Sign Language Phonology

INTRODUCTION
Every language has a phonological grammar that accomplishes fundamental tasks that organize the forms within it, and all native users of a signed or a spoken language know these things without being explicitly taught them. The principles of the organization of phonology are the same in signed and spoken languages, but the way that they are realized or expressed is different in some cases, due to the different modality or channel of communicated used—in sign language visual/gestural, and in spoken languages auditory/vocal. Just like spoken languages, sign language phonology is concerned with the meaningless units (segments, syllables, features) of a linguistic system and how they combine via a set of rules or constraints to form meaningful units (morphemes, words, clauses).

A period of over fifty years of research, beginning with William Stokoe’s work in 1960, has shown that the sign language dimensions of handshape, movement, place of articulation (sometimes called location), orientation, and non-manual behaviors (properties of the hands, arms, face and body) function quite similarly to their corresponding spoken language properties of place of articulation, manner, and voicing produced by the tongue, lips, vocal cords, and velum. Consider the “citation” or “dictionary” form of the sign INFORM (Figure 1). The Handshape includes all of the fingers bent at the knuckle joint and the fingertips are touching the forehead, the Place of Articulation. The Movement indicates the direction of the movement—away from the signer’s forehead. The fact that such a description is readily available might mistakenly cause us to conclude that most of the work needed to understand sign language phonology is already complete, but this is not at all the case. Knowing what the articulators are and how they move is just the beginning. The arms, hands, and body are used in many different ways in sign languages, and not all of them are phonological. In this entry we will address four main themes: 1) how to determine what is phonological from what is morphological on the one hand and from what is phonetic on the other; 1) 2) the major units in sign language phonology, 3) how rules and constraints do their work, and 4) what it means to have phonological knowledge in a sign language. The units discussed will be signs (lexical units) and units smaller than that (sub-lexical units). The sign INFORM in Figure 1 will serve as a concrete reference point for some of these topics.

PHONOLOGY VS. MORPHOLOGY
A phonological description is fundamentally about form, rather than meaning, but one of the most important roles of phonology is to determine those aspects of form that create distinctions in meaning; phonology and morphology and independent levels of grammatical description. The

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1 For detailed information on morphology and phonetics, see also the entries on these topics in the encyclopedia. Classifier constructions are morphologically complex and can often comprise a whole phrase or sentence. Space requirements necessitate that classifier constructions be left out of this entry.
units of form and the units of meaning have independent organizational patterns. This independent organization of form and meaning is sometimes referred to as duality of patterning. Some criteria that are used to rule in or rule out which properties to include in a phonological description include: whether changing the property creates a completely different sign (a minimal pair), or whether the property is needed to spell out a phonological rule, or whether they make a difference in producing the sign correctly (well-formedness).

The phonological word is the unit that most closely corresponds to the lexical sign, but this does not mean that one phonological word/sign (i.e., P-word) equals one morpheme. One “P-sign” can contain one or more morphemes. For example, looking a bit more closely at the sign INFORM, we see that there are several morphemes, even in this simple form. This “citation” form of the sign INFORM is also the same as the ‘I-inform-you’, which has three morphemes. One of them can occur alone; this is the free morpheme, which is the stem/citation form INFORM. The bound morphemes (i.e., affixes) cannot occur alone—those expressing the morphemes for the first person singular ‘I’ and second person singular ‘you’; these are expressed by the direction of movement and the associated locations for the beginning and end of that movement. Note that these are not pronominal forms, but rather locations at the beginning and ending of the movement of the stem. If the movement and locations are changed, we obtain different P-signs, each with three morphemes—e.g., the ‘you-inform-me’ form, or the ‘I-inform-them’ form. Each contains the stem INFORM, plus the different bound morphemes associated with different forms of person agreement. One can tell that these forms are just one P-sign because they are expressed with one set of selected fingers, in this case all of the fingers, with an open (extended) and a closed (flexed) variant. Selected fingers are those fingers that are considered “active” in the articulation of a sign: if there is contact they typically contact the body, and they are often (though not always) the extended fingers. This is an important general rule about the nature of P-words/signs in ASL, called the Handshape Sequencing Constraint:

(1) Handshape Sequencing Constraint on P-words

There is only one set of selected fingers per phonological word.

