From Phonetics to Discourse:

The Nondominant Hand and the Grammar of Sign Language

Wendy Sandler, The University of Haifa/University of Nijmegen

Are there universal aspects of phonological organization that are not directly traceable to phonetics? To probe this question is to search for a distinction between the physiology of the system and a ‘higher’ level of cognitive organization. Some scholars (such as Ohala, 1990) believe that no principled distinction should be made, while others (e.g., Keating, 1988) find that some aspects of phonology are not derivable from phonetics.

Natural sign languages can be instructive here. These languages arise spontaneously wherever a group of deaf people have an opportunity to gather and communicate regularly. Sign languages have been found to have significant structural similarities to spoken languages at all levels of structure, despite the radically different physical channel of transmission: the hands, face, and body and vision, instead of the vocal tract and audition (Sandler & Lillo-Martin, in preparation). The most intriguing level of structure is the level referred to in the contextual question posed above -- the phonetic/phonological level. The physical system from which the phonetics of sign language derives is beyond any doubt radically different from that of spoken language. If a distinct phonological level can be identified, then we must ask whether that level is similar in significant ways to phonological organization in spoken language. The claim made here is this: if the phonetic primitives of the system are organized in a way that is similar to the organization of spoken language phonetic primitives, then this organization must comprise an identifiable component of the grammar (phonology) – and it does not derive directly from the phonetics. This is clearly a complex question with important implications, and it has been approached from various perspectives in
the sign language literature (e.g., Sandler, 1989; Brentari, 1998; Sandler & Lillo-Martin, in preparation). The present investigation proposes to examine it in a restricted way, but one that is potentially especially revealing -- from the point of view of the nondominant hand, an element with no parallel in spoken language.

The nondominant hand is anatomically identical to the primary articulator of sign language, the dominant hand. Spoken language has no such dual articulator. The primary articulator of spoken language, the tongue, is unitary, as are all other elements in the articulatory apparatus of the medium. Despite the apparent phonetic anomaly of a dual articulator in sign language, all investigators to date concur that at the phonological level there is only one articulator in sign language, the (dominant) hand (Sandler, 1989, 1993; Brentari, 1990, 1998; Perlmutter, 1991; Brentari & Goldsmith, 1993; van der Hulst and Sandler, 1994; van der Hulst, 1996; Van Gijn, Kita, and Van der Hulst, in press).\(^1\) This means that the nondominant hand plays only a minor role in the lexical representation of signs. This finding will be clarified shortly.

Despite its apparent insignificance, the nondominant hand (henceforth, h2) is an important element in the grammar of the two sign languages that I have investigated, American Sign Language (ASL) and Israeli Sign Language (ISL). I will demonstrate this by tracing its functions at various levels of structure, beginning with a grammatical subsystem with clear ties to the gestural origin of sign languages (Section 1), proceeding to the lexicon (Section 2), and on to prosody (Section 3) and discourse (Section 4). The exploration reveals clearly how a single articulatory element unique to sign languages participates in grammatical structuring familiar from spoken languages, even though the physical modalities are starkly distinct from one another. The conclusion reached is that certain grammatical categories and patterns are encoded phonologically, irrespective of the phonetic underpinning.

\(^1\) The models of the nondominant hand presented in the works referred to here vary. However, there is a general consensus that the nondominant hand is not an independent articulator in the phonology of sign language.
Section 1. The nondominant hand as a morpheme: Classifiers

I have said that h2 plays only a minor role in the lexical representation of signs, a claim that we will return to in Section 2. This does not mean, however, that h2 is insignificant everywhere. In all sign languages studied to date, an elaborate system of classifier constructions exists, in which h2 does have an articulatory role. These structures, invoked to express events of motion and location, and spatial relations among concrete objects (Supalla, 1982, 1986), involve a set of handshapes that function as classifiers. Classifier handshapes classify referents in terms of semantic category (e.g., HUMAN, SMALL ANIMAL, VEHICLE, etc.), size and shape (SMALL-ROUND-OBJECT, FLAT-OBJECT, etc.), or the dimensions of the handler of an object (and by extension, of the object being handled). These combine with different paths and manners of movement, and with locations. In this system, each hand may represent a morpheme by its configuration.

