

for uncovering the sound pattern of a spoken language are useless for sign, or as if our hypotheses about sign should be shaped exclusively by them. My hypothesis is that the closer our analyses are to the phonetics, the more apparent the differences are between sign language and spoken language, and that the closer our analyses are to grammatical function, the more apparent the similarities become. As phonologists, we have a strong disciplinary history that has developed using spoken language forms, and my position is that, even at this early stage in the disciplinary history of sign linguistics, an ongoing dialogue between spoken and sign language phonologists would be more mutually beneficial than would separate, parallel lines of inquiry.²

The principle guiding the approach taken in this book is that phonological theory offers several innovative frameworks, each covering different conceptual problems in phonology. If one's aim is to account for a language-specific grammar, as mine is here, one must draw on insights arising from several frameworks. In chapter 2 I will point out why each of the theories listed here is useful in this project. In addition to the theories of autosegmental phonology and feature geometry, principles from constraint-based theories, primarily Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993b) and Harmonic Phonology (Goldsmith 1989, 1990, 1991, 1993), Dependency Phonology (Anderson and Ewen 1987; Drescher and van der Hulst 1994), and Phonetic Enhancement (Stevens, Keyser, and Kawasaki 1986; Stevens and Keyser 1989) will play a role in the book. I also make use of a model of the lexicon that Itô and Mester (1995a,b) propose for Japanese to show the relationship between the native component of the lexicon and the peripheral components.

Spoken language terms such as *syllable*, *segment*, and *mora* have been used in quite disparate ways in the literature, confusing readers interested in spoken language phonology and sign language phonology alike. I will therefore begin each analysis by referring only to weight units and timing units. That is, I will begin discussing sign units without referring to spoken language counterparts, saving discussion of overlap and nonoverlap with comparable units in spoken languages (e.g., syllable, mora, and segment) until the conclusion.³

1.2 Introduction to Sign Structures

Before giving an overview of the Prosodic Model in section 1.3, I describe here the eight types of ASL signs that will figure prominently in the

analyses in later chapters. These eight types form a kind of canonical set of structures for which any complete phonological model must be able to account. Because it is difficult to find minimal pairs, a key strategy for ascertaining the units of sign structure is to observe the alternations in output forms due to morphological and phonological operations in the various types of signs. The assumption made here is that if a unit must be referred to in phonological operations, it must be a part of the phonological representation.

From the monomorphemic forms in the ASL lexicon, any framework must minimally be able to account for restrictions on

1. simple one-handed signs,
2. two-handed signs, and
3. fingerspelled borrowings.

From the set of polymorphemic forms, any framework must be able to account for the formation of

4. derived nominals,
5. agreement affixation,
6. compounds,
7. derived words containing grammatical aspect affixes,⁴ and
8. “classifier forms” (Supalla 1982) or “polymorphemic verbs” (Engberg-Pederson 1993; Wallin 1994).

1.2.1 Monomorphemic Forms: One-Handed Signs

Simple one-handed signs display a wide range of phonological behavior that any framework of sign phonology must account for. Some of the systematic behaviors of these forms, and the terms I will use to describe them, are as follows.

All monomorphemic signs contain a movement, either a path movement or a local movement (Wilbur 1987, 1990; Brentari 1990b,c; Stack 1988; Perlmutter 1992). In this book *path movements* are movements made primarily with the elbow or shoulder. Formally, a path movement may be specified as either a movement feature (e.g., a path shape or a direction-of-movement feature) or a change in setting (i.e., a change in feature specification, such as ipsilateral/contralateral, top/bottom, or proximal/distal, within a major body region). *Local movements* are those made by the wrist, knuckles, or finger joints. Formally, they are expressed as a change in one or more features specified in the articulator branch of structure.



Figure 1.1
UNDERSTAND contains a local movement.



Figure 1.2
SIT contains a path movement.

For example, UNDERSTAND (figure 1.1) contains a local movement, SIT (figure 1.2) contains a path movement, and THROW (figure 1.3) contains both a path movement and a local movement.

Most monomorphemic signs have one major *place of articulation* (Mandel 1981; Battison 1978; Sandler 1987a). UNDERSTAND, SIT, and THROW all have one major place of articulation. The sign UNDERSTAND has two specifications for *aperture* (the degree to which the hand is open or closed): both hands are located at the forehead (the place of articulation), but the first handshape is closed and the second is open. The place of articulation for both SIT and THROW is *neutral space* (the area directly in front of the signer at the level of the torso), but each is articulated with respect to a different plane within neutral space. The plane of



Figure 1.3

THROW contains both a path and a local movement.

articulation of SIT is the horizontal plane in front of the signer. The plane of articulation of THROW is the midsagittal plane.

There is a tendency for words in ASL, especially monomorphemic forms, to be composed of a single movement; this has been referred to as *monosyllabicity* (Coulter 1982; Wilbur 1987, 1990). The number of syllables is roughly isomorphic with the number of sequential movements in a sign. Two-movement forms (disyllabic signs), although less numerous, reveal much about phonological structure in ASL. A rough guide to counting syllables, based on previous studies of sign language syllables (Chinchor 1978; Coulter 1982; Wilbur 1987, 1990; Brentari 1990b,c,d, 1993; Perlmutter 1992; Sandler 1993c), is given in (1).

(1) *Syllable-counting criteria* (Brentari 1994)

- a. The number of sequential phonological dynamic units in a string equals the number of syllables in that string.
 - i. When several shorter dynamic units co-occur with a single dynamic element of longer duration, the longer unit is the one to which the syllable refers.
 - ii. When two or more dynamic units are contemporaneous, they count as one syllable.
- b. If a structure is a well-formed syllable as an independent word, it must be counted as a syllable word-internally.

These criteria have several practical implications for counting syllables. (1a) excludes phonetic or redundant movements from the syllable count,

and it covers both cases where *trilled movements* (TMs; a term coined by Sandler (1993c) and discussed by Padden and Perlmutter (1987)) are layered contemporaneously with a path or local movement and cases where any local movement and path movement co-occur. In such cases co-occurring dynamic elements count as one syllable. (1b) requires any single place of articulation that co-occurs with a TM to be counted as a syllable, whether it is word-internal or word-final.

There is also a restriction on *selected fingers* (the fingers of a handshape that can move during the production of a sign, or that can touch the body—the “active fingers” (Mandel 1981)).⁵ This restriction, on which there is some consensus, is that only one set of selected fingers is allowed in a given minimal domain. This minimal domain has been formulated as the sign itself (Mandel 1981), the morpheme (Sandler 1987b), and the syllable (Brentari 1990b; Perlmutter 1992). In later chapters I will place this restriction on the prosodic word—a revision of my earlier proposals, and closer to what Mandel (1981) originally proposed.

Finally, Corina (1990b) has proposed a restriction on changes in handshape aperture, which he formulates roughly in terms of the sonority distance between the two aperture settings. The restriction states that there must be a minimum specified distance between two aperture settings of a handshape change. In Brentari 1990b I have proposed a constraint on aperture that restricts the number of partially open or partially closed handshapes in a phonological word.

1.2.2 Monomorphemic Forms: Two-Handed Signs

The hand/arm used to articulate fingerspelled forms and one-handed signs is called the *dominant hand* (abbreviated H_1 throughout this book); in two-handed signs, the other hand is the *nondominant hand* (abbreviated H_2). Battison (1978) has proposed three types of two-handed signs. In *type 1 signs* both hands are active and perform identical motor acts. The hands may or may not contact each other, they may or may not contact the body, and their pattern of movement may be either synchronous or alternating. For example, SINCE has a synchronous pattern of movement (figure 1.4), and BICYCLE has an alternating pattern. In *type 2 signs* one hand is active and one hand is passive, but both hands have the same handshape (e.g., REMEMBER (figure 1.5), SIT (figure 1.2)). In *type 3 signs* one hand is active and one hand is passive, and the two hands have different handshapes (e.g., TOUCH (figure 1.6)). (Battison also proposed a fourth type, *type C signs*, for compounds that combine two or



Figure 1.4

SINCE is a type 1 two-handed sign with synchronous (i.e., nonalternating) movement.



Figure 1.5

REMEMBER is a type 2 two-handed sign.



Figure 1.6

TOUCH is a type 3 two-handed sign.



Figure 1.7
An impossible two-handed monomorphemic sign

more of the above categories.) Example signs in each category are listed in the table that follows, and an impossible two-handed sign is shown in figure 1.7.

Examples of type 1, type 2, and type 3 two-handed signs

Type 1	Type 2	Type 3
SINCE	TRAIN	HELP (H ₂ HS: ‘B’; H ₂ contact: inside surface of fingers)
HEALTHY	WORK	FIRST (H ₂ HS: ‘A’; H ₂ contact: finger/thumb tip)
BODY	SCHOOL	TOUCH (H ₂ HS: ‘S’; H ₂ contact: back of palm)
SUNDAY	SIT	COMMUNIST (H ₂ HS: ‘C’; H ₂ contact: radial thumb)
NAVY	MONTH	PRACTICE (H ₂ HS: ‘1’; H ₂ contact: radial surface of finger)

Some constraints on two-handed signs are as follows. There may not be two distinct regions of the body or two distinct movements in a two-handed sign (from Battison 1978). If H₂ moves at all, it must articulate a version of the movement of H₁, executed either identically or in 180° asynchrony (alternating movement). H₂ may have a different handshape than H₁, but it must be selected from a limited set, the members of which are variations of selected finger groups ‘B’ and ‘1’. (There are seven handshapes altogether (Battison 1978): ‘B’, ‘A’, ‘S’, ‘C’, ‘O’, ‘5’, and ‘1’.) All signs with two different handshapes are type 3 signs. There are eight discrete places of articulation where H₂ contact can be made in type 3 signs. ‘B’ may be specified for all eight; ‘1’ may be specified for five

(Battison 1978). H_2 has two distinct roles in phonological structure: as a place of articulation and as an articulator (Sandler 1987b, 1989, 1993a). How these two roles should be represented, and other types of restrictions on two-handed signs, are the subject of chapter 7.

The restrictions outlined above are for monomorphemic, core, two-handed signs and do not cover all uses of H_2 . A signer need not use the same hand as H_1 in all linguistic contexts, but can systematically shift between hands under certain conditions, such as in narrative storytelling, in poetry, or for particular lexical emphasis (there is wide idiolectal variation on this last point). Also, H_2 can persevere while H_1 continues to articulate an utterance (2). The restrictions on H_2 in two-handed signs will be taken up at length in chapter 7.

(2) *Perseveration of H_2 in an utterance* (Brentari and Goldsmith 1993)

H_1 : $\overline{\text{PHOTOGRAPH}}$ ^t, MY MOTHER. INDEX₁ SEE SELF
 INDEX_a... GOOD AND BAD
 H_2 : ----- CL:B in PLACE_a -----

1.2.3 Monomorphemic Forms: Fingerspelling and Lexicalized Fingerspelled Borrowings

Fingerspelling, which is the representation of the letters of an alphabetic writing system via signs, is one way for sign languages to borrow words from spoken languages. The ASL manual alphabet is the set of names for the English orthographic letters. I include the ASL manual alphabet here among the monomorphemic forms, but their morphological status is somewhat ambiguous. Just as spoken languages have words for letters (e.g., for y : [wai] in English, [igrɛk] in French, [ipsilōw] in Portuguese, [ipsolon] in Italian), so the fingerspelled letters are words in their own right when uttered as single words. In some sign languages, this is the limited role that fingerspelled letters play, used as infrequently as speakers spell out words in English. Thus, in many sign languages (e.g., French, Dutch, German, Danish, Italian, Japanese, Chinese), words are not borrowed from the dominant surrounding language primarily by fingerspelling, but by some other means. In fact, ASL signers are thought to overuse fingerspelling by some members of such Deaf communities.

