Properties of Symbols in a Silent Language

2 The study of the structural properties of the sign languages used by deaf people is still in its infancy. For several centuries interest in sign language was the exclusive domain of speculative philosophers and pragmatic educators. But with the recent revolution in linguistics the study of sign language has assumed a new prominence. As questions about the nature and fundamental properties of human languages—questions about universal grammar—are formulated, understanding the properties of sign languages becomes of increasing importance.

At a 1965 conference entitled "Brain Mechanisms Underlying Speech and Language," Chomsky gave what has become the standard characterization of having a command of a language: "a language is a specific sound–meaning correspondence . . . Command of a language involves knowing that correspondence" (Chomsky 1967). Asked how he would consider the sign languages of the deaf in terms of this general characterization, Chomsky replied that he would rephrase his characterization so as to read a specific "*signal*–meaning correspondence." The issue is fundamental; it arises because modern linguistics has drawn its conclusions about the nature of language from studies of spoken languages; thus it has been difficult to separate the idea of language from the idea of speech. In a sense, there is a glottocentric bias—a preconception that sound is central, if not essential, to language. At the 1965 conference Chomsky took an unbiased view: "It is an open question whether the sound part is crucial. It could be, but certainly there is little evidence to suggest it is."

The existence of a communication system that is clearly a primary

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This chapter was written in collaboration with Don Newkirk and Robbin Battison.

language (for deaf people of deaf parents) not based on spoken language allows us to ask some fundamental questions about language which might otherwise have remained merely speculative and hypothetical. What aspects of language are essential to language qua language, and what aspects are products of the way language is produced and perceived? What difference, if any, does the modality of language make? The signal produced by the hidden tongue in speech is different from that produced by the visible hands in various shapes and motions. The processing of information by the ear is different from that done by the eye. What effect do such differences in articulatory and perceptual modes have on the system?

The Sequential and the Simultaneous

The physical signal in speech is a more or less continuously varying acoustic wave that can be specified in terms of frequencies, amplitudes, and durations. It is clear, however, that in interpreting a spoken utterance we do not proceed directly from the physical signal, as a global whole, to the meaning. This holds when the utterance is a sentence (the level of sound–meaning correspondence Chomsky was referring to) as well as for the isolated word. We perceive the signal—interpret it—linguistically. Linguists have tried to make explicit what goes into this linguistic interpretation. They have posited that spoken languages have a many-leveled grammar; sentences have several levels of structure.

One of the distinguishing characteristics of the internal structure of spoken languages is that the sequencing of segments plays a fundamental role. This is the case at the syntactic level, where the segments are lexical items (words) and other morphemes; it is also the case at the lexical level, where the segments are segmental phonemes (the meaningless differentiators that function to distinguish one meaningful unit from another). Sound segments, or phonemes, are sequentially ordered in different arrangements; consonants and vowels combine and recombine into different syllables. Phonemes sequentially combine into morphemes (meaning units); morphemes sequentially combine into words. The English word *passing* is a sequential composition of two morphemes, *pass* and *ing*. *Pass* is a sequential composition of three phonological segments: /p/, /æ/, and /s/ in that particular order. Other sequential orderings of these same three phonemes give other distinct English morphemes: *sap, apse,* and *asp.*

The organization of spoken language appears to be fundamentally conditioned, as Liberman and Studdert-Kennedy (1977) point out, by the severe limitation on our ability to produce and perceive a large number of distinctively different sound segments under the special

conditions imposed by speech—rapid rate of transmission of segments with permutations of order. Thus spoken languages are characterized by complex organizational rules by which the small number of sound segments (phonemes) of each language can be combined to produce a large number of distinctive lexical units: "given the limited number of signals we can command, languages use a very few meaningless segments—two to three dozen, in most cases—to construct a large number of meaningful ones. Hence, phonology." In any particular spoken language there are restrictions on the number and distribution of sound segments and on how sound segments may be combined in sequence to form morphemes. Not all combinatorial possibilities occur, and combinatorial constraints differ from one language to another (even when particular sounds in two languages may be the same). But in the lexical structure of all languages based on speech, sequential ordering is present, as phonemes combine into syllables and morphemes, morphemes into complex words. The combinatorial constraints on morpheme structure in some languages are extremely restrictive—in certain dialects of Chinese, for example (Klima 1975)—but there is no known language in which at least the sequence consonant-followed-by-vowel does not occur.

The segmental phoneme, then, is one of the basic building blocks of morphemes and words in every spoken language. But the segmental phonemes, which (along with stress and pitch in many languages) constitute these building blocks, are not unrelated unit differentiators. In all spoken languages that have been studied, the segmental phonemes constitute a network of oppositions based on shared phonetic features (the first segment of *bass* is opposed to that of *pass* as the first segment of *gas* is opposed to that of *Cass,* by the presence versus the absence of the phonetic feature of voicing). Thus the sound structure of language is not exclusively sequential. As Jakobson aptly observed, "though the predominantly sequential character of speech is beyond doubt," it cannot be considered as unidimensionally organized in time. Spoken language is conceived of as a "successive chain of phonemes" but the phonemes themselves are "*simultaneous* bundles of concurrent distinctive features" (Jakobson 1971, p. 370). These distinctive phonetic features are not simply one possible way of classifying phonemes: they characterize natural classes of sounds. The constraints on the sequence of permissible phonemes in a given language (their combinatorial possibilities) as well as the regular sound relationships that characterize morphologically related forms typically operate with respect to these shared features. In addition to a vast accumulation of internal linguistic evidence there is considerable experimental evidence that supports the claim that these linguistic constructs (phonemes, phonetic fea-

tures) are not just useful classificatory inventions but also play a significant role in the cognitive processing of language (Fromkin and Rodman 1974; Studdert-Kennedy 1977; Studdert-Kennedy 1974).