The P-sign above involves a stem (free morpheme) plus its affixes, but a P-sign can also be composed of more than one free morpheme. In other words, two signs that can occur elsewhere in the language as independent signs can sometimes fuse together to form a single P-sign—for example, a pronoun plus a stem (e.g., I+READ, Figure 2 (left)), a point indicating location plus a stem (e.g., SHOP+THERE, Figure 2 (right)) or a compounds, which are two lexical items (e.g., COLD+SHOULDER becomes COLD/SHOULDER (“aloof”, Figure 2 (bottom)). These are all one (P)honological sign, but two (M)orphological signs. These examples illustrate that phonology and morphology are organized independently in the grammar. When a P-sign is composed of two M-signs, we see additional rules that come in play (2):

(2) Rules for P-words in ASL composed of two M-words:

a. In one-handed forms, there is optional assimilation of handshape from the noun or verb to a pronoun.
b. In two-handed forms, there is optional coalescence of two M-signs into one P-sign.
PHONOLOGY VS. PHONOETICS

Let us now consider the difference between phonetics and phonology, again returning to the sign in Figure 1, INFO RM. Many properties are not mentioned in the phonological description of this sign, and this is because they are phonetic, rather than phonological. Phonetic properties do not create a completely different sign when they are altered, nor do they make a difference in producing a sign correctly, but they are every bit as important as phonological ones, and they perform different roles in the language. They may identify a distinct dialect of ASL or a difference in register, but these functions do not make these properties phonological. Just as in English, a vowel can be more tense, or a bit higher in the oral cavity, or be diphthongized and still be recognizable as the same vowel, but from a different dialect (e.g., p[ɛ]n is pronounced p[I]n in some dialects of English). A few examples that are possible phonetic variations for INFORM are given in (3).

(3) Phonetic variants for INFORM

a. Informal register: The place of articulation may be produced at the ipsilateral side of the forehead instead or slightly lower than the forehead, instead of in the center of the forehead;
b. Phonetic ease of articulation: In Figure 1, the arc shape is a function of the pivoting elbow (i.e., due to ease of articulation), but the movement might also have been produced as a straight movement without any curve at all.
c. Interface with gesture: The end of the movement may be produced at different heights depending on the height of the person receiving the information, instead of in the center of neutral space (i.e., if signing to a child or to an adult)

PHONOLOGICAL UNITS

We have already discussed the phonological word above, in describing the distinction between phonology and morphology. This is the largest of the six phonological units that will be addressed in this section. Moving from the largest to the smallest we now proceed to the syllable, the parameter, the feature class, the segment, and the feature.

The sign language syllable is based on the movement parameter; the number of movements equals the number of syllables. Criteria for counting the number of syllables are as given in (4). Most sign languages studied to date have a tendency towards having just one syllable per sign, but this tendency is stronger in some sign languages more than others.

(4) Syllable Counting Criteria: The number of syllables in a sequence of signs equals the number of sequential movements in that string.
a. When several shorter movements co-occur with a single movement of longer duration, the longer movement is the one to which the syllable refers. (e.g., EXPAND is one syllable; DESTROY is two syllables)

b. When two or more movements occur at exactly the same time, it counts as one syllable. e.g. INFORM is one syllable, which contains a handshape change and a path movement.

A **parameter** constitutes a fundamental group of features, similar to Vowels and Consonants in spoken languages, and they are often referred to as **major classes** in general phonological theory. The feature structure in Figure 3 shows the parameter **Handshape** and how the features within it are organized. Each parameter has its own exclusive set of features—Handshape, Movement, Place of Articulation (Location), and Non-manual behaviors are parameters. Orientation has been considered to be a parameter as well by some researchers, but others have achieved the same results by considering Orientation to be a relation between Handshape features and Place of Articulation features.

A **feature class** is a group of features that captures a phonological generalization about the language. For example joints and selected fingers (see Figure 3) vary independently and therefore must be separated. Based on the Handshape Sequencing Constraint, mentioned earlier, joint features are allowed to change from closed to open (or vice versa) during the articulation of P-sign, while in exactly the same phonological environment, selected fingers do not change. The **segment** is a timing slot, a slice in time, which includes all of the features happening during that timing slot. The beginning and ending of a movement are each segments. These elements do not create minimal pairs, but they are phonological because they are essential in describing where certain morphological inflections appear. For example, for the “intensive” inflection in ASL the first segment is lengthened, making the sign GOOD mean “really good”. For the “delayed completive” inflection the first segment includes a non-manual tongue wag, and the second and third segments, the movement and final location, are accompanied by a rapid closing of the mouth. See Figure 4 for UNDERSTAND “delayed completive” which means “delay the start of understanding and then understand all at once.”
The smallest unit, the feature, is the minimal property that can create a minimal pair. For example, the [+flexed] vs. [-flexed] (Figure 5, left) distinction creates the minimal pair CANDY vs. APPLE for the same set of selected fingers; the [+crossed] vs. [-crossed] distinction creates the minimal pair -R- vs. -U- for the same set of selected fingers (see Figure 5, middle). It is most often in the frequency and distribution of these features (and their values) that sign languages differ. There are also features that are important for two-handed signers, such as the features [+symmetrical], when the same part of the hand on both hands makes contact, or [-symmetrical], when the two hands make contact, but not on the same part of the hand. This distinction is seen in the signs for MEET vs. CORRECT (Figure 5, right). This feature is important in creating the rule of Weak Drop, described below.