Fingerspelling serves many other purposes in ASL, however, more than spelling does in spoken languages; I will describe four of these. First, fingerspelling is used when no ASL sign exists, in order to introduce a concept

(e.g., local proper names) used outside a community of signers. For example, there is a sign for the town name *Stockton, California*, but only local area residents would recognize it; when the town is mentioned by or to a nonresident, its name is fingerspelled. Second, fingerspelled forms may be used to emphasize a word for which an ASL lexical item does exist. For example, it would be appropriate to fingerspell the word ‘home’ in the following sentence if the signer is tired and is anxious to leave: WE-2 GO H-O-M-E! Third, there are fingerspelled forms that are completely assimilated into the lexicon; BREAD and NO are two such forms. These forms obey all constraints placed on words in the core lexicon.

Finally, in specific academic disciplines, fingerspelled forms are sometimes preferred over coined signs in order to highlight a technical versus nontechnical semantic distinction between uses of the same term (Padden 1995); or they may refer to domains of knowledge where consensus on the use of a specific sign has not been achieved. Fingerspelled forms of this type undergo a rapid lexicalization process, *local lexicalization*, whereby in a single discourse the fingerspelled form comes to represent, not each of the letters of the borrowed word, but the concept that word has in the source language. Local lexicalization of fingerspelled forms will be used as evidence in chapters 5 and 6.

The ASL fingerspelling alphabet is given in figure 1.8.

1.2.4 Polymorphemic Forms: Nominals

In this book I will discuss two kinds of nominalizations. Both are formed from verb stems: one by reduplication of a verb stem, and the other by adding a “trilled” feature to the movement of the stem. In chapter 5 I will argue that in addition to semantic requirements, the phonological shape of the stem of both types of nominals determines whether nominalization can occur.

1.2.4.1 Reduplicated Nouns The *reduplicated nouns* in ASL were first described by Supalla and Newport (1978). For each reduplicated noun there is a corresponding verb.⁶ The two signs are related in meaning, and the verb expresses the activity performed with or on the object named by the noun. The movement of the stem is repeated, and both movements are produced in a “restrained” manner (e.g., CLOSE-WINDOW/WINDOW (figure 1.9)). These forms have been given a segmental analysis, but in chapters 5 and 6 I will propose an analysis that includes both syntagmatic and paradigmatic components.

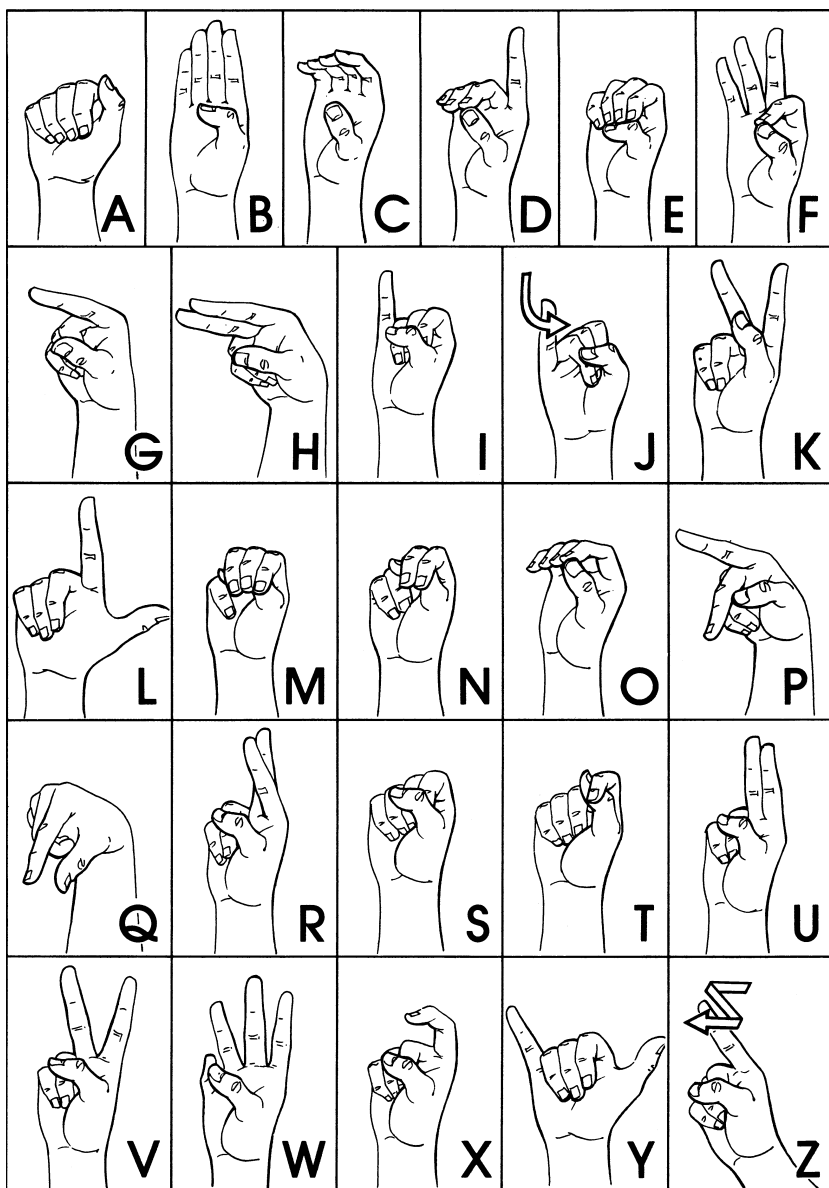


Figure 1.8

The ASL manual alphabet. Reprinted with permission from *A Basic Course in American Sign Language, Second Edition*, by T. Humphries, C. Padden, and T. J. O'Rourke. Copyright 1994. T. J. Publishers, Inc., Silver Spring, Md.



Figure 1.9

Two signs showing the operation of reduplication in nominalization: CLOSE-WINDOW/WINDOW. In CLOSE-WINDOW (left), there is a single path movement. In the noun WINDOW (right), there are two restrained path movements.

(3) *Reduplicated nominals in ASL (from Supalla and Newport 1978)*

SIT/CHAIR
 CALL/NAME
 HIT-WITH-HAMMER/HAMMER
 GO-BY-PLANE/AIRPLANE
 GO-BY-BOAT/BOAT
 GO-BY-ROCKET/ROCKET
 GO-BY-FLYING-SaucER/FLYING-SaucER
 GO-BY-SHIP/SHIP
 GO-BY-TRAIN/TRAIN
 PUT-ON-BACKPACK/BACKPACK
 GO-TO-BED/BED
 COVER-WITH-BLANKET/BLANKET
 PUT-ON-BRACELET/BRACELET
 PUT-ON-BROOCH/BROOCH
 CLOSE-WINDOW/WINDOW
 CLOSE-GATE/GATE

1.2.4.2 Activity Nouns The class of derived nominals known as *activity nouns* was first discussed by Padden and Perlmutter (1987). They might be seen as a type of gerund, since they function in this way. The derived form contains a trilled movement (TM). TMs have been defined as small, rapidly repeated, uncountable movements (Liddell 1990b) and



Figure 1.10

An example of trilled movement affixation forming a derived activity noun: READ/READING. In the verb READ (left), there is a single path movement. In the derived activity noun READING (right), a trilled movement feature is affixed to the stem.

have also been referred to by other names: local movement, oscillation (Liddell 1990b), secondary movement (Perlmutter 1992; Brentari 1993), and secondary path (Brentari 1990c). Semantically, the verb stems that undergo this operation denote atelic activities (Vendler 1967). The forms in (4a) may undergo this operation, and those in (4b) may not; figure 1.10 shows the acceptable pair READ and READING. Even though the verbs BAT and THROW, GIVE and TAKE denote similar types of activities, native informants respond differently to their derived activity nouns, rejecting THROWING and TAKING but accepting BATTING and GIVING.

(4) *Distribution of activity nouns*

a. *Examples of verbs and their derived activity nouns*

READ	READING
RAP	RAPPING
CHAT	CHATTING
DRIVE	DRIVING
DRAW	DRAWING
WRITE	WRITING
SHOP	SHOPPING
BAT	BATTING
GIVE	GIVING

b. *Examples of verbs that have no derived activity noun*

SIT	*SITTING
SMILE	*SMILING
STAND	*STANDING
WANT	*WANTING
DESIRE	*DESIRING
LOVE	*LOVING
LIKE	*LIKING
THROW	*THROWING
TAKE	*TAKING

1.2.5 Polymorphemic Forms: Agreement

One morphologically complex group of signs that has been studied at length using both internal and external linguistic evidence is the so-called agreement forms. If one were to describe in general how agreement works in sign languages, given research on *Langue des signes québécoise* (Nadeau 1993; Desouvrey 1994), Danish Sign Language (Engberg-Pederson 1993), Japanese Sign Language (Fischer 1996), Sign Language of the Netherlands (Bos 1990), Taiwanese Sign Language (Smith 1990), Swedish Sign Language (Wallin 1994), Italian Sign Language (Pizzuto 1987), Swiss German Sign Language (Boyes-Braem 1990), and ASL, it would be that referents for persons or objects are assigned a locus in the signing space that remains constant throughout a stretch of discourse.⁷ Whether these forms ought to be called agreement forms at all, or whether they should be considered to be outside the linguistic system altogether, is currently under debate. Liddell (1995) argues against calling spatial reference “agreement” because of the apparently infinite allomorphy of these forms. Engberg-Pederson (1993) argues that these references to objects in the signing space ought to be called “agreement,” because loci cannot be established randomly in the signing space. Instead, she argues (p. 80), the number of *deictic lines of reference* used by sign language grammars—the deictic, anaphoric sequence, and mixed time lines, and the calendar plane—is limited.⁸ If one accepts that these phenomena are linguistic, then another question arises: do these phenomena constitute one system of reference where all types are treated alike, two distinct systems of reference with different properties, or a category of subsystems that share overlapping properties but cannot be treated completely alike? Padden (1983, 1990) has argued for two distinct systems (one of person agreement,



Figure 1.11

DRIVE-TO is considered a typical spatial agreement verb, in which the initial and final loci refer to a spatial map.



