

Motivated phonological templates in Sign Language

Gal Belsitzman
University of Haifa
galbel84@gmail.com

Wendy Sandler
University of Haifa
wsandler@research.haifa.ac.il

1. Introduction

One of the most striking and universal characteristics of language is usually taken for granted: the existence of distinct structural levels. All languages have phonology, morphology, syntax, prosody, and semantics, and each level has its own types of forms and its own rules and constraints for combining them. Sign languages – which arise spontaneously within communities of deaf people – are no exception. In fact, sign language linguistics as a field was born as a result of the seminal discovery by Stokoe (1960) that the meaningful level of signs/words is distinguishable from a meaningless level, akin to phonology, which provides its building blocks. This discovery implies that signed and spoken languages are similar in basic ways. It was surprising because signs appear to have iconic form-meaning correspondences, and were therefore assumed to be wholes that could not be broken down into meaningless parts, unlike spoken words, which are divisible into meaningless phonological segments or features. Since Stokoe's work, linguists have gone on to analyze each level of structure in sign languages, and have found numerous similarities between them and spoken languages (Sandler and Lillo-Martin 2006).

Yet sign languages are exceptional in the degree to which their words are iconically motivated, and this high degree of iconicity means that the phonological and morphological levels cannot always be cleanly and discretely separated.¹ Here we will show a unique type of interaction between phonology and morphology in sign languages, suggesting that the physical form that a language takes influences its linguistic form in nontrivial ways. Specifically, we will show, following Lepic et al. (2016), that the availability of two hands in sign languages is exploited in lexical word formation in largely predictable ways, due to iconicity. That is, the phonological structure of certain categories of signs is determined by meaning. We go on to adopt a templatic account that is influenced by morphological templates in Semitic languages, but, in the sign language case only, we show how phonological aspects of lexical templates are determined by meaning.

We begin in Section 2 with a brief overview of sign language phonology, including both one- and two-handed signs, and of morphology, including inflectional morphological templates that have been proposed earlier. In Section 3, we proceed to demonstrate that whether an uninflected lexical sign is one- or two-handed is often determined by particular categories of meaning. We propose some templatic schemata – motivated phonological templates – for different categories of two-handed signs. Despite the fact that formational elements have meaning, such signs are typically analyzed as monomorphemic. This lexical motivatedness blurs the line between morphology and phonology that is usually assumed, and leads us to conclude in Section 4 that the phonological and the morpho-lexical levels of language are not mutually exclusive.

¹ Iconicity does not stop at the level of the sign. There is iconic motivation behind morphology and syntax in sign languages as well (Taub 2001; Wilcox 2004; Perniss, Thompson and Vigliocco 2010; Meir et al. 2013).

2. Phonology and morphology in Sign Languages

The purpose of this section is to demonstrate briefly that the two levels, phonology and morphology, are indeed distinguishable in sign languages.

2.1 Phonology

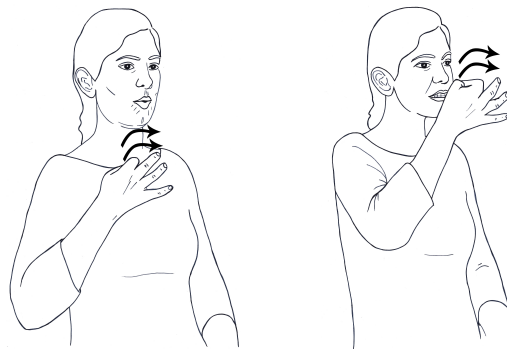
Signs are comprised of three major phonological categories: handshape, location, and movement (Stokoe 1960). Like consonants and vowels of spoken languages, each of these major categories consists of a list of features (Liddell and Johnson 1989; Sandler 1989; Brentari 1998). These elements behave phonologically, in the sense that the constraints on their structure and the rules that manipulate them are related to their form and not to meaning.

Turning first to contrastiveness, Figure 1 shows minimal pairs in Israeli Sign Language (ISL) that differ only in features of (a) handshape, (b) movement, and (c) location.

(a)



(b)



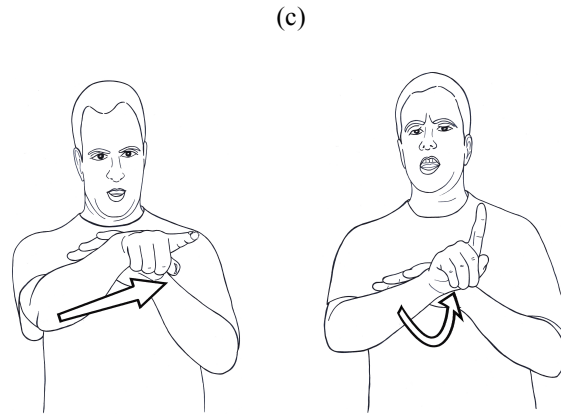


Figure 1: Phonologically distinguished minimal pairs in ISL, (a) MOTHER, NOON - different handshapes (b) WELL-BEING, CURIOSITY - different locations (c) ESCAPE, BETRAY - different movements

Slightly fewer than half of the signs in vocabularies of sign languages use two hands. Of these, there are two basic types (Battison 1978), called balanced and unbalanced (van der Hulst 1993) among other labels. In balanced signs like MEET in Swedish Sign Language (SSL) (Figure 2), the two hands are configured and move symmetrically, and in unbalanced signs like ESCAPE (Figure 1c) above, the nondominant hand serves as a location/place of articulation, while the dominant hand articulates the movement.



