The emergence of the phonetic and phonological features in sign language

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Abstract

Sign languages offer a unique and informative perspective on the question of the origin of phonological and phonetic features. Here I review research showing that signs are comprised of distinctive features which can be discretely listed and which are organized hierarchically. In these ways sign language feature systems are comparable to those of spoken language. However, the inventory of features and aspects of their organization, while similar across sign languages, are completely unlike those of spoken languages, calling into question claims about innateness of features for either modality. Studies of a young village sign language, Al-Sayyid Bedouin Sign Language (ABSL), demonstrate that phonological structuring is not in evidence at the outset, but rather self-organizes gradually (Sandler et al 2011). However, our new research shows that signature **phonetic** features of ABSL already can be detected when ABSL signers use signs from Israeli Sign Language. This ABSL 'accent' points to the existence of phonetic features that may not be distinctive in any sign language but can distinguish one sign language from another, even at an early stage in the history of a language. Taken together, the findings suggest that physiological, cognitive, and social factors are at play in the emergence of phonetic and phonological features.

The discovery that the signs of American Sign Language are composed of a finite list of meaningless units, like the words of spoken languages (Stokoe 1960), started a sea change in the way linguists view sign languages. The discovery meant that sign languages, like spoken languages, are comprised of two levels of structure, one meaningless and the other meaningful. This duality of patterning is a fundamental property of human language (Hockett 1960, Martinet 1960). Since sign languages have their roots in gestures that are in large part iconic, it is especially impressive that they manifest this property. Stokoe's discovery ran counter to the impressionistic observations, not only of lay people, but even of linguists as respected as Leonard Bloomfield (1933: 141), who described sign language as "merely developments of ordinary gestures", and, by implication, holistic in nature, and fundamentally different from spoken languages. The discovery also demonstrated that comparing natural languages in two different physical modalities makes thorny theoretical questions about universality and innateness in language structure more interesting and more tractable.

In work subsequent to Stokoe's, phonologists have fleshed out models of the phonological systems of various sign languages, demonstrating that the meaningless units indeed function systematically, and that they are best understood, not in terms of phonemes ('cheremes' in Stokoe's terminology), but in terms of features (Liddell and Johnson 1989, Sandler 1989, Corina and Sandler 1993, van der Hulst 1993, Brentari 1998; see Sandler 2012, Sandler and Lillo-Martin 2006 for different models of sign language phonology). In this way, sign languages provide independent evidence for features as a linguistic construct common to all languages, regardless of the physical modality of their transmission.

Does this mean that features are innate, as argued in Chomsky and Halle (1968) and assumed in much subsequent generative research? Or, like sound patterns in general (Blevins 2004), do features emerge in

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response to phonetic, acquisition, and historical pressures (Mielke 2008)? Again, sign languages provide novel and illuminating data for addressing these questions.

Clearly, the nature of the features themselves must be different, given the differences between the articulatory and perceptual systems. In the case of sign languages at least, the features are not likely to be innate, since spoken language was evolution's choice. If features are not innate in sign languages, but eventually arise, why not assume the same for spoken language as well? This obvious implication, though universally ignored in the literature (see Clements and Ridouane 2011), is a direct challenge to the idea of an innately specified set. Exploring the nature of sign language features promises to help us understand the way in which the physical system and other factors help to mold phonology and its features.

It is not only by comparing established languages in the two modalities that we can gain insight into theses issues. Unlike spoken languages, which are all thousands of years old or descended from old languages, sign languages can arise anew whenever a group of deaf people forms and has an opportunity to communicate regularly. Such new languages offer a chance to observe the emergence of phonology and all levels of language in real time. My colleagues and I have been investigating a new sign language of this kind -- Al-Sayyid Bedouin Sign Language -- for over a decade. In this paper, I review findings on the sublexical structure of both established sign languages (Section 1) and of this newly developing one (Section 2), to support the view that features and their organization are not innate, but emergent, and, more interestingly, to provide a glimpse at how they emerge.

In addition to distinctive features that partition phoneme inventories and cluster in classes in phonological processes, spoken languages have features that account for subtle differences in pronunciation of the 'same' sound in different languages. Together with clear phonological differences between languages, such as different phoneme inventories or stress systems, these low-level phonetic differences make an important contribution to understanding how we know what language we hear or see, even if we don't know the language, and what we perceive as a foreign accent. In our investigation of sign language in the Al-Sayyid village, we have discovered that it is possible to have a signature 'accent' in sign language too, even if a language has not yet converged on a fully crystallized phonological system. This is the subject of Section 3. I conclude in Section 4 with suggestions about which features are likely to phonologize, and which may remain as signature phonetic features of the ABSL 'accent'.

1. What does it mean to say that a sign language has phonology?[1]

In spoken language phonology, a level of structure below the phoneme – the level of features -- is motivated by the behavior of classes of sounds in phonological systems and alternations. In principle, any feature or feature combination can represent a class of sounds that may pattern together. This theoretical strength, however, is also a weakness, since the way that features cluster in sound patterns is not random. 'Feature geometry' models have sought to overcome this problem by hierarchically organizing features in groups, many of which correspond to physical articulators or areas of the vocal tract. Another generalization that some researchers have sought to capture through phonological representation of features is the way in which sounds group themselves in terms of 'markedness', in the sense of relative complexity and frequency in sound systems.[2]

But what does all this have to do with sign language? The first evidence provided for phonology by Stokoe in American Sign Language (ASL) is the existence of minimal pairs, distinguished by different Hand Configurations, Locations, or Movements, illustrated in Section 1.1. In addition to distinguishing

[1]For comprehensive treatments of sign language phonology, see Sandler (1989), Brentari (1998), and Sandler and Lillo-Martin (2006, Unit 3).

[2]This whirlwind overview of spoken language phonological organization omits references in the interest of space and relevance to this article. The most comprehensive recent treatment of theoretical phonology is the Blackwell Companion to Phonology, (2011), Marc van Oostendorp, Colin Ewen, Keren Rice, and Elizabeth Hume (Eds.).

minimal pairs, a theory of distinctive features must, as McCarthy (1994:191) put it, "be able to characterize all and only the natural classes of sounds that recur in the phonological **phenomena** of different languages" *(emphasis mine/WS)*. In Section 1.2, we'll see evidence for hierarchical organization of features from constraints on structure, and in Section 1.3, assimilation phenomena are shown to support the hierarchy. Evidence for a particular model of hand shape features comes from markedness phenomena, summarized briefly in 1.4 as a point of reference for the later discussion of feature emergence. Section 1.5 places the sign language findings in a broader theoretical context in which to consider sections that follow.

1.1 Minimal pairs

Examples in Figures 1-4 below come from Israeli Sign Language (ISL), in which signs are distinguished by the same major categories as those established for ASL.[3] The category of Orientation was added by Battison (1978), later argued by Sandler to be a subcategory of hand configuration (Sandler 1987), as explained in Section 1.3.

Figure 1. Minimal pairs in Israeli Sign Language (ISL) distinguished by features of handshape: (a) INTERESTING, (b) DANGEROUS

Figure 2. Minimal pairs in ISL distinguished by features of location: (a) SEND, (b) TATTLE

Figure 3. Minimal pairs in ISL distinguished by features of movement: (a) ESCAPE, (b) BETRAY

[3]A reviewer commented on non-neutral facial expressions that can be seen in some of the illustrations. There is indeed important and complex use of the face in sign languages, for a variety of functions, e.g., for conventionalized intonation (Sandler 2011), for adjectival and adverbial modification (Liddell 1980), and sometimes (rarely) as part of the lexical specification of a sign. In addition, the facial expressions of signers include nonlinguistic signals conveying emotions or attitudes, as do those of speakers.

(a) (b)

Figure 4. Minimal pairs in ISL distinguished by features of orientation: (a) USE, (b) PLAY

Stokoe provided a notation system that includes a list of 60 symbols representing different phoneme-like units in these categories, a number that is within the range of phoneme inventories of spoken languages. Following Stokoe's publication in 1960, researchers began to develop models that posed a set of features rather than phonemes as phonological units (Liddell and Johnson 1989; Sandler 1989). The signs SEND (2a) and TATTLE (2b), for example, are distinguished by major place features: [head] for SEND and [torso] for TATTLE, and the signs ESCAPE (3a); BETRAY (3b) are distinguished by the movement features, [straight] and [arc], respectively; and INTERESTING (1a) and DANGEROUS (1b) are distinguished by hand shape features, thumb and pinky vs. all five fingers.

1.2 Constraints and a hierarchy of features

The Hand Tier model of ASL phonological features (Sandler 1987, 1989) is a hierarchical 'geometry' in the spirit of Clements (1985).[4] As in spoken language feature geometries, the feature geometry of sign language phonology corresponds to the physical system to a certain extent. For example, the fingers selected for a sign are subordinate to the Hand Configuration, and their Position (open, closed, curved, or bent) is subordinate to Selected Fingers. Similarly, the particular spot (the 'Setting') on the major body area ('Place of articulation') is subordinate to the area itself. The ISL sign JUST-THEN, illustrated in Figure 5, is represented schematically in Figure 6 using this model. Here, the features have transparent, simplified labels for clarity.

