

1 INTRODUCTION

Signers or speakers of any language know things about the phonology of their native languages. Among the things they know is that the symbols of their languages have temporally ordered or sequenced parts. For example, English speakers know that [kip] and [pik] are two different, unrelated, words, just because the labial and dorsal gestures of the tongue are sequenced differently. They know that they need to store lexically whether the labial or dorsal gesture occurs first for those particular words.

On the other hand, they also know that some ordering in their language is fixed or constrained. For example, it will always be true that within an English syllable, [ipk], [ikp], [kpi] and [pki] are not possible sequences. Within an English syllable onset cluster, /s/ will precede any stop or liquid: /st/ but not /ts/; /sl/ but not /ls/. Within a segment, there is no such thing as an ‘anti-affricate’, that is, an affricate segment where the continuant feature precedes the stop feature (Lombardi 1990).

American Sign Language (ASL) signers know things about sequence in their language also. However, a lot of what they know can be thought of in terms of directions and not places, even though, physically, it must always be true that when an articulator such as a hand moves along a path, there is both a sequence of places, and a direction. If the hand moves in more than one direction, there can also be a sequence of directions. In this paper, I will be arguing that what a signer attends to

is the direction of a movement, and some but not all of the places moved through.

For example, a signer knows that the sign MY must be made by moving the hand *in*: beginning at a place in space in front of the chest and ending at a place on the chest. If they move *out* and *down*, starting with the place on the chest and ending with the hand at a place in space in front of the chest, it's not MY, it's ADMIT. Reversing the direction (and therefore reversing the sequence of places) changes the meaning of the sign.

Signers know that the directions of some signs are fixed by constraint, not lexically. For example, they know that signs that have two contacts on two very different parts of the body (such as face and trunk) must move *down*, which means that they must contact the higher area first. WOMAN must be made by moving the hand *down*: touching the face first, then the trunk. Signers know that the sequence of directions can also be fixed. For example, if a sign uses both hands in alternating *in* and *out* directions, as in the sign EXPLAIN, then the strong hand must begin by moving *out*.

Signers know that some signs have a fixed, lexical direction. For example, they know that GOAT must move *up* from the chin to the forehead, but SLEEP moves *down* the face.

Signers also know there are signs that don't have any fixed

direction. For example, the sign DEAF can move *down* from the ear to the jaw or *up* from the jaw to the ear - whichever direction it moves in doesn't change the meaning of the sign.

Signers know that there are signs where it isn't the direction, but the **sequence** of directions that doesn't matter. The sign DANCE moves back and forth across the weak hand palm, and can start by moving first either *tipward* (toward the tips of the fingers) or *heelward* (toward the heel of the palm) - whichever direction it moves in first doesn't change the meaning of the sign.

Signers know that for a lot of signs, moving in different directions means different things. But unlike ordinary minimal pairs for direction (such as MY and ADMIT) these signs have related meanings. For example, IMPROVE moves a hand *up* the other arm, and DETERIORATE moves *down* the arm. That is, step-wise motion on the arm (combined with a specific handshape and hand orientation) means a *change of state*. If the direction is up, it adds the meaning *positive, good*, and if the direction is down, it adds the meaning *negative, bad*.

How do people know/remember these things about the temporal order of elements, either segments or features within a segment? Given the theoretical entities of phonology (structures, constraints, and features¹), there are four possible answers to this question:

- (a) There is order in the structure: the roots are ordered or elements

- are on the same tier;
- (b) There is a phonological constraint governing order;
 - (c) The order we observe is merely phonetic. There is no underlying order;
 - (d) There is a feature from which order can be derived.

Option (a), structural ordering, has been used by autosegmental phonologists:

[kip] is different from [pik] because the roots of these three segments are structurally ordered in two different sequences.

Sagey (1986) claimed that affricates and prenasalized stops are contour segments that have two tokens of the same feature on the same tier and therefore, the two tokens are structurally ordered.

Option (b), phonological constraints, has been used:

McCarthy(1996) discusses a LINEARITY constraint. This requires that the elements of two structures in a correspondent relationship have the same precedence structure.

Option (c), merely phonetic ordering, has been used:

Lombardi (1990) claims that affricates are actually another form of complex, structurally unordered segments. The appearance of order in the surface form is a result of a phonetic requirement that only one order is allowed: stop precedes continuant.

Sagey (1986) argues that complex segments are structurally

unordered segments that have two place segments on different tiers.

Thus, within or across segments, phonologists have argued for options (a) through (c). However, to the best of my knowledge, no recent autosegmental phonologist has suggested that order could be derived from features (option d). For example, although a feature such as \pm rising could derive the surface order seen in some tonal sequences, such a feature has been explicitly rejected in favor of a structural ordering of high and low tones (Kenstowicz 1994 p. 314-315; Hayes, 1993).

In this paper, I argue that featural ordering (as well as constraint ordering and merely phonetic ordering) should be used in monomorphemic signs in ASL. I claim that:

- (a) Directional features are the best way to derive some places of a sign and account for many orderings of places in a sign.
- (b) A monomorphemic sign is a single segment,
- (c) A structurally ordered, multisegmental representation of a sign cannot correctly represent unordered signs like DEAF, or meaningfully reversing signs like IMPROVE and DETERIORATE.
- (d) Some cases of ordering are probably best explained as constraints,
- (e) Some signs are best explained as having only phonetic order and

no phonological order at all - not structural, not constraint-based and not featural.

The organization of this paper is:

- Section 2. The ASL data for direction in signs. Signs that reverse direction, signs that don't reverse direction, signs that have two directions.
- Section 3. My proposed representation of place and direction features for an ASL sign.
- Section 4. Interactions of direction and place features. How the proposed direction feature can be used to describe monomorphemic signs of various types.
- Section 5. A comparison of my monosegmental, structurally unordered representation and some multi-segmental, structurally ordered representations of a sign. Arguments against structural order within a sign. Arguments showing that fewer place features are required for a sign when direction features are used.
- Section 6. Arguments supporting a feature and constraint based representation.
- Section 7. Conclusion

Format and Notation Information

Appendix I contains definitions of some of the more common terms of sign linguistics which I use throughout the paper, such as *strong hand, contralateral, radial*, etc.

Pictures of many of the signs are also included in tables at the end. There is no accepted phonetic or phonological notation system for signs which would be easy to use, easy to understand, and appropriate for this paper. Glossing in capital letters is commonly used and I will use it here. With the addition of pictures, it will hopefully be adequate.

Translations are not given, since at the word level, the gloss of the sign is roughly equivalent to the meaning in ASL. When a gloss uses more than one English word for a single sign, the English words have hyphens between them, as in ALL-RIGHT or ALL-GONE.

2 DATA

This section lists all of the relevant data for ASL reversing directions that will be discussed at various other points throughout this paper. The data is all in one place so that by seeing all of the evidence together, the reader will get a better sense of the pervasiveness of this phenomenon.

In this section, I will speak of signs reversing (or not reversing) direction. Physically, or phonetically speaking, it must always be true that whenever a hand moves along a path, it has at least one direction and it moves through more than one place. Therefore, any such movement can be described in terms of either direction or places. Phonologically, some or even all of those places are not significant, and, as I will show, direction is not always significant either. In this data section, I will speak of all of the reversals as reversals of direction, and will avoid talking about places. Instead I will speak about contact points on the body, as a neutral way of recording the data, without committing to whether a specific place is actually phonologically significant or not. The drawback to this is that it may somewhat obscure the comparison with spoken language place sequences, but the gain in simplicity of exposition and in emphasizing my idea that directional features are a part of the representation, will hopefully outweigh this.

In ASL, reversing the direction that a hand moves in a sign can have different effects. Reversing directions can:

- Have no effect on the meaning of the sign;
- Reverse the meaning
- Produce an unrelated sign
- Produce an unacceptable sign

I also have data on what happens when a sign has two directions which alternate: bidirectional signs. As I will show, the two possibilities for sequencing bidirectional signs are:

- The initial direction is fixed by constraint
- Either direction may occur first

I will discuss in turn each of these possibilities with the relevant data.

When I use *direction* in this section, I will be referring to the common sense notion of a hand moving upward, downward, inward toward the signer, outward from the signer, or sideways (ipsilaterally or contralaterally). I will further discuss the idea of direction in section 3, where I discuss my proposed representation. When I use the word *reversing*, this can be understood to have the physical meaning that if a hand starts at place A and ends at place B, it *reverses* when it starts at place B and ends at place A.

This data was obtained in several different ways. Some was obtained from reading the literature of the field, and asking questions on the sign language linguistics listserv SL-LING. Some was obtained by looking through sign language picture dictionaries, including Costello

(1983), Sternberg (1981), Reikhehof (1985) and Hoemann (1973). I verified questionable data and obtained more data by consulting with various deaf signers, especially one native deaf signer whom I consulted regularly throughout this project.

2.1 **Reversing the direction has no effect on the meaning of the sign**

Several researchers (Liddell and Johnson 1989, Kegl and Wilbur 1976, Sandler 1989) have observed that some ASL signs can reverse without changing their meaning. This has generally been called *metathesis* (under the assumption that a sign is multi-segmental, and that what is reversing are segments).

Perhaps the best known example is the sign DEAF. It is signed by placing the hand on the ear and moving down to the chin (DEAF-ear-to-chin), or by placing the hand on the chin and moving up to the ear (DEAF-chin-to-ear). As Liddell & Johnson observe, DEAF-ear-to-chin `typically occurs immediately following signs produced in the higher facial areas`. They give as contrasting examples the two sentences:

1.

(f) FATHER DEAF-ear-to-chin

but

(g) MOTHER DEAF-chin-to-ear

`Father/Mother is deaf`

The sign FATHER contacts the forehead, while the sign MOTHER contacts the chin. Thus, the difference in where the preceding sign is made selects for the different directions in DEAF. If the preceding sign ends below the chin, DEAF will tend to move upwards; if above the ear, DEAF will tend to move downwards.

Table 1 lists examples of these reversing direction signs.

 Contact points (no particular order)

from Liddell & Johnson:

DEAF	chin; ear
HOME	chin; ear
PARENTS	chin; forehead
FLOWER	ipsi nose; contra nose
RESTAURANT	ipsi chin; contra chin
HONEYMOON	ipsi chin; contra chin
TWINS	ipsi chin; contra chin
BACHELOR	ipsi chin; contra chin
HEAD	hi side of head; lo side of head
CONGRESS	ipsi chest; contra chest
WE ₁	ipsi chest; contra chest
NAVY	ipsi waist; contra waist

In addition, I have verified the following:

EYES	ipsi eye; contra eye
BRIDGE	forearm near wrist; forearm near elbow
TOAST	palm; back of hand
GLOVES	ipsi hand; contra hand
FRIEND	ipsi index finger; contra index finger
JESUS	ipsi palm; contra palm
HAMBURGER	ipsi palm; contra palm
SLACKS	ipsi leg; contra leg
BOOTS	ipsi leg; contra leg

Except for PARENTS, which is a compound derived from MOTHER and FATHER, these signs are monomorphemic.

No change in meaning of these signs occurs whichever direction they are signed, and both forms are acceptable. This indicates that the forms have no underlying direction.

Classifiers for shape and size

Although I will not discuss these signs in detail, many classifier predicates² in ASL show a similar lack of phonological direction,

especially those classifiers concerned with describing the shape of entities. For example, when drawing a map in the air, the sign may begin at any phonetically easy point, and move in either direction along the perimeter of the imagined object being outlined. Another example would be describing the shape of an island. In each case, where the signer begins the shape is determined by phonetic ease, and there is usually more than one choice for where to begin. Changing the direction in which the hand moves does not change the meaning of the sign.

