

The cross-linguistic distribution of sign language parameters

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1 Introduction

While there is a great deal of information available about the cross-linguistic distribution of grammatical features in spoken languages (Crothers 1978; Haspelmath et al. 2005; Moran and Wright 2009), the distribution of grammatical features in signed languages has received less attention. The work that has been done focuses mainly on interrogatives and negations (e.g. Zeshan 2005) and the markedness and distribution of specific handshapes (Crasborn et al. 2001; Rozelle 2003).

What has not yet been established, however, is how the use of broader phonological distinctions – similar to features in spoken language phonology – are distributed. Commonly called parameters, these have been well studied in Deaf community sign languages such as American Sign Language (ASL) (Stokoe 2005; Klima and Bellugi 1979; Brentari 1998). But this does not shed light on some central questions about the nature of the tools available to signers. Which parameters are rarer and which are more common? Are some or any parameters used universally? How do they rank with relation to each other? Are some parameters highly marked in terms of cross-linguistic distribution? Are any possible parameters not used?

Investigating these questions is essential if we are to understand the limits of human language use. While the study of spoken language phonetics has explored and marked the boundaries of ‘the articulatory possibilities of man’ (Catford 1968), the articulatory possibilities of hands remain understudied.

1.1 Parameters

Which is not to say that it has not been studied at all. The sub-lexical phonological units of sign are commonly called parameters (no relation to the Chomskyian use of term), although Stokoe originally suggested the term ‘chereme’ (Stokoe 2005). At this point, there are at least six major parameters that have gained general acceptance: handshape, location, movement, number of hands, palm orientation and non-manuals.

Handshape, location and movement were all proposed by Stokoe in his seminal work on the structure of ASL (Stokoe 2005). Handshape refers to the overall shape of the hands, including selection and posture of the fingers. At least 160 distinct hand-shapes have been attested cross-linguistically (Prillwitz et al. 1989). A minimal pair for handshape in ASL is SOUR and APPLE. SOUR is produced at the side of the mouth with the index finger extended. APPLE differs only in that the index finger is bent at the first knuckle. Location is where in space the sign is produced, and is usually referred to using the part of the body or face

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closest to the hands during sign production. A minimal pair for location is APPLE and ONION. As mentioned above, APPLE is produced at the side of the mouth while ONION is produced at the edge of the eye. Finally, movement is how the hands or fingers move during sign production. A minimal pair for movement is CHAIR and TRAIN. For both signs, the index and middle fingers on both hands are extended. In CHAIR the fingers of the dominant hand tap those of the non-dominant hand twice, while in TRAIN the fingers of both hands remain in contact, but the fingers of the dominant hand slide from the finger tips to the first knuckle and back repeatedly. At least for American Sign Language however, these three parameters are not able to fully capture all distinctions between signs.

One aspect not captured by the above parameters is the relationship of the hands to each other. Bellugi and Fischer (1972) suggest that both the number of hands used and their relationship to each other are necessary to describe signs. This will be referred to as ‘number of hands’ from here on out, but it should be noted that the relationship between hands when signing is complex and subject to a number of phonological processes (Battison 1978; Napoli and Wu 2003). A minimal pair for number of hands from ASL is PURPLE and PARTY. For PURPLE the dominant hand is held in front of the body with a P handshape and is shaken back and forth. In one popular variant of PARTY the non-dominant hand mirrors the dominant hand.

Another parameter is palm orientation, or the rotation of the wrist and forearm (Friedman 1975). This is necessary for distinguishing between signs such as BALANCE and MAYBE. For both signs, both hands are held in front of the body, parallel to the floor with the fingers pointing away from the body, and one hand is raised while the other is lowered in an alternating motion. For BALANCE the palms face downwards, while in MAYBE they face upwards.

Not all information in signed languages is on the hands, however. The face and body can also be used to encode lexical distinctions, such as between LATE and NOT YET (Liddell 1978). These signs are identical except for a grammatical facial expression during production of NOT YET: the head shakes from side to side, the lips are slightly opened and the tongue is pushed forwards in the mouth (though not usually protruding beyond the lips). In some contexts, the sign may be produced with the facial expression but not the manual component. These lexical facial expressions will be referred to as ‘non-manuals’. Note that this is limited to non-manuals that are used to make lexical distinctions. They may also be employed for a range of grammatical functions, such a marking mood, aspect or syntactic structures such as topics (Pfau and Quer 2010). A language may use non-manuals for grammatical purposes but not lexical ones and only the latter will be considered here.

