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12 Gesture and the transition from one- to two-word speech: when hand and mouth come together

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1 Introduction

Despite the fact that they are produced in different modalities, gesture and speech form a unified communication system in adults. To explore whether symbolic communicative gesture and speech form a single system in young children, three girls and three boys were observed longitudinally during the transition from one- to two-word speech. Initially, gesture tended to be produced without speech, and, on the rare occasions when it was combined with speech, that speech was meaningless and not synchronized with the accompanying gesture. The two characteristics that define integration in adult speakers – semantic coherence (combining gesture with meaningful and related speech) and temporal synchrony (producing gesture in synchrony with speech) – were found to emerge in the children's communications at the same moment and prior to the onset of two-word speech. The onset of gesture–speech integration thus occurs during the one-word period and before words are combined with other words.

Adults and children typically express their thoughts in speech, and, along with that speech, they spontaneously produce gestures. Despite the fact that they are produced in different modalities, gesture and speech deliver a coherent message to the listener (Alibali, Flevares & Goldin-Meadow 1997; Goldin-Meadow & Sandhofer 1999; Goldin-Meadow, Wein & Chang 1992; McNeill, Cassell & McCullough 1994) and thus can be said to form a single unified communication system (Goldin-Meadow 1997; Goldin-Meadow, Alibali & Church 1993; McNeill 1985, 1992). According to McNeill (1992), this coherence is possible because gesture and speech share a common cognitive representation; that is, before the communication

unfolds, gesture and speech are part of a single idea. As expression proceeds, the message is parsed, with most information channeled into speech but some information channeled into gesture. The coordination of gesture and speech to convey a single message, and particularly the origins of such coordination, form the cornerstone of this study.

1.1 *Gesture and speech form an integrated system in adult speakers*

Evidence that gesture and speech form a single, unified system in adult speakers comes from two sources. First, gestures and speech are semantically and pragmatically co-expressive. When people speak, they produce a variety of gesture types (iconics, metaphoric, beats, cohesives, deictics; cf. McNeill 1992), and each type of gesture has a characteristic type of speech with which it occurs. For example, iconic gestures have a transparent relationship to the ideas they convey; iconics accompany utterances that depict objects and events and fulfill a narrative function (i.e., they accompany the speech that 'tells the story'). As an instance, a speaker produced the following iconic gesture when describing a scene from a comic book in which a character bends a tree back to the ground: the speaker grasped his hand as though gripping something and pulled his hand back. He produced this gesture as he uttered the words "and he bends it way back," a concrete description of an event in the story.

In contrast, metaphoric gestures are also pictorial but represent an abstract idea rather than a concrete object or event; metaphoric accompany utterances that refer to the pragmatic structure of the discourse as a whole. As an instance, a speaker produced the following metaphoric gesture when announcing that what he had just seen and was about to recount was a cartoon: the speaker raised his hands as though he were offering an object to the listener – a pictorial representation of the cartoon as a whole, but not a concrete one. He produced this gesture as he said, "It was a Sylvester and Tweety cartoon," an utterance which set up and introduced the topic of discussion rather than forming part of the storyline. Other gesture types similarly have their own parallels with speech (see McNeill 1992: ch. 7), suggesting a linked relationship between the two modalities.

It is important to note that, although the information conveyed by gesture is, for the most part, related in some way to the information conveyed by speech, the particular information conveyed by the two modalities need not be identical. For example, when describing Granny's chase after Sylvester in a cartoon narrative, a speaker moved her hand as though swinging an object while saying, "She chases him out again" (McNeill 1992). Speech conveyed the ideas of pursuit and recurrence, but gesture conveyed the weapon used (an umbrella) during the chase. Thus, the two

modalities may present a gesture and speech share during the speech act.

The second source of system comes from the Gesture is rarely produced emblem, e.g., the OK. McNeill (1992) found that when the gesturer was synchronized to each other in time are synchronized temporally within a single utterance, the same information gesture movement – the gestive segment. As an above, the speaker produced it way back" (see Kita 1 gesture adjust to each other evidence that the timing of the spoken word that gesture and speech speech-production process speaker is presenting the moment and that gesture

These findings strongly convey a single message modalities) and meaning conveyed in the two modalities, the origins of such a development. Is gesture communications of you modalities emerge at a component? We explored this from the production of situations.

1.2 *Gesture in the on*

At a time when children's avenue of expression that child can also gesture (cf. & Volterra 1979; Pettit

single idea. As expression production channeled into speech. The coordination of gesture particularly the origins of such unity.

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single, unified system in adult gestures and speech are semantically. When people speak, they produce accents, beats, cohesives, deictics; cf. a characteristic type of speech gestures have a transparent relationship to accompanying utterances that depict an event (i.e., they accompany the action). For example, a speaker produced the following utterance from a comic book in which a character grasped his hand as if to pull it back. He produced this utterance: "It ends it way back," a concrete

so pictorial but represent an event; metaphors structure the discourse as a metaphorical gesture and was about to recount was enough he were offering an object of the cartoon as a whole, but not as he said, "It was a Sylvester and he introduced the topic of discipline. Other gesture types similar (see McNeill 1992: ch. 7), two modalities.

the information conveyed by the way to the information conveyed by the two modalities describing Granny's chase after she moved her hand as though she was him out again" (McNeill 1992: 100). It is interesting to note that it and recurrence, but gesture during the chase. Thus, the two

modalities may present different aspects of the same event, suggesting that gesture and speech share a common cognitive representation at some point during the speech act.

The second source of evidence that gesture and speech form a unified system comes from the fact that the two are almost always synchronous. Gesture is rarely produced on its own in adults (except in the form of an emblem, e.g., the OK sign; see Kendon 1981 for discussion). Indeed, McNeill (1992) found that 90 percent of gestures in adults were produced when the gesturer was speaking. Thus, acts of speaking and gesturing are bound to each other in time at a general level. Moreover, gesture and speech are synchronized temporally at another, more refined level as well; even within a single utterance, the gesture and the linguistic segment representing the same information as that gesture are co-temporal. Specifically, the gesture movement – the 'stroke' – lines up in time with the equivalent linguistic segment. As an example, in the description of an iconic gesture above, the speaker produced the stroke of the gesture just as he said, "bends it way back" (see Kita 1993 for more subtle examples of how speech and gesture adjust to each other in timing; Morrel-Samuels & Krauss 1992 for evidence that the timing of gesture and speech is related to the rated familiarity of the spoken word; and Mayberry, Jaques & DeDe 1998 for evidence that gesture and speech are synchronized even when, as in stuttering, the speech-production process goes awry). Such synchrony implies that the speaker is presenting the same meaning in both channels at the same moment and that gesture and speech form a single integrated system.

These findings strongly suggest that gesture and speech work together to convey a single message integrated in both time (synchrony across the two modalities) and meaning (semantic coherence across the information conveyed in the two modalities) in adults. However, there is little work exploring the origins of such a system in children at the earliest stages of language development. Is gesture-speech integration characteristic of the earliest communications of young children, or does integration across the two modalities emerge at a consistent point in the young child's linguistic development? We explored this question in six children observed longitudinally from the production of single words to the production of two-word combinations.

1.2 Gesture in the one-word period of language development

At a time when children are limited in what they can say, there is another avenue of expression that may be open to them. In addition to speaking, the child can also gesture (cf. Bates 1976; Bates, Benigni, Bretherton, Camaioni & Volterra 1979; Petitto 1988). The use of gesture during the one-word

period can extend the range of ideas children can express. For example, Acredolo & Goodwyn (1985) describe a young language-learner in the one-word period who used gestures rather than words to refer to certain objects; for this child, a referent object was symbolized by either a gesture or a word, but not both (see also Acredolo & Goodwyn 1988, who describe this same phenomenon in a larger sample of children). In fact, in a study of twelve Italian children in the one-word period, Iverson, Capirci & Caselli (1994) showed that eight of the children exhibited a clear preference for communication in the gestural modality over the verbal modality.

Combining gesture and speech within a single utterance can also increase the communicative range available to the child. Most of the gesture-speech combinations that young children produce contain gestures that convey information redundant with the information conveyed in speech; for example, pointing at an object while naming it (de Laguna 1927; Greenfield & Smith 1976; Guillaume 1927; Leopold 1949). However, young children have also been found to produce gesture-speech combinations in which gesture conveys information that is different from the information conveyed in speech; for example, gesturing at an object while describing in speech the action to be done on the object (pointing to an apple and saying, "Give"), or gesturing at an object and describing in speech the owner of that object (pointing at a toy and saying, "Mine"; Boswell 1988; Goldin-Meadow & Morford 1985; Greenfield & Smith 1976; Masur 1982, 1983; Morford & Goldin-Meadow 1992; Volterra & Iverson 1995; Zinober & Martlew 1985). This second type of gesture-speech combination 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.