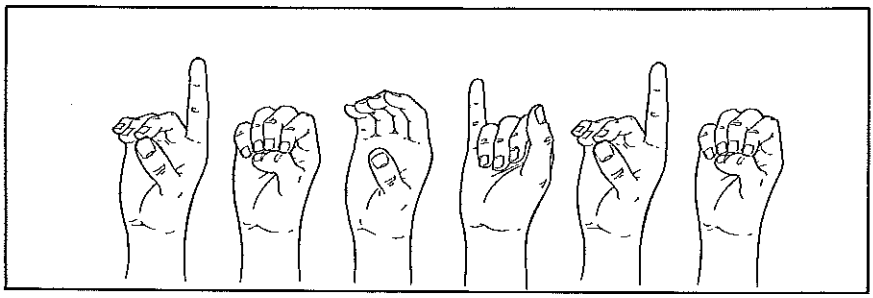
One of the basic questions sign language allows us to investigate is a question about the fundamental principle of language organization: what would languages be like with a realizational system other than one based on sequencing of sounds, other than one based on phonology in the strict sense? How is language organized when its basic lexical units are produced by hands moving in space and when the signal is organized spatially as well as temporally?

A glimpse of the visual signal in signing. There is of course, a sequential element in the organization of ASL at the syntactic level, as signs are arranged one after the other to form phrases, clauses, and sentences. But what is the nature of the organization of the visual signal at the lexical level in sign language? Consider briefly two contrasting examples of lexical units in visual-gestural systems.

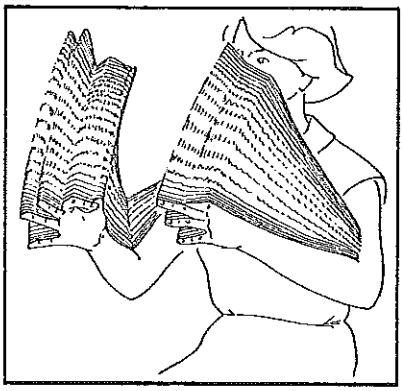
An internal organization of lexical units like that in spoken languages—basically sequential segments constituting lexical items—is possible in the visual-gestural mode and in fact exists in systems of fingerspelling. In the American manual alphabet, for instance, the letters of English words are represented by distinct configurations of the hand, and meaningful units (English words as represented by their letters) are conveyed by sequences of these configurations. The fingerspelled word *D-E-C-I-D-E,* for instance, is composed of six configurations of the hand in sequence (see figure 2.1a). In the hands of a proficient signer they are produced rapidly, presenting a continuous signal and influencing each other in production—as do the sounds that make up a spoken word. Thus, though a fingerspelled word is realized as an uninterrupted flow (the signal), like a spoken word it has as its underlying structure a sequence of discrete elements. But fingerspelling is a derived, secondary gestural system, based on English. Our interest is in the internal organization of the signs of a primary gestural system.

The individual lexical units of American Sign Language appear not to be internally organized in the same way as fingerspelled words. The ASL lexical sign DECIDE, for instance, consists of two hands in the same configuration moving simultaneously downward in the space in front of the signer (see figure 2.1b). The sign DECIDE cannot be analyzed as a sequence of distinct, separable configurations of the hand. Like all other lexical signs in ASL, but unlike the individual fingerspelled letters in *D-E-C-I-D-E* taken separately, the ASL sign DECIDE does have an essential movement; that is, there is an essential temporal property—a change in position in space. But this in itself does

Figure 2.1 Comparison of fingerspelled word and ASL sign.



(a) The fingerspelled word *D-E-C-I-D-E*



(b) The ASL sign DECIDE

not necessitate considering the movement anything other than a simple unitary downward motion. The handshape occurs simultaneously with the movement. In appearance, the sign is a continuous whole.

Thus the lexical items of ASL and all other primary sign languages we know of appear to be constituted in a different way from those of spoken languages: the organization of signs is primarily simultaneous rather than sequential. ASL uses a spatial medium; and this may crucially influence its organization. Not constrained by the special conditions imposed by speech, what is the internal organization of the signs of a primary visual language? Do ASL signs have a systematic internal structure?

The Structural Description of Signs

Until recently the signs of sign languages were regarded as global wholes without any formal internal structure. Most books classified signs into semantic groupings, such as Mental Action, Emotion and Feeling, Clothing, Animals (Riekehof 1963), or according to an alpha-

betical arrangement of word-for-sign translations (for example, Michaels 1923). The question of the formational components—the building blocks—of signs was almost completely ignored. Earlier writers focused on the physical form of the sign only to discuss the images that are generated by that form; a sign was considered to be a kind of icon for what it referred to (Mallery 1881; Wundt 1973). This focus on the image and the icon apparently prevailed over any consideration of the internal structure of signs.

