

*Establishing a sonority hierarchy in American Sign Language: the use of simultaneous structure in phonology**

Diane Brentari

University of California, Davis

0 Introduction

The purpose of this paper is to help define and limit the role that temporal ordering plays in morphophonemic representation, syllable structure and phrases in American Sign Language (ASL). First, I will list the ways in which temporal ordering plays a role in morphophonemic structures. Second, I will show that temporal ordering plays a limited role in ASL phrases. Third, I will argue that neither temporal ordering nor segmentation plays a role in syllables, and the bulk of this paper will be devoted to motivating this syllable template. Stokoe (1960) and Stokoe *et al.* (1965) proposed that ASL is organised according to simultaneous phonemes, but since Liddell (1984) the importance of temporally ordered structure in sign structure has been emphasised by many researchers (Liddell & Johnson 1989; Sandler 1986, 1989; Perlmutter 1990, 1992; Corina 1990a, b; to name a few). As the work presented in this paper will make clear, having a level of phonological structure sensitive to simultaneous structure does not deny the existence of segments or temporal ordering. Instead, it seeks to explain why there are so many inexplicable aspects to sign structure if we employ *only* temporally ordered units in well-formedness constraints and phonological rules to explain the gestural patterning of the language.

Issues concerning temporal ordering and segmentation must be kept separate. Segments have a range of functions. Phonologically, the segment is concerned with the relation between feature bundles and timing slots, especially where there are mismatches between the two (for example, in geminates, affricates and tone association). Phonetically, segment boundaries occur at junctures where movements of several different articulators must be coordinated to achieve a particular manner of articulation. For example, the velar port and the oral cavity both must be closed to achieve a plosive burst or a fricative manner of articulation (Ohala 1992).

Morphophonemically, segments may have played an important role in vocabulary building of spoken languages, given that segments are easier to manipulate than distinctive features (Ohala 1992). It has even been suggested that a phonological system is more highly valued to the extent that its underlying representations consist of uniformly linear sequences in which segments and features are aligned in a clear one-to-one fashion (Clements & Goldsmith 1984). Yet in ASL there is little evidence that the phonetic or morphophonemic functions of the segment play much of a role (see Meier 1993 for more detailed discussion of this topic).

The traditionally defined segments in ASL have been based on movement *vs.* non-movement portions of the sign stream. They are analysed as Movements and Holds in work by Liddell (1984), Liddell & Johnson (1989) and as Movements and Locations in Sandler (1986, 1989).¹ It is interesting, then, that new vocabulary in ASL is more often achieved by manipulating the simultaneously occurring parameters of handshape, location and movement for an entire sign than by manipulating movemental and non-movemental segmental units as they are traditionally defined. With respect to the phonetic role of segments described above, there is no reason why articulatory movements of signs must be coordinated in the same way as the vocal articulators must be to achieve acoustic effects. In sum, we see little evidence of the potential roles segments play in spoken languages appearing in segments as they have been defined in ASL.

Temporal ordering may be defined for our purposes as the extent to which a language in question needs to stipulate the linear position of one particular distinctive feature with respect to another. One set of cases where this type of temporal ordering is seen is in the phonological instantiation of polymorphemic forms; that is, the ordering of the morphemes themselves. For example, in the verbal form FLY,² there is no non-movement at the end of the sign; in contrast, in FLY-THERE, there is a period of non-movement at the end of the sign required by the specification of the morpheme THERE using a particular place of articulation (Supalla & Newport 1978). The movement occurs before the non-movement portion of the sign, and the designated place of articulation for the morpheme THERE must occur at the end of the movement. Another set of cases where morphophonemic ordering occurs in ASL is in signs with two ordered movements (such as in the sign WHEN), with two distinctly ordered places of articulation (such as in the sign KING; see Brentari 1990c for diagnostic tests for identifying such signs), or with two ordered handshapes (such as in the sign BE-PREPARED).³ My claim is that forms requiring morphophonemic ordering in ASL are a restricted set, and, in agreement with Wilbur (1993), that this ordering need not be expressed in segmental units. With handshape contours (a type of handshape change to be explained in more detail below), in particular, considerable progress has been made in predicting a sequence of two handshapes from a single underlying form (Sandler 1989; Corina 1993).

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least one aspect of these effects has been shown to be predictable. Perlmutter (1992) has convincingly shown by means of distributional evidence that the duration of holds is sensitive to position in the phrase, and that these can be best described in terms of moras and feature bundles as they relate to a linearly ordered syllable structure. The syllable argued for in Perlmutter (1992) is one constructed on the basis of adjacent, temporally ordered feature bundles, labelled Movement (M) and Position (P), respectively.

Let me now turn to the model in which I express my generalisations. I utilise Goldsmith's model of Harmonic Phonology (Goldsmith 1989, 1990, 1993). While there are at least two other phonological models appealing to constraint satisfaction rather than to linearly ordered rules in order to arrive at well-formed phonological structures (Prince & Smolensky 1993; Archangeli & Pulleyblank *in press*), Goldsmith's is the one that contains the most detailed work on aspects of syllable structure. The analyses in this paper are aimed at construction of a syllable template, and Goldsmith's model is the most useful for this purpose. The fact that Harmonic Phonology contains three levels of phonological representation is important in the analyses presented here. 'M-level' (roughly corresponding to the 'underlying representation') is the level at which morphophonemic structures are expressed in distinctive features in accord with principles of underspecification. Following Zec (1988), the sonority hierarchy is proposed to be available at this level. 'W-Level' (roughly corresponding to the 'phonological word' level) is where structures expressed in distinctive features are subject to a syllable template. 'P-level' (roughly corresponding to 'phrase' level) is the level at which structures larger than the phonological word are subject to well-formedness constraints, and redundant feature values are filled in. A second syllable template may be employed here. In other words, Harmonic Phonology proposes that there may be two syllable templates operating in a single language, one at P-Level and one at W-Level. This proposal is of particular reference to the present study.