Figure 5. JUST-THEN (ISL)

[4] Other hierarchical models of sign language phonological structure (van der Hulst 1993, Brentari 1998) have different motivations and capture certain different generalizations. These models have some things in common, but as yet there is no consensus.

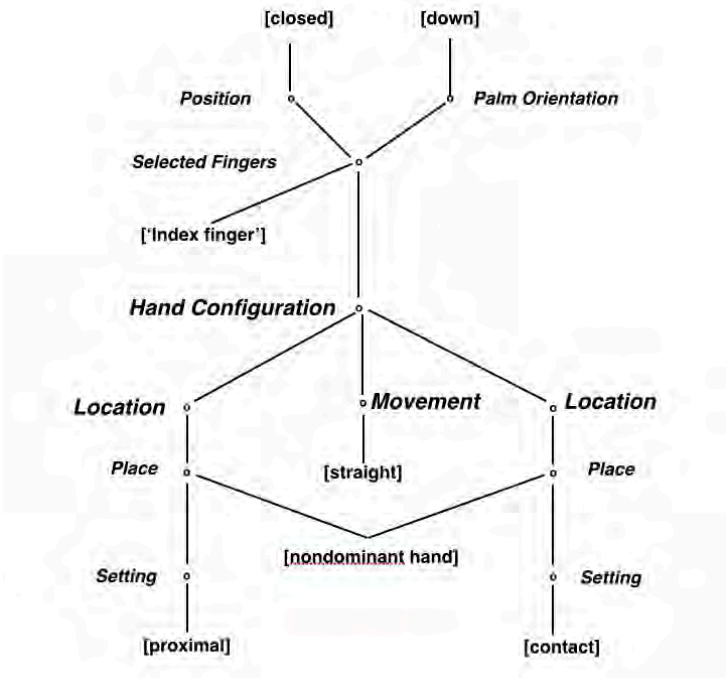


Figure 6. Schematic phonological representation of the ISL sign JUST-THEN in the HT model (following Sandler 1989)

The basic structure of the model represents movement from one location to another in a canonical sign as a series of three sequentially organized segments, Location, Movement, Location (LML).[5] A movement is obligatory -- either a path movement from one location to another, or an internal movement involving changes in Finger Position or palm Orientation, or path and internal movement combined simultaneously. Movement has been argued to constitute the syllable nucleus (Liddell 1984; Sandler 1989; 1993a; Brentari 1990; Perlmutter 1992; Wilbur 1993). Most signs are monosyllabic (Coulter 1982; Sandler 1999 *inter alia*), and consist of a simple LML structure, which has been likened to CVC syllables in spoken languages (Sandler 1993a). The fact that one hand configuration typically characterizes a whole sign is one of the motivations for representing the Hand Configuration class autosegmentally on its own tier in the HT model.

So far, we can see that features are motivated by minimal pairs and that their hierarchical organization reflects the physiology of the system to a certain extent. However, it is the systematic behavior of the posited phonological units in phonological phenomena, such as constraints on well formedness and phonological alternations, irrespective of meaning, that convincingly demonstrate the existence of a phonological system.

In hand configurations, constraints on well formedness support the Selected Fingers class and the hierarchical relation between Selected Fingers and Finger Position. Each canonical monomorphemic sign in ASL (and in other sign languages that have been studied) is characterized by a single group of Selected

[5]This basic CVC-like sequential structure shown in the HT model was first posited by Liddell (1984), who proposed that the C-like elements were 'Holds', holding the hands in place (resulting in HMH). Arguing that the beginning and endpoints are not underlyingly held static, but occur due to prosodic effects such as phrase final lengthening, Sandler (1986) proposed instead that these segments entailed reaching particular Locations. Perlmutter's treatment of sign language syllables (1992) later adopted a similar structure to Sandler's, but named the non-dynamic segments Positions. Whether or not the underlying structure of signs has sequential organization at all is still debated; see Channon and van der Hulst (2011) for a different view. For an overview of sequentiality, see Sandler and Lillo-Martin (2006; Chapter 9, Section 2).

Fingers (Mandel 1981). For example, in INTERESTING (Figure 1a), the thumb and pinky are selected and extended; in JUST-THEN (Figure 5), the index finger is selected, in a closed position, touching the thumb.[6]

Crucially, all Selected Fingers must be in the same Position and, if the hand shape changes by hand internal movement in the sign, as in SEND and TATTLE (Figures 2a and b), then all of the fingers move in the same way (from closed to open in these examples).[7] That is to say that the Selected Fingers specification does not change within a monomorphemic sign, but the finger position specification can be branching – with the beginning and ending position feature respectively specified on each branch. To capture these generalizations, the Finger Position node is represented as subordinate to the Selected Fingers node in the model.

The fingers that are not selected, the Unselected Fingers, are typically in a position that is opposed to that of the Selected Fingers. If Selected Fingers are closed (touching the thumb or the palm), Unselected Fingers are open (fully extended); if Selected Fingers are in any other position (curved, straight, bent), then the Unselected Fingers are closed (Corina 1993). To the extent that selection and position of Unselected Fingers are fully redundant, they need not be represented in the underlying representation. The opposing position of the Unselected Fingers relative to the Selected Fingers has been described in terms of Stevens and Keyser's (1989, 2010) notion of enhancement (Sandler and Lillo-Martin 2006).

Constraints on well formedness also support the hierarchical relation between Place and Setting features. While the hand usually moves from one location to another in a monomorphemic sign, two locations must be on the same major body area or Place (Battison 1978): the features of [head], [torso], or [nondominant hand]. This hierarchy allows us to posit a single small set of Setting features that specify Settings on any place of articulation: [high, low, ipsilateral, distal, proximal, and contact] (Sandler 1989). For example, an articulation may be at a [high] Setting on the head, the torso, or the nondominant hand, whichever Place feature has been specified for the sign.

1.3 Assimilation and hierarchy of features

Not only are signs typically limited in the number of segments that comprise them, the two types of segments, Locations and Movements, are very different in phonetic content. These two factors together make adjacency effects such as assimilation, epenthesis, or deletion unlikely between location and movement features within a canonical LML sign, and indeed they are not attested.

However, when signs are linearly combined in compounds, reduction and assimilation can result (Liddell and Johnson 1986; Sandler 1987, 1989, 1999). These effects are typically seen in lexicalized compounds, at least in ASL and ISL. Figure 7 shows the ISL compound THINK^STOP = SURPRISED/TAKEN-ABACK. Here we see deletion of the final Location of THINK and the initial Location of STOP, as well as total regressive Hand Configuration assimilation. Selective deletion of Location segments is one of the phenomena that support a sequential representation (Liddell and Johnson 1986; Sandler 1987, 1989).

Crucially, the orientation of the hand assimilates together with all of the other Hand Configuration features. In a study of ASL compound data collected in Ursula Bellugi's lab at the Salk Institute, I found that in assimilation of hand configuration features, (1) both hand shape (i.e., Selected Fingers and Finger Position) and Orientation features usually assimilate together; (2) Orientation features may assimilate

[6]The Finger Position feature [closed] means that the Selected Fingers are touching the thumb unless all fingers are selected, in which case they touch the palm of the hand (Sandler 1989).

[7]In some sign languages of the Far East, some different finger groupings and even different positions of Selected Fingers can be found (Eccarius 2002; Tang 2007; Fischer and Gong 2010, 2011), often as a result of borrowing of shapes from the fingerspelled characters of the written alphabet or from other graphic symbols.

alone; but (3) if Selected Fingers features assimilate, both Position and Orientation features always assimilate with them. In other words, the Position and Orientation of the hand are dependent on hand shape (Selected Fingers). This is just the kind of behavior that motivates feature class constituency in a hierarchy, and it motivates the hierarchical relation between the Selected Fingers class and the Position and Orientation feature classes in the HT model, a relation adopted in other models of sign language phonology as well (van der Hulst 1993; Brentari 1998; van der Kooij 2002).

Figure 7 shows total hand configuration assimilation in lexicalized compounds of ASL and ISL. The sign STOP is a symmetrical two-handed sign, unlike JUST-THEN (Figure 5), where the nondominant hand acts as a static place of articulation, making the sign asymmetrical. In symmetrical two-handed signs like STOP, the nondominant hand is represented as a Hand Configuration category, redundantly getting all its features from the dominant hand and articulating the same locations and movements (Sandler 1993b). Location and Movement segments delete, rendering a monosyllabic LML sign, the optimal form of the prosodic word (Sandler 1999). The process is represented schematically in Figure 8.