Figure 1.12

HELP is considered a typical person agreement verb, in which the initial and final loci refer to grammatical subject and object, respectively.

the other of spatial agreement), and there is neurolinguistic evidence that supports a distinction between person-inflection use of loci and spatial use of loci in the signing space (Poizner, Klima, and Bellugi 1987). Engberg-Pederson argues for a category of subsystems that share overlapping properties but cannot be treated completely alike, rather than the binary split of spatial versus grammatical. Figure 1.11 illustrates a typical verb of the spatial agreement class (DRIVE-TO); figure 1.12, a typical verb of the person agreement class (HELP). Comparison of figure 1.12 and figure 1.13 shows the difference in direction of the path movement between a



Figure 1.13

REQUEST is considered a “backward” agreement verb, in which the initial and final loci refer to grammatical object and subject, respectively.

verb (HELP) exhibiting typical (or forward) agreement and a verb (REQUEST) exhibiting backward agreement (Padden 1983; Kegl 1985; Brentari 1988; Meir 1995). Sentences exemplifying these types of verbs are given in (5)–(7). A case where the spatial and person systems of reference are mixed is shown in (8); here, the locus at the end of GO-TO is the same as the locus at the end of HELP, even though in the first case it expresses spatial agreement, and in the second case it expresses person agreement.

(5) *Spatial agreement verb*

a. *No spatial agreement loci*

\emptyset ₀DRIVE-TO-₀

‘I drive.’ (I drive (i.e., rather than walk, bike, or take the bus).)

b. *Final spatial locus only*

\emptyset ₀DRIVE-TO_a, DROP-OFF KIDS, SHOW-UP_c WORK 9:30.

‘I drive there, drop off the kids, then show up for work at 9:30 a.m.’

(6) *Person agreement verb*

a. *Subject and object agreement loci*

INDEX₁ ₁HELP₃ J-O-H-N INDEX₃.

‘I help John.’

b. *Subject and object agreement loci*

INDEX₂ ₂HELP₁.

‘You help me.’

c. *Object agreement locus only*

INDEX₃ J-O-H-N ₀HELP₄ INDEX₄ M-A-R-Y.

‘John helps Mary.’

(7) *Contrast between “forward” and “backward” verb agreement*

a. *Subject and object agreement loci*

J-O-H-N INDEX₃ ₃HELP₄ INDEX₄ M-A-R-Y. (typical class)

‘John helps Mary.’

b. *Object agreement locus only*

J-O-H-N INDEX₃ ₄REQUEST₀ M-A-R-Y INDEX₄. (backward class)

‘John requested [it of] Mary.’

(8) *Mixed spatial and person agreement*

INDEX₁ ₃REQUEST₀ J-O-H-N, “WHERE GO?” INDEX₃ SAY,
“GO-TO_a M-A-R-Y HER_a HOME. PROMISE ₀HELP_a.”

‘I ask[ed] John, “Where are you going?” He said, “To Mary’s house. I promised I’d help her.”’

The phonological representations of such forms, and their impact on a feature system for ASL, are issues addressed by the Prosodic Model. In my earlier work, forms such as HELP, REQUEST, and DRIVE-TO are used to argue for a feature [direction] in the underlying representation of such signs.

1.2.6 Polymorphemic Forms: Compounds

Compounds in ASL are limited to two stems. Specifying the grammatical class of the input stems of the compound is problematic because, as Supalla and Newport (1978) have argued for noun-verb pairs, the underlying structure may not be specified for class (in Supalla and Newport’s case, it may not be specified as either a noun or a verb), but is assigned the appropriate class by the morphology or syntax. Distinguishing between verbs and adjectives is also difficult in ASL, since almost all adjectives

may appear as syntactic predicates with no change in phonological structure. Examples of compounds appear in the table that follows; the compound operation for THINK ^ SELF ‘decide for oneself’ is shown in figure 1.14. There are monosyllabic forms and disyllabic compounds, using the syllable-counting criteria listed in (1).

Examples of ASL compounds (V = verb; N = noun; A = adjective) (examples from Svaib 1992)

Stem order	Examples	Grammatical category after compounding
VN	SLEEP ^ DRESS ‘nightgown’	noun
	THINK ^ SELF ‘decide for oneself’	sentence
NV	WATER ^ RISE ‘flood’	noun
	GIRL ^ MARRY ‘wife’	noun
VV	THINK ^ FREEZE ‘faint’	predicate
VA	NAME ^ SHINE ⁹ ‘good reputation’	noun
AV	NUDE ^ ZOOM ‘streak’	noun
AA	GOOD ^ ENOUGH ‘barely adequate’	predicate
AN	BLUE ^ SPOT ‘bruise’	noun/adjective
	YELLOW ^ HAIR ‘blond’	noun/adjective
NA	FACE ^ STRONG ‘resemblance’	noun
NN	GIRL ^ WEDDING ‘bride’	noun

Several segmental analyses of compounding have been proposed (Liddell and Johnson 1986; Sandler 1987b, 1989, 1993c); in chapter 5 I will add a paradigmatic component—one that I have previously sketched in Brentari 1990d, 1993—to the traditional analysis of compounding.

1.2.7 Polymorphemic Forms: Grammatical Aspect

ASL has a complex system of grammatical aspect and very little grammatical tense morphology (although some has been reported (Jacobowitz and Stokoe 1988; Aarons et al. 1995); also, auxiliary verbs have been described in Taiwanese Sign Language (Smith 1990)). The system of grammatical aspect in ASL encodes descriptions of both the temporal unfolding of an event and the distributional properties of the objects and persons involved in the event. Examples of the distributional and temporal aspects described in the literature are given in the table that follows. Klima and Bellugi 1979 remains the most comprehensive discussion of aspect; other



Figure 1.14
THINK (top left) and SELF (top right) are shown as single words and in the compound THINK ^ SELF (bottom).

work includes Liddell 1984b, Wilbur, Klima, and Bellugi 1983, Sandler 1990, and Brentari 1996b.

Examples of temporal and distributional aspect categories in ASL

Temporal	Distributional
protractive (Liddell 1990b)	multiple (Klima and Bellugi 1979)
unrealized-inceptive (Liddell 1984b)	exhaustive (Klima and Bellugi 1979)
delayed-completive (Brentari 1996b)	internal apportionative (Klima and Bellugi 1979)
habitual (Klima and Bellugi 1979)	external apportionative (Klima and Bellugi 1979)
durative (Klima and Bellugi 1979)	



Figure 1.15

A polymorphic form in ASL, which means ‘two, hunched, upright-beings, facing forward, go forward, carefully, side-by-side, from point “a,” to point “b”’

These categories provide fertile ground for paradigmatic and syntagmatic morphophonemic alternation, and they are used as evidence to support various analyses throughout the literature (e.g., Sandler 1993c; Brentari 1990c, 1992, 1993). Each category mentioned in the table has its own particular phonological shape, and these will be discussed when relevant for a particular analysis in later chapters.

1.2.8 Polymorphic Forms: Classifier Predicates

In the part of the ASL lexicon known as “verbs of motion and location” (Supalla 1982, 1985, 1990), words are constructed of many morphemes, each morpheme often consisting of a single feature or cluster of features.¹⁰ What is remarkable about these forms is that they may also be monosyllabic. The ASL word in figure 1.15 contains nine morphemes and one syllable. It means ‘two, hunched, upright-beings, facing forward, go forward, carefully, side-by-side, from point “a” to point “b”’. These forms have been discussed in some depth from a morphological point of view (Supalla 1982, 1985, 1990; Wallin 1994; McDonald 1982; Kegl 1985; Schick 1990), but little has been written about constraints on their phonological structure. They are syntactically verb phrases or sentences. Constraints that are unviolated in other parts of the native lexicon are relaxed in these forms; for example, the H_2 restriction on handshape does not apply to classifier forms. I consider these forms in this book because any phonological model proposed for sign languages must show the potential of being expanded to include them.

1.3 Overview of the Prosodic Model

The goal of the Prosodic Model is to integrate into one model the insights about systematicity in paradigmatic structure and syntagmatic structure in sign. This work was initiated by Stokoe (1960) and Klima and Bellugi (1979). Specifically, the model articulates a set of constraints in ASL that must refer to paradigmatic structure and complexity: co-occurrence prohibitions among features, redundancies among co-occurring features, and so on. Sign languages do not require different units of analysis or different kinds of constraints than do spoken languages; indeed, this model does not propose units or types of constraints that are unattested in spoken languages. What is claimed, however, is that ASL exploits paradigmatic constraints in a greater range of phenomena than do spoken languages. To take one example, it has been argued that H_2 is a weak branch of prosodic structure similar to a coda or a word-level appendix in spoken languages (Brentari and Goldsmith 1993). In ASL, however, this constituent is expressed simultaneously with the core syllable rather than sequentially as it is expressed in spoken languages.

In this section I will sketch the guiding principles and general claims of the model and give five central arguments for conceptualizing ASL phonological structure this way. The Prosodic Model makes a fundamental distinction between *prosodic features* and *inherent features*.

(9) *Definition of inherent features*

Inherent features are those properties of signs in the core lexicon that are specified once per lexeme and do not change during the lexeme's production (e.g., selected fingers, major body place).

(10) *Definition of prosodic features*

Prosodic features are those properties of signs in the core lexicon that can change or are realized as dynamic properties of the signal (e.g., aperture, setting).

As will become clear, for many reasons inherent features and prosodic features should be separate branches of structure. There is a systematic many-to-one relation between prosodic and inherent features; inherent features have more complex hierarchical structure than do prosodic features; inherent features are realized simultaneously, whereas prosodic features are realized sequentially.

This conceptual division draws on the distinction between inherent and prosodic features made by Jakobson, Fant, and Halle (1972 [1951], 13):

The opposition grave vs. acute, compact vs. diffuse, or voiced vs. unvoiced, and any other opposition of inherent distinctive features appears within a definite sequence of phonemes but is, nevertheless, definable without any reference to the sequence. *No comparison of two points in a time series is involved* [emphasis mine]. Prosodic features, on the other hand, can be defined only with reference to a time series.

As examples of prosodic features, Jakobson, Fant, and Halle note that in Old Czech the feature [syllabic] is contrastive in the pair /břdu/ versus /brdu/, and that in Polish [length] is contrastive in vowels (e.g., /prava:/ vs. /pra:va/). In both examples it is clear that these features differ from features, such as [voice] and [nasal], that can be identified within a single segment by their articulatory or acoustic correlates. [Syllabic] and [length] must be placed in a context where their properties can be measured with respect to other segments in the local domain. In current theories the properties of length and syllabicity are aspects of segmental or syllabic structure rather than features; but my point here focuses on how these two types of contrast differ from one another.

Although the distinction between inherent and prosodic features used here draws most directly on the basic distinction made by Jakobson, Fant, and Halle (1972 [1951]), the term *prosody* or *prosodic* has had several somewhat overlapping uses in linguistics, and a discussion of some of these may be helpful here. Firth (1957) uses the term *prosody* to describe phonological properties that extend beyond the segmental unit to the syllable; examples include tone melodies in tone languages and register in Mon Khmer languages. This Firthian type of prosodic unit is developed by Haugen (1949), who expands on ideas in Firth's unpublished work of the 1930s. Haugen uses the term *prosodeme* as a variant of Jakobson, Fant, and Halle's *prosodic phoneme* to describe alternations in speech sounds involving tone, stress, and duration. Autosegmental phonology (Goldsmith 1976) has developed in contemporary theory a formal way of expressing the relative independence of such properties as tone, stress, and duration in phonological representations. McCarthy and Prince (1986), Itô (1986), Selkirk (1984), Selkirk and Tateishi (1988), and Nespor and Vogel (1986) use the term *prosodic structure* to talk about canonical shapes of the syllable, prosodic word, prosodic phrase, and so on, which interact with other components of the grammar and with each other.