Classifier constructions are most clearly reminiscent of the gestural origins of sign languages, yet these structures are not pantomimic analogs. Rather, they are comprised of a finite list of components, they are rule-governed (Supalla, 1982, 1986), and they pose a challenge for the child acquiring sign language (Supalla, 1982, 1986; Slobin & Hoiting, in press). Nevertheless, linguists often treat the system separately from the rest of the language, because of the formal structure of classifier constructions, which is quite different from that of lexical signs. To begin with, each of the main components – handshape, location, and movement – has meaningful morphological status. This is in direct contrast with ordinary words of sign languages, in which each of these categories is strictly phonological, and by definition meaningless.

Classifier constructions are not words (Sandler & Lillo-Martin, in preparation), but are best described as predicates (Schick, 1990). A construction with a single classifier might span only a single syllable, giving it the appearance of
a word. But such a single-classifier expression might also span several prosodic constituents (such as intonational phrases) and represent a chain of events in which the classifier’s referent participates (Aronoff, Meir, Padden, & Sandler, in press; Sandler & Lillo-Martin, in preparation). Each morpheme is independently listed in the lexicon. Crucially, each is a bound morpheme and cannot constitute a word by itself. Of special interest to us here is an additional anomaly of this subsystem: in classifier constructions, the nondominant hand (or h2) can function as an independent classifier (Supalla, 1982).

In Figure (1), h2 is configured as an AIRPLANE classifier, and the dominant hand as an UPRIGHT-HUMAN. It is taken from an ISL sentence meaning, ‘a person approaches an airplane’. Figure (2) is extracted from a sequence with a meaning like ‘a person proceeds forward, dragging a dog squirming behind’. One hand represents an upright human and the other a legged-creature. In the next section, we will see that such structures are not possible in lexical words.

Figure (1) ‘a person approaches an airplane’ (ISL)

Figure (2) ‘a person proceeds forward, dragging a dog squirming behind’ (ASL)
2. The nondominant hand in the lexicon

In the classifier constructions pictured in Figures (1) and (2) above, the nondominant hand functions as a meaningful morpheme. In the words of the lexicon, however, the situation is radically different: the nondominant hand represents a meaningless phonological element, and its shape and behavior are so strictly constrained as to make it largely redundant. This is even the case with words that originated as classifier constructions and have been lexicalized. An example of the latter is ISL WRITE, shown in (3). Presumably, WRITE originated as a classifier construction in which the dominant hand, h1, is configured as the handler of a small manipulable object, and h2 represents a flat object, the piece of paper being written on.

![Figure (3) the ISL word, WRITE]

As is the case with any other words and unlike the classifier constructions from which they evolved, each of the formational categories in WRITE (handshape, location, movement) is meaningless (Stokoe, 1960).

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2 Most of the examples in this section are from ASL because most of the relevant research on h2 has been carried out on this language. The constraints discussed apply to ISL as well.
The formational elements in sign language words are subject to phonological constraints (Sandler, 1989, 1999a, Brentari, 1998; Sandler & Lillo-Martin, in preparation). For example, words typically consist of a single movement, often considered synonymous with a single syllable (Coulter, 1982). Another constraint is the Selected Finger Constraint (Mandel, 1981), according to which there can only be one group of selected fingers in a word. Among the constraints on words are two that hold on the nondominant hand: the Dominance Condition and the Symmetry Condition (Battison, 1978). These constraints are paraphrased in Example (1).

(1) a. **The Dominance Condition**

If the hands of a two-handed sign do not share the same specification for handshape (i.e., they are different), then one hand must be passive while the active hand articulates the movement, and the specification of the passive handshape is restricted to be one of a small set:

![Image of handshapes]

b. **The Symmetry Condition**

If both hands of a sign move independently during its articulation, then both hands must be specified for the same handshape and the same movement (whether performed simultaneously or in alternation), and the specifications for orientation must be either symmetrical or identical.