The first serious attempt at a structural description of the basic lexical units of a sign language was made only in 1960, marked by the appearance of William Stokoe's *Sign Language Structure,* which was followed by his *Dictionary of American Sign Language* (1965) and *Semiotics and Human Sign Languages* (1972). Stokoe was the first to try to develop a workable transcription system for signs and to organize an extensive glossary of over 2,000 items—though by no means a complete dictionary of ASL—based on his preliminary analysis of the formational components of American Sign Language.[1] *Sign Language Structure* and the *Dictionary of American Sign Language* (hereafter, DASL) mark a transition point for the study of sign language in that these are the first works to investigate the internal organization of the individual signs and to make some of that organization explicit.

Stokoe observed that ASL signs are not just uniquely and wholly different from one another and posited that they can be described in terms of a limited set of formational elements that recur across signs. He worked out a descriptive analysis for the signs, proposing that in order to distinguish one sign from all others in the language, specific and criterial information about at least three simultaneously occurring attributes of the sign is required: information about (1) the configuration of the hand or hands in making the sign, (2) the location of the sign in relation to the signer's body, and (3) the movement of the hand or hands. We have called these three parameters Hand Configuration (HC), Place of Articulation (PA), and Movement (MOV).

In Stokoe's system each of the parameters—hand configuration, place of articulation, and movement—has a specified limited number of values or primes, which Stokoe called cheremes (by analogy to the term *phoneme*). Stokoe's approach was that of the American phonemicists; each prime (chereme) represented a class of visually similar subprimes (allochers) no two of which constituted the sole difference between two distinct signs. The DASL posits 19 hand configuration primes, 12 place of articulation primes, and 24 movement primes (which can combine in clusters).

In structuralist terms, each prime names a class of actual handshapes, locations, or movements. In Stokoe's analysis, the objective

was to identify recurring components, equating those that count as the same in the formation of ASL signs; for example, formationally similar handshapes (subprimes) were assigned the same prime value if their differences as handshapes alone did not differentiate between existing ASL lexical signs.[2] Thus the list of primes for each parameter was posited on the basis of the occurrence of minimal pairs (two lexical items that contrast in only a single component).

For each major parameter there are many contrastive sets of signs. CANDY, APPLE, and JEALOUS contrast only in handshapes: in CANDY, the index finger is extended from a closed hand; APPLE is made with an extended, bent index finger; and JEALOUS with an extended little finger from a closed hand. Because the signs are distinguished only by that difference, those values are considered as distinct hand configuration primes (see figure 2.2a). SUMMER, UGLY, and DRY differ only in place of articulation; SUMMER is made on the forehead, UGLY at the nose, and DRY on the chin (figure 2.2b). TAPE, CHAIR, and TRAIN differ only in movement: TAPE is made with a sideways brushing movement, CHAIR with a tapping movement, and TRAIN with a back-and-forth brushing movement (figure 2.2c).

Stokoe's analysis suggests that the signs of ASL are symbols whose form is decomposable into a limited set of distinct recurring components—components that are drawn from several different dimensions of spatial patterning.

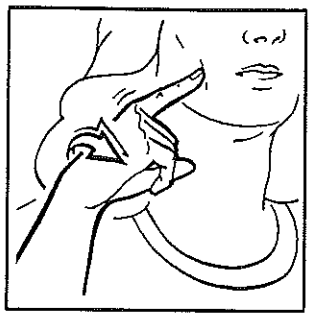
Different analysts have reclassified the inventory of parametric subprimes and posited different numbers of hand configuration, place of articulation, and movement primes (Battison 1977; Friedman 1975; Newkirk 1976). Determining the precise number depends on a more complete phonetic-level analysis than is now available and on resolving a number of descriptive problems.[3]

Such an analysis reveals an important similarity in the organization of spoken language and sign language: both exhibit sublexical structuring; that is, their lexical units are composed of a restricted set of distinct sublexical elements that at one level of structure function purely as meaningless differentiators.

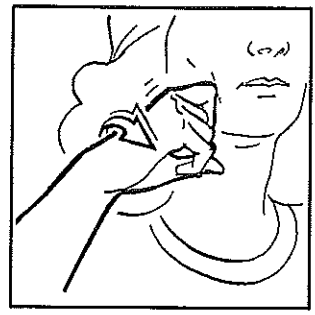
But the analysis, if correct, also reveals what appears to be a basic difference in the organization of words and signs: the word is organized sequentially—as a linear sequence of sound segments; the sign is organized as a combination of simultaneously occurring components taken from several spatial dimensions. A sign is a hand or hands in a particular configuration moving in a specified way with respect to a particular locus or place, and these values co-occur in time in constituting the sign.

The descriptions of formational properties of ASL signs which have

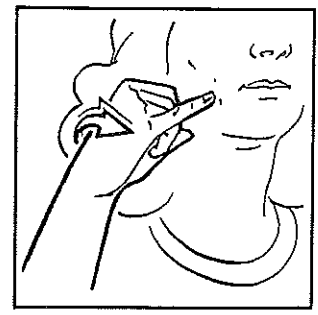
Figure 2.2 Minimal contrasts illustrating major formational parameters.



