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SIGN LANGUAGES

When deaf people get together in a community, a sign language emerges. The sign languages of linguistic investigation are these naturally developing languages. They stand in contrast to the invented sign systems developed by educators to "teach" language. The sign systems may be designed to represent, for example, English on the hands, using some vocabulary borrowed from the natural sign language but following English grammar. The natural sign languages – such as American Sign Language (ASL) in the United States, or British Sign Language (BSL) in the UK – have distinct grammatical systems. In this light, the fact that sign languages do not necessarily correspond with spoken languages (e.g., ASL and BSL are distinct, despite the common spoken language) should not be mysterious.

Some sign languages are related historically, just as spoken languages have historical ties (see HISTORICAL LINGUISTICS). One fairly well-known family tree involves French Sign Language (Langue des Signes Française, LSF), which has descendants in much of Europe and the United States due to the fact that in the nineteenth century, graduates of the French National Institution for the Deaf, who all used a common sign language, were dispersed to a number of countries and helped to establish schools there. In many cases, there was no common sign language across groups of deaf people until the schools were formed and attracted a community. Whatever signs were used previously combined with LSF, and the national sign language grew out of this connection (Lane 1984).

In part because of these historical relations, a signer of ASL may have an easier time communicating with a signer of, say, Swedish SL, than hearing speakers of English and Swedish. However, it is important to note that the sign languages are distinct, each having its own vocabulary and grammar. There is no universal sign language, and couldn't be, for the same reasons that there is no universal spoken language.

History of Sign Language Research

For many years, the communication between deaf persons was not considered to be a true linguistic system. In the 1960s, William Stokoe published a short grammar of ASL and a dictionary based on linguistic principles (Stokoe, Casterline, and Croneberg 1965), since taken to be the groundbreaking works in arguing for the linguistic status of a sign language. Stokoe, working in a structuralist approach (see STRUCTURALISM), showed that signs could be described as combinations of a limited set of parts – akin to the PHONOLOGY of spoken languages. (He eschewed the terms *phonology* and *phoneme* because of their auditory bias and coined the term *chereme* from Greek *cher-* "handy"; but researchers since then have used the *phon-* terms to emphasize the level of structural analysis.)

Many sign language researchers focused on providing more evidence for the linguistic status of sign languages, and slowly, more and more researchers began to treat sign languages linguistically. Starting in the 1970s, Edward Klima and Ursula Bellugi,

MOTHER (ASL)   IDEA (ASL)

Figure 1.

Figure 2.

working with a team of researchers at the Salk Institute, studied ASL from both linguistic and psycholinguistic viewpoints (see, e.g., Klima and Bellugi 1979). Other linguistic and psycholinguistic studies of various sign languages soon followed. Conferences on sign language research were held starting in the late 1970s, and in 1986, the main sign language research conference series, Theoretical Issues in Sign Language Research (TISLR), began. This meeting is the major international gathering of sign language researchers, held in a different location every two to four years. The growth of this meeting, the establishment of several journals and many edited books devoted to sign language research, and the formation of the Sign Language Linguistics Society are indications of the recent surge in growth in the field.

Areas of Sign Language Research and Their Current State

Various natural sign languages have been studied by linguists, with several goals in mind. Some of the research aims to describe the lexicon, phonology, MORPHOLOGY, SYNTAX, and SEMANTICS of different sign languages. It is descriptive, comparative, typological, and theoretical in approach. Some of it is in the areas of PSYCHOLINGUISTICS, including studies of language acquisition, parsing (see PARSING [HUMAN]), and neurolinguistics.

This entry focuses on current theoretical approaches to sign linguistics (cf. SIGN LANGUAGE, ACQUISITION OF and SIGNED LANGUAGES, NEUROBIOLOGY OF). The theoretical work has focused on analyses of sign language phonology, morphology, and syntax.