The goal of the Prosodic Model is to develop this line of inquiry for sign languages.¹¹

Properties from these works that are important in the Prosodic Model are listed in (11).

(11) *Properties of prosodies, such as “tonal melodies”*

- a. Prosodies are timed with respect to units larger than the segment.
- b. Prosodies have a restricted set of abstract patterns.
- c. Prosodies have autosegmental status.
- d. Prosodies can carry lexical contrast.

In tone languages, tonal prosodies are often called tonal melodies, and tone patterns within stems are often drawn from a restricted set. Venda, for example, exhibits a wide range of surface tone patterns, arising from a small set of underlying primitive tone patterns: (L), H, (L)-H, H-(L)-H, and H-(L). (Low tones are not specified underlyingly.)

“Tonal melody” inventories for Venda stems (Cassimjee 1983)

Underlying representations		Surface forms	
		(Post L-tone)	(Post H-tone)
thamaha	L	thamaha	thámâha
madzhi	H	mádzhiê	mádzhie
danana	LHL	danána	dánâna
khokhola	HLH	khókhôla	khókholá
phaphana	LHH	phapháná	pháphâna
dukana	LLH	dukaná	dúkâná
dakalo	HHL	dákálo	dákalo

In itself this is unremarkable, since distinctive features do the same thing. But Goldsmith (1976) has convincingly shown that tone is not just another set of distinctive features, but maintains a type of autonomy and stability within the system, since a restricted inventory of abstract patterns is involved. This autonomy is expressed by placing tone on a separate autosegmental tier, which allows a much more explanatory account of tonal phenomena than was previously possible. In the Prosodic Model, movement is claimed to behave in ways strikingly similar to the way that tones behave in Venda.

The arguments for placing all movement features on a separate branch of structure in ASL will take the form shown in (12). All movement features share the same behavior with respect to these characteristics.

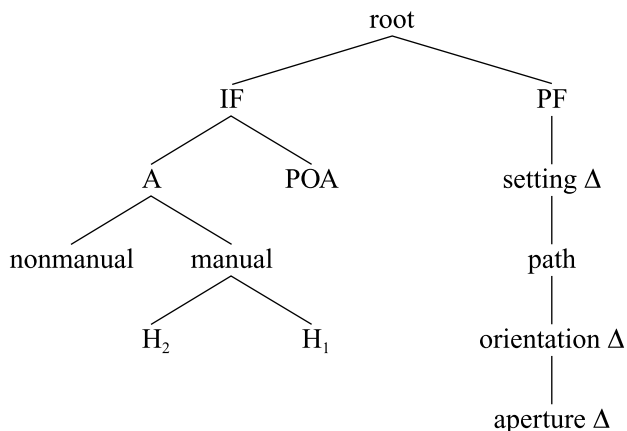
- (12) *Arguments for placing movement features on a separate branch of structure are based on*
- a. the timing of movement features within and between words,
 - b. the ability of movement features to “migrate” by means of phonetic proximalization or distalization,
 - c. the distribution of prosodic-to-inherent features,
 - d. the distribution of disyllabic movement patterns,
 - e. the mutual exclusivity of inherent features and prosodic features (movement features).

Regarding timing evidence: the specific temporal relationship among parallel aspects of lexical movement makes it clear that they are linked to timing units and that they are linked to these timing units in similar ways, distinct from those aspects of handshape, orientation, and location that are not part of the movement parameter. Regarding the ability of movement features to “migrate”: phonetic arguments will show that underlying movement melodies are executed on the surface by a “default joint” in the absence of any impetus to the contrary, or by another joint by means of “translation statements” that allow a movement to spread or be displaced to a joint more proximal to the body or to a more distal joint of the arm or hand. This reinforces the position that abstract properties of movement are realized in a variety of phonetic forms. Regarding distribution of prosodic-to-inherent features: I will argue that handshape, orientation, and place of articulation each contain prosodic features—properties that change throughout the articulation of a lexeme—and inherent features that do not change. This division has been demonstrated convincingly with respect to handshape and can be extended to place of articulation and orientation. Regarding distribution of disyllabic movement patterns: the prosodic features in disyllabic forms (i.e., signs with two-movement sequences) that are executed by handshape change, location change, and orientation change can be shown to come from the same set of combinatoric possibilities. Thus, movement prosodies span all of the traditional parameters, and the argument supports grouping handshape changes, orientation changes, and location changes together. Regarding the

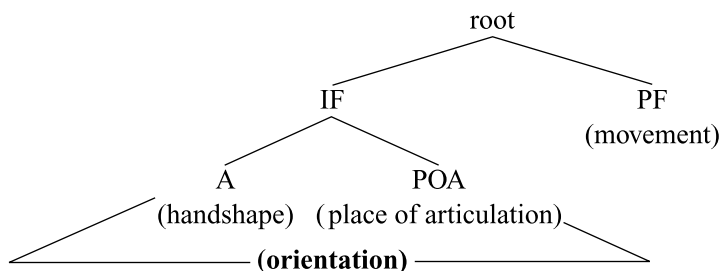
argument that the inherent and prosodic features constitute mutually exclusive sets, with the exception of [ipsilateral] and [contralateral] no feature of the model appears in both the inherent and the prosodic branches of structure. The structure that I will propose is shown in (13).

(13) *Overall structure of inherent and prosodic features in ASL*

a. *Feature organization*



b. *Parameters in the model*



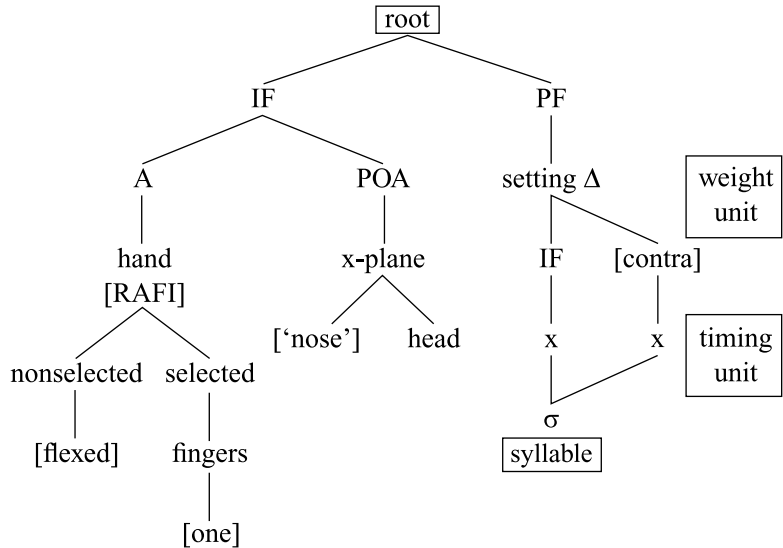
New aspects of the model since Brentari 1990c include an explicit proposal for a feature tree, an explicit proposal for segmental structure, and a more explicit definition of sonority and how it works in ASL phonology. In earlier work I divided the phonological grammar into three levels of structure: the M(orphological) Level, which contained the underlying structure and the sonority hierarchy; the W(ord) Level, which contained the syllable template and constraints on distinctive features; and the P(honetic) Level, which added redundant features to strings and expressed constraints dealing with timing units. Here I have abandoned this division



Figure 1.16
FALSE

into levels, because the structural units themselves and constraints among them can achieve the necessary contrasts and perform the operations to construct the phonological grammar.¹² The structure for FALSE (figure 1.16) argued for in this book is given in (14).

(14) *Prosodic Model representation of FALSE*



In the Prosodic Model, sonority will be defined phonetically both perceptually and articulatorily. Perceptually, it is defined as the property that enhances the ability of a property of a sign to be perceived at greater

distances; in this regard, perceiving a property of a sign, discriminating it from other similar properties, and identifying it are taken to be separate operations in the act of comprehension. Articulatorily, sonority is defined and measured on the basis of the joint(s) used to articulate a single movement. The specific claim that the Prosodic Model makes about sonority is that it is expressed differently in sign languages than in spoken languages, but that in both cases it involves perceptual salience. The formal difference between sonority in spoken languages and sonority in sign languages is that in the former sonority can be calculated from the presence of a single feature, which is an inherent property of the sound in question, whereas in the latter it must be calculated from the difference between two prosodic features in a sequence. Furthermore, sonority in sign languages is subsumed under the notion of phonological complexity. Phonological complexity, described in Dependency Phonology (Anderson and Ewen 1987; Dresher and van der Hulst 1994), is based on the number and type of branching structures contained in a given form. This notion captures a grammatical preference for economy of structure in grammars, and also allows for a grammar to distinguish between structures of greater or lesser complexity. For example, stress phenomena in spoken languages often co-occur with the most complex unit at a specific level of structure (i.e., foot or syllable structure); therefore, it becomes important for a grammar to make such complexity distinctions.

The Prosodic Model also makes an explicit proposal regarding segmental structure, defining segments as the minimal concatenative units of the system. As in earlier versions of the model, a mora fulfills the minimal requirement for a well-formed syllable, and moras are weight units that may occur simultaneously with one other. One advance of the current version is to show how moras and segments interact with one another and how they play a role in constraining phonological outputs.

1.3.1 Support for a Unified Group of Movement Features: Timing Evidence

The first argument in (12) is based on the timing of handshape change, orientation change, location change, and path movements within words, and how it aids in independently establishing the binary branching structure of movement features (or prosodic features) and inherent features.

In studies focusing on a measure called the *handshape change duration/movement duration ratio* (abbreviated HSA/Mov ratio), Brentari and

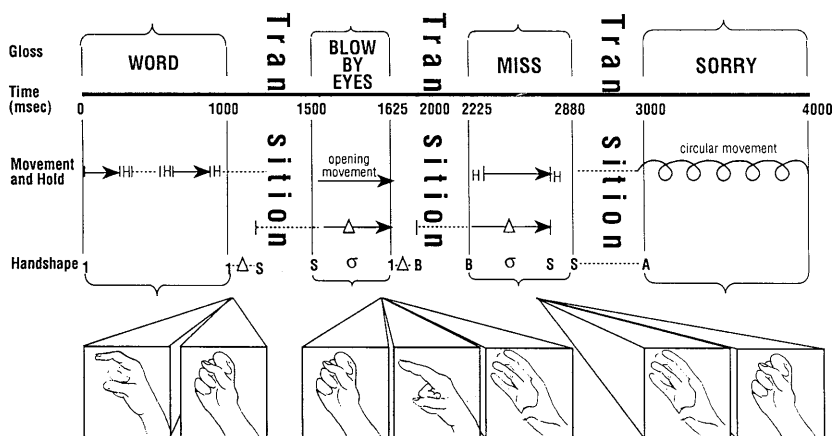


Figure 1.17

Temporal relations of WORD BLOW-BY-EYES MISS SORRY (from Brentari, Poizner, and Kegl 1995)

Poizner (1994) and Brentari, Poizner, and Kegl (1995) found an interesting type of systematicity in all prosodic features. The HSA/Mov ratio measure is the amount of time a subject takes to execute a given handshape change simultaneously with a given movement. Consider the example in figure 1.17. In the ASL sentence WORD BLOW-BY-EYES MISS SORRY 'The word went by too quickly. I missed it, sorry', the handshape remains the same throughout the signs WORD and SORRY; that is, there is no word-internal handshape change. There is a word-internal handshape change in the signs BLOW-BY-EYES and MISS. Between WORD and BLOW-BY-EYES and between BLOW-BY-EYES and MISS there is also a handshape change, but it is a transitional one between signs. In frame-by-frame analysis of recorded, spontaneous signing and elicited signed sentences by signers with Parkinson's disease and by age-matched controls, we found that in the productions of control signers the HSA/Mov ratio is very high word-internally and very low between words. Examination of the first and second handshape changes reveals this difference. Between WORD and BLOW-BY-EYES the handshape change takes only a small portion of the time that the movement takes and is not temporally linked to the beginning and end of the movement (i.e., a low HSA/Mov ratio—approximately 40%); the word-internal handshape change in BLOW-BY-EYES occurs simultaneously with the

movement and is temporally linked with the beginning and end of the movement (i.e., a high HSA/Mov ratio—approximately 100%). Further measures of orientation changes reveal the same co-temporal relationship.

