

On the Complementarity of Signed and Spoken Languages

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This chapter considers some implications of the relation between sign language and spoken language for a general theory of human language. Previous research revealing both similarities and differences between languages in the two modalities is taken into account here. In addition, the nature of gesture that accompanies language in each modality is explored in an attempt to better understand universal features of human communication. Whereas speakers gesture with their hands, the preliminary investigation described here suggests that signers gesture with their mouths. The picture that emerges is one in which the two natural language modalities converge in some areas, but diverge in others, and only together reveal the human language capacity in its entirety.

Sign languages are normal languages that arise when the channel for oral–aural communication is absent. Linguists study the very ordered system that emerges from this situation to gain insight into the nature of human language in general. Natural sign languages, then, represent a special instantiation of language, and as such, they provide an important means for determining the essential properties of human language and the contribution that the physical modality makes to language structure and organization. This chapter deals particularly with sign language competence, and with a perhaps surprising overlap between speakers and signers in the use of gestures specific to each modality. The discussion ends with suggestions as to how the particular whole human language

approach presented here may also be relevant to the study of language disorders in general and to SLI in particular.

TWO COMPLEMENTARY MODALITIES OF NATURAL LANGUAGE

Forty years of research on sign languages has demonstrated that the languages themselves are full natural languages with phonological, morphological, and syntactic systems (Emmorey, 2002, in press-b; Sandler & Lillo-Martin, 2000). They have such purely linguistic characteristics as phonological substructure (Stokoe, 1960) with sequential properties (Liddell, 1984); autosegmental and hierarchical relations among phonological elements (Sandler, 1989, 1993b); productive inflectional and derivational morphology (Aronoff, Meir, & Sandler, 2000; Padden, 1988; Supalla, 1986; Supalla & Newport, 1978); recursivity in syntax (Padden, 1988); and licensing of null arguments (Lillo-Martin, 1991). This research explains that the human brain spontaneously creates alternative full language systems when the auditory channel necessary for spoken language is not available. In order to understand what language is, then, it seems imperative to reach a profound understanding of the characteristics of these "other" languages.

A hypothesis is presented here that spoken and signed language manifest two parts of a single human language faculty. This hypothesis is different from others that assume sign languages are essentially the same as spoken languages, peacefully existing in a single language module, differing only trivially in the peripheral systems. The theory proposes that these two natural systems, spoken and signed, are similar in certain ways but different in others, and they complement each other within the realm of human cognition, together forming the whole human language.

Compare the whole human language theory with two other viewpoints. The first proposes that sign languages are not real languages, and the second is its opposite, saying that sign languages are just like spoken languages in all the important respects:

1. *The Speech Is Language Theory.* Humans are endowed by evolution for speech. Sign languages are not part of this endowment, are not natural languages, but instead are adaptive communication systems. The theory would predict that either (a) sign languages are entirely derivative of spoken languages, or (b) the grammatical organization of sign languages should be substantially different from that of spoken languages; there should be a different language-brain map, and sign languages should not have the same innate underpinnings as spoken languages. Proponents of this view would need evidence to support the claim that humans are not innately endowed with a pro-

propensity for sign language: The course of sign language acquisition should be different and longer, and should contain errors not predicted by general linguistic principles such as those embodied in a theory of universal grammar.

2. *The Modality-Independent Language Module Theory.* This is the mirror image of the first theory. It holds that signed and spoken languages are the same in all important respects and are mediated by a single language module, cognitively and neurologically. Only the peripheral systems, which make a trivial contribution to language structure, are different. It would predict that the grammatical systems of sign languages should conform to all principles of general linguistic theory. Within this overall constraint, sign language grammars should differ from one another as do the grammars of spoken languages; humans are endowed with an innate propensity for spoken and signed languages equally, and should show the same acquisition course; and sign languages should be controlled in the same areas of the brain as spoken languages.

3. *The Whole Human Language Theory.* Signed and spoken languages are two parts of one language faculty, partly overlapping, partly complementing each other, and together manifesting the full human endowment for language. The mind encompasses the potential for both systems, but each modality plays a nontrivial role in determining the linguistic structure of the resulting language. The theory would predict that there should be both significant grammatical similarities between spoken and signed languages, but also significant grammatical differences due to modality. Language in the two modalities should be innate to the same extent: There should be similar courses and timetables of acquisition. The language–brain map should reflect the influence of modality, and early experience with either modality could result in selective differences in brain organization.

Other theories are possible.¹ These three are presented here because the predictions of each theory are relatively coherent, and each theory is clearly distinguishable from the others. This chapter is devoted to providing evidence to support the whole human language theory. The discussion begins by demonstrating both grammatical similarities and differ-

¹The theories as presented here reflect ideas that have been in the air in one form or another, but do not necessarily conform strictly to specific proposals in the literature. The Speech is Language Theory follows from the Speech is Special theory proposed by Liberman and his colleagues at Haskins Laboratories (e.g., 1967), although those researchers did not take sign language into consideration at the time. The Modality-Independent Language Module theory is in the spirit of Fodor's (1983) modularity theory. It is this theory that explicitly or tacitly underlies much current sign language research (e.g., Poizner, Klima, & Bellugi, 1987; Kegl, Senghas, & Coppola, 1999). Theory III, The Whole Human Language Theory, is compatible with the views of McNeill and his colleagues (e.g., McNeill, 1992), here somewhat expanded in scope and extended to include sign language.

ences between spoken and signed languages. There is an overview of recent work on prosody and on verb agreement in Israeli Sign Language. Then some results in acquisition and brain research are briefly summarized. The chapter concludes by highlighting complementary traces of each system within the other—in manual and oral gestures.

