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Modality Issues in Signed and Spoken Language

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The modality of a language is the means by which that language is produced and perceived. Linguists long believed that human language was bound to a particular modality; language was necessarily spoken and heard (e.g., Hockett, 1960). Reading and writing were not overlooked, but these visual representations are largely derivative of a primary spoken language. Research since 1960 has shown that there are two modalities in which naturally evolved human languages are expressed: not only the oral–aural modality of spoken languages, but also the visual–gestural modality of signed languages. There may even be a third possibility: specifically the tactile–gestural modality that is used in deaf–blind signing (see Quinto-Pozos, 2002). However, we know of no independent languages that have emerged within the tactile–gestural modality.

Signed and spoken languages are encoded using different articulators, and decoded using different sensory-perceptual systems. Beyond such obvious facts as the irrelevance of voicing to signed languages and of handshape to spoken languages, there are interesting differences between the two language modalities; see Table 1 and Table 2 (adapted from Meier, 2002b). For example, in speech, the oral articulators are largely hidden from view; thus the failure of lip reading as a means of understanding speech. Although hearing addressees are not blind to the visual configuration of the oral articulators (as demonstrated by the McGurk effect), addressees must perceive the acoustic consequences of oral articulation if they are to understand the speaker. The relationship between auditory percept and articulator movement is exceedingly complex, a fact that

Table 1 Some properties of the articulators in sign and speech

Sign	Speech
Light source external to signer	Sound source internal to speaker
Manual articulation not coupled (or loosely coupled) to respiration	Oral articulation tightly coupled to respiration
Manual articulators move in a transparent space	Oral articulators largely hidden
Manual articulators relatively massive	Oral articulators relatively small
Manual articulators paired	Oral articulators not paired
No predominant oscillator associated with sign syllables	Mandible is predominant oscillator associated with speech syllables

Table 2 Some properties of the sensory and perceptual systems subserving sign and speech

Sign	Speech
Signer must be in view of addressee	Speaker need not be in view of addressee
High bandwidth of vision	Lower bandwidth of audition
High spatial resolution of vision; lower temporal resolution than audition	High temporal resolution of audition; lower spatial resolution than vision
Articulatory gestures as the object of perception	Acoustic events as the object of perception

contributes to the intractability of the so-called invariance problem in speech perception.

Because the manual articulators move within the transparent space in front of the signer (the 'signing space'), the postures of the hands and their movements can be directly observed. If he or she chooses, the addressee can attend to the movements and postures of those articulators (although any addressee normally attends to the signer's message, not its articulation). The addressee in a spoken conversation cannot attend directly to the position of the vocal cords, or to movements of the tongue body, or to the lowering or raising of the velum.

Do such modality differences have important effects on the structure, acquisition, and processing of signed versus spoken languages? The research to date inescapably leads to the conclusion that there are many noneffects of modality upon linguistic structure and processing. In crucial ways, signed and spoken languages are structured similarly. Evidence for particular modality effects is more scattered. The subsequent paragraphs examine: 1) Noneffects of modality, 2) Methodological issues that make the identification of modality effects difficult, and 3) Evidence for modality effects.

Noneffects of Modality

Spoken and signed languages share many properties. In signed and spoken languages, a lexical item is a form-meaning pair that is conventional within a particular linguistic community (see Saussure, 1916/1959). Just as the English word *tree* and the Spanish word *arbol* share the same meaning but have very different forms, the signs for 'tree' in American Sign Language (ASL), Danish Sign Language, and Chinese Sign Language are quite distinct in form, although – as it happens – each of these signs is in its own way quite iconic (Klima and Bellugi, 1979). In signed and spoken languages, meaningful units (words or signs) are built in rule-governed ways from meaningless units of sound or gesture (Brentari, 1998; Stokoe

et al., 1965). Slips of the hand show that these sublexical units are not merely convenient descriptive devices for the linguist; they are instead integral to a signer's planning of utterances (for ASL, Klima and Bellugi, 1979; for German Sign Language, Hohenberger *et al.*, 2002). These meaningless units of handshape, movement, and place of articulation form the lines of cleavage along which signs break apart when signers err, just as phonemic segments may be switched, anticipated, or perseverated in slips of the tongue. Thus, signed and spoken language show what Hockett (1960) called duality of patterning.