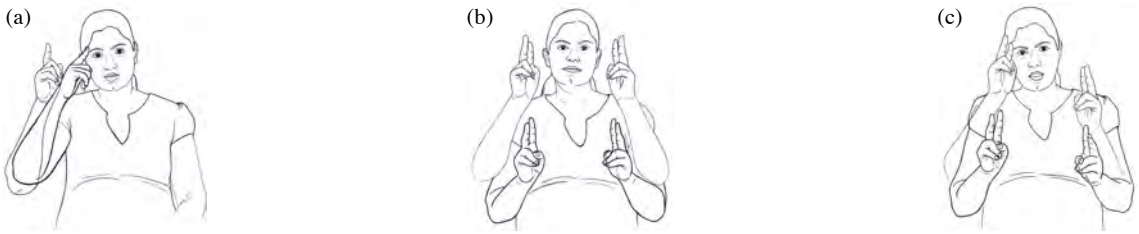


Figure 7. Reduced ISL compound with hand configuration assimilation: (a) THINK, (b) STOP, (c) TAKEN-ABACK

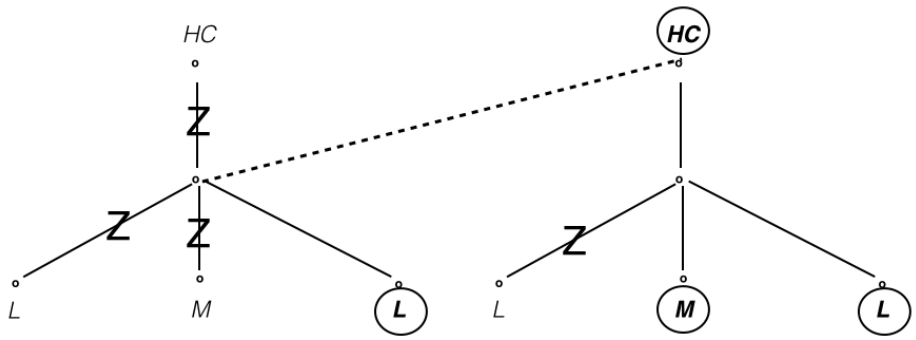


Figure 8. Schematic representation of hand configuration assimilation

1.4 Markedness and features

Another generalization about the form of signs, in particular of hand shapes, involves markedness, and phonologists have turned to the internal organization of features to represent it.

The term 'markedness' in phonology has many different interpretations and theoretical motivations (see Hume 2011 for a recent overview). In the present context, I adopt Jacobson's (1968 [1949]) notion that correlates markedness with complexity, difficulty, frequency, order of acquisition, and other factors. The basic assumption is that complexity and difficulty are inversely related to cross linguistic frequency. Out of about 20 hand shapes native to ASL (i.e., not borrowed from fingerspelling shapes for the English

alphabet), there is a set of seven or eight that are generally referred to as unmarked.[8] These shapes tend to meet the traditional criteria for unmarked elements: they are relatively easy to articulate motorically (Ann 1993, 1996; Mandel 1981, *inter alia*), maximally distinct from one another and most frequently occurring (Battison 1978), not easily confused with one another (Bellugi and Klima 1979), acquired early by children (Boyes Braem 1981), and most likely to be substituted for other shapes by children acquiring ASL (McIntire 1977) and by aphasics (Whittemore 1986).

Furthermore, distinguishing marked from unmarked shapes facilitates the statement of constraints in sign formation. An example is the constraint on handshape in two-handed signs that are not symmetrical, such as ISL JUST-THEN, shown in Figure 5. For formal treatments of the differences between the two types of two-handed signs, see, e.g., Sandler (1993), Brentari & Goldsmith (1993); Blevins (1993); van der Hulst (1996). In American Sign Language (Battison 1978) and other sign languages, only unmarked shapes may occur on the nondominant hand in nonsymmetrical two-handed signs. The nondominant hand may only have a marked shape if it is the same as the shape on the dominant hand, in which case the sign is symmetrical.[9] It is reasonable to assume that it is harder to articulate two different shapes on the two hands if both shapes are complex, which leads to us to infer that the occurrence of unmarked shapes on the nondominant hand when the two are not the same is an indication of their relative simplicity. The Symmetry Condition (Battison 1978) holds for other sign languages as well. The sign JUST-THEN in ISL, illustrated in Figure 5, is an example of a two-handed sign in which the dominant hand is configured in a marked shape, while the nondominant hand is configured in an unmarked shape. This type of two-handed sign has a different structure than symmetrical two-handed signs such as that in those shown STOP, Figure 7b and represented schematically in Figure 8.

The Dependency Phonology framework (Anderson and Ewen 1987; van der Hulst 1989) offers a way to reflect markedness as complexity in phonological representations. The model relies explicitly on a small set of privative features that combine with one another in different head-dependent relations. The number of features, dependencies, and internal dominance relations for a given sound directly reflect the markedness of the sound. A model of hand shape features that adopts this approach is proposed in Sandler (1996a).[10] We will see in Section 2.2, that representations of this kind help to identify the birth of a phonological system in a new language.

Examples of unmarked, marked, and unattested (more marked) signs are shown in Figure 9. The shapes in Figure 9g-h violate the Unselected Finger Constraint constraint, and indeed are unattested in lexical signs.[11] Figure 10 shows representations in the dependency model of an unmarked shape (corresponding to Figure 9a) and a more marked shape (corresponding to Figure 9f).

The selected finger feature [broad] by itself means that all fingers are selected, while the feature [digitated] by itself indicates a selected index finger only.[12] Hand shapes marked only by one or the other of these features are unmarked, but when they are combined in a dominance relation the result is a more marked hand shape that is more complex in its representation. The particular dominance relation between

[8]The number of hand shapes included in the unmarked set depends on whether one counts phonetically similar shapes that can sometimes be contrastive as two shapes or one. Different researchers in different kinds of investigations vary somewhat in this judgment.

[9]Kita et al (2014) argue that the Symmetry Constraint on two-handed signs (Battison 1978) is grounded in phonetics and in general cognition, rather than in a more abstract, specifically linguistic system.

[10]The feature geometry adopted for feature categories described in Section 1.2. is not a dependency model; integrating the two approaches awaits future research.

[11]The unattested shapes in Figure 9g-h are typically not found in core sign language lexicons -- the generalization captured by the dependency model -- but can occur in the less constrained so-called spatial forms or classifier constructions (see Brentari and Padden (2001).

[12]In later developments stemming from this model, the features [broad] and [digitated] were renamed [all] and [one], respectively (Brentari et al 1996; Brentari 1998). See Brentari (2011) for a recent overview of hand shape.

the two features in Figure 7, with the index and middle fingers selected, represents a finger selection that is more digitated than broad ([digitated] is the head and [broad] is the dependent). Similarly, the relation between the Finger Position features [open] and [closed] shown here indicates a curved Finger Position.[13] (The opposite dependency relation for the same two position features represents a bent shape that appears more closed than open, in which the fingers are bent at the first joint, and open or extended at the other joints.)

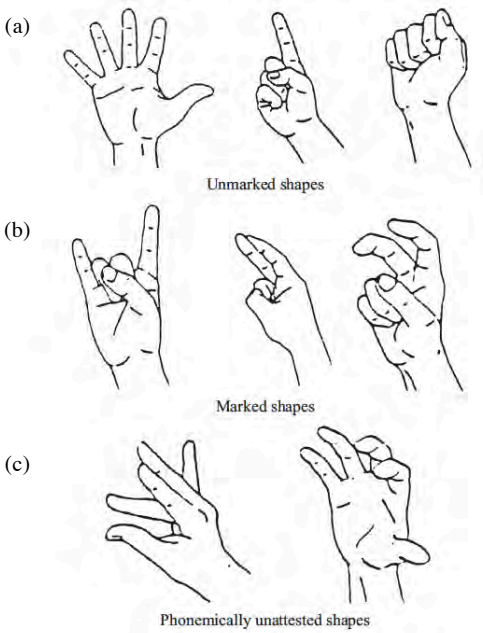


Figure 9. (a) Unmarked, (b) marked, and (c) unattested hand shapes across sign languages. See Sandler (2012).

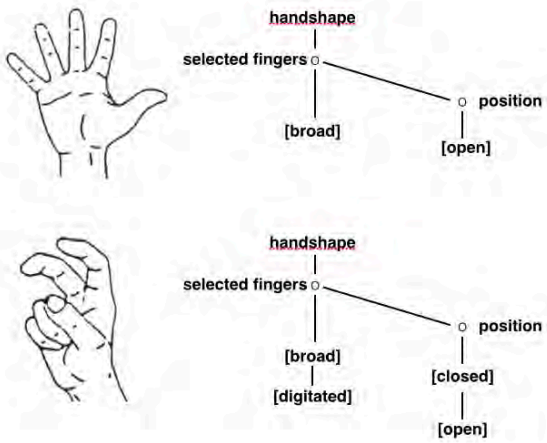


Figure 10. Unmarked and marked representations

[13]The choices illustrated here are limited in the interest of space and brevity. More marked shapes are reflected in more complex representations, as explained in Sandler (1996a).

1.5 Theoretical implications

All of the phenomena mentioned refer to individual features or feature classes, and are neither derived from nor affected by meaning. They therefore constitute evidence that there is a systematic, meaningless level of structure below the meaningful level of morphemes and words, allowing us to conclude that a phonological component is a universal property of (established) human languages.

A picture of what we know at present about features and their organization across modalities, vastly oversimplified for present purposes, appears in Table 1. The insight here is that, in each modality, a finite and relatively constant set of features and type of feature organization can characterize phoneme level contrasts, degrees of complexity, and phonological processes in all languages within each modality, while the content of the features and feature classes differs across modalities.

	Finite inventory of distinctive features	Feature content	Hierarchical organization of feature classes	Class content and organization
Across spoken languages				
Across sign languages				
Across the two modalities		X		X

Table 1. Generalizations within and across modalities. Shaded cells mean 'mostly the same' and 'Xes' mean 'different'.