Figure 2: Balanced sign, MEET in SSL

The canonical phonological shape of a sign consists of a single hand configuration that moves from one location to another, to manifest a Location-Movement-Location (LML) monosyllable (Liddell 1984; Liddell and Johnson 1986; Sandler 1986, 1987, 1989). The fingers selected that specify a given hand configuration remain constant across a sign, but their position may change, e.g., from open to closed.

In addition to the criterion of contrastiveness, categories and their features are subject to rules based on their form. Processes like assimilation and deletion can affect whole feature categories without regard to meaning, even if the base sign is iconic, in which case the iconicity can be obscured. This means that these formational elements are phonological. Furthermore, if the sign is two-handed, the behavior of each hand is determined by its phonological category membership, as would be expected if meaning is irrelevant. For example, the ISL lexicalized compound THINK+STOP = TAKEN-ABACK (“surprised”) reduces to a canonical, monosyllabic LML form (Sandler 1989, 1999a) by deleting locations and assimilating hand configuration regressively, as shown in Figure 3 (a-c). Crucially, the fact

that the two-handedness of the second sign assimilates regressively, obscuring the form of the first sign of the compound, shows that two-handedness behaves like a phonological element.

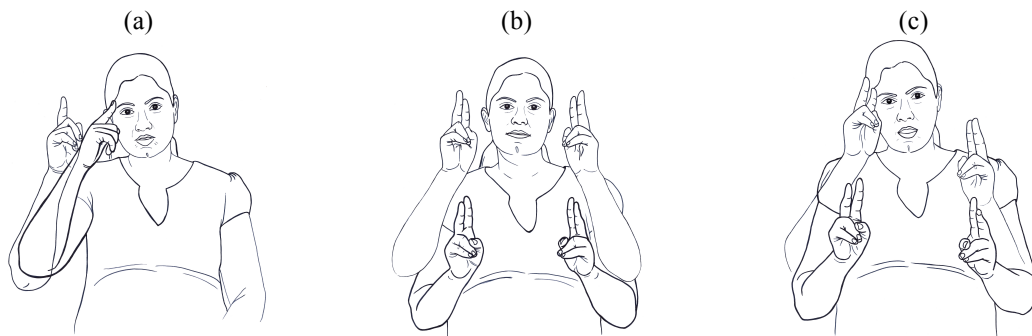


Figure 3: Lexicalized compound in ISL, (a) THINK + (b) STOP = (c) TAKEN-ABACK ("surprised")

2.2 Morphology

Compounding is but one example of sign language morphology, perhaps the richest and most dynamic level of structure in established sign languages. Even though sign languages are young compared to spoken languages – at most 300 years old -- these languages exhibit a range of inflectional and derivational processes, such as verb agreement (Fischer and Gough 1978; Padden 1988; Meir 2002), compounding (Klima and Bellugi 1979; Liddell and Johnson 1986; Sandler 1989), complex classifier constructions (Supalla 1982; Emmorey (ed.) 2003), and temporal aspect inflection (Klima and Bellugi 1979; Sandler 1989, 1990). All of these processes are typically found across sign languages, with similar (but not identical) formal properties, apparently because they are based on iconic images and iconic use of space, while more opaque affixal processes that rely on grammaticalization are fewer and take longer to emerge (Aronoff et al. 2005).

Here we exemplify a particular type of morphological process that is analyzed as templatic: temporal aspect morphology, that is, inflections for aspects such as iterative, durational, etc. There are many other types of morphology, as sketched in the previous paragraph, but we present temporal aspect here because it is templatic, as background for the phonological templates that we will propose for two-handed signs in section 3. Originally described for American Sign Language (ASL) by Klima and Bellugi (1979), and developed by Newkirk (1979, 1981), verbs are inflected for aspects such as habitual, durational, continuative, and iterative. They do so, not by added affixes, but by systematically altering the shape and/or rhythm of the sign's production. The citation form of the sign LOOK-AT and its inflected Durational form are illustrated in Figure 4 (a,b).



Figure 4: ASL sign LOOK-AT (a) citation form and (b) durational form, reproduced with permission from Ursula Bellugi ©

Since the form of these aspects involves gemination of locations or movements and/or changes in the shape of movement, typically from a straight path to an arc, they may be considered comparable to prosodic morphological templates of Semitic languages as proposed in McCarthy (1979, 1981). In that model, the root consonants are associated with templates that account for gemination by double association of the features of the root consonant to C timing slots. Vowel “melodies” vary roughly according to inflectional class, such as active or passive. If a given form requires gemination of the vowel, its features too are doubly associated to V slots. In McCarthy’s model, each ‘tier’ – the consonantal features tier, the vowel features tier, and the CV tier of prosodic form – has the status of a morpheme. Some examples from standard Arabic are shown in Figure 5 (a,b).