The systematic coupling and decoupling of handshape changes and movements has an important theoretical implication: namely, it constitutes evidence that the representation of word-internal movements includes timing units. In purposeful nonlinguistic gesture, the joints are systematically coordinated but not necessarily co-temporally so (Poizner et al. 1990; Poizner 1990).¹³ Because ASL is a system of purposeful gestures, coordination between local and path movements (Sainburg et al. 1995), but not co-temporal linking, would be expected here as well. The crucial point is that syllable-internal movement components within ASL words are unexpectedly co-temporal when contrasted with nonlinguistic complex movements of the same type. The features grouped together as prosodic features in the model are all temporally linked in the same manner with units on the timing tier. This is support for grouping these features together in the phonological representation, and it is an important step in establishing the fact that changing features are alike in the way they behave toward timing units.

1.3.2 Support for a Unified Group of Movement Features: Distalization and Proximalization of Movement

The next argument in (12) is that abstract movement categories govern the production of movement and therefore should be dominated by a single node in the feature tree. Movements are phonetically realized by “default joints” that execute handshape changes (i.e., finger joints), orientation changes (i.e., wrist and forearm), path features (i.e., elbow), and setting changes (i.e., shoulder). However, a sign is often executed by joints in addition to those specified by its default joint by a process of movement spread, or by joints other than those that execute it in the default case. The table that follows lists five signs, each with three variants: a *citation form*, a *reduced* (or *distalized*) *form*, and an *enhanced* (or *proximalized*) *form*.¹⁴ (Distal joints are smaller joints, closer to the extremities; proximal joints are larger joints, closer to the torso.) Figure 1.18 shows two versions of the one-handed form of TAKE, a sign with a path movement and a handshape change: the citation form, using the default joints, and the reduced form, in which the movement has been distalized from the elbow to the wrist.



Figure 1.18
The citation form of TAKE (left), which is a sign with a path movement and a handshape change, and the reduced form of TAKE (right), with a handshape change and a movement that has been distalized from the elbow to the wrist

Examples of signs with movements executed by their default joints and by atypical joints

	Default joint(s)	Reduced form (“dis- talized form”)	Enhanced form (“proximalized form”)
REFER	wrist	knuckles	+elbow
SEND	fingers/elbow	fingers/wrist	+shoulder
TAKE	fingers/elbow	fingers/wrist	+shoulder
ASK	fingers/elbow	fingers/wrist	+shoulder
GIVE	fingers/elbow	fingers/wrist	+shoulder

The next few paragraphs discuss the anatomical and physiological underpinnings of proximalization and distalization. Figure 1.19 (left) shows the *fundamental standing position* (hands at sides, palms in). The Prosodic Model defines the *fundamental signing position* as shown in figure 1.19 (right); it consists of the fundamental standing position, with the addition that the elbows are flexed.¹⁵ In figure 1.20 the three dimensions and planes in which movements are executed are shown with respect to the body: the x dimension projecting forward from the body, the y dimension projecting vertically from the top of the head, and the z dimension projecting from the sides (Luttgens and Hamilton 1997, 38). Since a plane can be defined by the dimension running perpendicular to it,

the planes shown in figure 1.20 are described as the frontal (i.e., x-) plane, the transverse (i.e., horizontal, y-) plane, and the midsagittal (i.e., z-) plane; these are the terms I will later use in referring to planes of articulation. In the table that follows I list the joints of the arm and hand (omitting the thumb joints, because they do not bear on this discussion). Figures 1.21–1.23 illustrate the movement types based on the various joint possibilities.¹⁶

Articulatory correlates—joint capabilities

Common name	Anatomical name	Type of joint	Degrees of freedom	Utilization in ASL movement types
shoulder	glenohumeral	ball & socket	3-axial	(path movement)
elbow	humeroulnar	hinge	1-axial	(path movement)
	humeroradial	ball & socket	3-axial	(path movement)
forearm	prox. radioulnar	pivot	1-axial	(orientation Δ)
	distal radioulnar	pivot	1-axial	(orientation Δ)
wrist	radiocarpal	ovoid	2-axial	(orientation Δ)
fingers	metacarpophalangeal	ovoid	2-axial	(handshape Δ)
	prox. interphalangeal	hinge	1-axial	(handshape Δ)
	distal interphalangeal	hinge	1-axial	(handshape Δ)

The names and types of joints are of more anatomical and physiological interest than phonological interest. What is of phonological interest is that movements of signs can be executed in similar manners by a number of joints of the hand and arm. One example is that the fingers, wrist, elbow, and shoulder all allow vertical flexing movements; therefore, given a particular palm orientation, these joints can execute many phonetic variants of direction-of-movement features. Another example is that any of the following combinations of joint movements result in a circular movement: abduction/adduction and flexion/extension of the fingers, flexion/extension of the wrist and rotation of the forearm, flexion/extension and abduction/adduction of the wrist, horizontal flexion/extension of the shoulder and vertical flexion of the elbow, flexion/extension and abduction/adduction of the shoulder.

In the case of phonetic enhancement, the movement spreads from the default joint to a more proximal joint; in the case of phonetic reduction, movement migrates to a more distal one. The spread of joint extension

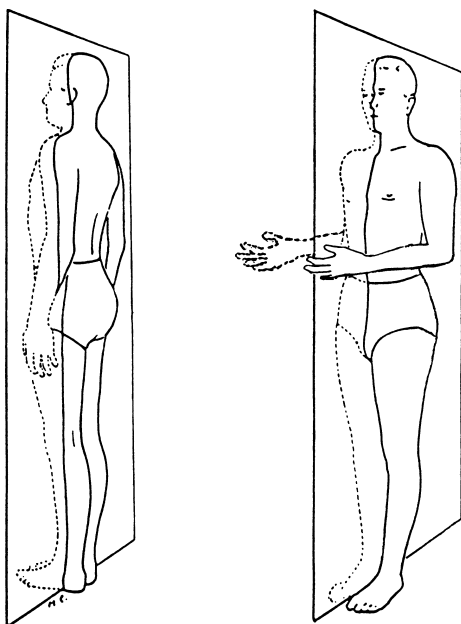


Figure 1.19

The fundamental standing position (left), with hands at sides and palms oriented inward toward the midsagittal plane. In the fundamental signing position (right), the elbows are flexed, and the three dimensions and planes in which movements are executed with respect to the body are taken into consideration. (Based on Luttgens and Hamilton 1997, 38, fig. 2.8; by permission.)

from wrist to elbow is an effect that cannot be easily captured if orientation and path movement are in separate portions of the representation, as they are in other current models of sign phonology. In the models proposed by Sandler (1989), Wilbur (1993), and Uyechi (1995), changes in handshape, orientation, and place of articulation are represented in separate places. In the Prosodic Model this type of enhancement or reduction can be straightforwardly handled by adding an association line within the prosodic branch of structure, since orientation and path movements are dominated by a single node in the representation. Furthermore, abstract features of movement such as [direction] and [tracing] show the common basis of movement classes, regardless of whether they are articulated by the shoulder, elbow, wrist, or hand joints.

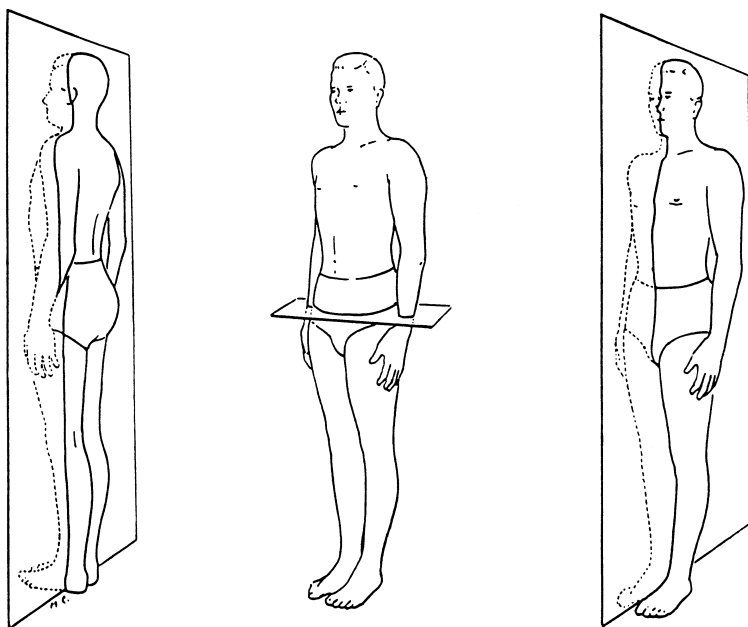


Figure 1.20

The planes of articulation are described as the ventral (i.e., frontal, x-) plane (left), the transverse (i.e., horizontal, y-) plane (middle), and the midsagittal (i.e., z-) plane (right) (from Luttgens and Hamilton 1997, 38; by permission).

1.3.3 Support for a Unified Group of Movement Features: Many-to-One Relation in the Core Lexicon

The third argument in (12) is that all four parameters of sign languages—handshape, orientation, location, and movement—exhibit a many-to-one autosegmental relationship between prosodic features and inherent features based on their distribution. The various representations proposed for sign languages (see (15)–(21)) suggest generalizations about the way features have been grouped. (The details of these models will be explained as needed later; at this point only the number of parameters represented and the relations among the tiers of features are important.) In the models proposed by Stack (1988), Uyechi (1995), and van der Hulst (1996)—(15)–(17)—handshape, orientation, and location are the only parameters, and these are dominated by the root node of the feature tree. In the models proposed by Ahn (1990), Wilbur (1993), and Liddell and Johnson (1989)—(18)–(20)—movement or manner of movement is

on a separate tier from handshape, orientation, and location, but movement in these models is defined as path movement only, and local movements are dominated by the place, handshape, and orientation class nodes. The Hand Tier Model proposed by Sandler (1989), a schema of which is given in (21), separates handshape and orientation from movement and location. Sandler argues that hand configuration features form a unified group and should be separate from location and movement features, and that location and movement features form the bases of segmental structure.

