7. Gesture and speech

BERNARD RIMÉ AND LORIS SCHIARATURA

Rimé, B. & Schiaratura, L. (1991). Speech and gestures. In R. S. Feldman & B. Rimé (Eds.), *Fundamentals of nonverbal behavior*, pp. 239-281. New York : Cambridge University Press.

Introduction

Some years ago, we instructed volunteer subjects to interact verbally with an experimenter according to two conditions of communication content (Rimé & Gaussin, 1982). The first one simulated a situation of "objective" communication and was presented to the subject as a short-term memory task. It consisted of repeating series of digits enumerated by the experimenter. In the second condition, the subjects were asked to describe to the experimenter noteworthy events that had occurred in their personal life during the preceding week. These interactions were videotaped, and the subjects' nonverbal behaviors were analyzed. The dependent variables were movements of the eyes, head, eyebrows, trunk, and hands. The data showed that the subjects were certainly not immobile when repeating digits during the first condition. Merely pronouncing words thus seems to give rise to some degree of body movement. However, although needed phonation efforts were theoretically exactly the same for repeating digits as for telling personal events, a flow of motor activity occurred in the latter case, with most statistical comparisons between the two conditions resulting in values exceeding the .001 level of significance. The strongest effect actually involved hand gestures.

Why this motor activity of subjects sharing verbally some of their personal representations? Do people perceive their efforts to communicate verbally as insufficient by themselves? Do they consequently try to compensate with attempts at depicting what they mean through nonverbal displays? If this were the case, one would expect nonverbal behaviors

This work was supported by grants 1.5.410.86F from the Fonds de la Recherche Fondamentale Collective (FNRS) and IM-787-205 from the Ministère de l'Education Nationale (FRSFC).

to occur less frequently when subjects interact without seeing one another. This issue was examined in a study in which pairs of subjects were asked to hold a conversation about films they saw recently (Rimé, 1982). Half of these dyads interacted with an opaque screen separating the two partners during the conversation. The other half were face to face with no obstacle preventing mutual visibility. These situations were videotaped, and nonverbal behaviors were analyzed. The results showed that compared with subjects who interacted in the face-to-face condition, those who communicated without seeing one another evidenced no decrease in frequency of movements of the trunk, head, eyebrows, or lips. There were only marginally significant differences for movements of the hands and eyes. Overall, among the 15 dependent variables of nonverbal behavior in this study, none was observed to differentiate significantly the two conditions of interaction. At first glance, these data may appear surprising. But anyone who has ever observed the gesturing and facial movement of someone holding a phone conversation would be easily convinced of their ecological validity.

If the amount of nonverbal behavior remains constant when people interact without seeing one another, their function must be other than communicative. Can the display of nonverbal behavior be explained by some increase in the speaker's general arousal level? Indeed, arousal, which happens to be one of the most frequently indexed words in Harper, Wiens, and Matarazzo's (1978) *Nonverbal Communication*, has often been mentioned as an explanatory variable with respect to nonverbal behavior. This arousal explanation of gesturing was tested in an unpublished study by Rimé, Boulanger, and Thomas. Subjects with either a high or a low basal heart rate were selected from among 300 students, and each of them was invited to perform a 150-second biking exercise on a laboratory bicycle. For half of these subjects, the bicycle's resistance was set at a low level, and for the remaining half, the resistance was high. The inducement of either high or low arousal increases was thus achieved, and heart rate measurement confirmed the effectiveness of this manipulation. Immediately after the exercise, the subjects had to hold a conversation with an experimenter so that their speech-accompanying nonverbal behaviors could be monitored. Neither basal arousal nor experimentally induced arousal was found to have a significant effect on these variables. Consequently, the arousal explanation of speech-accompanying gestures was completely unsupported by the facts.

Faced with these negative results, we decided to explore what would

happen if subjects were prevented from making the major movements they normally make during a conversation (Rimé, Schiaratura, Hupet, & Ghysselinckx, 1984). Subjects held a 50-minute conversation while sitting in an armchair devised to restrain movements of the head, arms, hands, legs, and feet during part of the experiment. The procedure involved first a 15-minute baseline period with free movements, then a 20-minute period of immobilization, and finally another 15-minute period with free movements. The subjects' nonverbal activity was measured in the body zones that remained free to move during the immobilization, that is, the eyebrows, eyes, mouth, and fingers. The data revealed very strong effects of the immobilization on these variables. Indeed, with respect to base levels, highly significant increases in activity were recorded in all four observed body zones for the immobilization period, with a subsequent return to base levels when free movements were recovered. As these effects were observed only when the subjects were speaking and in no manner when they were listening, the speech processes clearly were included in their elicitation. Any explanation using some arousal consequence of the situations' unusual character seemed unlikely, as temporal analyses failed to detect a habituation effect during the 20-minute immobilization period. These data thus showed that verbal encoding is, at the very least, not dissociable from gesticulation and body movement. But nonverbal channels were not alone in being affected by immobilization. Samples of the dialogues were submitted to a computerized technique of content analysis, and a significant decrease was recorded for vividness of imagery during movement restriction, as compared with baseline and recovery periods. Speech content, then, was also affected by the restriction of the usual speech-accompanying movements.

These data suggest that the gestural motor activity of a speaking person is inextricably linked to his or her verbal encoding activities. This question of the speaking person's motor involvement will be the object of this chapter. Two things in particular have stimulated our scientific curiosity with respect to this phenomenon: First, the speaker's gesticulation is one of the facts to which human beings are most often exposed, as observers as well as actors, and yet it usually goes unnoticed in everyday life. Second, the phenomenon simply cannot be assimilated by current theoretical models in psychology; it even challenges some fundamental distinction usually maintained in this domain. Thus with the gestures and bodily movements of the speaking person, we are faced with embodied thinking. Such a challenge to our respectable conceptual

assumptions might offer an opportunity to modify some of our scientific horizons.

To allocate reasonable limits to our enterprise, this chapter will be concerned with only the most typical and most visible manifestations of speech-accompanying nonverbal behaviors, that is, hand gesturing. The topic of speech-accompanying hand gestures has elicited a number of scientific efforts that we shall examine. First, we shall describe the object, by examining a classification of hand gestures.

A classification of speech-related hand movements

Any reader who has ventured into the research literature on hand gestures has been confronted by a jungle of classes of and labels for gestures. Nearly each author invented his or her own solutions to the difficult classification problem raised in this field, so that important obstacles are encountered when communicating ideas and comparing data. Therefore, trying to put some order in the universe of gestures is a reasonable and worthwhile enterprise.

Various classifications have been proposed for speech-related hand movements (Cosnier, 1982; Ekman & Friesen, 1972; Freedman, 1972; McNeill, 1985, 1987a; McNeill & Levy, 1982), although virtually all the gestures considered by these classifications were already mentioned in the system proposed earlier by Efron (1941/1972) in his pioneering work on conversational behaviors among Jewish and Italian immigrants in New York City. Efron himself was partly relying on a classification of gestures introduced by Wundt (1900/1973) at the beginning of this century. We shall review Efron's classes of gestures and compare them with those proposed by later systems. When useful, we shall suggest some extensions or specifications of Efron's categories in order to bring them up to date with respect to related observations by later authors. Next we shall propose amendments to Efron's labels as some of them were far from being self-explanatory. Finally, we shall organize the various categories. The titles and subtitles we use will sometimes not correspond to Efron's labels but, rather, to those we shall propose for the various categories in what might best be considered as a "revised Efron system of gestures" (Schiaratura & Rimé, 1990).

The principal distinction that Efron introduced concerned the referent and was reproduced in every succeeding classification. It assumed that although some hand gestures are obviously related to some external referent – an object or event about which the speaker is talking – others have their referent within the speaking person's ideational process itself.

Gestures referring to the ideational process

Gestures referring to the ideational process follow the contour of the speech by marking the speaking person's logical pauses, stresses, and voice intonations. According to Efron (1941/1972), there are two major subclasses in this category: speech-marking hand movements and ideographs.

Speech-marking hand movements. This first subclass comprises what Efron called *batonlike gestures,* which time the successive stages of the referential activity. All the other existing classifications mention categories of gestures representing some variant of this one:

- Freedman's (1972) *punctuating movements* were described as related to the emphatic aspects of speech, occurring in bursts and in close coordination with the rhythmic aspects of speech.
- Freedman's (1972) *minor qualifiers* are movements having some characteristic form (e.g., a turning of the wrist), but without being staccatolike. Devoid of representational activity, they may be considered stylized accentuation movements.
- McNeill and Levy (1982) and McNeill (1985) distinguished *batonic movements,* which they defined as functioning to stress some linguistic item that the speaker wishes to emphasize.
- Close to the latter are Ekman and Friesen's (1972) *batons,* which they defined as accenting or emphasizing a particular word or phrase.
- McNeill (1987a) also mentioned small uniform movements, which he called *beats.* A typical beat is a simple up-and-down or back-and-forth movement of the hand. Such movements are said to appear with clauses that are performing an extranarrative role, such as introducing new characters, setting scenes, summing up, or anticipating a story.
- Cosnier (1982) gathered under the label *paraverbal* those hand gestures that stress speech intonation or emphasis or that mark the major stages of reasoning.

Taken together, these various items argue in favor of a general class of speech-marking hand movements. The referential correlates of these speech markers lie within the speech process, and they (1) stress some elements of the speech for the sake of clarity or emphasis, (2) introduce some new element into the talk, or (3)"chunk" the sentence according to the underlying reasoning.

Ideographs. A second class of hand gestures that Efron considered in the broad category of those referring to the ideational process consist of *ideographs*, or logicotopographic gestures. Efron defined ideographs as hand or finger movements sketching in space the logical track followed by the speaker's thinking. In his thinking, Efron was inspired by Gratiolet (1865), a 19th-century French specialist of the study of expression who considered that "when thinking is strongly patterned, while the mind is feeling every bend of it, the raised eye and finger appear as following the thread of some very complicated meander" (p. 322). Although obviously present in everyday life situations, ideographs have less often been isolated than speech markers by later classifications. Nevertheless, Ekman and Friesen (1972) clearly mentioned ideographs under this label and defined them as movements sketching the path or direction of thought. Similarly, McNeill (McNeill, 1985, 1987a; McNeill & Levy, 1982) recognized the existence of ideographs in what he called *metaphoric gestures*, which depict some abstract meaning occurring in the speech (e.g., the logical relation of reciprocity being represented by a hand movement from left to right and from right to left).

With ideographs, we thus have access to hand gestures that have some depictive function. Going one step further, Efron (1941/1972) described other classes of gestures in regard this time not to the speaker's ideation process but, rather, to the object of his or her speech. Some of these gestures still are depictive ones, whereas others are to be considered as evocative ones. We shall examine these two broad classes in the next two sections.

Gestures referring to the object of the speech: Depictive type

Two types of gesture that Efron considered can be placed in this class: *physiographic* and *pantomimic gestures*. As we shall explain later, physiographic gestures will be relabeled as *iconic gestures*.

Iconic gestures. Physiographic gestures are, according to Efron's (1941/1972) definition, hand movements that parallel the speech by presenting some figural representation of the object evoked simultaneously. Gestures of this kind have been mentioned in every existing classification. Freedman (1972) included them under the label of *motor primacy representational movements*, and McNeill (1985, 1987a; McNeill & Levy, 1982) under the label of *iconic hand gestures*. Such gestures were also mentioned by Cosnier (1982) in his class of *illustrative gestures*, as well as by Ekman and Friesen (1972) in their class of *illustrators*. Although often referred to in the research literature, this latter class was too all-encompassing, and so easily led to confusion. Indeed, under this single label of illustrators were grouped together eight different types of gesture. Among them were the aforementioned *batons*, and also the *emblematic gestures* to be described later. Research would likely benefit from more specific categories of gesture.