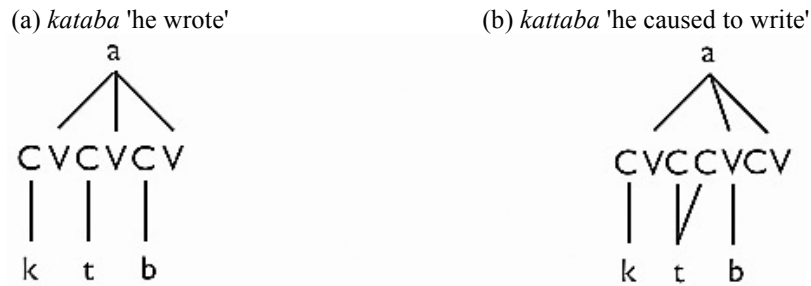


Figure 5: Arabic examples of McCarthy's model, (a) *kataba* and (b) *kattaba*

We have seen that the canonical form of a sign in sign language is LML (roughly comparable to CVC). Under temporal aspect inflection, the basic features of handshape and location stay the same; movements, like vowels, can change their shapes, creating circles, for example, and the prosodic form is altered through gemination of one or more segments. Templates of the citation form of the ASL sign LOOK-AT and its Durational form are shown in Figure 6a and b.² The model schematized here and throughout this paper is from Sandler (1989), inspired by models of CV phonology (Clements and Keyser 1983), autosegmental phonology (Goldsmith 1976) and prosodic templatic morphology (McCarthy 1979, 1981).

The citation form (6a) is produced by configuring the hand with the index and middle fingers extended, fingertips pointed outward, and moving the hand from a position near the body (proximal) to a position farther from the body (distal).³ In (6b), the movement segment is specified for the feature [arc] and the sign is reduplicated, resulting in the circular movement pattern (see Sandler 1990 for details). Temporal aspect morphology of a similar character is found in ISL. For example, the Continuative is formed in ISL by making the final location longer in duration, represented schematically in Figure 7.

² LOOK-AT is an agreement verb, which inflects for subject and object by changing the direction of movement, i.e., by changing the feature specifications of each location (see e.g., Meir 2002). The inflected form can still undergo temporal aspect inflection in the same way as shown in Figure 6, since the aspectual template does not affect the location features, only their durations and whether the sign is reduplicated.

³ The sequential structure shown here, in which locations follow one another separated by a movement, originated in a different model with Liddell (1984); see Sandler and Lillo-Martin (2006, chapter 9) for detailed discussion of sequentiality/linearity in sign language.

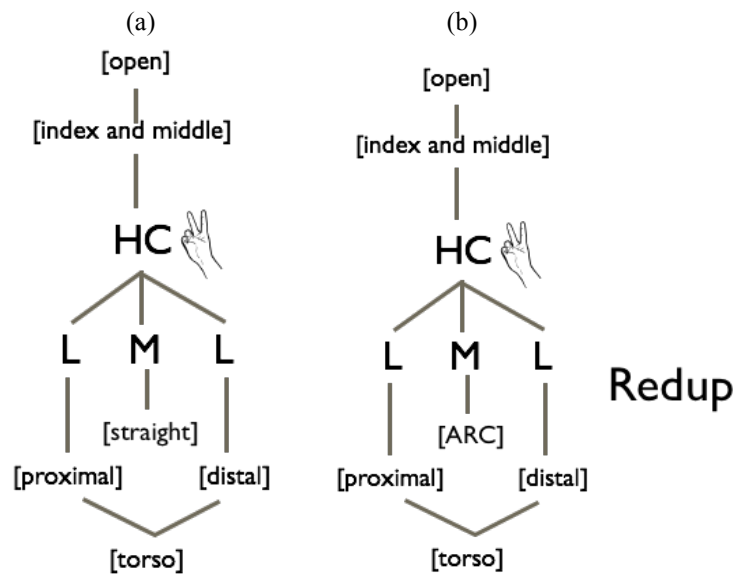


Figure 6: Templates of (a) Partial citation form of ASL LOOK-AT and (b) association to the Durational form (after Sandler 1990). The movement feature in the Durational template is [arc], and the whole sign is reduplicated.

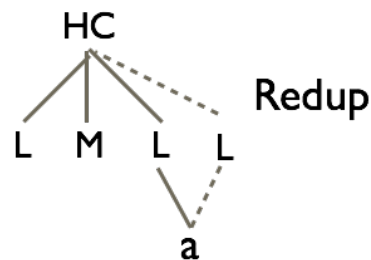


Figure 7: Association of a verb to the Continuative template in ISL (Sandler 1993)

The templates shown involve formal inflectional processes that apply to lexically specified base forms that are comprised of meaningless phonological material. In all of these ways, we find that sign languages are similar to spoken languages in the sense of having distinctly identifiable phonological and morphological levels. In what follows, we demonstrate that certain phonological elements of two-handed signs are semantically motivated, and we propose partially specified phonological templates for these forms.

3. Semantic motivation for phonological features

For many years, sign language researchers were influenced by de Saussure's observation (de Saussure 1983) that the relation between sound and meaning is arbitrary, eschewing iconic motivation in sign language on the assumption that it is 'nonlinguistic'. One reason for treating formational properties such as two-handedness as meaningless is the existence of linguistic constraints and processes that treated them as such, for example, assimilation that affects the nondominant hand as a formational element, together with the dominant hand in symmetrical signs, without reference to meaning (Sandler 1989, 1993). However, in recent years, sign language researchers have begun to view the correspondence between form and meaning in lexical signs as an important clue for understanding linguistic structure (e.g., Taub 2001; Wilcox 2004; Perniss, Thompson and Vigliocco 2010; Meir et al. 2013).