There are different ways to interpret this state of affairs, and each interpretation leads to a different paradigm for research. One interpretation is to propose that features are innate, as in Chomsky and Halle (1968) and a body of subsequent work in different frameworks. This view is challenged by sign languages, which develop phonological features that are unlikely to be innate, since we apparently did not evolve for sign language. Although some authors have proposed that spoken languages evolved from more basic gestural systems (e.g., Armstrong, Stokoe, and Wilcox 1995; Corballis 2002; Arbib 2012), even these proposals do not assume that duality of patterning, and with it phonological features, could have arisen at this early pre-proto-language stage.

Chomsky has more recently referred to sign language to suggest that phonology, presumably including features, is irrelevant for any characterization of the language faculty. 'Externalization [the phonetic interpretation of the computational-syntactic system /WS] appears to be independent of sensory modality, as has been learned from studies of sign language in recent years" (Chomsky 2007:22), and "externalization is secondary, not essential to language." (Chomsky 2012). This can be interpreted as meaning either that the two externalization systems are very similar or that neither has any important impact on the structure of the computational-syntactic system, or both.

Indeed, certain abstract organizing principles underlying all phonology regardless of modality have been implicated by many sign language researchers. Examples, some of them seen in the previous discussion, include features (Liddell and Johnson 1989; Sandler 1989, 1996a; syllables and other aspects of word-level prosodic structure (Sandler 1989, 1993a, 1999; Perlmutter 1992; Wilbur 1993; Brentari 1998); sequential segments (Liddell 1984; Sandler 1989); autosegmental associations (Liddell 1984; Sandler 1989, 1990); feature geometry (Sandler 1987, 1989); underspecification (Sandler 1987, 1989; Corina 1993; Brentari 1998); headedness and binarity (van der Hulst 1993). In her book, *The Phonological Mind*, Berent (2013) argues that while phonology adapts to the properties of the human production and perceptual systems, it is also characterized by organizational properties that can't be explained on that basis alone, and suggests that such properties are innate and characterize sign languages as well. Krämer (2012) goes so far as to propose phonological features that are abstract enough to be

shared with other levels of linguistic form such as event structure (e.g., telic/atelic), as well as with sign languages.

These approaches are driven by the guiding principle of generative linguistics, that the ways in which languages – and by extension language modalities -- are alike is more illuminating than the ways in which they differ. They conform to a paradigm which seeks to unify cross-linguistic properties and characterize them as universal. One cannot deny that utilizing linguistic theories based on this principle and on spoken language research has led to the discovery of many crucial and sometimes surprising similarities across the modalities.

However, despite the fact that certain important organizing principles do hold for both spoken and signed languages, the features, constraints, syllables, and other aspects of phonological form are quite different in languages in different sensory modalities. These differences are not trivial. They are important for two reasons. First of all, they can teach us about the way the human body organizes language, a nontrivial theoretical goal that many scholars have sought to reach. Second, differences are also important because there is concrete evidence that, despite important similarities at the higher levels of morpho-syntax and syntax proper, there are also differences at these higher levels as a direct result of the physical modality (the externalization system), differences that can't easily be overlooked in accounting for the language faculty. Examples of ways in which the physical system influences higher levels of structure are the grammatical use of space for coreference and particular types of predication, and simultaneity of structural relations in morphology, syntax and even discourse (Sandler 1993c; Meier et al 2002; Liddell 2003; Sandler and Lillo-Martin 2006, Chapter 25; Aronoff et al submitted).

A different approach acknowledges that phonological patterns are neither innate nor theoretically trivial. Jackendoff (2011) stresses the fact that duality of patterning is unique to our species and that it is essentially computational in nature, and must be taken into account in defining the language faculty. This approach maintains that properties of language should be explained on the basis of interaction among all systems that contribute to them: cognitive, perceptual, motoric, neural, and social, among others (Blevins 2004; Mielke 2008; Jackendoff 2011; Sandler et al 2011). In the paradigm that results from this view, characterizing generalizations is only the beginning and not an end in itself.

This paradigm requires careful comparison of features of the two modalities, spoken and signed, to better understand **how** two such different physical systems wind up with the constellation of similarities within and across modalities as well as the differences across modalities shown in Table 1.

There are many ways in which the sign language and spoken language systems can be compared. Our knowledge of feature inventories across sign languages is still incomplete. But a survey of the literature on different sign languages suggests that phonetic grounding of phonological features in the sense of Archangeli and Pulleyblank (1994) is at work, based on such factors as handshape frequencies and well formedness constraints.[14] In the case of spoken language we are still left with the question of whether this grounding only took place in the course of language evolution, leaving us with an innately specified, fixed inventory for any language to choose from, or whether the same production, perception, cognitive, and acquisition pressures are always at work in shaping feature inventories, their patterning and change (Mielke 2008).

As for sign language, there is no human community that just happens to use sign language as its primary linguistic system, which strongly suggests that humans did not evolve for sign language, as noted above. Since sign languages develop features anyway, features that bear no relationship to those of spoken language, this implies that the innateness scenario is highly unlikely. And yet, as shown in the previous section, the existence of features and feature organization and other similarities with spoken

[14]Studies of phonology in different sign languages include: American Sign Language, Liddell and Johnson (1989); Sandler (1989, 1996a,b); Brentari (1998); Sign Language of the Netherlands: van der Hulst (1996); Crasborn (2001) van der Kooij (2002); Japanese Sign Language: Osugi (1997); Hong Kong Sign Language: Mak and Tang (2011); Taiwanese Sign Language: Ann 2006.

language have managed to arise. This is noteworthy because sign languages are much younger than spoken languages: continuous communities of deaf people have only been around since the advent of residential schools for the deaf, at most 300 years ago (Woll et al 2001).

How does phonology happen, and is there a lesson in sign language for the origin of phonology in spoken language? My answer is that sign languages have much to teach us, since they are the only languages that we may be lucky enough to observe as they emerge. When given this rare opportunity, we find that a language can be born without phonological features and feature organization, and will gradually develop them over time.

2. Al-Sayyid Bedouin Sign Language

Two hundred years ago, a man left Egypt and settled in the Negev Desert of present day Israel where he took two wives. Five generations later, beginning in the 1930s, four deaf siblings were born into a family of hearing parents and siblings. In later generations, deaf children were born into other families. Now, about eighty years later, there are approximately 130 deaf people in a village of about 4,000 (Kisch 2008). Al-Sayyid Bedouin Sign Language (ABSL) has persisted across four generations, changing with each generation, as more people use the language. There is no stigma against sign language, and a striking characteristic of the village is the widespread use of sign language on the part of hearing people as well as deaf. More information about the socio-linguistic picture in Al-Sayyid is presented in Section 3.1.

My colleagues and I have been investigating Al-Sayyid Bedouin Sign Language (ABSL) for over a decade, and have found that it functions as a fully-fledged language, in which people express themselves freely and without hesitation on a wide range of topics, from life histories to nearly forgotten folk remedies, dreams, national insurance, suspicions, cooking, and wedding preparations. We were surprised to discover, in this fully functional language, that the degree of grammatical complexity and conventionalization reported in more established sign languages, such as those of America, Israel, or the Netherlands, is not present at any level of linguistic structure in this young and socially circumscribed language. But we were excited to find, at each level, the kernels of systematic language, and clues to the ways in which it would grow, if left to its own devices (see Aronoff et al 2008 and Sandler et al 2014 for general overviews). Much of the description of the emergence of phonology in ABSL and figures in this section are synthesized from Sandler et al (2011).

In Section 2.1, I present some of the evidence for our claim that ABSL has not yet developed a crystallized phonological system, mostly taken from Sandler et al (2011). By comparing our findings in a picture description task with a case study of translation of lexical signs from ISL to ABSL in Section 2.2, we see intriguing empirical evidence suggesting that a language starts off with a wide range of hand shapes, marked and unmarked, for descriptive purposes, but begins to hone in on the least marked shapes in creating lexical entries. Section 2.3. documents the birth of the hand shape feature category in an ABSL familylect.

2.1 No crystallized phonology across the ABSL community.

We observed from the beginning that there is a good deal more lexical variation than we had anticipated in a small community, and assumed that there were two reasons for this. One is iconicity. Although iconicity and transparency are not the same thing (Klima and Bellugi 1979; Meir et al 2013; Sandler 2013), iconicity can contribute to this variation. Experience with an iconic relation between form and meaning should make different signs for the same concept more accessible than if they were totally arbitrary. Such experience as well as shared context may also make variants interpretable within the village. The other reason for lexical variation is the likelihood that, in such a small population, signers may be able to label and store variants that are different from their own, tolerating synonymy of this kind.

Interestingly, we discovered that there is more variation than expected at the sublexical level as well. A comparison of the "pronunciation" of fifteen signs across ten signers of ABSL, ISL, and ASL revealed that there is significantly more variation in ABSL than in the other two languages (Israel 2009;

Israel and Sandler 2011). The variation in ABSL sometimes crosses boundaries of what are major phonological categories in other sign languages, e.g., Selected Fingers and Place of Articulation, in addition to finer-grained variation that might be considered phonetic, such as whether the fingers are spread or adjacent, their Position, or specific Settings like high or low within a body area. An example of variation in major body area is seen in two exemplars of the sign for DOG, shown in Figure 11a and b, one signed near the torso and the other near the head. These two major location categories are distinctive in ISL. Compare ISL SEND and TATTLE in Figures 2a and 2b above. Another example of sublexical variation is seen in SCORPION, Figure 12 a and b, in which two different orientations (up and down) are found in our data. Compare with contrastive use of these features in ISL USE and PLAY, Figures 4a and 4b.