CANDY

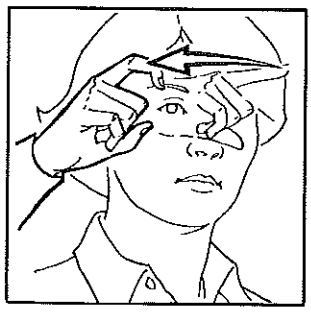


APPLE



JEALOUS

(a) Signs contrasting only in Hand Configuration

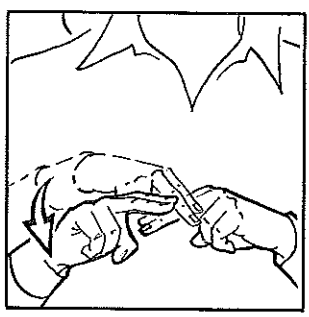


SUMMER

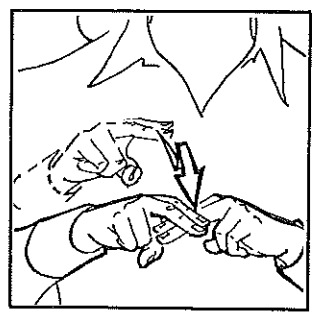
UGLY

DRY

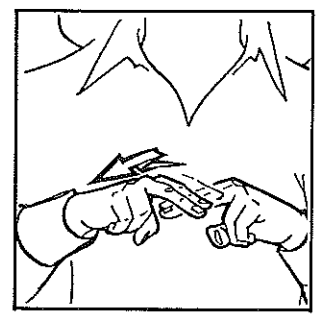
(b) Signs contrasting only in Place of Articulation



TAPE



CHAIR



TRAIN

(c) Signs contrasting only in Movement

been developed in the past decade are all based on Stokoe's seminal work; we too shall describe signs in those terms (adding, where required for later discussions, some suggestions for reanalysis). Descriptions pertain to the structure of only *lexical* signs—the basic vocabulary items of the language—as they would be made in citation form.

Formational Parameters of Signs

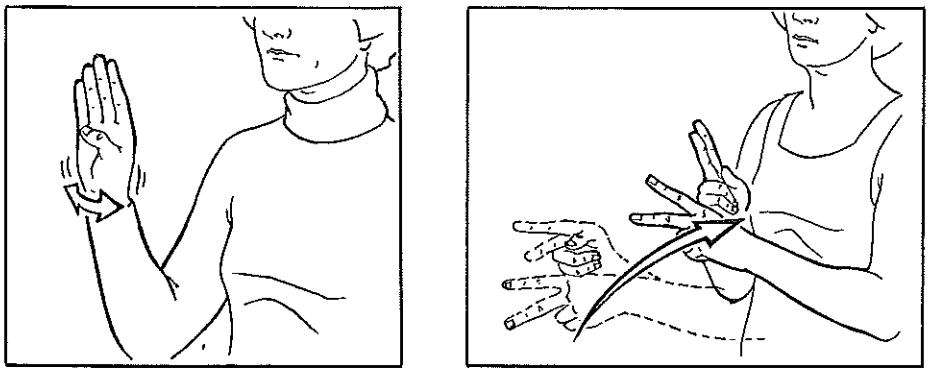
A simple lexical sign is essentially a simultaneous occurrence of particular values (particular realizations) of each of several parameters. We describe here the parameters of hand configuration, place of articulation, and movement, discussing minor parameters of hand use as well.

Hand Configuration

The hand configuration (HC) of a sign is a particular distinct shape assumed by the articulator(s). BLUE, for instance, is produced with one hand held with palm open, fingers extended and in contact (see figure 2.3a); BORROW is produced with both hands held with index and middle fingers extended, the thumb touching the middle finger at the second phalange (figure 2.3b). Each of these shapes is a distinct HC used in many ASL signs.

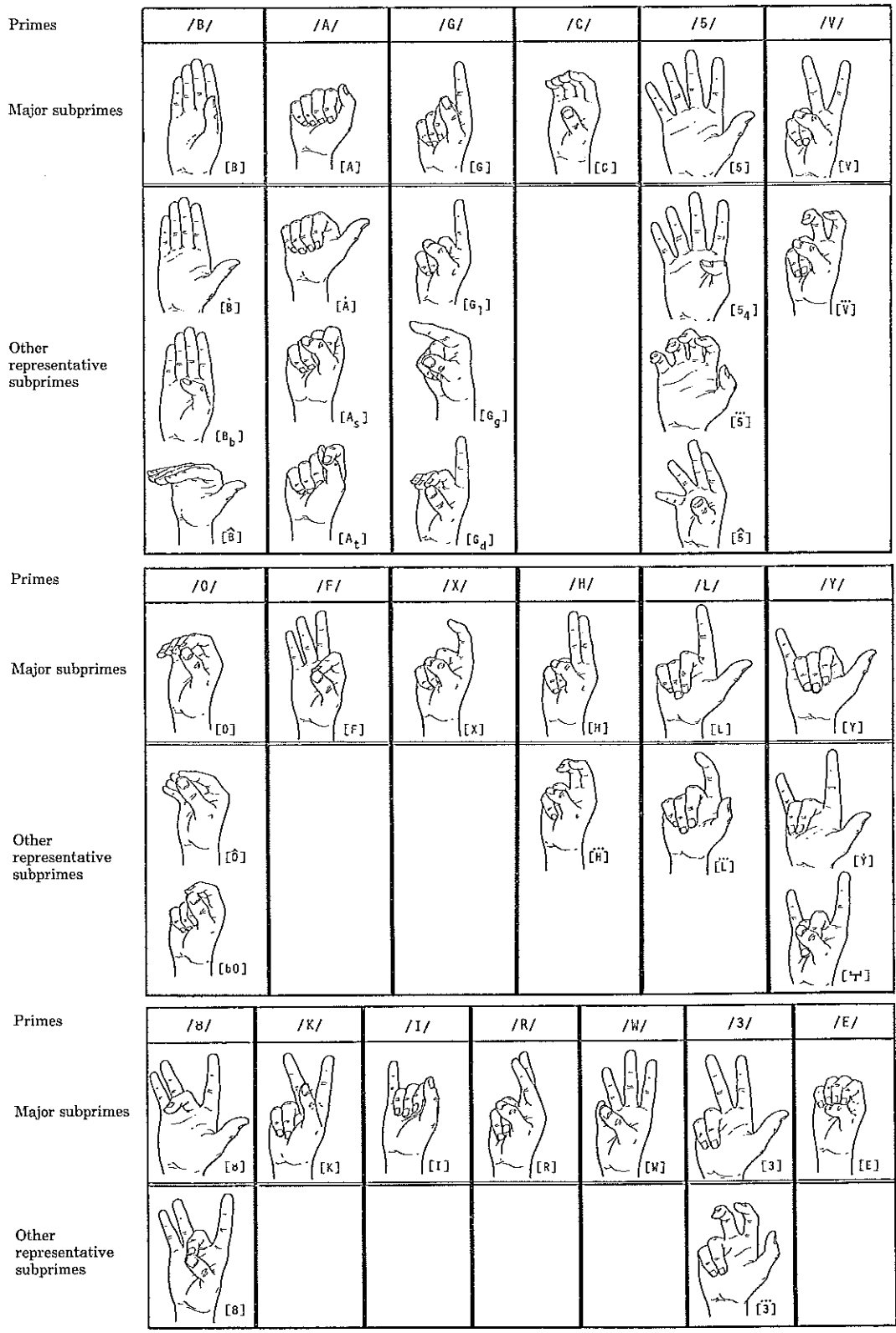
The hand is a highly articulate organ. Its muscular structures permit differential extension, as well as flexion, at the individual joints of the thumb and fingers. Digits can extend, bend, contact, or spread apart; the thumb can assume variable positions with respect to the fingers; the hand can curve or close into an O shape. Handshapes are thus