Given that young children do use gesture communicatively during the one-word period of language development, and given that adults' gestures are integrated with speech in both timing and meaning, the question naturally arises as to whether communicative gesture forms an integrated system with speech in the one-word speaker as well. Is there a time early in development when communicative gesture is used primarily without speech? If young children do produce gesture in combination with speech, are the two modalities integrated both temporally and semantically, as they are in adult systems? This study was designed to address these questions.

2 Method

2.1 Subjects and procedure

The subjects for this study were six children, three boys and three girls, videotaped in their homes over a period of months. Videotaping began

Table 12.1. *Subject information*

| First name | Sex | Ages observed |
|-------------|-----|---------------|
| Christopher | M | 12 to 23. |
| Emily | F | 13.5 to 1 |
| Nicholas | M | 15.5 to 2 |
| Beth | F | 15.5 to 2 |
| Ann | F | 15.5 to 2 |
| Joseph | M | 21 to 27. |

Note:

^a These four children produced

when each child was in t continued until the child the six children were (weather, illness, vacation subjects were seen approx age range during which taped sessions conducted

All of the data were which the children interviewed. In order stimuli across subjects, the child's home by the Goldin-Meadow & Mc and procedures). The pl and parents were encouraged play sessions lasted approx

2.2 Identifying and

We focused in this study tively. All of the communicative behavior of each child during a half that half-hour did not y tional tape was coded communicative behavior on its own (either mean speech produced together

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Table 12.1. *Subject information*

| First name | Sex | Ages observed | No. of sessions observed | Age of first meaningful word | Age of two-word combination |
|-------------|-----|----------------|--------------------------|------------------------------|-----------------------------|
| Christopher | M | 12 to 23.5 mo. | 11 | 13.0 | 21.0 |
| Emily | F | 13.5 to 19 mo. | 9 | 13.5 ^a | 18.0 |
| Nicholas | M | 15.5 to 21 mo. | 11 | 15.5 ^a | 18.5 |
| Beth | F | 15.5 to 21 mo. | 5 | 15.5 ^a | 18.0 |
| Ann | F | 15.5 to 25 mo. | 6 | 16.5 | 22.5 |
| Joseph | M | 21 to 27.5 mo. | 10 | 21.0 ^a | 26.5 |

Note:

^a These four children produced meaningful words during their first observation sessions.

when each child was in the one-word period of language development, and continued until the child began producing two-word combinations. Four of the six children were seen approximately every 2 weeks (except when weather, illness, vacations, etc. delayed taping sessions); the remaining two subjects were seen approximately every 6 to 8 weeks. Table 12.1 reports the age range during which each child was observed and the number of videotaped sessions conducted during this period.¹

All of the data were collected in spontaneous play situations during which the children interacted with their primary caregivers and/or the experimenter. In order to facilitate conversation and provide consistent stimuli across subjects, two large bags of toys and books were brought to the child's home by the experimenter (see Goldin-Meadow 1979 and Goldin-Meadow & Morford 1985 for further information on the toys and procedures). The play session was not structured by the experimenter, and parents were encouraged to engage their children in conversation. The play sessions lasted approximately one hour.

2.2 *Identifying and coding communicative utterances*

We focused in this study on gesture and speech that was used communicatively. All of the communicative gestures and vocalizations produced by each child during a half-hour of videotape were transcribed and coded. If that half-hour did not yield one hundred communicative behaviors, additional tape was coded until one hundred behaviors were transcribed. A communicative behavior was defined as either a gesture on its own, speech on its own (either meaningless or meaningful; see below), or a gesture and speech produced together. The mean number of minutes transcribed per

session for each child was: Ann, 41 minutes; Beth, 48; Emily, 30; Christopher, 33; Nicholas, 31; and Joseph, 39.

2.2.1 Coding speech. All of the communicative vocalizations that each child produced were coded and classified into one of two categories. (1) Meaningful vocalizations were either actual English words (e.g., "dog," "cat," "duck," "hot," "walking") or speech sounds that were consistently used by a particular child to refer to a specific object or event (e.g., using "bah" to refer to a bottle). (2) Meaningless vocalizations were speech sounds that were not used consistently to refer to a particular referent but appeared to be communicative nonetheless; that is, they were directed toward another individual (e.g., the child looks at a picture, produces the sound "buh," and looks up at the adult; "buh" does not have any apparent relation to the object in the picture, which was neither a ball, a book, nor anything whose name began with 'b', but it does appear to have been produced for the benefit of the listener).

2.2.2 Coding gesture. The criteria for isolating gestures grew out of a concern that the gestures meet the minimal requirements for a communicative symbol (see Goldin-Meadow & Mylander 1984 and Butcher, Mylander & Goldin-Meadow 1991 for discussion) and were as follows:

(1) The gesture must be directed to another individual; that is, it must be communicative. In particular, we required that the child establish eye contact with a communication partner, or be assured of the partner's attention, in order for the child's act to be considered a gesture.

(2) The gesture must not itself be a direct manipulation of some relevant person or object (i.e., it must be empty-handed; cf. Petitto 1988). When a child puts a telephone to the ear and pretends to have a conversation, it is not clear whether that act should be regarded as designating the act of telephoning (and therefore a symbol), or as the child's attempts to practice the act of telephoning (and therefore not symbolic at all; cf. Huttenlocher & Higgins 1978). To be conservative, all acts that were done on objects were excluded, with one exception – if a child held up an object to bring it to another's attention, an act that serves the same function as the pointing gesture, it was counted as a gesture. In addition, functional acts were not considered gestures; for example, neither holding out an object to transfer it to another person nor reaching for an object was considered a gesture. However, if the child extended a hand toward the desired object (but did not try to capture it) and looked at the experimenter, this act was not a direct act on the object and thus was considered a gesture (cf. Masur 1983).

(3) The gesture must not be part of a ritual act (e.g., to blow a kiss at someone leaves the house) or game (e.g., patty-cake). In general, the

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symbolic nature of language flexibility: a word can be used in a variety of contexts; thus were not considered j

(4) The gesture must not be a copy of a preceding gesture. This criterion was used to rule out copying – with little or no modification – by communication partners produce

Note that these criteria are more stringent than those that have been used with children (e.g., Volterra, 1985). They require a gesture to be completely divorced from the actual action it represents. In this study closely follow the criteria of Goldin-Meadow (1988), and Morford & Goldin-Meadow (1992).

The form of each gesture was coded. The hand, the type of movement, and the duration of the gesture typically consist of the following: holding out an open hand, palm up, signifies "Give" or "Gimme," a pointing handshape held steady represents an elephant; see Goldin-Meadow (1992). In a non-linguistic context, the pointing gesture was directed toward the action or attribute designated by the gesture was considered a gesture (see Goldin-Meadow & Mylander 1984 for discussion assigned to gesture).

2.3 Coding the relationship

Gestures produced without speech were identified as gestures. Gestures combined with speech were identified as gesture-speech combinations. A gesture had a *semantic relationship* to speech if those in which gesture was combined with speech. In addition, the *temporal relationship* between gesture and speech was coded. A gesture-speech combination was coded as a gesture-speech combination and gestures combined

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symbolic nature of language allows for a particular type of communicative flexibility: a word can be used for multiple discourse functions. Acts that are tied to stereotyped contexts of use clearly do not have this flexibility and thus were not considered gestures.

(4) The gesture must not be an imitation of the communication partner's preceding gesture. This criterion assured that the child was not merely copying – with little or no comprehension – the gestures his or her communication partners produced.

Note that these criteria for identifying gestures are somewhat more stringent than those that have been used in some studies of gesture in young children (e.g., Volterra, Bates, Benigni & Camaioni 1979, who did not require a gesture to be communicative, nor did they require a gesture to be divorced from the actual manipulation of an object). The criteria used in this study closely follow those used by Acredolo & Goodwyn (1988), Petitto (1988), and Morford & Goldin-Meadow (1992).

The form of each gesture was described in terms of the shape of the hand, the type of movement, and the place of articulation. At this age, gestures typically consist of pointing, holding up objects to call attention to them, holding out an open flat palm as if to receive an object, which signifies "Give" or "Gimme," and a very small number of iconic gestures (e.g., a pointing handshape held at the nose and arced upward and off the nose to represent an elephant; see Goldin-Meadow & Morford 1985; Morford & Goldin-Meadow 1992). Meanings were assigned to gestures on the basis of non-linguistic context. The object, person, or place toward which a pointing gesture was directed was considered to be the referent of that point, and the action or attribute depicted by the motion or handshape of an iconic gesture was considered to be the referent of that iconic (see Goldin-Meadow & Mylander 1984 for a detailed description of how meaning was assigned to gesture).

