than an utterance containing that same information conveyed entirely within speech. In fact, one-word speakers have been found to extract propositional meaning from a gesture + speech combination (*open* + point at box) more easily than from the same meaning expressed entirely within speech (*open box*; Morford & Goldin-Meadow, 1992). Receiving supplementary gesture + speech combinations as input could have encouraged children to use supplementary combinations to convey propositional information and, in the end, to use two-word combinations for the same purpose. Input containing gesture conveying different information from the speech it accompanies has, indeed, been found to promote learning on other tasks and in older children. Children make more progress on mathematical equivalence problems if the instruction they receive contains one piece of information in speech and a different piece in gesture than if the same two pieces of information are presented entirely within speech (Singer & Goldin-Meadow, 2005). Thus, the caregivers' supplementary combinations could have provided just the right input for a child on the cusp of learning how to express propositional information.

However, the distribution of gesture + speech combinations differed for caregiver and child. The children showed increases in all three types of combinations during this period; the caregivers displayed no changes at all (Figure 3). Moreover, at all time periods, supplementary combinations accounted for a larger percentage of gesture + speech combinations for the children than for the caregivers (29% vs. 21% at 1;2, 40% vs. 18% at 1;6, 36% vs. 17% at 1;10). Even in terms of absolute numbers, at 1;10, the children were producing more supplementary gesture + speech combinations than their caregivers.

Why are supplementary gesture + speech combinations so much more prevalent in the children's communications than in their caregivers'? In a supplementary combination, gesture conveys different information from the information conveyed in speech (e.g. *you* + move hand up down as if hammering an object). In this sense, supplementary gesture + speech combinations are comparable to the gesture + speech combinations that older children and adults produce when learning a task. These combinations have been called MISMATCHES because the information conveyed in gesture is not the same as the information conveyed in speech[4] (Church & Goldin-Meadow,

[4] It is commonly assumed that the gesture-speech MISMATCHES that older speakers produce contain gestures that conflict with speech. However, the term MISMATCH, as used in relation to both older and younger speakers, refers to combinations in which gesture

1986). Importantly, mismatches in older children have been found to reflect an unstable knowledge state and a readiness-to-learn – children who produce mismatches on a task are more likely to profit from instruction on that task than children who do not produce mismatches (e.g. Church & Goldin-Meadow, 1986; Pine, Lufkin & Messer, 2004). In other words, in other contexts, speakers who produce mismatches on a task appear to be in a transitional state with respect to that task.

This characterization fits the children in our study as well. Indeed, in previous work, producing gestures that convey different information from the speech they accompany (i.e. supplementary gesture + speech combinations) has been found to mark the young language-learner as transitional – the age at which a child first produces supplementary combinations predicts with great precision the age at which that child will first produce two-word combinations (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). The onset of supplementary gesture + speech combinations thus appears to reflect a period of cognitive instability, indicating that the young language-learner is on the threshold of a cognitive change (the transition to two-word speech).

Our findings on caregivers' gestures reinforce this interpretation. The caregivers in our study produced supplementary combinations at precisely the same rate throughout the observations. The changes in young children's supplementary combinations can therefore NOT be traced back to their caregivers' gestures and, as a result, are likely to reflect changes in the child's own cognitive and communicative skills.

The function of supplementary gesture + speech combinations for child and caregiver

The children use supplementary gesture + speech combinations to express simple propositions that they seem unable to express in speech alone (see also Özçalışkan & Goldin-Meadow, 2005a). In contrast, the caregivers have no difficulty producing multi-word sentences to express propositions of this sort. The caregivers do not need gesture to expand their linguistic resources. Why then do they produce any supplementary combinations at all?

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conveys information that is different from (but not necessarily contradictory to) the information conveyed in speech. As discussed in Goldin-Meadow (2003), although the information conveyed in gesture may appear to conflict with the information conveyed in speech in a mismatch, there is almost always a larger framework within which the two pieces of information can be brought together and resolved. The interesting question is whether the speaker is aware of that larger framework when uttering the mismatch.

Speakers of all ages produce utterances in which gesture conveys information that is different from the information conveyed in speech (e.g. Stone, Webb & Mahootian, 1991; Alibali, Bassok, Olseth, Syc & Goldin-Meadow, 1999; Beattie & Shovelton, 1999; Garber & Goldin-Meadow, 2002). And even adults will produce many gesture+speech mismatches when they have not yet mastered a task and are in a state of transition (Perry & Elder, 1997).

But speakers also use mismatches (supplementary combinations in our terms), although not as many, when they are NOT in transition. For example, Goldin-Meadow & Singer (2003) observed teachers individually instructing children in mathematical equivalence. The teachers were experts in mathematical equivalence yet nevertheless produced gesture+speech mismatches, and they produced a relatively large proportion of mismatches when teaching children who themselves produced mismatches. The teachers' mismatches did not reflect their own uncertainty about the concept (since they had none) but the mismatches may have reflected their uncertainty about how best to teach the concept to children who were themselves uncertain. In other words, the teachers' mismatches may have reflected the give-and-take of conversation with a child in the throes of change, rather than the teacher's own cognitive state (which was not at all unstable with respect to mathematical equivalence). Support for this hypothesis comes from the fact that the teachers' mismatches were qualitatively different from the children's. All of the information that the teachers produced in the gesture component of their mismatches could be found in their speech in some other utterance; in other words, the teachers produced no information uniquely in gesture. In contrast, the children routinely expressed information in the gesture component of their mismatches that could not be found anywhere in their speech. Experts and novices produce different kinds of gesture+speech mismatches and, we suggest, produce them for different reasons.

The caregivers in our study were clearly experts when it comes to expressing simple propositional information in sentences, and they expressed all of the constructions found in their supplementary gesture+speech combinations entirely within speech in other utterances (see Özçalışkan & Goldin-Meadow, 2005b, for further evidence supporting this claim). The children were novices and, indeed, were trying out constructions in gesture+speech that they were not yet able to express entirely within speech (see also Özçalışkan & Goldin-Meadow, 2005a). We suggest that the caregivers' supplementary combinations reflect their own adjustments to the conversation, the flexibility of an expert. In contrast, the children's supplementary combinations reflect the incipient steps a learner takes when beginning to master a task, the first progressive steps of a novice. This interpretation is bolstered by the fact that, across observations,

supplementary combinations accounted for approximately 35% of the children's gesture + speech combinations, but only 19% of the caregivers'. For the children, supplementary combinations are an index of cognitive instability. For the caregivers, they are an index of discourse instability – a moment when speech and gesture are not completely aligned, reflecting the dynamic tension of the speaking process (McNeill, 1992; see also Goldin-Meadow, 2003). As mentioned earlier, this difference is not a developmental difference but rather reflects the state of the speaker's knowledge – adults will produce mismatches comparable to child mismatches when they too are learning a task (Perry & Elder, 1997).

In summary, children at the earliest stages of language-learning use gesture to augment their linguistic resources, both at the lexical level and the sentence level. Our findings make it clear that adults provide models for the different types of gestures and gesture + speech combinations that young children produce, models that could play a role in getting the early stages of language-learning off the ground. Nevertheless, the ways in which children use their gestures in these early stages cannot be traced to changes in their caregivers' gestures, and thus are likely to reflect growth in the child's own cognitive and communicative skills. It is in this sense that parents do not lead their children by the hand.

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