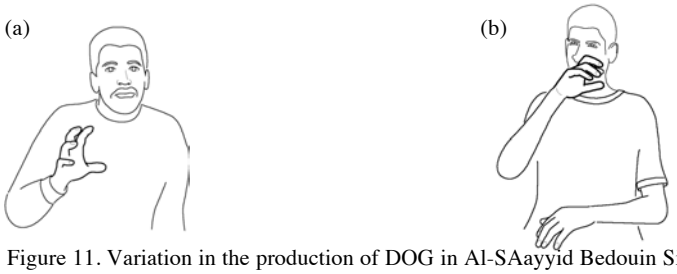


Figure 11. Variation in the production of DOG in Al-SAayyid Bedouin Sign Language (ABSL): (a) location at the torso, (b) location at the head

Figure 12. Variation in the production of SCORPION in ABSL: (a) palm orientation downward, (b) palm orientation upward.

For DOG we found a wide range of variation, shown in Table 2. While most ABSL signers select all fingers for DOG, one, signer A, selects only three. Major body area (Place), another high level distinction, varies from head to torso to nondominant hand. The type of movement varies from hand internal movement (changes in Finger Position or hand Orientation), to path movement in subject Z.

Many of these differences, then, are at higher levels of the hierarchy -- comparable, for example, to a contrast between coronal and dorsal places of articulation, rather than to finer distinctions such as between [+anterior] and [–anterior] within the coronal class. We assume that early contrasts would be at grosser rather than at the finer levels of articulation that might conceivably be phonetic variation in a young language. If the language does not exploit these broader categories to make distinctions, it seems unlikely that it will exploit finer distinctions. But at the broader, major category levels in ABSL, we find non-contrastive variation and we have also not encountered minimal pairs. Many finer variations are also found, such as whether the orientation of the hand/s is outward or sideward, whether the fingers curve, claw, or close, whether or not there is thumb restraint, and whether the internal movement involves the fingers (most subjects) or the wrist, in the nodding movement of subject Sm. In established sign languages, most of the differences in Table 2 are typically either contrastive or invariant in citation forms for reasons of well-formedness.

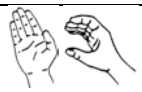
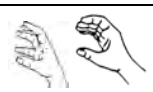
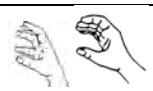
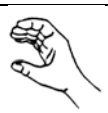
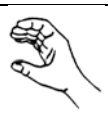
	hand shape	orientation	# hands	location	movement	# movements
Signer B		Outward/ downward	1	Torso (low)	Closing (thumb restraint)	2
Signer A		Contralateral Sideways	1	Torso (high)	Curving	1
Signer M		Contralateral Sideways	1	Torso (mid)	Closing	2
Signer S		Outward	2	Torso (mid)	Clawing	2
Signer I		Contralateral Sideways	1	Head (side of mouth)	Curving	3
Signer Mh		Contralateral Sideways	1	Head (center of mouth)	Clawing	1
Signer R		Facing each Other (contra-lateral sideways)	2	Torso (mid)	Curving	3
Signer F		Facing each Other (contra-lateralsideways)	2	Torso (mid)	Curving	2
Signer Sm		Outward	1	Torso (mid)	Nodding (wrist)	1
Signer Z		Outward	2	Head (near mouth)	Path Movement forward	2

Table 2. Variation across signers in the ABSL sign for DOG.

What all versions of DOG have in common is an iconic representation of the barking mouth of the dog. Iconicity is not fully determinate of structure, and this is not the only way that DOG could be represented iconically. In Israeli Sign Language, it is the loping front legs of the dog that are represented in the sign

DOG, while in American Sign Language, the sign looks like snapping one's fingers to call a dog.[15] This unified concept in all the ABSL forms shown in Table 1 means that we are dealing with the same lexical item, despite wide phonetic variation.

In a study of phonetic variation, Israel (2009; Israel and Sandler 2011) found that ABSL signs sometimes were not characterized by any lexical movement; instead, only a transitional movement to a single location could be detected. We will return to this observation in Section 3.3.

2.2 Unmarked, maximally distinct shapes in the earliest lexicon.

Our larger study on which the above findings are based relies mainly on 128 elicited items produced by 23 signers in response to pictures. In these elicitations, a large number of hand shapes were recorded, pictured in Table 3. Many of these are uncommon or infrequent in the inventories of familiar sign languages, i.e., unattested or marked shapes. It appears that these shapes occur randomly as signers seek to create visual images of objects, even everyday household objects, and not to retrieve them as lexical items.

OBSERVED ABSL HANDSHAPES

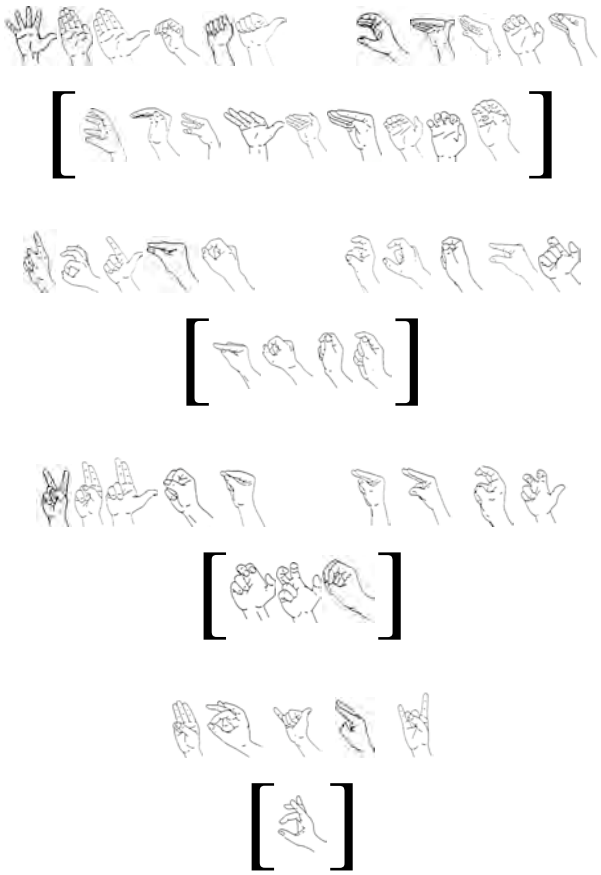


Table 3. Handshapes observed in picture description task.

[15]The finger snap sign for DOG apparently derived from a fingerspelled version of the word 'dog', in which only the 'd' and 'g' survived (Battison 1978), with a change in hand orientation, possibly iconically motivated, so that it now looks like a finger snap.

We followed up by looking at a list of signs produced by one signer, literate in Hebrew because of her schooling, whom we asked to translate a list of Hebrew words to ABSL. The results were strikingly different from those of the picture description task. Of 387 signs (translations of 218 words; many of them compounds whose hand shapes were counted individually), 297 had a hand shape with all fingers and thumb selected, shown in Figure 8a and repeated in Figure 13a for convenience: 194 in a fully extended position and 103 in a more lax position. 80 signs used the extended index finger shape shown in Figure 8b, and repeated in Figure 13b. Only 10 signs had neither of these two maximally distinct, unmarked hand shapes. Reading the words apparently triggered specific lexical entries rather than the more idiosyncratic descriptions that we saw in the picture task. And these words in this young language tend to be specified for only one of two unmarked hand shapes – Selected Fingers either [broad] or [digitated] and Position [open], in the terminology of the markedness model described in Section 1.4. These are the simplest possible shapes, easy to produce, and are also maximally distinct perceptually. While [closed] is easier to produce physically than [open] according to Ann (1993), the open shapes are likely to be more perceptually salient and hence earlier to arise in the first hand shapes of a fledgling lexicon.

This finding, though preliminary, is compatible with the discovery in spoken language research that the articulatory/perceptual distance between vowels in spoken language inventories can be predicted by the number of vowels in the inventory. The fewer the number of vowels, the more distant from one another in articulation/perception space (Liljencrants and Lindblom 1979, Lindblom 1983).[16] Apparently, a language may be communicative without a phonologically constrained vocabulary, but it begins to create a formal lexicon with a small number of unmarked components that are maximally distinct, simple in structure, and easily produced.

(a) (b)

Figure 13. Maximally simple and distinct handshapes predominate in translation case study.

In a study of signers of an established sign language (ASL and Italian Sign Language), homesigners[17], and hearing gesturers, Brentari et al (2011) used a measure of complexity based on the same principles as the one described in Section 1.4. above. The authors used an elicitation task to investigate the structure of hand shapes that corresponded to two different kinds of classifiers in many established sign languages, those used to describe objects and those used to describe how objects are handled. In the two established sign languages, object shapes are more complex than handling shapes. The researchers found that object hand shapes were similarly complex for homesigners as for signers, and that handling shapes were less complex than object shapes in both groups, though the signers' handling shapes were less complex than those of the homesigners. The hearing gesturers, asked to use gesture without speech to describe the pictures, showed the reverse pattern: their handling shapes were more complex than their object shapes. The authors interpret their findings as evidence for the emergence of morpho-phonological categories in sign language, with the homesigners displaying a pattern more like that of signers, though less robust, while gesturers, who have no experience with manual representation of concepts exclusive of speech,

[16]Thanks to Björn Lindblom (p.c. 2008) for this observation.