Figure 2.3 Two signs showing distinct Hand Configurations used in many ASL signs.



(a) BLUE (b) BORROW

Figure 2.4 Hand Configuration primes shown with representative subprime values.



differentiated by the spatial configurations of the hand, resulting from extension, contraction, contact, or divergence of the fingers and thumb; the digits may be arranged in a variety of ways and may be held so as to form a vast array of static configurations.

The formational system of ASL, however, includes only a limited set of those handshapes permitted by the muscular structure of the hand. Stokoe's classification in the DASL lists 19 classes of HC primes; each configuration class has criterial aspects and conditions of well-formedness. Figures 2.4 and 2.5 list the classes in order of frequency; representative subprime values appear in figure 2.4.[4]

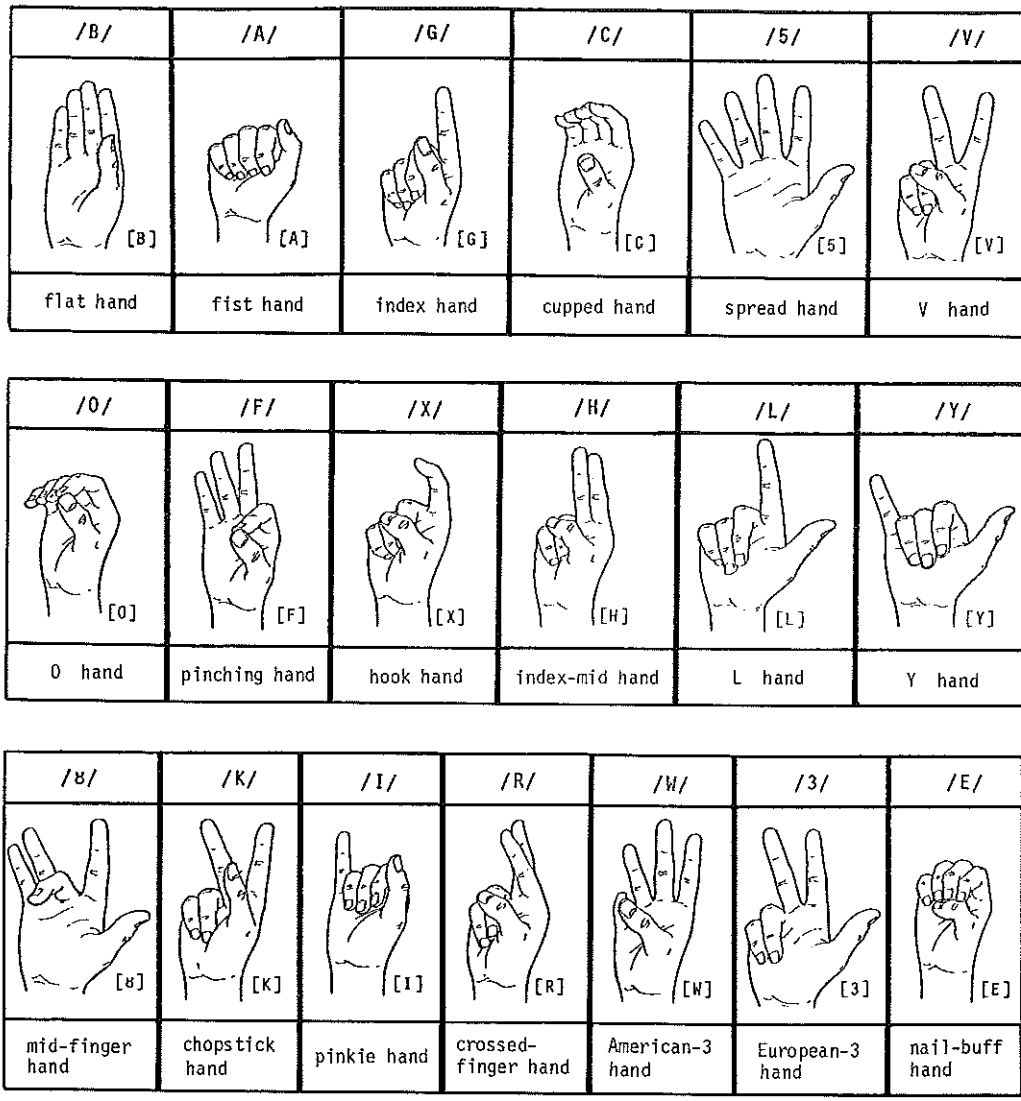
Different HCS have different numbers of subprime values, some freely variable and some predictable from the other components of the sign in which they occur. A closed fist /A/ HC, for instance, can assume several shapes through variations in the position of the thumb, which can be at the side of the index finger, [A], crossed over the other fingers, [A_s], or extended [Å]. The linguistic description implies that out of all the possible shapes the hands can assume, ASL selects a limited number of distinct handshapes, which represent an even more limited number of more abstract, functionally distinctive HCS.[5]