2.3 *Coding the relationship between gesture and speech*

Gestures produced without speech, and vocalizations produced without gesture, were identified and categorized but coded no further. Gestures combined with speech were divided into two types: those in which gesture was combined with a meaningful word – that is, combinations in which gesture had a *semantic relationship* to the speech it accompanied – and those in which gesture was combined with a meaningless vocalization. In addition, the *temporal relationship* between gesture and the speech it accompanied was coded to the nearest video frame (1/30 second) for all gesture-speech combinations (gestures combined with meaningful words and gestures combined with meaningless vocalizations). Following

McNeill (1992) and Kendon (1972, 1980), gesture–speech combinations were considered synchronous if the vocalization occurred on the stroke of the gesture or at the peak of the gesture (the farthest extension before the hand began to retract).

2.4 Coding reliability

Reliability between two independent coders was assessed on a subset of the videotaped sessions. Reliability was 92% agreement between the two coders ($N = 142$) for isolating and identifying an utterance, 95% ($N = 120$) for classifying these utterances as speech alone, gesture alone, or gesture and speech in combination, 96% ($N = 98$) for dividing speech into meaningless and meaningful vocalizations and for assigning particular meanings to the meaningful vocalizations, 96% ($N = 49$) for assigning meanings to the gestures, 84% ($N = 45$) for coding the semantic relationship between gesture and the meaningful vocalization it accompanied, and 100% ($N = 32$) for coding the timing between the gesture and vocalization in a gesture–speech combination.

3 Results

3.1 Characteristics of the children's speech

Table 12.1 presents the age at which each child first produced a meaningful vocalization (with or without a gesture) on our videotapes, and the age at which the child first produced a two-word combination on the videotapes. Note that since our videotaped sessions necessarily represent a small sample of each child's communications, the onset ages listed in Table 12.1 may inflate the actual ages at which these children began producing meaningful words and two-word combinations. Four of the children (Beth, Emily, Nicholas, and Joseph) were already producing meaningful words during their first observation sessions; the remaining two (Ann and Christopher) were not and produced their first meaningful words on the videotapes at ages 16.5 and 13 months, respectively. The ages at which the children began producing two-word combinations on our videotapes ranged from 18 to 26.5 months, an age span that falls within the range typically reported for the onset of two-word speech (cf. Bloom & Capatides 1987; Bowerman 1973; Braine 1976).

3.2 Gesture production during the one-word period

Figure 12.1 presents the number of communicative symbolic gestures each of the six children produced, expressed as a proportion of the total number

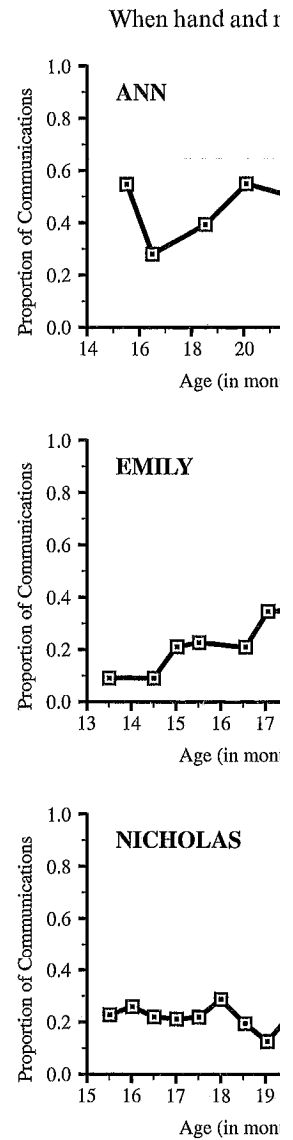


Figure 12.1. Proportion of communications produced at each session for three children.

gesture–speech combinations occurred on the stroke of the farthest extension before the

was assessed on a subset of the agreement between the two coders. In general, 95% (N = 120) for classifying gesture alone, or gesture and adding speech into meaningless, or assigning particular meanings to the gesture. The relationship between gesture and speech was analyzed, and 100% (N = 32) for generalization in a gesture–speech

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Child first produced a meaningful word on our videotapes, and the age at which the combination on the videotapes necessarily represent a small subset of onset ages listed in Table 12.1 of the children began producing mean-

Four of the children (Beth, Christopher, and Nicholas) were producing meaningful words before the remaining two (Ann and Emily) first produced meaningful words on the videotapes. The ages at which the children produced combinations on our videotapes that falls within the range typically observed for the onset of gesture–speech (cf. Bloom & Capatides

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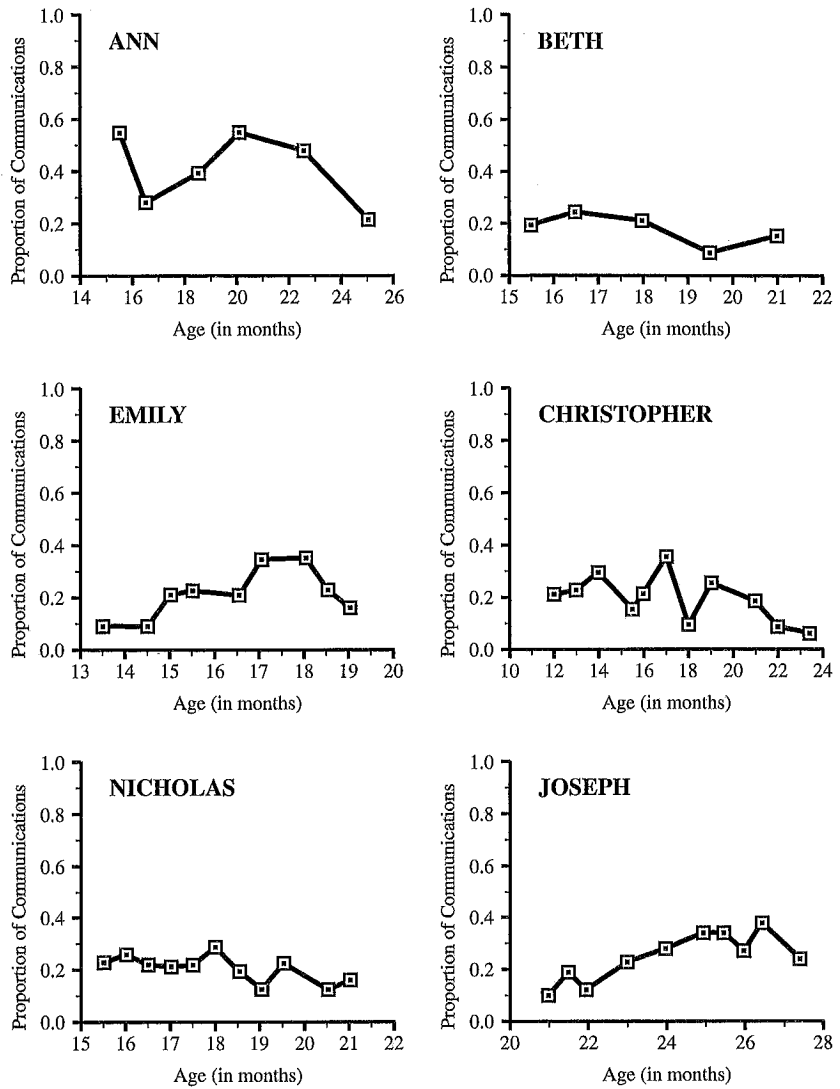


Figure 12.1. Proportion of gesture in each child's communications. The figure displays the number of communications containing gesture as a proportion of the total number of communications that the child produced at each session. Note that, for each child, the proportion of communications containing gesture remains relatively stable over time.

of communications (speech and/or gesture) the child produced at each observation session. There were some individual differences across children in the level of gesture production. Five of the children produced gestures in approximately 20% of their communications, while the sixth child, Ann, produced gestures in approximately 40% of her communications across the observational period. However, for each child, the proportion of gesture produced was relatively stable over the period of observations.

3.3 *Is gesture produced without speech during the one-word period?*

One of the characteristics of adult gesture that lead McNeill (1992) to suggest that gesture and speech form an integrated system is the fact that gesture is rarely produced on its own without speech. Approximately 10 percent of the gestures adults produce occur without speech. We first ask whether the children in our study looked like adults in this regard, or whether their gestures frequently occurred on their own without speech.