Signs are typically articulated at or near one major body area (Battison, 1978), called place of articulation in the model used here. Places of articulation include the head, trunk, and nondominant hand (h2). Normally, h1 moves from one setting to another (e.g., high to low, contralateral to ipsilateral, or proximal to distal) with respect to the place. The Dominance Condition is relevant for signs in which

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3 The constraints mentioned here do not apply to compounds or signs with sequential affixes.

4 Recent models further narrow the inventory of possible shapes on the nondominant hand to three.
only one hand, h1, articulates, and h2 is a place of articulation (Sandler, 1989, 1993a). An example of a sign in which h2 is a place of articulation is (ISL) AT-THAT-MOMENT, pictured in Figure (4). Example (2) is a schematic representation of such signs. In this schematic example, HC stands for the category of Hand Configuration; Ls are location slots; and M is a movement slot. In the sign, the dominant hand is configured in a particular shape and orientation, represented in a complex feature hierarchy (Sandler, 1987, 1989). In the schema here, an icon is used for simplicity. The hand moves from one location to another, on or near a single major body area, such as the head, the trunk, or in the case in question, the nondominant hand, labeled [h2] in the schematic representation. The single major area is labeled ‘Place’, for place of articulation.

Figure (4) AT-THAT-MOMENT (ISL)
Such signs are formally identical to one-handed signs (the majority of signs in a sign language lexicon), in which the place of articulation is the head, the trunk, neutral space, or, as in this example, the nondominant hand.

The Symmetry Condition refers to signs in which h2 is essentially a copy of the dominant hand, h1. In such signs, h2 is simply represented as a member of the Hand Configuration class (Sandler, 1989, 1993a). An example is (ISL) CAT, shown in Figure (5). Signs in which h2 functions like a copy of h1 may be represented as in Example (3). The h2 node is associated to the same feature complex as h1, and articulates the same locations and movement.
In both types of two-handed signs, the nondominant hand is underspecified. In the type in which h2 is a place of articulation (Figure 4, Example 2), the hand must either have one of only a few unmarked handshapes, or it is redundantly marked for the same shape as h1. In this example, the handshape is the unmarked shape 🙇. The notion of markedness assumed here is that of Jakobson, and underspecification is seen as a device for expressing relative markedness: the less specified, the less marked (see Sandler, 1994, 1995 for a treatment of handshapes in this framework). In the symmetrical type (Figure 5),
Example (3)), h2’s shape, and the locations and motion it articulates, are all completely unspecified, assuming those of h1 by default.⁵

Furthermore, in the morphophonology of ASL, h2 patterns with h1 in symmetrical signs, and with the place of articulation class in the other type of two-handed sign (Sandler, 1989, 1993). For example, in lexicalized reduced compounds in ASL, hand configuration often assimilates. If the base sign is symmetrical two-handed, i.e., if h2 is part of the HC class, then both hands assimilate. Similarly, if h2 is a place of articulation, it behaves like other places of articulation in compounds and under aspectual inflections (Sandler, 1993a).

Because of the Symmetry and Dominance constraints, the two classifier constructions shown in Figures (1) and (2) would be impossible as lexical signs. In the first figure, one hand is passive and the other hand moves in a single straight path towards it. But the shape of the passive hand is marked: . As such, the form would be ruled out as a word by the Dominance Condition. The second figure is extracted from a form in which both hands move, but they have different handshapes and different movements: one of them (the ‘human’ hand) moves in a straight path and the other (the ‘dog’ hand), moves in a zig-zag path. A word with this form cannot occur because of the Symmetry Condition.⁶

Of the sign languages that have been studied, vanishingly few minimal pairs have been attested in which the presence or absence of h2 is contrastive. In fact, h2 is so redundant in the signs of the ASL lexicon that it can often be omitted, by a process called Weak Drop (Padden & Perlmutter, 1987; Brentari, 1998; and for Sign Language of the Netherlands, van der Kooij, 2002). Phonological analyses vary, but there is a consensus on the following claim: there is phonologically only one major articulator in lexical signs: h1, the dominant hand (Sandler, 1989, 1993a;

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⁵ In the case of symmetrical two-handed signs, the representation reflects the least marked possibility for two-handed signs: one in which only one handshape is represented.