During the last six years or more, the explanatory power of the syllable has gained wide appeal. In addition to the shift from conceptualising the syllable as a process or rule to treating it as a static template to which structures conform in order to be well-formed, there is also mounting evidence that there may be more than one template operating in a given language. Shaw (1992) argues that the language-specific syllable templates for Nootka are more restricted in contexts where reduplication occurs, copying only the onset and nucleus of the syllable; this reduced syllable structure prohibits the appearance of codas that are allowed in the syllable in other phonological contexts. Bosch (1991) argues that in the Barra dialect of Scottish Gaelic there is a syllable template that is relevant for prosodically prominent (i.e. stressed) syllables, and another, more restricted one for unstressed syllables. Wiltshire (1992) argues that word edges may be treated differently at different levels of the phonology, and that in Malayalam, Cairene Arabic and Tamil there is evidence that

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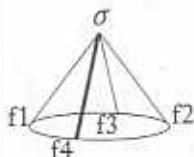
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syllable codas or word-level appendices should be treated differently at the W-Level and the P-Level of the phonology. If we accept the conclusions presented in this paper *and* those in Perlmutter (1991, 1992) concerning duration of holds, ASL is a clear example of how matters of timing are handled by one syllable structure and matters concerning simultaneous structure are handled by another. As such, the work presented here for ASL may well prove illuminating for more general issues concerning disjunction of syllable structure at different levels of the phonological grammar.⁴

My claim is that Perlmutter's ASL sequential syllable operates at P-Level since it predicts phenomena relevant at the phrasal level; his Mora Insertion rule has a phrasal domain. The simultaneous syllable I will argue for here operates at W-Level. The representation of the simultaneous syllable I will be arguing for is given in (1):

(1) *Representation of the simultaneous syllable (f = feature)*



At this point the formalism is quite simple. There is a syllable node to which distinctive features are attached in a three-dimensional space. In (1), each feature occupies its own autosegmental tier. It is plausible that when a consensus for a feature geometry for ASL is arrived at, the nodes that are the immediate daughters of the syllable node may turn out to be class nodes that group together features that are aspects of path movements, handshapes and locations, but at present this simultaneous 'paddle-wheel' arrangement of features is the least restrictive. The properties which Perlmutter's sequential syllable and the simultaneous syllable in (1) have in common is that both predict patterns of distribution for path movements, handshape change, secondary movement and orientation change according to a sonority hierarchy; however, the sequential syllable seeks to explain sonority on the basis of the linear arrangement of feature bundles rather than on the basis of comparing instances of simultaneously occurring features.

Why is the structure in (1) a syllable, rather than a segment or a morpheme or a mora? It is because this unit has been shown to be a prosodic unit rather than a morphological unit or a segmental unit. This unit can not be morphological because it has been shown by Brentari (1990a, b, c), Brentari & Goldsmith (1993) and Perlmutter (1990, 1991, 1992) that there are restrictions on handshape changes that cannot be explained in terms of morphological structure.

There are two types of handshape changes in signs: handshape contrasts and handshape contours. Handshape contrasts are changes involving a

change of selected fingers selected that changes GROUND). Handshape fingers within a single changing to an open in (5)).

Monomorphemic BACKGROUND, SOCIAL-inserted preceding movement with the c signs demonstrates the syllable (Perlmutter

A well-formed sign cannot be a segment, in handshape can apply in terms of visual example, no handshape movement, but must Perlmutter 1992 for argues that handshape stipulate segmental movements, but the ones be in the service of the syllable. For generalisations about segments, and then and explanatory power (1989) can be enhanced I will not discuss a framework, since in syllable to be the most an understanding of structure.

This paper consists power of the simultaneous the paper address the phenomenon, and sign for syllable structure sign structure. Temporal and non-movement these phenomena. The shorthand term for consists of simultaneous segments may contain features specification is proposed to perfect this paper, rather than

change of selected fingers; for example, a handshape with all four fingers selected that changes to one with the index finger selected (e.g. BACKGROUND). Handshape contours are changes involving the position of the fingers within a single set of selected fingers; for example, a flat position changing to an open position (e.g. INFORM; these shapes are illustrated in (5)).

Monomorphemic signs containing two sets of selected fingers, such as BACKGROUND, SOCIAL-WORK and CURRICULUM, will have short movements inserted preceding the change in selected fingers. The insertion of movement with the change of selected fingers in such handshape contrast signs demonstrates that there may be only one selected finger group per syllable (Perlmutter 1992).

A well-formed sign can consist of a single unit like that in (1). This unit cannot be a segment, because systematic restrictions upon where changes in handshape can appear in a monomorphemic sign can only be explained in terms of visual sonority as a suprasegmental phenomenon. For example, no handshape contours can occur before or after a sign-internal movement, but must occur simultaneously with such a movement (see Perlmutter 1992 for impossible forms of this type). Perlmutter (1992) argues that handshape contours must occur on syllable peaks. One could stipulate segmental sequence constraints on dynamic elements in segments, but the ones adduced thus far in the literature can be shown to be in the service of a higher order prosodic unit which I take to be the syllable. For example, Perlmutter (1992) first tries to capture generalisations about the movements and handshape changes in terms of segments, and then unifies them by means of the syllable. Also, the scope and explanatory power of Sandler's Handshape Sequence Constraint (1989) can be enhanced if the syllable is employed (Brentari 1990, 1992). I will not discuss moraic structure in this paper within a harmonic framework, since in constructing this phonological model, I take the syllable to be the most basic element of prosodic structure, and, therefore, an understanding of the syllable must precede an understanding of moraic structure.

This paper consists of two sections, both of which show the explanatory power of the simultaneous syllable for sonority in ASL. Both sections of the paper address the notion of 'visual sonority' as a suprasegmental phenomenon, and show that only by attending to a simultaneous domain for syllable structure can we explain the distribution of dynamic aspects of sign structure. Temporal ordering (especially temporally ordered movement and non-movement segments) actually limits our ability to explain these phenomena. This unit, which I call the 'simultaneous syllable', is a shorthand term for the basic prosodic unit of signed languages which consists of simultaneously occurring autosegmental tiers. These autosegments may consist of a branching structure containing ordered features specifications. There are two reasons why a simultaneous syllable is proposed to perform the tasks concerning ASL sonority addressed in this paper, rather than a sequentially ordered syllable structure consisting

of segments. First, if we assume (instead of a simultaneous syllable) a segmental, sequential syllable, signed languages must always assess the sonority values of path movements, handshape changes and orientation changes across more than one unit, rather than within a single unit. Unlike the situation in spoken languages, where sonority of a single feature value can be assessed (e.g. the feature [low] in /a/), in signed languages no sonority value can be obtained by examining a single segment (i.e. a single specification for handshape or orientation). The sonority value can be obtained for these properties only by summing two specifications on an autosegmental tier. In models for sign where segments are explicitly argued for (e.g. Liddell & Johnson 1989; Sandler 1989), each segment specifies only one handshape feature, which makes the minimal unit for evaluating sonority two segments. The simultaneous syllable allows for sonority to be assessed within a single unit. Second, I have argued elsewhere (Brentari & Goldsmith 1993) that the coda in ASL is realised simultaneously with the rest of the syllable. This level of simultaneous organisation in the phonology of ASL (or in other signed languages) has no immediately apparent analogue in spoken language formalism, since even subsyllabic units in spoken languages are realised linearly. The data come primarily from compounds and polymorphemic forms from the aspectual system of ASL. In this work, I make the crucial assumption inherent in Harmonic Phonology allowing for two syllable templates in a single language. Also, I assume a model which expresses properties of path movement as distinctive features. Stack (1988), Hayes (1993) and Uyechi (1993) have proposed models for ASL without movement features in underlying structure. On independent grounds, I have argued for the movement features [direction] (Brentari 1988) and [tracing] (Brentari 1990a).