1.2 Village Sign Languages

The above parameters have been proposed based mainly on American Sign Language and other Deaf community sign languages. These are not, however, the only type of signed languages in use today. Deaf community signed languages are the primary languages of culturally Deaf populations that exist as a sub-culture within hearing society. The social situation is very different for village sign languages, however. This typological category of signed languages is characterized by use in small endogamous populations with a high proportion of deafness. In these communities, deaf individuals are fully incorporated into the

social life of a community where both hearing and deaf individuals use the signed language. Village sign languages often show grammatical divergence from other sign languages (Zeshan 2010). Given this, should village sign languages be included in this analysis? Can they be analysed in a parameter framework at all?

In order to clarify this question, I will focus on one of better-studied villages sign languages: Al-Sayyid Bedouin Sign Language, which is used in southern Israel. It has been argued that Al-Sayyid Bedouin Sign Language does not use parameters in the same way as languages such as American Sign Language:

ABSL exhibit[s] the most variation in the formation of handshapes...ABSL signers are aiming for a holistic iconic image, and ... discrete phonological categories are not yet robust in the language.
(Israel and Sandler 2011:6)

ABSL signers exhibit quite a bit of linguistic variation. The handshape used for the same sign may vary quite a bit between signers. This is not the case in more established languages such as ASL. Israel and Sandler argue that this is due to the fact that phonological categories are not yet solidified in ABSL. Given this, is it reasonable to say that ABSL makes use of handshape?

For the purposes of this analysis, yes. While there is not yet consensus in the language community about the phonological form of each sign, there is consensus that it should include a handshape. This is in contrast to what has been observed for some homesigners, for example, where the hand's shape is not always contentful (Coppola and Brentari 2014). The stance that ABSL does make use of parameters has also been taken by Al-Fityani (2007) in a cross-linguistic comparison of Arab Sign Languages. While village sign languages and emerging sign languages may tolerate more variation in production, they do make use of the same parameters as Deaf community sign languages.

1.3 Markedness

Most previous work looking at parameters cross-linguistically has focused on the distribution of possible settings within each parameter, such as the use of the same handshape across multiple sign languages (Mandel 1979; Rozelle 2003). That is in contrast to this investigation, which asks whether a sign language uses handshape at all.

But what will this analysis tell us? Two things, both of which fall under the general header of "markedness". (For a more in-depth discussion of how the term has been used, see Haspelmath (2006) and Rice (2007)). The first is the distribution of parameters, the second is their hierarchical relationship and the final is the identification of highly marked parameters.

Since no previous work has been done on this question, a general description of the distribution of parameters is a clear first step. While most grammars of signed languages do include information about which parameters the language uses, this information has not been previously compiled and analyzed. This means that it has not previously been possible to address questions such as whether some or any parameters are universals in a principled, quantitative way.

Once the general distribution has been described, the next step is to determine if there appears to be any relationship between parameters. Can a hierarchy be constructed such that higher ranked parameters must be present if lower ranked parameters are observed? Implicational hierarchies are often used in discussions of markedness in spoken languages (Greenberg 1966), but have not been applied to the use of different parameters in signed languages.

A final question that this analysis will address is the existence of “edge cases”. What parameters are used by at least one sign language but are very rare? These are of especial interest because they help us to delimit what is a possible sub-lexical units in signed languages.

2 Data

In order to answer questions about the cross-linguistic distribution of parameters, parameter data from a large number of signed languages was necessary. This investigation uses data from the Sign Language Analyses (SLAY) database (Tatman 2015) for that purpose.