Slow-motion viewing of isolated signs reveals that the distinct shape of the HC of a sign is assumed shortly before the onset of the sign and is in most signs maintained as a static feature of the sign throughout the sign's movement. Some HCS, however, do permit internal flexion or extension of the fingers as a part of the sign's movement, as in SHOWER, in which the fingers open; or DEVIL in which the two extended fingers repeatedly bend; or STUDY in which all the fingers wiggle (see figure 2.6). But with the exception of such hand-internal movement, maintenance of a static HC from onset to offset is a dominant characteristic of the simplex sign, lending support to the claim that a sign is essentially a simultaneous realization of parameter values.[6]

Functional attributes and potentials of the hands other than their shape are employed in the formational system of ASL. To fully describe a sign and distinguish it from all others, it is necessary to specify information about three additional dimensions of hand use: *contacting region* or focus, *orientation,* and *hand arrangement.*[7] These dimensions of sign formation are termed minor parameters, since they may be viewed as subclassifications of hand configuration; whereas major parameters distinguish very large classes of signs, minor parameters distinguish limited sets of minimal pairs, yet further differentiate signs.

One minor parameter of hand use is contacting region, the part of the hand that serves as a focus for contact or pointing during the movement of a sign. A few pairs of signs are distinguished by contacting region alone. The signs EVERYDAY and GIRL, both made with a fist

Figure 2.5 Hand Configuration primes arranged in order of frequency (with descriptive phrases used to refer to them).



hand /A/ brushing the cheek, are distinguished by their contacting regions; thumb tip in GIRL (which calls for the [Å] variant), palm side of the hand in EVERYDAY (see figure 2.7). Other primes for contacting region include the back of the hand, the tips of the fingers, the ulnar side of the hand, the index side of the hand, and so forth.

Hand configurations differ in the number and locus of permissible

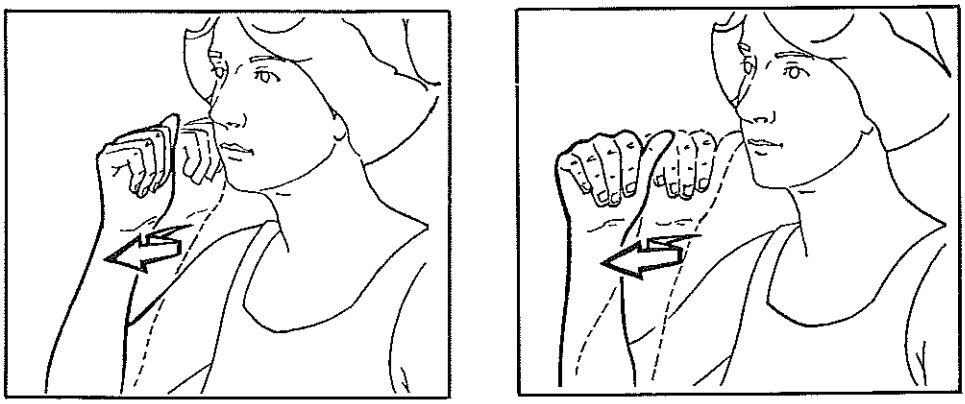
Figure 2.6 Three ASL signs showing hand internal movement.

SHOWER DEVIL STUDY

contacting regions. The /G/ index hand and the /B/ flat hand have several contacting regions, whereas the bent mid-finger hand /8/ has only one permissible region: the tip of the bent middle finger. Signs with /8/ HC, such as TASTE, SMART, TOUCH, all use that contacting region, as do newly coined signs such as CONTACT-EACH-OTHER, in which the middle fingers of the two hands touch (see figure 2.8). Using that HC with any other contacting area would result in an excluded or impossible sign form in ASL.

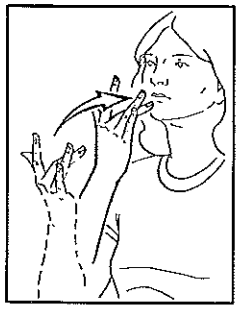
A second minor parameter is the orientation of the hand(s) with respect to the signer's body. In signs made in space without physical contact, the orientation of the hand(s) alone may distinguish pairs of otherwise identical signs. The orientation of a HC is specified by reference to the direction in which the palmar surface of the hand(s) face. The

Figure 2.7 Signs differing only in contacting region.