GRAMMATICAL OVERLAP

Much of the past 40 years has been spent demonstrating that there are similarities in the grammars of spoken and signed languages. Stokoe's discovery that American Sign Language exhibits duality of patterning started the ball rolling. He showed that signs are not holistic gestures, but are comprised of a finite list of discrete, meaningless, contrastive units that combine to produce a potentially large vocabulary (Stokoe, 1960). A substantial body of linguistic research on the phonology of sign language followed, demonstrating that there are constraints on the combination of these units (e.g., Battison, 1978; Sandler, 1989), that despite significant simultaneous structure there is also sequential structure in sign language words (Liddell, 1984; Sandler, 1989), that there are autosegmental relations among phonological elements as well (Sandler, 1986, 1989), and that the sign language syllable has a visual equivalent of sonority (Brentari, 1990, 1998; Corina, 1990; Perlmutter, 1992; Sandler, 1993c).²

Others investigated morphology in American Sign Language, finding systems of verb agreement (Padden, 1988), verbal aspect inflection (Klima & Bellugi, 1979), and a rich system of classifier complexes (Supalla, 1982, 1986). Although most of these discoveries were made in studies of American Sign Language (ASL), research on other sign languages reported similar findings. Among the earliest studies of a sign language were those conducted by Schlesinger and his colleagues on Israeli Sign Language (ISL), which described certain grammatical regularities (Cohen, Namir, & Schlesinger, 1977; Schlesinger & Namir, 1978). Fundamental similarities in the syntactic structures of ASL and many spoken languages have also been shown to exist. For example, ASL has embedded sentences that can be formally distinguished from coordinated sentences (Padden, 1981, 1988); it has null arguments (Lillo-Martin, 1986, 1991), and *wh*-movement in questions (Neidle, Kegl, McLaughlin, Bahan, & Lee, 2000; Petronio & Lillo-Martin, 1997).

Recent research on prosody in Israeli Sign Language serves as one example of the many grammatical similarities that have been found between languages in the two modalities. Prosody is potentially of special interest for

²See Corina and Sandler (1993), Brentari (1995) for overviews of sign language phonology research.

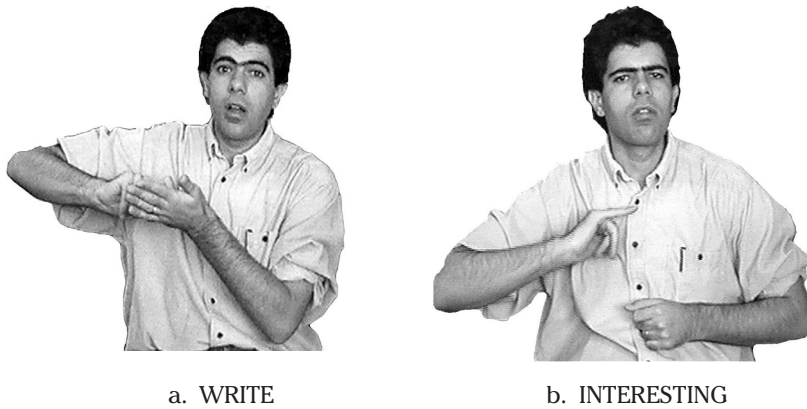


FIG. 15.1. Change in body and face across Intonational Phrases.

In sign language, several researchers have claimed that facial expression corresponds to intonation in spoken language (e.g., Nespor & Sandler, 1999; Reilly, McIntire, & Bellugi, 1990; Wilbur, 1996).⁴ The sign language correlate of intonation has been called *superarticulation*, and the combination of superarticulations *superarticulatory arrays* (Sandler, 1999b). Like intonational tunes of spoken language, the superarticulatory arrays of sign language also have the intonational phrase as their primary domain. For example, each of the intonational phrases in the sentence glossed in Example 2 is characterized by a completely different set of nonmanual markers, pictured in Fig. 15.1: a change of head position at the intonational phrase boundary, and differences in all aspects of facial expression (e.g., eyebrows, upper and lower eyelids, and mouth) in each intonational phrase.

- (2) [[book-there]_p [he write]_p]_i [[interesting]_p]_i
 ‘The book he wrote is interesting.’

As in vocal intonation, sign language superarticulation is also componential. For example, the superarticulatory array of a wh-question can be combined with the superarticulation that has the meaning, ‘shared information’. The wh-question array in ISL is typically characterized by furrowed eyebrows, as shown in Fig. 15.2a. A different superarticulation—a squint of the eyelids, shown in Fig. 15.2b—signals information that is to be considered shared by both interlocutors. These two can be combined. For example, in the following wh-question, the underlined part is established as shared in-

⁴This view contrasts with the position of some researchers that grammatical facial expressions of sign languages reflect syntax directly (Liddell, 1980; Neidle et al., 2000).



a. wh-question



b. shared information



c. wh-question and shared information

FIG. 15.2. (a) Superarticulation for a wh-question in ISL. (b) Superarticulation for shared information in ISL. (c) Componential superarticulation: Wh-question and shared information

formation: ‘Who is the woman you met last week?’. As Fig. 15.2c shows, the facial expression for the that part of the sentence combines the wh-furrowed brows with the shared information squint.