While semantic motivations that underlie phonological elements in sign language lexicons have often been overlooked or ignored, some studies have dealt with them explicitly (e.g., Brennan 1990; Johnston and Schembri 1999; Wilbur 2008; Strickland et al. 2015). Van der Kooij (2002) specifically discusses semantic aspects of unbalanced two-handed signs. She argues that in many asymmetric signs the non-dominant hand is not a phonological element that represents a place of articulation, but in fact a separate morpheme that is semantically motivated. In our analysis, we discuss both balanced and unbalanced two-handed signs, but we do not consider the non-dominant hand to represent a separate morpheme, since its omission from a sign does not leave a morphological unit of any kind. In this section, we present templates of two-handed signs and we identify iconic motivations for several features that have traditionally been treated as meaningless.

3.1 Motivating two-handedness

Broadly speaking, two-handed signs are either balanced or unbalanced.⁴ Figure 8 (a,b) shows representations of these two types of two-handed signs, with examples. Specifically, the representations show that the nondominant hand either acts as a copy of the dominant hand, in balanced signs, or as a place of articulation in unbalanced signs. The details of representations for such signs are different representations in other models of sign language phonology (e.g., Stokoe 1960; Blevins 1993; van der Hulst 1993; Brentari 1998), but in all of these, the elements that are represented are treated as meaningless. We show below that two-handedness is not random, and briefly describe relationships between form and meaning in two-handed signs, following Lepic et al. (2016). It is not only whether a sign is balanced or unbalanced that is motivated; other phonological details such as movement type and contact between the two hands are systematically related to meaning as well, which we illustrate with templates in Section 3.2.

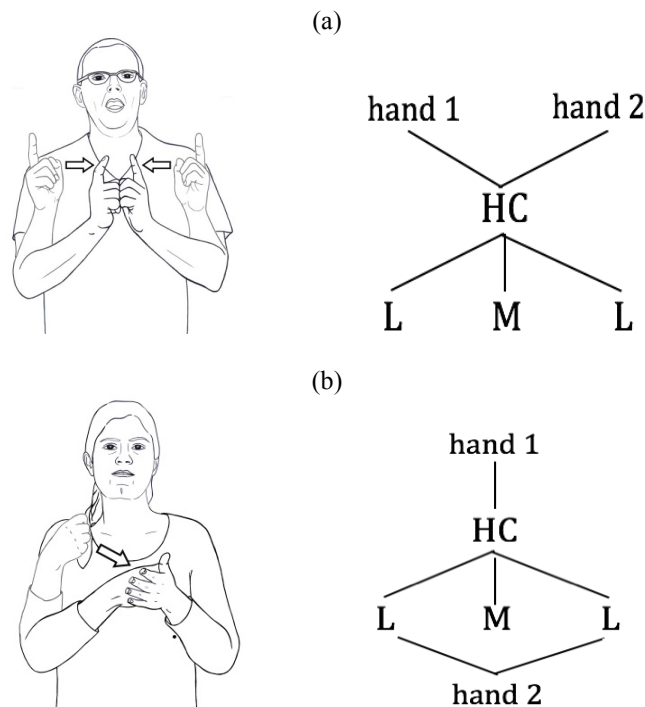


Figure 8: Underspecified templates for two-handed signs, (a) a two-handed balanced template in the SSL sign MEET and (b) a two-handed unbalanced template in the ISL sign END (templates after Sandler 1989, 1993).

⁴ The terms “balanced” and “unbalanced” are from van der Hulst (1993).

As mentioned above, the distribution of signs in the vocabulary of any given sign language is nearly even, about half of the signs are one-handed and the other half, two-handed (Nilsson 2007). Therefore, it may appear as if two-handedness is a chance phenomenon, and that the choice between using one or two hands in a new sign is arbitrary. However, the use of two hands in a sign is often semantically motivated, either underlyingly or by inflection (see references above).

A recent study by Lepic et al. (2016), on which this section focuses, is a cross-linguistic study on three unrelated sign languages – American Sign Language (ASL), Israeli Sign Language (ISL), and Swedish Sign Language (SSL). The study provides comparative data to support the claim that two-handedness in uninflected signs is neither random nor meaningless phonological structure. The study compares 200 lexical items in the three sign languages and finds that the number of cases in which the same concepts were two handed in all three sign languages is highly significant: 33%, where random distribution would be 13%. This study finds that, although the two-handed signs for the same concepts are not necessarily identical in form across the three languages, they draw upon a similar kind of iconic mapping, a similar link between form and meaning. For example, the sign EMPTY is realized in ASL, ISL, and SSL with the non-dominant hand representing a surface or container, and the dominant hand acting upon it, to indicate bareness or lack of content (Figures 9 a-c). As is often the case, the signs are not phonologically identical in the three languages, but the fact that they are two-handed and unbalanced in all three languages is not random. Rather, these aspects of phonological form are motivated by meaning.