2.2 **Reversing direction reverses the meaning**

Unlike the above signs where direction could be reversed without changing the meaning of the sign, there is another very large group of signs where direction of movement is meaningful, and a change in direction produces a related change in meaning. The kinds of meanings will vary, but the following should give an idea of what is involved.

Table 2 lists examples of signs where a change in direction implies parallel change in meaning. For example, the sign IMPROVE moves the hand up the arm, while the sign DETERIORATE moves the hand down the arm. Not all of these signs move in exactly opposite directions, and not all share the same handshape within the group. However, the distinction in meaning within each set is based on the difference in direction.

For many of them, the reason why a particular direction has been chosen is iconically obvious. However, it is not true that all signs which could use an iconic direction do so. For example, the signs GOOD and SATISFIED which are positively valued, like HAPPY in the table below, uses a downward, not an upward, direction. Also, pairs of opposites do not always use reversing directions. For example, the signs CAN and CAN'T both have downward directions. The reversing directions of these pairs and groups must therefore be lexically stored in some way.

up

IMPROVE
APPEAR
UP
ABOVE
GAIN WEIGHT
EXCEED
NORTH
GROW-UP, TALL
HAPPY, EXCITE
LIGHT

up and out

EXPRESS-FEELINGS

down (sharply)

DECIDE
CAN

contralateral

WEST
LEFT

to center

NARROW
AGREE
JOIN
MARRY, WEDDING, MEET
SLAVE
DARK

in toward signer

AHEAD

approach body part

FOLLOW
ON
GOAL, TOWARD
NEAR
TOGETHER, WITH
ENTER, IN, INCLUDE
PARTICIPATE

*Handshapes are not identical

down

DETERIORATE
DISAPPEAR
DOWN
BELOW
LOSE WEIGHT
LESS THAN
SOUTH*
SHORT*
SAD, DEPRESSED*
HEAVY*

in and down

GULP-DOWN-FEELINGS

up and down

JUDGE
DOUBT, MAYBE, BALANCE*

ipsilateral

EAST*
RIGHT*

to side

BROAD
DISAGREE, ENEMY
DISCONNECT*
DIVORCE*
SAVE, LIBERTY*
LIGHT*

out (toward viewer)

BEHIND

go away from body part

AVOID
OFF
OFF-THE-POINT
FAR
SEPARATE
OUT, OUTSIDE
QUIT*

Time-values

Many of the signs pertaining to time use a time-line which runs from behind the signer to in front of the signer. Forward is equated to the future, and backwards to the past. Thus the signs FUTURE and PAST have the same handshape, but FUTURE moves forward in front of the shoulder, and PAST moves backward toward the shoulder. For each pair of these signs the handshapes are the same. **Table 3** lists a representative sample of these sign pairs.

Out toward viewer	Back toward signer
FUTURE	PAST
AFTER	BEFORE
TOMORROW	YESTERDAY
FAR-FUTURE	LONG-LONG-AGO
NEXT-YEAR	LAST-YEAR
2-YEARS-FUTURE, etc	2-YEARS-PAST, etc.
NEXT-WEEK	LAST-WEEK
2-WEEKS-FUTURE, etc	2-WEEKS-PAST, etc.

Agreement verbs

Many verbs move in directions associated with their indirect object and sometimes the subject. Thus, to indicate *I ask you* the hand moves from signer to viewer (2nd person), while to indicate *You ask me* the hand moves from viewer to signer. Padden (1988) gives a non-exhaustive list

of 63 such verbs, including GIVE, ASK, TELL, MOOCH-ON, and BORROW.

In the direction reversing signs discussed above (IMPROVE etc.), there are usually only two possible directions. For example, one sign moves *up*, its partner moves *down*, as in IMPROVE and DETERIORATE. With agreement verbs, directions will vary in as many different ways as there are possible subjects and objects. For example, I-GIVE-YOU, I-GIVE-HIM, YOU-GIVE-ME, YOU-GIVE-HER, SHE-GIVES-ME, HE-GIVES-YOU, SHE-GIVES-HIM would all have different directions.

Location verbs

There is a small set of verbs which are not classifier predicates (see below) but which incorporate location information by changing the direction of movement. Thus the sign GO-UP-BY-ELEVATOR moves the hand up, and the sign GO-DOWN-BY-ELEVATOR moves down. In the signs GO and COME, COME moves toward the signer, and GO away.

Classifiers for movement

For many classifier predicates, reversing the direction of the sign reverses the meaning of the sign. For example, I can use a classifier for flying in an airplane. By moving the classifier handshape from point X to point Y, where X represents San Diego, and Y represents Washington,

I can indicate that an entity, such as Kim, went from San Diego to Washington. If I reverse the direction, it would mean that Kim went from Washington to San Diego.

The point here, is that although classifier predicates are beyond the scope of this paper, meaningful reversal of directions is not an exceptional or marked phenomenon in ASL. It pervades the language.

2.3 **Reversing the direction produces an unrelated sign - Minimal pairs for direction**

There are some cases where reversing the direction of a sign produces a sign totally unrelated in meaning. Some examples are listed in **Table 4**. For example, the sign MY moves the flat unspread hand toward the chest; the sign ADMIT moves the flat unspread hand away and down from the chest. The sign ADOPT moves the hands up while closing the hands; the sign DROP moves the hands down while opening the hands. The sign GIVE-UP moves both hands up and toward the shoulders; the sign/gesture OH-GO-ON moves one or two hands down from the shoulder.

Most of these minimal pairs do have some slight variation in the form of the movement as well as the direction itself. For most of the outward moving signs, there seems to be both an outward and downward motion, while the inward moving signs have a simple toward gesture. As

will be discussed in section 4, it appears that most if not all signs that move toward the body, move in the simplest, phonetically easiest way, which is not necessarily in a line perpendicular to the signer's body. Signs moving out from the body, however, often move either up or down as well, and these directions are required.

	Direction of first sign	Direction of second sign
MY/ADMIT	in	out
MOTHER/VOMIT	in	out
FATHER/INVENT	in	out
GIVE-UP/OH-GO-ON	up/in	down/out
ADOPT/DROP	up	down
STAR/SOCKS*	up	down
WHAT/ONCE**	ulnar side of hand	radial side of hand
SOME/ ALL-RIGHT**	ulnar side of hand	radial side of hand
NICE/COVER**	finger tips	heel of palm
SATISFY/ LIMIT**	in	out
ALL-GONE/EARN***	finger tips	heel of palm

*(with hand orientation change also)
**Mentioned in Sandler (1989).
***Mentioned in Perlmutter (1990).

2.4 Reversing direction produces an unacceptable sign

Direction governed by constraint on Major Body Area

Do all signs permit reversing directions? The answer is no. First there is a group of signs which never reverse directions because they are governed by a constraint which requires downward movement. These are the signs which have two contact points on two different major body areas, such as face and trunk, or face and weak hand. Examples of these

	Contact 1	Contact 2
WOMAN	chin	center chest
MAN	center forehead	center chest
DAUGHTER	ipsi jaw	elbow
SON	ipsi forehead	elbow
WIFE	ipsi jaw	palm of weak hand
HUSBAND	ipsi forehead	palm of weak hand
TOMATO	mouth	index, weak hand
SQUIRREL	nose	fingers, weak hand
PICTURE	ipsi cheek	palm weak hand
LETTER	mouth	palm weak hand
FUN	nose	weak hand
NOTICE	ipsi cheek	palm weak hand
SECRETARY	ear	palm weak hand
DEAF(formal)	ear	weak hand
THANKSGIVING	chin	upper chest

non-reversing signs are listed in **Table 4**.

(Note that DEAF (formal) is a different sign from the DEAF listed in **Table 1**. DEAF(formal) contacts the ear/jaw area and then the hand moves down to contact the other hand. The unordered sign DEAF contacts the ear/jaw area and the chin.)

It is noticeable that all of these signs move downward, from a

higher place to a lower place³. Svaib (1992) observes that this appears to be a general constraint for compounds. She cites Wallin (1981)⁴ as claiming a similar tendency in Swedish Sign Language: if two signs have their place of articulation at different levels of the body (e.g., head and hand) then the sign with the highest level (head) will tend to become the first element in the compound (but not if both signs are signed at head level)'. Friedman and Battison (1973) made a similar claim that signs with double contact in ASL usually move from *head to trunk* or *head to arm* and not vice versa. They claim however that signs can move from *head to hand* or *hand to head*. Brennan (1990) and Schembri (1995) make similar claims for British Sign Language and Australian Sign language respectively, with the difference that *hand to head* is uncommon.⁵

I posted a question on the sign language linguistics listserv (SL-LING) concerning this claim about compounds and also asking about all signs that move between Major Body Areas. I received no response which clearly refuted this claim. The counter examples offered were generally of signs which did not actually make contact at two different Major Body Areas, or signs moving within one Major Body Area or signs which I deal with elsewhere such as IMPROVE.

My observation is that this tendency is not limited to compounds. Sign with two different contacts on the body on two different Major

Body Areas will move downward, (perhaps with the exception of hand to head). Although most signs crossing major body areas are compounds, there are a few, such as FUN and THANKSGIVING, which are not clearly compounds, but also move downwards. In other words, it seems that it may not be the derivational status of the sign, but rather the contacts on two different major body areas that triggers the constraint.

If this Major Body Area constraint on direction has been correctly formulated, then the prediction is that reversing direction signs across major body areas will not occur. This is confirmed by Liddell & Johnson (1989) who observe that signs crossing two Major Body Areas never metathesize (in my terms, never reverse directions). To the best of my knowledge there are also no meaningfully reversing signs (like IMPROVE) which cross Major Body Areas.

These signs (WOMAN etc.) are examples where the direction would not be part of the representation, as in the signs discussed above which have no direction (DEAF etc.). But unlike the DEAF group, instead of direction being decided phonetically and varyingly by the contact point of the prior sign, direction for these signs with two major body areas is governed by a general constraint.

Direction provided lexically

There are other two contact signs, some of which are given in **Table 6**, which also do not permit direction reversal. These signs appear

to require storing the direction lexically - that is, I find no constraint

	Contact 1	Contact 2	Direction
KING	hi contra chest ipsi waist		down, ipsi
CHRIST	hi contra chest ipsi waist		down, ipsi
WE ₂	ipsi chest	contra chest	contra
BODY	hi chest	lo chest	down
INDIAN	chin	cheek	up
BLOUSE	hi chest	lo chest	down
CHILDREN	ipsi space	ipsi space	ipsi
THING	ipsi space	ipsi space	ipsi
GOAT	chin	forehead	up

All except GOAT are from Liddell & Johnson (1989)

which would govern their direction.

Note that WE₂ is close to a minimal pair with WE₁ which is listed in

Table 1. WE₂ has a more pronounced curve and the orientation of the hand is different from that in WE₁, but the two contact points and the handshape are the same. They have slightly different meanings: WE₁ is a generic first person plural, while WE₂ means *you who are present in front of me and myself*.

No one that I am aware of has suggested a principled means of separating into distinct categories the reversing signs like DEAF and these non-reversing signs. It appears to be an arbitrary lexical fact that some signs reverse and some don't.

2.5 Bi-directional signs

If a sign moves in two different directions (a bidirectional sign⁶), how does the signer know which direction to move in first? Perlmutter (1990) gives two answers to this question: a) fix the initial direction by constraint, or b) let either direction occur first. He also claims that it never happens that a bidirectional sign has its initial direction determined lexically.