⁶ In a study comparing signs with cospeech gestures, van Gijn, Kita, & van der Hulst (in press) suggest that the Symmetry Condition reflects neither phonetics nor phonology but a higher level of cognitive organization.

So far we have compared the behavior of h2 as a morpheme in the classifier subsystem, which has gestural remnants but is grammaticized, with that of h2 as a meaningless phonological element in lexical words. The comparison offers a dramatic demonstration of the way in which linguistic constraints impose themselves on a language that evolves from nonlinguistic gestures. It is likely that a combination of motoric, perceptual, and cognitive factors underlies the dramatic subordination of h2 to h1 within words. Discovering what these factors are and how they interact is a topic worthy of future research. But whatever they are, the end result is a lexicon in which the form of two-handed words is severely restricted and the specification of the nondominant hand is largely redundant.

The question of why h2 appears at all in lexical words is worthy of attention. Part of the answer is surely phonetic: the nondominant hand is there, and it is subject to motor patterns that are dictated by bimanual coordination. Yet for reasons that I will call phonological, its role within the lexicon is minimal. The redundant properties of h2 in lexical words may also be significant in sign language processing. It is reasonable to speculate that the redundancy itself signals to the child acquiring sign language or to the addressee that a two-handed articulation so formed has the status of a word. Psycholinguistic experiments are called for to test this hypothesis.

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7 We will return to the notion of phonological employed here in the conclusion.
3. A grammatical role for h2: the delineation of prosodic constituents

Does the phonological redundancy of h2 in the lexicon mean that the nondominant hand plays no grammatical role in the phonology of sign languages? Interestingly, the answer is ‘no’.

An investigation of the prosodic structure of Israeli Sign Language conducted in large part with Marina Nespor (Nespor and Sandler, 1998; Sandler, 1999) revealed that h2 functions as a delineator of boundaries of two prosodic constituents: the phonological word and the phonological phrase. A brief review of those results will demonstrate how this phonetic element is recruited by the prosodic phonology.

Throughout the following discussion, the prosodic hierarchy and theory of prosodic phonology put forward in Nespor and Vogel (1986) are assumed. In the corpus of 90 sentences (30 x 3 signers) that formed the basis of the Nespor & Sandler study, facial articulations (positions/movements of the eyebrows, eyelids, cheeks, nose, and mouth), head and body position, and rhythm and prominence of hand movements were all carefully coded. After noticing that the nondominant hand often behaves differently in connected signing than might be predicted from the citation form of signs, we tracked and coded its behavior as well. All coding was done by a research assistant together with a native signer consultant, by viewing the data on videotape repeatedly, in slow motion, and recording the behavior of each articulation of the face, head, hands, and body on a different line. We now turn to the results relevant to the nondominant hand.

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8 The term phonological word is interchangeable here with the term prosodic word, and phonological phrase is interchangeable with intermediate phrase (Beckman & Pierrehumbert, 1986).
3.1. The prosodic word

In Israeli Sign Language (ISL), if a symmetrical sign is followed by a pronoun in the prominent (final) position of a phonological phrase, the pronoun can cliticize to its host through coalescence. The nondominant hand articulates only the host sign, while the dominant hand simultaneously articulates both the host and the clitic pronoun in the same time span. Figure (6) is from a sentence meaning ‘The shop around the corner went bankrupt’. Use of the deictic sign THERE is a typical sign language device, locating a concrete noun in space at first mention, establishing a locus for spatial referencing later in the discourse.

![Figure (6) SHOP-THERE and cliticized form](image)

In this example, the sign SHOP (6a) is a symmetrical two-handed sign and the deictic pronoun THERE (6b) is one-handed, normally signed with the dominant hand. In the cliticized prosodic word, the dominant hand signs only half of the sign SHOP, and then changes hand configuration to that of the sign THERE, while moving forward to complete that sign – a kind of coalescence process (6c).