1 Sonority proposals in ASL

Sonority has been studied in two ways in the recent literature (Ohala 1990; Ohala & Kawasaki 1984; Zec 1988; Clements 1990; Goldsmith & Larson 1990). One has been called 'inherent sonority', which we can characterise for a given speech sound in isolation as a composite property that depends on the way it is specified for each of a certain set of features, such as [vocalic], [approximant] and [sonorant]. Plus specifications for any of these features have the effect of increasing the perceptibility of a sound with respect to otherwise similar sounds having minus specifications. The other type of sonority calculation has been referred to as 'relative' or 'derived' sonority, which is a notion that considers the inherent sonority of a feature in a given phonological context. Highly sonorous features, such as [low] in /a/, will demand to occupy the syllable peak within a local context. For spoken languages, the local context includes the /a/, or local sonority peak, plus the segments flanking it on either side. Local maxima of sonority become syllable peaks in this way.

These aspects of sign properties of sign work on the visual (1965) and expanded have learned that anatomically distributed system, performs parvocellular system objects, making first takes place quite two systems in hand I have used these that might contribute. The aspects of sign into the 'magnoc detection. Phonological subsystem include another, or change path movement, handled here as we have been shown (1990, 1993; Wilb mutter 1992). It w concern us in this

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These aspects of sonority in speech focus on perceptibility. What properties of sign might enhance their perceptibility? Through recent work on the visual system begun in the 1960s by Hubel & Wiesel (1962, 1965) and expanded on by Livingstone & Hubel (1987a, b, c, 1990), we have learned that the visual system is composed of two functionally and anatomically distinct subsystems. One of them, called the magnocellular system, performs stereopsis and motion detection. The other, called the parvocellular system, performs tasks that have to do with scrutinising objects, making fine distinctions of form and colour. This functional split takes place quite early in visual processing. While the work done on these two systems in humans has, thus far, not addressed the issues raised here, I have used these researchers' general findings to divide the types of things that might contribute to visual salience in ASL into two broad categories. The aspects of signs that are dynamic and change quickly over time tap into the 'magnocellular system', which performs stereopsis and motion detection. Phonological aspects of signs that might be handled by this subsystem include changes caused by movements from one location to another, or changes in properties of handshape or orientation. Features of path movement, such as the shape or direction of a movement, would be handled here as well. Signs not containing one of these aspects of change have been shown elsewhere to be ill-formed in the language (Wilbur 1987, 1990, 1993; Wilbur & Nolen 1986; Brentari & Goldsmith 1993; Perlmutter 1992). It will be the dynamic aspects of visual salience that most concern us in this paper.

The other type of visual salience, which I connect with processes carried out by the parvocellular system, is important for scrutinising static objects and for distinguishing among the various foregrounded details of the static components of signs. These might include, for example, such tasks as handshape discrimination, distinguishing a 'W' handshape with three fingers extended from a 'V' handshape with two fingers extended. In fact, one proposal for assigning sonority peaks in signed languages (Edmondson 1990) takes the static aspects of signs, such as restraint of movement (that might be attributable to the parvocellular system), as local maxima of sonority. Edmondson's main argument for this view stems from an analogy to vowels, the sonority peaks in spoken languages, since vowels are produced and perceived by means of maintaining a more or less steady state in the vocal tract. Yet there is no distributional evidence from signed languages that supports this view, since units not containing some aspect of change (not stasis) have been convincingly shown to be ill-formed signs, and ill-formed syllables. Further, phonetic measures of handshape changes that are sign-internal and of handshape changes between signs show that handshape changes within signs are slower and more gradual than handshape changes between signs. That is, sign-internal handshape changes maximise the dynamic property of the change (Brentari *et al.* 1993). This adds to the body of evidence showing that dynamic aspects of signs are phonologically significant.

I am calling the property of visual salience addressed in this paper

'sonority' for both phonetic and phonological reasons. The paragraph above gives a description of the sensitivity of the visual system to the dynamic properties of signs, yet appealing to phonetic parameters alone will not account for phenomena I will address here, for two reasons. First, there are a large number of dynamic properties to be discussed in this section, namely those containing either movement accompanied by a handshape change or a handshape change accompanied by an orientation change, that have equally complex counterparts which occur between signs (e.g. between the signs GO and HOME or between the signs TELL and FRUSTRATED). Such dynamic elements occurring *between signs* are inserted by a phonetic level rule and completely ignored by the phonology. Second, in ranking orientation change and handshape change along a scale of perceptual salience, there are no phonetic properties that *a priori* would help us decide which one would be the more salient. As we will see in this section, distributional evidence shows that ASL consistently favours handshape change over orientation change as a syllable peak. This can be explained if we appeal to ASL's language-specific grammar's role in deciding which of two properties will have a higher sonority rank when they are similar with respect to their phonetic salience. To take an example from spoken languages, liquids and nasals do not have the same sonority rank universally (Zec 1988).

Why are we calling the hierarchy developed here a sonority hierarchy rather than a kind of feature hierarchy, such as those developed in Sandler (1987, 1989) and Wilbur (1993), following in the tradition of Clements (1985)? Let me discuss Sandler (1989) as a point of comparison to justify treating the hierarchy being developed here as a sonority hierarchy. The dependency relations Sandler establishes in her feature hierarchy are based on assimilatory phenomena in ASL and on the ability of the various features dominated by class nodes she proposes to behave in a unified fashion with respect to assimilatory phenomena. For example, spreading of the orientation specification (but not the selected fingers) from the second stem of a compound to the first stem is presented in Sandler's work as evidence for the orientation class node being dominated by the handshape (or Hand Configuration) node. The elements relevant for Sandler's analyses are single instantiations of features. In contrast, the elements relevant for my analysis are sites of change in the sign's structure, not static specifications. This is especially apropos in §3 on compounds, where the relevant elements are the nuclei of the syllables that are in the first stem of the compound, not single instantiations of features.

As I have shown above, ASL is sensitive to dynamic aspects in constructing well-formed prosodic units, but does ASL scan a sequential local domain or a simultaneous local domain in constructing syllables? Corina (1990a) addresses this concern by asking whether a sequentially organised sonority curve is a universal property of all natural languages. He concludes that the sequential sonority curve is of little use for signed

languages, and in conclusion.⁵

The ASL syllable elements within a sonority sequence may reflect the difference between signed and spoken

There have been two proposals for ASL syllable structure: one by Corina (1990) in (2b). These two proposals differ with respect to the generalisation that the most sonorous and the least sonorous elements in a syllable are the most and the least dynamic elements in the syllable, respectively. I will show that the first proposal is more differentiated.

- (2) *Sonority profile*
- a. Corina (1990)
 - movement
 - location
 - b. Blevins (1990)
 - path movement
 - location

As indicated above, the most dynamic elements in ASL, because orientation change is not a dynamic element, are the most dynamic elements in a single segment. In (3) we see the sonority profile of a syllable with an orientation change. The most dynamic element in the syllable is the orientation change; it is the most dynamic element in the syllable; it is evaluated for their dynamicity.