Initial direction is fixed by constraint

Perlmutter found that in many bidirectional signs there was a predictable initial direction. In MAYBE, for example, both hands alternate in moving straight up and down in front of the chest, and the strong hand always begins by moving downward. **Table 7** lists Perlmutter's examples of these signs, which I show with their fixed initial directions:

<u>Signs moving up and down</u>	<u>Initial Direction</u>
MAYBE	down
JUDGE	down
PROBLEM	down

Signs moving in to the center
and sideways:

COLD	center
AFRAID	center
DUAL-HIGHWAY	center

Signs moving in and out

EXPLAIN	out
CONVERSE	out
INTERVIEW	out
COMMUNICATE	out
CONTROL	out

Either direction may occur first

Perlmutter also found that in many bidirectional signs there was no required initial direction:

...[T]he direction of initial movement is irrelevant. Either direction is possible for the first movement, and two executions different only in the direction of initial movement are repetitions of the same sign....Thus there are no pairs of ... [bidirectional signs] in the lexicon that contrast only in the direction of initial movement. The direction of initial movement is predictable in some cases and irrelevant in others. (p. 79)

In DANCE, for example, the strong hand moves back and forth across the palm of the hand, and the strong hand may begin by moving toward the tip or toward the heel of the weak hand.

Table 8 gives Perlmutter's examples of signs which may start

moving in either direction:

	Directions - in no particular order
DANCE	tipward; heelward
PRACTICE	tipward; heelward
WASH	tipward; heelward
NEW-YORK	tipward; heelward
BUSY	tipward; heelward
SHORT	tipward; heelward
TRAIN	tipward; heelward
BATHE	up; down
ERASER	ipsi; contra
BABY	ipsi; contra
TOOTHBRUSH	ipsi; contra

Although Perlmutter does not mention what distinguishes bidirectional signs with a fixed initial direction and signs where either direction may be initial, from his examples and my own knowledge, it appears that the distinction is as follows:

- a) reversing direction: on the weak hand or other body place⁷
- b) non-reversing (fixed) initial direction: in neutral space.

2.6 Summary of ASL reversing data

I will summarize the data here, giving example signs or groups of signs in parentheses.

ASL has signs where reversing the direction:

- does not change the meaning of the sign (DEAF, some

classifier predicates).

- is not possible: signs of a certain group are governed by a constraint and must move in a specific direction (WOMAN).
- is not possible: signs are lexically specified for a certain direction (KING).
- reverses the meaning of the sign (IMPROVE/DETERIORATE, PAST/FUTURE, agreement verbs, locative verbs, some classifier predicates).
- produces an unrelated sign (MY/ADMIT).

ASL also has signs where reversing the sequence of directions:

- does not change the meaning of the sign (DANCE).
- is not possible: signs are governed by a constraint for initial direction (MAYBE).

3 REPRESENTING MONOMORPHEMIC SIGNS AS A SINGLE FEATURE-ORDERED SEGMENT

In this section I will discuss the direction and place features needed to describe monomorphemic signs as single structurally unordered segments.

3.1 General characteristics of a sign in my representation

I represent a monomorphemic sign⁸ as a single segment, as have Stokoe (1965), van der Hulst (1993), and others. Brentari (1993), Wilbur (1993) also represent a sign as a single unit, but their units appear to be segmentless syllables. Stack (1988) and Uyechi (1993) use a cell notation which seems similar to one or two segments with a maximum of two segments.

represent a sign-segment as being structurally unordered. There is no movement segment. Movement is not represented directly, although characteristics of movement, such as its direction, are. The novel feature of my representation is that I propose that the order of place features (and the lack of order), is a function of direction features, not of segmental structure. Order can be derived from the interaction of direction and place features, or can sometimes be derived by constraints on the members of the segment. In other words, I am proposing an

approach which has elements of both a simultaneous and a sequential approach, but with the sequential information carried by direction features, and not by segment structure.

3.2 Description of features

The two sets of features important for this paper are direction and place⁹. Both features are privative and on separate tiers (as are all other features). Some other features that I will mention or use occasionally are reduplication [redup], wiggling of the fingers [wiggle], and grazing [graze] - the hand makes a grazing contact with the place of articulation.

Much of the material discussing the hierarchical relationships for direction and place features will be relegated to appendix III. This is because the most important point of this paper is simply that directional features of some kind will explain a lot of facts in ASL. The precise nature of these features and their relationship to other features is not as important, although obviously, it is necessary that some kind of relationship be specified and that it describe the facts accurately. But if the specific hierarchical relationships were found to be different from what I have claimed, or the direction features needed to be specified differently, this would not invalidate the main point, that direction features should be used.

I use privative features for two reasons.

1. As will be explained below, if equipollent features are used, they establish a structural linear order for the tier they are on. But many ASL signs do not have underlying structural linear order, and equipollent features would be incorrect for them. There seems to be no reason to use equipollent features for some signs and privative for others, so therefore I use privative features for all signs.

2. Using equipollent features for places in ASL means that a value must be given to things like [-chin]. Furthermore, since ASL has many places, it would seem that if equipollent features are used, all places must be specified both positively and negatively. For example, a place such as *eye*, must be specified as: [+eye], [-forehead], [-ear], [-mouth], [-trunk], etc. Although it is possible to argue that direction features are equipollent and place features are privative, there would need to be positive evidence for such a duplication of effort, and this would still not avoid problem 1, the linear order created by equipollent features.

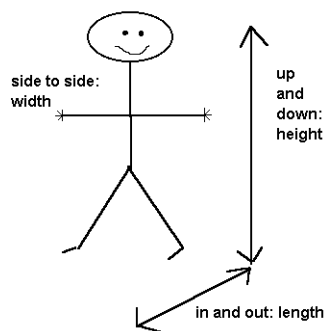
3.2.1 Direction

I follow a number of researchers in proposing some kind of direction feature, including Stokoe (1965), Friedman (1977), Brentari (1993), and Greftegreff (1992), although the details of these direction features may vary. Brentari and Greftegreff both propose direction features which have values for *toward* and *away*, which are not adequate

for the data discussed here, but may work better for agreement verbs and classifier predicates.¹⁰ Further study may well show that both the directional features that I have proposed AND the directional features proposed by Brentari and by Greftegreff are needed in some form.

There are two sets of Direction features: one set for signs made on the body or in space, and one set for signs made on the weak hand. I use a class node, Direction Plane, to handle some of the constraints used to sequence signs, as will be discussed below.

Body and space Direction features use three perpendicularly intersecting lines as referent points (see **Figure 1**). One line bifurcates the signer from top to bottom. A second line makes a right angle in front of the signer and runs along the ground. A third line is parallel with the arms when extended to the sides.



2.

Feature	Example
Class node: Height	
[up]	GROW-UP
[down]	GOOD; DEPRESSED
Class node: Length	
[in]	TAKE
[out]	GOOD
Class Node: Width	
[ipsilateral]	AND
[contralateral]	FALSE

For example, in GROW-UP, the hand will be positioned on the ipsilateral side of the body and will move straight up. The sign DEPRESSED will move the hands downward on the chest.

The second set of direction features is for signs where the weak hand is used as the place¹¹ where the strong hand is located. I use Liddell & Johnson's (1989) labels for these features, but their understanding of these features is quite different. They call these *spatial relationship* features for the weak hand, and claim that these are static features which describe the locational relationship between the strong and weak hand. I claim that these features tell the strong hand which direction to move in.

3.

Class node: **hand length**

[tipward] (toward fingertips) RESEARCH

[baseward] (toward wrist) COVER-UP

Class node: **hand width**

[toward ulnar] (little finger) side WHAT

[toward radial] (thumb) side ONCE

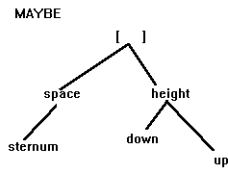
Class node: **hand height**

[palmward] (toward palm) OWE

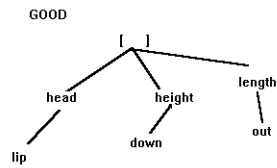
[backward] (toward back of hand) TOAST

For example, in RESEARCH, the strong hand moves tipward, that is toward the tips of the weak hand fingers.

I use the 6 Directional Plane class nodes: height, length, width, hand-height, hand-length and hand-width in order to provide a simple way to distinguish between signs with two non-opposing directions (such as [up] and [out]) as opposed to signs with two opposing directions (such as [up] and [down]). Non-opposing directions are under two different class nodes; opposing directions are under the same class node. **Figure 2** and **Figure 3** show how these two kinds of directions will be



represented.



Direction is represented as an independent element, not a dependent of Place, since I know of no clear justification for a dependency relationship. See Appendix III for some discussion.

3.2.2 Place and Major body area

A class node, Major Body Area, groups the various place

features¹². This node is based on Sandler's (1989) *place* feature except that I have added [space].

(4)

Major Body Areas:

head, neck, shoulder, trunk, arm, hand, space

I will use Liddell & Johnson's 18 body places (=their [location]) features and 38 weak hand places, listed below, with their abbreviations for each place. For the sake of clarity, I will use the full names of the places.

5.

Place =	Abbreviation	Example
back of head	BH	PONYTAIL
top of head	TH	HAT
forehead	FH	FATHER
side of forehead	SF	DEER
nose	NS	FLOWER, FALSE
cheek	CK	DEAF, HOME
ear	ER	EARRING
mouth	MO	EAT
lip	LP	HEARING
jaw	JW	DEAF, HOME
chin	CN	GIRL
neck	NK	THIRSTY
shoulder	SH	BOSS
sternum	ST	COUGH
chest	CH	FINE, KING
trunk	TR	MONKEY
upper arm	UA	POWER
forearm	FA	IMPROVE

abdomen	AB	RUSSIA, KING
leg	LG	DOG

6.

Weak hand places:

inside:	hand*, fingers, index, middle, ring, little
pad	fingers, thumb, index, middle, little
back	hand, fingers, thumb, ring
radial	hand, fingers, index, middle, ring, little
ulnar	hand, fingers, thumb
tips	fingers, thumb, index, middle, ring, little
knuckle	hand
base	hand
heel	hand
web	fingers, thumb, index, middle, ring, little

*The inside of the hand is the palm.

The reader is referred to Liddell & Johnson (1989) for a complete set of examples for each place, but a few of their examples are listed here:

7.

inside of hand:	OWE
pad of fingers:	EXCUSE
back of ring:	ENGAGED
radial side of index:	MONTH-AFTER-MONTH
ulnar side of hand:	HELP
tip of little finger:	PREPARATORY STUDENT
knuckles:	GAME
base of hand:	FOLLOW
heel of hand:	PAPER
web of middle:	START

3.2.2.1 Signs made in space

Many signs do not contact the body but are made near some body part. For monomorphemic signs, it will be sufficient to list the Major

Body Area as [space] with the place specified from the list above. For example, YEAR, which is made in space in front of the chest, will have a Major Body Area of Space, and place of [chest].

3.2.2.2 IC and TB

IC and TB specify the side to side and up and down dimensions of a place more exactly. This is similar to Liddell & Johnson's diacritical markings for locations.

IC features are:

(8)

Ipsilateral (=ipsi)	FLOWER, BORING
Contralateral (=contra)	COP, FLOWER, KING

TB features are:

(9)

Top	HEARING-AID
Bottom	CALIFORNIA

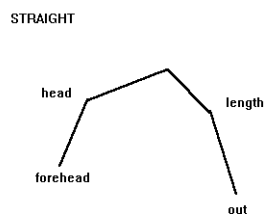
If no value for IC is listed, then the place is neither ipsilateral nor contralateral, and therefore it is centrally located. For example, the sign KID is centrally located on the nose. If no value for TB is listed, then the place is assumed to be central. For example, the sign HEAR is centrally located on the ear. On the weak arm, [top] can be interpreted as the upper surface of the wrist, elbow, forearm or upper arm, and [bottom]

is the under surface of these areas. I will tentatively consider that IC and TB are dependents of place. See Appendix III for some discussion of these dependencies.