These examples show that sign language superarticulation, like spoken language intonation, is componential. But there is a difference, which is due to the modality. Each superarticulation can be superimposed simultaneously with the others, and with the whole stretch of the utterance that they characterize. As the facial articulators responsible for superarticulation are independent of each other and of the manual channel that transmits the words of the language, all articulations are free to combine simulta-

neously. This effect of the modality will be discussed further in the next section, in which other differences in the grammars of signed in spoken languages are presented.

GRAMMATICAL DIFFERENCES

The videotaped series, “The Human Language,” presents an excellent and engaging introduction to the leading modern approach to linguistics conceived of primarily by Chomsky. One installment of the three-part series,⁵ revealed that language is very good at some things—like expressing the relation of people and things to some activity or event (through agreement, case marking, word order, etc.). But it is also explained that language is bad at other things—like describing a map (how to get somewhere) or shapes and dimensions of objects (like “spiral shape”). Well, this statement as it stands is wrong. Spoken languages are bad at these things, but sign languages are great at them. Not only are sign languages extremely good at expressing things related to visuospatial cognition, but more than that, they all seem to do it pretty much the same way, and to encode visuospatial concepts in their grammars. Here is where the grammatical systems of spoken and signed languages part ways.

A typical example of a grammatical process in sign language that exploits visuospatial cognition is verb agreement. Although many spoken languages have verb agreement, the verb agreement of sign languages is different. First described and analyzed in detail for American Sign Language (ASL) by Padden (1988), the system indicates the referents of arguments of the verb by moving the hands among points in space that correspond to these referents. For example, the signs meaning ‘I give you’ and ‘S/he gives me’ are represented in Fig. 15.3.

In a discourse, there can be many referents (physically present or not), each with its own locus in space. The way in which this system exploits spatial relations is immediately obvious. But it might still be claimed, as many people have, that it is nevertheless just verb agreement—a system that grammatically marks on the verb certain properties of its arguments, much as Hebrew or Italian do. This claim is not accurate, however, because there are several other ways in which the sign language system differs from spoken language verb agreement. For example, not all verbs agree. There is a class of plain verbs that do not take any agreement. In addition, there is a class of verbs like TAKE that seem to move backward; instead of the hands articulating a movement that goes from the subject locus to the object locus as in GIVE (Fig. 15.3), the direction of movement in

⁵*The Human Language: Colorless Green Ideas*. 1993. Gene Searchinger, Producer. Equinox Films.

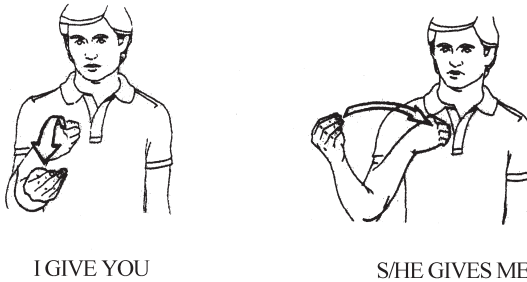


FIG. 15.3. Example of verb agreement in ASL. Reprinted with permission from *A Basic Course in American Sign Language*, T. Humphries, C. Padden, and T. J. O'Rourke. 1980. Silver Spring, MD: TJ Publishers.

backward verbs is from object to subject.⁶ Meir (1998b, 2002) showed that these and other properties of the verb agreement system of Israeli Sign Language can be explained by a few simple principles that reveal how ISL reflects visuospatial cognition in its grammar.

VERB AGREEMENT PRINCIPLES

Meir (1998a) proposed the following verb agreement principles:

1. Agreement verbs are verbs involving *transfer*, physical or metaphorical.
2. Movement of the hand follows a path from *source* to *goal*.⁷
3. Facing of the hand is toward the *syntactic object*.

This analysis explains why some verbs are agreement verbs and others are not: Only verbs of transfer agree. For example, the verbs HOLD and THINK are not agreement verbs as there is no transfer involved, whereas the verbs GIVE and TEACH are both agreement verbs, involving transfer of goods and of information, respectively. In addition to explaining which are and are not agreement verbs, the principles also explain which agreement verbs are regular and which are backward. The regular agreement verb GIVE and the backward verb TAKE are both verbs of transfer. In both signs, the hand moves from source to goal as the second principle requires. This explains why, in a sentence meaning 'I give you', the hand moves from the signer (subject) to the addressee (object), whereas in 'I take from you', the

⁶An additional difference, also first described by Padden (1988), is the existence of a third class, called spatial verbs, whose movement paths are interpreted literally, i.e., from specified point a to specified point b.

⁷Other researchers working within different theoretical frameworks have also claimed that the sign language agreement system refers to source and goal rather than subject and object, e.g., Friedman (1976), Kegl (1985), and Bos (1998).

hand moves from the addressee (indirect object) to the signer (subject)—backward from a syntactic point of view. In both verbs, the signing hand faces the addressee, the syntactic object. What is backward about TAKE type verbs is their inherent lexical semantics, and not their agreement properties: The source corresponds to the object and the goal to the subject, unlike regular agreement verbs in which the source corresponds to the subject and the goal to the object (Meir, 1998a, 1998b). But as far as agreement is concerned, backward verbs are like other agreement verbs, moving from source to goal.

The verb agreement system is linguistic: It involves specific semantic and syntactic categories, and it is rule governed. However, it clearly exploits spatial locations and relations. In fact, the system may exploit essentially any visible and comfortably reachable spatial location within the signing area, and the grammar does not limit the number of locations that can be employed within a discourse. These aspects of agreement have been argued to rely on general cognition and not on a linguistic system (e.g., Liddell, 1995, 2000).