- (3) *Segmental representation of orientation change*
- a. DOUBT (handshape change)

[+periph

languages, and in this section I will offer evidence supporting his conclusion.⁶

The ASL syllable does not seem to honor a principle which sequences elements within a syllable in terms of sonority... the differences in the sonority sequencing principle between signed and spoken languages may reflect the different constraints imposed by the modalities in which signed and spoken languages are realized (Corina 1990a).

There have been two other proposals for sonority hierarchies in ASL – one by Corina (1990a), given in (2a), and one by Blevins (1993), given in (2b). These two proposals are in accord with the one I will present with respect to the general direction of sonority, with path movements being most sonorous and locations least sonorous. However, each of them fails to sufficiently discriminate among the various types of change occurring within the category of ‘non-static articulators’. Blevins labels handshape change, orientation change and secondary movement as a single category. Corina puts handshape change and orientation change at the same sonority level, and does not include secondary movement in the hierarchy at all. I will show that only by looking at simultaneously occurring dynamic elements can the relative sonority of non-static articulators be differentiated.

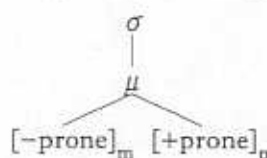
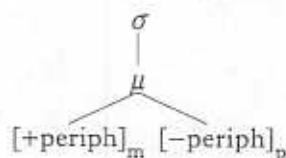
(2) *Sonority proposals in ASL* (most sonorous > least sonorous)

- a. Corina (1990a)
 movement > handshape change = [sic] orientation change > location change
- b. Blevins (1993)
 path movement > non-static articulator > static articulator > location-hold

As indicated above, the sequential categories of holds and movements or positions and movements won't help in sorting out relative sonority in ASL, because orientation changes and handshape changes are not expressed in a single segment; they are expressed over at least two segments. In (3) we see the segmental representations for handshape change and orientation change. The two positions of the hands each occupy one segmental unit; it is only when taken together that these positions can be evaluated for their visual sonority.

(3) *Segmental representation for handshape change and orientation change*

- a. DOUBT (handshape change)
- b. FOR (orientation change)



(The syllable and segmental units are from Perlmutter 1992; the features are from Brentari 1990a.) The appropriate unit for evaluating sonority contains a minimum of one of the dynamic properties in (2) contained across both feature bundles in each of the forms in (3). By employing this simultaneous notion of the syllable, we can establish a more detailed sonority hierarchy for ASL than was previously possible. The first approximation of the sonority hierarchy I will be arguing for is given in (4):

(4) *Proposed sonority hierarchy for ASL*

path	>	handshape	>	orientation	>	secondary
features		change		change		movement
[tracing]		[peripheral]		[prone]		[path2]
[direction]		[closed]				

The [tracing] feature specifies contour or shape of path and the [direction] feature direction of movement; these are proposed in Brentari (1990a). Features specifying a handshape change or an orientation change contain two ordered values. Ordering of two values of [prone] demonstrates an orientation change, referring to the direction the palm is facing. [+prone] specifies that the palm is down; [-prone] specifies that the palm is up. Ordering of two values for the feature [closed] and/or [peripheral] demonstrates a handshape contour. Both features are required to represent the range of contrastive handshapes in ASL. [+closed] specifies closed handshapes; [-closed] open handshapes. [+peripheral] specifies fully open or fully closed handshapes; [-peripheral] partially open or partially closed handshapes. The handshape features are argued for in Brentari (1990b), producing the four contrastive classes of ASL handshapes shown in (5):

(5) *The four contrastive classes of handshapes in ASL*
(from Brentari 1990b)

open handshape: [+peripheral, -closed]



curved handshape: [-peripheral, -closed]



flat handshape: [-peripheral, +closed]



closed handshape: [+peripheral, +closed]



Secondary movement phonetically realises movements in a sign change and orientation as subtypes of other (1990); however, in singly instantiated archy, even if they phonological separate few examples of sign is signed as small 'circling' secondar AROUND. There are handshape changes a subtype of a hand closes repeatedly. change is seen in t

For the following containing at least a change, orientation capable of assuming these dynamic elements

2 Secondary movement

All of the forms identifying syllable referred to as 'second strength of this to summarise them POSITIONS (Ps; i.e. MOVEMENTS (Ms) are not equally sonority Ms are analogous evidence comes from movements associated to a P when sign. From this preferred syllable attachment can be Perlmutter's conclusion limited, since he must be compared call the site of attachment

Secondary movements are specified by the feature [path2]. These are phonetically realised as a number of small, repeated, uncountable movements in a sign drawn from the properties of path movements, handshape change and orientation change. This description of secondary movements as subtypes of other dynamic elements of signs is adopted from Liddell (1990); however, in (4c) I have placed secondary movements and their singly instantiated counterparts in different places on the sonority hierarchy, even if they are phonetically related.⁶ I will be arguing for this phonological separation in the section on compounds (§3). Here are a few examples of secondary movement types. If a secondary movement is signed as small circles, it is a subtype of path movement. We see a 'circling' secondary movement [tracing: circle] in the sign TRAVEL-AROUND. There are also secondary movements which are subtypes of handshape changes or orientation changes. A secondary movement that is a subtype of a handshape change is seen in the sign MILK; the handshape closes repeatedly. A [path2] feature that is a subtype of an orientation change is seen in the sign YELLOW (illustrated in Fig. 4 below).

For the following analysis, the local domain considered will be a unit containing at least one of these dynamic aspects of signs – path, handshape change, orientation change and secondary movement – all of which are capable of assuming a syllable peak. Forms containing two or three of these dynamic elements will also be considered.

2 Secondary movement attachment

All of the forms in this section are subject to a diagnostic test for identifying syllable nuclei, developed in Perlmutter (1992), which will be referred to as 'secondary movement attachment'. Since one can grasp the strength of this test only after following Perlmutter's arguments, I will summarise them here. Perlmutter's model is a linear one, in which POSITIONS (Ps; i.e. places in the signing space or on the body) and path MOVEMENTS (Ms) are sequentially ordered. He argues that Ms and Ps are not equally sonorous, and that Ms are more sonorous than Ps; therefore, Ms are analogous to vowels and Ps are analogous to consonants. His evidence comes from the fact that handshape contours and secondary movements associate to path Ms whenever possible, and may only associate to a P when a M is unavailable in the underlying structure of the sign. From this evidence, Perlmutter concludes that path Ms are the preferred syllable peaks in ASL. For my purposes secondary movement attachment can be used to identify syllable peaks. I will demonstrate that Perlmutter's conclusion about differences in the sonority of segments is limited, since he fails to notice that simultaneously occurring features must be compared in order to choose the appropriate syllable peak. I will call the site of attachment the 'docking site' for secondary movement.

utter 1992; the features for evaluating sonority properties in (2) contained (3). By employing this I establish a more detailed hierarchy as possible. The first argument for is given in

secondary movement

[path2]

shape of path and the re proposed in Brentari or an orientation change uses of [prone] demonstration the palm is [-prone] specifies that feature [closed] and/or path features are required es in ASL. [+closed] shapes. [+peripheral] [-peripheral] partially pe features are argued rative classes of ASL