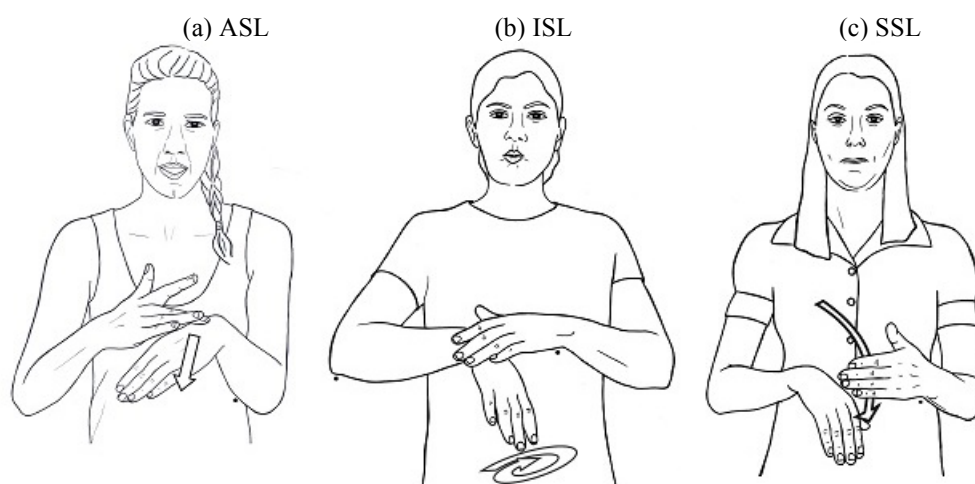


Figure 9: The sign EMPTY in (a) ASL (b) ISL and (c) SSL (from Lepic et al. 2016)

The iconic motivations that underlie the use of two hands in lexical signs typically encode particular types of relationships, shown in (1). Note that (a) and (b) represent relationships that obtain between individual entities, while (c) and (d) represent relationships between component parts of single entities.⁵

(1) Types of relations that motivate two-handedness

- a. *Interaction*: Paired, interacting entities are mapped onto each of the two hands
- b. *Location*: Paired entities and their locations are mapped onto each of the two hands
- c. *Dimension*: Boundaries of an entity's shape/volume are mapped onto the two hands
- d. *Composition*: Component parts of an entity are mapped onto the two hands

⁵ For details of the semantic analysis and illustrations of these relations, see Lepic et al. (2016).

It is not only two-handedness that is often motivated; whether two-handed signs are balanced or unbalanced is often motivated too, as we show in Section 3.2.

The observations in (1) lead to the conclusion that meaning is a key factor, though not the only factor, in predicting two-handedness, a characteristic that was usually treated as strictly phonological. Thus, the templates for two-handed signs are in fact not meaningless – the specification of two hands as a part of the template is itself often motivated by the meaning of the sign.

3.2 Motivation of balanced and unbalanced phonological templates

The two basic forms for two-handed templates correspond to the basic division of two-handed signs – balanced and unbalanced. We now go on to show the relationship between the form of these two templates and meaning.

The two-handed **balanced** template typically represents signs that encode symmetrical relations between similar entities (e.g., SSL MEET, shown in Figure 8a above). By doubly associating the hand configuration (HC) category to each hand, as well as to the same location-movement-location (LML) sequence, the template ensures that both hands have the same handshape and move together. It is known that there are constraints on two-handed signs (Battison 1978). Specifically, if the nondominant hand moves, then it must be configured with the same handshape as the dominant hand and execute similar movement. The phonological template is designed to capture these similarities (Sandler 1989). What now becomes clear is the fact that these similarities are also motivated by the symmetrical semantic relationship between two like entities, in the MEET example, between two people meeting one another.

The two-handed **unbalanced** template typically represents signs that encode an asymmetrical semantic relationship between entities, such as figure-ground (as defined in Talmy 2003; e.g., ISL EMPTY, shown in Figure 9b above; ISL END, Figure 8b). The relationship is clearly reflected in the template so that the non-dominant hand (hand2) represents the *ground* and, as a place of articulation, does not move, and the dominant hand (hand1) represents the *figure* and moves from one location to another. The fact that the nondominant hand does not move in such signs, behaving instead as a location, is motivated by the figure-ground relationship. The constraint on such signs (Battison 1978) is that the nondominant hand must be configured in one of a small number of unmarked handshapes. This too now follows from its status as a more general notion associated with the ground, vis à vis the figure enacting the event.

The form of these templates, we argue, is motivated by the semantics of the two-handed concepts. Are all of the rest of the features in each of these sign types (i.e., features of hand configuration, location, type of movement etc.) provided by the individual lexical representations, or are any of them motivated as well? Lepic et al. (2016) argue that some of them are in fact motivated too, and here we propose that they be included in motivated templates. We focus here on *type of movement* and *contact* in two-handed signs.

3.3. Motivated movement features in balanced signs

In balanced signs, both hands move, and the type of *movement* in such signs may also be specified in the template, in particular, whether the movement is synchronized or alternating. The hands move in a synchronized manner in (1a) and the signs typically represent a relationship denoting synchronized movement of entities, or a symmetrical shape of objects. For example, MEET (Figure 8a above) encodes an event in which two people are approaching each other together, and therefore the movement is synchronized. We repeat the example here, adding the feature [synchronized] (Figure 10).