Another unusual property of sign language agreement is that the agreement morphology is superimposed on the sign in a way that is more simultaneous than is the case with the typically sequential affixal morphology of spoken languages. And yet another fact about sign language agreement makes it different from grammatical systems in spoken languages: All established sign languages have essentially the same system.⁸ They all have a class of agreement verbs with the same spatial organization, a subclass of backward verbs, and a class of plain verbs that do not agree. It is clear that this system, although grammatical, reflects universal aspects of visuospatial cognition.

In addition to verb agreement, sign languages in general have other morphological systems in common, such as verbal aspect morphology and classifier complexes. Aronoff, Meir, and Sandler (2000) and Aronoff, Meir, Padden, and Sandler (in press) proposed that sign languages reflect this kind of cognitive system directly because they are visual. Spoken languages would if they could, but they can't, so they don't. Rather, the grammatical systems of spoken languages are for the most part not directly determined by visuospatial cognition, and they differ from one another much more widely. Under the whole human language theory, it is expected that some significant grammatical differences between spoken and signed languages will result from the physical modality. Visually motivated, sign language universal morphological processes, such as verb agreement, are examples of such differences.

⁸Though strikingly similar in overall structure, some differences have been found among sign languages in verb agreement. For example, some sign languages have auxiliary verbs for marking agreement where the main verb does not inflect for agreement (Smith, 1990; Bos, 1994). Fischer and Osugi (2000), have found that in Nihon Syuwa (the Sign Language of Japan), an 'indexical classifier', articulated in neutral space by the nondominant hand, marks the locus of agreement.

Lest the reader form the mistaken impression that sign language morphology has little in common with that of spoken language, it should be noted that there are also sequential affixes grammaticalized from independent words in ASL and ISL, the two sign languages studied in Aronoff et al. (2000, in press). These show the same kind of arbitrariness, language specificity, and idiosyncrasy that derivational affixes manifest in spoken languages. From a comparison of the two types of morphology, it may be concluded that sign languages do draw from the pool of grammatical possibilities available to all languages regardless of modality, but they also have some properties unique to them and predictable on the basis of visuospatial cognition (Aronoff et al., 2000, in press). It has also been argued that even the more typical simultaneous sign language morphology bears structural similarities to that of some spoken languages, in particular, to the templatic type of morphology found in Semitic languages (Sandler, 1990).

The superarticulation system described earlier, although bearing certain important similarities to intonation in spoken language, also manifests a nontrivial difference resulting from the modality, as explained. In particular, the primitives of the system and their distribution within a prosodic constituent are quite different from those of spoken intonation. Spoken language intonation consists of H and L tones that are lined up in a sequence, especially at phrase boundaries, but sign language superarticulation consists of configurations of the brows, upper and lower eyelids, cheeks, and mouth, which co-occur with each other simultaneously in different combinations as exemplified in Figs. 15.2a–c. In addition, the whole array cooccurs simultaneously across entire prosodic constituents, not just at their boundaries.

Spoken language intonational contrasts are produced by the frequency of vibration of a single articulator, the vocal cords, which is involved in the transmission of speech apart from intonation. Different frequencies or tones can only be produced and perceived in a sequence. The sign language modality recruits many more articulators (i.e., the brows, eyelids, cheeks, mouth, etc.) and none are involved in producing signs. This results in an intonational system in sign language that has more primitives than the H and L tones of spoken language. The primitives of sign language intonation co-occur simultaneously with each other instead of following one another in a sequence, and also co-occur simultaneously with the entire prosodic constituent that they characterize, rather than clustering at the boundary. It appears then that when sign language is considered alongside spoken language, the modality-determined differences between them cannot be considered trivial. Rather, in each case, the modality imposes significant aspects of linguistic structure on language (Sandler, 1999c).

THE COURSE OF ACQUISITION

There is quite an extensive literature on the acquisition of American Sign Language by deaf children of deaf signing parents. (For overviews, see Newport & Meier, 1985, and Peperkamp & Mehler, 1999; for syntheses, see Meier, 1991, and Sandler & Lillo-Martin, 2001.) Researchers concur that language is acquired by children along a comparable time course in the two modalities. Early milestones are reached at comparable ages.⁹ Difficult parts of the grammar are acquired later than simpler parts in both modalities. For example, despite the fact that verb agreement is motivated by general properties of visuospatial cognition, the system is formally complex, and is only acquired in ASL between ages 3 and 4 (Meier, 1982). The error pattern of deaf children confirms that they are acquiring language as a formal, componential system, and not as an iconic gestural system. For example, small children can confuse the pronouns 'I' and 'you' in sign language as in spoken language, despite the fact that the ASL pronouns have the seemingly transparent form of pointing gestures toward oneself and one's addressee, respectively (Pettito, 1987).

THE LOCALIZATION OF LANGUAGE IN THE BRAIN

A range of different research methods has been applied in attempts to map various cognitive functions to specific areas of the brain. Traditionally, the field was based on the study of aphasics, and relied on comparing CAT scans picturing the brain lesions with language performance. Real-time studies on normal brains have been made possible by using the event-related potential (ERP) method, and more recent methods of positron emission tomography (PET) and functional magnetic resonance imaging (fMRI), and these studies have challenged some of the earlier assumptions. Overall, the most significant generalization is also the broadest: "In about 98 per cent of strong right-handers from right-handed families, the left perisylvian association cortex accomplishes most . . . language processing functions" (Caplan, 2000, p. 594).