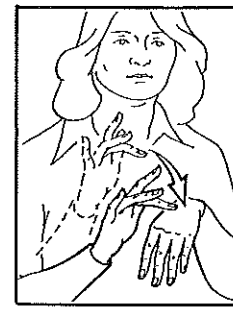


EVERYDAY [A] GIRL [Ā]

Figure 2.8 Signs made with /s/ Hand Configuration. (Note that all use the same contacting region.)


TASTE


SMART


TOUCH

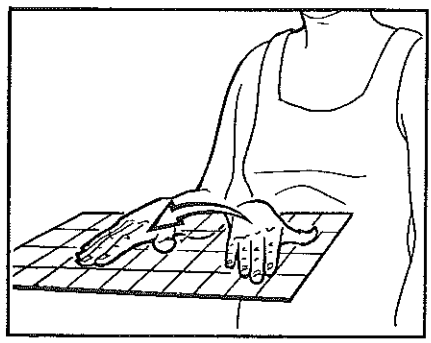

CONTACT-EACH-OTHER

signs CHILD and THING differ only in orientation: palm down in CHILD, palm up in THING (see figure 2.9).

A third minor parameter is the number of hands used to make signs and the functional relation between the hands, a parameter we call hand arrangement.[8] ASL lexical signs exhibit three different hand arrangements: about 40 percent of the signs in DASL are made with one hand only, for example, DEVIL, SUMMER, WRONG (figure 2.10a); 35 percent are made with two hands active and moving, as in FAMOUS, QUIET, MEET (figure 2.10b); and 25 percent are made with one hand acting on the other as a base or locus, YEAR, PAPER, SIT (figure 2.10c).

The existence of two independently manipulable articulators permits the possibility that signs can be minimally distinguished by virtue of whether they are made with one or two hands; YELLOW and PLAY differ only in hand arrangement (YELLOW is made with one

Figure 2.9 Signs differing only in orientation of the palm.


CHILD

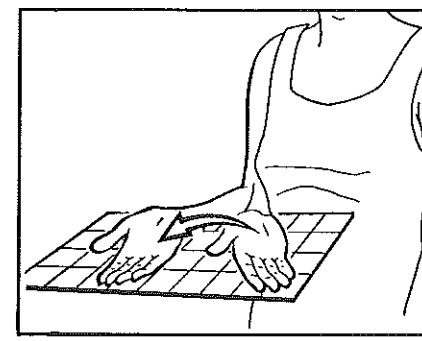

THING

Figure 2.10 Signs in different hand arrangements.

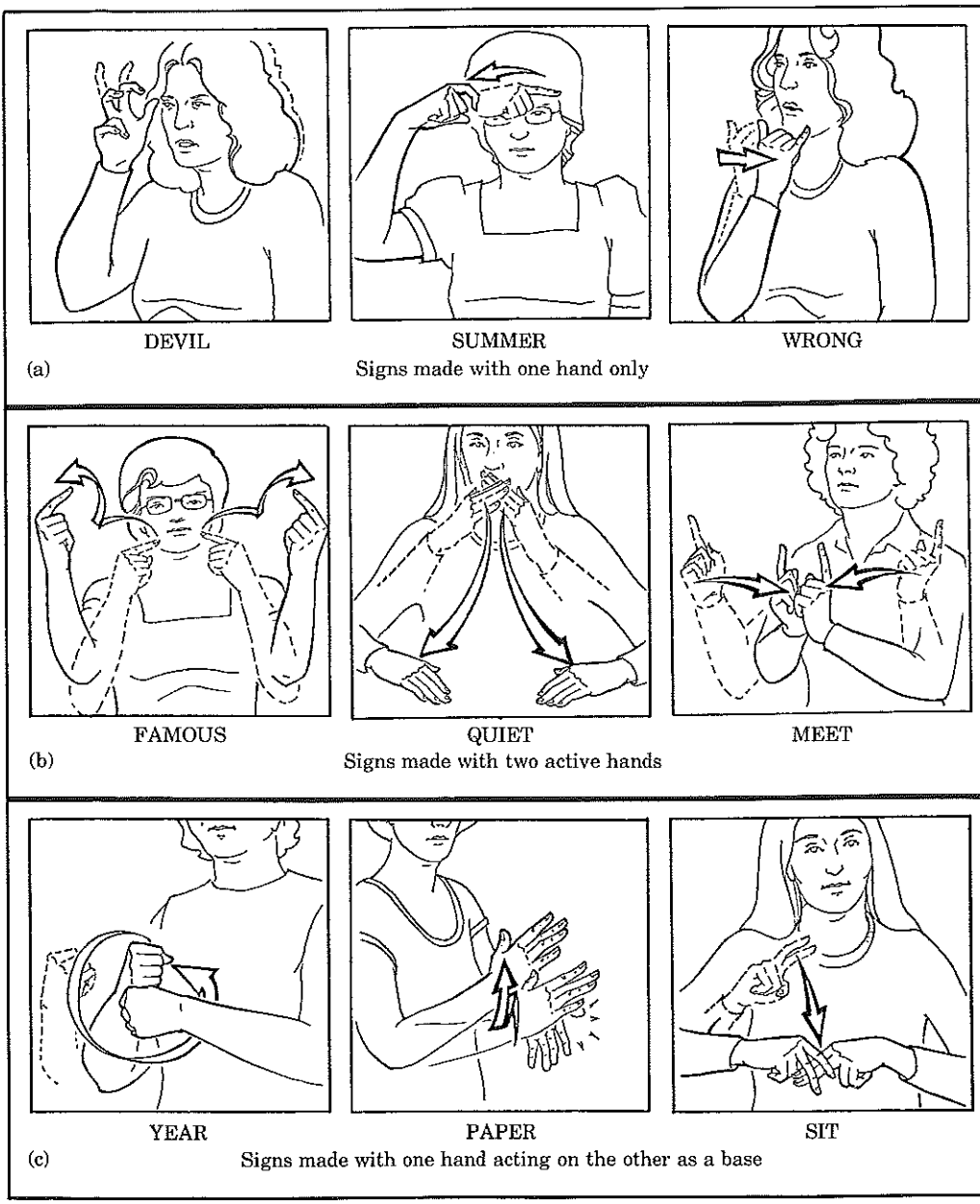
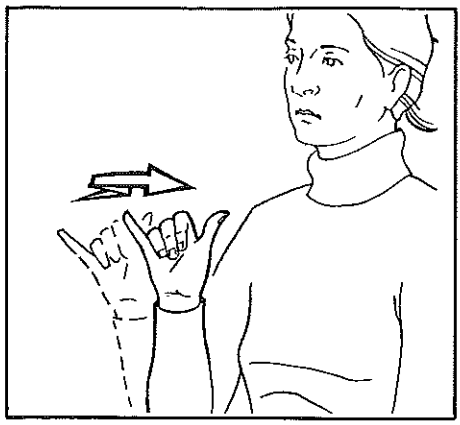
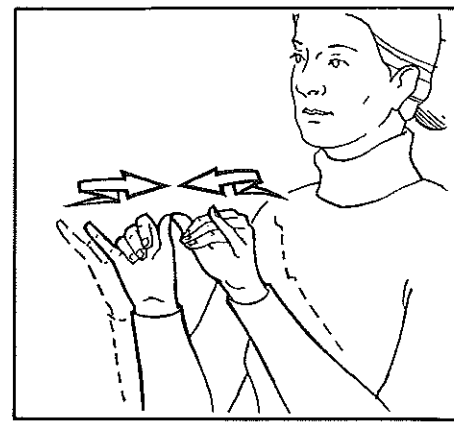