SLAY contains condensed cross-linguistic grammatical information from 87 signed languages, almost two-thirds of the roughly 140 attested signed languages. The information in the database is taken from a variety of different sources: primarily descriptive grammars, but work from related fields such as automatic sign language recognition was included if no other sources were available for a language. Sources from different scholarly traditions – such as Kakumasu (1968) and Fabian and Francik (2001), which do not use Stokoe’s framework – were included to contribute converging evidence to the analysis. In addition, the database distinguishes between languages which were observed to use a parameter, those where it was explicitly looked for but not found and those analyses where a parameter was not discussed at all. Since the second is a stronger argument than the third, the difference is important to maintain.

There were some drawbacks to using SLAY, however. The first and most obvious is that it does not include primary linguistic data and relies on the accuracy of the grammars it includes. This is a potential source of error. In addition, as mentioned above, not all the included analyses were done by trained linguists. Given that signed languages are often un- or under-documented this was unavoidable. Because the grammars themselves were from different scholarly traditions and occasionally different languages, some analysis was necessary to determine if two different terms were referring to the same parameter. In addition, there is currently only one source for each language in the database, though this may change as more sources are included.

There is one final advantage of the database that can help to assuage these criticisms, however. It is currently publicly available via SQLShare, courtesy of the University of Washington (Howe et al. 2012) and interested researchers are encouraged to download, modify and append it as they see fit.

Parameter	Present	Absent	Not discussed
Handshape	100%	0%	0%
Movement	98.86%	0%	1.14%
Location	94.25%	0%	5.74%
Palm Orientation	51.14%	6.89%	41.37%
Non-manuals	35.23%	8.04%	56.32%
Number of Hands	13.64%	8.04%	78.32%

Table 1: Percentage of signed languages that make use of each parameter.

3 Findings

3.1 Distribution

The raw percentages of signed languages which make use of each parameter are summarized in Table 1. Note that, as mentioned above, there is a distinction maintained between languages where a parameter was looked for and not found (“Absent”) and those languages where analyses do not mention the given parameter at all (“Not discussed”).

The most striking pattern in the data is the fact that almost every language uses handshape, movement and location. Further, no researchers who looked for handshape, movement or location failed to find it. This suggests that handshape, movement and location may be universally used by signed languages to encode lexical differences. The other parameters—palm orientation, non-manuals and number of hands—were observed in roughly half or fewer of the languages. Further, all of these parameters were explicitly searched for but not observed in six or seven languages. This reinforces the idea that handshape, movement and location are preferred cross-linguistically and are thus less marked.

3.2 Markedness Hierarchy

The idea that handshape, movement and location are unmarked is further supported by a markedness hierarchy which emerges from the data. In a traditional implicational hierarchy, if a language has a given feature it must also have all features ranked more highly. Due to the number of analyses that did not include any argument either for or against all parameters, it is not yet possible to construct a complete hierarchy. However, it is possible to rank the parameters with relation to each other.

In constructing this hierarchy, a parameter was ranked above another parameter if it was observed while the second parameter was found to be missing. Analyses where a parameter was not discussed, or excluded, were not considered in this ranking, so “excluded” may be ranked higher or lower than either “yes” or “no.” Using these criteria, it was not possible to rank handshape, movement and location with relation to each other. This hierarchy, as well as the number of languages in SLAY which displays each combination of parameters, is summarized in Table 2. The ranking can be represented more concisely as:

HANDSHAPE, MOVEMENT, LOCATION > PALM ORIENTATION > NON-MANUALS >
NUMBER OF HANDS

Handshape	Movement	Location	Palm Orientation	Non-manuals	Number of Hands	# of Langs.
yes	yes	yes	yes	excluded	excluded	20
yes	yes	yes	excluded	excluded	excluded	14
yes	yes	yes	yes	yes	excluded	14
yes	yes	yes	excluded	yes	excluded	6
yes	yes	yes	excluded	excluded	excluded	4
yes	yes	yes	excluded	excluded	yes	4
yes	yes	yes	no	no	no	4
yes	yes	yes	excluded	yes	yes	2
yes	yes	yes	yes	excluded	yes	2
yes	excluded	excluded	excluded	yes	excluded	1
yes	yes	excluded	excluded	excluded	excluded	1
yes	yes	excluded	excluded	excluded	yes	1
yes	yes	excluded	yes	yes	excluded	1
yes	yes	excluded	yes	excluded	no	1
yes	yes	yes	excluded	yes	excluded	1
yes	yes	yes	excluded	yes	no	1
yes	yes	yes	excluded	yes	yes	1
yes	yes	yes	no	excluded	excluded	1
yes	yes	yes	no	no	excluded	1
yes	yes	yes	yes	no	excluded	1
yes	yes	yes	yes	excluded	excluded	1
yes	yes	yes	yes	no	excluded	1
yes	yes	yes	yes	yes	excluded	1
yes	yes	yes	yes	yes	no	1
yes	yes	yes	yes	yes	yes	1
yes	yes	yes	yes	yes	yes	1