PHONOLOGY. At the phonological level, several authors have proposed different models to represent the structure of signed words. The models have emphasized phonological representation, rather than phonological processes, although some information about representation has been gleaned from processes, particularly lexical ones, including compounding and affixation.

The earliest linguistic representation of signs (proposed by Stokoe) considered them to consist of a simultaneous combination of a specification of handshape, location, and movement. In a sign like MOTHER, shown in Figure 1, the handshape is open with all five fingers extended, the location is the chin, and the movement is tapping the thumb on the chin.

Scott K. Liddell and Robert E. Johnson (1986) showed convincingly that the simultaneous model proposed by Stokoe failed to capture significant aspects of signs, and that sequentiality is an important component of signs. Their model analyzed signs as sequences of movements (M) and holds (H), with information
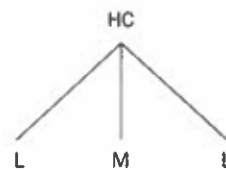
about location and handshape specified for each M and H segment. Wendy Sandler (1989) advanced the theory of sequentiality by changing the segments to movements and locations (L), with the typical sign consisting of a sequence of LML (movement from one location to another). In the sign IDEA (see Figure 1), then, the first segment is the temple location, and the sign moves to a few inches away from the temple. The extended pinky handshape (HC) is used throughout the sign. On this model, the handshape is specified in a separate hierarchically structured unit that connects and spreads across the LML units, as shown in Figure 2, following the principles of autosegmental phonology. This permits phenomena such as handshape assimilation in compounding to be efficiently accounted for by the delinking of one handshape and spreading of another.

Diane Brentari's (1998) model starts with different assumptions. On her account, the primary division in a sign's characteristics is between those elements that move (the prosodic elements) and those that do not (the inherent features). While a sign typically moves from one location to another, it is also possible for the handshape or orientation to change, either with path movement or without. Some such prosodic element (path movement and/or handshape/orientation change) is required for a (monomorphemic) sign to be licit. Brentari captures this requirement for path, handshape, or orientation to change by grouping these "prosodic" elements together in the representation.

The models summarized here are based largely on data from American Sign Language and Israeli Sign Language (ISL), but they are intended as models of signs more generally. It is clear that different sign languages have different inventories of phonological primitives, particularly handshapes, but strikingly different patterns of organization or phonological processes have not been identified.

One major theoretical issue that has been addressed in sign language phonology is the SYLLABLE. The syllable is an important component of spoken language phonology as it is an organizing unit that has both universal and language-particular aspects. There is also an intuitive component to the syllable, and it is often taken advantage of in poetry and other areas of language use. So it might be natural to ask whether there is an analog to this important unit in sign languages.

The answer seems to be yes and no. Researchers have identified units that serve a similar function to spoken language syllables with respect to timing, generally consisting of one LML unit. There are constraints on these units that point out the need for positing their existence apart from the word or morpheme. However, sign language syllables are not bound by sonority in the same way that spoken language syllables are, and there is no clear equivalent to a sonority cycle. That is, in spoken languages, the nucleus of the syllable (generally the vowel) is the most sonorous element, while elements further away (in either direction)
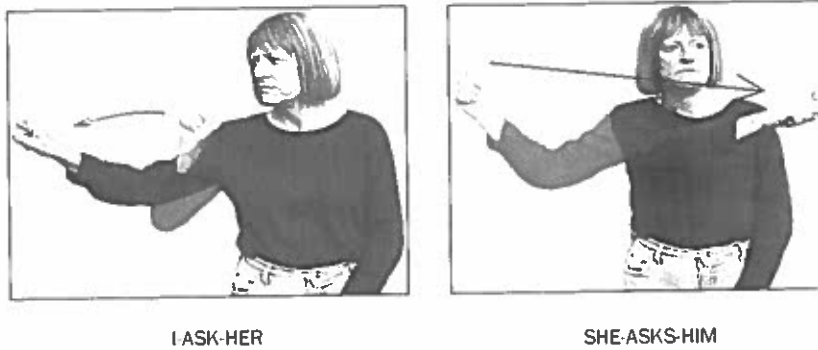
I-ASK-HER   SHE-ASKS-HIM

Figure 3.

become progressively less sonorous. In sign languages, it is not clear that there is a comparable hierarchy of degrees of sonority that limits sequences of segments before and/or after the most sonorous nucleus.