What is of interest here is the behavior of h2. As the dominant hand coalesces, blending two signs, the nondominant hand simply completes the sign SHOP over the same temporal span. As with cliticization processes in spoken languages, the clitic loses its syllabicity or prominence. In the ISL case specifically,
the effect is to create an optimal monosyllable\(^9\) over the domain of the prosodic word (Sandler 1999a,b). In this process, then, h2 serves to mark the boundaries of the prosodic word. As a postlexical phenomenon, coalescence is non-structure preserving -- it violates the Symmetry Condition.

### 3.2. The phonological phrase

A higher level in the prosodic hierarchy is the phonological phrase, projected from the heads of syntactic phrases such as NPs, VPs, and AdjPs, though not isomorphic with the syntactic boundaries of those phrases (see Nespor & Vogel, 1986, for a formal definition and explanation).\(^10\) Evidence for the existence of this constituent from the prosodic phonology is found in external sandhi rules whose application is restricted to the domain of the phonological phrase. An example is French liaison (Nespor & Vogel 1986; Selkirk, 1986). The underlying final consonant, normally deleted, is pronounced before vowel-initial words if the two words are in the same phonological phrase. Liaison does not apply between words across a phonological phrase boundary.\(^11\) In Example (4), taken from Nespor & Vogel (1986), the symbol ^ is used where the final consonant is pronounced, i.e., where liaison applies. Where liaison does not apply, the symbol // is used. The symbol Ø is used as a subscript to mark phonological phrase boundaries.

4a. Cette famille a [trois beaux\(^^\wedge\)enfants]\(_0\)

‘This family has three beautiful children.’

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\(^9\) See Sandler (1993b) for a discussion of the tendency for morphologically complex words to reduce to the canonical monosyllabic form of the sign language word.

\(^10\) We assume with Nespor & Vogel (1986) that very short prosodic constituents may be restructured into larger units.

\(^11\) According to Selkirk (1972), the prosodic behavior of liaison is most consistent in informal registers.
b. Les enfants [sont^allés] = à l’école.  
   ‘The children went to school.’

c. Le garçon [les^aidait] = [activement]
   ‘The boy helped them actively.’

ISL utterances are also divided into phonological phrases. Final phonological phrase boundaries are marked phonetically by holds, reiterations of the last sign, or pauses (Nespor & Sandler, 1999; Sandler, 1999b), as indicated in Example (5).

   hold        redup        redup
   ‘The book he wrote is interesting.’

Confirmation for the existence of the phonological phrase constituent was found in an external sandhi rule involving h2, called Nondominant Hand Spread (NHS). This sandhi rule does not involve sequential segments. Rather, the spread of the nondominant hand from the triggering two-handed sign is simultaneous with the signing of other words by the dominant hand. An example is the phrase I BAKE from the sentence meaning ‘The cake I baked is very tasty’. The sign BAKE is a two-handed sign, in which h2 is a place of articulation. Triggered by the sign BAKE, h2 spreads regressively to the beginning of its phonological phrase. In other words, it assumes its hand configuration and place of articulation before the sign is articulated by the primary articulator, h1. The sentence is shown in Example (6), and the sandhi is illustrated in Figure (7). (7a,b) show the signs in citation form;
(7c,d) show the forms in context, with sandhi.

6.  

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\begin{align*}
[ [ \text{CAKE THERE} ] \circ [ \underline{\text{BAKE}} ] \circ ]_1 & [ [ \text{TASTY VERY} ] \circ ]_1 \\
\end{align*}
\]

‘The cake I baked is very tasty.’