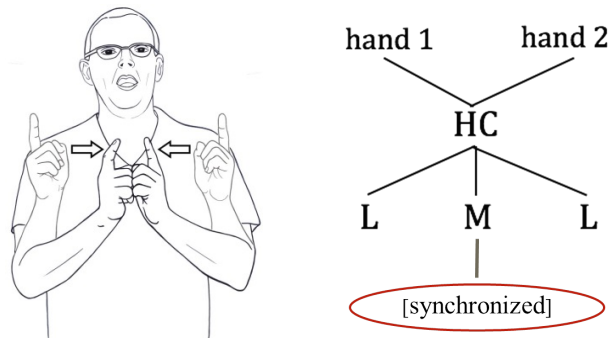


Figure 10: SSL MEET, balanced synchronized template

The feature [alternating movement] is represented in templates to encode a relationship in which one event/entity follows another repeatedly. For instance, in the ISL sign for NEGOTIATE (Figure 11) the hands represent two lines of communication, and the alternating movement shows that the conversation is going back and forth between the participants.

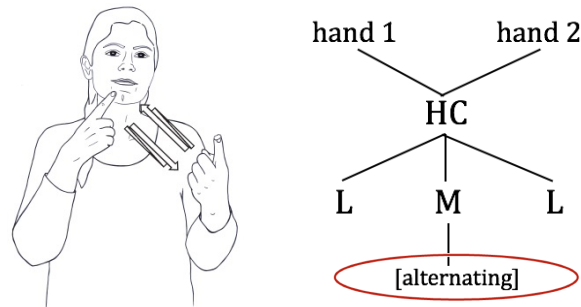


Figure 11: ISL NEGOTIATE, balanced alternating template

3.4. Motivated contact in balanced and unbalanced signs

The contact between the two hands in both balanced and unbalanced signs encodes the spatial relationship/interaction between entities in any of the four relationship types shown in example (1). The contact can be final, as in SSL MEET (Figure 10 above) or ISL END (Figure 8b above), or contact may be initial, as in the SSL sign for SEMESTER, in which the contact notes the beginning of the semester and the movement towards the final location represents the period of time of the semester. Figure 12 repeats the ISL sign END and Figure 13 shows SSL SEMESTER, with the [contact] feature entered into the templates.⁶ The point in the sign at which contact takes place is another example of motivated phonology.

⁶ The fact that the contact may occur on different segments is one of the theoretical motivations for the sequential structure of the model (Sandler 1989).

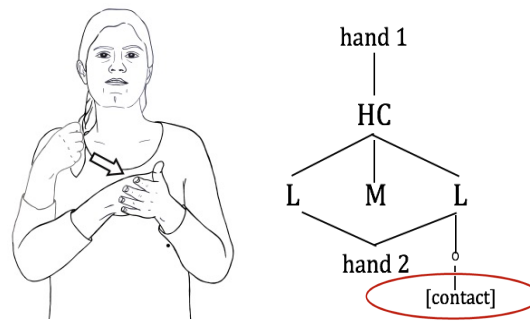


Figure 12: SSL END, unbalanced, final-contact template

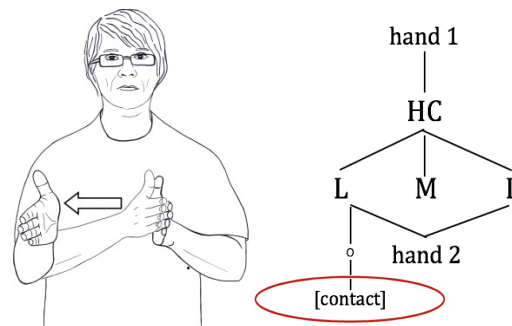


Figure 13: SSL SEMESTER, unbalanced initial-contact template

4. Conclusion: blurring the line between levels of structure

In Section 1, we showed that two-handedness has often been treated as a purely phonological characteristic of signs. The nondominant hand in signs is treated by the phonology as formational elements belonging to the categories of hand configuration or location, both in their specifications, and also in phonological processes, such as assimilation. In various derivations and inflections, the nondominant hand is also referred to without any reference to lexical meaning (see especially Klima and Bellugi 1979; Padden and Perlmutter 1987). However, Lepic et al. (2016) show in detail that two-handedness in a disproportionate percentage of signs in any sign language lexicon is accounted for by meaning. Other aspects of phonological form in these signs are motivated as well, such as the type of two-handed sign, balanced or unbalanced, whether the movement is symmetrical or alternating, and whether and where the dominant hand will contact the nondominant hand. We've made these findings explicit by showing which elements in the abstract templates that have been proposed for signs – previously considered strictly phonological and meaningless – are motivated. In so doing, we see that in sign languages, the line between the phonological and morpho-lexical levels of structure is not as sharp as often assumed. In fact, other aspects of phonological form, such as movement types and locations, are also motivated. Since it has been shown that each of these elements behaves phonologically as well, it is left for future models of sign language structure to incorporate this ambivalence in a theoretically satisfactory way.