MORPHOLOGY. The sign languages that have been most intensively studied are clearly morphologically complex. They generally contain a number of morphological processes applying to predicates, such as subject and object agreement, location agreement, and aspect, as well as a system of classifier predicates by which verbs of movement and location can express characteristics of theme, instrument, and agent arguments (cf. THEMATIC ROLES) together with the predicate. The morphological processes employed are generally nonconcatenative. For example, they may alter the movement of the root, or the beginning or ending location, and so on, rather than adding prefixes or suffixes. This means that a single signed syllable may express multiple morphemes (frequently 3 to 5, occasionally as many as 10 or 12).

The process commonly known as verb agreement in sign languages is illustrated in Figure 3. Verb agreement makes use of spatial loci, which are either abstract or determined by actual physical locations of actual objects. In the examples, we understand a location on the signer's right side to be representing one person (female), and a location on the signer's left side another one (male). When the verb (ASK) moves from the location of the signer to the location on the right, it is understood as "I ask her." When it moves from the location on the signer's right to the location on her left, it is understood as "she asks him."

This process has received much attention in the literature on sign languages. It is intriguing because it does look in many ways like verb agreement, yet has important differences from typical agreement systems in spoken languages. One difference is that there is a good deal of optionality associated with the use of agreement; another is that it applies only to a subset of verbs that is largely semantically determined. Recent research has attempted to provide clear explication of the verbs that do and do not undergo this process, and to examine the interaction of agreement with issues of syntactic structure.

While the bulk of sign language morphology is nonconcatenative, there are sequential processes as well. Mark Aronoff, Irit Meir, and Wendy Sandler (2005) propose that the difference between these types is related to the historical depth of sign languages. They claim that the nonconcatenative processes are iconically grounded and that the sequential process are due to historical development, and therefore found only in sign languages with some historical depth.

SYNTAX. There have been a number of analyses of sign language syntax within the Chomskyan generative framework, particularly the PRINCIPLES AND PARAMETERS THEORY. Some of these studies have focused on establishing the basic clausal structure of ASL or another sign language. In addition to basic word order, such studies address the order of functional projections and the movement of constituents within the phrasal structure. Evidence for structure dependence, hierarchy, and recursion has shown that sign languages share these basic properties of grammar with spoken languages.

One conclusion reached by many of these studies is that a good number of sign languages are *discourse oriented*, using changes in word order to convey information structure notions, such as TOPIC and FOCUS. For example, sign languages tend to use the sentence-initial position for topics (old information), and at least some use the sentence-final position for focus (new information). Constituents in these positions have particular discourse functions, and they are marked syntactically in particular ways. As do other discourse-oriented languages, sign languages tend to permit arguments to be nonovert, understood according to context. The result of these two characteristics is a good deal of surface variation in sentence structure.

One issue that has received a fair amount of attention is the analysis of wh-questions in ASL and other sign languages. Sometimes, the wh-phrase may show up in the sentence-final position, as in *John buy yesterday what?* In other examples, the wh-phrase shows up in the sentence-initial position, as in *Why you leave?* Some researchers have argued that ASL has regular wh-movement to the end of a sentence, making it different from spoken languages, which, it seems, universally use the sentence-initial position for regular wh-movement. According to the usual generative assumptions, regular wh-movement moves wh-elements to the position called *specifier of complement phrase* (Spec, CP), which is to the left of the rest of the sentence, and so this view makes sign languages special. However, others have argued that Spec, CP is on the left in ASL and other sign languages, and the appearance of wh-words in the sentence-final position is due to a focus operation. This makes the analysis of wh-questions in ASL more like that of numerous spoken languages that permit wh-words to undergo wh-movement or focus movement. On the surface, wh-words appear in a variety of positions - it's their analysis that causes such a debate.