(15) *Model of feature organization proposed in Stack 1988*

(*HS, O, L*|| \emptyset)

FALSE

LOC [nose, ipsi] [nose, contra]

PO [to nose]

HC [1, open]

(16) *Model of feature organization proposed in Uyechi 1995*

(*HS, O, L*|| \emptyset)

FALSE

LSS	[Loc: [+base-LSS:nose-GSS]]	
in		Or: ["anchored (default)"]		
GSS		[HP Loc in [base-HP:+base [+center]] LSS Or [front-HP:contra side-LSS top-HP:+local-LSS] [front-HP:local-LSS top-HP:contra side-LSS]

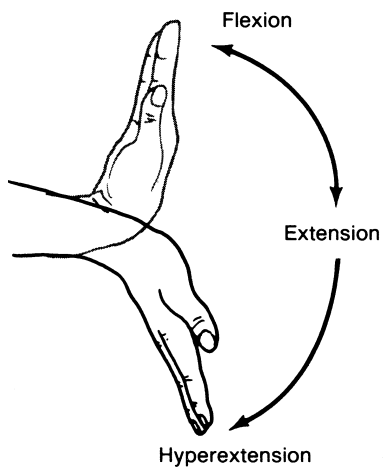
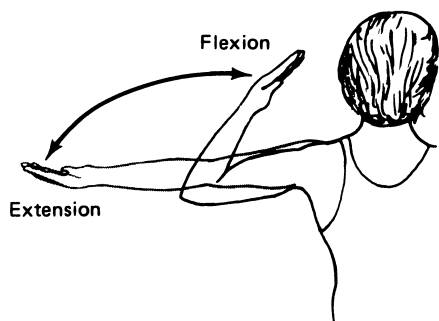


Figure 1.21

Movement types and possible joints of execution: vertical or horizontal extension or flexion (from Luttgens and Hamilton 1997, 142, 153, 158; by permission)

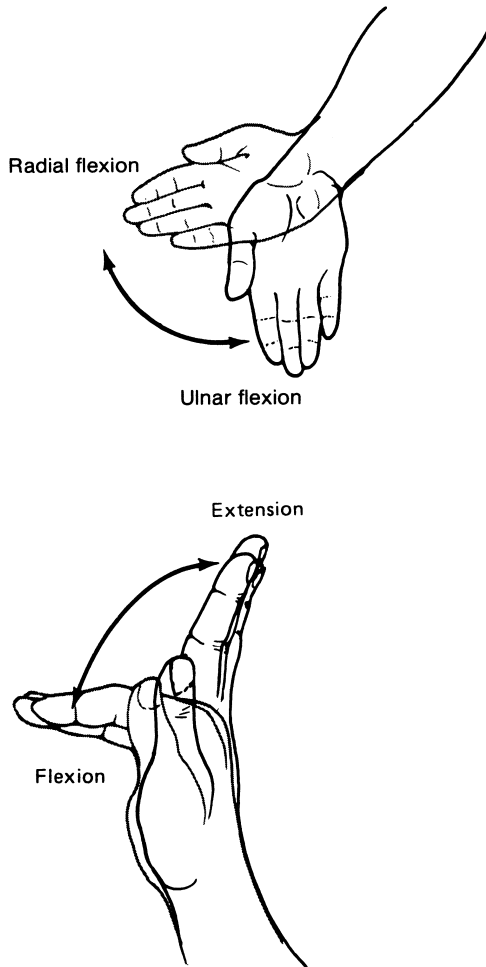


Figure 1.21 (continued)

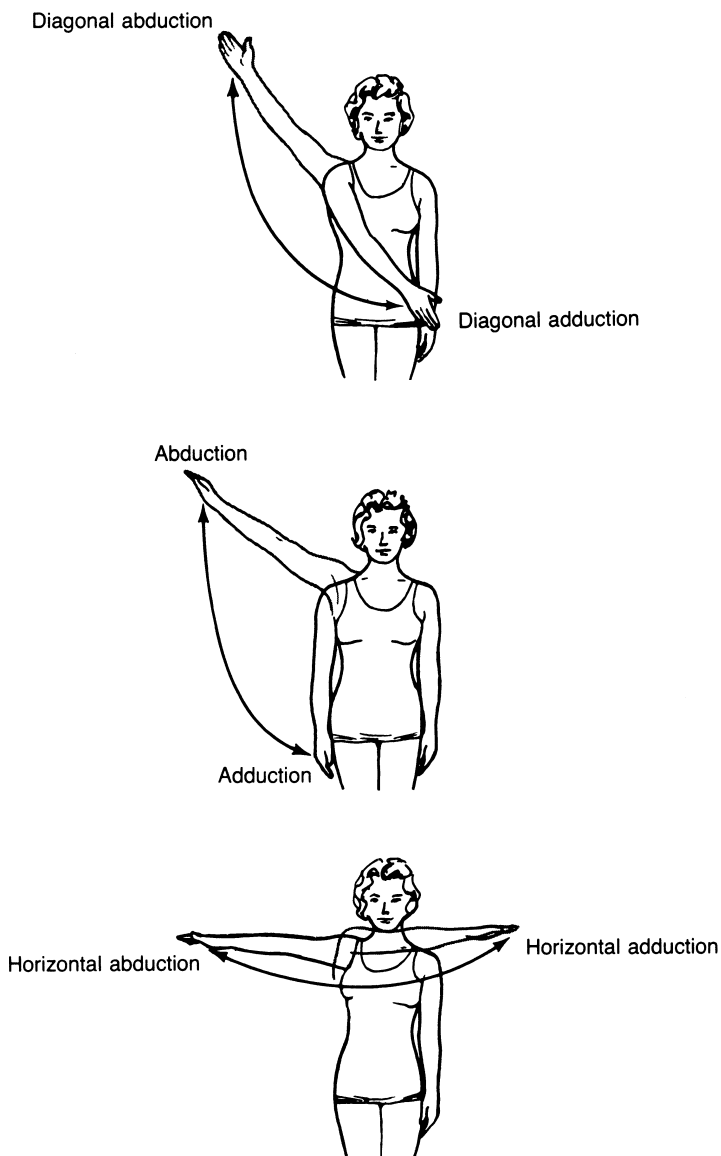


Figure 1.22

Movement types and possible joints of execution: abduction or adduction (from Luttgens and Hamilton 1997, 116, 158; by permission)

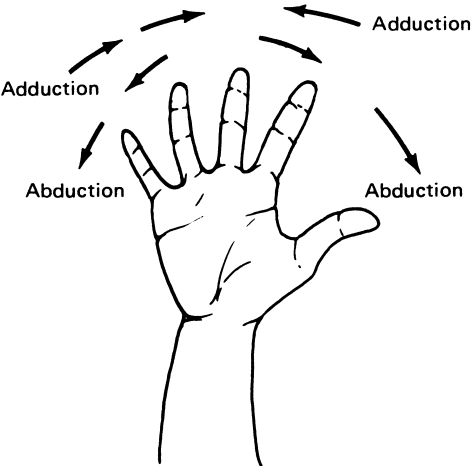
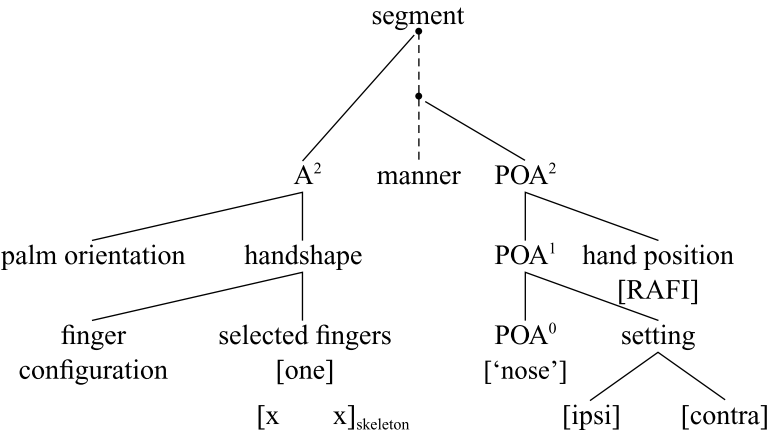


Figure 1.22 (continued)

(17) *Model of feature organization proposed in van der Hulst 1996*
(*HS, O, L||∅*)
FALSE



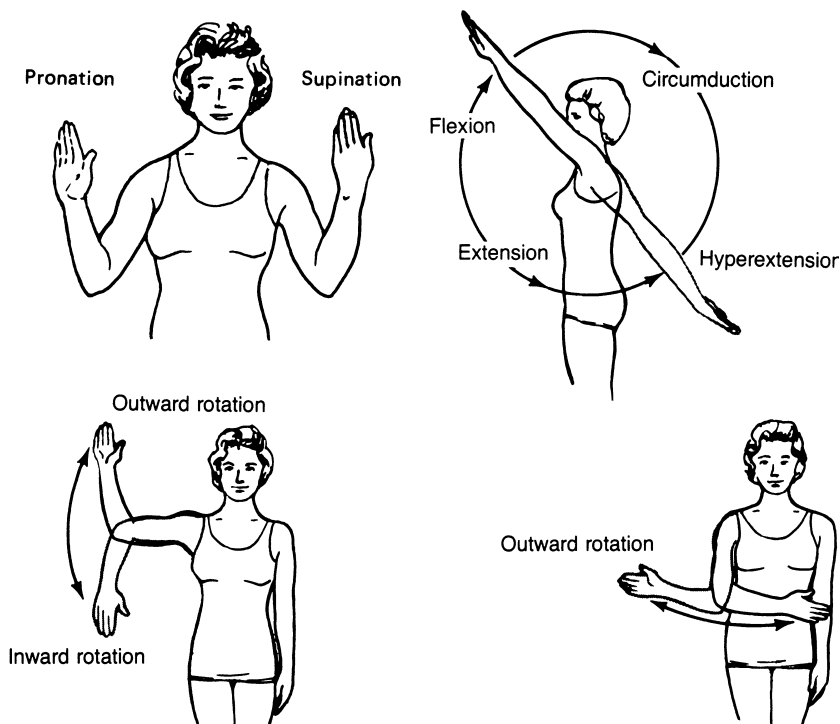
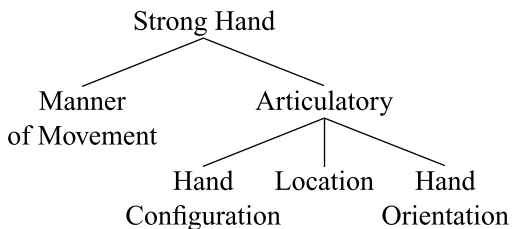


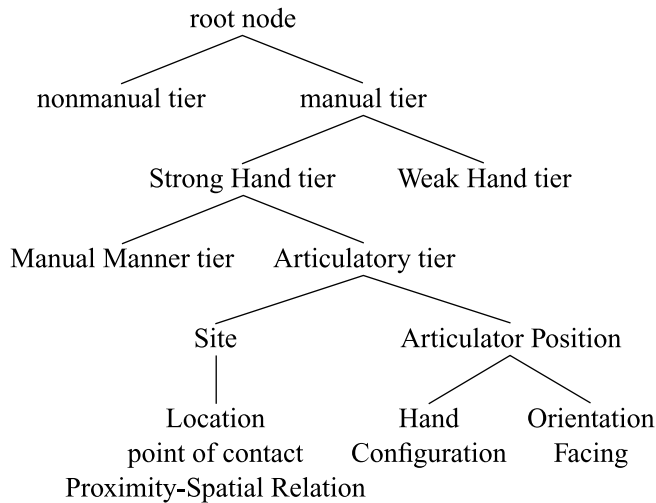
Figure 1.23

Movement types and possible joints of execution: rotating movement (from Luttgens and Hamilton 1997, 116, 142; by permission)