![Images of sign language gestures]

(a) I  (b) BAKE  (c) I (with sandhi)  (d) BAKE

Figure (7) Nondominant Hand Spread in a phonological phrase

The spread of h2 is only to the edge of the phonological phrase. This is seen clearly in this example. The phrase that precedes the one with BAKE has only one-handed signs in it. If there were a two-handed sign in it, the presence of a specified h2 might conceivably be blamed for the blocking of nondominant hand spread further back from the phrase I BAKE. However, the preceding phrase contains only one-handed signs, so that there is no phonetic barrier to the spread of h2 all the way to the beginning of the sentence. Nevertheless, in all such examples in our corpus, the phonological phrase boundary prevented the further spread of h2. Furthermore, the spread is discrete and not gradient; it extends clearly to the
edge (right, left, or both) of the prosodic constituent. From this we conclude that NHS is a phonological process marking a prosodic constituent, and not a phonetic process of coarticulation. As a postlexical process, it is, like coalescence, non-structure preserving: the result of NHS is the presence of two places of articulation during the production of one sign (here, the sign ‘I’). At the lexical level, only one place of articulation is licensed (Battison, 1978).

I’ve suggested that h2 participates in signs, despite its redundancy, partly because of the physiology of the system, which includes motoric organization of bimanual coordination. The behavior of h2 in the ‘cake’ sentence (Example (6)), is a good example of this. The signer’s nondominant hand is present in the signing space, in a neutral configuration and location, even when it is participating neither in a two-handed sign nor in Nondominant Hand Spread. The neutral configuration for this particular signer is one in which the index finger is slightly prominent and the rest of the fingers are loosely curled, and the hand is held close to the body. This is shown (from a different recording of the sentence) in Figure (8), during the signing of THERE in the phonological phrase that precedes I BAKE. The transition from this neutral configuration and location to those of the sign BAKE, assumed precisely at the onset of the next phonological phrase, difficult to convey in still pictures, is striking on the videotape. For BAKE, the hand assumes a configuration in which all fingers are extended, and a location that is clearly at a medial distance from the body and not close to the body as in the neutral position.

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12 The coding was not facilitated by instrumental measurements. Nevertheless, as the naked eye could judge, the boundaries of NHS in our data were sharp, and not blurry.
3.3. H2 as a Discourse Marker

We’ve seen that in lexical words, h2 is largely redundant, while the prosodic system exploits this apparently insignificant phonological element to demarcate prosodic constituents. So far, it is only in the classifier subsystem that has h2 been shown to be relatively independent, both morphologically and phonologically. But it has been demonstrated that at higher levels of structure, too, h2 conveys meaning and enjoys concomitant phonological independence.

At the discourse level, h2 articulations can also break the bounds of the signs and sentences in which they originate by persisting in the signal to track and background referents and events (Frischberg, 1985; Brentari, 1995; Emmorey & Falgier, 1999; Brentari & Crossley, in press). Frequently, such discourse tracking occurs when h2 is a classifier, independent of h1. H2 as a classifier with discourse status may also derive from signs like WRITE that originated diachronically as a classifier construction involving both hands as morphemes. In such situations, the sign is synchronically decomposed into the classifier components from which it originated (Brentari, 1995; Aronoff, Meir, Padden, & Sandler, in press). Also, h2 can independently articulate a one-handed word, such as LOOK-AT, and remain in the signal while the dominant hand signs the events being looked at. Other

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13 Sandler & Lillo-Martin (in preparation), propose that this decomposition of a lexical sign into its classifier components is a sign language-particular kind of back formation.
interesting ways in which h2 behaves independently at the level of discourse are discussed in Padden (1988), Frishberg (1985), and Zimmmer & Patchke (1990), summarized in Brentari & Crossley (in press).

The following example (Figure (9)), from Emmorey & Falgier, 1999, illustrates the first type of discourse role mentioned above – a situation in which h2 articulates an independent classifier, and remains in the signal for as long as its referent is relevant to the discourse. In the sequence, the signer tells of a friend who bought a fancy new car, a Porsche. The friend drives up to a shopping area in the Porsche, represented by the nondominant hand configured as the ASL VEHICLE classifier. She parks the car and gets out, runs some errands, gets back into the car, and drives off. Throughout this discourse segment, h1 articulates the person getting out of the car and going shopping, and getting back into the car. Throughout, h2 remains in the signing space; the fancy car is prominent in the story even when it is not a participant in the events. At the end, the dominant hand, configured as the LEGS classifier, conveys the woman getting back into the car. Then the VEHICLE (h2), which has waited patiently, simply announcing its presence throughout, drives off into the distance.
Figure (9). The nondominant hand as a backgrounding device in discourse.