Signed and spoken languages have open-ended vocabularies; they add new lexical items by means of derivational morphology (e.g., Supalla and Newport, 1978), compounding (Klima and Bellugi, 1979), and borrowing (Battison, 1978; Padden, 1998). In signed languages, as in spoken languages, syntactic rules constrain the concatenation of signs within sentences (Liddell, 1980). Signed languages display the same parts of speech as spoken languages. They use word order and verb agreement to mark subject and object. Evidence of subordinate clauses in ASL and other signed languages means that recursion is a property of signed and spoken languages alike (e.g., Padden, 1983).

The developmental milestones of language occur on roughly the same schedule in signing and speaking children (Newport and Meier, 1985; Meier, 1991). In general, adult processing of signed and spoken languages has proven to be fundamentally similar, although there have been discussions about the extent of right hemisphere involvement in the processing of sign and about whether sign shares with speech the property of being categorically perceived; see Emmorey (2002) for a review.

Noneffects of modality can be important for our understanding of human language. The findings reviewed here show that many crucial properties of human language are not products of a particular modality of transmission; instead those properties are common to signed and spoken languages. The striking similarities in linguistic structure, in child language development, and in adult processing between signed and spoken languages demonstrate that, with respect to the modality of language, the human language capacity is highly plastic.

Problems in Identifying Modality Effects

Given that signed and spoken languages share so many fundamental properties, are there nonetheless interesting differences between signed and spoken languages? For various reasons, it is not easy to

identify effects of the particular modality in which a language is expressed or perceived. First, there are problems of sample size: there are many fewer signed languages than spoken languages. The much larger set of spoken languages gives those languages more opportunity to express linguistically unusual properties. Even within the relatively small set of signed languages, most attention has focused on just one language, ASL. Although recent years have brought important work on other signed languages, much of that work has examined European signed languages, some of which have historical links to ASL through French Sign Language.

A second problem lies in the fact that most, if not all, signed languages are relatively young languages. Young languages – whether signed or spoken – may not fully represent the space of linguistic possibilities that are available within a given language modality; thus spoken Creole languages may be relatively uniform in their structure (Bickerton, 1984). Note that, the youth of signed languages is not an inherent property of the modality, but is instead an artifact of the demography of the deaf community and of attitudes toward deaf education. Interestingly, the unusual demographics of signing communities may serve to keep signed languages young. For deaf children, parent-to-child transmission of language is the exception, not the rule. Few deaf children are the offspring of native signing parents. Frequent interruption of the generation-to-generation transmission of language may mean that in signed languages, more than in spoken languages, children can shape languages that conform to their own biases. Languages that closely fit children's biases may represent only a subset of the kinds of languages that are learnable within a given modality.

Examples of Possible Modality Effects

The Resources of the Visual–Gestural Modality

The visual–gestural modality makes a three-dimensional space available to signed languages. It also enables many conceptually important lexical items to have some iconic basis. Iconic lexical items are possible in both language modalities: in spoken languages, onomatopoetic words such as *cock-a-doodle-doo* or Spanish *quiquiriqui* are sound images. Such words are not *ad hoc* creations; they are instead conventional members of the lexicon of a specific language. The resources of the visual–gestural modality appear to allow more frequent iconicity in sign language lexicons. For example, the ASL sign HOUSE seems to sketch a two-storey house with a peaked roof, as shown in Figure 1. However iconic,
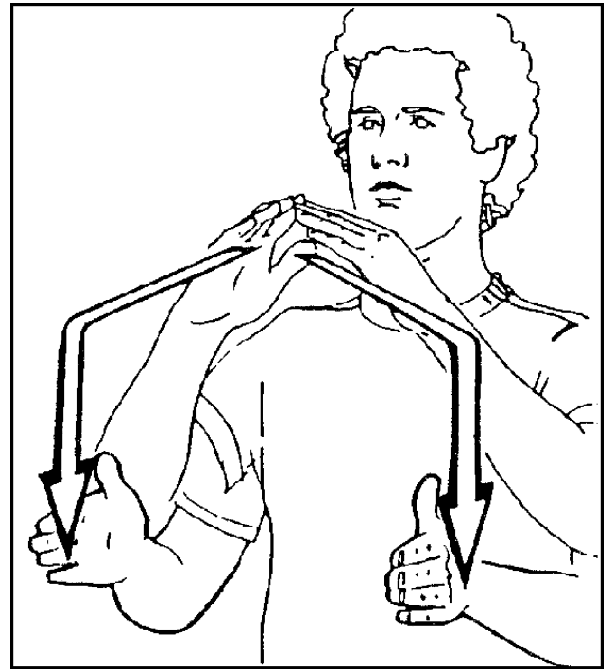