[17]Adult homesigners are deaf people who were not exposed either to sign language or to accessible speech, and created a communication system of their own (Goldin-Meadow 2003).

show a different pattern. The study confirms that the degree of complexity found in the organization of features is a useful device for capturing phonological generalizations. The results can also be interpreted as supporting the view promoted here and in earlier work (Israel 2009; Israel and Sandler 2011; Sandler et al 2011) that phonological structuring is emergent, and that social factors such as the existence and size of a community play a role (Meir et al 2012).

2.3 The emergence of a feature category: assimilation in a familylect

At each level of analysis, we have gained insight into how language begins: in syntax (Sandler et al 2005, Padden et al 2009); prosody (Sandler, Meir, et al 2011) morphology (Meir et al 2010), and phonology (Sandler, Aronoff, et al 2011). Some signs have changed in the direction of ease of articulation, obscuring iconic origins. One case that we traced within a single family offers a fascinating glimpse into how a feature category can emerge.

The sign for EGG is quite standard across the village. It is a compound sign, shown in Figure 14. The members of this compound are the sign for CHICKEN, a pecking motion with a curved index finger representing a chicken's beak, and a classifier sign often used for handled food items like fruits or vegetables, glossed as HOLD-OVAL-OBJECT.

Figure 14. Conventionalized ABSL compound sign for EGG: (a) CHICKEN + (b) HOLD-OVAL-OBJECT

We have found that vocabulary within families is a good deal more stable than across the community, giving rise to our term, *familylect*. In one familylect, used by a deaf woman and her eight children, of whom five are deaf, the sign for EGG has changed. Their sign for EGG is shown in Figure 15. In their sign, the hand shape from the sign for HOLD-OVAL-OBJECT has assimilated regressively to the sign meaning CHICKEN. Like assimilation generally, this assimilation is prompted by ease of articulation (the same hand shape for both parts of the sign), and it results in a sign that is less iconic than the original form. The features of the hand shape that assimilate are those of the Selected Fingers and Position categories. In CHICKEN, only the index finger is selected, articulating a curved position, with all the other, Unselected, fingers closed, while in HOLD-OVAL-OBJECT, the index, middle, and thumb are selected, all curved (two fingers and a thumb from HOLD-OVAL-OBJECT supplant a single index finger of CHICKEN) and their position. Each of these hand shapes is iconic; for CHICKEN, a single finger represents the pointy shape of a beak, and for HOLD-OVAL-OBJECT, the hand represents a hand holding a small oval object. The fact that an articulatory category is involved in a phonological process irrespective of meaning (even contrary to meaning, since a chicken's beak is pointy and not three-pronged and curved) is an indication that a meaningless level of structure is emerging. The Selected Fingers of HOLD-OVAL-OBJECT assimilate, and the Finger Position assimilates with it. This assimilation is attested across four members of the household videotaped, and we infer that the shape of the hand no longer iconically represents 'beak' or 'hold oval object'. Instead, features characterized roughly as [index, middle, thumb] Selected Fingers and [curved] Position have taken on a life of their own.[18]

[18]Interestingly, the Orientation does not assimilate. This kind of assimilation is not attested in either ASL or ISL compounds, in which Orientation assimilates with the Selected Fingers, as in TAKEN-ABACK, Figures 9 and 10, and which motivated the hierarchy discussed in Section 1.3.

(a) (b)

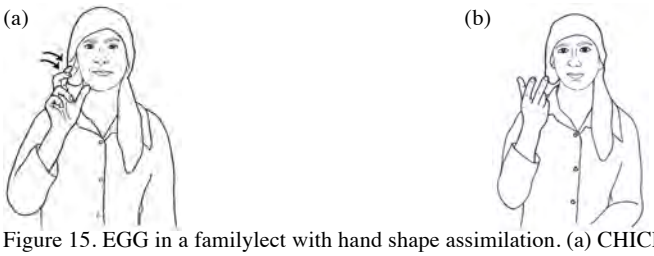


Figure 15. EGG in a familylect with hand shape assimilation. (a) CHICKEN + (b) HOLD-OVAL-OBJECT. First member of compound (CHICKEN) signed with hand shape of second member (HOLD-OVAL-OBJECT).

This family, like many in the village, has its own hens, and the topic of eggs must come up quite often among the many family members. We attribute the emergence of a phonological system to the conventionalization and automaticity that is inherent in increased use among more people as the language matures and expands.

One young girl in the family provided another intriguing datum to our understanding of the emergence of phonology. When we first videotaped her signing vocabulary items, she signed EGG the same way as the rest of her family, as shown in Figure 15. A few years later, she produced the sign shown in Figure 16. This form is even less iconic than the sign in 15, and phonologically speaking, it is a (reduplicated) monosyllable, the optimal form of the prosodic word in more established sign languages.

Figure 16. Iconically opaque reduced monosyllabic form of EGG in young signer of familylect

3. Features of a signature 'accent' in sign language[19]

The socio-linguistic map of Israel is very complex. According to the 2013 report of the Israeli Central Bureau of Statistics, there are 6,042,000 Jewish citizens and 1,658,000 Arab citizens of the State of Israel. Hebrew and Arabic are the official national languages. The number of deaf people is estimated at 10,000, and most of them use ISL as their primary language. But the situation is more intricate than this, and to set the stage for a discussion of the features of accent in sign languages, I begin with a brief description of the Israeli linguistic mosaic in 3.1. In 3.2, I sketch some examples of the small phonetic differences that often characterize foreign accent. What could constitute a foreign accent in sign language? This is the topic of Section 3.3.

3.1 Spoken and signed languages in Israel

Hebrew is the native language of all Jewish citizens of Israel who were born in the country or who emigrated at a young age, and it is the primary language for the vast majority. Many other languages are spoken among the Jewish population of Israel, ranging from Russian to French to Yiddish, Amharic to Aramaic, and different Arabic languages of North Africa and the Middle East.

[19] In ongoing research, we have been conducting two studies of foreign accent in the Haifa Sign Language Research Lab, one on foreign accent of ABSL signers in ISL (with Irit Meir, Gal Belzitsman, and Itamar Kastner), and one on foreign accent of ASL speakers in ISL and of ISL speakers in ASL (with Gal Belzitsman and Tory Sampson).

The Arab, Druze, and Bedouin populations of Israel are native speakers of some variety of Arabic, as are diminishing groups of older Jews who came from Arab countries to Israel during the mass flight from those countries in the 1950s and 1960s. Some of these 'varieties' of Arabic are different dialects of the same language (namely, those of the same geographical region, e.g., Nazareth Arabic and Kfar Qassem Arabic in Israel) and some are not mutually intelligible (e.g., Arabic of Nazareth, Israel, and Arabic of Casablanca, Morocco).

In Israel, as throughout the Arabic speaking world, literate Arabic speakers are diglossic in Arabic. The written language is standard Arabic while the spoken language is either one of a variety of dialects of Palestinian Arabic (related to Arabic of Lebanon and Syria), or a Bedouin Arabic dialect (related to Arabic of Saudi Arabia). Although these Arabic varieties and Standard Arabic are related and are all called 'Arabic', they are quite different languages.

The national education system in Israel is organized into three sectors along religious and linguistic lines: Jewish secular, Jewish religious, and Arabic speaking (which includes Moslems, Christians, and Druze). In the Jewish education sectors, instruction is in Hebrew, and Arabic is taught as a second language. In the Arabic speaking education sector, Arabic is the language of instruction, with Hebrew taught as a second language.

Throughout Israel, Hebrew is the dominant language in higher education, the work place, government agencies, law courts, the parliament (*Knesset*), health services, etc. Most people in Israel for whom Arabic is the primary language also speak Hebrew, at varying levels of proficiency, from minimal to very high. While some people for whom Hebrew is the primary language speak Arabic well, most do not.[20]

Now to sign languages. Israeli Sign Language (ISL) was formed as a kind of creole (Meir and Sandler 2008), beginning in the 1930s, through contact among Jews who emigrated from different countries and a very small group of deaf people already here, as well as with home signers -- deaf people who had grown up in hearing households and developed a communication system within the family. A deaf school was established in Jerusalem in 1932, providing a locale for regular use of the emerging language, and a Deaf Association was formed in 1944. The language developed and became conventionalized over time. Today it is the language of deaf education, certified sign language interpreting, and associations and organizations that serve deaf people. Throughout the vast majority of the Jewish deaf community, ISL is the only language generally used.

While ISL is by far the dominant sign language in Israel with an estimated 10,000 signers, a number of other sign languages exist across the communities in this strip of land the size of New Jersey. There are two other sign languages apart from ISL found among deaf Jews in Israel. One is Algerian Jewish Sign Language (AJSL), still used by a community of deaf Jews from the town of Ghardaia, Algeria (Lanesman and Meir 2012). In that town, there was a walled Jewish quarter, where congenital deafness spread due to marriage patterns within the community, much like ABSL. When the Jews of Ghardaia emigrated en masse to Israel and France in the 1950s and 1960s, they brought their language with them, and the older generation of signers, numbering in the hundreds, are bilingual in ISL and AJSL, and still use AJSL, especially with older hearing relatives. The other is Russian Sign Language, brought on the wave of emigration to Israel of one million Jews from the Former Soviet Union, mainly within one decade, from 1990-2001. RSL is still used in this community, especially among older people and within deaf families.