Various kinds of gestures belonging to the physiographic group have been mentioned by the different proposed classifications, and so we shall examine them further. Basically, three types of physiographic gesture seem to be distinguished with respect to the aspect of the referent being depicted by the speaker's movement. First, the gesture may describe the shape of the referential object, as is the case in the well-known upward spiraling movement of the finger of the person describing a spiral staircase. This type of gesture was called an *iconograph* by Efron (1941/1972), a *pictograph* by Ekman and Friesen (1972), and a *pictomimique* by Cosnier (1982). Second, the gesture may represent some spatial relationship regarding the referent, as in the two open hands placed palm to palm in the person referring to the restaurant located between the bank and the department store. Such gestures were assimilated into the former iconographs by Efron (1941/1972) but were separated from this class or its equivalents by both Ekman and Friesen (1972) and Cosnier (1982). Cosnier labeled them *spatiographic gestures*. Gestures of this kind should not be confounded with ideographs, in which the depicted relationship always is abstract. Third, the gesture may describe some action of the object, as in the ascending movement that accompanies the verbal expression "growing out" or as in the descending one that would parallel some mention of "falling down." These action-depictive gestures were labeled *kinetographs* by Efron (1941/1972) and Ekman and Friesen (1972) and *kinemimic* by Cosnier (1982). A reasonable standardization of the various labels proposed for these three types of physiographic gesture would result in, respectively, *pictographic*, *spatiographic*, and *kinetographic*. The general label of *iconographic* or, more simply, *iconic gestures*, as introduced by McNeill and Levy (1982), better fits the class as a whole than does the label *physiographic* originally proposed by Efron. The latter appeared as poorly evocative, as suggested by the very loose way in which it is used in the literature.

Pantomimic gestures. Pantomimic gestures are another category that Efron proposed (1941/1972). These and the iconic gestures were distin-

guished nicely by McNeill and Levy (1982), who referred to Werner and Kaplan's (1963) criterion of the level of differentiation between a gesture and the referred object. At the lower level of this differentiation, the hands of the gesturing person are playing their own role, illustrating their function of manipulating objects. In this case, the referred object of the speech is some acting person, and the described actions are imitated by the speaker's hands. For instance, to illustrate the words "he grasped the box," the speaker's hands shape an imaginary box. This type of hand gesture must be distinguished from those in which the hands play a more abstract role in the representational process, as when the sentence "he swallowed it" is accompanied with a movement of the left hand "swallowing" the right fist. Here, there is a marked differentiation between the referent and the symbol (McNeill and Levy, 1982). Although this second case clearly exemplifies a spatiographic hand gesture, that is, a subclass of iconic gestures, the first one with the lower symbol–referent differentiation introduces us to *pantomimic gestures*, which consist of true mimetic actions. Although pantomimes may be restricted to the activity of the hands, they are often likely to engage the whole body, so that the speaker also becomes an actor. In their strongest form, pantomimes do not need to be accompanied by speech and instead may become autonomous, constituting a conversation in themselves. This is the lowest level of symbol–referent differentiation (see Rimé, 1983).

Gestures referring to the object of the speech: Evocative type

The last two classes of gesture that Efron considered may be grouped in a category referring to their evocative aspect. By this we mean that these gestures no longer depict the referent, as was the case for the iconic and pantomimic gestures. Rather, they simply evoke this referent by some action likely to elicit its presence in the common mental space created between the speaker and the listener. The two types of gesture in this category were labeled by Efron (1941/1972) as, respectively, *deictic* and as *symbolic* or *emblematic gestures*.

Deictic gestures. Deictic gestures, also called *pointing* in lay language, consist of hand or finger gestures directed toward some visually or symbolically present object that is simultaneously referred to in the speech. This object might be a place or an event. Such gestures have been considered by every existing classification. For instance, McNeill (1987a) argued that deictics represent an abstract form of iconic gestures and that they are in fact the first form of iconic gestures displayed by children.

Symbolic gestures. Symbolic gestures, also called *emblems* by Efron, are gestural representations devoid of any morphological relationship with the visual or logical object represented. A common example of symbolic gesture is hand waving as a greeting device. Mentioned by most existing classifications, symbolic gestures have very strictly defined characteristics in nonverbal communication research. According to Ekman and Friesen (1972), they are verbal acts that (1) have a direct verbal translation consisting of one or two words, (2) have a precise meaning known by the group, class, or culture, and (3) are most often used intentionally to send a particular message to the receiver.

Conclusion

The list of hand gestures summarized in Table 7.1 covers the various hand gestures likely to be displayed by any speaking person in connection with some structural or content aspect of his or her speech. It would be a matter of convention to add to this list gestures like self-scratching, self-touching, hand-to-hand contact, or object manipulation. Such gestures are not integrated with speech, as are the classes of movements just considered. But they have been hypothesized as sometimes occurring coincidentally with significant points of the speech flow (see, e.g., Freedman, 1972).

The validity of this classificatory system is supported by the remarkable agreement among the classes of gesture considered by Efron and those proposed by later authors. Nevertheless, there has been no empirical assessment of exhaustiveness, independence of categories, interjudge agreement, and reliability in using them. But research in this direction, on classes of gesture close to those considered here, has now been initiated (Feyereisen, Van de Wiele, & Dubois, 1988).

Efron's classes suggest a number of processes that people use to express personal representations in words. Thus, speech markers evidence that while expressing the verbal message, the speaker keeps monitoring the potential ambiguities of the message content, the relative importance and novelty of introduced elements, and the successive steps of his or her own reasoning. Ideographs indicate that while speaking, the subject also keeps representing the logical track underlying the development of the message. Iconics and pantomimes show that when

Table 7.1. *The revised Efron system of speech-related hand gestures*

Gestures referring to the ideational process

1. Nondepictive gestures: speech markers
   - Stress some elements of the speech for the sake of clarity.
   - Parallel the introduction of some new element in the discourse.
   - Chunk the sentence following the steps of the underlying reasoning.

   Related classes: batonlike (Efron, 1941/1972), punctuating movements (Freedman, 1972), minor qualifiers (Freedman, 1972), batonic (McNeill, 1985; McNeill & Levy, 1982), batons (Ekman & Friesen, 1972), beats (McNeill, 1987a), paraverbals (Cosnier, 1985).

2. Depictive gestures: ideographs
   - Sketch in space the logical track followed by the speaker's thinking.
   - Parallel abstract thinking.

   Related classes: logicotopographic gestures (Efron, 1941/1972), metaphoric gestures (McNeill, 1985; McNeill & Levy, 1982).

Gestures referring to the object: depictive kinds

1. Iconographic or iconic gestures
   - Present some figural representation of the object evoked in speech.
   - Subclass: a. *pictographic:* represents the shape.
     b. *spatiographic:* represents some spatial relation.
     c. *kinetographic:* represents some action.

   Related classes: physiographic (Efron, 1942/1972), motor-primacy representational movements (Freedman, 1972), illustrative gestures (Cosnier, 1982), illustrators (Ekman & Friesen, 1972).

2. Pantomimic gestures
   - "Play" the role of the referent.

Gestures referring to the object: evocative kinds

1. Deitic gestures or pointing
   - Point toward some visually or symbolically present object.

2. Symbolic gestures or emblems
   - Are devoid of any morphological relation with visual or logical referent.
   - Have a direct translation into words.
   - Have a precise meaning known by the group, class, or culture.
   - Usually deliberately used to send a particular message.

displaying spatial or dynamic configurations, the speaker may use readily available bodily displays likely to parallel the speech (iconics) or to substitute for it (pantomimics). Deictics show that the speaker actively maintains a topographical relationship with the referent. Finally, symbolic gestures indicate that although involved in verbal coding, the speaker is likely to switch instantaneously to a quite different coding system when it becomes useful to his or her communicative purposes. In sum, then, the observation of speech-accompanying hand gestures

suggests that the mental environment of a speaking person is still much more complex than what is suggested by considering speech alone. The next section of this chapter will review the major empirical findings regarding the relationship between speech and gestures.

Review of research data

The study of the relationships between speech and gestures, with a few exceptions, has practically no real empirical tradition and lacks any systematic exploration. The available studies are generally scattered across types of gestures as well as subdisciplines and journals in the behavioral sciences. Literature reviews are virtually nonexistent. We organized the available material into five groups, each of which covers a different dimension of the relationship between speech and gestures: (1) verbal development and verbal abilities, (2) speech content, (3) speech flow, (4) relative difficulty of verbal performance, and (5) effects of gestural activity on cognitive and verbal performance.

Gestures, verbal development, and verbal abilities

The prevailing ontogenetic view has been that gesture is an expressive system different from and independent of speech. According to Hewes (1973), early iconic gestural language was progressively transferred to vocalizations and then verbal expression. De Laguna (1927) and Werner and Kaplan (1963) also considered gestures to originate as a primitive mode of cognitive representation. Bates and her colleagues (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1977; Bates, Shore, Bretherton, & McNew, 1983) suggested a continuity between preverbal and verbal signaling. Deictics, or pointing gestures, have been the object of special attention by authors sharing Bates's view. Thus, Murphy (1978) observed pointing gestures in infants aged 9, 14, 20, and 24 months who were looking at books. She found pointing to emerge at 9 months but not to be integrated with vocal activity until 14 months. Masur (1983) traced the emergence and development of three object-related gestures: pointing, extending objects, and open-hand reaching in infants aged 9 to 18 months. Pointing was the last among these gestures to emerge, at 12 to 14 months of age. In a careful ontogenetic observation of two children between the ages of 10 and 21 months, Zinober and Martlew (1985) confirmed this. They found that instrumental gestures such as offering objects and reaching were displayed before pointing and showing were.

Pointing was not firmly established until 14 months, and by this time, when used with vocalizations, such gestures fulfilled only the function of indicating. Once conventional words were coordinated with gestures, pointing began to serve a number of new functions: labeling, requesting, and asking for information. Pointing was also observed to be used with a variety of words, with verbal and nonverbal modes conveying either similar or complementary meanings.

The view that gesture is a primitive precursor to later verbalization might mean that it would gradually vanish from children's communication repertoire once their language begins to develop. However, many observations refute this prediction. When, comparing 2-year-old children with superior verbal competence with a group of children of the same age with normal verbal abilities, Dobrich and Scarborough (1984) found no significant difference in the frequency of use of deictic gestures. Emslie and Brooke (1982) observed pointing to be frequently used among 4-year-old children. In order to stimulate deictics among 2- to 9-year-old children, Pechman and Deutsch (1982) asked them to indicate among various objects the one that they would like to offer to some friend. The older children resorted to the verbal channel when the gestural one was likely to elicit ambiguity. But when confusion was unlikely, these children used gestures as often as the younger children did. Evans and Rubin (1979) observed gestural behavior among children of three different age groups who were instructed to explain the rules of games to an adult. No decrease with age was recorded, as both the younger (6 years old) and the older (10 years old) children in this study were the most likely to display speech-accompanying gestures.