One issue that has come up in connection with this debate is the role of the nonmanual marking that accompanies wh-questions and other structures. These nonmanual markings are often described as grammatical, in contrast to emotional facial expressions. Some researchers consider them a part of prosody, akin to intonation – making them clearly related to syntactic structure but also not strictly determined by syntax alone (see Sandler and Lillo-Martin 2006 for review and references).

Aside from the generative approach, there has been a growing body of research on sign linguistics from a COGNITIVE GRAMMAR perspective. This research attempts to account for the construction of meaning in language using reference to MENTAL SPACES, taking into consideration gradience and optionality as well as systematicity. Since the use of spatial locations is integral to signing, this approach has been very appealing to some researchers.

Major Research Issues and Questions

Research on sign linguistics is a young field. There are many questions even in basic description, particularly with respect to sign languages other than ASL and some of the European sign languages, which have received the most attention. Linguists need such information as a full range of phonological processes and varieties of sentence types to formulate analyses, and are often stymied when attempting to test predictions because of a lack of available data.

Nevertheless, some major research questions have emerged. An important one is the extent to which sign languages form a group, such that all sign languages have certain characteristics in common. While acknowledging the lack of data on more than a handful of sign languages, sign linguists have been struck by the remarkable similarities across these languages in certain aspects. An explanation for the existence of these particular characteristics is an important goal of linguistic theory.

For example, all known sign languages productively use nonconcatenative morphology to express multiple morphemes in what is typically a single syllable. Sign languages also seem to share the characteristics of discourse-oriented languages, productively employing special processes to organize sentences and sequences of sentences in accordance with the demands of INFORMATION STRUCTURE.

Another aspect which has shown up in a number of sign language areas concerns optionality. There are a number of ways in which sign languages show a notable ability to chose from multiple options. For example, verb agreement with the subject is considered optional in many (all?) sign languages; most of the phonological processes that have been identified are optional, and several sign languages have been reported to permit either the option of leaving wh-elements in situ or of moving them.

Although sign languages seem to be more coherently similar to one another than spoken languages are, it is still an issue to inquire whether sign languages show many modality-particular characteristics. Certainly the tendency for lexical items to be monosyllabic may be related to the modality, but just where modality effects are to be found is still a matter of investigation.

Research on sign languages is hindered by a particular sociolinguistic situation that is rarely found in spoken language communities. Only a small percentage (perhaps 5%) of signers have been exposed to their language by their parents from birth; fewer

still have parents who were themselves exposed from birth. Most deaf children are born to hearing parents who do not know sign language or the deaf community. The parents may be advised to expose their children to sign language, but even if they chose to do so, there may not be programs available for their children to be exposed to fluent signers for more than a few hours per week. Deaf signers begin to learn sign language at a wide variety of ages, and their input providers themselves have a range of skills. To make matters more complicated, deaf signers frequently must communicate with others who are not fluent in sign language, and they have varying degrees of multilingualism, including knowledge of the dominant spoken language(s) in their community.

This situation leads to a number of questions concerning how to define a "native" speaker and which dialects/registers of the language to use as a model. Disagreements among linguists about basic facts are not uncommon, and signers frequently discuss varying judgments on particular examples at sign linguistics conferences.

One response may be to attempt to narrowly define native signers and contexts of data collection (e.g., having only naturalistic data or having only native signers interview consultants); another response may be to attempt to explain the range of judgments observed in linguistic terms. In any case, sensitivity to the difficulty of collecting reliable data is of great importance.

– Diane Lillo-Martin

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SINEWAVE SYNTHESIS

Sinewave synthesis is a technique for creating digital acoustic signals by computationally combining simulated pure tones of