Reprinted with permission from Emmorey & Falgier (1999)

4. Conclusion

We’ve now traced the nondominant hand in a full circle through the grammatical system of sign language. A meaningful role for the nondominant hand is seen in the classifier predicate system, where it has the status of a morpheme and enjoys almost as much phonological freedom as the dominant hand. In the lexical words of sign languages, those that originated diachronically as classifier constructions, as well as those that did not, h2 is considerably less independent; its handshape, place of articulation, and movement are severely restricted. In words, there is only one major articulator, the dominant hand, and the nondominant hand plays a subordinate and largely redundant role. The prosodic system exploits this seemingly redundant element to demarcate prosodic constituents at different levels.
of the prosodic hierarchy, as we have seen.\textsuperscript{14} At the discourse level, h2 can be quite useful in rhetorical devices of sign languages, tracking referents and backgrounding portions of the discourse. At this higher level of structure, h2 conveys meaningful expressions, in a sense completing the circle that began with classifiers, which are also meaningful in themselves.\textsuperscript{15}

It should be quite clear by now that the nondominant hand is utterly unique to sign language, that there is no corresponding element in spoken languages. But the important question in the present context is whether the linguistic roles that it plays are different as well.

At the two extremes of the grammar – the classifier subsystem and the discourse level – h2 behaves, in a sense, as nature made it. The nondominant hand in these systems is an equipotential articulator, behaving similarly to its physiological twin, the dominant hand. Although it is likely to be subordinate to h1, having fewer degrees of freedom and articulating far fewer meaningful units in a given string than the dominant hand even in these systems, h2 does represent actual signs in some situations, and represents classifier morphemes in others. No individual phonological element in spoken languages functions systematically and cross-linguistically as a full morpheme. In this way, in fact, not only the nondominant hand, but both hands are different from any spoken language articulator.

But in other ways, h2 fulfills roles that are quite familiar from spoken languages. Let’s first consider the word. Just as spoken words have structural constraints, so do signs. In most sign language words, h2 must either be an articulator that is symmetrical with h1, or it must be an underspecified place of

\textsuperscript{14} The work on sign language prosody reported here was conducted on ISL. It is suggested in Brentari & Crossley (in press) that h2 plays roles in the prosody of ASL that are similar to those found in the ISL studies.

\textsuperscript{15} There must surely be constraints on the discourse behavior of h2 at all levels – phonological, prosodic, syntactic, semantic, and discourse as well. But such constraints have never been seriously investigated, and are a topic for future research.
articulation. While the specific constraints are obviously different, the fact that phonological elements and their cooccurrence are constrained within words is well known from spoken languages. Presumably, this kind of predictability has acquisition and processing advantages in both modalities. Sign language can also be instructive in considering the relation between phonetics and word structure constraints. In the sign language case, it is quite clear that the phonetics do not completely determine these constraints. We know this because in the classifier subsystem and for rhetorical effect, the constraints are freely violated in the same language, as we have seen. I see this as an indication that there is a higher level of organization that contributes to constraining the phonological structure of the word. The existence of constraints that make canonical words identifiable is a requirement of language, regardless of modality.

Another way in which sign language phonology behaves like that of spoken language despite very different phonetics is in signaling prosodic constituents. In many languages, assimilation rules that cross word boundaries, external sandhi rules, have been shown to respect particular prosodic constituent edges (Nespor & Vogel). One can think of this merging of words that stops at the boundary of a prosodic constituent as a way of binding together words within that constituent. In spoken languages, where linear structure is prominent, sandhi normally occurs between adjacent segments. In sign languages, in which structure at all levels is more simultaneous, sandhi can merge more than just adjacent segments; it can merge whole words together. This is the effect of NHS. The seemingly redundant articulator of sign language, the nondominant hand, can spread simultaneously across whole words within a phonological phrase, with the effect of binding together the words in the constituent simultaneously. The phonetics of external sandhi processes is starkly different in the two modalities, but the phonological effect is arguably quite similar.
This investigation, considering only one aspect of sign language structure, reveals both universal and modality-specific properties. The specific feature pool and feature classes, and the details of phonological processes are not universal; they differ in the two modalities. Furthermore, spoken languages tend to have sequential organizing properties and phonological processes that affect sequentially arranged elements, while sign languages have a good deal more nonlinear or simultaneous structure and processes.\(^\text{16}\)