Jancovic, Devoe, and Wiener (1975) addressed the question of an evolving amount of gesturing across stages of speech development. They recorded the occurrence of deictics, pantomimics, and more complex speech-accompanying hand movements (punctuations, ideographs, and iconographs; see Table 7.1) among children aged 8 to 18 years who answered questions about a cartoon they had just seen. The data evidenced no developmental change for deictics. But pantomimics showed a strong linear decrease with age, and a significant corresponding increase was recorded for more complex speech-accompanying gestures. Thus, rather than a disappearance of gesturing, the developmental data show a shift in the type of gestures displayed as age increases.

The emergence of more complex speech-accompanying hand gestures like ideographs or iconographs in children's repertoires of nonverbal behaviors has been documented by studies of the development of symbolic activities in expressive manifestations (e.g., Acredelo & Goodwyn, 1988). In studies by Overton and Jackson (1973) and Jackson (1974), gestural symbolic acts were elicited from 3- to 8-year-old children by instructing them to pretend using various objects in action sequences. The younger subjects had marked difficulties in performing such imaginary actions. Those in the intermediate age group were able to perform, but they had to use some of their body parts to represent objects in the sequence. Finally, the older children were perfectly able to represent objects through purely symbolic gestures. Not only is the capacity to produce symbolic gestures modified by developmental changes, but these changes also have been shown to affect temporal synchronization between gestures and speech. Van Meel (1984) observed 4- to 6-year-old children making gestures before the beginning of their verbal answer. Eight- to 10-year-olds tended to gesture at the beginning of their speech and to continue it throughout their utterance. Finally, the older children, aged 12 to 14 years, displayed their gestures in temporal correspondence with the part of the sentence comprising the symbolized element.

These developmental data may be added to observations of the relationships between mental or linguistic abilities and gestural behavior. Thus, in a sample of 8- to 16-year-old children with mental deficits, Duffy and Moore (1971) recorded moderate significant positive correlations between verbal performance and intelligence scores, on the one hand, and indices of proficiency and frequency of gestural usage, on the other hand. Similarly, in a study investigating performances of normal and mentally deficient children in various tasks of cognitive and verbal encoding, Van Meel and Van den Brink (quoted in Van Meel, 1984) demonstrated a positive relationship between the level of mental development and the use of gestural techniques. Finally, Rimé, Thomas, Laubin, and Richir (1983) observed the frequency of speech-accompanying movements in epileptic adolescents who were assessed for verbal expressive abilities. These adolescents, ranging from 11 to 20 years of age, were placed in two conversational situations, one with a peer subject of a comparable verbal level and one with the same peer and an adult. During both types of conversation, those subjects classified as high in verbal expressive abilities showed a much higher rate of speech-accompanying hand movements than did the subjects classified as low in expressive abilities, even though these two groups spoke for the same length of time.

Overall, then, the data suggest gestural behavior to precede verbal expression and to pave the way for the later emergence of communicative abilities. But this precursor does not seem to vanish once linguistic abilities show up. Rather, the evolution of symbolic thinking that parallels language development appears to elicit shifts in the gestural universe as well and to lead to the progressive emergence of more complex manifestations in gestural speech-accompanying activities.

Gestures and speech content

As we mentioned in the introduction of this chapter, Rimé and Gaussin (1982) observed many gestural behaviors and bodily movements among subjects engaged in verbal interactions of high communicative density (i.e., talking about one's recent life events), compared with those in an interaction of low density (i.e., repeating digits in a memory task). Bull and Brown (1977) had data suggesting that gestures occur more frequently in utterances in which the speaker introduces much information (e.g., declarative sentences) than in utterances with weaker informational value (e.g., questions).

Besides simple density of information, the type of information communicated seems also to be an important determinant of gestural behavior. Thus, "physiographic movements" (i.e., iconographic movements in our classification; see Table 7.1) were found by Riseborough (1982) to be abundantly elicited among children instructed to talk about pictures or to describe previously executed motor activities. However, when these children were asked to tell a story, almost no such gesture was observed. This was consistent with earlier observations by Hoffman (1968), showing that description tasks such as those involved in the classic Thematic Apperception Test produced more "representational hand movements" (i.e., again, iconographic movements in our proposed standardization) than storytelling tasks did. Hoffmann discovered that such gestures were most likely to occur when the idea seeking expression was in pictorial form in the mind. In a similar vein, Barroso, Freedman, Grand, and Van Meel (1978) and Van Meel (1982) showed that when children performed a verbal task involving mental images of actions or of objects, they displayed significantly more iconographic gestures than when the verbal task required less visual imagery. Observations of this kind led Riseborough (1982) to hypothesize that iconographic expression would be used when there was some discrepancy between units of thought and units of speech: "A discrepancy is assumed to exist when information of an essentially visual, spatial, or motoric nature has to be verbalized. Vice versa, the finding that stories produced very few gestures reflects closer correspondence between the units involved in thinking and speaking" (Riseborough, 1982, p. 502). This would explain why Shephard and Feng (1972) observed that subjects engaging in "mental paper folding tasks" used iconic gestures when requested to verbalize this task. A view similar to this one was also expressed by Freedman (1972) and by Rimé (1983).

Indeed, there is persuasive evidence that dense information in speech content leads to increased gesturing and that when speech involves verbalization of visual, spatial, or motoric information, iconographic gesturing would be most likely elicited.

Gesture and speech flow

Many data suggest that bodily movements and hand gestures tend to occur electively and in temporal coincidence with pauses and hesitations in the course of verbal utterances (Dittman, 1972; Dittman & Llewelyn, 1969; Marcos, 1977; Ragsdale & Silvia, 1982). De Long (1981) observed a similar relationship among 5-year-old children. Butterworth and Beattie (1978) obtained data showing that gestures illustrating speech content (i.e., iconic or iconographic, according to our standards) occurred more frequently with pausing in the course of fluid utterances, whereas rhythmic or punctuating gestures were associated with periods of phonation. In a related field, Hadar, Steiner, and Rose (1984a,b) observed head movements as also occurring with speech pauses and hesitation. This finding may be relevant to our topic, as in addition to the hands, the head is a body zone particularly actively associated with speech (Ragsdale & Silvia, 1982).

Although predominantly based on small samples of speech and case studies, other data on the temporal relationship between gesture and speech flow strongly suggest the temporal precedence of gestures with respect to related verbal events. Dittman and Llewellyn (1969) equipped subjects with accelerometers on their arms while holding a conversation. Hand movements were observed to be particularly concentrated around the first word of fluid verbal utterances, as well as around the first word following a hesitation. An analysis of a sample of speech led Kendon (1972) to conclude that when the form of the movement could be definitely matched to a lexical item, the movement in question had begun before the lexical item it was to mark. From simi-

lar analyses, Butterworth and Beattie (1978) concluded that the initiation of iconic gestures usually precedes and never follows the words with which they are associated, the mean delay being around 0.80 seconds, with a range of 0.10 to 2.5 seconds. Finally, Kendon (1980) had samples of conversations analyzed into tone units, each characterized by an accentuation mark in the utterer's tone of voice. He observed that each such tone tended to be accompanied by a gesture. In regard to temporal relationship between gestural and tonal events, Kendon surmised that the gesture always begins before and never after the accentuation point of the tone unit. Bull and Connelly (1985) had data confirming the temporal associations of nonverbal behavior with vocal accentuations by the utterer.

In summary, the data on the relationships between gesture and speech support the view that gestures usually precede speech. The recurrently observed association between gesture and pauses or hesitations also contributed to the view that speech-accompanying gestures pertained to launching the cognitive processes underlying speech, particularly in the case of cognitive complexity or cognitive difficulty. Studies specifically designed to test this hypothesis have been carried out.

Gestures and the relative difficulty of verbal performance

Cohen (1977) instructed subjects to describe a given geographical itinerary three times successively. The frequency of speech-accompanying hand gestures was shown to decrease linearly from the first to the third trial as the encoding process was facilitated by means of repetition. Moreover, a higher rate of gesture was associated with descriptions of more complex itineraries. This occurred despite the presence or absence of an addressee. Van Heugten and Van Meel (1980) observed that in children, more frequent and longer representational gestures accompanied the verbal encoding of more complex geometric figures. Verbal encoding is usually considered to be more difficult in a second language than in the mother tongue. Several studies have shown that when subjects speak in a second language, they use more gestures than they do with their usual language (Grand, Marcos, Freedman, & Barroso, 1977; Marcos, 1979a,b). Verbal encoding is also more difficult for people with neuropsychological handicaps, particularly aphasic subjects who display a higher frequency of speech-accompanying gestures than do nonimpaired control subjects (Feyereisen, 1983).

Although these data clearly suggest a positive relationship between the cognitive complexity of verbal performance and speech-accompanying hand movements, any simple conclusion in this regard is nevertheless precluded by other research findings. In line with what has been reviewed thus far, one might assume that more fluent subjects would gesticulate less, and less fluent ones would gesticulate more. Hoffman (1968) also posited this hypothesis, yet he actually found that less fluent subjects seldom gestured and that the relationship between gesture and fluency was complex, particularly for the most fluent subjects. Other confounding results were found by Baxter, Winters, and Hammer (1968), who compared subjects with high and low verbal competences instructed to talk about either a familiar or an unfamiliar topic. People with low verbal competence tended to display more gestures in the unfamiliar topic condition than in the familiar one, which is indeed consistent with the cognitive complexity hypothesis. But, subjects with high verbal competence displayed gestures at a maximal frequency level in the familiar topic condition, which contradicts this hypothesis.

The effect of gestural activity on cognitive or verbal performance

Some experimental data support the view that motor activity has some impact on coding or symbolic activity. Miller (1963) approached this question from the angle of semantic satiation, that is, the loss of meaning that occurs when a person repeats a word several times in rapid succession. Subjects had to repeat a word such as *push, pull, lower,* or *lift*. The delay for semantic satiation to set in was considerably lengthened when the repeated word was accompanied by the corresponding movement, whereas the delay was shortened when the movement opposed the meaning of the word. In a study of the tachistoscopic recognition of action words, Dowling (1962) found the level of recognition to be lower when the subjects had to carry on an activity corresponding to the meaning of the stimulus word. The opposite was observed when the activity was a discordant one. Rand and Wapner (1967) had their subjects assume different postures while learning a series of nonsense words. The subjects' performance was better when relearning the series of syllables if they did so in the learning posture. Saltz and Dixon (1982) investigated the effects of motoric enactment (pretend play) of sentences on the remembering of these sentences. Motoric enactment facilitated the remembering of sentences in both children and adults. But contrary

to what would have been expected from Rand and Wapner's (1967) results, motoric enactment was not found to be an important cue for retrieval. This result – which clearly contradicts the hypothesis of speech-accompanying gesture as a cue to retrieval in the verbal encoding process – certainly deserves further experimental consideration.

Besides these studies in which semantic, perceptual, or memory aspects were taken as dependent variables, experimental studies have also considered the impact of variations in gestural activity on speech structure or content. For example, McNeill (1975) found that adults were unable to produce patterned speech when instructed to simultaneously verbalize and execute complex, unfamiliar movements. In another study, Rimé, Schiaratura, Hupet, and Ghysselinckx (1984) found no significant modifications in speech fluency among subjects physically restrained from performing bodily movements, as compared with subjects free to move. In this study, however, speech content was affected by immobilization, as the restrained subjects evidenced a lower level of imagery of speech than did the subjects free to move. Graham and Heywood (1975) had their subjects describe linear figures to a partner who then had to find the figure among a series of graphic reproductions. In one condition, the subjects were instructed to remain immobile while speaking. When compared with subjects free to move, immobility induced changes in the semantic content of utterances, increased time spent pausing while speaking, and caused a poorer performance by their partners (Graham & Argyle, 1975). Finally, Wolff and Gutstein (1972) had their subjects produce imaginary short stories while performing either circular or linear movements. A content analysis revealed that the type of gestures performed definitely affected the content of the produced stories.