Figure 12.2 presents the number of gestures produced without speech as a proportion of the total number of gestures the child produced at each observation session. Five of the six children produced a large proportion of gestures without speech during their initial observation sessions. Of Ann's gestures ($N=34$), 0.97 were produced without speech during her first observation session, as were 0.80 of Beth's ($N=38$); these two children were seen once every two months, and at their second sessions, the majority of their gestures were produced *with* speech. The decline in production of gesture without speech was also evident in the children observed at shorter intervals. Emily produced 0.60 of her gestures ($N=27$) without speech during her first two observation sessions and then slowly began producing more and more gestures with speech. Joseph produced from 0.60 to 0.90 of his gestures without speech during his first three sessions ($N=39$) and then began to consistently produce more gestures with speech. Christopher exhibited a more erratic pattern, producing approximately 0.70 of his gestures without speech during his first two sessions ($N=41$) but not showing a consistent decline in gesture without speech until the sixth observation session. The final child, Nicholas, produced a relatively small proportion of gestures without speech (0.30) at his first observation session ($N=54$) and continued to do so throughout the study.

Thus, while the proportion of communications containing gesture remained relatively stable over development (cf. Figure 12.1), the way in which the children used gesture during this time period (Figure 12.2) did not. Five children began the period producing gestures without speech. By the end of the one-word period, when the child used gesture it was primarily used in combination with speech. The sixth child, Nicholas, was produc-

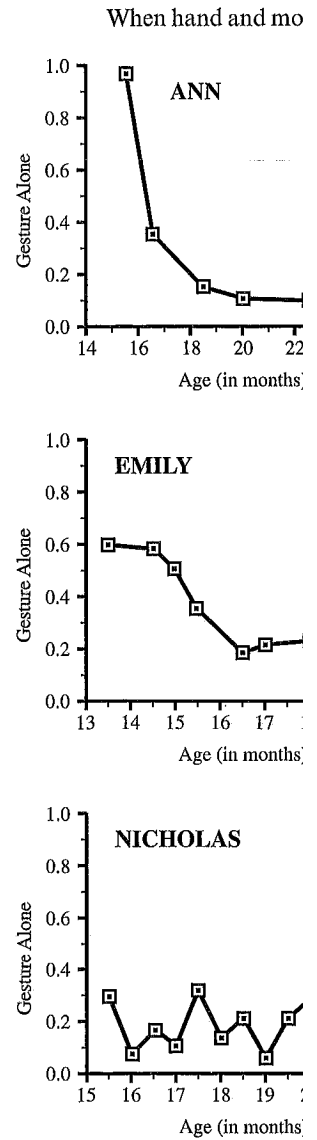


Figure 12.2. Proportion of communications as a proportion of gesture (i.e., gesture alone). Note that the proportion of gesture alone over time for five of the children. Note that very few gesture-alone

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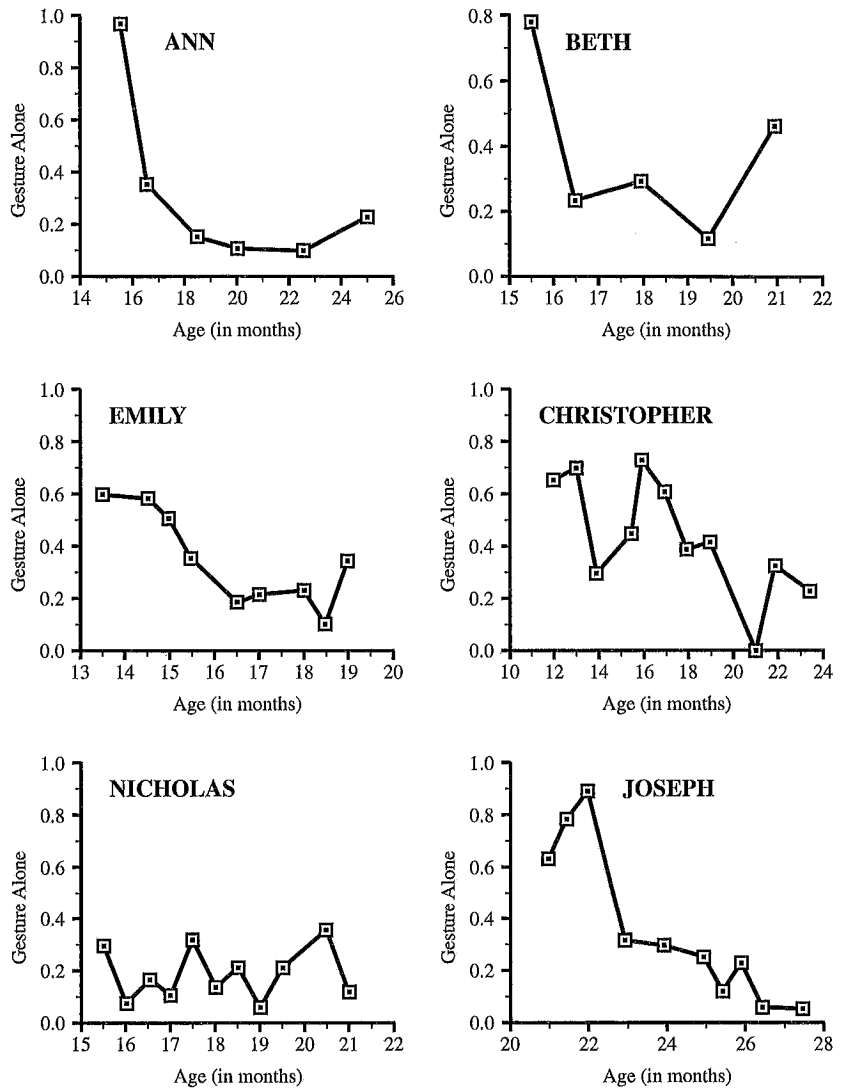


Figure 12.2. Proportion of communications containing gesture alone. The number of communications containing gesture without speech is shown as a proportion of the total number of communications containing gesture (i.e., gesture with or without speech) that each child produced. Note that the proportion of gesture-alone communications decreased over time for five of the six children (the sixth child, Nicholas, produced very few gesture-alone communications from the beginning of the study).

ing a large proportion of gestures with speech at the start of our study. We speculate, though of course we cannot be certain, that he had already shifted to an integrated gesture–speech system before our first videotaping session at 15.5 months. One obvious implication of these data is that there appears to be a time early in the one-word period when communicative gesture is *not* yet fully integrated with speech. We now turn to the characteristics of the integration process.

3.4 *When gesture is combined with speech, is it synchronous with that speech?*

McNeill (1992) noted that one characteristic of gesture–speech integration in adults is the fact that gesture is synchronously timed with respect to the speech it accompanies. We asked whether the children in our study, when they produced their first gesture–speech combinations, timed those gestures in a synchronous fashion with respect to speech.

Figure 12.3 presents the proportion of gesture–speech combinations that were synchronous (i.e., the stroke of the gesture co-occurred with the speech) at each observation session for the six children. The proportions in Figure 12.3 included all gesture–speech combinations, even those in which gesture was combined with a meaningless (as opposed to a meaningful) vocalization. Five of the six children initially produced gesture–speech combinations in which gesture was *not* synchronous with speech. The sixth child, again Nicholas, produced gesture–speech combinations that were synchronously timed throughout the period when he was observed. The fact that most of the children experienced a period when their gestures were not synchronized with the speech they accompanied further suggests that gesture and speech do not form a completely integrated system from the start but may require some time to become aligned with one another.

3.5 *When gesture is combined with speech, is it semantically coherent with that speech?*

The final piece of evidence suggesting that gesture and speech form an integrated system in adults (McNeill 1992) is the fact that gesture is semantically coherent with respect to the speech it accompanies. Although gesture does not always convey precisely the same information as does speech, the information conveyed by gesture tends to be related in some way to the information conveyed by speech – the two “cover the same idea unit” (McNeill 1992: 27), thus creating semantic coherence across the modalities. We therefore explore the onset and developmental trajectory of communicative symbolic gesture combined with *meaningful* words.