Table 2: Table summarizing markedness hierarchy between parameters. If a parameter was searched for and found absent, then no lower-ranked parameter (those to the right) were observed. The inverse is not always true, due to the number of empty cells, but the ordering should remain relatively stable as those cells are filled. The rightmost column tallies the number of languages in the SLAY database which use each combination of parameters.

As in the raw distribution, handshape, movement and location enjoy a privileged position, though they cannot be ranked with relationship to each other. Palm orientation is next highest ranked, followed by non-manuals and then number of hands. It is somewhat surprising that non-manuals are ranked so low given their central role in Deaf community sign languages such as ASL. And, indeed, many signed languages make use of them for grammatical purposes, but not to make lexical distinctions. Even ASL may eventually move away from using non-manuals lexically if historical trends continue (Frishberg 1975).

3.3 Highly-marked Parameters

The parameters discussed above are not, however, an exhaustive list of possible parameters. One minor parameter, contact, was often included in analyses. In addition, two other ways of encoding lexical distinctions are included in the database: duration and hand choice. These are notable for being highly marked. Not only do they occur in very few languages, but they are also used in a very restricted ways in those languages.

One parameter which was observed relatively often but is not used to make lexical distinctions (and is thus considered a “minor” rather than “major” parameter) is contact (Klima and Bellugi 1979). While many of the analyses in SLAY include contact, no minimal pairs

were offered in any language. It is mentioned here only in the interests of completeness.

Duration is used in many sign languages for encoding aspect. However, it does not appear to be widely used for lexical distinctions. Palestinian Sign Language does have a clear minimal pair for duration between HONEY and CRUSHED-SESAME (Abdel-Fattah 2005). Duration has also been proposed as a minor parameter in Australian Sign Language, also known as Auslan (Johnston and Schembri 2007). It was not included as a major parameter in any other signed languages, however. This suggests that, while duration is available for lexical distinctions in signed languages, it is highly marked. Perhaps it is the fact that duration is so often recruited by other levels of the grammar which makes it dis-preferred for lexical encoding. Like non-manuals, sign duration is often recruited by the syntax and morphology. The use of duration to encode aspect may be iconically motivated (Sexton 1999; Dahl 1994), which would help to explain its frequency. As a result, this may block it from being productively used for lexical encoding in most signed languages, in order to avoid confusion.

An even more marked parameter is hand choice. In most signing, the signer uses their dominant hand to produce signs (Vaid et al. 1989; Brentari 1998). There is no distinction between the same one-handed sign produced with the right hand by a right-handed signer and the left hand by a left-handed signer. However, Turkish Sign Language does make use of hands differently (Kubuş 2008). In the fingerspelling system¹, the letter P is produced with the non-dominant hand. However, signs produced with a p handshape, such as FIGHT are made with the dominant hand. Kubuş argues that this is due to the fact that the fingerspelling system has not undergone phonologization. Regardless of its phonological status, the use of the non-dominant hand for canonical signs is highly marked. The only other instance of producing signs with the non-dominant hand is in Walpiri Sign Language, used in central Australia. For a very small set of family signs, the same relation on the distaff and spear sides are signed with the same sign produced by different hands (Kendon 1988). It is not surprising that this parameter is incredibly rare; it's far more surprising that any sign language at all makes use of the non-dominant hand preferentially, even for a small portion of the signing system. Previous research suggests that language use, brain lateralization and lateralization of hand use are intrinsically linked (e.g. Bonvillian and Richards 1993; Skoyles 2000; Corballis 2003). Thus preferential use of the dominant hand during signing seems to be necessitated by cognitive factors and it is no surprise that assigning grammatical function to hand choice is so highly marked.