Conclusion

The research findings can be summed up as follows. With movements like deictics – and perhaps also like pantomimics – gesture first emerges in development as a percursor of verbal expression, which then gradually coordinates with speech. Gesture is certainly not a substitute for verbal language. Indeed, early forms of gesturing continue to be displayed even when language is fully developed. Moreoever, the evolution of symbolic thinking parallels the emergence of new and more complex gestural forms like punctuations, ideographs, and iconographs, which suggests that speech-accompanying movements fulfill functions of their own in the expressive process. Data from studies of the relationships between gesture and speech content indicate that dense information leads to increased gesturing. Also, it seems that iconic gestures are elicited mainly when there is a discrepancy between units of thought and units of speech, as is the case when the verbalization of visual, spatial, or motoric information is involved. Various data support the view that gestures often precede in time the corresponding units in speech. They also seem to occur in association with pauses and hesitation and are displayed more frequently with more complex or more difficult verbal performances. Finally, some data show that gesticulation might have a causal impact on speech performance or speech content.

Theoretical views of gestures and speech

Several authors have constructed theories regarding speech-accompanying gestures in their relationships to the speech process (Freedman, 1972; Freedman & Hoffman, 1967; Kendon, 1984, 1986b; McNeill, 1985, 1987a; McNeill & Levy, 1982; Rimé, 1979, 1983, 1985). In this section, we shall review the various positions adopted by Freedman, by Kendon, and by McNeill.

Freedman: Gestures as instrumental to speech

Freedman's interest in gestures began with a study of movement behavior during clinical interviews (Freedman, 1972; Freedman & Hoffman, 1967). He regards movement and speech as two vehicles of a common symbolic process. Among bodily movements, those of the hands accompanying either the content or the rhythm of speech play a critical role in verbal encoding. Freedman believes that they define the structures underlying speech. With respect to this, two types of speech-accompanying gesture, ranging along a continuum, have been distinguished (Freedman, 1972). At one extreme, Freedman considers *speech-primacy* gestures (speech markers in the revised Efron system), which closely parallel the formal and rhythmic properties of speech, as the most integrated into the verbal content. At the other extreme of the continuum, *motor-primacy* gestures (iconics in the revised Efron system), which consist of movements that are representational in themselves, are only minimally integrated into the verbal content. The motor act itself becomes representational.

When speech-primacy movements (speech markers) predominate in

the speaker's expression, speech is usually the primary vehicle of the message. The language forms tend to be strongly differentiated and characterized by a relatively complex syntactical structure. Hand gestures play only an ancillary role in such a context, being restricted to a self-monitoring and clarifying function similar to that ascribed by some authors to vocalization. Much more central in this respect are motor-primacy gestures (iconics), which represent a visible expression of the speaker's thought. Freedman's view is that motor-primacy responses indicate a failure to verbalize and to transform images into word representations. Each such movement manifests a surplus meaning, that is, something not fully verbalized, that seeks its immediate expression. Iconic gesturing, to use an analogy, serves the same function as taking a detour when in a traffic jam (Freedman, 1972). In a later work, however (e.g., Barroso, Freedman, Grand, & Van Meel, 1978), Freedman and his colleagues also specified an instrumental role played by these gestures with respect to the speech process. They stated that these gestures were intimately involved in activating connections between symbols (e.g., words) and their referents. Thus iconic hand movements could aid in the image–symbol linkage by reactivating a decaying image or enhancing an as-yet unclear visualization. Such gestures, then, play a crucial role in maintaining fluency, especially verbal descriptions.

Freedman's views of gesture and speech are summarized in Figure 7.1. Its major statements are as follows: First, gesture originates in the mental image that the speaker is attempting to translate into words. When the translation process proceeds without difficulty, no representational or iconic (motor-primacy) gesture is expected. Second, an inverse relationship is predicted between the level of speech sophistication and the patterning of gesture. The less articulated the speech is, the more the gesture will be patterned, and vice versa. Third, the gesture always fulfills some instrumental role with respect to the speech process, either through the self-monitoring function of speech-primacy gestures or through the reactivation of images and their link to words in the case of motor-primacy gestures.

Kendon: Gestures as substitutes for speech

Kendon's basic interests are anthropological and center on the origins of language (e.g., Kendon, 1983, 1984, 1986a,b; but see also Kendon, 1972, 1980). He therefore has made careful case studies of how expressive structures are modeled by communication circumstances.

Kendon insists that as conveyors of meaning, spoken utterances are

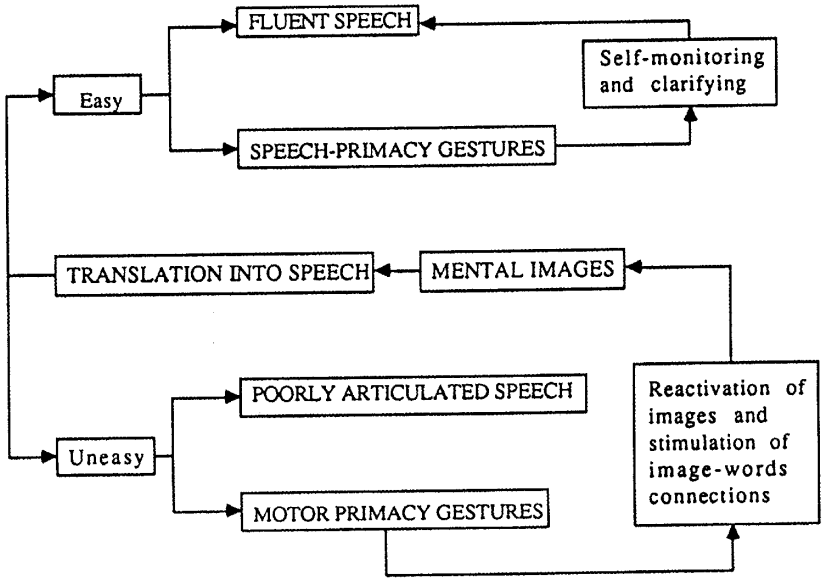

Figure 7.1. A summary of Freedman's view of the relationship between speech and gesture (based on Barosso et al., 1978; Freedman, 1972; Freedman & Hoffman, 1967).

subject to limitations that are not encountered by gestures. Indeed, spoken utterances must be primarily structured according to the rules of the language system (e.g., form of lexical elements, rules of syntax, sequential order of elements) and only indirectly to any aspect of the structure of what is being referred to. In contrast, with gestures, motions can be used that have a direct relationship to the action sequence: Pictorial diagrams may be produced; a spatial relationship may be directly portrayed; and parts of the body – or even the whole body – may be moved around as if they were actual objects. Therefore, there are more degrees of freedom for expression in gestures than in spoken utterances. In fact, from picturing to lexicalization, every mode of representation can be used in the gestural medium, whereas only the lexical mode is used in speech (Kendon, 1986b). Thus, we find the following:

- In the gesture phrase, which expresses a complex idea in a single unit of action and cannot be analyzed into constituents, the picturing possibilities of gesturing are at their maximum. Gesture phrases are fully part of the utterance plan, but they encode aspects of the meaning quite differently than do words. Furthermore, they encode aspects of the meaning that are not even alluded to in the words.
  In speech-alternate gestures, which Kendon describes as occurring in alternation with speech, the spoken phrase is typically incomplete. Unless we take

into account the gesture phrase, we can make no sense of what is said. Although the speech-alternate gestures do the work of lexical items in a sentence, they are more complex. Gestures convey complex images that can be translated into words, but only by using extended phrases. They rarely replace single words.

- In autonomous gestures (i.e., symbolic or emblematic in the revised Efron system), which may be used as complex utterances of their own, gestures do not refer anymore to complex images. Although they are not fully lexicalized, they are, in some respect, more like words than anything considered so far.
- In gesture systems like the sign language of deaf–mute persons, there is a full lexicalization of gestures. Here, from a repertoire of gestural forms, organized sequences are chosen to convey meaning in much the same way as do words in spoken language.

This led Kendon to consider that overall, in speech-accompanying gestures we do not observe a representation of the same material that is also, perhaps later, represented in words. Rather, we observe components of the utterance content that are not represented in words but that the utterer nevertheless is striving to represent. In most cases, indeed, gestures allow for representing aspects of the experience that can be represented in words at best only indirectly and, in some respects, not at all. For instance, it is impossible to display the occurrence of an action except through some form of action, or to represent spatial arrangements without moving the hands and the body.

Speech-accompanying hand movements are thus characterized by Kendon as an integral part of an individual's communicative effort. This applies to all gesticulation, even to that comprising only rhythmic spatial patterning without informational content or any apparent communicative function. Such hand movements actually constitute part of a person's actions used to represent meaning to another. In this sense, gestures are employed not to meet the transmission conditions of the interactional event but, rather, to meet the requirements of representational activity. Thus, when gesticulation takes a beatlike form, it functions as a visual analogue of the phonological "chunking" carried out by stress intonation, and pause. With iconic gestures, the speaker appears to be visually representing aspects of content that are not referred to in the verbal component of the utterance. When gesticulation is emblematic or symbolic, the speaker uses gestures as an alternate to speech, letting them do the work of the utterance. Overall, then, utterers use gesture as one of the resources available to them for getting their meaning across. Speech-accompanying gestures do not constitute an externalization of the encoding of "thought" into spoken language.

Rather, they are a consequence of the translation of thought into utterance, of which speech is another consequence.

As we mentioned, part of Kendon's work focused on the various conditions under which individuals use the gestural expressive mode (e.g., Kendon, 1984):

1. To supplement speech when certain environmental factors, such as distance or ambient noise, make it difficult for speech to be received.
2. As a substitute for speech when the speech channel is already occupied by another speaker.
3. As a device for completing a sentence that, if spoken, might prove embarrassing to the speaker.
4. To clarify some potentially ambiguous word.
5. As a means of telescoping what one wants to say, when the available turn space is smaller than one would like.
6. As an additional component of the utterance, when the spoken account appears unlikely to approach the suitable representation of what the speaker intends.

From such examples, Kendon concluded that the speaker divides the task of conveying meaning between the two expressive modalities in such a way as to achieve either economy of expression or a particular effect on the recipient.

One can sum up Kendon's position on the relationship between speech and gesture as follows (Figure 7.2): The speaker is described as fundamentally impelled by the requirements of the representational activity in which he or she engages. Inherent limitations of the verbal channel as a conveyor of meaning, as well as constraints exerted on this channel by situational contingencies, contribute to the speaker's using the more flexible gestural channel as an alternative tool for expressing representations. Therefore, speech-accompanying gestures usually represent components of the utterance content that are not represented in enunciated words. In contrast with Freedman (1972), who assigned to gestures important functions in cognitive processes such as monitoring speech and transforming meaning into words, Kendon concentrated on the expressive aspects of gestures. Nevertheless, the two conceptions are largely compatible, as both see the primary role of speech-accompanying gestures as representing meanings not conveyed by words.