4 Implications and functions of features

4.1 Deriving places and order of places from directional features

A direction feature is a command to move the hand in some direction. For example, in the sign STRAIGHT (**Figure 4**), there is one direction: [out], and one place: [forehead]. Therefore, STRAIGHT is performed by moving the hand out from the forehead¹³. In the sign MY (**Figure 12**), the direction is [in] and the place is [chest]. Therefore the hand is moved inward to the chest¹⁴.

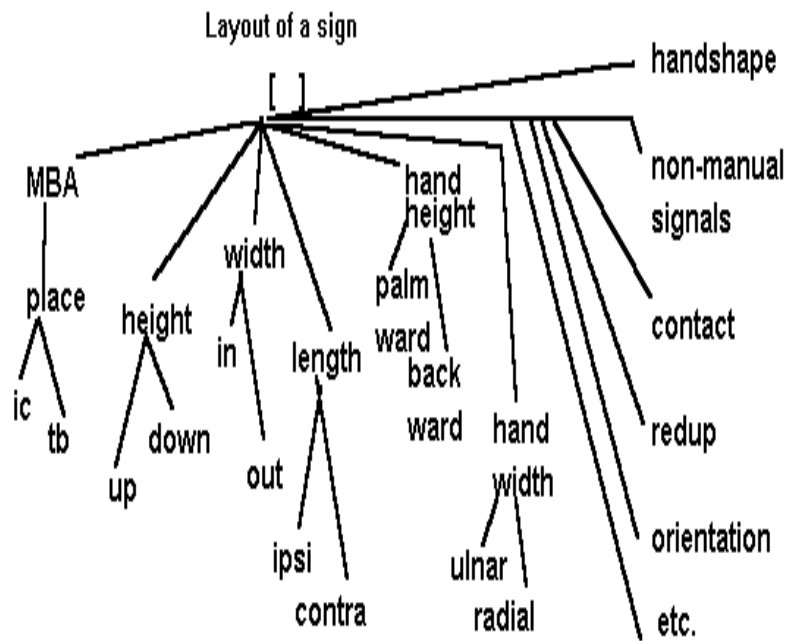


Direction is also a feature from which the order or sequence of

places in two-place signs can be derived, as in the sign GOAT (**Figure 9**). Since GOAT has two places, [chin] and [forehead], the sequence of these places can be determined from the direction [up]. Since the hand must move *up*, then it follows that the hand must be at [chin] before it moves to [forehead].

4.2 Layout of complete sign structure

Figure 5 shows a suggestion for an autosegmental structure of a sign. Since I am here discussing only place and direction, all other features must be considered tentative, although all of the features shown are commonly accepted features for a sign. Not all details are included - for example, there are many dependent features of a handshape. The picture is included here to give a better idea of the general notion of a monomorphemic sign as a single segment. The root of this representation is empty.



4.3 Table of kinds of signs

The following table shows that both the number of directions and the number of places in a sign can vary:

	0 Places	1 Place	2 Places
No Direction	RIGHT	MOTHER	DEAF WOMAN
1 Direction		IMPROVE FALSE RESEARCH	GOAT
2 Directions		MAYBE GOOD	KING DANCE

I will discuss each of the direction-place groups below, starting with the simplest and probably most common group, the one direction signs. Next I will discuss two-direction signs, followed by signs with no direction.

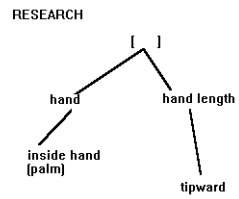
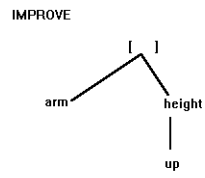
4.4 One-direction signs

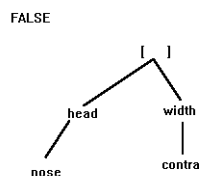
4.4.1 One-direction, one-place signs: FALSE, IMPROVE, RESEARCH

Signs with one direction and one place are one of the most common type of sign (the other common group is signs with no direction

and a single place--see below). Three examples of representation are **IMPROVE (Figure 6)**, **RESEARCH (Figure 7)** and **FALSE (Figure 8)**. Probably all of the signs with meaningful reversals (IMPROVE/DETERIORATE etc.) fall in this group¹⁵. In some cases, but not all, one-place, one-direction signs reduplicate, using transitional movements to return the hand to the starting position (as in **FALSE** and **RESEARCH**). **RESEARCH** is of interest as a near minimal pair with **DANCE (Figure 10)**, to be discussed below.

Sandler (1989) observes that the most common sign in her representation is an LML sign, a sign with two place segments (locations) and a movement segment. In my system most such signs usually become a sign with one place and one direction, where the direction will determine the other place of Sandler's representation (see section 4 for further discussion of the distinctions between Sandler's representation and mine).





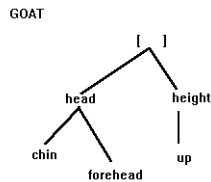
4.4.2 One-direction, two-place signs: GOAT

A much less common type of sign is one with 1 direction and 2 places.

In examining over 1000 signs in Costello, I found only about 20 non-reversing signs that had two contacts on the same Major Body Area.

(Signs with contact on two different Major Body Area, which are also not common, are not in this group since they have no underlying direction.)

If a sign has two places, then the order of the places will be determined by the direction, as discussed above in 4.1 . **Figure 9** shows my representation of GOAT.



4.5 Two-direction signs

How are the two Direction features sequenced? The three possibilities are:

- (a) simultaneously ordered
- (b) sequentially ordered
- {c} pronounced sequentially but not ordered underlyingly

What happens depends on whether or not the two directions are opposing or non-opposing.

Opposed directions

Two opposed directions are impossible to interpret simultaneously: a hand can't be moved simultaneously up and down, for example. Therefore, the directions must be either unordered, or ordered by a constraint. Both seem to occur. As Perlmutter (1990) has shown, signs which move up and down like MAYBE (**Figure 2**), in and out like EXPLAIN, or ipsi and contra like COLD have a constraint which

requires that the strong hand first moves down, in, or contra, respectively. On the other hand, cases like DANCE (**Figure 10**) are examples of two unordered opposed directions - either direction can occur first.¹⁶

Non-opposing directions

Non-opposing directions, on the other hand, **can** be performed simultaneously, and it seems that they generally are. For example, if Direction = [out] and [down], then there will be an outward and downward movement, as in GOOD(**Figure 3**). I suggest, that by the nature of a single segment structure, there is a constraint on all features which says `Be simultaneous`. Only when this becomes impossible, as with two opposing directions, like up and down, will non-simultaneous movements occur, which must be either unordered or constraint ordered.¹⁷

4.5.1 Two-direction, one-place signs: MAYBE, DANCE, GOOD

This is a common sign type.

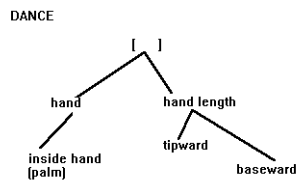
RESEARCH (**Figure 7**), a one-direction, one place sign mentioned above, DANCE (**Figure 10**) and MAYBE (**Figure 2**) form an interesting comparison. Aside from a slight difference in handshape (RESEARCH crosses the middle and index, DANCE does not),

RESEARCH and DANCE differ only in that DANCE is a bidirectional sign and RESEARCH is a unidirectional sign.

All three are reduplicating path signs. MAYBE, like DANCE, is also a bidirectional sign, with two underlying opposed direction. The directions of MAYBE are sequenced by a constraint. Because DANCE has two unsequenced directions, the sign can begin at either the tip or the base of the hand. RESEARCH which has only one direction, will always begin at the base of the hand, and in order to reduplicate, an transitional movement is inserted to return the hand to the base.

For MAYBE, the constraint says, `Go down first`. For RESEARCH, one needs to assume a constraint of the form `Begin with the underlying direction.` For DANCE, there is a constraint saying something like `Exhaust all directions before repeating, and continue repeating in the same pattern as the initial cycle.` (This would prevent sequences such as tipward, baseward, baseward, tipward, or tipward, tipward, baseward, baseward. That is, repeating sequences may only be of the form ab, ab, ab... or ba,ba,ba... and not ab,ba,ba... or aabb, etc)

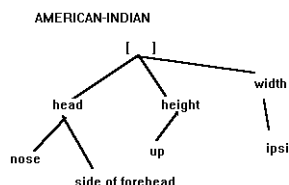
One-place signs with opposing directions generally have reduplicated paths.



4.5.2 Two-direction, two-place signs: INDIAN, KING

Two direction and two-place signs are quite rare. I know of less than 15 such examples, and a number of these (KING, CHRIST, QUEEN, EMPEROR, LORD, PRINCE) are the same base sign with different initialized handshapes. In all of these cases, the two directions are non-opposed, and occur simultaneously. As discussed above for GOAT, a one-direction, two-place sign, the two direction features will determine which place is first and which is second.

The representation for INDIAN is shown in **Figure 11**.



4.6 No-direction signs

If there is no direction feature, there is either no direction, or a default, uncharacterized motion toward whatever place or places have been specified.

Many signs have no specification of direction. This is of course true of all signs that reverse without a change in meaning, such as DEAF, but it is also true of many other signs as well, as will be discussed below.

It is also true that many signs can have one movement which has a directional feature, and another, transitional movement, as in RESEARCH. In many signs, there are one or more transitional movement(s) required to move the hand to the specified place (see Stack 1988, Perlmutter 1990, Liddell 1990). But the movement in itself has no features, including no features for direction, because the movement is not in the underlying representation at all. Any sign without path movement

(such as COLOR) will have no direction. Circular signs have no direction¹⁸. Signs whose direction is given by a constraint will not have an underlying direction. (But note that signs for which the sequence of directions is given by constraint (such as MAYBE) will still have underlying directions.)

4.6.1 **A no-direction, no-place sign: RIGHT**

The sign RIGHT or CORRECT, which Costello(1983) represents as the strong hand moving down to contact the weak hand, is actually a sign that can occur on almost any convenient part of the body or furniture, not just the weak hand. The strong hand must move toward (and contact) some body part (thigh, chest, arm). Since the sign can move in any direction toward any body part, an underlying direction or place would be incorrectly specific. Phonetic and social factors will prevent contacting on the face, or on taboo areas of the body, or on parts of the body that are not reachable or not visible. It should be said, however, that this is the only sign that I know of that has neither direction nor place.

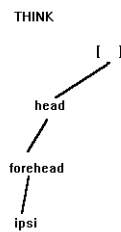
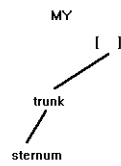
4.6.2 **No-direction, one-place signs: MOTHER**

These one-place and no direction signs are not ordered, since they have no direction feature, but because of the simplicity of their structure,

they appear to be ordered on the surface.

Signs like MOTHER(**Figure 14**), MY (**Figure 12**), THINK (**Figure 13**), etc., are like RIGHT in that they also do not have a direction feature. However, they do have a place, and they move toward this place in the phonetically easiest way, depending on where the hands were at the beginning of the sign¹⁹. The hand is not required to move in a particular pattern. If we claimed that these signs have a direction, it would be contrary to the fact that the hand can move in various unemphatic forms toward the body part.²⁰

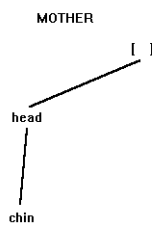
For example, in a phrase such as PRAISE MOTHER, since PRAISE is articulated at chest height on the contralateral side, then the hand can approach in an upward, ipsilateral direction to contact the chin for MOTHER. If the phrase were HEAVEN MOTHER, then since HEAVEN ends with the hands above the head directly above the chin, then the hands can approach the chin for MOTHER in a downward direction. The hand does not need to move first to some specific place a few inches out from the chin, and perpendicular to it. The meaning of the movement is not in its direction, but rather that the hand must contact the chin in the phonetically easiest way.