ASL



(6) *Docking site for secondary movement*

<i>uninflected form</i>	<i>morphologically related form</i>	
single instance of dynamic property	secondary movement	docking site
<i>a. Path movement</i>		
GO-TO	GO-TO [habitual] 'attend'	[direction]
LOOK-AT	LOOK-AT [habitual]	[direction]
GO-BACK-AND-FORTH	GO-BACK-AND-FORTH [habitual] 'commute'	[direction]
QUIET	QUIET [characteristic] 'taciturn'	[tracing]
AWKWARD	AWKWARD [characteristic] 'clumsy'	[direction]
CHAT		[direction]
<i>b. Handshape change</i>		
DOUBT	DOUBT [characteristic]	[peripheral]
ASK	ASK (idiomatic) 'hmm?'	[peripheral]
ANGRY	ANGRY [characteristic] 'grouchy'	[peripheral]
WANT	WANT [characteristic] 'needy'	[peripheral]
<i>c. Orientation change</i>		
FOR	WHY? (idiomatic)	[prone]
BLUE [intensive]	BLUE	[prone]
YELLOW [intensive]	YELLOW	[prone]
RED [intensive]	RED	[prone]

In (6) we see pairs of morphologically related forms. One member of the pair of signs is made with a single execution of a path movement, handshape change or orientation change. The other member of the pair is a form which contains oscillating secondary movement – uncountable repetitions of the dynamic aspect of the sign. In (6a) the docking site is the path movement as in GO-TO/ATTEND; in (6b) the docking site is in the handshape change; in (6c) the docking site is in the orientation change, as in BLUE [intensive]/BLUE. From these pairs and the arguments adduced in Perlmutter (1992), we can conclude that the docking sites for secondary movement are local maxima of sonority, in addition to being the syllable

peaks. One might expect handshape change in the same direction as in earlier work (Brentari 1989) on movements, and word.

Even though there are morphological pairs containing (Padden & Perlmutter 1992). There are also pairs in punctual verbs 'perform' 'x' once becomes GO-BACK-FORTH with secondary movement contain the second in (6); namely, F sign roughly corresponds phonological, no

Thus far, we have seen orientation change and ability to be dominated by sonority among simultaneously change and path. We can use the same hierarchy. The and handshape change

(7) *Docking :*

Forms with
OVERSLEEP
BELIEVE f
BLESS

While the forms of secondary movement and handshape change is illustrated. The change and a path handshape change in the [habitual] is more sonorant [habitual] forms movement; in the first syllable of

peaks. One might correctly note that the forms containing a single handshape change (6b) or orientation change (6c) also contain a movement in the same direction as the handshape change or orientation change. In earlier work (Brentari 1990a, c), I analysed these movements as redundant movements, and therefore not present at the level of the phonological word.

Even though the signs in (6) form a homogeneous phonological group, there are morphological differences among the sets of forms. There are pairs containing a verb stem 'x' and an adjective 'characteristically x' (Padden & Perlmutter 1987). For example, TO-WANT becomes NEEDY. There are also pairs containing a verb stem 'x' and a second verb form. In punctual verbs, the secondary movement changes the meaning from 'perform 'x' once' to 'perform 'x' habitually' (e.g. GO-BACK-AND-FORTH becomes GO-BACK-AND-FORTH [habitual] or 'commute'). In adjectives the form with secondary movement is the plain form; the intensive does not contain the secondary movement. There are also two idiomatic expressions in (6); namely, FOR and FOR-FOR ('Why?'), and ASK and ASK [idiomatic], a sign roughly corresponding to English 'hmm?' We focus here on phonological, not morphological, patterns.

Thus far, we have shown that path movements, handshape changes and orientation changes can all function as sonority peaks, by virtue of their ability to be docking sites. Let us now try to establish a hierarchy of sonority among these three elements by looking at forms that contain simultaneously occurring distinctive specifications for both handshape change and path movement or handshape change and orientation change. We can use the same test of secondary movement association to establish this hierarchy. The forms in (7) contain specifications for path movement and handshape change:

(7) *Docking site for secondary movement: path movement*

Forms with path movement and handshape change

OVERSLEEP (from SLEEP + SUNRISE)	OVERSLEEP [habitual]
BELIEVE from THINK + MARRY)	BELIEVE [habitual]
BLESS	BLESS [habitual]

While the forms are not numerous, they do show a clear preference for secondary movement to dock on the lexical movement rather than on the handshape change. In Fig. 1, the pair OVERSLEEP and OVERSLEEP [habitual] is illustrated.⁷ There are two forms of OVERSLEEP, one with handshape change and a path movement in the second syllable, and one with no handshape change. Only the form without the handshape change appears in the [habitual] form. Consequently, we can conclude that path movement is more sonorous than handshape change. One thing to note is that [habitual] forms reduce disyllabic forms before associating the secondary movement; in the case of OVERSLEEP, only the second syllable appears. The first syllable of OVERSLEEP does not appear in the [habitual] form.

lated form
ent docking site

[direction]

[direction]

[direction]

[tracing]

[direction]

[direction]

[peripheral]

[peripheral]

[peripheral]

[peripheral]

[prone]

[prone]

[prone]

[prone]

forms. One member of
of a path movement,
member of the pair is
movement - uncountable
the docking site is the
docking site is in the
orientation change, as
arguments adduced in
ing sites for secondary
to being the syllable



Figure 1

For the sign *OVERSLEEP*, a sign containing movement and handshape change, there is one variant (left) containing a handshape change during the upward part of the movement; in the other variant (middle), there is no handshape change. In *OVERSLEEP* [habitual] (right), the secondary movement has docked onto the movement, and the handshape change does not surface

In (8), we see forms that contain both a handshape change and an orientation change:

(8) *Docking site for secondary movement: handshape change*

Forms with orientation and handshape change⁸

LOCK	LOCK [habitual]
EXCERPT	EXCERPT [habitual]

In Fig. 2, the pair *EXCERPT* and *EXCERPT* [habitual] is illustrated. By observing where secondary movement docks in these forms, we can establish the preference for syllable peak when handshape change and orientation change occur simultaneously. In the cases in (8), secondary movement docks on the handshape change, and the orientation change is not realised. To describe what is happening here in terms of a hypothetical example from spoken languages, it would be as if there were a vowel occurring in a syllable nucleus containing both a [+low] feature and [-back] specification (e.g. the English vowel /æ/), but after undergoing a particular morphophonemic strengthening process, such as lengthening, the [-back] specification is lost and the vowel /a/ (unspecified for [back]) surfaces. This would be a highly unnatural process for a spoken language, and I have thus far found no such case.