Sign languages rely on visuospatial abilities, as the discussion of verb agreement indicates. Visuospatial cognition is understood to be primarily controlled by the right hemisphere. If sign language is an adaptive system as the Speech is Language Theory proposes, then it might be expected that its organization in the brain is determined primarily by general cognitive abilities and not by operations specific to language. For example, sign language

⁹Some researchers have found an early advantage for the acquisition of first signs over first spoken words (see Newport and Meier 1990 for a theoretical discussion of these results). However these findings are based on studies of a small number of children, and other researchers have refuted them because of conflicting evidence (Volterra and Iverson, 1995).

might be expected to be controlled primarily in the right hemisphere like any other function relying on visuospatial cognition. However, if the linguistic organization of spoken and sign language are independent of the physical modality in which they are transmitted, as the modality-independent language module theory would have it, then sign language should be controlled by the left hemisphere to the same extent as spoken language. The predictions of the whole human language theory are less clear-cut at this stage, but ultimately may prove more interesting. If spoken and signed languages belong to the same system, then significant overlap in brain organization should be found. But differences in brain organization should also be found. These differences in brain organization should go beyond peripheral motor activity. They should also correspond directly to the ways in which each physical modality influences linguistic structure. The following paragraph summarizes some of what is known about sign language and the brain.

Poizner, Klima and Bellugi (1987) studied six deaf signing patients, three with right hemisphere lesions, and three with left hemisphere lesions. They found that the LH patients all exhibited aphasia in sign language production, whereas the RH patients did not, even though they did exhibit visuospatial deficits such as left neglect. These results are striking, but cannot be considered conclusive. First, although the sign language production of Poizner et al.'s RH patients was intact, they did have difficulties in comprehension of spatial syntax. Second, recent studies on normal brains, surveyed in Peperkamp and Mehler (1999), reveal a more mixed picture. For example, they described an fMRI study showing bilateral representation of both spoken and signed language in hearing native signers (i.e., hearing people with deaf parents; Soderfeldt, Risberg, & Ronnberg, 1994). They also reported on an ERP study by Neville et al. (1997) showing bilateral representation of visually presented written English and signed ASL in deaf and hearing native signers. Taken together, it appears that early acquisition of sign may lead to bilateral representation in the brain of any language, spoken or signed, whereas the acquisition of spoken language alone results in representation mostly in the left hemisphere.¹⁰

EVIDENCE FOR COMPLEMENTARITY: GESTURE IN BOTH MODALITIES

The primary channel for spoken language is the oral–aural channel. Largely as a result of this modality, speech is segmented and sequential, and the words of spoken language are mostly arbitrary. However, the spoken medium with its inherent arbitrariness and sequentiality of structure are apparently insufficient for human communication. Studying de-

¹⁰See Corina (1998, 1999) and Emmorey (2002) for overviews of research on sign language and the brain.

scriptive narratives from vastly different cultures, McNeill (1992) and his team found that people invariably gesture when they speak. Together with Kendon (1988) and others,¹¹ McNeill argued that gesture is part of language, and not extraneous to it:

My own hypothesis is that speech and gesture are elements of a single integrated process of utterance formation.” p 35 “The utterance has both an imagistic side and a linguistic side. The image arises first and is transformed into a complex structure in which both the gesture and the linguistic structure are integral parts. (pp. 29–30)

McNeill (1992) distinguished gestures from the linguistic units of language along the following five parameters:

1. Gestures are global (in the sense of having no subunits like the phonemes of words for example).
2. They are noncombinatoric: Each gesture is an idea unit with no ordered or hierarchical organization between it and other gestures.
3. Their interpretation is context dependent: The same entity can prompt different gestures in different contexts.
4. They are idiosyncratic; there are no standards of form.
5. They either anticipate or cooccur with speech. They neither follow speech nor occur independently.

Gesture is thus distinct from the linguistic elements of speech. But according to McNeill, gesture is part of language, as attested by the fact that gestures and speech do not always manifest the same information, often complementing each other instead. Speech and gesture are interwoven to form a rich communicative amalgam. The gestural component of this amalgam is divided into four categories: Gestures may be iconic, metaphoric, beat, or deictic. Anticipating a comparison with sign language, the focus here is only on iconic gestures. These are “gestures that bear a close formal relationship to the semantic content of speech . . . (and) display aspects of the same scene that speech also presents” (p. 78). An example from the McNeill corpus is a gesture that accompanies the words, *and he bends it way back*, in describing a scene in a cartoon in which a character bends back a tree. The hand appears to grip something anchored from below and to bend it toward the speaker. This iconic gesture is semantically related to the spoken utterance, and also adds information that is not present in the utterance, information about shape, dimension, anchoring, and the spatial relation between the character and the object.

¹¹See Kendon (1994) for a recent overview of research on gesture in communication.



FIG. 15.4. Iconic gestures accompanying speech.

Even the most articulate speakers enhance their speech with gesture. A professor of English literature describes how she makes her favorite *hallah*, a traditional bread for Sabbath and holidays. The relevant part of the narrative is shown in Example 3, in which words that were accompanied by gestures are underlined. The specific gestures accompanying the words that are in boldface are shown in Fig. 15.4.