Figure 1 The ASL sign HOUSE. Drawing by Frank A. Paul, copyright RPM.

this sign is a conventional member of the ASL lexicon. What allows frequent iconicity in the visual–gestural modality? Contributors may include the fact that the two hands can move in tandem through the transparent sign space to sketch the shape of objects. The visible movement of hands through that sign space can also be used to represent the movement of objects in the world (including movement of the hand itself). In contrast, the oral–aural modality of spoken languages seems to have a limited capacity for iconic representation; in most instances, arbitrary words are the only available option (cf. Goldin-Meadow and McNeill, 1999).

The incidence of iconicity in signed languages – and the less-frequent occurrence of iconic spoken words – allows us to reassess the role of arbitrariness in language. The human language capacity does not demand arbitrary words or signs. Instead, all languages must allow arbitrary signs. Absent arbitrariness, languages could not readily express concepts that are not imageable. So, in ASL, signs such as BLACK, HOME, CURIOUS, and GIRL are fundamentally arbitrary; as shown in Figure 2, an inward rotation of the forearm in the sign BLACK causes the tip of the index finger to brush the forehead. This sign has no obvious motivation.

Iconicity appears to have few consequences for the grammar of signed languages: for example, morphological processes are not blocked by the iconicity of the lexical items to which those processes apply (e.g.,

Figure 2 The ASL sign BLACK. Photograph by Claude Mauk, copyright RPM.

ASK
Citation Form

$_1$ASK$_2$
'I ask you'

$_2$ASK$_1$
'You ask me'

$_2$ASK$_{3j}$
'You ask him'

Figure 3 Four forms of the ASL verb ASK. The citation form is the uninflected form of the verb. The three other forms mark spatial locations associated with the subject and object of the verb. The subscripts indicate locations associated with the signer (1), the addressee (2), and a nonaddressed participant on the signer's left (3j). Drawings by Frank A. Paul, copyright RPM.

Klima and Bellugi, 1979). In many instances, the iconic properties of signs have been obscured by historical change (Frishberg, 1975). Iconicity does not appear to be an important determinant of the overall timecourse of language acquisition, of the kinds of errors children make, or of which signs children learn first (see Newport and Meier, 1985, for a review). But the iconic potential of the visual–gestural modality does appear to be an important contributor to the rapid emergence of signed languages, in particular the home sign systems that are invented by deaf children of hearing, nonsigning parents (Goldin-Meadow, 2003). A deaf child can reasonably expect that iconic gestures will be understood by nonsigning parents.

The resources of the visual gestural modality give signed languages access to a three-dimensional space not just for the movement of the hands, but also as a source of locations that signs may indicate. To refer to people, objects, and locations that are not present in the immediate environment of a signed conversation, the signer may associate that referent with an empty location in space. Later in the conversation, signer and addressee alike can continue to use that location when they wish to refer anaphorically to that same referent (Bellugi and Klima, 1982). Many transitive verbs can move between locations in space (whether the real-world locations of referents or empty locations established in the sign space) to indicate the referents of their subjects and objects; see Figure 3. The ready availability of the sign space for referential purposes appears to have important consequences for the grammar of deixis (Meier, 1990; McBurney, 2002), verb agreement (Meier, 2002a; Liddell, 2003),
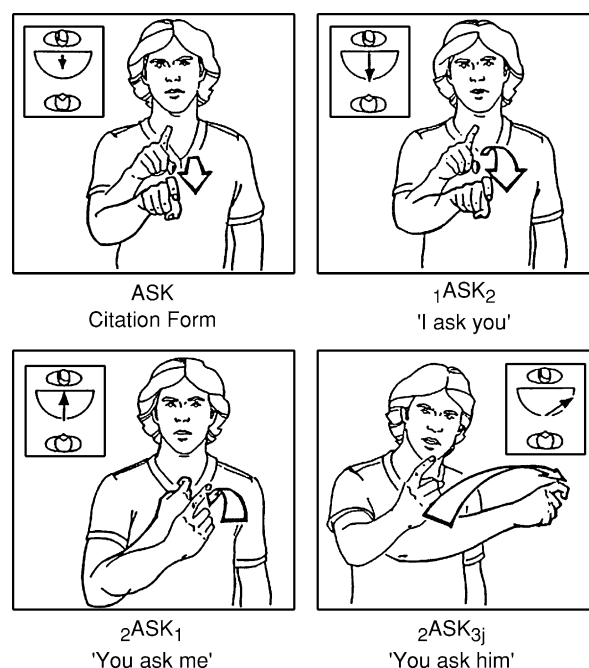
and anaphora (Lillo-Martin, 1990) in signed languages. The availability of this sign space may also be one factor accounting for the substantial uniformity in how these grammatical phenomena are manifest in different signed languages.