In some Arab, Bedouin, and Druze towns and villages throughout the country, local sign languages like ABSL have arisen. We have identified at least five 'village' sign languages scattered throughout the country, with the highest percentage of deaf people found in the Bedouin village of Al-Sayyid (Meir et al

[20]Some Arabic words have been borrowed into Hebrew and among Arabic speakers there is considerable code switching with Hebrew. In the Druz villages of Usfiya and Daliat Al-Carmel in the North of Israel, Hebrew is intermixed with Arabic to such a large extent that it can be argued that a mixed language is in the making (Abu Roken 2014).

2010, 2012). In earlier years, when the number of deaf people was very small in these locations, deaf children either did not benefit from education or were sent to programs in the Jewish sector. In the past decade or so, with growing numbers of deaf children, deaf education has developed in the Arabic speaking sector, where educators have elected to use ISL in the schools. There are several reasons for this choice: ISL is a well established and widely used language; it has been used in schools since the 1970s, and has developed vocabulary suitable for use in education; ISL is seen in television interpreting; and it is accessible to professionals such as teachers through sign language courses. As there is also no single sign language used throughout the Arabic speaking sector, ISL seemed the logical choice.

Let's now place Al-Sayyid within this mosaic. The language of hearing people in the village is a Bedouin dialect of Arabic belonging to the NW Arabian or Hijazi type (Henkin 2008). Hearing men tend to speak Hebrew as well, from a basic level of Hebrew needed for work outside the village and for contact with agencies such as health care, to highly proficient Hebrew that comes with higher education. The older women in this village of conservative Moslem/Bedouin traditions tend to have minimal education and not to speak Hebrew at all, although there are some exceptions, and children speak a little Hebrew from school.

One of the most striking characteristics of Al-Sayyid is its particular brand of multilingualism – Arabic, Hebrew, and ABSL, with ABSL thought of as a second language of the village (after Arabic). While most hearing people in the village sign, some of them natively, there is no evidence of influence from any spoken language on ABSL (Sandler et al 2005, 2014). However, there is influence from ISL on ABSL.

The young people of the Al-Sayid village have had a good deal of exposure to signs from Israeli Sign Language in school settings. Until about a decade ago, deaf children from Al-Sayyid attended a mixed deaf school (Jewish and Bedouin children) in Beer Sheva, where ISL was used. Now, small children are schooled in special classes in the village, and from middle school on they mostly go to an Arab sector school in nearby villages. As a group, their exposure to vocabulary from ISL is wide, but their exposure to ISL grammatical structure as it is signed by deaf people is limited. In school, the teachers speak Arabic, accompanied by ISL signs. This is not ISL, since the grammar of the sign language is very different from that of the spoken language, and, as with other sign-supported speech systems, when both channels are used at the same time, one or the other (usually the sign language) is seriously disrupted. Some of the young deaf men in Al-Sayyid did have extended exposure to ISL in their late teens when they attended a mixed vocational high school (Jewish and Arab pupils with ISL signing deaf teachers), now closed down. The bottom line is that people under the age of 30 have had considerable exposure to ISL vocabulary and sporadic exposure to its grammatical structure.

We have only recently begun to focus on the age group now under the age of 25. Some young people seem to use predominately ISL vocabulary, although we have not yet quantified this. Whether they have a kind of creole or mixed language on their hands (literally and figuratively) remains to be determined.

When viewing videotape of ABSL signers in our lab in Haifa, ISL consultants invariably remark that even when the vocabulary is predominately from ISL, the signing looks 'different'. Part of the reason is that the ABSL signers do not use ISL grammatical constructions consistently or at all, a fact that we have documented in a number of publications (See Aronoff et al 2008 and Sandler et al 2014 for overviews). But there is also the matter of foreign accent.

3.2 Phonological and phonetic basics of foreign accent

Many different aspects of speech pronunciation contribute to native speakers' impression that they are perceiving a foreign accent. Here I touch very briefly on key points that are relevant for our purposes.

First of all, the phoneme inventory of L1 may be different from that of L2. Hebrew but not English has the voiced uvular fricative [ʁ]; English but not Hebrew has the voiced alveolar approximant [ɹ]. Speakers of either language as a second language often substitute a sound from their own inventory for

the alien sound. Second, stress patterns may be very different. There are many variables in assigning stress; any number or combination of them may vary from language to language, and can be carried over into L2 pronunciation. Phonological processes also transfer readily to a foreign language. English speakers typically reduce unstressed vowels to schwa, as in English, when speaking a foreign language that preserves full vowel quality in this environment, and the opposite is also true: a speaker of Hebrew may preserve full vowel quality in English, whether or not a vowel is stressed.

In fact, it is often possible to learn a good deal about the phonology of any language by carefully observing the accent of its speakers when speaking a foreign language, especially if they are not proficient in it. In this sense, 'foreign' accent is also a signature phonetic pattern of a native language. How strong an accent a person has in a foreign language varies. Usually, the more proficient one is in a foreign language, due to younger age of acquisition or simply a knack for acquiring languages, the more one is able to compensate for such phonological differences.

However, there are more subtle phonetic differences that also mark a speaker as foreign, and these differences are especially difficult to overcome in foreign languages acquired after what Lenneberg (1967) dubbed the critical period for language acquisition, perhaps because they are more difficult to perceive, or because they are more closely linked to an automatic motor program rehearsed since infancy.

For example, the 'same' sound may be pronounced slightly differently in different languages (Lehiste 1988). As an example, consider coronal stops. These are found in most if not all phoneme inventories of the world's spoken languages. But they are not all pronounced the same way. In English, [t,d] are pronounced with tongue tip touching the alveolar ridge, while in French, Hebrew, and other languages, the tongue tip touches the teeth, as shown in Figure 17, producing different acoustic results.

(a) (b)

Figure 17. Different pronunciations of coronal stops. Alveolar in English, (a), and dental in French, (b). Reprinted with permission from Mannell (2001).

Such sounds are characterized by the same phonological place features, [+coronal, +anterior], although they are phonetically different. And no Hebrew speaker would misunderstand an English speaker's pronunciation of *Tel Aviv*[21], as the difference in pronunciation of the coronal is not contrastive in Hebrew. But s/he would perceive an accent that is 'somehow' foreign.

Ladefoged and Maddieson (1996) show that Italian and Yoruba have the same vowel inventories, but the acoustic properties of each vowel are slightly different in the two languages, due to minute differences in the position of the articulators. This is illustrated in Figure 18.

[21]In my pre-linguist days, when I first came to Israel, I discovered that there are several differences in the English and Hebrew pronunciations of the name of Israel's biggest city – when an actress did an impersonation of an American speaking Hebrew. I heard my own accent for the first time in her voice. The English speaker will pronounce the [t] not only as alveolar, but also as aspirated, unlike the Hebrew. The vowel in *Tel* is not [ɛ] and not [ej], the nearest English vowels, but undiphtongized [e]. The last sound of *Tel* is different too. In English, the [ɬ] is velarized, but not in Hebrew. This was quite a disheartening discovery, since I had until then deluded myself into believing that the only problems I would have to overcome to speak accentless Hebrew were in learning phonemes that don't exist in English like [χ] and [ʁ].

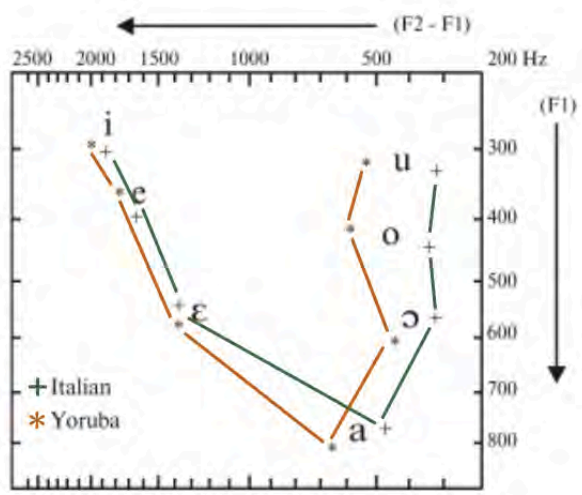


Figure 18. Acoustic vowel space of Yoruba and Italian. Adapted from Ladefoged and Maddieson (1996).

Especially in two such similar inventories, speakers of either language would be very likely to carry over their own vowels into the other language if they were to learn it as a foreign language.

Examples like those offered here ring familiar to anyone who has encountered a foreign accent in a spoken language (which is nearly everyone in today's multilingual world). But what could constitute an accent in a sign language?

3.3 Sign language accent

In their seminal book about American Sign Language, Klima and Bellugi (1979) noted that not all sign languages look alike. As in many other areas of inquiry, this book was pioneering. The authors showed that the formational constraints of Chinese Sign Language (CSL) were different in some ways from those of ASL. They gave an example of the ASL hand shape commonly referred to as 'A', which is a closed fist. The main difference is in the top knuckle, closest to the fingertip. In ASL, this knuckle is bent like the other knuckles of the fingers; in CSL, the top knuckle is not bent. In neither language are such features contrastive, yet they allow us to distinguish the two languages (Figure 19). In ASL, there is a contrast between a bent hand shape in which only the knuckle nearest the hand is bent, and a curved hand shape, in which all knuckles are bent. However, there is no contrast in ASL or other languages studied between bending at the middle and top knuckles. The difference seen in CSL and ASL 'A' here apparently involves a phonetic feature of accent, whether closed shapes involve bending at two knuckles or three.