It is also useful to consider parameters which are possible but have not been observed in signed languages. For example, the use of the feet has been observed in homesign² (Hunsicker and Goldin-Meadow 2013). However, no analysis in the database suggested that the feet were used to make lexical distinctions. They were used as a location, notably in languages such as Adamorobe Sign Language (Nyst 2007) and Yolngu Sign Language (Bauer 2014) that are mostly produced while seated cross-legged on the ground, but not as active articulators. The lack of the use of the feet by signed languages may be due to perceptual pressures. Eye-gaze focuses on the face during the perception of sign (Emmorey et al. 2009).

¹A method of manually encoding written language, with each written letter given a distinct handshape. Most signed languages used by Deaf communities in literate societies make use of fingerspelling.

²Gesture systems used for communication by deaf children who are not afforded access to full sign languages.

As a result, gestures made with the feet would be difficult to perceive without shifting the gaze drastically and possibly missing important grammatical information encoded on the face. This helps to explain why even signs which have a strong iconic reason to be produced with the feet, such as KICK, are produced with the hands instead. While this observation is predictable given previous research, it was not verifiable without a robust cross-linguistic sample of information about the phonological tools used by signed languages.

These edge cases help us to constrain the limits of what sign phonology should encompass. These limits will become firmer as more signed languages are documented and existing documentation is expanded upon.

4 Conclusion

To review, this cross-linguistic investigation of the use of parameters in signed languages has made three main contributions. The first is information on the general distribution of the parameters in signed languages. The evidence so far suggests that the use of handshape, movement and location may be universal in signed languages. This observation has emerged even in work outside of the Stokoe tradition. While lesser-used parameters, such as non-manuals, are necessary to describe distinctions between signs in languages such as ASL, this does not appear to be true in the majority of languages.

The second contribution is a preliminary markedness hierarchy of parameters in signed languages. Handshape, movement and location were the highest ranked and thus least marked in the hierarchy as well. There was also consensus between the two methods about the markedness of palm orientation, non-manuals and number of hands. They were ranked in that order using both in terms of frequency of observance and in their position in the markedness hierarchy. This is converging evidence that handshape, movement and location are unmarked when compared to other common parameters, and that they may be universals.

On the other end of the markedness spectrum, there are very rare parameters, as well as those which are observed in homesign but not included in full sign language systems. This may be due to a number of different factors. Languages may prefer to use a certain parameter at other levels of the grammar, as for duration and possibly non-manuals. Or there may be cognitive factors that make a parameter unfeasible, as with the use of hand choice. Or a parameter may simply be very difficult to perceive, such as the use of the feet. We may expect that any additional parameters observed as the result of on-going documentation work will be restricted by these same factors.

There is substantial room for future research on this and related questions. One obvious space is the inclusion of additional signed languages and analyses in the database. As more sign languages are documented, we will develop a clearer picture of how sign languages encode lexical differences. The markedness hierarchy proposed here, for example, may change as "excluded" cells are filled in or if alternate analyses are adopted for some languages.

Another area for future work is to apply other types of markedness analyses to parameters. A good deal of psychological and developmental work has been done on parameters, especially in ASL, that helps to shed light on the relationship between handshape, movement and location. Hildebrandt and Corina (2002), for example, found that handshape may be of less central importance than movement and location for sign recognition. Movement between different handshapes is also acquired after other types of movements (Karnopp 2002). There

has been less attention paid to very rare parameters, though. This would be an interesting area for future experimental work.

Language change in sign languages is another area to mine for information on the markedness of parameters. Frishberg (1975) argues that as ASL developed, it moved towards the use of primarily the hands during signing and away from obligatory lexical non-manuals. Later work (Ceil et al. 2002) has supported this claim. The finding here that lexical non-manuals are marked cross-linguistically is unsurprising in light of these observations. But do similar processes of diachronic change take place in other signed languages, where more marked parameters are slowly lost from the canonical form of signs? This question may become clearer with as more work is done in under-studied sign languages.

5 References

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