# Sign Language Phonology
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Phonology is more closely tied to the production and perception systems than any other abstract level of linguistic structure. As sign languages are transmitted in a different physical modality, the discovery that they too have a phonology has therefore been considered especially significant. Stokoe (1960) demonstrated that the signs in the lexicon of American Sign Language (ASL) are not holistic gestures, but are comprised of a relatively small number of meaningless units that may recombine to produce a potentially large lexicon. Since that pioneering work, other researchers have shown that these units are subject to constraints on their combination, and are systematically altered in different phonological and morphological contexts. In addition to these shared general characteristics, certain formal similarities between phonologies in the two modalities have also emerged. Most is known about the phonology of ASL; however, other sign languages, such as Sign Language of the Netherlands and Israeli Sign Language, are being shown to have similar phonological properties.

Stokoe showed that features of handshape, location, and movement can recombine to form minimal pairs of signs. For example, the signs DRY, UGLY and SUMMER in ASL are minimally distinguished by features of location.
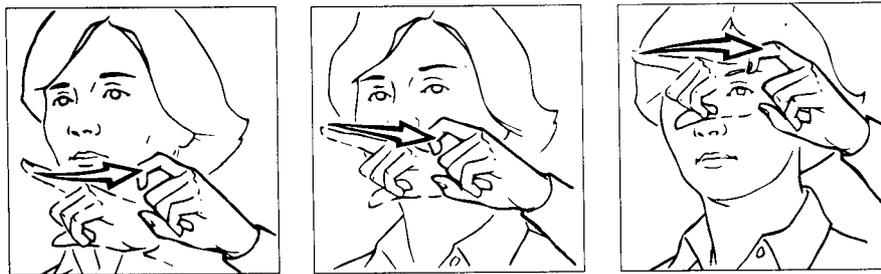
DRY	UGLY	SUMMER

Figure 1. Minimal triplet in ASL, distinguished by features of location. (Reprinted with permission from Klima and Bellugi, 1979.)

While early analyses emphasize the apparent simultaneity with which the formational elements are articulated, subsequent studies point to significant sequential properties (Liddell, 1984a; Sandler, 1989; Brentari, 1998), and models have been developed to reflect this sequentiality (Liddell and Johnson, 1989; Sandler, 1989; Perlmutter, 1992; van der Hulst, 1993). One of many examples of sequentiality is seen in the morphological operation of verb agreement, which requires distinct reference to the beginning and ending of the sign.

*Figure 2. I GIVE YOU; S/HE GIVES ME reprinted with permission from
A Basic Course in American Sign Language.*

The illustrations above show that on the surface, signs are typically sequences of two locations with a movement in between. The number of sequential units is limited, which contributes to the impression of simultaneity. Another reason for this impression is that key features of the most complex element, the handshape, generally remain constant throughout a sign (Mandel, 1981). To account for both sequential and simultaneous properties, the theories of autosegmental phonology (Goldsmith, 1976) and nonconcatenative morphology (McCarthy, 1979) have been adopted from spoken language research. The hand configuration class with long distance properties may be represented on a separate tier, a representation that has explanatory consequences for other aspects of the phonology and morphology (Sandler 1986, 1989).
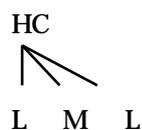

*Figure 3. Sequential Location and Movement segments and a Hand
Configuration augosegment (Sandler, 1989)*

This separation of the HC category from other categories facilitated the further development of hierarchical representations of articulator-based feature classes within the HC category (following Clements, 1985), which capture partial and total assimilation phenomena (Sandler, 1987; Corina, 1990a).

Various morphological operations require signs to conform to a prosodic template that may be partially prespecified (Liddell 1984b). This templatic approach expresses formally the observation that the morphological complexity of sign language words is in some sense 'simultaneous' -- i.e., nonconcatenative. For example, some ASL temporal aspect morphology changes the single straight movement path of a verb to a repeated circular one (Klima & Bellugi, 1979). This is analyzed as associating a verbal root to an LML template with an arc feature preassociated to the movement segment, and then reduplicating (Sandler, 1989, 1990).

Phonological and morphological rules interact in sign language as in spoken language. And, as in spoken language, the lexical and postlexical components are distinct (Kiparsky, 1982). In particular, it has been shown that the output of phonological rules cannot undergo derivational **morphological** rules (Padden & Perlmutter, 1987).

One sign language phenomenon with no parallel in the spoken modality is the existence of two anatomically identical potential articulators, the two hands. Despite this potential, and although both hands are involved in the formation of many signs, there is only one primary

active articulator in lexical items (the dominant hand), as there is only one primary active articulator in spoken words (the tongue). Normally, within a word, the nondominant hand either 'copies' what the dominant hand is doing, or it does not articulate at all, serving as a place of articulation like the head or trunk (Stokoe, 1960; Battison, 1978; Sandler, 1993a). Abstracting away from these two roles, the nondominant hand can be seen as essentially subordinate to the dominant hand regardless of its role (Brentari & Goldsmith, 1993). The tenets of **the theory of d**ependency **p**honology (Anderson and Ewen, 1987) allow direct representation of the particular types of asymmetries that exist between the two hands: the dominant hand is **represented as** the head and the nondominant hand **as** the dependent of the articulatory node of structure (van der Hulst, 1996).

In addition to autosegmental structure, researchers have also found evidence for suprasegmental structure. A principled distinction can be made between a sign language syllable spanning a single movement (or a simultaneous combination of path movement with handshape change or orientation change) and morphosyntactic units like morphemes or words (Brentari, 1990). Several researchers suggest that movement represents a kind of visual sonority (Brentari, 1990, 1998; Corina, 1990; Perlmutter, 1992; Sandler, 1993b). Arguing further that all dynamic elements form a phonological class, Brentari (1998) proposes a model of sign structure that represents the sonorous elements separately.

The distribution of various types of movement has been a key tool for developing sonority scales and models of syllable structure. Perlmutter (1992) uses the distribution of 'secondary' movement to support the claim that there is a syllable peak which usually occurs on the movement element of a sequentially organized syllable similar to the one pictured in Figure 3, in which the locations are compared to consonants and movements to vowels. Other researchers (e.g., Brentari, 1998) see sonority as simultaneously realized over the whole syllable, and in this sense quite different from its spoken language counterpart.

Recent work has looked to higher levels of prosody, investigating the phrasal phonology of sign languages. Sign language utterances, like those of spoken language, are rhythmically chunked into units that have regular prominence patterns and that partly correspond to syntactic constituents (Wilbur, 1991, 1994, 1999; Nespor & Sandler, 1999; Sandler & Lillo-Martin, in preparation). It has even been suggested by these researchers that prosodic constituents carry intonational patterns of facial expression. The pictures below show facial intonation, or 'superarticulation', in Israeli Sign Language, conveying wh-questions (mainly furrowed brows), shared information (mainly squinted eyes), and a simultaneous combination of the two. Although the prosodic domains for intonation appear to be the same as in spoken language (Nespor & Sandler, 1999), such simultaneous componentiality is different from the sequential nature of componential pitch excursions in spoken language intonation (Pierrehumbert & Hirschberg, 1990).

wh question superarticulation   shared information superarticulation

wh-question and shared information superarticulation

Figure 4. Simultaneous componential intonation (superarticulation) in Israeli Sign Language (Reprinted with permission from Meir & Sandler, in press)

Research on sign language phonology leads to two conclusions, which are also important directions for future research in this relatively new field: (1) there are universal properties of phonological organization common to natural language in radically different physical modalities, but (2) there are substantial areas in which the physical production and perception systems mold the phonology of **both** modalities.

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