The use of space is not an inevitable product of the visual-gestural modality, although it appears characteristic of all naturally evolved signed languages examined to date (with the apparent exception of Abu-Shara Bedouin Sign Language, a very newly emerged sign language described by Aronoff *et al.*, forthcoming). Sign systems that do not use space are imaginable: for example, artificial sign systems such as Signing Exact English (SEE 2) are organized like English and make little use of the sign space for referential purposes. However, deaf children who are exposed only to SEE 2 adapt that system so that space is used in ways akin to the uses of space in naturally evolved sign languages (Supalla, 1991).

Rate of Signing

Perhaps because the sign articulators are massive and must often execute long movement excursions, signing rate (i.e., the rate at which signs are produced) appears relatively slow compared to the rate at which English words are produced. But, paradoxically, the

rate at which propositions are transmitted is the same in ASL and English (Bellugi and Fischer, 1972; Klima and Bellugi, 1979). How can this happen?

Bellugi and Fischer resolved this paradox – a slow signing rate that has no effect on the rate at which propositions are transmitted – by looking to the typological organization of signed languages. They argued that simultaneity in ASL morphology and in syntactic marking allows efficient transmission of propositions. In this view, natural signed languages largely avoid sequential morphological structure; that is, they avoid affixation. In Bellugi and Fischer's data, utterances from an artificial sign system that has English-like morphological structure (i.e., affixation) were slow to be produced and, for that reason, such systems may be disfavored by the Deaf community. Instead, natural sign languages rely largely on morphological processes that are nonconcatenative: for example, contrasting patterns of repetition, doubling of the hands in one-handed signs, and changes in movement direction or palm orientation that reflect the spatial locations linked to a verb's arguments. Sign languages also seem to favor the use of facial expression as adverbial markers and as markers of grammatical structure: e.g., facial expressions marking different sentence types. These nonmanual markers may be articulated simultaneously with manual signs.

Nonconcatenative morphology is certainly possible in spoken languages: e.g., the root and pattern morphology of Semitic languages, ablaut in Germanic languages, and tonal morphology in many African languages. However, signed and spoken languages seem to differ in their preferred type of morphological organization, with spoken languages generally opting for sequential structures of stems and affixes. In contrast, such morphology is sparse in signed languages; although compounding (which is of course sequential) is common in signed languages, nonconcatenative inflectional and derivational morphology is, with a small set of possible exceptions, the rule (Aronoff et al., 2005).

Conclusions

Signed and spoken languages share many fundamental properties of linguistic organization. They may differ in subtle ways, too: for example, signed and spoken languages may differ in their predominant typological organization. It has also been hypothesized that signed and spoken languages might differ such that signed languages are relatively more uniform in their grammatical properties, whereas spoken languages are more diverse (Newport and

Supalla, 2000). Much further research will be necessary to confirm the extent to which these hypothesized differences are true. Explaining these differences will also require substantial work. For example, the relative uniformity of signed languages in contrast to the diversity of spoken languages might arise from the differing properties of the two language modalities. But it might also be a consequence of the interesting history and demography of signing communities – specifically the fact that signed languages are relatively young languages (sometimes exceedingly young, as is Nicaraguan Sign Language (Senghas and Coppola, 2001)). The demography of signing communities might mean that the learning biases of children – and not necessarily the constraints of the visual–gestural modality – may have a crucial role in structuring signed languages. We have every reason to think that children's biases are much the same from community to community and generation to generation. Further research is needed to examine just how varied signed languages are, to detail the role that children play in elaborating signed languages, and to uncover the precise role that modality factors might have in shaping signed languages.

See also: Iconicity: Sign Language; Pidgins and Creoles: Overview; Saussure: Theory of the Sign; Sign Language: Interpreting; Sign Language: Morphology; Sign-Based Morpology.

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Modern Greek *See:* Greek, Modern.

Modern Hebrew *See:* Hebrew, Israeli.