Before ending this discussion, I must mention two well-known exceptions to this analysis – *CAN'T-DO-IT* [habitual] and *DON'T-WANT* [habitual]. Both forms are negative forms, where the orientation change carries the 'negative' morpheme. In these cases the orientation change does not delete. I would claim that these forms are exceptions precisely because of the information load on the negative



In the sign *EXCERPT* orientation change movement that has

morpheme. Despite handshape change sonority relationship movement attachment

(9) *Partial sonority path movement*

3 Compounds

Let us now look at secondary movement but what about secondary (if not all) secondary classes in (9). Does class for the purpose their respective feature literature about what shape change, orientation movements are simple phonologically like (1992) has argued that second segment, while hand constrained by the Perlmutter's general instantiations of dy



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ge during the upward
here is no handshape
movement has docked
does not surface

shape change and an

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or a spoken language,

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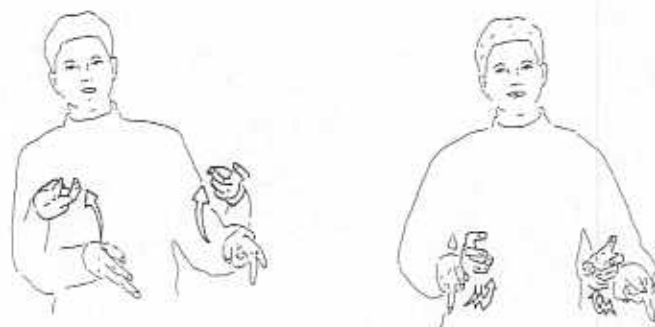


Figure 2

In the sign EXCERPT (left), we see a singly executed handshape change and orientation change. In EXCERPT [habitual] (right), we see a secondary movement that has docked onto the handshape feature [peripheral], and the orientation change does not surface

morpheme. Despite these exceptions, this evidence establishes that handshape change is more sonorous than orientation change. The sonority relationship among these three parameters based on secondary movement attachment is shown in (9):

- (9) *Partial sonority hierarchy*
path movement > handshape change > orientation change

3 Compounds and secondary movement

Let us now look at compounds to assess relative sonority. We have used secondary movement attachment as a test in the forms presented thus far, but what about secondary movement itself? As I mentioned earlier, many (if not all) secondary movements are executed as a subtype of one of the classes in (9). Does secondary movement form a distinct phonological class for the purposes of sonority, or does each of the subtypes group with their respective features? There has been a great deal of discussion in the literature about whether secondary movement is independent from handshape change, orientation change and movement or whether secondary movements are simply multiple executions of single changes and behave phonologically like their singly instantiated counterparts. Perlmutter (1992) has argued for the independence of secondary movement on the grounds that secondary movement is constrained by the domain of the segment, while handshape change (and presumably orientation change) is constrained by the domain of the mora. In this section, I can strengthen Perlmutter's general conclusion that secondary movement and single instantiations of dynamic elements in signs are phonologically distinct by

arguing that secondary movements and single instantiations of dynamic elements have a distinct phonological status on the sonority hierarchy. In an earlier paper (Brentari 1990c), I argued that secondary movements are not as sonorous as path movements, on the grounds of their behaviour in compounds. I have argued elsewhere that the underlying representations of stems, rather than surface forms of single signs, are the input to compound formation (Brentari 1990c).

It is important to tease apart the evidence for the sonority hierarchy I am arguing for from the evidence for a feature geometry for which Sandler (1987, 1989) argues. The phenomena in compounds presented here are relevant for a sonority hierarchy rather than a feature geometry because my arguments have come exclusively from material in the initial stem that occupies a syllable peak in the single-word form of the stem rather than from single feature specifications. To take a concrete example of this difference, let us look at orientation specification. My evidence comes from forms occupying the first stem in which the orientation specification changes (i.e. BLUE, GREEN, YELLOW have an orientation change from [-prone] to [+prone]). Sandler's evidence comes from forms where there are two different single orientation specifications in each stem (i.e. in the compound THINK-SELF 'decide yourself', the palm orientation is downward in THINK and inward in SELF).

ASL exhibits a strong tendency for monosyllabic forms (Coulter 1982), and this pressure is seen in the formation of compounds (Chinchor 1978; Sandler 1989; Corina & Sandler this volume). A number of analyses of ASL compounds show that the initial stem is especially vulnerable to assimilation and reduction (Liddell & Johnson 1986; Sandler 1989; Brentari 1990c). Compounding is productive, and there are phonological restrictions on the phonological structure of the initial stem, as well as at least two diachronic stages of reduction as a compound becomes lexicalised (Frishberg 1975; Klima & Bellugi 1979). Three of the phonological restrictions on the initial stem discussed in Svaib (1992) are: (i) the first stem must be a sign with a place of articulation higher on the body than the second stem; (ii) the first stem must have a place of articulation at the same distance from the body or closer to the body than the second stem; and (iii) the first stem must not involve more hands in its articulation than the second stem (that is, a two-handed first stem is prohibited when the second stem is one-handed). In doing this work, another structural restriction on first stems of compounds emerged; that is, in the corpus of 101 compound nouns I analysed (from Svaib 1992), none contained a first stem with both a handshape change and an orientation change. For my analysis here, such forms would have been very informative, but they are systematically excluded from this phonological context.

Let us first focus on compounds that appear as disyllabic on the surface. If each stem of the two stems of the compound contains a dynamic element in underlying structure (one of the properties on the sonority hierarchy in (4)), then the resulting compound will be disyllabic; that is, if the initial stem of a compound is path movement, handshape change or



The two stems BL/ feature. In the

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orientation change are given in (10). 1

(10) *Disyllabi*

a. *Move*

(i)

(ii)

(iii)

(iv)

(v)

b. *Hana*

(vi)

(vii)

c. *Orien*

(viii)



Figure 3

The two stems BLACK (left) and NAME (centre) each contain a path movement feature. In the compound BLACK-NAME 'bad reputation' (right), both movements surface.

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orientation change, it will be maintained in the compound. These forms are given in (10). BLACK-NAME 'bad reputation' is illustrated in Fig. 3.

(10) *Disyllabic compounds in stage 1 of reduction*

a. *Movement in the first stem*

	<i>stem</i>	<i>syllable peak</i>	<i>compound</i>
(i)	BLACK NAME	[tracing] [direction]	BLACK-NAME 'bad reputation'
(ii)	NAME SHINE	[direction] [direction]	NAME-SHINE 'good reputation'
(iii)	THRILL INFORM	[direction] [direction]	THRILL-INFORM 'news event'
(iv)	WEDDING CELEBRATE	[direction] [direction]	WEDDING-CELEBRATE 'anniversary'
(v)	NUDE ZOOM	[tracing] [direction]	NUDE-ZOOM 'streak'

b. *Handshape change in the first stem*

(vi)	PILL QUIET	[+closed],[−closed] [tracing]	PILL-QUIET 'tranquilliser'
(vii)	SLEEP CLOTHES	[−closed],[+closed] [+periph],[−periph] [tracing]	SLEEP-CLOTHES 'pyjamas'

c. *Orientation change in the first stem*

(viii)	COOK CHAIR	[+prone],[−prone] [direction]	COOK-CHAIR 'kitchen chair'
--------	---------------	----------------------------------	-------------------------------

instantiations of dynamic sonority hierarchy. In secondary movements are kinds of their behaviour in underlying representations signs, are the input to

the sonority hierarchy geometry for which Sandler understands presented here are feature geometry because initial in the initial stem that of the stem rather than concrete example of this on. My evidence comes orientation specification orientation change from s from forms where there in each stem (i.e. in the stem orientation is down-

ic forms (Coulter 1982), pounds (Chinchor 1978; A number of analyses of especially vulnerable to n 1986; Sandler 1989; d there are phonological initial stem, as well as at ound becomes lexicalised ree of the phonological b (1992) are: (i) the first higher on the body than ace of articulation at the y than the second stem; ls in its articulation than i is prohibited when the ork, another structural that is, in the corpus of 2), none contained a first ntation change. For my nformative, but they are ontext.