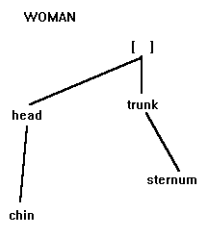
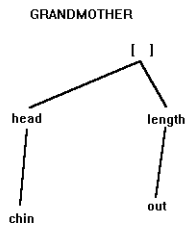


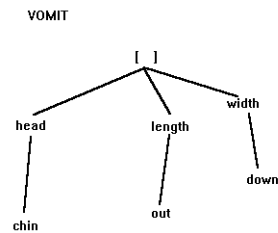
A set of almost minimal pairs can be seen with MOTHER (Figure 14), VOMIT (Figure 17), GRANDMOTHER (Figure 15), and WOMAN (Figure 16). All of these have the same handshape as MOTHER²¹. However, VOMIT has two directions: [down] and [out]. While the sign MOTHER can approach the chin from various directions,

the sign VOMIT must move away from the chin in an downward and outward, not an upward direction. The outward component of VOMIT can be seen by comparing it with WOMAN which also moves downward from the chin, but not outward. The one handed form of the sign GRANDMOTHER moves out from the chin with a double arcing motion. **Table 10** below and the figures shows the distinctions:

	Place	Direction
MOTHER	[chin]	none (therefore toward place)
GRANDMOTHER	[chin]	[out] (in double arc)
VOMIT	[chin]	[out],[down]
WOMAN	[chin],[chest]	down by constraint







None of these signs, as can be seen, is a true minimal pair for direction with MOTHER. That is, none of these are a sign with one place, and one direction, and everything else exactly the same.

GRANDMOTHER has a distinction in movement shape (which I do not discuss in this paper) as well as direction; VOMIT has two directions; and WOMAN has two places and two different Major Body Areas.

However, as near minimal pairs, they may help to show that direction or the absence of it, can be phonologically significant.

The distinguishing characteristic of these signs without direction is that they will move toward the underlyingly specified place from any phonetically possible and easy/economical direction. The direction will depend on the last place of the preceding sign.

4.6.3 No-direction, two-place signs: DEAF, WOMAN

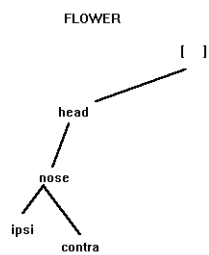
Some no-direction, two-place signs are not only underlyingly unordered, but they also appear on the surface to be unordered. Either place can occur first. These are the signs which Liddell & Johnson call metathesizing signs, and which form the primary basis for my rejection of a structurally ordered or multisegmental representation (see Section 5 on problems with structural order). In my representation, the lack of order for these signs is represented by a lack of directional features. Since no direction or constraint orders the places, either order can occur on the surface, depending on phonetic factors such as ease of articulation or the last place of the prior sign.

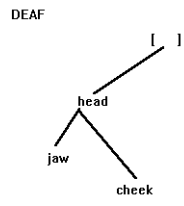
Phonetic Order Only

No direction, two-place sign most commonly have an ipsi and contra place, as in FLOWER (**Figure 18**) (ipsi and contra nose), RESTAURANT (ipsi and contra chin) and WE (ipsi and contra sternum). However, other kinds of no direction, two-place signs occur such as DEAF (**Figure 19**) and HOME (jaw and cheek) or HEAD (top and bottom side of head), or between two similar body parts (right and left eyes, hands, or legs, as in EYES, JESUS, and PANTS). None of these signs reduplicate as long as they actually have two places. However, in at least one sign, HOME, a version with one place does occur, and this version will reduplicate.

Constraint-Ordered

A second set of no direction, two-place signs are compound-derived signs such as WOMAN (**Figure 16**) which cross a Major Body Area. For these signs, although there is also no underlying direction, surface order of places will occur because of the constraint which requires all such signs to move downwards.





5 **COMPARISON OF A MULTI-SEGMENTAL,
STRUCTURALLY SEQUENCED REPRESENTATION
AND A MONOSEGMENTAL, FEATURE-ORDERED
REPRESENTATION**

It may be helpful at this point to look at a few examples of a multi-segment, structurally-ordered representation and my proposed single-segment, feature-ordered representation.

The best known multi-segmental, sequential representations of a sign are those proposed by three different groups of researchers:

- Johnson & Liddell (1984), Liddell (1984a, 1984b, 1990, 1993), Liddell & Johnson (1986, 1989)
- Sandler (1989, 1993a, 1993b)
- Padden and Perlmutter (1987), Perlmutter(1990, 1992, 1993)

In Appendix II, I list the movement and place features in Liddell & Johnson's and Sandler's representation. I will not discuss Perlmutter and Padden in detail here, since they do not give the features for their representation (they are mostly concerned with the supra-segmental part of the sign). All three of these representations agree that the vast majority of signs are multi-segmental, and that one segment type is movement. They each have two different kinds of segments (sometimes

compared to consonants and vowels):

- Liddell & Johnson: Movement (M) and Hold (H)
- Sandler : Movement(M) and Location(L)
- Perlmutter and Padden: Movement(P) and Position (P)

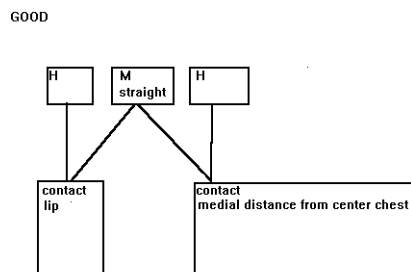
The representations shown below are adapted from drawings in Liddell & Johnson (1989) and Sandler (1989). The adaptations are to remove features not needed for this discussion, such as handshapes or hand orientation, or sometimes to add numbers to features or segment to identify which element is being discussed (as in **Figure 20**, for example).

As I discuss the differences between their representations and mine, I will also point out some problems with structural order.

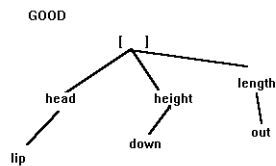
GOOD in Liddell & Johnson's representation and mine

In GOOD, the hand moves from the lip downward and outward to end in space somewhere out from the chest. The representation of GOOD by Liddell & Johnson is shown in **Figure 20**. GOOD has three places: the lip, the chest, and a dependent place: a medial distance out from the chest. GOOD contacts the lip and the spot a medial distance out from the chest; it does not contact the chest²². GOOD has three segments: an initial hold at the lip, a movement from the lip to in front of

the chest, and a final hold in front of the chest. GOOD is structurally ordered: the hold at the lip occurs first, and the hold in front of the chest occurs last, and we know this because the Ms and Hs form a root node tier.



In my representation (**Figure 21**), GOOD is a sign with one segment, one place and two directions. The final place is derived from the directions operating on the place: if the hand begins at the lip and moves a comfortable distance both downward and outward, it will automatically arrive at a place “a medial distance out from the chest”. For example, it will not end up at the ipsilateral side, since no ipsilateral direction was given. It will not end up at the feet, because this distance



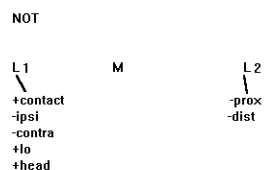
would be more than the natural motion of the joints of the arm.

NOT in Sandler's representation and mine

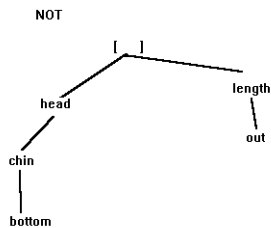
Sandler does not give a representation of the sign GOOD, but she does show a similar sign, NOT (**Figure 22**). NOT begins with a contact under the chin and moves outward. The representation has two places: an initial place where the hand is in contact with low center head (the chin), and a final place that is a medial distance (-proximal, -distal) out from the low center head. NOT has three segments: an initial location at the chin, a movement from chin to in front of the chin, and a final location out from the chin. It is structurally ordered so that the chin place in segment L1 must occur before the place a medial distance out from the chin in segment L2, because there are three root nodes.

Notice that in a representation without directions, NOT must

have at least two places, since if only a movement and a place at the chin were specified, the movement could occur in any direction, instead of only out in front.



My representation of NOT (**Figure 23**) has a single segment, a single place, and a single direction, with the final positioning of the hands at a point out from and in front of the chin derived from the direction (out) and the underlying place (chin).



In both GOOD and NOT (and many others) I claim that there is a single place and a single segment, but both Liddell & Johnson and Sandler claim multiple places and multiple segments.

How many places?

Support for the idea that these signs have only one underlying place comes from Liddell (1990), who observes:

The sign MY, for example, begins by moving toward the chest and ends after it contacts the chest. During the course of its movement the hand traverses several inches of space on its way to the chest. The path taken by the hand could be described mathematically as being composed of an unbounded number of separate points. But it seems necessary to specify only a single locus as being linguistically significant in the production of this sign. That locus is the point on the chest that the hand contacts.

Viewed in this way the production of the sign MY can be described as beginning its movement ahead of that body locus and ending its movement in contact with that body locus.

Fuzzy end points; non-distinctive distances

I would also argue that in many cases places should not be underlying because they are actually somewhat indeterminate places which are determined by the direction of the hand and the natural length of a line traced by the movement of the wrist, elbow, and/or shoulder. For example, the place at the chest in GOOD should not be underlying because although the hand often ends up in front of the chest, the hand can also move so short a distance that it ends up in front of the neck or chin. The length of the arm and physical ease give a measurement of distance which, when combined with direction, produces a fuzzy endpoint. Thus even the most energetic signer cannot move beyond the point reached by a fully extended arm. Physical ease generally shortens this to a medial (or even proximal) distance. Furthermore, the interplay between physical ease and emphasis means that a sign like GOOD can be produced using movement from the shoulder, from the elbow, or from the wrist, or various combinations of these movements, without changing the meaning of the sign.²³

I know of no minimal pairs where two unrelated signs are

distinguished solely by the length of the movement or line traced.

Distinctions in the length of the movement appear to be used only as forms of emphasis. For example, for a single signer, in a specific situation, GOOD with the hand moving only slightly away from the mouth could mean *good*; GOOD moved a medial distance could mean *very good* and GOOD at a distal distance could mean *VERY VERY GOOD*. For another signer, GOOD at a distal distance might be the norm, or GOOD at a proximal distance could mean *good*. Although these are meaningful distinctions, they should not be considered minimal pairs in the sense that these distinctions are part of the underlying featural representation. These are distinctions similar to *Good* and *GOOOOOOOOOD*, or *good* in a whisper and *good* shouted in spoken English. They are analog distinctions of emphasis; not featural distinctions.

Greftegreff (1992) remarks

Provided that the hand moves toward the forehead the actual starting and ending points of the movements in NTS [Norwegian Sign Language] TRO ... are relatively insignificant. This allows for sign variants with a very long movement, as well as for articulations with a very short movement. [The Norwegian Sign Language sign TRO means “believe/know”. The index finger moves toward, and sometimes contacts the side of the forehead. The sign is similar, if not identical, to the ASL sign THINK.] ...I have not been able to find any pair of lexical signs that can be used to establish the distinctness of the positions described by the features *distal*, *proximal* or *contact*. On the contrary, in regular lexical signs at least, it appears that these positions are non-distinctive.... The most straightforward explanation for this is *contact and distance features are non-significant*, as long as the

directionality and the *location* of the articulation is indicated successfully [author's italics].

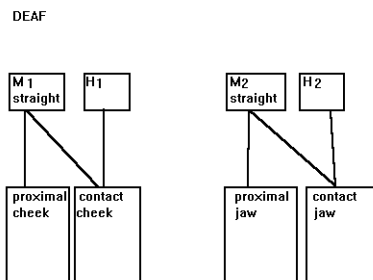
Greftegreff's article concerns both ASL and Norwegian Sign Language and her comment covers both languages. (Her directionality feature is different from mine, and more like Brentari's, but the point that directionality is significant and length is not remains valid for my proposal as well.)