- (18) *Schematic model of feature organization proposed in Ahn 1990*
 (HS, O, L||Manner)

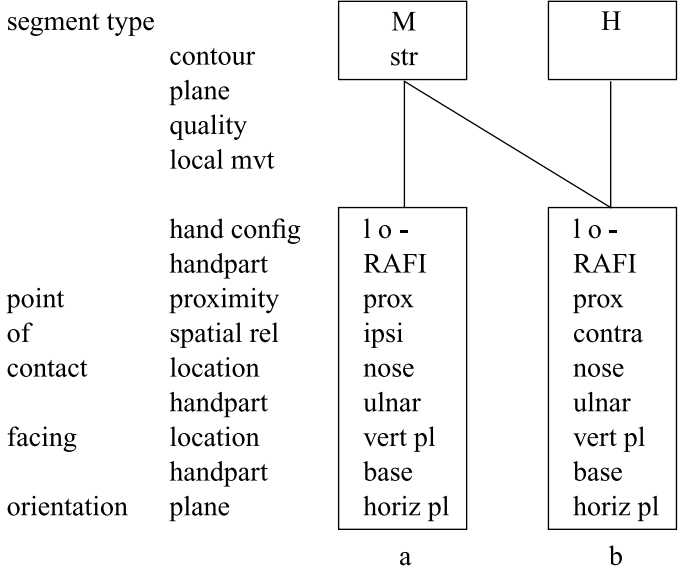


(19) *Schematic model of feature organization proposed in Wilbur 1993 (HS, O, L||Manner)*



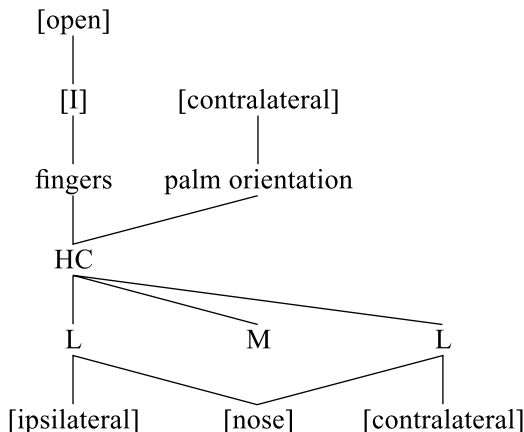
(20) *Model of feature organization proposed in Liddell and Johnson 1989 (HS, O, L||M)*

FALSE



- (21) *Model of feature organization proposed in Sandler 1989*
 (HS, O||L, M)

FALSE



Within the hand configuration tier, following insights by Mandel (1981) and Stokoe (1960), Sandler argues that “selected fingers” should be separated in the representation from “position” (“aperture” in the Prosodic Model). She bases her argument on the distribution of the two types of features in monomorphemic signs, such as those in (22) (see figure 1.3 for photograph of THROW): signs of this class use just one set of selected fingers but may exhibit more than one position.

- (22) *Signs with two aperture features and one set of selected fingers*

THROW	closed ‘H’ → open ‘H’
ASK	open ‘1’ → curved ‘1’
INFORM	flat ‘B’ → open ‘B’

The same argument concerning the division of labor between selected fingers and position can be extended to major body place (“place” in the Prosodic Model) and major body position (“setting” in the Prosodic Model). Features of place and setting are distributed in monomorphemic signs in the same way as selected fingers and aperture. There is typically only one place of articulation, even though the setting within that place may change. Example signs are given in (23); figure 1.24 illustrates the sign DEAF. Sandler (1987a) analyzes this phenomenon as place harmony, rather than proposing a unified analysis for handshape and loca-



Figure 1.24
DEAF

tion, even though in her representation of location, major body place and setting are on separate tiers dominated by the Location feature tree, just as position (i.e., aperture) and selected fingers are dominated by the hand configuration node.

(23) *Signs with two setting features and one place*

FLOWER	contra ['nose'] → ipsi ['nose']
BODY	top ['torso'] → bottom ['torso']
DEAF	top ['cheek'] → bottom ['cheek']

The next step is to extend the notion of the division of labor between inherent and prosodic features within sign handshape and location to the orientation parameter. As Crasborn (1995) makes clear in his description of joint movement, the orientation parameter is quite complex to represent, because the joints in the forearm are responsible for prone/supine rotation, and the wrist is responsible for both vertical and horizontal extension/flexion and abduction/adduction. Although all three movements are physiologically possible, for any given lexeme at least one and more often two of them remain constant, and if two movements involving orientation change within a sign, they change in sequence rather than in parallel. Examples are given in (24); figure 1.25 illustrates the use of each type of orientation change in the signs REBEL, INSULT, and YES.



Figure 1.25

Possible types of movements involving changes in orientation. In REBEL (top left), the movement involves pronation of the forearm, an orientation change from [supination] to [pronation]; in INSULT (top right), the movement involves radial flexion (or [abduction]); in YES (bottom), the movement involves [flexion] of the wrist.

(24) *Signs with an orientation change*

HAPPEN, REBEL: supination \rightarrow pronation (IF \rightarrow [pronation])

no side-to-side or vertical movement

INSULT, ALL RIGHT: adduction \rightarrow abduction

(IF \rightarrow [abduction])

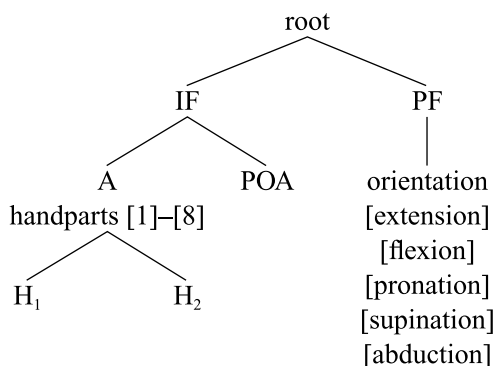
no vertical movement or rotation

YES, FIGHT: extension \rightarrow flexion (IF \rightarrow [flexion])

no side-to-side movement or rotation

In HAPPEN and REBEL, there is no side-to-side or vertical movement, only rotation; in INSULT and ALL RIGHT, there is no vertical movement or rotation, only radial flexion (or abduction); in YES and FIGHT, there is no side-to-side movement or rotation, only vertical flexion. These facts can be captured as shown in (25) by allowing the types of movement possible with the forearm and wrist to be expressed as features dominated by the prosodic feature branch of structure; the constant properties are captured by features dominated by the inherent feature branch. By employing a two-part relation between the relevant handpart of a given handshape and the major body place of articulation, the Prosodic Model account stabilizes the relevant aspects of inherent orientation. This is all that is necessary to capture the constant properties of orientation. The details of this analysis are given in chapter 3.

(25) *Representation of inherent and prosodic aspects of orientation*



That orientation should be treated as a relation between two aspects of phonological structure has been proposed by Liddell and Johnson (1989), Uyechi (1995), and Crasborn and van der Kooij (1997). In the Hand Tier Model, Sandler (1989) proposes the use of features, but these are not sufficient to capture orientation because they are based on palm orientation alone; this creates ambiguities in the lexicon. Consider forms like OLD, LOVE-SOMETHING (i.e., 'kiss'), and CHERISH. The place of articulation is the chin, and if the handparts are specified with respect to it, only one feature is needed to capture the contrastive orientation of the hand: radial for OLD, back of palm for LOVE-SOMETHING, and back of fingers for CHERISH. The eight places on the hand used to specify underlying orientation (figure 1.26) are the same eight places on the hand

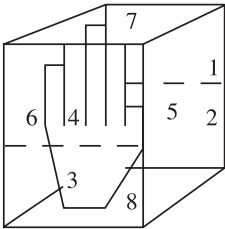


Figure 1.26
Schema of places on H₂

that are needed to express the places of contact on H₂ in type 3 two-handed signs.

Hand places¹⁷

	Role in two-handed signs	Role in underlying orientation
[1] Palm of hand	LEARN	MY
[2] Finger fronts	DISMISS	LABEL
[3] Back of palm	TOUCH	LOVE-SOMETHING
[4] Back of fingers	EASY	CHERISH
[5] Radial side of selected fingers	WOOD	OLD
[6] Ulnar side of selected fingers	TICKET	BROKE (i.e., ‘no money’)
[7] Tip of selected fingers/thumb	TOP	COMPLAIN
[8] Heel of hand	CHEESE	SLIP

1.3.4 Support for a Unified Group of Movement Features: Movement Sequences in Disyllabic Signs

The fourth argument in (12) in favor of analyzing movements as prosodies is that disyllabic signs contain the same limited set of movement sequences, regardless of whether they are path, handshape change, orientation change, or location change movements. This unified distributional behavior further supports placing all movements in a single phonological group, rather than having movements of separate phonological parameters in different branches of structure. ASL contains a reasonably large number of disyllabic signs, but these signs exhibit relatively few permissible combinations of movement types, just as tonal languages exhibit a relatively small set of tonal melodies. The following table lists ten different types of movement, along with the ways in which

movement types are expressed in path movement (or location change), handshape change, and orientation change. Possible monosyllabic movements as well as disyllabic sequences are included. Signs showing the realization of one two-movement sequence ([O], [—]) are given in figure 1.27.

Abstract movement types and their expression

	Path (location Δ)	Handshape Δ	Orientation Δ
1-movement types			
straight: from [>]	TELL	WAKE-UP	OPEN
straight: to [<]	SIT	SAY-NO	CLOSE
tracing [—]	BLACK	****	LONG
circle [O]	YEAR	BEAUTY	ALL
2-movement sequences			
repeat	MILITARY	MELON	BETRAY
repeat: 90° '7'	DETROIT	REMOVE	****
repeat: 90° 'X'	CANCEL	****	HOSPITAL
repeat: set. _i set. _j	CHILDREN	NAVY	GO/RETURN HERE
repeat: 180° (bidirectional)	JUMP	WHITE (race)	COOK
alternating	BICYCLE	JESUS	COMPETITION
[O], [—]	WHEN	APPOINTMENT	LOCK

Among disyllabic signs, the widest range of movement sequences is found in path movements. Both handshape change and orientation change display a subset of the sequence types that path movements display. If handshape change, orientation change, and place-of-articulation change were functioning as independent branches of structure, we would expect to find a few places where these three different types of movement fail to overlap—but we don't. Some ill-formed combinations of handshape and orientation movement sequences are given in (26). Figure 1.28 shows an impossible monomorphemic lexeme combination, containing an ill-formed straight+circular movement.