disyllabic on the surface. nd contains a dynamic perties on the sonority ill be disyllabic; that is, at, handshape change or



Figure 4

The sign YELLOW (left) contains an orientation change and a secondary movement. When YELLOW appears as the first stem of the disyllabic compound YELLOW-HAIR (right), the secondary movement does not surface



Figure 5

The sign SPEAK (left) contains a secondary movement and no other dynamic element. When SPEAK appears as the first stem of the compound SPEAK-NAME 'mention' (right), the secondary movement does not surface, resulting in a monosyllabic compound

Secondary movements in signs that surface in single words never surface when the same sign occurs as a compound-initial stem. This is shown in (11). If we look at compounds that contain both a secondary movement and either a handshape change or an orientation change in the initial stem (11a, b), we see that secondary movement does not surface in these compounds. The example YELLOW-HAIR 'blond' is illustrated in Fig. 4. Further, when the initial stem contains a secondary movement and no other dynamic elements, such as the forms in (11c), the secondary movement still does not surface, resulting in a monosyllabic compound in these forms. The example SPEAK-NAME 'mention' is illustrated in Fig. 5.

These forms supply the evidence we need to show that secondary movement is less sonorous than handshape change or orientation change. On these grounds, secondary movement should be placed lower on the

- (11) Stage 1 re
Secondary
[[path2] =
- a. Second
st
- (i) RI
H
(ii) RI
BI
- b. Second
(iii) BI
SF
(iv) YI
H
(v) GI
GI
- c. Second
st
(vi) SP
N:
(vii) W:
RI

sonority scale than
change. The sonorit
is as in (12):

- (12) Sonority hi
path move
secondary r

I would like to pr
phonological reduct
might help explain

(11) Stage 1 reduction in compounds

Secondary movement deletion in compound initial stems
 ([path2] = [secondary movement])

a. Secondary movement cooccurring with handshape change

stem	features involved	locus of secondary movement	compound
(i) RED HAIR	[path2] [+periph],[−periph] [direction]	handshape change	RED-HAIR 'redhead'
(ii) RED BIRD	[path2] [+periph],[−periph] [+periph],[−periph] [−closed],[+closed]	handshape change	RED-BIRD 'cardinal'

b. Secondary movement cooccurring with orientation change

(iii) BLUE SPOT	[path2] [−prone],[+prone] [direction]	orientation change	BLUE-SPOT 'bruise'
(iv) YELLOW HAIR	[path2] [−prone],[+prone] [direction]	orientation change	YELLOW-HAIR 'blond'
(v) GREEN GROW	[path2] [−prone],[+prone] [direction]	orientation change	GREEN-GROW 'plant'

c. Secondary movement cooccurring with no dynamic element

stem	syllable peak	compound
(vi) SPEAK NAME	[path2] [direction]	SPEAK-NAME 'mention'
(vii) WATER RISE	[path2] [direction]	WATER-RISE 'flood'

sonority scale than path movements, handshape change and orientation change. The sonority hierarchy in ASL based on the evidence presented is as in (12):

(12) Sonority hierarchy

path movement > handshape change > orientation change > secondary movement

I would like to propose a syllable-driven analysis of the two stages of phonological reduction that occur in the compound lexicalisation that might help explain the variability in the forms of compounds, and make



change and a secondary movement of the disyllabic compound does not surface



and no other dynamic element of the compound SPEAK-NAME does not surface, resulting in a

single words never surface in a stem. This is shown in a secondary movement change in the initial stems does not surface in these 'is illustrated in Fig. 4. secondary movement and no in (11c), the secondary monosyllabic compound in 'is illustrated in Fig. 5. to show that secondary movement or orientation change. be placed lower on the



Figure 6

The stems GIRL (left) and SAME (centre) each contain a movement feature. In Stage 1, these forms would be expected to result in a disyllabic compound.

The description in Long (1918) supports my prediction. In Stage 2 of compound lexicalisation, in the compound GIRL-SAME 'sister' (right), the nucleus of the syllable in the first stem does not surface, resulting in a monosyllabic compound.

Illustrations of the signs in Figs. 6 and 7 are from T. Humphries, C. Padden & T. J. O'Rourke (1980), *A basic course in American Sign Language*, T. J. Publishers, Inc., 817 Silver Spring Avenue, Silver Spring, MD 20910, U.S.A.

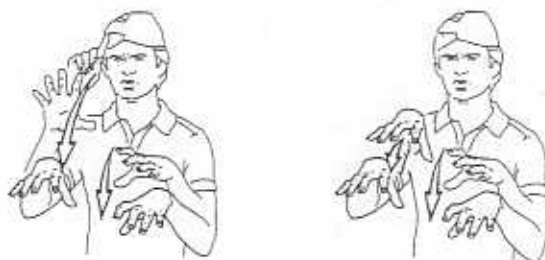


Figure 7

The stem THINK contains no dynamic element; therefore, the Stage 1 form of the compound THINK-FREEZE 'shock' (left) is monosyllabic. In the Stage 2 form of 'shock', no property of the first stem appears

predictions about what to expect for a compound of a particular phonological shape. The first stage of lexicalisation of compounds that I propose is the reduction of the first stem to the syllable nucleus alone, if the feature the nucleus is constructed on is sufficiently sonorous to sustain itself. While movement, handshape change and orientation change are sufficient to sustain a nucleus under the pressure to reduce in Stage 1, secondary movement is not. The types of reduction we might see at this stage are those seen in (11).⁹ The second stage of compound formation I would like to propose is as follows. For compounds surfacing as disyllabic in Stage 1, Stage 2 further reduces the first stem of the compound by completely eliminating the nucleus of the syllable contained in the first stem. For

compounds surfacing as disyllabic, the first stem does not appear in the Stage 2 form of compound format in Fig. 6 (it only appears in the Stage 1 form in Long (1918) we first illustrated in Fig. 7 (1990c), I argue that this should be realised as a syllable

(13) Stage 2 in:

a. Reduct

ste

(i) GI

SA

(ii) GI

M

(iii) M

M

(iv) M

SA

(v) RI

SI

b. Reduct

(i) T

FI

(ii) T

T

(iii) T

SI

In this section I have argued that the first stage of lexicalisation is the reduction of the first stem to the syllable nucleus alone, if the feature the nucleus is constructed on is sufficiently sonorous to sustain itself. In the second stage of reduction, only the handshape and orientation of the first stem surface as monosyllabic in Stage 2. These two stages are illustrated in the records on ASL (1)

compounds surfacing as monosyllabic forms in Stage 1 (11c), the entire first stem does not appear in Stage 2. Forms that have undergone this stage of compound formation are given in (13). GIRL-SAME 'sister' is illustrated in Fig. 6 (it only appears in a Stage 2 form synchronically; however in Long (1918) we find the Stage 1 variant); THINK-FREEZE 'shock' is illustrated in Fig. 7 in both Stage 1 and Stage 2 variants. In Brentari (1990c), I argue that the sign THINK undergoes a syllable repair in order to be realised as a single sign.