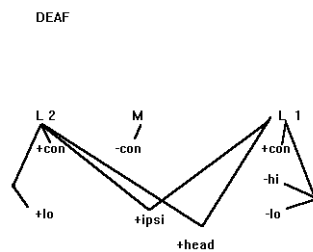
Any sign that moves along a path will have an uncountable number of places, but as Liddell says, not all of them are significant. Most of them can be interpolated, and I claim that many more can be interpolated than has been thought, if we allow for direction features.

Problem: Segments imply order, but some signs are unordered

A serious problem with any multi-segmental, structurally ordered representation is that it cannot handle signs like DEAF which reverse places without changing the meaning of the sign. Following McCarthy (1989), Archangeli (1985) and others, I assume that a structurally ordered autosegmental representation is ordered because it has an ordered set of root nodes: "Segments are ordered in virtue of a linear sequence of `skeletal' positions or `timing slots,'" (Kenstowicz 1994 p.152). For example, in a multi-segment syllable such as /kip/, *k* will precede *p*, by virtue of the three skeletal positions.

Although Liddell & Johnson, Sandler, and Perlmutter all allow for a few single segment signs, they all agree that most signs, including underlyingly unordered signs like DEAF, FLOWER, PARENTS, WE₁, etc. are multi-segmental. For example, **Figure 24** shows Liddell & Johnson's representation for DEAF²⁴, and **Figure 25** shows Sandler's representation of the same sign.

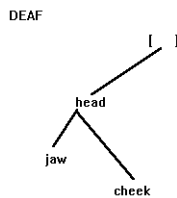




DEAF is considered a sign that is either three or four segments long. Since it has more than one segment, we know that the representation is structurally ordered. In Liddell & Johnson's representation, the segments M_1 and H_1 precede the segments M_2 and H_2 . But because DEAF is an unordered sign, it is also true that M_2H_2 can precede M_1H_1 . This means that the representation includes information that is not just redundant, but incorrect. Similarly in Sandler's representation of DEAF, the notation claims that the L_1 segment precedes the M segment which precedes the L_2 segment, but it is also true that L_2 can precede the M segment which can precede the L_1 segment. The same problem will occur for any multi-segmental representation of any unordered sign.

As can be seen (**Figure 26**) my representation of DEAF avoids these problems and shows DEAF as a sign with two unordered places. Although I **can** represent order by using direction features, my

representation can also represent a lack of order, simply by omitting the direction feature, as is done here.



Problem: Multiple tokens of a feature within or across a segment also imply order

Features within or across a segment may also be structurally ordered if they are on the same tier. Following Archangeli (1985), “Tier” refers to plane-internal sequences of matrices parallel to the core skeleton. So, for example, a segment with two values of a binary feature such as +cont and -cont will necessarily order these features.

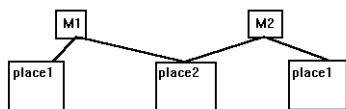
Both Liddell & Johnson and Sandler have repeated tokens of the same feature on one tier (across segments), because their features are either equipollent or multivalent. Even if their representations were changed to single segment representations, they would still have a problem with

tier ordering for these signs, unless they used privative features for places. Since I use only privative features, this is not a problem for my representation.

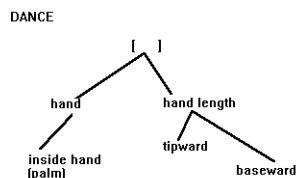
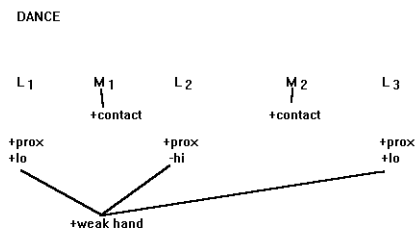
A direction sequencing problem with bidirectional signs like DANCE

Sequencing problems also occur with bidirectional signs like DANCE. For Liddell & Johnson²⁵ (**Figure 27**) and Sandler (**Figure 28**), this is a multi-segment sign with multiple place specifications. In

DANCE - Liddell & Johnson



my representation (**Figure 29**), DANCE has two unordered directions.



As can be seen in the drawings, both Liddell & Johnson and Sandler show DANCE as a structurally ordered sign: M1 must occur before M2; Place1 must occur before place2; L1 must occur before M1 and M1 must occur before L2, and so on. But as I discussed in section 2, Perlmutter showed that these signs are not ordered in terms of which

direction occurs first, or, in Liddell & Johnson's and Sandler's terms, which movement or place occurs first. A structurally ordered representation therefore incorrectly represents order when order is not underlyingly present. My representation of DANCE, by using two unsequenced direction features, allows for a lack of underlying order.

Redundant information in the lexicon - MAYBE and WOMAN

Following Kiparsky (1982), I assume that redundant information should not be stored in the lexicon. However, for a number of signs, a structurally ordered representation has redundant data in the lexicon for order. As I discussed in section 2, Perlmutter has shown for signs like MAYBE, and Svaib and others have shown for signs like WOMAN, that the order in these signs is predictable. Bidirectional, two-handed signs made in space always begin by moving down (MAYBE), out (EXPLAIN) or contra (COLD). Signs that cross Major Body Areas always move downward. Since this information is contained in a constraint, it is unnecessary to list it also in the lexicon. My representation, because it is a single segment, does not need to include this information for these signs, but structurally ordered representations must necessarily and redundantly include this information.

6 ARGUMENTS SUPPORTING A MONOSEGMENTAL, FEATURE-ORDERED REPRESENTATION

In the preceding section, I have given arguments to show that there are serious problems with a structurally ordered, multi-segmental approach to a sign. In this section, I give a number of arguments to support the idea that a monosegmental, feature-ordered representation is possible and desirable.

6.1 Information bearing capacity of a signed segment

How is it possible for all monomorphemic signs to be a single segment when in spoken languages there are only a few single segment words in any language? The answer is that there are far more distinct features in a sign. The number of possible combinations for a sign greatly exceeds the possible combinations for a spoken language segment.

A sign has 56 distinct places, and 2 values each for IC and TB. Liddell & Johnson (1989) claim there are more than 150 distinct hand configurations. There are at least 6 palm orientations, at least 3 different types of contact, and 12 directional features, and this does not exhaust the list of significant distinctions. The possible combinations of these features alone exceed 7 million.

Brentari's (1990) representation lists 20 sets of features, of which many are multivalent. For example she has a 16 value place feature, and

a 10 value feature for non-manual signals. There are about 19 billion possible combinations for her feature system.

The number of features in spoken languages is much smaller. Halle (1992) proposes a set of 18 binary features (plus 9 nodes, which I ignore here since the equipollent terminal features fully determine the possible unique combinations). These produce 262,244 (2 to the 18th power) possible combinations.

Thus, a signed segment has millions to billions of possible combinations of features, while a spoken segment has thousands of possible combinations. Obviously, due to many constraints on these combinations, not all combinations are instantiated for either spoken or signed languages. Still, it seems that there is more than one order of magnitude of difference between spoken and signed segments. A spoken segment may simply not have sufficient information carrying ability to function as a complete symbol, but it would seem that sign segments do. Therefore, although structurally, a sign segment resembles a spoken segment, in terms of information bearing capacity, the sign segment is more similar to a spoken word than to a spoken segment.

6.2 Directional features as morphemes instead of structural order as morpheme

Another advantage of a direction-feature representation is that

certain directional morphemes are represented more similarly to well attested spoken language morphemes. As I discussed in the data section, for many pairs or groups of signs, the direction of movement is clearly meaningful or morphemic. For example, in the signs IMPROVE and DETERIORATE (**Figure 32** and **Figure 33**), the upward or downward motion of the hands carries the meanings *positive* and *negative* respectively, while the handshape, stepwise motion and place combined mean *a change of state*. In the signs BROAD and NARROW (**Figure 34** and **Figure 35**), moving the hands in toward each other (that is moving the strong hand contralaterally) adds the meaning of *contracting* or *small*, and moving the hands away from each other (moving the strong hand ipsilaterally) produces the meaning of *expanding* or *big*. The base meaning can be thought of as *width measurement*.

If these sign pairs are represented in my model, they will have a feature direction which for these signs is both a morpheme and a feature.

That features can also be morphemes is well known. Two examples are:

1. A palatalization feature-morpheme in Japanese which means “uncontrolledness” or more specifically, depending on the base: “childishness, immaturity, instability, unreliability, uncoordinated movement, diversity, excessive energy, noisiness, lack of elegance, and cheapness” (Ito and Mester 1989). Examples are:

zabu-zabu	splashing
z ^y abu-z ^y abu	splashing indiscriminately
poko-poko	up and down movement
p ^y oko-p ^y oko	jumping around imprudently

2. A palatalization feature-morpheme in Chaha. “Palatalization of the last root consonant, if it is palatalizable, marks the verb for

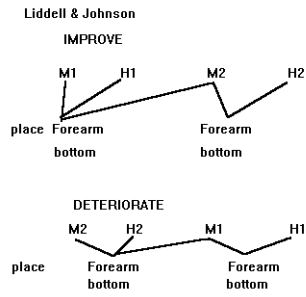
agreement with a second person feminine singular subject.
(McCarthy 1983)

On the other hand, if IMPROVE or DETERIORATE are represented as multisegmental and without directional features, then it becomes necessary to represent the *order* of the segments as morphemic. But this is absolutely unknown in spoken languages. To give a hypothetical example, this would be the same as a language in which we had pairs of words like the following:

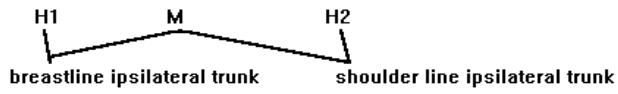
/tik/	a good thought	/kit/	a bad thought
/pig/	good weather	/gip/	bad weather
/live/	a good life	/evil/	a bad life

Order of segments can produce changes in meaning, but in spoken languages, it is not itself morphemic. This is the same thing as observing that while *gap* and *cap* are minimal pairs, *g* and *k* are not, in this context, morphemic. Order of segments can produce temporal order minimal pairs such as *keep* and *peek*, but order is not morphemic.

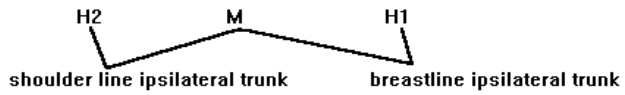
Consider the two sign pairs IMPROVE and DETERIORATE²⁶ and BROAD and NARROW, which have similar meaningful direction reversals. Liddell & Johnson's notation for IMPROVE and DETERIORATE, BROAD and NARROW would produce something like what is shown in **Figure 30** and **Figure 31** (they do not give these example, but I believe the representations are correct, based on their descriptions of their system). :



Liddell & Johnson
BROAD



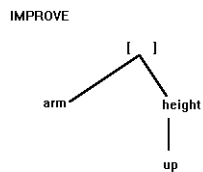
NARROW



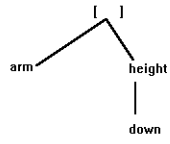
Since in these representations, everything is the same, except the

order of the segments, we are forced to claim that the order itself is morphemic.

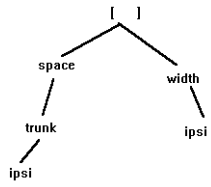
In my model on the other hand, IMPROVE and DETERIORATE, BROAD and NARROW, and the many other pairs which I mentioned in the data section, can be represented with change of a single direction feature, which can be easily assigned morphemic status.