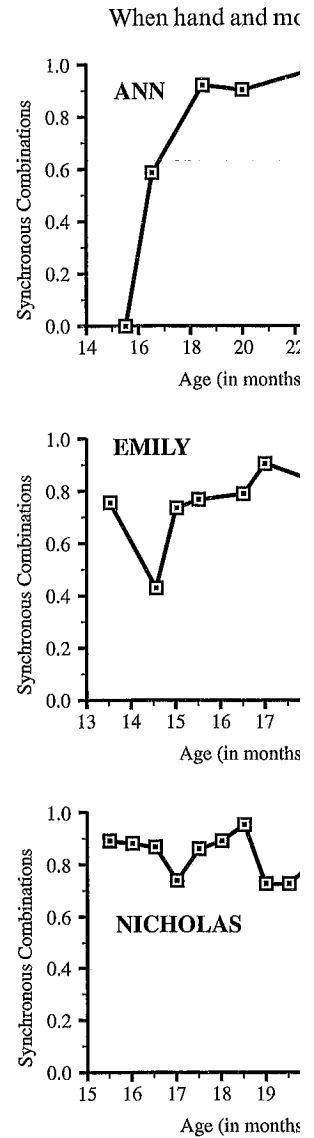


Figure 12.3. Timing of the number of synchronous combinations of the total number of gesture–speech combinations produced at each session for the six children, except Nicholas, who was synchronous from the start.

Figure 12.4 presents the number of gestures combined with meaningful speech as a proportion of all gesture-speech combinations produced by the six children at each observation session. Gesture-plus-meaningful-word combinations increased during this period in each of the six children. All of the children produced combinations in which gesture conveyed the same information as speech (e.g., point at box + "Box"), as well as combinations in which gesture conveyed different, but related, information from speech (e.g., point at box + "Open"). Note that in this second type of combination, the child is conveying two elements of a single proposition, albeit across two modalities. Thus, the ability to combine gesture and meaningful speech in a single utterance greatly expands the child's communicative range.

It is important to note that the relatively late onset of communicative symbolic gesture combined with meaningful speech is *not* due to the absence of meaningful words in the child's repertoires. All of the children except Ann and Christopher were producing meaningful words during session 1, and even Christopher produced his first meaningful words during session 2, one session prior to his first gesture-plus-meaningful-word combination.

3.6 *The convergence point: when gesture and speech come together*

More interesting than the fact that gesture-plus-meaningful-word combinations increase over time is the developmental moment at which these combinations first appear. Figure 12.5 presents three pieces of data superimposed on a single graph: (1) the proportion of gesture-alone communications, which declines over time; (2) the proportion of synchronized gesture-speech combinations, which increases over time; and (3) the onset of combinations containing gesture plus meaningful words, shown as a vertical line on each graph. Note that, for each of the five children who began to produce gesture-plus-meaningful-word combinations during our observation sessions, the three events converge: gesture-alone combinations began to decline and synchronous gesture-speech combinations began to increase at just the moment when gesture was first combined in the same utterance with a meaningful word (the sixth child, Nicholas, had presumably gone through this convergence point prior to our observations). Thus, the age at which each of the children began to produce communicative gestures in combination with meaningful words was precisely the age when timing began to improve dramatically in each child's gesture-speech combinations.

Note that in Figure 12.5 the measures of synchronization prior to the onset of gesture combined with meaningful speech (i.e., left of the vertical line) are based only on combinations of gesture with meaningless vocaliza-

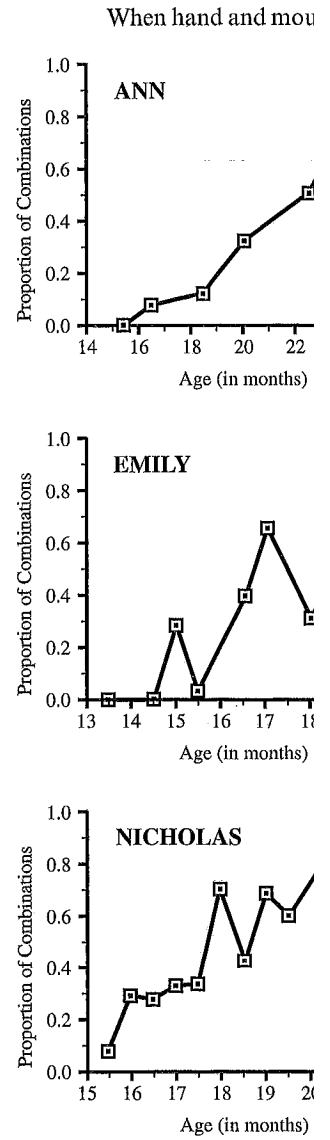


Figure 12.4. Onset figure displays the proportion of gesture-plus-meaningful-word combinations as a proportion of all gesture-speech combinations during each session.

ures combined with meaningful h combinations produced by the Gesture-plus-meaningful-word in each of the six children. All of hich gesture conveyed the same "Box"), as well as combinations elated, information from speech his second type of combination, single proposition, albeit across e gesture and meaningful speech ild's communicative range.

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ve and speech come together

e-plus-meaningful-word combi- mental moment at which these sents three pieces of data super- on of gesture-alone communi- e proportion of synchronized uses over time; and (3) the onset eaningful words, shown as a ver- 1 of the five children who began combinations during our obser- ge: gesture-alone combinations -speech combinations began to was first combined in the same h child, Nicholas, had presum- rior to our observations). Thus, to produce communicative ges- rds was precisely the age when h child's gesture-speech combi-

of synchronization prior to the l speech (i.e., left of the verti- cture with meaningless vocaliza-

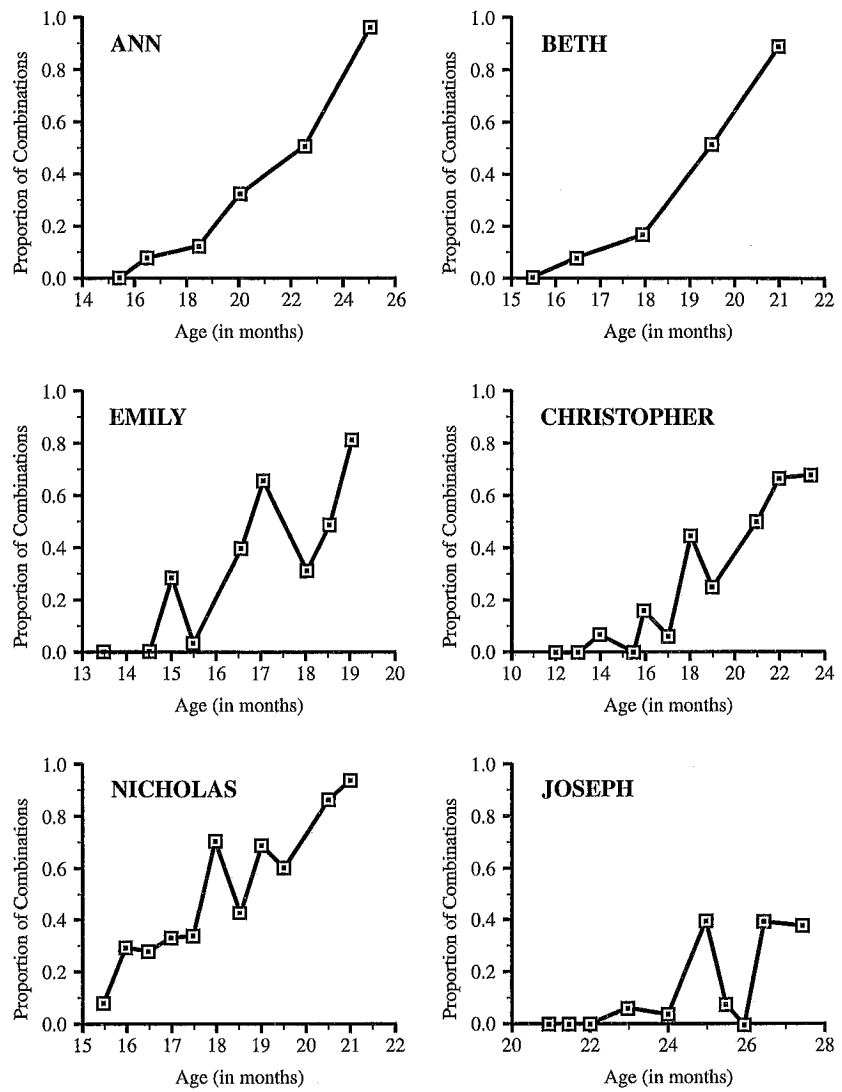


Figure 12.4. Onset of gesture combined with meaningful words. The figure displays the number of combinations containing gesture plus meaningful words as a proportion of all gesture-speech combinations (including those containing meaningless vocalizations) that the child produced at each session.