(13) *Stage 2 in compounds*a. *Reductions to forms that are disyllabic in Stage 1*

	stem	nucleus of syllable 1	compound
(i)	GIRL SAME	[tracing] [direction]	GIRL-SAME 'sister'
(ii)	GIRL MARRY	[tracing] [direction]	GIRL-MARRY 'wife'
(iii)	MALE MARRY	[periph],[periph] [-closed],[+closed] [direction]	MALE-MARRY 'husband'
(iv)	MALE SAME	[periph],[periph] [-closed],[+closed] [direction]	MALE-SAME 'brother'
(v)	RED SLICE	[path2] [+periph],[−periph] [tracing]	RED-SLICE 'tomato'

b. *Reductions to forms that are monosyllabic in Stage 1*

(i)	THINK FREEZE	no dynamic element in UR [+periph],[−periph]	THINK-FREEZE 'shock'
(ii)	THINK TOUCH	no dynamic element in UR [tracing] (continuative aspect)	THINK-TOUCH 'obsess'
(iii)	THINK SPECIFIC	no dynamic element in UR [direction]	THINK-SPECIFIC 'goal'

In this section I have shown that the pressure on compounds to conform to a monosyllabic form results in two stages of reduction of compound lexicalisation. I have proposed that, for disyllabic compounds, the first stage reduces the stem to the nucleus of the syllable alone; the second stage of reduction eliminates the nucleus of the syllable as well, leaving only the handshape and location of the first stem. In compounds that surface as monosyllabic in Stage 1, the first stem is entirely eliminated in Stage 2. These trends in reduction have been suggested by the historical records on ASL (Frishberg 1975; Klima & Bellugi 1979), but have not



n a movement feature. In
a disyllabic compound.
ediction. In Stage 2 of
SAME 'sister' (right), the
surface, resulting in a

F. Humphries, C. Padden
Sign Language, T. J.
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syllabic. In the Stage 2
stem appears

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ight see at this stage are
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g as disyllabic in Stage 1,
omponent by completely
ed in the first stem. For

been fully documented, given the small amount of historical material available on ASL. I have used structural variation in compounds to reconstruct stages in compound formation.

4 Conclusion

In both of the previous sections I have shown that the well-formedness conditions that organise distinctive features either to associate secondary movement to syllable nuclei or to reduce structures in compound formation utilise a sonority hierarchy. This sonority hierarchy can only be ascertained by assessing features within a local domain that is simultaneously organised. The timing of duration and stasis won't help in sorting out relative sonority in ASL, because orientation changes and handshape changes are not expressed in a single movement or non-movement segment; they are expressed over at least two segments. I have also shown that the appropriate unit for evaluating sonority is the syllable, since, in addition to containing a minimum of one of the dynamic properties in (12), it also explains organisational principles of these dynamic elements. By employing this simultaneous notion of the syllable we can explain how syllable peaks are chosen from among several simultaneously occurring dynamic elements, and we can establish a more detailed sonority hierarchy for ASL than was previously possible.

From these analyses we can conclude that perceptual salience underlies the notion of sonority for both signed and spoken languages. In future work, I will explore the possible ranking of individual distinctive features within the larger domains of path movement, handshape change and orientation change, for example, [tracing] *vs.* [direction] or [peripheral] *vs.* [closed]. At this point, my sonority hierarchy is language-specific for ASL, but I would not be surprised to find that certain features, such as [tracing] and [direction], are highly sonorous in all signed languages, just as [vocalic] and [sonorant] appear to be highly sonorous in spoken languages. This work develops a sonority hierarchy for ASL that shows that a sequential sonority curve is not universal, and that sonority is sensitive to the specific perception system used.

NOTES

- * I wish to thank the anonymous *Phonology* reviewers for their helpful comments on an earlier draft of this paper.
- [1] Perlmutter's Movements and Positions are described as feature bundles, not segments, so I have not included them here.
- [2] English glosses for ASL signs are given in upper case letters. When an expression contains words separated by hyphens, it is an indication that one ASL sign designates the whole expression. In glosses for verbs containing aspectual morphology, the aspect is shown in square brackets (e.g. QUIET [characteristic]).
- [3] Signs containing opening handshape changes often contain a redundant direction of movement away from some specified locus (e.g. INFORM, OFF-THE-POINT,

ADVISE); signs co direction of mov CATCH, MEMORISE

- [4] I suggest that the phonological word logical phrase, w space, specific ar
- [5] Sandler (this vo fortunately, her 1
- [6] [Wiggling] is a ty a single instantiat is related to hand
- [7] The form OVERSL by Corina (1993)
- [8] The small numb containing both a uncommon.
- [9] Stage 1 might be in Sandler (1987, stem of a comp assimilation (e.g.

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- ADVISE); signs containing closing handshape changes often contain a redundant direction of movement towards some specified locus (e.g. TAKE-ADVANTAGE-OF, CATCH, MEMORISE).
- [4] I suggest that the division of labour for syllable structure in ASL is between the phonological word, which is sensitive to simultaneous structure, and the phonological phrase, which is sensitive to sequential structure. Due to considerations of space, specific arguments will not be presented here.
 - [5] Sandler (this volume) argues for a sequential sonority cycle in ASL. Unfortunately, her piece was not available for me to consider it in my work.
 - [6] [Wiggling] is a type of secondary movement which has a less clear counterpart as a single instantiated dynamic property. Corina (1990b) has argued that wiggling is related to handshape changes, and I am accepting his account of wiggling here.
 - [7] The form OVERSLEEP [habitual] was first brought to my attention in this context by Corina (1993).
 - [8] The small number of forms in this section is due to the fact that ASL signs containing both a handshape change and an orientation change or movement are uncommon.
 - [9] Stage I might be further delineated, given the forms and assimilations presented in Sandler (1987, 1989). Compounds containing no dynamic elements in the first stem of a compound first undergo orientation assimilation and then total assimilation (e.g. THINK-SELF 'decide for yourself' has two forms of this type).

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