In spoken languages, the acoustic-auditory medium limits the extent to which parts of words that are not morphemes can be motivated. At the same time, Bloomfield (1933) demonstrated that this does occur in so-called sound symbolism, such as *sn* in words like *sniff*, *snuff*, *snore*, *snort* all reflecting some kind of breath noise through the nose. In Japanese

mimetics, Hamano (1986) demonstrated that phonetic features correspond to meanings, for example, [-voice] for small/light/fine events, and [+continuant] for continuous movement or shapeless objects.

Sign languages merely show us the extent to which the duality of patterning in human language can be blurred. They also suggest that the paucity of motivation within the phonology of spoken language does not make it insignificant. It is just an accident of modality.

Acknowledgments

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References

- Aronoff M., I. Meir & W. Sandler (2005) The paradox of sign language morphology. *Language* 81: 301-344.
- Battison, R. (1978) *Lexical borrowing in American Sign Language*. Silver Spring, MD: Linstok Press.
- Bergman, B. (1979) *Signed Swedish*. Stockholm: Liber.
- Bergman B. (1983) Verbs and adjectives: Morphological processes in Swedish Sign Language. In: J. Kyle & B. Woll (Eds.), *Language in sign: An international perspective on sign language*. London: Croom Helm, 3-9.
- Blevins J. (1993) The nature of constraints on the non dominant hand in ASL. In: G. Coulter (Ed.), *Current issues in ASL phonology: Phonetics and Phonology 3*. New York, NY & San Francisco, CA: Academic Press, 43-62.
- Bloomfield, L. (1933) *Language*. New York: Henry Holt.
- Börstell C. (2011) *Revisiting Reduplication: Toward a description of reduplication in predicative signs in Swedish Sign Language*. M.A. thesis. Department of Linguistics, Stockholm University.
- Brennan, M. (1990) *Word formation in British Sign Language*. Stockholm: Stockholm University.
- Brentari, D. (1998) *A prosodic model of sign language phonology*. Cambridge, MA: MIT Press.
- Brentari D. & J.A. Goldsmith (1993) Secondary licensing and the nondominant hand in ASL phonology. In: G. Coulter (Ed.), *Current issues in ASL phonology: Phonetics and Phonology 3*. New York, NY & San Francisco, CA: Academic Press, 19-41.
- Clements, G.N. & S. Keyser (1983) *CV Phonology: A generative theory of the syllable*. Cambridge, MA: MIT Press.
- Crasborn O. (2011) The other hand in sign language phonology. In: M. van Oostendorp, C.J. Ewen, E. Hume & K. Rice (Eds.), *The Blackwell companion to phonology*, Vol. 1. Malden, MA & Oxford, 223-240.
- Emmorey K. (Ed.) (2003) *Perspectives on classifier constructions in sign languages*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Fischer S. & B. Gough (1978) Verbs in American Sign Language. *Sign Language Studies* 7: 17-48.
- Goldsmith J. (1976) *Autosegmental phonology*. Ph.D. thesis. MIT.
- Hamano S.S. (1986). *The sound symbolic system of Japanese*. Ph.D. thesis. University of Florida.
- Hockett C. F. (1960) The origin of speech. *Scientific American* 203: 88-96.
- Hulst H. van der (1993) Units in the analysis of signs. *Phonology* 10: 209-241.
- Hulst H. van der (1996) On the other hand. *Lingua* 98: 121-143.
- Johnston T. & A. Schembri (1999) On defining lexeme in a signed language. *Sign Language & Linguistics* 2(2): 115-185. doi.org/10.1075/sll.2.2.03joh
- Klima, E.S. & U. Bellugi (1979) *The signs of language*. Cambridge, MA: Harvard University Press.
- Kooij, E. van der (2002) *Phonological categories in Sign Language of the Netherlands: The role of phonetic implementation and iconicity*. Utrecht, the Netherlands: LOT.
- Kyle J.G. & B. Woll (Eds.) (1985) *Sign language: The study of deaf people and their language*. Cambridge: Cambridge University Press.
- Lepic R., C. Börstell, G. Belsitzman & W. Sandler (2016) Taking meaning in hand: Iconic motivations for two-handed signs. *Sign Language & Linguistics*, 19(1).