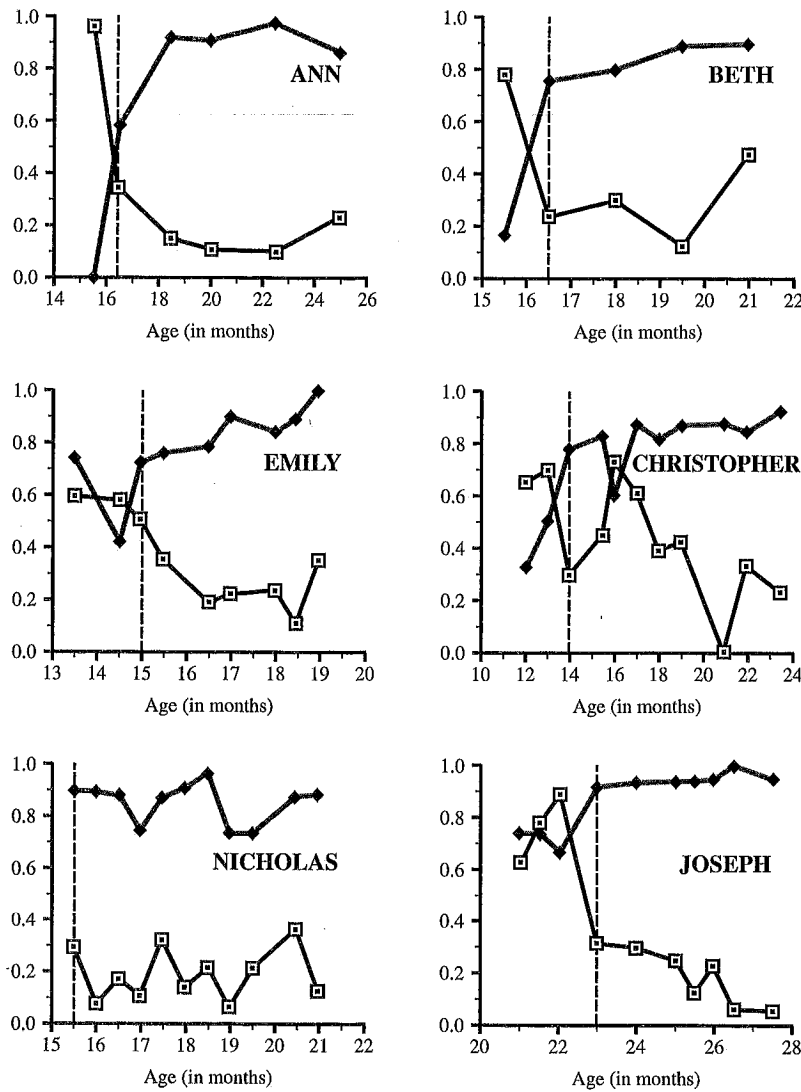


Figure 12.5. The convergence point. The figure displays the proportion of gesture-alone combinations (black diamonds) and the proportion of synchronous gesture-speech combinations (white squares) for each child. The vertical line demarcates the age at which each child first produced gestures in combination with meaningful words. The convergence point of the three marks the integration of gesture and speech in terms of temporal synchrony and semantic coherence.

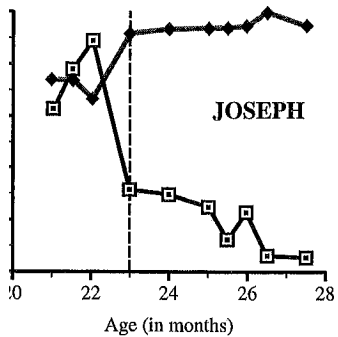
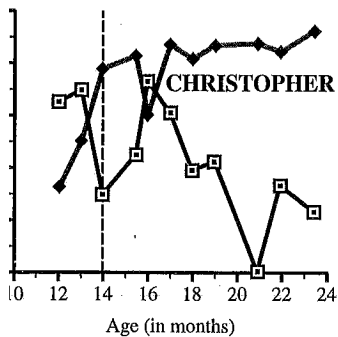
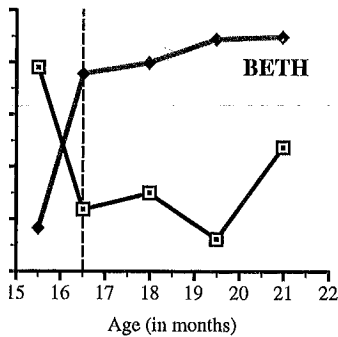
tions, since, by definition, introduced at that point. In cor and beyond (i.e., to the r gesture with either meanin tant to note that, after g speech, the proportion of binations of gesture with tions of gesture with *mea* 0.91 vs. 0.89; Beth 0.80 vs. 0.86; Nicholas 0.86 vs. 0.8 an increase in synchrony vocalizations over this tir children's first gesture-plu

Thus, the two characte adult speakers – temporal be absent at the onset of one-word period. When cl ful words, they also begi speech (both meaningful a

In sum, we have observ there is a period when the that function relatively : gesture is frequently prod bined with speech, that s) the accompanying gestur integrated – the child begi ingful words and to synch ingful and meaningless s meaningful speech and th to mark the beginning of :

4 Discussion

This study explored the gesture and speech in you development. Our findin; produce communicative s; most of the communicati our study were unaccomp or not). Moreover, during ing independently of spe their gestures with speech



The figure displays the proportion of asyndes (black diamonds) and the proportion of syndes (white squares) for each child, which each child first produced gesture words. The convergence point of gesture and speech in terms of temporal

sions, since, by definition, this is the only type of combination the child produced at that point. In contrast, the synchronization measures at this point and beyond (i.e., to the right of the line) are based on combinations of gesture with either meaningful or meaningless speech. It is therefore important to note that, after gesture began to be combined with meaningful speech, the proportion of synchronous combinations was the same in combinations of gesture with *meaningless* vocalizations as it was in combinations of gesture with *meaningful* words for each of the six children (Ann 0.91 vs. 0.89; Beth 0.80 vs. 0.84; Emily 0.79 vs. 0.89; Christopher 0.83 vs. 0.86; Nicholas 0.86 vs. 0.89; Joseph 0.93 vs. 0.98). In other words, there was an increase in synchrony in combinations of gesture plus meaningless vocalizations over this time period – an increase that coincided with the children's first gesture-plus-meaningful-word combinations.

Thus, the two characteristics that define gesture–speech integration in adult speakers – temporal synchrony and semantic coherence – appear to be absent at the onset of one-word speech and converge later during the one-word period. When children begin to combine gestures with meaningful words, they also begin to synchronize their gestures with respect to speech (both meaningful and meaningless vocalizations).

In sum, we have observed the following developmental sequence. First, there is a period when the child produces communicative symbolic gestures that function relatively independently of speech. During this period, gesture is frequently produced without speech, and, even when it is combined with speech, that speech is meaningless and not synchronized with the accompanying gesture. Next, gesture and speech become more fully integrated – the child begins to produce gesture in combination with meaningful words and to synchronize gesture in relation to speech (both meaningful and meaningless speech). Thus, the combination of gesture and meaningful speech and the synchronization of gesture with speech appear to mark the beginning of gesture–speech integration.

4 Discussion

This study explored the relationship between communicative symbolic gesture and speech in young children at the beginning stages of language development. Our findings suggest that there is a period when children produce communicative symbolic gestures independent of speech. Initially, most of the communicative symbolic gestures produced by the children in our study were unaccompanied by speech sounds of any sort (meaningful or not). Moreover, during this period (when gesture appeared to be operating independently of speech), even for the few times children combined their gestures with speech sounds, the gestures were not synchronous with

were not meaningful. It was not clear with meaningful words that respect to speech. Note that the words on their own (i.e., without help here is the ability to *combine* the ability to produce meaning-

to see across gesture and speech to a fully developed motoric skill in the hand and mouth to work together. If so, what is the result in synchrony across the modalities in the semantic system. For example, meaningful information in two distinct communicative acts. This finding reinforces the importance of gesture-speech integration – that in an integrated system both in terms of semantic coherence. Both are part of the same system.