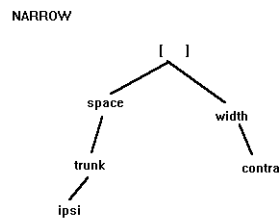


DETERIORATE



BROAD





Of course, this does not by any means imply that direction features are always morphemic in ASL. Signs can be found, such as WOMAN, or FALSE, where direction is clearly not morphemic. Furthermore, as in spoken languages, the meaning of the feature-morpheme can vary. For example, in IMPROVE, [up] has a meaning of *positive*; in GROW-UP, [up] has the meaning of to become *taller*, and so on.

Although morphemic features are attested, they nevertheless appear to be somewhat uncommon in spoken languages. The reason is no doubt that in any given language, there are perhaps 20-40 distinct features. Feature-morphemes could not be a large part of the vocabulary without extensive homonymy.

In ASL, the situation is somewhat different. The number of features (as discussed above) is much greater, and in addition, the iconic or metaphorical meaningfulness of some of these features, especially

places and directions, would seem to encourage their use as morphemes.

The significant point of this argument is that if signs were structurally ordered, like spoken languages, then it would be necessary to claim that sign languages are very fundamentally different from spoken languages. There are no examples in spoken languages where reversals are used to convey meaning changes. There are no languages where reversing the words of a sentence are used to make a question; there are no languages where reversing the sounds of a morpheme systematically reverse the meaning of a word. Movement does occur, syntactically and phonologically. But reversals do not. By using direction features, sign languages can be shown to obey this fundamental constraint, even though the type of feature used is different from spoken languages.

6.3 Some impossible signs that this representation correctly excludes

Perlmutter (1992) discusses a type of impossible sign. He shows that a sign with path movement can have secondary movement such as wiggling (FINGERSPELL, LONG-AGO) or circling (TRAVEL, CHASE) occurring at the same time. A sign without path movement can also have wiggling (GERMANY, COLOR, DIRTY, etc.) or circling (WHEEL, COMPUTER, ALONE). However, he points out that a sign with path movement cannot have any of the following kinds of sequences:

1. The stationary hands wiggle or circle.
2. Then the hands move downward/inward, etc.

Or

1. The hands move downward/inward, etc.
2. Then the stationary hands wiggle or circle.

Or

1. The stationary hands wiggle or circle.
2. Then the hands move downward/inward, etc.
3. Then the stationary hands wiggle or circle.

He shows that similar sequences are also not possible for handshape changes. For example:

1. The hand changes from one shape to another.
2. Then the hands move in some direction.

That is, all of the movements (path movement, secondary movement, or handshape change) must all occur at the same time.

Perlmutter explains this in terms of a sonority hierarchy, in a multisegmental representation. His representation uses M and P (movement and position) segments, and he claims that movement segments are more sonorous than position segments. In this system, the following are acceptable sequences:

[P] [M + secondary movement] [P]

[P] [M + secondary movement]

[M + secondary movement] [P]

[M + secondary movement]

[P + secondary movement]

The following are not allowed:

[P + secondary movement] [M] [P + secondary movement]

[P + secondary movement] [M] [P]

[P] [M] [P + secondary movement]

(Similar restrictions hold for handshape change.)

Perlmutter argues that a sign can be thought of as having an analog of consonants, vowels and syllables. Movements are like vowels and are more sonorous than positions (consonants). Normally, movements because they are more sonorous than positions will function as the nucleus of the syllable; but positions may also function as a nucleus if there is no (path) movement. Given this theoretical apparatus, he then makes the generalization that secondary movement (and handshape change) can only occur on the nucleus of a syllable.

However my representation also explains this, perhaps more simply and less stipulatively. Since the sign is a single segment, all movements, including handshape change, wiggling, and path movement

must be simultaneous whenever possible, and this prevents all of the representations above. Clearly, in cases with no path movement, wiggling or hand change can occur on their own.

A caveat must be made. Classifier predicates can not be included in the generalization that (in my representation) all movements must occur at the same time and in Perlmutter's representation that secondary movement occurs only on the nucleus. In some classifier predicates it is certainly possible to have, for example, a secondary movement with stationary hands followed by a hand moving on a path. It is not however clear that such predicates should be considered to be a single sign, and they are equally a problem for Perlmutter and myself.

If only lexical, monomorphemic signs are considered, then Perlmutter's generalization holds true, and my representation of such signs as a single segment will correctly exclude them.

6.4 A handshape contour feature similar in type and function to direction features

The direction features that I am proposing are somewhat unusual. As I mentioned at the beginning of this paper, contour features, such as [rising] have been rejected for spoken languages. As Hayes (1993) observes, spoken language phonologists have concluded that static targets are sufficient. It is unnecessary to use features which include the

notion of movement or change within them, such as delayed release or rising.

The direction features I am proposing do include some notion of movement within them. A direction [up] implies that the hand moves in an upward direction from one place to another. I also claim that it is NOT necessary or desirable to use all of the possible static targets. That is, in a sign like GOOD, it is possible to claim, as Liddell & Johnson, Sandler, and Perlmutter do, that there are two static targets: the beginning and end points of the movement. In contrast, I claim that only the beginning point is underlying, and that it is more appropriate to add a direction feature, which will predict the second target, instead of the target itself.

Because the kind of feature I am using does not occur in spoken languages, it is therefore worth noting that in a completely different domain of sign language - handshape change - another linguist, Corina (1993) has argued for a different contour feature, [\pm closing]. He also argues that in signs with two handshapes, (that is, two static targets), only one of them is underlying, and that the contour feature predicts the other handshape. This is a close parallel to my proposal that a sign has some but not all static targets underlying, and that some static targets, instead of being underlying, are predicted by a contour feature.

For example, in the sign FIND, he claims that the underlying

handshape is a closed handshape, which is both [+bent] and [+hooked]. From the value of his contour feature, [+closing], he derives the other handshape, a bent and hooked index finger. He also knows that the bent, hooked handshape occurs first, and the straight (open) handshape occurs second.

The sign INFORM has a [-closing] feature. The underlying handshape is +bent, -hooked (the tips of the fingers touch the thumb). Is the underlying handshape the first or second handshape? There are two possible sequences:

- a. If the underlying handshape is the first handshape, then the second handshape must be more open: -bent -hooked.
- b. If the underlying handshape is the second handshape, then the first handshape must be more closed: +bent +hooked.

Corina claims that only one of these sequences occurs in ASL (sequence a). Thus, with a combination of constraints and a contour feature, he can derive both non-underlying handshapes, and the handshape sequences.

Corina's argument differs from mine in that he claims that it is always true that only one handshape remains underlying and that the other handshape is underspecified. I do not claim that there are never two places in underlying form. I claim that two places are less common

occurrence in the language, but there are monomorphemic two-place signs such as DEAF and KING.

The most significant point of Corina's argument for my purposes is that he suggests a sequencing feature [\pm closing] which is very similar to my sequencing directional features. His feature derives non-underlying handshapes; my feature derives non-underlying places. This means that the underlying representation of the sign-segment will normally consist of a single handshape and a single place. The fact that a similar kind of contour feature can be used for both places and handshapes, suggests that feature-sequencing is a general process in sign languages, not something specific to, or strange about, places.

6.5 Rarity of two-place signs explained if a sign is a single segment

Two-place signs in ASL are, in my representation, uncommon - less than about 6 percent. Most of these two place signs are compounds, and it is well known that many compounds lose one of these places, if it does not result in homonymy. For example, there are versions of REMEMBER (THINK-STAY) which no longer have a forehead place, but only a place on the weak hand.

A number of researchers including Stack (1988), Uyechi (1993), Brentari (1993) and Wilbur (1993) have observed that a sign has

restrictions such that there are not more than two handshapes or places in a monomorphemic sign. If Corina's argument discussed above is correct, in fact a sign has only one underlying handshape, and if my argument is correct, most signs will have a single place.

If the nature of a segment is considered, this may make sense, and reveal a parallel with spoken languages. The unmarked segment is one that has not more than one value for place. For example, although complex segments exist with two place features (Sagey 1986), these are rare compared with the unmarked one-place segment in spoken languages. There are exceptions in both spoken and signed languages, but in both signed and spoken languages, it seems that the preferred segment has one place.

6.6 **Summary of arguments**

I have given the following arguments for a monosegmental structurally unordered representation using direction features to sequence place features.

I have argued that a structurally ordered representation will fail to correctly represent underlyingly unordered signs like DEAF and DANCE. It will also be redundant by ordering signs like WOMAN and MAYBE which are already ordered by constraint. I have argued that a representation which does not use directions, must use many more places. Many of these places are more properly seen as not underlyingly

represented, but simply as the result of moving the hand a natural distance in a certain direction. I have argued that a single segment representation of a morpheme is more feasible in sign language than in spoken language because of the far greater number of available features. I have shown that some impossible signs are correctly excluded by a monosegmental structurally unordered account but not by a multi-segmental structurally ordered account. I have argued that Corina's suggested representation for a single underlying handshape is similar to my direction features, in that it can be used instead of structure to order features. I have argued that the restrictions on signs in terms of number of places, handshapes, etc. make sense if the sign is a single segment where the unmarked segment has zero or one token of any feature type. I have argued that sign pairs or groups with meaningful reversal of direction are more naturally explained using direction features as morphemes rather than segmental order as a morpheme.

7 CONCLUSION

I will summarize here the conclusions of this paper. As a memory aid, I include in parentheses the name of a sign that I used to illustrate each point.

A single-segment, feature and constraint ordered representation can be used for monomorphemic signs, provided that direction features can be used. I use 12 privative direction features: [up], [down], [in], [out], [ipsilateral], [contralateral], [tipward], [baseward], [toward ulnar], [toward radial], [palmward], and [backward]. With these features, the movement itself does not need to be represented underlyingly.

I have shown that direction features can be used to derive both places, and sequence of places, for many signs. For signs with one underlying place, and a path, the direction feature will derive both all non-underlying places and the sequence of places (FALSE). For signs with two underlying places and a path, the direction feature will derive the sequence of the two places (GOAT).

Signs without a path will not have a direction feature (COLOR) but even some signs with a path do not have a direction feature (MOTHER, DEAF, WOMAN). Some signs with two places are sequenced by a constraint (WOMAN).

I have also shown that some signs can have two directional features. Two unopposed directional features will be executed

simultaneously (GOOD). Two opposed directions will be sequenced by a constraint (MAYBE), or be surface unordered (DANCE).

Thus:

Both place and direction features may fail to be phonologically sequenced.

Both places and directions may be sequenced by constraints.

Places, but not directions, can be sequenced by a feature.

The number of signs with two underlying places will be greatly reduced when using a directional feature, so that most monomorphemic signs have a single underlying place. Of those that still have two underlying places, the majority appear to be either constraint ordered or unordered.

The single segment representation also does not allow certain combinations of movements which a structurally ordered, multi-segmental representation would incorrectly allow (Perlmutter's impossible signs).

The structurally ordered, multi-segmental representations that have been proposed for a sign can't correctly represent unordered signs (DEAF). Structurally ordered representations will also produce very unusual morphemes consisting of the ordering relation itself (IMPROVE/DETERIORATE).

How is ASL different from spoken languages?

- In ASL, a morpheme is normally a single segment or less.
- Because a morpheme is less than or equal to a single segment, it therefore follows that ASL uses feature and constraint based order instead of structural order at the morpheme level.
- ASL has many more potential phonological distinctions and many more features.
- At the segment level, ASL can be less simultaneous than spoken languages, because direction features and Corina's handshape contour feature allow for feature sequences. These are non-simultaneous, although structurally unordered. At the morpheme level, ASL can be more simultaneous than spoken languages because for many morphemes there is a single place, direction, and handshape which all occur at the same time. Many sign linguists have commented on the high degree of simultaneity in signed languages at the word level, compared with spoken languages, but in fact, the degree of simultaneity depends on whether the word/morpheme level or the segment level is being considered.
- ASL has features which order other features: Corina's contour feature for handshapes (+close) and my proposed directional features.

