Signed language description and notation

Nathan Sanders, Lex Konnelly, and Pocholo Umbal (2021–2025)
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> **Learning objectives.** After reading these notes, you should be able to:
> - define the parameters of a sign and identify which joints are used for each parameter;
> - identify all parameter values for a given sign;
> - explain the concept of minimal pair in the context of signed languages; and
> - describe some difficulties in notation systems for signed languages.

1 Parameters

Just as we have a set of dedicated vocabulary to describe consonant and vowel phones (such as *voiced uvular fricative* for [ʁ] and *lax mid back round vowel* for [ɔ]), we have similar kinds of vocabulary to describe the articulations used for signs in signed languages. The various properties of signs that we can describe are usually called **parameters** (sometimes also called *primes*). There are four basic manual parameters that are traditionally recognized: handshape, orientation, location, and movement. In addition, nonmanual articulations are also considered a fifth parameter, but these are complex and beyond the scope of these notes. However, they still play a crucial role in signed language articulation that cannot be ignored in a more complete analysis of signed language articulation.

2 The handshape parameter

Handshape is created by configuring the base knuckles and interphalangeal joints. We can describe a handshape by which of the five fingers have any flexion or extension of the base knuckles and/or interphalangeal joints and any abduction or adduction of the base knuckles, as in the following.

extended base knuckles and interphalangeal joints for all fingers
abducted base knuckles for all fingers

extended base knuckles and interphalangeal joints for middle, index, and thumb
flexed base knuckles and interphalangeal joints for pinky and ring
abducted base knuckles for middle, index, and thumb

extended base knuckle for index
flexed base knuckles for pinky, ring, middle, and thumb
flexed interphalangeal joints for all fingers

These kinds of prose descriptions can take up a lot of space and be difficult to interpret, so it is more convenient to use some kind of symbol. A graphical representation of handshape, like the images above, are easy to interpret, but they can be difficult to insert into a document. One solution is to draw inspiration from the IPA and use a single symbol to represent a handshape. Some handshapes already represent letters and numbers with handshapes, so this can be adopted for some handshapes. For example, the handshape represents the number FIVE in ASL, so it can be called the "5-handshape".

This kind of system can lead to problems. For example, the ⟨handshape⟩ handshape represents the letter B in ASL but the letter D in Swedish Sign Language. So when trying to notate this handshape, it could be confusing to call it the B-handshape when talking about Swedish Sign Language or in a discussion of both signed languages together. But even if we are only describing a single signed language with language-specific notation, we do not have enough numbers and letters to notate every handshape. For example, the ⟨handshape⟩ handshape (like the ⟨handshape⟩ handshape, but with the thumb along the side of the hand) is common in many signed languages, but in ASL, it does not represent any letter or number. One way to solve this problem is to treat it as a variant of the ⟨handshape⟩ handshape, using a modifying adjective. So you may sometimes see it handshape called the "flat-B" handshape, since it is like the B-handshape, but flattened by moving the thumb to the side rather than across the palm. There are many such adjectives that are commonly used in this kind of notation, such as *open*, *closed*, and *bent*. However, there is a lot of variation in how these adjectives are used.

To avoid these problems, many linguists just use handshape images, as in these lecture notes. However, the use of letters, numbers, and adjectives is still very common in the literature, and if you go on to do further study of signed language linguistics, you will need to become familiar with that system.

Sometimes, a distinction is made between two types of handshapes. Some of these are called **unmarked handshapes** (Battison 1978), which tend to be the most common handshapes, both across signed languages and within a single language, as well as the earliest ones acquired by children. They are typically the easiest handshapes to both articulate and visually distinguish from each other. They are also often used as default or substitute handshapes in certain circumstances. More recent work argues that the set of unmarked handshapes is probably smaller than previously thought, perhaps containing only the four below (Henner et al. 2013).


flat-B   5   A   1
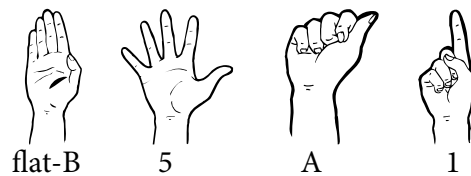
Marked handshapes are all other possible configurations of the fingers. These are not universal, so a particular marked handshape may be used in some languages but not in others, and when it is used, it may be common in some languages and rare in others.

3   The orientation parameter

Orientation of the hand is created by configuring the remaining four joints: the wrist, the radioulnar joint, the elbow, and the shoulder. Different configurations of these joints can cause the hand to be oriented in many different ways. The orientation of the hand is divided into two components: the **palm orientation** (which way the palm faces) and the **finger orientation** (which way the fingers point). For example, with the fingers pointing upward, the palm could face toward you or away from you, as in ⟨handshape⟩ versus ⟨handshape⟩. Similarly, with the palm facing toward you, the fingers could point upward or to the left, as in ⟨handshape⟩ versus ⟨handshape⟩. In both cases, many other directions are also possible.