But there are also significant properties that this brief investigation of the nondominant hand in sign language shows to be universal. The existence of features, feature classes, and processes that systematically change underlying form are linguistic universals. For example, in the model assumed here, h\(2\) may either be represented as a member of the HC class or of the Place of Articulation class, and in each case it behaves like other members of its class in the morphophonology.\(^\text{17}\) This indicates that languages universally organize features into classes (in the sense of Clements, 1985), regardless of modality. In addition, the very fact that the surface forms of signs can differ systematically from the underlying forms, i.e., that there are phonological rules, is also universal. The present investigation has demonstrated two such rules involving h\(2\): coalescence and Nondominant Hand Spread. Concomitantly, we see that when words are strung together in sentences, constraints on canonical word form are relaxed. In other words, there is a distinction between lexical and postlexical phonology in both modalities.\(^\text{18}\)

We have also seen that the existence of underspecified or default forms is a universal property of language. The nondominant hand must share the specification

\(^{\text{16}}\)This is not to say that there is no sequential structure in sign language phonology and morphology. See Liddell (1984), Liddell & Johnson (1989), Sandler (1989, 1993b) for specific arguments and analyses.

\(^{\text{17}}\)Detailed arguments for this model and for the representation of h\(2\) either as a member of the HC class or as a member of the place of articulation class are presented in Sandler, 1993a. For alternative analyses in which h\(2\) is represented in a unitary way regardless of sign type, see van der Hulst (1996) and Brentari (1998).

\(^{\text{18}}\)See Padden & Perlmutter (1987) and Sandler (1993c) for discussions of the lexical-postlexical distinction in ASL.
of h1 in symmetrical signs; it gets its specifications by default. In signs in which h2 is a place of articulation, it may only be specified for one of a few unmarked handshapes, another form of underspecification (Sandler, 1995, 1996; van der Kooij, 2002).

Finally, the segmentation of the language stream into prosodic constituents is universal. These constituents are marked by cues related to rhythm and prominence, and their cohesion is often reinforced by sandhi rules that may not cross the prosodic constituent boundary. The present discussion points to two such phenomena, both of them sandhi-type rules instantiated by the nondominant hand. Coalescence characterizes the prosodic word constituent (host+clitic), while Nondominant Hand Spread characterizes the phonological phrase.

This study was introduced with the question of the relation between phonetics and phonology. While the phenomena reported here do not resolve the issue, they do serve to focus it in an interesting way and to rule out overly simplistic solutions to it. The claim that certain principles unify phonetics and phonology (e.g., Ohala, 1990; Flemming, 2001), may well be valid across modalities. For example, it is likely that phonetic coarticulation is the source of the sandhi rules in French and in ISL. But it is equally clear that it is not possible to derive all of phonology from phonetics (Keating, 1988). The phonetics of spoken and signed languages have absolutely nothing in common. Yet in each modality the very different phonetic raw material is recruited to similar phonological ends. Both spoken and signed languages restrict the way in which phonetic elements may combine within words. In both modalities, potentially gradient coarticulation effects are selectively molded into discrete phonological processes. And in both, some of these phonological processes obey the bounds on prosodic constituency.

Taken together, these observations point to an important role for higher levels of grammatical organization that are expressed through the phonology. And

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19 As is the case with the other properties mentioned here, the bulk of the evidence for such constituents is presented elsewhere (Nespor & Sandler, 1999; Sandler, 1999a,b).
they point as well to a phonological component that gathers the raw phonetic material provided by the physiology, distinct in each modality, and organizes it according to regular constraints and processes that have much in common with each other across modalities. This line of reasoning suggests that it is only by conceding a separation between phonetics and phonology as a research strategy that we can find universals of phonological organization across natural language modalities.

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