McNeill: The interaction of imagistic and syntactic thinking

Primarily psycholinguistic, McNeill's (1985, 1987a; McNeill & Levy, 1982) interest in gesture evolves from his approach to the temporal devel-

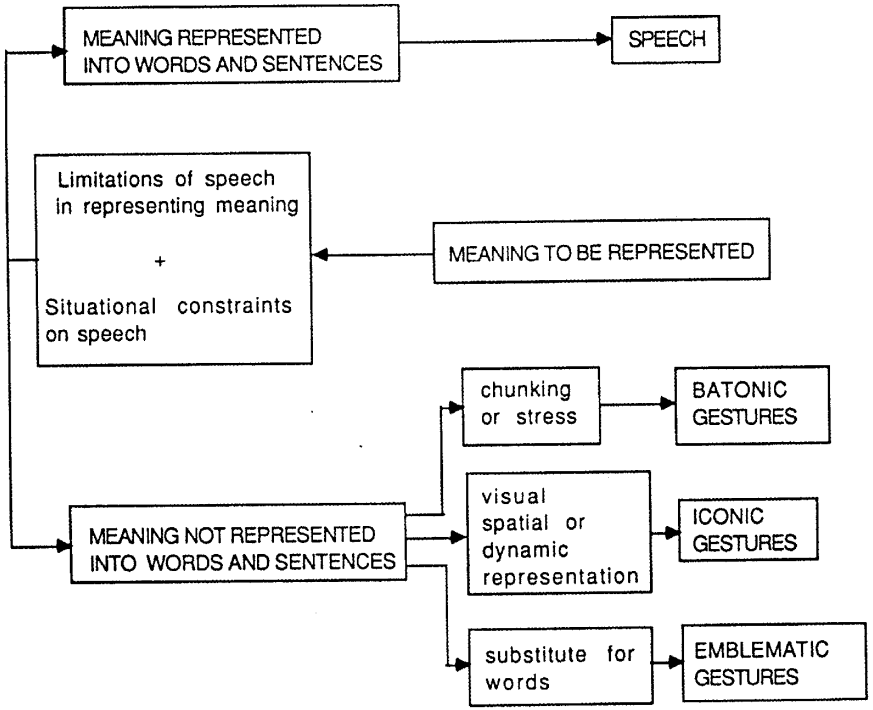

Figure 7.2. A summary of Kendon's view of the relationship between speech and gesture. Note that batonic and emblematic gestures are equivalent to speech markers and symbolic gestures, respectively, in the Revised Efron System (based on Kendon, 1983, 1984, 1986a,b).

opment of linguistic acts, with an emphasis on the processes taking place in "deep time," that is, the early stages of sentence elaboration. With this framework, McNeill sees speech-accompanying gestures as integral parts of sentences belonging to the early stages of language production.

McNeill's basic statement is that in speaking, a transformation of thinking from one type to another occurs, so that thinking and speaking have to be considered as lying on a continuum. "At one end of the continuum, thinking is more global and imagistic, and at the other end, more segmented and syntactic" (1987a, p. 1). From wordless thought, through inner speech, and then to outer speech, there is a certain continuity. As we pass along this continuum, our visual–imagistic cognition declines and our verbal elaboration increases. With thinking that is highly intense and concentrated, inner linguistic symbols may be completely replaced by images. Under these circumstances, the person may actually feel incapable of speaking, a phenomenon about which physicists and others engaged in sustained mathematical reasoning often complain. With verbal rehearsal just before emitting speech, on the other hand, images may disappear, to be replaced by fully developed sentences. Ordinary thinking occupies an intermediate place along this continuum and is characterized by the interplay of two forms of symbolization, that is, the phonological and the analogical. In this case, the symbols of inner speech appear in an environment of images.

The occurrence of gestures as a person speaks reveals that he or she is engaging in two types of thinking simultaneously: imagistic (i.e., thinking that is global and synthetic) and syntactic (i.e., thinking that is linear and segmented). Indeed, the linguistic act creates a synthesis, or mutual penetration, of both types of elements. Images are shaped by the system of linguistic values, and sentences are shaped by the images they unpack. A critical concept in McNeill's view is that the sentence is, at all stages, both imagistic and syntactic. There is no break between input and output in this situation, but only different developmental stages of a single process. Influencing one another, gesture and speech refer interactively to a single memory system in which complex configurational structures are stored.

Not only do gestures cooccur with their sentences and exhibit imagistic thinking, but gestures and sentences also are, to a degree, interchangeable. Complexity shifts between them. They exist in the same form at an early stage in deep time and can take each other's place in the developing sentence after this stage. The speaker's meaning can appear in either channel, depending on the tactical problem of expressing it in spoken rather than gestural form. Indeed, McNeill reported having observed subjects describing scenes with words containing information first presented only in gestural form and, conversely, subjects producing gestures containing information first presented only in spoken form. The balance, then, between imagistic and syntactic thinking changes progressively until thought achieves a form that can be spoken. The linguistic symbol and image emerge together. The image particularizes the symbol, and the symbol codifies the image (McNeill, 1987a).

To summarize, McNeill's view of the relationship between speech and gesture evolved from his conception of how knowledge is stored mentally. He views meanings as being stored in complex configurational structures, independent of language formats. In the speech process, meanings are transformed directly into either linguistic or gestural form,

the choice between the two depending on the utterer's tactical decisions. A detailed discussion of McNeill's positions can be found in Feyereisen (1987) and in Butterworth and Hadar (1989), as well as in responses by the author (McNeill, 1987b, 1989).

Conclusions

All three theoretical positions that we have examined rest on the assumption that gestures originate somewhere in the process through which unarticulated mnemonic elements – imagistic representations for Freedman, global representations for Kendon, and complex configurational structures for McNeill – are translated into the articulated speech formats. The three views vary with respect to the reasons for the emergence of gestures.

According to Freedman, when representational material is easily transformed into sentences and words, only rhythmic, speech-marking gestures occur. Patterned, representational iconic gestures are displayed only when the translation process partially fails to accomplish its aim. Such gestures help restore this process, by further activating image–word connections. In Kendon's view, the verbal expression of global representation may be limited by the available verbal resources or by constraints exerted on the verbal channel by situational or social contingencies. This results in the use of the alternative channel, that is, the gestural one, which allows not only the expression of structural aspects of representations (stress, intonation, pauses, logical relationships, logical steps, etc.) but also the expression of the content aspects of these representations (shape of the referent, action, spatial arrangement, etc.). For both Freedman and Kendon, then, gestures manifest a surplus of meaning beyond what is temporarily permitted in the verbal expressive channel. Although both authors recognized the details of the representational material to be a major cause of such calls to gesticulation, Kendon also emphasized the effect of social and communication circumstances. Whereas Freedman attributed to gestures an instrumental role in restoring the prevalence of speech, Kendon sees them as substitutive expressive resources in the communication process. Finally, in McNeill's view, imagistic and syntactic thinking complement each other in elaborating unarticulated memory elements into speech. The occurrence of gestures depends on the tactic of expression temporarily preferred by the speaking person, either fully spoken or more imagistic. However, variables that could influence the speaker's choice in this respect are not specified by the theory, so that finally it fails to predict conditions under which gestures would be observed.

A cognitive-motor view of expression

The cognitive-motor view of expression (Rimé, 1979, 1983, 1985) was instigated by the puzzling occurrence of depictive gestures – pantomimes, iconics, ideographs – in speaking persons. To take an extreme case of this type of gesturing, consider the 7-year-old boy who has just come back from a fun fair and gives his parents a detailed account of his experiences. A child in this situation hardly limits himself to verbal description. Objects, scenes, and events are depicted bodily. The boy is again speeding up and down in the wagon of the spiraling train. He is the witch who has frightened him in the magic tunnel. He is the plastic duck against which he has been throwing balls. Bodily participation is typical of children's verbal expression, but this type of expression fades as the child's communication abilities improve. Yet, the frequent occurrence of depictive gestures accompanying adults' speech demonstrates that the phenomenon is still alive later in life. Moreover, it can dramatically reappear when the adult refers in speech to some animated or exciting event, for instance. According to the cognitive-motor view, such manifestations cannot be explained without considering the contribution of motor processes to shaping representations of reality.

Motor processes in perception

Motor processes contribute to perception in at least four different ways. First, the sense organs are far from operating independently of the rest of the organism: These organs' activities strongly depend on the motor tracking of stimuli by oculomotor movements, by movements of the head, and, in most instances, by movements of various other parts of the body. Feedback information from these motor processes should thus be assumed to be part of the sensory data. Second, the person involved in perception and reality processing is usually far from being passive. Responses generally are being adapted from moment to moment, and again, efferent and afferent data are necessarily associated in stored information. Thus, anticipatory head, hand, and leg movements by the baseball player ready to catch the ball, are blended with eye-tracking movements and with the picture of the ball crossing the sky. Third, as neutral stimuli are rare, most stimulations elicit in the perceiver the af-

fective or emotional reactions manifested in the form of postural and facial changes. This constitutes another element to be added to the efferent data collected in perception. Finally, there is still a fourth way in which motor aspects contribute to mental representation. Virtually forgotten by modern psychology, this dimension was recognized by Aristotle, who considered that the "human being is the most mimetic of all animals, and it is by mimicking that he or she acquires all his or her knowledge" (quoted in Jousse, 1955/1974, p. 55). We do not limit ourselves in selecting verbal attitudes to qualify objects or events we meet. We also, tacitly, make abundant use of motor coding by means of motor attributes. Thus, the spiraling movement is latent in our representation of a spiraling staircase. A mouse may be motorically coded by its two mobile ears, its long pointing nose, its gnawing jaws, or the fast movement of its body when escaping. As with verbal attributes, several motor codes are usually selected for the same object, and they are hierarchically organized according to their perceived saliency. Often, when we fail to remember the name of an object, its attributes still are available in our conscious memory, and we are able to display gesturally our motor codes for it.

This perspective on the role of motor processes in perception cannot be reconciled with the widespread view that the psychological universe is split into a stimulus and a response side. Transactions between individual and external reality are such that in terms of collected information, "responses" generally cannot be dissociated from "stimuli." Represented stimuli would probably have no adaptative meaning if they were not made up of response elements that contributed to their being built up in the subject's mind.

Elements of representations

We come then to a consideration of our representations of reality as containing three types of element: (1) concepts and verbal attributes likely to be articulated into language propositions, (2) images, and (3) incipient somatotonic changes reminiscent of the various motor responses involved in the perception of the referent. This view is close to Lang's (1979) theory of emotional imagery and traces back to Jacobson's (1930a,b, 1931) studies, which revealed that low-level physiological changes usually accompany mental processes. Jacobson observed that when asked to think of certain events or to imagine certain actions, the subjects mental activity was invariably accompanied by electrical

activity in the muscular groups associated with the imagined actions. Observations of this kind have now been replicated in the study of mental imagery of emotion (e.g., Ekman, Levenson, & Friesen, 1983; Sirota & Schwartz, 1982). Through their interactions, somatotonic elements of a representation form with imagery the active reminiscence of the apprehension process. Concepts and verbal forms associated with these elements are both a part and a consequence of their cognitive processing. Each of the three elements has the property of eliciting, or cueing, the two others. Thus, concepts, images, and motor changes are equally appropriate inputs to the network of elements that constitutes the representation.