Note that finger orientation is actually a bit of a misnomer, because it is defined based on the orientation of the **metacarpals** (the bones inside the hand, highlighted in the following image) rather than the the actual finger bones outside the hand. The definition allows handshape and orientation to be completely independent, but it can be confusing if the handshape involves flexion of the base knuckles and/or interphalangeal joints, so be careful in interpreting what "finger" orientation means.

metacarpals
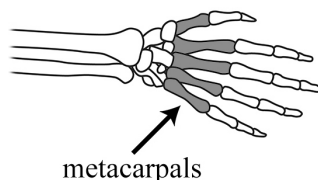
For example, [image] and [image] both have an upward finger orientation the metacarpals are pointing up in both, even though the actual fingers are pointing in different directions. Think of finger orientation as the direction the fingers would be pointing if they were fully extended. Note that since palm orientation and finger orientation are defined based on the palm, they are always perpendicular, allowing them to define any three-dimensional orientation of the hand.

The following signs in ASL have the same [image] handshape but with different orientations. The given URLs link to videos from Signing Savvy (2009/2018), an online repository of ASL signs.

YOUR	https://www.signingsavvy.com/media2/mp4-ld/28/28810.mp4
THANK-YOU	https://www.signingsavvy.com/media2/mp4-ld/21/21533.mp4
BED	https://www.signingsavvy.com/media2/mp4-ld/6/6637.mp4

For YOUR, the palm orientation is outward (away from the signer), while the finger orientation is upward. For THANK-YOU, the palm orientation starts as inward (towards the signer) but moves to be more upward, while the finger orientation starts as upward but moves to be more outward. For BED, the palm orientation is inward toward the side of the face, while the finger orientation is upward alongside the face. Since the head is tilted in BED, the fingers are not actually pointing upward in an absolute sense, but instead, upward in relation to the signer's face. Thus, orientation may sometimes be absolute and sometimes relative to some part of the signer's body.

4 The location parameter

Location is where a sign is articulated, and this is determined by a combination of all joints. **Neutral signing space** is the space in front of the chest (as in ASL YOUR and the end of ASL THANK-YOU), and it serves as the default location. Signs can have locations elsewhere, almost anywhere on or near the body, although most signed languages only make use of locations above the waist and in front of or to the sides of the body (see Nyst 2012 for discussion of some exceptions). Many of the most common locations are on or near parts of the head, such as the chin at the beginning of ASL THANK-YOU and the side of the face in ASL BED. The following ASL signs show other possible locations: the chest (MY), the top of the head (HAT), and the nondominant hand (WARN).

MY	https://www.signingsavvy.com/media2/mp4-ld/21/21545.mp4
HAT	https://www.signingsavvy.com/media2/mp4-ld/6/6388.mp4
WARN	https://www.signingsavvy.com/media2/mp4-ld/7/7415.mp4

5   The movement parameter

For some signs, the handshape, orientation, and location are stable with fixed configurations of the six joints. However, if any of the joints move during the sign, then we need the fourth parameter of **movement** to fully describe the sign. Note that the movement parameter is only concerned with inherent movement during the sign (such as the movement during ASL THANK-YOU and HAT), and not any incidental movement that might be required to transition from one sign to another during conversation. For example, there are different transitional movement needed to get to BED in ASL MY BED versus YOUR BED. Transitioning from MY to BED requires moving the hand outward and upward, while transitioning from YOUR to BED requires moving the hand inward. These movements are not inherent to MY, YOUR, or BED as individual signs.

There are two types of true movement inherent to a sign, depending on which joints are moving. If movement occurs at the elbow and/or shoulder, such as the elbow extension in ASL THANK-YOU, it is called **path movement**. If movement occurs at any combination of the other four joints, such as the flexion and extension of the wrist in ASL WARN, it is called **local movement** or **internal movement**.

6   Minimal pairs in signed languages

Parameters are similar to the phonetic properties of phones. Two phones can match in all phonetic properties except one. For example, [s] and [z] have the same place and manner of articulation, but they have different phonation. The same can happen with signed language parameters, with two signs matching in all parameters except one. The resulting signs a called a **minimal pair**. The ASL signs SORRY and please linked below create a minimal pair for handshape, since they have the same orientation, location, and movement, but they have different handshapes: 🤛 for SORRY and 🖐 for PLEASE.

SORRY	https://www.signingsavvy.com/media2/mp4-ld/21/21532.mp4
PLEASE	https://www.signingsavvy.com/media2/mp4-ld/21/21530.mp4

The following are signs from ASL that form minimal pairs for orientation (PROOF, STOP), location (APPLE, ONION), and movement (THINK, WONDER).

PROOF	https://www.signingsavvy.com/media2/mp4-ld/30/30746.mp4
STOP	https://www.signingsavvy.com/media2/mp4-ld/30/30455.mp4
APPLE	https://www.signingsavvy.com/media2/mp4-ld/21/21609.mp4
ONION	https://www.signingsavvy.com/media2/mp4-ld/8/8081.mp4
THINK	https://www.signingsavvy.com/media2/mp4-ld/24/24787.mp4
WONDER	https://www.signingsavvy.com/media2/mp4-ld/7/7495.mp4

These four minimal pairs are summarized in the following table, with the relevant parameter that differs **highlighted in red**.