Between communicative symbolic modalities in early stages of language development. Conducted by Bates, Thal, and Goldin-Meadow modeled gestures for 13-month-olds to accompany each gesture.² They found that the onset of lexical development imitated the onset of the speech that accompanied the gesture. Their performance on a gesture was similar to that which occurred, suggesting that gesture and speech into a single system at the onset of lexical development. This finding is significant upon the words that accompany the gesture. Do not treat gesture and speech as two separate modalities – as they have begun to integrate gesture and

speech into two important points. First, the integration seen in development when communication modalities *not* yet form a fully integrated system. Second, that the integration seen across modalities is evident in comprehension as well as production (see Bates et al., 1979, who also found evidence for integration in one-word speakers). In 9- to 13-month-olds, Bates et

al. (1979) found a correlation between gesture production at 9 months (an age several months prior to the age at which we have found that gesture and speech become integrated into a single system) and word comprehension at the later ages. It is important to point out that early gesture use can be correlated with later word use (both reflecting a shared underlying cognitive ability) and still not be integrated with speech in the sense that we use the term. Indeed, Bates et al. (1979: 128) argue that the correlation they have found between gesture and speech reflects just such an ability, in particular an underlying capacity for communication via conventional signals.

Bringing together gesture and speech into a single well-integrated system allows the child to produce utterances in which words and gestures work together to produce a single message. Indeed, in additional analyses conducted on these same six children, Goldin-Meadow & Butcher (n.d.) found that the integration of gesture and speech set the stage for a novel type of combination – combinations in which gesture conveyed different (but related) information from that conveyed in speech. For example, after integration (but not before), each of the children produced combinations of the following type: gesture conveyed the object of a desired action (e.g., point at a box), and speech conveyed the action itself (“Open”); together, the two modalities conveyed a single proposition (open box). As another example, one child produced a FALL DOWN gesture (a palm flipping over in the air) and said, “Mouse,” thus describing both the action and the actor of the proposition he intended to communicate. These new types of gesture + speech combinations represent a communicative, and perhaps even a conceptual, breakthrough for the child – a breakthrough that at the least is made evident, and might even be facilitated, by the integration of gesture and speech.

The appearance of these new types of gesture-speech combinations, in turn, heralded the onset of two-word speech. In these six children, the correlation between the onset of combinations in which gesture and speech conveyed different information and the onset of two-word combinations was high ($r_s = .90$) and reliable ($p < .05$; Goldin-Meadow & Butcher n.d.). Thus, the children who were first to produce combinations in which gesture and speech conveyed different, yet conceptually related, information were also first to produce two-word combinations. It makes intuitive sense to expect a child who can convey two elements of a single proposition across modalities to be closer to developing the ability to produce those two elements within a single spoken utterance – certainly closer than a child who has not yet demonstrated the ability to produce those two elements within a single communicative act in any form at all. The positive correlation confirms this intuition and makes it clear that the cognitive ability to concatenate elements of a proposition within a single communicative act, although

necessary, is not sufficient to guarantee two-word speech – all of the children we have observed thus far were able to concatenate elements of a proposition across gesture and speech at a time when they were unable to accomplish this feat in speech alone.

We have shown that when, early in development, children use communicative symbolic gesture, they use it relatively independently of speech. In other words, gesture does not form a fully integrated system with speech from the outset. At some point during the one-word period, children begin to combine their communicative symbolic gestures with meaningful speech and at the same moment produce those gestures in temporal synchrony with that speech. We take the convergence of the semantic union and the temporal union of the two modalities to be the beginning of gesture–speech integration in the young child. This integration sets the stage for the onset of gesture–speech combinations in which gesture conveys different (but related) information from the information that is conveyed in speech. These combinations, in turn, herald the onset of two-word speech. Thus, gesture provides the child with an important vehicle for information that is not yet expressed in speech, and, as such, it provides the listener (as well as the experimenter) with a unique window into the child's mind.

NOTES

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- 1 Two of the subjects in this study, Ann and Beth, were described by Goldin-Meadow & Morford (1985). The current study differs from the previous account in that additional videotapes were included in the data set and a variety of new analyses were performed on that entire set.
- 2 The gestures Bates et al. (1989) modeled for the children in their study were different from the gestures we observed in our study in that they were performed with objects. For example, for the phone gesture, a block was held to the ear as if it were a receiver. Although these gestures were not 'empty-handed', which was a requirement for a gesture in our study (cf. Petitto 1988), all of the actions were performed on blocks of different sizes, shapes, and colors and thus could not have been functional acts. In this sense, the gestures used in the Bates et al. study were comparable to the behaviors we took to be gestures in our study.

REFERENCES

- Acredolo, L. P. & Goodwyn, J. M. 1988. Gestures in early language development: a case study. *Human Development* 11: 1–12.
- Acredolo, L. P. & Goodwyn, J. M. 1990. Gestures in early language development. *Child Development* 59: 4–12.
- Alibali, M., Flevares, L. & Woodward, J. 1997. Conveyed in gesture: do teachers use gesture to convey information? *Psychology* 89: 183–193.
- Bates, E. 1976. *Language and gesture in the early child*. Cambridge, MA: MIT Press.
- Bates, E. with Benigni, L., & Caselli, V. 1989. *The Emergence of Symbolic Communication*. New York: Academic Press.
- Bates, E., Thal, D., Whiteside, L., & Snowling, K. 1990. Gesture and gesture in infancy. *Child Development* 61: 100–108.
- Bloom, L. & Capatides, J. B. 1975. *Language and gesture in infancy*. Chicago: University of Chicago Press.
- Boswell, M. 1988. *Gestures in early language development*. Dissertation, University of Chicago.
- Bowerman, M. 1973. *Early language acquisition*. Special Reference to Finnish. *Journal of Child Psychology and Psychiatry* 14: 1–12.
- Braine, M. D. S. 1976. *Child language*. New York: Academic Press.
- Butcher, C., Mylander, C. & Goldin-Meadow, S. 1998. A self-styled gesture system. *Child Development* 69: 315–342.
- Collins, A. (ed.) 1978. *Minnesota studies in the philosophy of language*. NJ: Erlbaum.
- de Laguna, G. 1927. *Speech and gesture*. New York: University Press.
- Emmorey, K. & Reilly, J. S. (eds.) 1997. *Gesture and cognition*. NJ: Erlbaum.
- Goldin-Meadow, S. 1979. *Stimulus and response without a conventional language*. In W. H. Winitz & J. W. Winitz (eds.), *Whitaker & Whitaker (eds.)*. NJ: Erlbaum.
- Goldin-Meadow, S. 1997. *Learning to gesture*. *Directions in Psychological Science* 6: 1–12.
- Goldin-Meadow, S., Alibali, M., & Church, L. 1996. *Gesture and language acquisition: using the hands to talk*. *Child Development* 67: 279–297.
- Goldin-Meadow, S. & Butcher, C. 1998. *Children's gestures*. In Kita (ed.), *Gesture and language*. NJ: Erlbaum.
- Goldin-Meadow, S. & Morford, A. 1985. *Deaf and hearing children*. In W. H. Winitz & J. W. Winitz (eds.), *Whitaker & Whitaker (eds.)*. NJ: Erlbaum.
- Goldin-Meadow, S. & Mylander, C. 1998. *Children's gestures: the effects and development*. *Monographs of the Society for Research in Child Development* 63: 1–121.

o-word speech – all of the children concatenate elements of a proper name when they were unable to

development, children use communicative gestures independently of speech. In an integrated system with speech, during the one-word period, children begin to use gestures with meaningful speech. These gestures are in temporal synchrony with semantic union and the tempo-beginning of gesture–speech interaction sets the stage for the onset of gesture. Gesture conveys different (but related) information that is not yet understood by the listener (as well as the child's mind).

March of Dimes Foundation and the Communication Disorders (RO) program from the Home Health Care Center of Neonatology, Department of Pediatrics, thank Samar Ali, Vera Joanna, and the videotapes and establishing the project; and David McNeill, and William throughout the project; and David comments on the manuscript itself. Department of Psychology, University of Chicago, IL 60637.