(26) *Nonoccurring disyllabic sequences in monomorphemic words*

- a. *wrist extension of open 'B', followed by a closing 'B'
- b. *prone 'B' → supine 'B' → abducted 'B'
- c. *straight movement → circular movement



Figure 1.27

Signs showing realization of a two-movement, circular+straight combination (i.e., [O] [—]) sequence. The circular movement is realized as a path movement in WHEN (top left), as a handshape change in APPOINTMENT (top right), and as an orientation change in LOCK (bottom).

The fact that orientation and handshape disyllabic sequences are proper subsets of the set of path movement disyllabic sequences is evidence that these sequences constitute one set of abstract phonological categories that cut across these different sorts of realizations. On the basis of this evidence, I conclude that the prosodic node of structure dominates all features of this type.

1.3.5 Support for a Unified Group of Movement Features: Exclusivity of Feature Sets

The fifth argument in (12) for the binary split in structure between inherent and prosodic features is that the two sets of features are mutually ex-



Figure 1.28

An ill-formed two-movement, straight+circular sequence for monomorphemic signs. It occurs legitimately in the phrase ${}_2\text{GIVE}_1$, SORRY ‘Give [it] to me, sorry’.

clusive, except for two features [ipsilateral] and [contralateral]. I list the members of each set in (27)–(28); I will justify and further define them in subsequent chapters.

(27) *Inherent features*

a. *Articulatory features*

[symmetrical]: analogous parts of the hand oriented toward each other (e.g., WITH, REQUEST, BICYCLE)

[spread]: fingers contrastively spread (e.g., JAIL, FOOTBALL, WANT)

[flexed]: fingers bent at specified joints (e.g., GIVE, WANT, SNAKE)

[stacked]: fingers in a position, one above the other as in a “squash racket grip,” with the index finger on top and pinkie finger on the bottom (e.g., FEW, ‘K’)

[crossed]: fingers crossed middle over index (e.g., ROPE, CIGAR)

[opposed]: thumb in a plane perpendicular to the palm

[unopposed]: thumb in the same plane as the palm

[all]: all fingers selected

[one]: one finger selected

[ulnar]: reference made to the pinkie side of the hand

[mid]: reference made to the middle finger

[extended]: nonselected fingers extended rather than flexed

[2-handed]: sign articulated with two hands

b. *Place-of-articulation features*

- [1]–[8]: vertical strips that divide the head, arm, or torso into eight regions, and H₂ into eight places
- [ipsilateral] ([ipsi]): same side of the body as H₁
- [contralateral] ([contra]): opposite side of the body from H₁
- [contact]: contact with a place of articulation or between the two hands

(28) *Prosodic features*

- [ipsilateral] ([ipsi]): same side of the body as H₁ within a place of articulation
- [contralateral] ([contra]): opposite side of the body from H₁ within a place of articulation
- [top]: the upper portion of a place of articulation
- [bottom]: the lower portion of a place of articulation
- [arc]: an arc movement shape
- [distal]: a setting relatively far from the body within a y-plane or a z-plane
- [proximal]: a setting relatively close to the body within a y-plane or a z-plane
- [straight]: a (contrastive) straight movement shape
- [circle]: a circular movement shape
- [trilled movement]: an uncountably, rapidly repeated movement
- [alternating]: a movement in two-handed signs in which the hands are 180° out of phase
- [pivot]: a movement that maintains one fixed point around which the movement occurs
- [repeat]: a movement that is repeated (e.g., MILITARY, COUGH)
- [tracing]: a movement that takes place within a plane
- [direction]: a movement that takes place perpendicular to a plane
- [extension]: a movement extending the wrist
- [flexion]: a movement flexing the wrist
- [pronation]: a movement to a prone position of the palm
- [supination]: a movement to a supine position of the palm
- [abduction]: radial flexion of the wrist
- [open]: a handshape change to an [open] allophonic handshape
- [closed]: a handshape change to a [closed] allophonic handshape

The mutual exclusivity of feature sets in the Prosodic Model introduces several innovations. The first, which I adopt from van der Hulst 1995,

separates the features specifying the joints [flexed] in underlying handshapes and the aperture settings [open] and [closed]. Previous work on handshape has conflated these two roles, but separating them achieves a more comprehensive account of underlying handshapes and a more predictive account of handshape change (for more detail, see chapters 3 and 4). Second, in the parameter of orientation, the functions served by the inherent and prosodic features are strikingly different. As an inherent property, orientation is relational; it is a relation between a handpart and a place, and the only features that must be added to account for this are the specifications for the eight surfaces of the hand. Prosodic features of orientation are not relational; they specify absolute values such as [supination], [pronation], [flexion], and [extension], which capture the way the wrist can move. Third, the feature [contact] is an inherent feature in the Prosodic Model. In previous work (Brentari 1988, 1990c) I have argued that [tracing] is a path feature that predicts continuous contact throughout a movement, whereas [direction] is a path feature that predicts contact at either the beginning of a path movement ([direction: |>]) or the end ([direction: >|]). Thus, [contact] no longer needs to be a property of both place of articulation and movement; instead, it can be seen as an inherent feature in a system in which its phonetic realization can be predicted on the basis of path features.

There are, however, two features that are both inherent and prosodic: [ipsilateral] and [contralateral]. There is at least one pair of signs for which [ipsilateral] and [contralateral] are contrastive—namely, PITTSBURGH and LEATHER. These features function also as settings in a very productive way—FLOWER, CONGRESS, NAVY. Note also that [flexed] is an inherent feature of handshape, whereas [flexion] is a prosodic feature of orientation. Likewise, [extended] is an inherent feature of handshape, whereas [extension] is a prosodic feature of orientation. To date I have not been able to solve these problems, and I leave them for future research.

In sum, these five arguments justify only the initial split into inherent and prosodic features. In order for the model to work, the sub-branches forming the internal structure of each branch must be cohesive, and their relation to segmental and syllable structure must be spelled out. In later chapters I will make proposals in these regards. I will address the phonological function of each substructure, and in chapter 8 I will compare each with its spoken language counterpart, so that future research can reexamine the definition of these fundamental phonological units.

Chapter 2

The Use of Constraint-Based Frameworks and Prosodic Units in Analyses of Sign Languages

2.1 General Assumptions

In this chapter I will highlight the aspects of phonological theory that will be relevant for my analyses, and I will point out aspects of other researchers' work on sign language phonology that the Prosodic Model draws upon. First, however, I would like to explicitly state a few basic assumptions, since they are part of the specific tacit knowledge about the field that helps to shape the problems and analyses taken up here.

General assumptions

1. Lexical entries are determined by eliminating all possible redundancy due to grammatical operations; they should minimize abstract elements to the greatest extent possible (see Halle 1959; Chomsky and Halle 1968 (*SPE*), 12).¹
2. A grammar should operate on the principles of simplicity and economy. It should contain the fewest number of constraints, and these constraints and the representations referred to in them should contain the fewest number of "marks" possible. The grammar should cover as many forms as possible with the fewest number of exceptions. Frequent operations should be easy to express; infrequent or nonoccurring operations should be difficult to express (see *SPE*, 330–335; Clements 1985).²
3. The phonological word is subject to all phonological operations, and morphological and phonological boundaries are visible to the phonology (see *SPE*, 371; Goldsmith 1989).³
4. Phonological words are constructed out of the underlying representations of their component morphemes in one step (*SPE*, 13; Goldsmith 1989).

5. Surface forms seek to meet the well-formedness conditions of the language to the greatest extent possible (Goldsmith 1989; Prince and Smolensky 1993; McCarthy and Prince 1993b).

6. Units of analysis can be uncovered by internal linguistic evidence (e.g., by finding minimal pairs and by observing the units referred to in phonological operations) and supported by external linguistic evidence (e.g., diachronic change, language acquisition, language breakdown).

Assumptions 1–2 are very general and have been accepted in the field at least since *SPE*. The seeds of assumptions 3–5 are found in *SPE*, but during the period dominated by Lexical Phonology, these ideas were reconfigured. For example, assumptions 3–4 express ideas about boundaries that have attracted renewed attention in constraint-based models, ideas that resonate more with their original formulation in *SPE*: that is, the boundaries themselves are always straightforwardly visible to the phonology rather than being visible only during a specific portion of the derivational process. In the analyses developed in this book, I will adopt the following principles and formalism specific to Optimality Theory:

Principles of Optimality Theory adopted in this book (from Prince and Smolensky 1993; McCarthy and Prince 1993b)

1. Each possible output candidate that is generated is evaluated for its well-formedness with respect to the ranked set of constraints.
2. Constraints on forms are ranked with respect to one another in a constraint tableau. This indicates the extent to which a constraint is violable (i.e., it exhibits surface exceptions).
3. Constraints are intended to be universal; hence, they are expressed in the most general possible terms rather than in language-particular ways.
4. The principle of *Local Constraint Conjunction* holds and is defined as follows: A and B are each ranked lower than constraint C ($C \gg A, B$), and this no longer holds true when both A and B are violated. This allows $A+B$ to be ranked higher than either A or B alone.⁴

Constraints in Optimality Theory should not look like language-particular rules, but instead they are instantiations of the more general families of phonological operations that are known to exist. In the Prosodic Model, two such constraint families are important for analyzing ASL: ALIGNMENT and FAITHFULNESS. The ALIGNMENT constraints align the edges of prosodic units, such as syllables, with morphological or morphosyntactic units, such as stems; they play a role in the analysis of

fingerspelled borrowings in chapters 5–6. The FAITHFULNESS constraints require that the input should look like the output as much as possible. Features in the input should appear in the output; this is ensured by PARSE constraints (i.e., there should be no deletion). Features in the output should have a corresponding feature in the input; this is ensured by FILL constraints (i.e., there should be no epenthesis).⁵ PARSE constraints play a role in the analysis of two-handed signs and fingerspelled forms. Local Constraint Conjunction is needed to account for the distribution of the optional operation of Weak Drop (Padden and Perlmutter 1987), in which a two-handed input surfaces as a one-handed output.

2.2 How Constraint-Based Models Operate

In this book I adopt a constraint-based approach to phonological operations rather than a derivational one. In Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993a,b) and Harmonic Phonology (Goldsmith 1989, 1990, 1991, 1993), as well as in other constraint-based theories such as Declarative Phonology (Scobbie 1991, 1993) and Theory of Constraints and Repair Strategies (LaCharité 1993; Paradis 1988; LaCharité and Paradis 1993), surface forms are arrived at using nonderivational constraints. These models differ in many ways, but they all have the result of displacing the derivation—which had been a cornerstone of phonological theory since *SPE*, and in linguistics as a whole since the late 1950s (Chomsky 1957)—from its central role in phonology. Although the constraint mechanisms needed to describe spoken languages have been shown to be quite complex, the constraints proposed by these nonderivational models can perform much, if not all, of the temporal work performed by the derivation, and even by the cycle as it was formulated in Lexical Phonology (Kiparsky 1979, 1982).

Sign language phonology is a fertile context for addressing issues of abstract representations, because sign language presents fresh challenges to an architecture of phonology theory based on spoken languages. The interaction of sign language phonology with the phonology of spoken languages is advantageous to both enterprises. Sign languages benefit from an enhanced range of structure, since abstract prosodic units such as the mora, the minimal word, and the syllable provide new tools for addressing sign-specific problems. Spoken language phonology models can benefit from the test of submitting the definitions of these units to the