- Liddell S.K. (1984) THINK and BELIEVE: Sequentiality in American Sign Language. *Language* 60: 372-99.
- Liddell, S.K. (2003) *Grammar, gesture, and meaning in American Sign Language*. Cambridge: Cambridge University Press.
- Liddell S.K. & E.R. Johnson (1986) American Sign Language compound formation processes, lexicalization, and phonological remnants. *Natural Language and Linguistic Theory* 8: 445-513.
- Liddell S.K. & E.R. Johnson (1989) American Sign Language: The phonological base. *Sign Language Studies* 64: 197-277.
- McCarthy J. (1979) *Formal Problems in Semitic Phonology and Morphology*. Ph.D. thesis. MIT.
- McCarthy J. (1981) A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry* 12: 373-418.
- Meir I. (2002) A cross-modality perspective on verb agreement. *Natural Language & Linguistic Theory* 20: 413-450.
- Meir I., C. Padden, M. Aronoff & W. Sandler (2013) Competing iconicities in the structure of languages. *Cognitive Linguistics* 24(2): 309-343. doi:10.1515/cog-2013-0010.
- Meir, I. & W. Sandler (2008) *A Language in space: The story of Israeli Sign Language*. New York, NY & London: Lawrence Erlbaum Associates.
- Nespor M. & W. Sandler (1999) Prosody in Israeli Sign Language. *Language and Speech* 42(2-3): 143-176. doi:10.1177/00238309990420020201.
- Newkirk D. (1979) *The form of continuative aspect inflection on ASL verbs*. Ms.
- Newkirk D. (1981) *Rhythmic features of inflections in American Sign Language*. Ms.
- Nilsson A.L. (2007) The non-dominant hand in a Swedish Sign Language discourse. In: M. Vermeerbergen, L. Leeson, & O. Crasborn (Eds.), *Simultaneity in signed languages: Form and function*. Current Issues in Linguistic Theory Vol 281. Amsterdam/Philadelphia, PA: John Benjamins, 163-185.
- Padden, C. (1988) *Interaction of morphology and syntax in American Sign Language*. New York, NY & London: Garland Publishing, Inc.
- Padden C. & D.M. Perlmutter (1987) American Sign Language and the architecture of phonological theory. *Natural Language & Linguistic Theory* 5: 335-375.
- Perniss P., R.L. Thompson & G. Vigliocco (2010) Iconicity as a general property of language: evidence from spoken and signed languages. *Frontiers in psychology* 1: 227. doi:10.3389/fpsyg.2010.00227.
- Pfau R. & M. Steinbach (2003) Optimal reciprocals in German Sign Language. *Sign Language & Linguistics* 6(1): 3-42.
- Pfau R. & M. Steinbach (2006) Pluralization in sign and in speech: A cross-modal typological study. *Linguistic Typology* 10(2): 135-182. doi.org/10.1515/LINGTY.2006.006
- Sandler W. (1986) The spreading hand autosegment of American Sign Language. *Sign Language Studies* 50: 1-28.
- Sandler W. (1987) Assimilation and feature hierarchy in American Sign Language. In: *Papers from the Chicago Linguistic Society, Parasession on Autosegmental and Metrical Phonology*. Chicago: Chicago Linguistic Society, 266-278.
- Sandler, W. (1989) *Phonological representation of the sign: Linearity and nonlinearity in American sign language*. Dordrecht: Foris.
- Sandler W. (1990) Temporal aspect and American Sign Language. In: S. Fischer & P. Siple (Eds.), *Theoretical Issues in Sign Language Research*. Chicago: University of Chicago Press, 103-129.
- Sandler W. (1993) Hand in hand: The roles of the nondominant hand in sign language phonology. *The Linguistic Review* 10: 337-390.
- Sandler W. (1999a) Cliticization and prosodic words in a sign language. In: T. Hall & U. Kleinhenz (Eds.), *Studies on the phonological word*. Amsterdam: John Benjamins, 223-255.
- Sandler W. (1999b) Prosody in two natural language modalities. *Language and Speech* 42(2-3): 127-142. doi:10.1177/00238309990420020101.
- Sandler W. (2006) Phonology, phonetics, and the nondominant hand. In: L. Goldstein, D.H. Whalen & C. Best (Eds.), *Papers in laboratory phonology: Varieties of phonological competence*. Berlin: Mouton de Gruyter, 185-212.
- Sandler W. (2012) The phonological organization of sign languages. *Language and Linguistics Compass* 6(3): 162-182. doi:10.1002/lnc3.326.
- Sandler, W. & D. Lillo-Martin (2006) *Sign language and linguistic universals*. Cambridge: Cambridge University Press.
- Saussure, F. de (1983) *Course in General Linguistics*, trans. by Harris, R. Open Court Classics, Chicago, IL.
- Stokoe W.C. (1960) *Sign language structure: An outline of the visual communication system of the American Deaf*. Studies in linguistics: Occasional papers 8. Buffalo, NY: Dept. of Anthropology and Linguistics, University of Buffalo.

- Strickland, B., Geraci, C., Chemla, E., Schlenker, P., Kelepir, M., & Pfau, R. (2015). Event representations constrain the structure of language: Sign language as a window into universally accessible linguistic biases. *Proceedings of the National Academy of Sciences* 112 (19): 5968-5973.
- Supalla T. (1982) *Structure and acquisition of verbs of motion and location in American Sign Language*. Ph.D. thesis. University of California, San Diego.
- Talmy L. (2003) The representation of spatial structure in spoken and signed language. In: K. Emmorey (Ed.), *Perspectives on classifier constructions in sign languages*. Mahwah, NJ: Lawrence Erlbaum, 169-195.
- Taub, S. (2001) *Language from the body: Iconicity and metaphor in ASL*. Cambridge: Cambridge University Press.
- Vermeerbergen M., L. Leeson & O. Crasborn (Eds.) (2007) *Simultaneity in signed languages: Form and function*. Amsterdam/Philadelphia, PA: John Benjamins.
- Wilbur R.B. (2008) Complex predicates involving events, time and aspect: Is this why sign languages look so similar? In: J. Quer (Ed.), *Signs of the time: Selected papers from TISLR 2004*. Hamburg: Signum Verlag, 217-250.
- Wilcox, S. (2004) Cognitive iconicity: Conceptual spaces, meaning, and gesture in signed languages. *Cognitive Linguistics* 15(2): 119-147.