- (3) “I like to make . . . a traditional braided *hallah*, made with three long segments that are narrower at the ends than at the middle. Then when you **braided them** it’ll be **slightly higher in the middle** and **tapered at the ends.**”

Whereas this speaker is especially articulate, describing objects and activities in clear detail verbally, she nevertheless enhances these verbal descriptions with simultaneous gestures.

It is clear that gestures are a natural part of linguistic communication, just as the basic organizing properties of language are natural for humans. People even gesture when they cannot be seen, for example, on the telephone. Iverson and Goldin-Meadow (1997, 1998) reported more impressive findings—that congenitally blind people use similar gestures to those of sighted people when they talk. Volterra and Iverson (1995) reported that small children (hearing and deaf alike) typically use a good deal of gesture in the early stages of language acquisition. One study (Iverson, Capirci, & Casell, 1994) showed that many small hearing children (16 months old) with no exposure to sign language use gesture more frequently than words, even when their verbal vocabulary is larger. Gesture, then, is natural.

The ability to organize and convey thoughts through a linguistic system that has a broad foundation of universal properties is, of course, also natural. The naturalness both of gesture and of linguistic organizing principles explains

why sign languages arise spontaneously wherever a group of deaf people has an opportunity to congregate and interact: Sign languages originate as gesture systems and quickly become grammaticized (Kegl et al., 1999).

It is extremely important to underscore the fact that the signs of established sign language are not gestures. Evaluated according to all of the criteria used by McNeill to define gestures, the lexical signs of real, grammatically organized sign languages are distinct from gestures, exactly as spoken words are distinct from gestures. Sign language signs are componential rather than global; they are combinatoric, entering into hierarchical phonological, morphological, and syntactic structures; they have meaning independent of context; and they are standardized (i.e., signs are like spoken words and unlike gestures).

However, signs do use the manual/visual channel that gestures use. Does the fact that the hands are busy “talking” preempt the possibility of gesture in sign language? Preliminary research indicates that it does not. Instead, signers may gesture with the other articulatory mechanism with which humans are endowed for linguistic communication: the mouth.

The mouth is very active in sign language communication, performing an eclectic variety of tasks. A small number of lexical signs in Israeli Sign Language require a mouth shape or movement of some kind as part of their lexical representation. Like any sign, such signs are lexically specified for hand configuration and for the location and movement articulated by the hand. But these signs are also lexically specified for a particular mouth shape or movement. Whether the mouth movements have internal structure is not yet clear; however, it is clear that they themselves are contrastive subunits like phonemes, entering into the higher word structure. These lexical mouth specifications are completely standard and required by the grammar.¹²

Other mouth movements function as grammatical morphemes. Certain mouth shapes, co-occurring with verbs or verb phrases, have an adverbial meaning (Liddell, 1980; Anderson & Reilly, 1998). For example, a laxly open mouth with the tongue visible but not protruding, co-occurring with an ISL verb, means ‘for a long time’. Other mouth shapes add other adverbial modifications, such as ‘carelessly’ or ‘with effort’. These two functions—as part of a lexical representation and as an adverbial morpheme on verb phrases—are part of the linguistic system of the language. They are standard subunits in the language, entering combinatorially into the grammatical system.

In addition to these native mouth shapes and movements, selective and sometimes partial mouthing of words from Hebrew is fairly common in ISL, as in many other sign languages (Boyes-Braem & Sutton-Spence, 2001). Although clearly borrowed from the spoken language, this mouthing has inherent patterns that are determined in large part by language-internal criteria. An

¹²See Woll (2001) and Bergman and Wallin (2001) for suggestions about internal structure to mouth movements in lexical signs.

example of such a pattern is found in ISL constructions of a content-word host plus a pronominal clitic. In these forms, if the Hebrew word corresponding to the sign that hosts the clitic is mouthed, the mouthing stretches over the whole host plus clitic construction (Sandler, 1999a, 1999b).

In sum, the investigation of Israeli Sign Language is showing that there is a stream of linguistic mouth shapes and movements with different functions accompanying the manual signing (Sandler, in preparation).¹³

Apart from this plethora of linguistic roles, the mouth is also used for gestures in ISL. These mouth gestures are all iconic, representing some physical aspect of an object or event.¹⁴ For example, they may represent a tactile effect, either of an object (e.g., soft or lightweight) or of a motion event (e.g., friction or vibration); or a physical state, such as being filled to capacity. In the corpus studied, three native signers signed the same 20 sentences, which were elicited for a study on an unrelated topic and happened to be especially rich in mouth gestures. A detailed treatment of these phenomena is beyond the scope of this discussion. What follows demonstrates briefly what is meant by mouth gestures, so that the bearing they have on the more general topic under discussion may then be examined.

The mouth shapes that express physical properties in ISL indeed appear to be gestures. Unlike the linguistic mouth units already described, the mouth gestures are independent of the grammatical system. They have no internal structure, and they are also noncombinatoric in McNeill's sense that each gesture is an idea unit, and that no ordered or hierarchical organization exists among gestures (McNeill, 1992). Further distinguishing these gestures from linguistic mouth units is the fact that the gestures have no ordered or hierarchical relation with the linguistic content. The gestures are context dependent: The same gesture may have different interpretations, depending on the sentence with which it occurs. The three signers sometimes used the gestures idiosyncratically. In some cases, one or two signers used mouth gestures and the other(s) did not. In other cases, the same signer either used different gestures to

¹³Linguistic functions for the mouth have been reported in other sign languages as well. Liddell (1980), Anderson and Reilly (1998), and others have described adverbial mouth positions in ASL. For example, Bergman and Wallin (2001) examine mouth 'segments' in Swedish Sign Language, and Woll (2001) describes the behavior of lexical mouth movements in British Sign Language. The reader is referred to Boyes-Braem and Sutton-Spence (in press) for a collection of interesting papers on the behavior of the mouth in a variety of sign languages. An additional role for the mouth is reported by Obando et al. (2000), who describe an elaborate system of lip pointing in Nicaraguan Sign Language that was apparently modeled on simpler lip pointing gestures of hearing Nicaraguans.