Sometimes when comparisons between the number of phonological properties of signed and spoken languages have been attempted, it might appear that sign languages have more than spoken languages, and to some extent this is true because there are at least four parameters (handshape, movement, place of articulation, and non-manuals) instead of two (consonants and vowels). But it is also true that equivalent units are often not being compared. The number of features is the relevant level of comparison, because the feature is the minimal unit of contrast in both types of languages. Examples for spoken languages include [spread glottis] for vocal folds, [dorsal], [lateral] for tongue, and [nasal] for the velum. Examples for sign languages include [crossed] for handshape; [ipsilateral] for place of articulation, and [arc] for movement. When one is comparing segments, modality comes into play. Sign languages organize their features more simultaneously than do spoken languages, and parameters are organized simultaneously as well; Place of Articulation (Location) and Handshape occur simultaneously in sign languages,
while Vowels and Consonants occur sequentially in spoken languages. At this level sign languages have more possibilities because the comparison is between whole signs from sign languages and sounds from spoken languages.

PHONOLOGICAL RULES AND CONSTRAINTS

Phonological constraints or rules can determine the form that words/signs are allowed to have in a given language. This type of rule is often referred to as a phonotactic constraint. Two examples are given in (4).

(4) Phonotactic Constraints in Sign languages for monomorphemic signs

a. The Handshape Sequencing Constraint (mentioned above in (1)): There is only one set of selected fingers per phonological word.

b. The Constraint on Major Locations: A phonological word is allowed to have only one major location—either on the body or a plane in neutral space (the horizontal, vertical or mid-sagittal plane)

There are also other linguistic processes—phonological, morphological or syntactic—that are widespread but which are blocked from applying to certain forms because of their phonological properties. “Weak Drop” is an example of such a process that allows two-handed forms to become one-handed, and for which the feature [+symmetrical] becomes important. There are three kinds of two-handed signs—Type 1, Type 2 and Type 3—and while Weak Drop can occur with some forms in all three types, it occurs most prevalently in Type 1 signs, which are two-handed signs with the same handshape and movement. Some Type 1 allow 1-handed variants; in these signs the two hands contact one another on non-symmetrical parts of the hand (e.g., QUIET (Figure 6, left), CORRECT, NAME); notice that in the two-handed form of QUIET the pinkie finger side of the dominant hand contacts the index finger side of the non-dominant hand. Another group other two-handed signs does not allow one-handed variants. These are signs where the two hands contact one another on symmetrical parts of the hand (e.g., WITH (Figure 6, right), CONTACT, JAPAN, NICARAGUA); notice that in the two-handed form of WITH the backs of the fingers of both hands contact each other. The [+symmetrical] feature blocks Weak Drop from occurring.

Figure 6. The sign QUIET, which is [-symmetrical] and allows a 1-handed variant via “Weak Drop” (left), and the sign WITH which is [+symmetrical] and does not allow a 1-handed variant via “Weak Drop” (right). (Reprinted with permission, MIT Press)
PHONOLOGICAL KNOWLEDGE

Native signers of sign languages possess the knowledge of all of the facts presented above, without being taught them explicitly, just as native speakers of a spoken language possess the same knowledge of their languages. Users of a language cannot describe this knowledge to another person, or name the rules that apply in their language, because it is implicit knowledge; however, researchers can tap into this knowledge by designing psycholinguistic tasks that present well-formed and ill-formed structures to signers under a variety of controlled conditions, some involving specialized instrumentation. By employing these methods, such as grammaticality judgments, the length of reaction time, or differences in neuroimaging patterns, results may be obtained that reveal this implicit knowledge. Such studies allow linguists to test the generalizations they believe to be true from studying the grammar alone by obtaining independent measures from users of the language in real time. There is evidence suggesting that age of acquisition affects the way that phonological units are accessed and stored in the brain in both signed and spoken languages. Using the methods described above helps researchers understand the affects of age of acquisition of a sign language on phonology, as well as other on grammatical components.

In sum, the phonology of sign languages describes the forms and their distribution in a single sign language, and is also capable of revealing differences among sign languages as well as similarities among them that unite them due to their shared modality.

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Cross References
Linguistics: Morphology; Linguistics: Phonetics; Linguistics: Pragmatics; Linguistics: Spatial Grammar; Sociolinguistics: Registers

References