Each element of a network is itself associated with elements of other networks or representations, because of either structural analogy or former evocation in spatiotemporal contiguity. Therefore, any new external or mental event is likely to elicit through its own representational components the activation of motoric, imagistic, or conceptual elements associated with other representational networks. Although motoric elements usually go unnoticed by the subject, the imagistic ones are perceived, and the conceptual elements accompanying them are articulated and rationalized through the sense-giving activity of silent language. This gives rise to the continuous flow of inner speech and imagery characteristic of mental life. Through this continuous activity, representations are processed. Images emerge under new variations; they simplify and present increasingly schematized forms. Simultaneously, they are transformed by the sense-giving activity of silent language. Accompanying labels and concepts become richer and more apt. Successive repetitions of this cognitive work may lead the network to the point that its linguistic formalization is completed. In this case, it is available to the subject in a well-integrated conceptual form, which is typically the stage at which a writer begins writing sentences on paper.

When processed as described here, the representational elements issued from the subject's perception of the world are progressively articulated into an *expressive structure*. In this new structure, the raw material of experience is organized in accordance with the rules of rationality and language and is ready for verbal expression. This structure evolves from the progressive differentiation or articulation (Werner & Kaplan, 1963) of the representation's *raw structure*, that is, the original motoric, imagistic, and raw conceptual material issuing from the experience of the world. The expressive structure may now be handled – in thinking and in communication – with relative independence with respect to the raw

structure. Nevertheless, the raw structure itself is never reduced or erased but retains its position as the core of the representation.

Expressing representations

Verbal expression, or the attempt to share a representation with other persons, is a challenging task. A complex, multidimensional matrix of information has to be expressed as a one-dimensional string of verbal communication and has to follow rules of lexicon, syntax, and logic. The difficulties in these cognitive operations can be easily overcome if the representational network to be evoked in speech already possesses, because of former processing, a highly articulated expressive structure. In this case, the material likely is already organized into sequential forms; appropriate concepts have become part of the network; and schemata of sentences may already be available. In other words, the representation is stamped by the subject's linguistic–cognitive processes. One can expect, then, that the speech will be fluent, relatively devoid of hesitation, and characterized by abstract, objective expression and by the use of conventional, highly codified lexical forms and strongly articulated syntax. Because the raw structure of the representional network need not be very active to permit such communication, we can expect the speaker's muscular activity to be weak. Thus, he or she is likely to display predominantly the small, rhythmical head and hand gestures that generally accompany the melody of fluent verbal expression.

If the speaker's representation to be unfolded in speech has only a poorly articulated expressive structure or, for some reason, if this speaker has to refer directly to the raw structure, this raw structure will have to be activated during the communication process. This will allow the motoric elements of the representational network to prime the conceptual and linguistic forms likely to approximate the meanings they carry. In this case, then, verbal expression is properly the result of a dynamic interplay between the subject's visceromotor matrix of information and his or her general matrix of conceptual competences. This explains, in our view, the occurrence of the speaker's hand gestures that depict in some rough manner the referent of the speech. Such gestures are generally made completely out of the speaker's awareness, but by priming appropriately related conceptual forms, they help pave the way to verbal expression. In such instances, verbal expression is expected to be only partially fluent, with pauses, hesitations, and word searches. Lexical forms are more likely to have a relatively personal, idiomatic character. Syntax tends to be relatively poor, with weakly articulated linguistic connections. Finally, the vocal signal itself is likely to present colorful variations isomorphic to the referred representational events.

Speech styles

These considerations lead to a contrast of two types of speech style that can be conceived of as lying at two opposite ends of a continuum. One of them, poorly articulated and weakly codified, concrete, and subjective, develops when the speaker is relying mainly on the raw structure of its representation, and it thus is characteristically related to iconic hand gestures. We could call this the *direct* verbal–gestural style. The second one, highly articulated, distant from personal experience, conventional, abstract, and objective, occurs when the speech evolves from surface structures of representations, and it thus is expected to be paralleled by speech-marking hand gestures. This second style could be called the *mediated* or *elaborate* one. This contrast between two speech styles is hardly a new one. Authors like Wallon (1970), Jousse (1955/1974), Moscovici (1967), and Werner and Kaplan (1963) have already proposed distinctions close to this one (for a review, see Rimé, 1983).

The question now arises of the conditions influencing the type of verbal–gestural style adopted by a speaker in a given circumstance. Rimé (1983) has proposed the rule according to which a speaker's style is a function of his or her degree of differentiation from each of the elements in the communication process, that is, the referent, the representation, the addressee, and the medium of communication. For each of these four items, this rule may be specified as follows:

Referent. One expects a speaker to present a "direct" style when he or she is weakly differentiated from the referent of his or her speech. This happens when this referent (1) is new, unusual, or recently experienced; (2) is personally involving; (3) has marked perceptive–dynamic dimensions; or (4) comprises complex, wholistic structures. In all such instances, the raw structure of the speaker's representional activity tends to predominate, and iconic gestures accompanied by concrete and subjective, weakly articulated verbal expressions are expected. The reverse prediction also applies to opposite conditions.

Representations. A "direct" verbal–gestural style is expected when the speaker's personal characteristic (e.g., age, developmental level, socio-

cultural characteristics, mastery of language, cognitive style) makes him or her weakly differentiated from his or her representations, thus limiting his or her competence to develop articulated structures of expression.

Addressee. A "direct" style is predicted when the speaker feels weakly differentiated from his or her addressee. Vygotsky (1962) mentioned the impact of interpersonal intimacy on the communication style of adults, stating that the weak polarization of relations creates an expressive style very close to the forms of expression used when addressing oneself. As we go from the intimate relationship toward relationships that are more differentiated, we should observe the verbal–gestural style sliding toward forms that are more articulated, more conventional, and even close to protocol. This is the case to a certain degree when the speaker addresses someone whom he or she perceives as being dominant or hierarchically superior. On this continuum, the expressive style becomes progressively more codified, with its extreme being a style close to written language. As suggested by Moscovici and Plon (1966), in written language, the speaker–addressee differentiation is maximal, the addressee being anonymous as well as psychologically, spatially, and temporally distant.

Medium. The medium, or means of communication that the speaker uses encompasses both physical supports (e.g., telephone, interphone, loud speakers, video) and ecological conditions (e.g., spatial position, distance from partner). These aspects of the communication setting may be either familiar or new to the speaker. The more familiar the medium is, the less differentiated the speaker's relation to it will be, which leads us to predict the usage of a direct verbal style with iconic gestures. Conversely, when the speaker expresses himself or herself under unfamiliar conditions or settings, he or she is expected to use a strongly articulated, formal, expressive style.

Conclusions

The cognitive-motor view of gestural behavior stresses speech-accompanying gestures as emerging from the speaker's attempts to communicate what could be called an embodied matrix of data. This matrix, or system of information, is viewed as having evolved from patterns of sensory and motor components of the subject's apprehension of external objects

and events. In his or her communication efforts, the speaker is trying to unpack the system into the sequential terms of vocal expression. The tools for this task are the socially shared elements of logic, syntax, and lexicon. By making a communicative effort, the speaker is most often led to reactivate the embodied elements or the raw structure of the representational matrix. The reactivated material is what he or she tries to signify in the social setting, and this reactivation materializes in gesturing. In some cases, the earlier cognitive processing leads the speaker to develop inner logical, syntactical, and lexical coverages of the matrix of data. Then, verbal expression is likely to induce only a low reactivation of this processing, and in this case, gestural behavior is only minimal. What the subject expresses verbally in this case is restricted to a schematic, simplified structure of data. The cost in density of information is compensated by the greater accuracy and communicability.

Social perception and the social impact of hand gestures

So far in this chapter, we have considered speech-accompanying hand gestures exclusively from the encoder side, that is, in their relationships with representational and expressive processes. Now, we shall switch to the decoder side and explore the role of these hand gestures with respect to the communication itself. Laypersons usually believe that a speaker's hand gestures carry meanings that complement and supplement his or her words and sentences, that hand gestures influence the addressee's decoding activity. But this view is contradicted by the following three facts: First, the addressee usually does not notice the speaker's hand gestures. Contrary to external observers, people who have been personally involved in a verbal interaction are, after the fact, usually unable to remember anything about the speaker's hand gestures. Do they process this information in an out-of-awareness mode? If this were the case, a second fact would refute the view of gestures as carriers of critical information in the communication process. Experimental data have shown that those communication situations in which the interactants cannot see each other are no different from face-to-face situations, from neither an interpersonal point of view nor that of message reception and understanding (Rimé, 1982; Williams, 1977). A third fact is that subjects are unable to guess the speech content to which gestures relate, which supports the view that hand gestures do not provide independent access to a meaning expressed in words (Feyereisen, Van de Wiele, & Dubois, 1988).

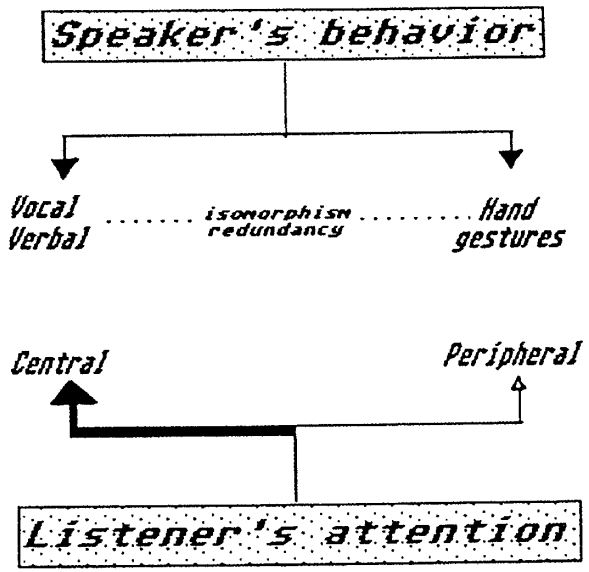

Figure 7.3. The figure–ground model of the listener's attention to the speaker's verbal and nonverbal behaviors.

A figure–ground model

The latter data open the way to understanding some of the reasons that the speaker's gestures usually have no impact on the decoding person. Consistent with the view that gestures are manifestations of the motor representations underlying speech, there is usually much redundancy in the verbal and gestural channels. An immediate consequence of this redundancy is that listeners often neglect one of these two sources of information. Naturally, the listeners' attention is much more likely to be directed to the complex, more exhaustive, and codified verbal message than to the simpler, allusive, and idiosyncratic hand gesture. This is the basis on which we developed a figure–ground model of the relationships between verbal and nonverbal materials with respect to decoding activities (Rimé, 1983).

According to this figure–ground model (Figure 7.3), a speaker's nonverbal behavior is usually only at the periphery of the listener's attention, whereas the center is focused on the heavy task of decoding the verbal message and encoding potential verbal answers. Nevertheless, the nonverbal data – elements of the ground – are always present as potential attention captors. Even when they do not retain central attention, they probably color the central verbal figure. But as important redundancies link verbal and nonverbal material, this coloring is probably negligible. The figure–ground model also implies that the relation may slip and reverse temporarily, so that nonverbal data take the role of the figure, thereby occupying the center of the perceiver's attention. Two types of situation are likely to induce such an effect: a rise in intensity in the nonverbal channel and a fall in intensity in the verbal channel (Figure 7.4).