¹⁴The term 'mouth gestures' as used here refers only to a particular subset of what are labeled with the same term in Boyes-Braem and Sutton-Spence (2000).



FIG. 15.5. *Friction gesture.*

describe the physical situation involved, or gradient degrees of intensity to iconically reflect different degrees of intensity involved.

Consider three examples here. The first gesture accompanied the ISL translation of the sentence, ‘He emptied the water out of the pool.’ The gesture, pictured in Fig. 15.5, creates friction as the air passes through the constricted lips, and represents the draining of water through a small opening. Like manual gesture accompanying spoken language, this mouth gesture complements the signed message, adding information about the way in which the water was emptied from the pool: creating friction (by forcing it through a small opening).

Goldin-Meadow and McNeill (2000) independently suggested that “the mouth movements associated with particular sounds might assume the mimetic function for signers,” and cited an observation to this effect in Padden (1990). By putting such gestures to the tests listed earlier, the present investigation suggests that their speculation is correct, that mouth movements corresponding to sounds such as one created by friction are among the mouth gestures of ISL. Figure 15.5 is one of several examples in the corpus.

Another example focuses on the physical state of an object, specifically, the state of being filled to overflowing. The gesture is one or two puffed cheeks. In addition to conforming to other gesture criteria, this gesture is nonlinguistic in an additional respect: It is gradient rather than discrete. In the example shown in Figs. 15.6 and 15.7, as the wagon gets fuller, the puffing spreads from one cheek to two. These gestures occurred in sequence, with a signed utterance, meaning “He loaded the wagon with grass.” The cheek-puff cannot be considered part of a lexical word, FULL. Rather, its interpretation is context dependent, another crite-

FIG. 15.6. Gradient mouth gesture—*full* gesture.FIG. 15.7. Gradient mouth gesture—*stuffed* gesture.

tion of gesturehood. In a different utterance in the corpus, the cheek-puff coincided with ‘carried a suitcase’, in which the suitcase had previously been described as heavy. In the utterance from which Fig. 15.8 was extracted, the gesture complements the words, adding the information that the suitcase was heavy. This sort of complementary function is analogous to McNeill’s tree bending example described earlier.

It seems clear that these mouth gestures are qualitatively different from signs: They conform to McNeill’s gesture criteria, whereas lexical signs do not.

At this stage of research, it is already becoming apparent that mouth gestures are also different from intonational use of the face. The mouth gestures in the corpus are iconic, representing either the appearance of something (e.g., stuffed-full, large, etc.) or another physical property, like vibration (e.g., to spray bullets vs. to pop bullets; spray or drain water,



FIG. 15.8. *Heavy gesture.*

etc.). The superarticulatory facial expressions of sign language intonation are not iconic in this way. The raising of eyebrows does not correspond in form to any external object or event, for example. In addition, the elements of intonational facial expression are componentially structured, and mouth gestures appear to be independent of each other and of the elements of superarticulation.

A good deal remains to be learned about mouth gestures and their place in sign language communication. Readers familiar with sign language may be interested to know that mouth gestures often accompany classifier constructions. Such constructions are arguably standardized and combinatorial and thus linguistic (e.g., Supalla, 1982, 1986), but they also differ in significant ways from lexical signs (see Emmorey, in press, for current views and analyses). The various functions of classifier complexes all involve visual aspects of some event. They describe size and shape of referents, spatial relations and interactions among them, and the path shapes and manners of movements that they enact. Current investigations concentrate on whether the tendency for mouth gestures to co-occur with classifier constructions is coincidental, because such constructions also tend to be used when describing physical shapes, states, and relations, or whether there is a more principled relation and interaction between the two.

Another area currently under investigation is the degree of idiosyncrasy in sign language mouth gestures. Whereas idiosyncrasy has been found in the ISL mouth gestures, it may turn out that McNeill's criterion—that gestures are idiosyncratic, having no standards of form—will have to be relaxed somewhat for the mouth gestures of sign language. The mouth gestures may be somewhat less free in form than are the manual gestures that accompany spoken language. In fact, it may turn out that there is a continuum from true mouth gestures to more conventionalized mouth shapes of

the adverbial system, for example. There are two good reasons for a tendency from gesture toward conventionalization in this modality. First, the mouth has far fewer configurational options than the hands, especially the two hands together. This means that each mouth gesture is relatively simple and easy to process. The fact that the sign language addressee looks smack at the face of the signer, rather than at the hands (Siple, 1978), may make this processing even more immediate. Second, mouth gestures are transmitted visually, like the rest of sign language. The pressure to conventionalize simple and salient gestures that are transmitted in the same perceptual modality as the words of the language might in some cases overwhelm the idiosyncrasy that mouth gestures have at their origin.