	PROOF	STOP	APPLE	ONION	THINK	WONDER
hs						
or	**palm up metacarpals out**	**palm left metacarpals out**	palm down/out metacarpals toward head		palm down metacarpals toward head	
loc	nondominant palm		**side of chin**	**temple**	temple	
mov	down		twist twice		**move in**	**circling**

Note that movement can affect the other three parameters, since movement causes the configuration of one or more joints to change. If there is significant movement of the base knuckles and/or interphalangeal joints, then handshape may be affected, and if there is significant movement of the wrist, radioulnar joint, elbow, and/or shoulder, then orientation and/or location may be affected.

For example, the radioulnar twisting in APPLE and ONION causes the palm orientation of the sign to change, with the palm shifting between facing outward and facing downward. This makes it difficult to specify the orientation of these signs, since it is not fixed. However, specifying the movement in cases like this is often sufficient, though in some cases, more detailed description may be necessary.

7   Notation

William Stokoe (1960, 1965) is notable for having helped demonstrate that signed languages are languages, with the same complexity and structures. As part of his work, he also developed a notation system for signed languages that is sometimes called **Stokoe notation**. It is based on his analysis of the structure of signs, with separate symbols assigned to values for each of the four parameters. Stokoe originally considered orientation to be part of handshape, though it has generally been considered a distinct parameter due to the work of (Battison 1978).

Notating signs is quite difficult, especially in more complex signs that involve both hands and/or multiple kinds of movement. Very simple signs, with only one hand and one kind of movement, can be notated with the template $LH_O{}^M$ in Stoke notation. The L position in this template is replaced with the appropriate symbol for location, the H position is replaced with the appropriate symbol for handshape, the subscript $_O$ position is replaced with the appropriate symbol for orientation, and the superscript ^{M} position is replaced with the appropriate symbol for movement, Some of the symbols in Stokoe notation are given below.

L		H		O		M	
Ø	neutral space	A	✊	ɑ	palm facing up	^	upward
◯	face/head	B	🖐	ɒ	palm facing down	∨	downward
⌒	brow/forehead	5	🖐	⊤	palm facing signer	ᴺ	up and down
⊔	eyes/nose	C	🤏	⊥	palm facing away from signer	>	to dominant side
◡	lips/chin	E	✊	>	palm facing dominant side	<	to nondominant side
ʒ	cheek/temple/ear	F	🤌	<	palm facing nondominant side	ᶻ	side to side
π	neck	G	👉	∧	fingers pointing up	⊤	toward signer
[ ]	torso/shoulder	H	✌	∨	fingers pointing down	⊥	away from signer
\	upper arm	I	🤙			⊺	to and fro
✓	elbow/forearm	K	🤟			ᵃ	turn palm up
ɑ	inside of wrist	L	🤟			ᴰ	turn palm down
ɒ	outside of wrist	3	🤟			ω	turn wrist back and forth

For example, we could notate the ASL sign THANK-YOU as ◡Ḃ⊤⊥ in Stokoe notation. The symbol ◡ represents that the beginning location of this sign is on the chin. The symbol Ḃ represents that the handshape is in the B-handshape family; in this case, it is 🖐, with the thumb extended and abducted, which is indicated by the dot ˙ diacritic over the letter B. The subscript symbol ⊤ represents that the beginning orientation is facing inward toward the signer. Finally, the superscript symbol ⊥ represents that the movement is outward away from the signer.

This is just a brief overview of Stokoe notation and learning how to use it would take an entire course! Stokoe's use of parameters to break down notation has inspired many other systems, and two are briefly described below. See Hochgesang 2014 for a fuller overview of the issue of signed language notation. **SignWriting** (Sutton 1981, 1990) and **Hamburg Notation System (HamNoSys)** (Prillwitz and Schulmeister 1987, Prillwitz et al. 1987, 1989) have some more iconic symbols than Stokoe notation, especially for handshape, making them more universal. Stokoe notation uses symbols for handshape that are ASL-specific, so it can be problematic for notating other signed languages.

Consider the SignWriting symbol ⥮ and the HamNoSys symbol ⊌, which both represent the ✌ handshape. In these symbols, the extended middle and index fingers are iconically represented by lines sticking out from the hand (the HamNoSys symbol even represents the thumb crossed over the palm). In comparison, this same handshape is represent by U in Stoke notation, because this handshape is used in ASL to represent the English letter U. This is useful if you already know ASL, but it would not be very memorable if you were working on different signed languages where that handshape serves a different function, as in Jordanian Sign Language, in which it represents the Arabic letter ت (Hendriks 2008). The Arabic letter ت corresponds to the phone [t], so it has no meaningful relationship to the English letter U. So when notating signed languages like Jordanian Sign Language, more iconic systems like SignWriting and HamNoSys may be more suitable.

Among the many competing notation systems, none has emerged as a preferred standard like the IPA for spoken languages. These systems are also difficult to use, because they contain symbols that do not yet exist in Unicode, resulting in ad hoc solutions. This impedes sharing and making progress on research in signed language phonetics and phonology and is a key problem that needs a solution.

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