How is ASL like spoken languages?

- ASL is like spoken languages in that features are sometimes morphemes, but order is not.
- ASL has a segment that, like spoken segments, normally has one or zero tokens of any given kind of feature, such as place features. Two tokens of one kind of feature, or two tokens of a feature class (such as place or direction) are possible, but less common. Three tokens, in either signed or spoken languages, appear to be unattested.
- In ASL, structural order within a segment does not occur. In spoken languages, structural order at the segmental level does not occur often - it is a marked event. If Lombardi (1990) is correct in her re-analysis of affricates as unordered complex segments, and not ordered contour segments, then there are very few cases of order within a segment. Perhaps the segment could be defined as the largest phonological element which in the unmarked case is structurally unordered, for both spoken and signed languages.
- Both signed and spoken languages have constraints which order some phonological elements some of the time.

ASL can be represented using the theoretical entities of phonological theory, such as feature, constraint, and segment. In some of the specifics of the theory - in what features are used, how many there are, in the function of a segment - in these things ASL is different from spoken languages.

I believe that the most important points of this paper are that a sign is structurally unordered, that direction features can order other features, and that using direction features, even though they are not used in spoken languages, means that sign languages are able to follow more fundamental principles of human language.

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1. I will assume here the viewpoint of Optimality Theory which claims that there are no rules, only constraints. However, nothing vital in this paper depends on the distinction between rules and constraints.
 2. *Classifier* is a term used in sign languages to indicate handshapes which behave as a kind of pronominal reference for a group of entities, and *classifier predicate* for when the classifier handshape is combined with a movement, orientation and placement to produce a sign. For example, the extended index finger, normally pointing upwards, can stand for a number of objects conceived of as being longer than they are wide. The most common use is to stand for a human being, but rockets, pencils, and penises are also in this group. Another classifier uses the extended thumb, index and middle finger pointing horizontally (usually) to indicate vehicles such as a car or boat. The movement of the hand will indicate the action of the pronominal entity. The orientation can also be changed. For example, moving the vehicle classifier in a wild up and down motion and ending with the hand oriented so that the thumb is closer to the ground than the middle finger would show a vehicle that moves wildly and ends upside down. In other words, the movement and the orientation of the hands are meaningful and changeable; the handshape is also meaningful, and parts of the handshape are also meaningful. For example, the tip of the finger in the long-thin-entity classifier will be considered to be the top of the object - the head of the person, the eraser end of the pencil, etc.

A second type of classifier predicate uses varying handshapes to indicate sizes and shapes. For example, the extended index finger can be used to indicate something which is either thin or thought of as two-dimensional (such as a map). As another example, the slightly spread, curved, extended hand can be used to show the rounded shape of an island, a mass of sand, the rounded back of a turtle, etc. For more about classifier predicates in ASL see Liddell & Johnson's (1987), Supalla (1982, 1986, 1990), Newport & Meier (1985), DeMatteo (1977), Macken, Perry and Haas (1993), Mandel (1977) and many others.
 3. Where the weak hand is used as a contact point, it is positioned at mid chest height for all of the signs listed.
 4. E-mail correspondence with B. Woll (1996) on the Sign Language Linguistics Listserv (SL-LING) produced a slightly different reference for Wallin - Wallin (1983). I list both in the reference section since I have not yet tracked down either reference, and I am not clear if there is an error in the reference or just similarly named articles.
 5. I thank Adam Schembri for pointing out the references for Friedman and Battison (1973) and Brennan (1990).
 6. As Supalla and Newport (1978) established, and Perlmutter (1990) enlarged on, there are both unidirectional and bidirectional signs. A unidirectional sign may repeat, but there is only one underlying direction, and Perlmutter has shown that the movement returning the hand back to the original position is a transitional phonetic movement which is not phonologically represented.

That is, the transitional movement is physically necessary in order to return the hand to its initial position when reduplicating the phonologically significant movement. In contrast, bidirectional signs have phonologically significant motion in both directions. Perlmutter shows that bidirectional signs for example, can graze (brush the finger tips across the contact point) in both directions, whereas a unidirectional sign, (if it has the feature graze) will graze in only one direction. He gives as examples the unidirectional sign RESEARCH and the bidirectional sign DANCE. DANCE grazes the weak hand in both directions, RESEARCH grazes only on the forward direction motion.

7. For the distinction between weak hand as echo articulator and place see Sandler 1993.

8. It is possible that some compound signs whose synchronic appearance still shows their two-word origin should be thought of as two segment signs. For example, there is a form of WOMAN where the hand has a baby O handshape at the jaw. The hand moves down and changes to an open 5 handshape at the chest. Signs like this with 2 different handshapes and 2 different places are almost certainly 2 segments, and more similar to a 2 word string, than to a single sign. However, I leave this for future research.

9. Some of the other features of a sign are:

Handshape

Hand Orientation

Non-manual information (body shifts, head tilts, eyebrows, eyes, mouth movements, nose wrinkling, etc.)

Does the sign contact a body part, and if so, how? (Brushing, single point, linearly....)

Does the sign have reduplicated path movement?

However, I am confident that all of these elements can be added without major adjustments to the model here presented.

One significant element that I am ignoring for now is the question of what I call anchors. Most simple signs refer to either the signer's body or to `neutral` space, and not, for example, to the viewer's body or an imaginary entity. However, it is clear that agreement verbs, classifier predicates and pronouns can also refer to other real or imagined bodies. For example, pronouns point at the chest of the real or imaginary entity being referred to. However, for the simple signs I am considering, I will ignore this, and allow all signs to refer to signer's body or space.

A second significant element that I also ignore is the question of the movement shape, such as circular, arcing, straight or other movement shapes. I believe there are signs where shape and not direction should be used, and some signs where both shape and direction are required. In other words, there are signs, especially classifier predicates, which this system will not adequately describe.

10. As an example of why Brentari's direction features are not adequate, consider the sign GOOD. If GOOD (as I claim) has one underlying place, then a direction *away* or *toward* will not be sufficient to determine in which direction the hand moves. If the underlying place is at the chin, then *away* could mean that the hand moves upward or straight out or to the side. But in fact the sign must move outward and downward. Similarly, if the underlying place were a position

somewhat out from the chest, then the direction *toward* would not determine toward what, unless it were toward the underlying place, in which case the question is where does the hand start. If both beginning and ending place were underlying, then it would be difficult to determine in a non arbitrary way, which place the direction feature should apply to. If the beginning and ending places are specified, as well as the order in which they occur, then the direction feature becomes completely redundant.

11. The weak hand does not always function as a place. I follow Sandler (1993) in distinguishing between the weak hand as a place (discussed in this paper) and the weak hand as an echo articulator (not discussed here). An example of the distinction is between the two two-handed signs RESEARCH and MAYBE. In RESEARCH, the weak hand functions as a place - the fingers of the strong hand contacts the palm of the weak hand. In MAYBE, both hands perform symmetrical, alternating gestures in space without touching. In general, when the weak hand acts as an echo articulator, it behaves in identical or symmetrical fashion to the strong hand. It will have the same handshapes, the same or mirror contact points. Places will usually be the same or mirror images on some body axis, and orientations will be the same or mirror images (Battison 1978).

12. A number of phonological generalizations appear to require this node. Most significantly for this paper, it appears that there is a constraint such that signs crossing Major Body Areas will move downwards. Other generalizations are that a one contact sign on the trunk, arm, or hand will be contralateral, and on the head will be ipsilateral, and marked handshapes are more common on the head than on the trunk. (Battison 1978). Sandler (1989) shows that almost all signs have a single Major Body Area. The exceptions are compounds and compound derived signs, and many of these have lost one Major Body Area over time.

13. I assume that the slight downward motion that often occurs in this sign is phonetic.

14. Although it seems theoretically possible that there could be a place in space and a place on the body for the same sign, I know of no monomorphemic sign which requires this.

15. Exceptions may be the signs UP and DOWN, RIGHT and LEFT, NORTH, SOUTH, EAST, WEST . It is possible that these signs should be thought of as having a direction, but no place. They are articulated in neutral space in the most phonetically simple position. are similar.

16. It also appears that a lack of order similar to that in DANCE occurs for one handed, initialized, reduplicated signs made in space such as TOILET, EASTER, DEMOCRAT.

17. It is also possible that two directions are to some extent an artifact of the features I have chosen. That is, it is possible that signs with opposing directions ought to be represented with a feature [alternating] and a single direction, and unopposed directions should be represented with some kind of single diagonal value. That is, instead of representing GOOD as having both a value for [out] and a value for [down], perhaps some kind of alternative direction system could be used. Many of the signs with two unopposed directions appear to be the natural, unmarked

result of the arcing motion of the joints of the arm. That is, it is easier for the arm to move out while moving down than it is to move straight down from the chin. Hayes (1993) cites the work of Nagahara (1988) who proposes multiple coordinate systems including a Cartesian coordinate system with values of up/down etc. relative to the body. This is the kind of system I have proposed. However, Nagahara also proposes a polar coordinate system. This would use “a globe centered at the elbow, with the North Pole at the shoulder” (Hayes 1993, p. 223). Using a polar coordinate system in addition might eliminate the need to specify two unopposed directions. I leave this for future research.

18. Circular motion never has a minimal pair which goes in the other direction, but in the same plane of motion. There are minimal pairs for circular motion in two different planes, such as SIGN and ALWAYS. However, this distinction is dealt with through hand orientation. In SIGN, the hand points sideways and the circle moves through the vertical/sagittal plane - up and down, in and out. In ALWAYS the hand points upwards and the circle moves in the horizontal/sagittal plane.

19. I thank Linda Lombardi for pointing out to me that these signs could be considered to be directionless.

20. It is also possible that these signs should be thought of as having a direction toward a place. This would be similar to Brentari's (1990c) direction features, which are toward and away from points. At this point, I do not have the data to choose between these two alternatives, so I have selected the simpler one - no direction, until evidence is provided for the more complex system.

21. Some forms of VOMIT have the same handshape: a spread open hand; some forms have the thumb folded in.

22. Although I believe that this sign does not need to make any reference to the chest, there are signs which do not contact a place, but must refer to that place. A simple example is EYE - which is a point to the eye. The significant place is clearly the eye, but for obvious reasons, no contact will be made. Pronouns (except for first person) don't normally contact the person or thing being referred to, but the underlying representation of these signs will almost certainly need to refer to the places on the entities.

23. My observation is that non-native signers will frequently use the larger muscles routinely, not as a matter of emphasis, and this will give them a somewhat over-emphatic, jerky appearance. Nevertheless, their rendition of the sign is not ungrammatical, just stiff. It is similar to a foreigner who enunciates each word carefully.

24. Liddell & Johnson claim that the underlying form of DEAF has 4 segments as shown and that, since this form is unpronounceable (there is no movement between the cheek and jaw) an epenthetic movement is added between the first H and the second M to produce the surface form..

25. Liddell & Johnson do not give a sample representation for DANCE, so I based the drawing on their representation for MAYBE, which is a very similar sign with respect to number of segments and places.

26. Although there are several forms for the signs IMPROVE and DETERIORATE, I will pick the two simplest forms which consist of two contacts on the upper surface of the arm below the elbow. The various forms consist of changes in the size of the stepping motion up or down the arm, and in the number of steps. For example, large steps will mean *a large change of state*; many small steps means *many small changes of state*, slow motion implies slow change, and so on. What remains constant is the place (the arm), the handshape, the ulnar contact point of the hand with the arm, and that there are one or more steps.