To summarize the investigation thus far, natural sign language utterances are often accompanied by gestures. These gestures are made with the mouth and have much in common with the iconic gestures made by the hands of speakers of spoken language. The most obvious difference between the two is that the gestures accompanying spoken language are transmitted in a different modality from that of the language itself, whereas the gestures accompanying sign language are transmitted in the same modality.

THE WHOLE HUMAN LANGUAGE

If the preliminary results reported in the previous section are correct, then all human language requires augmentation with gesture. That is, both modalities require a holistic, idiosyncratic, iconic, and simultaneous means of complementing the linguistic signal. How can these new findings be integrated with the selective survey of sign language research contained in previous sections, and within the context of the theories of language introduced earlier? And what are some possible implications for the study of SLI?

An example in the literature showing that sign languages and spoken languages share certain key properties was presented earlier. The particular system described there was the prosodic system. Similarities to spoken language in the prosodic system are added to significant similarities at the phonological, morphological, and syntactic levels reported here and elsewhere in the sign language literature. In addition, both spoken and signed languages are acquired without instruction along the same time course. These two shared characteristics, specific structural and organizational features and the timetable for acquisition, are defining properties of natural language. It follows that a theory the Speech is Language Theory, predicting that only the spoken modality will have these features, should be rejected as an explanatory theory of language. This leaves the modality-independent language module theory and the whole human language theory for consideration.

The modality-independent theory predicts that, phonetics aside, the modality will have no important effect on grammatical organization. It also predicts that the organization of language in the brain should be the same in any modality. How do these predictions fare in the light of the sign language facts reported here?

As discussed earlier, intonational sequences of units that differ from each other in binary fashion (H or L), that fall on stressed words and cluster at prosodic constituent boundaries, characterize spoken languages but not sign languages. Rather, sign language superarticulation, which seems to have the same function as intonation, is comprised of a larger pool of primitives that combine simultaneously rather than sequentially and characterize whole constituents instead of occurring mainly at boundaries.

A previous section showed clear differences in the morphology of spoken and signed languages. The modality-independent theory predicts both that sign languages should draw from the same pool of morphological possibilities as spoken languages, and that individual sign languages should differ from each other to the same extent that spoken languages do. However, it was shown that significant blocks of sign language morphology have a predictable and nonarbitrary relation to visuospatial cognition that is lacking in spoken languages, and that all sign languages studied so far are very similar with respect to these morphological systems. The expected variation across sign languages has not emerged. More arbitrary morphology, like the sequential affixes in ASL and ISL, as well as more cross sign language variation will emerge and increase, to the extent that sign languages are able to accrue diachronic depth at a rate comparable to that of spoken language (Aronoff et al., 2000, in press). Because typically only fewer than 10% of deaf people are native signers, this diachronic depth is always confounded by the fact that interaction takes place in a community in which 90% are not native users of the language. Although the kinds of morphology more commonly found in spoken language are still predicted to increase over time, it is also expected that the sign language typical morphology will persevere in all sign languages, simply because of the modality. Such differences in grammatical organization between the two modalities are not expected under the modality-independent theory.

The results of brain research also challenge that theory. The use of language in both modalities involves extensive left hemisphere involvement, but the right hemisphere is also activated by sign language, quite possibly because of the interaction between visuospatial cognition and language. Interestingly, early acquisition of sign language by hearing people results in right hemisphere involvement for spoken language as well. Evidence of this kind argues against a language module like that proposed by Fodor (1983) and also predicted by the modality-independent theory, which requires fixed neural architecture for the language module.¹⁵

¹⁵See also Sandler (1993a) for several arguments from sign language against Fodor's (1983) modularity model.

However, if signed and spoken languages are complementary aspects of the whole human language faculty, such differences would be expected. The whole human language view holds that, within the human mind, the propensity for language in both modalities exists. This seems to be true despite the apparent evolutionary predominance of speech. Such predominance seems indisputable, as no known hearing community just happens to use sign language as its primary means of communication. But, regardless of the conditions under which one modality emerged as dominant, the potential for sign language is as much a part of the human language capacity as is the potential for spoken language. Whereas similarities abound between languages in the two modalities, there are important differences as well. The Whole Human Language is the combination of the two.

GESTURES ARE INTEGRAL TO LINGUISTIC COMMUNICATION

The gesture studies are especially intriguing in the pursuit of the defining characteristics of human language. The claim that natural gestures are integral to linguistic communication has four solid pieces of evidence to support it.

1. Speaking people apparently must gesture when they speak, whether or not these gestures are even perceived by the speakers or their interlocutors.
2. The gestures are often not redundant; they complement the message being conveyed.
3. In the absence of the auditory channel, human communities create bona fide languages from gesture spontaneously and in a short time.
4. Gesture accompanies any natural language, whether spoken or signed.

The language–gesture amalgam may hint at a more primal bimodal foundation for linguistic communication: Both modalities use oral and manual channels simultaneously in the service of language. If the oral channel is used for the purely linguistic signal, then the hands supply the gestural complement. If the manual channel is the medium for language, then the mouth provides the complementary gestures. Both modalities are natural; traces of each are found in the other, and together they comprise the whole human language.

One implication of this theory is clear. In order to study language, whether in linguistically normal populations such as speakers or signers,

or in populations with language impairments such as those seen in aphasia, autism, or SLI, it is not possible to rely on the structure of spoken language alone, sign language alone, or gesture alone. Rather, serious consideration must be given to the organization of language in both spoken and signed modalities, as well as to the interaction of each with gesture.

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