In a study of the foreign accent of signers of the sign language of Mexico (LSM) who interact with ASL signers across the U.S.-Mexico border, Quinto-Pozos identified a difference in the way the hand shape commonly called 'F' is produced (Quinto-Pozos 2008). In ASL, the index and thumb tips touch, while in LSM, contact is made at the first knuckle, as pictured in Figure 20. The description implies that languages may differ in the place of finger contact with the thumb, either fingertip contact, as in ASL, or contact at the first knuckle, as in LSM.

(a) (b)

Figure 19. The closed handshape in (a.) American Sign Language and (b) Chinese Sign Language. Reprinted with permission from Klima and Bellugi (1979).

(a) (b)

Figure 20. Production of ASL 'F' handshape in American Sign Language and in the ASL accent of signers of Mexican Sign Language (LSM). Illustrated with permission from a figure in Quinto-Pozos (2008).

We were intrigued when deaf ISL signing consultants in our lab pointed out that the ABSL signers 'sign different', and we began to investigate. In our analysis of the way in which ABSL signers sign ISL signs, we are finding similar subtle differences to those illustrated in Figures 19 and 20, leading us to posit phonetic features of foreign accent, which are apparently not contrastive. Our investigations are still in progress, but we have already identified several features that distinguish the signing of ABSL signers in ISL. Our data come from two sources. One is a vocabulary study in the Al-Sayyid village, and the other comes from narratives by two young female ABSL signers (around age 20), primarily with ISL lexicon. We compared the vocabulary items with the same items elicited from ISL signers. In the case of the narratives, we asked an ISL consultant in our lab to write down each story in glossed form, internalize it, and then sign it from memory in ISL. We then compared the narratives.

The first feature involves what we are calling hand part prominence, or hand prominence for short. ABSL signers are more likely to exhibit dorsal hand part prominence in signs which in ISL have fingertip, radial, or ulnar prominence. Specifically, in the narratives, the back of the hand was prominent in 68% of the video frames of the ABSL signers, compared with 38% percent for the same narrative signed by the ISL signer. An example is the sign EXACTLY, shown in Figure 21.

(a) (b)

Figure 21. The ISL sign EXACTLY as signed (a) by an ISL native signer and (b) by an ABSL signer.

Another example of a phonetic difference is degree of hand tension. ABSL signers use observably more lax hand shapes than ISL signers for the same signs. Our preliminary investigation of accent in second language signers of American and Israeli Sign Languages suggests that tense/lax is a matter of degree and part of foreign accent, since ISL signers appear to use more lax hand shapes than ASL signers, in both their native and second languages. This suggests a cline from more tense to more lax: ASL >

ISL > ABSL. The features that characterize these differences will most likely turn out to be at the level of phonetic detail, rather than at the level of distinctive features.

Other accent features involve differences in movement -- the syllable nucleus of the sign. Unlike hand prominence and tenseness, which are noncontrastive and presumably not part of the phonology, these movement features are phonologically relevant. As noted, we found in our earlier study of ABSL phonology, briefly described above, that it is not obligatory in ABSL to include movement as part of a sign, so that a sign can consist of a single location segment.[22] For example, a sign like JUST-THEN shown in Figure 5 could be signed in ABSL without the initial location; movement to contact on the nondominant hand is only transitional movement from the previous sign, and not a lexical movement from a location 'setting' above the hand. This carries over into signs from ISL for ABSL signers.

Some signs have complex movement: both a path movement from one location to another and a simultaneously executed internal movement, consisting of a change in either Finger Position or palm Orientation. SEND and TATTLE (Figures 2a and b) are such signs. An example from our comparative vocabulary study is the sign for FLOWER, shown in Figure 22a,b. This contrasts with ABSL, in which we have not found path and internal movement together in any signs. Each component -- path movement and internal movement – exists in ABSL, but we have not found the two together in any of our studies of ABSL vocabulary. And indeed, such ISL signs are reduced by ABSL signers to an internal movement only. Signs that have complex movement in ISL, such as FLOWER, with a path movement upward simultaneously with an opening of the fingers, is reduced by ABSL signers to the opening movement alone at a single location, as in Figure 23a,b. The ABSL system allows only simple movement or no movement, and this is what we see in the accent in ISL signs. This appears to be a typical example of foreign accent, in which a phonological characteristic of one language is carried over into the foreign language.

Figure 22. (a) Beginning and (b) end of the ISL sign FLOWER signed by an ISL signer. Path movement and internal finger opening movement signed simultaneously; radial hand prominence.

Figure 23. (a) Beginning and (b) end of the ISL sign FLOWER signed by an ABSL signer. Movement reduced to finger opening only, without path movement; dorsal hand prominence.

[22]The epenthesis of movement on the part of a young girl, in a compound that is articulated without movement in her familylect, may be an indication that mandatory movement found in other sign languages is beginning to develop in ABSL (Sandler 2011).

These examples illustrate two accent features. First, we see that the ISL sign has complex movement consisting of a path movement upwards from the torso to the face, with a simultaneously articulated opening internal movement of the fingers. In the ABSL pronunciation of this sign, the hand remains at the chin location, executing only the internal movement, but no path movement. Second, while the radial part of the hand is prominent in ISL, it is the dorsal part of the hand that is prominent in the ABSL signer's FLOWER. The features of ABSL-accented ISL are characteristic of ABSL signs as well, but do not create contrasts in either language.

Another feature that characterizes ABSL signing in ISL narratives is what we call 'wrist lead'. We see it in the transitions between signs. Instead of a gradual transformation from the hand and wrist configuration of one sign to those of the next, we see a bending of the wrist, with the wrist leading the rest of the hand to the location of the following sign. This characteristic movement is transferred from ABSL and is part of the signature accent of Al-Sayyid. To sum up, features of the ABSL accent that we have identified and discussed here are shown below:

- dorsal hand prominence
- lax fingers
- lack of complex movement
- wrist lead.

4. Discussion and Conclusion: Emergence of phonological and phonetic features

In previous work, we demonstrated that a fully phonological system has not yet crystallized across the ABSL community, summarized briefly in Section 2. However, we see directions for phonologization. First, conventionalization through frequent interaction within a small group (a familylect) leads to reduced sublexical variation. Second, we hypothesize that conventionalization leads to automaticity, which in turn leads to a diminished connection to iconic motivation and to heightened systematicity in the articulatory behavior of meaningless components. The example shown here was assimilation of the features of hand shape. In our studies to date, there was variation across the community for these Selected Fingers and Finger Position features for the same signs, leading us to conclude that they are not contrastive. However, their manipulation in assimilation without reference to meaning (and even contradictory to it) suggests that they are becoming phonologized. In a case study requiring retrieval of lexical items, rather than descriptions, we found intriguing evidence for the birth of two recurrent, unmarked, articulatorily distinct handshapes. The evidence weighs against any notion of innately predetermined features and in favor of emergent features in sign languages.

In our accent study, we are discovering features that distinguish the signing of ABSL signers from that of ISL signers. The features, dorsal hand prominence, lax fingers, movementless signs and lack of complex movement, reveal a level of phonetic detail that has not been noted in research on sign language phonology or phonetics and is apparently not contrastive, but nevertheless describes real differences between the two languages.

Which of the ABSL accent features are transient traces of a young language that has not yet developed a phonology? Which would be likely to persist and be as characteristic of ABSL as nasality in French vowels or as geminates in Arabic? We cannot know for sure, but based on experience with other sign languages we can take an educated guess about three features: Lack of movement is probably transient, while dorsal hand prominence and wrist lead may well persist as characteristic features in the language.

Movementless signs are quite anomalous in sign languages. This is all the more noteworthy because many lexical movements are straight path movements with no special shape or manner features, and only a small number of contrastive features of path movement have been argued for (Sandler, 1996, Brentari 1998). It has been hypothesized that movements occur for perceptual reasons, to give salience to the other features of the sign. For these reasons, researchers attribute visual sonority to movement (e.g., Brentari 1990; Perlmutter 1992; Sandler 1999; Sandler & Lillo-Martin 2006, Chapter 14), with path movement

constituting the peak of a sonority cycle (Sandler 1993a). From the point of view of iconic motivation, most nominal signs in particular could symbolize objects without any lexical movement, yet movement is required in established sign languages. It is reasonable to hypothesize that movement may eventually come to characterize signs in ABSL as well, and that lack of movement is an early articulatory phase (see Footnote 23).

The two features that are most noticeable in the signing of ABSL signers are dorsal hand prominence and wrist lead. There is no phonetic or phonological reason that would prevent these features from persisting, and they may simply become the nasals or geminates of ABSL. The occurrence of wrist lead and dorsal hand prominence is not yet predictably systematic as far as we can tell, but it is conceivable that they may phonologize, becoming either contrastive or systematically allophonic. The fate of these features is one of the mysteries of this new language.

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