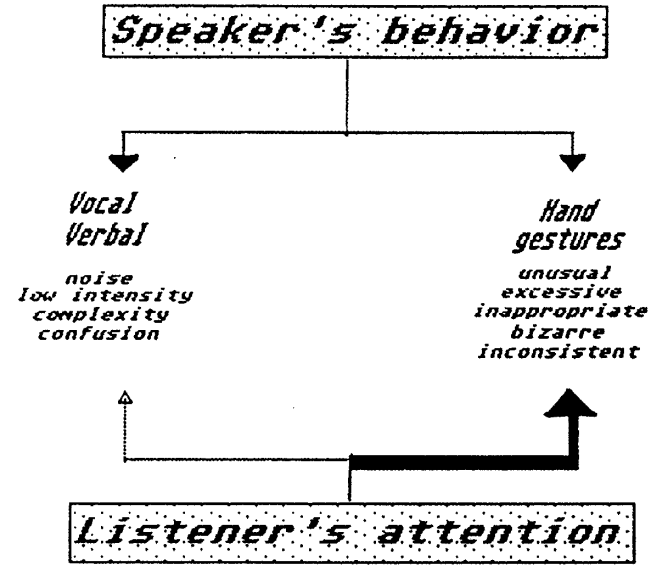

Figure 7.4. Major conditions for a figure–ground reversal in the listener's attention to the speaker's verbal and nonverbal behavior.

The effects of an increase in the intensity of nonverbal materials

When unfamiliar, excessive, bizarre, or discordant with regard to the situation or context, nonverbal material may be said to rise in intensity in the observer's or partner's eyes, as in such circumstances it becomes noticeable. We assume that under such circumstances, nonverbal material becomes the figure, with a resulting heightened potential impact on the observer's or partner's reaction. Concomitantly, verbal data, slipping to the ground, lose importance. Data supporting this view can be found in a study in which the degree of concordance or discordance between the verbal message and the visible expression of a communica-

tor were systematically varied (De Paulo, Rosenthal, Eisenstat, Rogers, & Finkelstein, 1978). When in the discordant condition, the receivers of these messages were found to switch their allocation of attention from the audible message to the visible expression of the communicator, as predicted by the figure–ground model. In regard to the impact of unfamiliar or excessive nonverbal behavior, an illustration of the effects described by the figure–ground model may be found in data from a study in which psychopathic and nonpsychopathic subjects were compared for nonverbal behaviors in interview situations. Rimé, Bouvy, Leborgne, and Rouillon (1978) observed marked differences between these two groups of subjects. As a group, psychopaths had a higher rate of gestures; they directed their gaze much longer at the interviewer; sat markedly closer to him; and smiled less frequently. Though unaware of the subject's psychopathic or control status in the study and even though he was instructed to maintain the same behavior throughout the interviews, the interviewer spoke for a shorter time when interacting with psychopaths, compared with the control subjects. Thus, the excessive nonverbal behavior of these psychopathic individuals appeared to have a marked correlative counterpart in their interviewer's reactions, as predicted by the figure–ground model.

The effects of a decrease in the intensity of nonverbal materials

The second prediction of the figure–ground model is that a decrease in the intensity of the sender's verbal channel can also induce the figure–ground reversal, thus bringing the sender's nonverbal behavior closer to the center of the receiver's attention. This would be the case when the intensity of the physical signal decreases, when a noise occurs in the communication, or when the intelligibility of speech content itself degrades. In regard to the effects of noise, supporting evidence may be found in data by Rogers (1979). The subjects received messages from a speaker according to three modalities: complete audiovisual signals (i.e., face, body, and voice), altered audiovisual signals (by eliminating face and lips), and audio signals alone. In all these modalities, the audio signal was altered according to one of four levels of noise intensity. The independent variable was the degree of the subject's comprehension. The results showed that for a weak noise level, the three modalities of sending produced levels of comprehension that varied very little from one another. But as the noise level increased, these three modalities produced increasingly different levels of comprehension, favoring complete audiovisual signals and not audio-only signals. It is clear that as the audio signal decreases in intelligibility, the need to use visible information, weakly present in normal conditions, becomes more important. Further evidence supporting this prediction of the figure–ground model can be found in a study in which the intelligibility of speech content was varied according to three conditions (Rimé, Boulanger, & d'Ydewalle, 1988). Flemish-speaking subjects were exposed to a videotape display of a female professional interpreter who was telling the same story either in the subjects' own language, or in a language they could understand more or less well (French), or in a language that none of them could understand (Russian). The interpreter's nonverbal behaviors (gaze, iconic gestures, and speech markers) were completely standardized across conditions. While watching this videorecording, the subjects' ocular activity was continuously monitored by means of an eye movement registration apparatus (using the corneal reflection-pupil center method and tracking eye movements with a resolution of 20 msec). The data demonstrated a very low level of attention ($\overline{X}$ = 6.66% of the time) to the speaker's hand gestures when she was speaking the subject's own language. This confirmed the view that the speaker's gestures generally have a weak saliency to the receiver's eyes. However, as predicted by the figure–ground model, this attention for gestures nearly doubled ($\overline{X}$ = 11.20%) when the speech was only partially understandable and tripled ($\overline{X}$ = 19.65%) for the Russian version. Nevertheless, despite this considerable rise in attention to gestures, no subject in the last condition was able to report anything coherent about the content of the speech. Here again, gestures seem not to have contributed to the understanding of the message.

General conclusions

To conclude this chapter, we shall consider the practical question of whether the speaker should or should not use gestures if he or she wants to achieve optimal communication.

Controlling one's gestures would probably require lengthy training, as this activity is automatic to a large extent. Nevertheless, the data collected on the decoder's point of view offer some interesting hints. In an unpublished study, Rimé, Boulanger, and Thomas showed subjects a videotape of speaking persons whose rate of speech-accompanying gestures was either low (10% of speaking time or less), moderate (11 to 20%), or high (more than 20%). Half of the subjects viewed the mate-

rial while a mask covered the lower part of the screen so that only the face and not the hand gestures of the speaking person could be seen. The remaining subjects saw the full screen. All of the participants were then invited to rate the speaking person on two types of scale, one assessing qualities of the speech (clarity, fluidity, and accuracy) and the other, the qualities of the speaking person (warmth, presence, and relaxation). The data showed the speech quality ratings to be affected by both quantity and visibility of hand gestures. Indeed, the speech was perceived as less clear and less fluid when the speaking person used many gestures. The same happened when the gestures were visible, compared, with the masked screen condition. This suggests that the presence of gestures in the decoding person's perceptual field has some detrimental effect on his or her subjective appreciation of the verbal material to which this person is exposed. The figure–ground model would attribute it to an intrusion of nonverbal materials on focal attention, thus competing with the decoding of verbal information. However, the data on the qualities of the speaking person showed that displaying a relatively high rate of gestures is far from having only negative consequences on social perception. Indeed, higher gesturers were rated as much warmer and much more relaxed than were speakers making fewer gestures. Interestingly, this effect occurred independently of whether the gestures were visible or masked on the video screen. This led us to conclude that it had to be attributed not to gestures as such but, rather, to the global expressive style correlated with the display of a high rate of gesture. Therefore, according to our current knowledge,the person who intends to speak is faced with two contradictory alternatives: If he or she wants to be clearly understood, he or she should display as few gestures as possible. But if this person wants to be positively perceived and appreciated for interpersonal qualities, he or she should adopt a speech style using an abundance of gestures.

References

Acredelo, L., & Goodwyn, S. (1988). Symbolic gesturing in normal infants. *Child Development, 59*, 450–466.

Barroso, F., Freedman, N., Grand, S., & Van Meel, J. (1978). Evocation of two types of hand movements in information processing. *Journal of Experimental Psychology: Human Perception and Performance, 4*(2), 321–329.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1977). From gesture to the first word: On cognitive and social prerequisites. In M. Lewis & L. A. Rosenblum (Eds.), *Interaction, conversation and the development of language* (pp. 247–307). New York: Wiley.

Bates, E., Shore, C., Bretherton, I., & McNew, S. (1983). Names, gestures and objects: Symbolization in infancy and aphasia. In K. E. Nelson (Ed.), *Children's language* (Vol. 4, pp. 59–123). Hillsdale, NJ: Erlbaum.

Baxter, J. C., Winters, E. P., & Hammer, R. E. (1968). Gestural behavior during a brief interview as a function of cognitive variable. *Journal of Personality and Social Psychology, 8*(3), 303–307.

Bull, P. E., & Brown, R. (1977). The role of postural change in dyadic conversations. *British Journal of Social and Clinical Psychology, 16*, 23–33.

Bull, P. E., & Connelly, G. (1985). Body movement and emphasis in speech. *Journal of Nonverbal Behavior, 9*(3), 169–187.

Butterworth, B., & Beattie, G. (1978). Gesture and silence as indicators of planning in speech. In R. N. Campbell & P. T. Smith (Eds.), *Recent advances in the psychology of language* (pp. 347–360). New York: Plenum.

Butterworth, B., & Hadar, U. (1989). Gestures, speech, and computational stages: A reply to McNeill. *Psychological Review, 96*(1), 168–174.

Cohen, A. (1977). The communicative functions of hand illustrators. *Journal of Communication, 27*, 54–63.

Cosnier, J. (1982). Communications et langages gestuels. In J. Cosnier, J. Coulon, J. Berrendonner, & C. Orecchioni (Eds.), *Les Voies du langage: Communications verbales, gestuelles et animales* (pp. 255–303). Paris: Dunod.

De Laguna, G. A. (1927). *Speech, its function and development*. New Haven, CT: Yale University Press.

De Long (1981). Kinesic signals at utterance boundaries in preschool children. In A. Kendon (Ed.), *Nonverbal communication, interaction and gesture* (pp. 251–281). The Hague: Mouton.

DePaulo, B. M., Rosenthal, R., Eisenstat, R. A., Rogers, A. L., & Finkelstein, S. (1978). Decoding discrepant nonverbal cues. *Journal of Personality and Social Psychology, 36*, 313–323.

Dittman, A. T. (1972). The body movement–speech rhythm relationship as a cue to speech encoding. In A. R. Siegman & B. Pope (Eds.), *Studies in dyadic communication* (pp. 135–151). Elmsford, NY: Pergamon.

Dittman, A. T., & Llewellyn, L. C. (1969). Body movement and speech rhythm in social conversation. *Journal of Personality and Social Psychology, 11*(2), 98–106.

Dobrich, W., & Scarborough, H. S. (1984). Form and function in early communication: Language and pointing gestures. *Journal of Experimental Child Psychology, 38*, 475–490.

Dowling, R. (1962). *Effect of sensorimotor and conceptual activity on perceptual functioning*. Unpublished doctoral dissertation, Clark University, Worcester, MA.

Duffy, R. J., & Moore, M. (1971). The relationship between intelligence and gestural behavior in a mentally retarded population. *Journal of Genetic Psychology, 119*, 195–202.

Efron, D. (1941/1972). *Gesture, race and culture*. The Hague: Mouton.

Ekman, P., & Friesen, W. (1972). Hand movements. *Journal of Communication, 22*, 353–374.

Ekman, P., Levenson, R. W., & Friesen, W. V. (1983). Autonomic nervous system activity distinguishes among emotions. *Science, 221*, 1208–1210.

Elmslie, T. J., & Brooke, J. D. (1982). Communicative gestures of the hand and arm when 4-year-old sons and their mothers interact. *Journal of Experimental Child Psychology, 34*, 151–155.

Evans, M. A., & Rubin, K. (1979). Hand gestures as a communicative mode in school-aged children. *Journal of Genetic Psychology, 135*, 189–196.