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REFERENCES

- Acredolo, L. P. & Goodwyn, S. W. 1985. Symbolic gesture in language development: a case study. *Human Development* 28: 40–49.
- Acredolo, L. P. & Goodwyn, S. W. 1988. Symbolic gesturing in normal infants. *Child Development* 59: 450–466.
- Alibali, M., Flevares, L. & Goldin-Meadow, S. 1997. Assessing knowledge conveyed in gesture: do teachers have the upper hand? *Journal of Educational Psychology* 89: 183–193.
- Bates, E. 1976. *Language and Context*. New York: Academic Press.
- Bates, E. with Benigni, L., Bretherton, I., Camaioni, L. & Volterra, V. (eds.) 1979. *The Emergence of Symbols: Cognition and Communication in Infancy*. New York: Academic Press.
- Bates, E., Thal, D., Whitesell, K., Fenson, L. & Oakes, L. 1989. Integrating language and gesture in infancy. *Developmental Psychology* 25: 1004–1019.
- Bloom, L. & Capatides, J. B. 1987. Expression of affect and the emergence of language. *Child Development* 58: 1513–1522.
- Boswell, M. 1988. Gesture and speech in the one-word stage. Unpublished Ph.D. dissertation, University of Chicago.
- Bowerman, M. 1973. *Early Syntactic Development: A Cross-Linguistic Study with Special Reference to Finnish*. New York: Cambridge University Press.
- Braine, M. D. S. 1976. Children's first word combinations. *Monographs of the Society for Research in Child Development* 41 (164).
- Butcher, C., Mylander, C. & Goldin-Meadow, S. 1991. Displaced communication in a self-styled gesture system: pointing at the nonpresent. *Cognitive Development* 6: 315–342.
- Collins, A. (ed.) 1978. *Minnesota Symposia on Child Psychology*, vol. 13. Hillsdale, NJ: Erlbaum.
- de Laguna, G. 1927. *Speech: Its Function and Development*. Bloomington: Indiana University Press.
- Emmorey, K. & Reilly, J. S. (eds.) 1995. *Language, Gesture, and Space*. Hillsdale, NJ: Erlbaum.
- Goldin-Meadow, S. 1979. Structure in a manual communication system developed without a conventional language model: language without a helping hand. In Whitaker & Whitaker (eds.), pp. 125–209.
- Goldin-Meadow, S. 1997. When gesture and words speak differently. *Current Directions in Psychological Science* 6: 138–143.
- Goldin-Meadow, S., Alibali, M. W. & Church, R. B. 1993. Transitions in concept acquisition: using the hand to read the mind. *Psychological Review* 100: 279–297.
- Goldin-Meadow, S. & Butcher, C. n.d. Pointing toward two-word speech in young children. In Kita (ed.).
- Goldin-Meadow, S. & Morford, M. 1985. Gesture in early child language: studies of deaf and hearing children. *Merrill-Palmer Quarterly* 31: 145–176.
- Goldin-Meadow, S. & Mylander, C. 1984. Gestural communication in deaf children: the effects and non-effects of parental input on early language development. *Monographs of the Society for Research in Child Development* 49: 1–121.

- Goldin-Meadow, S. & Sandhofer, C. M. 1999. Gesture conveys substantive information about a child's thoughts to ordinary listeners. *Developmental Science* 2: 67-74.
- Goldin-Meadow, S., Wein, D. & Chang, C. 1992. Assessing knowledge through gesture: using children's hands to read their minds. *Cognition and Instruction* 9: 201-219.
- Greenfield, P. & Smith, J. 1976. *The Structure of Communication in Early Language Development*. New York: Academic Press.
- Guillaume, P. 1927. Les débuts de la phrase dans le langage de l'enfant. *Journal de Psychologie* 24: 1-25.
- Huttenlocher, J. & Higgins, E. T. 1978. Issues in the study of symbolic development. In Collins (ed.), pp. 98-104.
- Iverson, J. M., Capirci, O. & Caselli, M. C. 1994. From communication to language in two modalities. *Cognitive Development* 9: 23-43.
- Iverson, J. & Goldin-Meadow, S. (eds.) 1998. *Nature and Functions of Gesture in Children's Communication*. San Francisco: Jossey-Bass.
- Kendon, A. 1972. Some relationships between body motion and speech: an analysis of an example. In Seigman & Pope (eds.), pp. 177-210.
- Kendon, A. 1980. Gesticulation and speech: two aspects of the process of utterance. In Key (ed.), pp. 207-227.
- Kendon, A. 1981. The geography of gesture. *Semiotica* 37: 129-163.
- Kessel, F. (ed.) 1988. *The Development of Language and Language Researchers: Essays in Honor of Roger Brown*. Hillsdale, NJ: Erlbaum.
- Key, M. R. (ed.) 1980. *The Relationship of Verbal and Nonverbal Communication*. The Hague: Mouton.
- Kita, S. 1993. Language and thought interface: a study of spontaneous gestures and Japanese mimetics. Unpublished Ph.D. dissertation, University of Chicago.
- Kita, S. (ed.) n.d. Pointing: where language, culture and cognition meet. Unpublished manuscript.
- Leopold, W. 1949. *Speech Development of a Bilingual Child: A Linguist's Record*, vol. III. Evanston, IL: Northwestern University Press.
- Masur, E. F. 1982. Mothers' responses to infants' object-related gestures: influences on lexical development. *Journal of Child Language* 9: 23-30.
- Masur, E. F. 1983. Gestural development, dual-directional signaling and the transition to words. *Journal of Psycholinguistic Research* 12: 93-109.
- Mayberry, R. I., Jaques, J. & DeDe, G. 1998. What stuttering reveals about the development of the gesture-speech relationship. In Iverson & Goldin-Meadow (eds.), pp. 89-100.
- McNeill, D. 1985. So you think gestures are nonverbal? *Psychological Review* 92: 350-371.
- McNeill, D. 1992. *Hand and Mind: What Gestures Reveal about Thought*. Chicago: University of Chicago Press.
- McNeill, D., Cassell, J. & McCullough, K.-E. 1994. Communicative effects of speech-mismatched gestures. *Research on Language and Social Interaction* 27: 223-238.
- Morford, M. & Goldin-Meadow, S. 1992. Comprehension and production of gesture in combination with speech in one-word speakers. *Journal of Child Language* 9: 559-580.

- Morrel-Samuels, P. & Kraus
chrony of hand gestu
Learning, Memory and
Petitto, L. A. 1988. 'Lang
187-221.
- Seigman, A. & Pope, B. (ed
NY: Pergamon.
- Volterra, V., Bates, E., Beni
and action. In Bates et
Volterra, V. & Iverson, J. M
language acquisition? I
Whitaker, H. & Whitaker, H
York: Academic Press.
- Zinober, B. & Martlew, M. I
relation to acts and vc
Developmental Psychol

Gesture conveys substantive information to listeners. *Developmental Science* 2:

1992. Assessing knowledge through gestures in young children's minds. *Cognition and Instruction* 9:

1-12. *Communication in Early Language*

et le langage de l'enfant. *Journal de*

la psychologie 11: 1-12. The study of symbolic development.

From communication to language. *Journal of Child Psychology and Psychiatry* 35: 23-43.

The Nature and Functions of Gesture in Language. In: G. S. Mossey-Bass.

Body motion and speech: an analysis. *Journal of Child Psychology and Psychiatry* 35: 177-210.

Aspects of the process of utterance.

Journal of Child Psychology and Psychiatry 37: 129-163.

Language and Language Researchers: A Guide for Researchers. NJ: Erlbaum.

Verbal and Nonverbal Communication.

A study of spontaneous gestures and speech. Ph.D. dissertation, University of Chicago.

Language, culture and cognition meet.

Linguistic Child: A Linguist's Record. Cambridge: Cambridge University Press.

Object-related gestures: influences on language. *Journal of Child Psychology and Psychiatry* 9: 23-30.

Unidirectional signaling and the transition to speech. *Journal of Child Psychology and Psychiatry* 12: 93-109.

What stuttering reveals about the child. In: Iverson & Goldin-Meadow (eds.), *Nonverbal Communication*.

Nonverbal? *Psychological Review* 92: 1-12.

What Gestures Reveal about Thought. Chicago: University of Chicago Press.

1994. Communicative effects of gesture. *Journal of Child Psychology and Psychiatry* 35: 27-43.

Comprehension and production of gestures by hearing-impaired word speakers. *Journal of Child Psychology and Psychiatry* 35: 27-43.

Morrel-Samuels, P. & Krauss, R. M. 1992. Word familiarity predicts temporal asynchrony of hand gestures and speech. *Journal of Experimental Psychology: Learning, Memory and Cognition* 18: 615-622.

Petitto, L. A. 1988. 'Language' in the pre-linguistic child. In Kessel (ed.), pp. 187-221.

Seigman, A. & Pope, B. (eds.) 1972. *Studies in Dyadic Communication*. Elmsford, NY: Pergamon.

Volterra, V., Bates, E., Benigni, L. & Camaioni, C. 1979. First words in language and action. In Bates et al. (eds.), pp. 141-222.

Volterra, V. & Iverson, J. M. 1995. When do modality factors affect the course of language acquisition? In Emmorey & Reilly (eds.), pp. 371-390.

Whitaker, H. & Whitaker, H. A. (eds.) 1979. *Studies in Neurolinguistics*, vol. IV. New York: Academic Press.

Zinober, B. & Martlew, M. 1985. Developmental changes in four types of gesture in relation to acts and vocalizations from 10 to 21 months. *British Journal of Developmental Psychology* 3: 293-306.