Feyereisen, P. (1983). Manual activity during speaking in aphasic subjects. *International Journal of Psychology, 18,* 545–556.
(1987). Gestures and speech, interactions and separations: A reply to McNeill (1985). *Psychological Review, 94*(4), 493–498.
Feyereisen, P., Van de Wiele, M., & Dubois, F. (1988). The meaning of gestures: What can be understood without speech? *Cahiers de Psychologie Cognitive, 8*(1), 3–25.
Freedman, N. (1972). The analysis of movement behavior during the clinical interview. In A. R. Siegman & B. Pope (Eds.), *Studies in dyadic communication* (pp. 153–175). Elmsford, NY: Pergamon.
Freedman, N., & Hoffman, S. P. (1967). Kinetic behavior in altered clinical states: Approach to objective analysis of motor behavior during clinical interviews. *Perceptual and Motor Skills, 24,* 527–539.
Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra-verbal meaning by gestures. *International Journal of Psychology, 10*(1), 57–67.
Graham, J. A., & Heywood, S. (1975). The effects of elimination of hand gestures and of verbal codability on speech performance. *European Journal of Social Psychology, 5,* 189–195.
Grand, S., Marcos, L. R., Freedman, N., & Barroso, F. (1977). Relation of psychopathology and bilingualism to kinesic aspects of interview behavior in schizophrenia. *Journal of Abnormal Psychology, 86*(5), 492–500.
Gratiolet, (1865). *De la Physionomie et des mouvements d'expression.* Paris: Hetzel.
Hadar, U., Steiner, T. J., Grant, E. C., & Rose, F. (1983). Head movement correlates of juncture and stress at sentence level. *Language and Speech, 26*(2), 117–129.
Hadar, U., Steiner, T. J., & Rose, F. (1984a). Involvement of head movement in speech production and its implications for language pathology. In F. C. Rose (Ed.), *Advances in Neurology. Vol. 42: Progress in Aphasiology* (pp. 247–261). New York: Raven Press.
(1984a). The timing of shifts of head postures during conversation. *Human Movement Science, 3,* 237–245.
(1984b). The relationship between head movements and speech dysfluencies. *Language and Speech, 27*(4), 333–342.
Harper, R. G., Wiens, A. N., & Matarazzo, J. D. (1978). *Nonverbal communication: The state of the art.* New York: Wiley.
Hewes, G. W. (1973). Primate communication and the gestural origins of language. *Current Anthropology, 14,* 5–24.
Hoffman, J. P. (1968). *Empirical study of hand movements.* Unpublished doctoral dissertation, New York University, New York City.
Jackson, J. P. (1974). The relationship between the development of gestural imagery and the development of graphic imagery. *Child Development, 45,* 432–438.
Jacobson, E. (1930a). Electrical measurements of neuromuscular states during mental activities: Evidence of contraction of specific muscles during imagination. *American Journal of Physiology, 95,* 703–712.
(1930b). Electrical measurements of neuromuscular states during mental activities: Visual imagination and recollection. *American Journal of Physiology, 95,* 694–702.
(1931). Electrical measurements of neuromuscular states during mental activities: Variations of specific muscles contracting during imagination. *American Journal of Physiology, 96,* 115–121.

Jancovic, M., Devoe, S., & Wiener, M. (1975). Age-related changes in hand and arm movements as nonverbal communication: Some conceptualizations and an empirical exploration. *Child Development, 46,* 922–928.
Jousse, M. (1955/1974). *L'Anthropologie du geste.* Paris: Gallimard.
Kendon, A. (1972). Some relationships between body motion and speech. In A. W. Siegman & B. Pope (Eds.), *Studies in dyadic communication* (pp. 177–210). Elmsford, NY: Pergamon.
(1980). Gesticulation and speech: Two aspects of the process of utterance. In M. R. Key (Ed.), *The relationship of verbal and nonverbal communication* (pp. 207–227). The Hague: Mouton.
(1983). Gesture and speech: How they interact. In J. M. Wiemann & R. P. Harrison (Eds.), *Nonverbal interaction* (pp. 13–45). Beverly Hills, CA: Sage.
(1984). Some uses of gestures. In D. Tannen & M. Saville-Troike (Eds.), *Perspectives on silence* (pp. 215–234). Norwood, NJ: Ablex.
(1986a). Current issues in the study of gesture. In J. l. Nespoulous, P. Perron, & A. R. Lecours (Eds.), *The biological foundations of gestures, motor and semiotic aspects,* pp. 23–47. Hillsdale, NJ: Erlbaum.
(1986b). Some reasons for studying gesture. *Semiotica, 62*(1/2), 3–28.
Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology, 16,* 495–512.
McNeill, D. (1975). Semiotic extension. In L. R. Solso (Ed.), *Information processing and cognition. The Loyola symposium* (pp. 351–380). Hillsdale, NJ: Erlbaum.
(1985). So you think gestures are nonverbal? *Psychological Review, 92*(3), 350–371.
(1987a). *Psycholinguistics: A new approach.* New York: Harper & Row.
(1987b). So you think gestures are nonverbal! Reply to Feyereisen. *Psychological Review, 94*(4), 499–504.
(1989). A straight path – to where? Reply to Butterworth and Hadar. *Psychological Review, 96*(1), 175–179.
McNeill, D., & Levy, E. (1982). Conceptual representations in language activity and gesture. In R. Jarvella & W. Klein (Eds.), *Speech, place and action* (pp. 271–295). New York: Wiley.
Marcos, L. R. (1977). *Hand movements in relation to the encoding process in bilinguals.* Unpublished doctoral dissertation, Downstate Medical Center, State University of New York, Brooklyn.
(1979a). Hand movements and nondominant fluency in bilinguals. *Perceptual and Motor Skills, 48,* 207–214.
(1979b). Nonverbal behavior and thought processing. *Archives of General Psychiatry, 36,* 940–943.
Masur, E. F. (1983). Gestural development, dual-directional signaling, and the transition to words. *Journal of Psycholinguistic Research, 12*(2), 93–109.
Miller, A. (1963). Verbal satiation and the role of concurrent activity. *Journal of Abnormal and Social Psychology, 66*(3), 206–212.
Moscovici, S. (1967). Communication processes and the properties of language. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 3, pp. 225–270). New York: Academic Press.
Moscovici, S., & Plon, M. (1966). Les situations-colloques: Observations théoriques et expérimentales. *Bulletin de Psychologie, 19*(274), 702–722.
Murphy, C. M. (1978). Pointing in the context of a shared activity. *Child Development, 49,* 371–380.
Overton, W. F., & Jackson, J. P. (1973). The representation of imagined objects in action sequences: A development study. *Child Development, 44,* 309–314.

Pechman, T., & Deutsch, W. (1982). The development of verbal and nonverbal devices for reference. *Journal of Experimental Child Psychology, 34,* 330–341.
Ragsdale, J. D., & Silvia C. (1982). Distribution of kinesic hesitation phenomena in spontaneous speech. *Language and Speech, 25*(2), 185–190.
Rand, G., & Wapner, S. (1987). Postural status as a factor memory. *Journal of Verbal Learning and Verbal Behavior, 6,* 268–271.
Rimé, B. (1979). *Communication non verbale ou comportements nonverbaux? Vers une théorie cognitivo-motrice des comportements non verbaux.* Unpublished manuscript, University of Louvain, Department of Psychology, Louvain-la-Neuve, Belgium.
(1982). The elimination of visible behavior from social interactions: Effects on verbal, nonverbal and interpersonal variables. *European Journal of Social Psychology, 12,* 113–129.
(1983). Nonverbal communication or nonverbal behavior? Towards a cognitive-motor theory of nonverbal behavior. In W. Doise & S. Moscovici (Eds.), *Current issues in European social psychology* (Vol. 1, pp. 85–141). Cambridge: Cambridge University Press.
(1985). "Do you see what I mean?" The process of sharing representations in interpersonal communication. *Symposium on the Social Constitution of Meaning in Interpersonal Communication.* Bad Homburg, December 4–7.
Rimé, B., Boulanger, B., & d'Ydewalle, G. (1988). *Visual attention to the communicator's nonverbal behavior as a function of the intelligibity of the message.* Paper presented at the Symposium on TV Behavior, 24th International Congress of Psychology, Sydney, Australia, August 28–September 2.
Rimé, B., Bouvy, H., Leborgne, B., & Rouillon, F. (1978). Psychopathy and nonverbal behavior in an interpersonal situation. *Journal of Abnormal Psychology, 87,* 636–647.
Rimé, B., & Gaussin, J. (1982). Sensibilité des comportements non verbaux aux variations de la densité de communication. *L'Année Psychologique, 82,* 173–187.
Rimé, B., Schiaratura, L., Hupet, M., & Ghysselinckx, A. (1984). Effects of relative immobilization on the speaker's nonverbal behavior and on the dialogue imagery level. *Motivation and Emotion, 8,* 311–325.
Rimé, B., Thomas, D., Richir, M., & Laubin, P. (1983). *The nonverbal behavior of individuals with different levels of verbal deficit.* Unpublished manuscript, University of Louvain, Department of Psychology, Louvain-La-Neuve, Belgium.
Riseborough, M. G. (1982). Meaning in movement: An investigation into the interrelationship of physiographic gestures and speech in seven-year-olds. *British Journal of Psychology, 73,* 497–503.
Rogers, W. T. (1979). The relevance of body motion cues to both functional and dysfunctional communicative behavior. *Journal of Communication Disorders, 12,* 273–282.
Saltz, E., & Dixon, D. (1982). Let's pretend: The role of motoric imagery in memory for sentences and words. *Journal of Experimental Child Psychology, 34,* 77–92.
Schiaratura, L., & Rimé, B. (1990). *Les gestes des mains chez le locuteur: Catégories et classifications.* Unpublished manuscript. University of Louvain, Belgium.
Shepard, R. N., & Feng, C. A. (1972). A chronometric study of mental paper folding. *Cognitive Psychology, 3,* 228–243.
Sirota, A. D., & Schwartz, G. E. (1982). Facial muscle patterning and lateralization during elation and depression imagery. *Journal of Abnormal Psychology, 91,* 25–34.

Van Heugten, A. A. T., & Van Meel, J. M. (1980). Handbewegingen tijdens de opname van in benoembaarheid en moeilijkheidsgraas variënde informatie. *Nederlands Tijdschrift voor de Psychologie, 35,* 23–40.
Van Meel, J. M. (1982). The nature and development of the kinetic representational system. In B. de Gelder (Ed.), *Knowledge and representation.* London: Routledge & Kegan Paul.
(1984, March). *Kinesic strategies in representation and attention-deployment.* Paper presented at the Symposium on the Relation of Language, Thought and Gestures. Tilburg, the Netherlands.
Vygotsky, L. S. (1962). *Thought and language.* Cambridge, MA: MIT Press.
Wallon, H. (1970). *De l'Acte à la pensée.* Paris: Flammarion.
Werner, H., & Kaplan, B. (1963). *Symbol formation.* New York: Wiley.
Williams, E. (1977). Experimental comparisons of face-to-face and mediated communication: A review. *Psychological Bulletin, 84,* 963–976.
Wolff, P., & Gutstein, J. (1972). Effects of induced motor gestures on vocal output. *Journal of Communication, 22,* 277–288.
Wundt, W. (1900/1973). *The language of gestures.* The Hague: Mouton.
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,* 203–306.