Figure 2.11 Signs differing in number of hands used.



SAME



MEASURE

hand, PLAY with two hands); SEEM and COMPARE, SAME and MEASURE are also so distinguished (see figure 2.11).[9] But such minimal pairs are rare in ASL; the use of one as opposed to two hands rarely distinguishes between semantically unrelated lexical items, but it plays a major role in morphological processes (see chapter 12).

A spatially organized language with two articulators (the two hands) that can function independently and are independently perceivable presents special structural possibilities. Many signs are made with two hands: the hands in such signs can appear in different spatial relationships—one above the other (in ESTABLISH); one beside the other (WITH); one behind the other (FOLLOW); and one below the other (ASSISTANT). One-handed signs have specification for HC, PA, MOV; two-handed signs can in principle assume different specifications in these parameters, one for each hand. However, there are constraints in ASL signs on how their components may occur simultaneously, as well as on their spatial relations to one another. In spoken language a syllable can contain several consonant segments, but the temporal relations of the segments must be specified, as in the case of *asp, apse, sap,* mentioned earlier. A sign in ASL can contain two hands, each with independent specifications, and the spatial relations of the two hands must be specified, as in the case of ESTABLISH, WITH, FOLLOW, ASSISTANT. As spoken languages have constraints on the consonants that can occur sequentially, ASL has constraints on the particular parameter values, and their spatial relations, which may occur together simultaneously in constituting a sign.

Place of Articulation

The second major parameter of ASL lexical signs is the locus of a sign's movement, its place of articulation (PA). The primes of place of

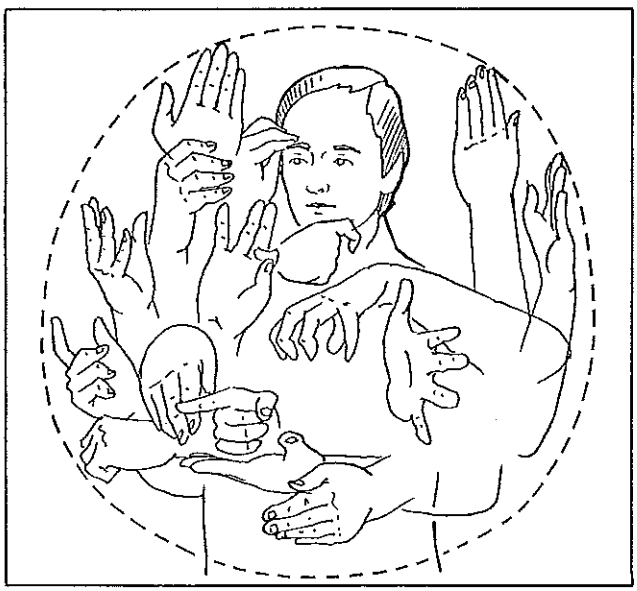
articulation are defined with respect to particular locations and areas on and around the body within a delimited region we call the signing space.

In free pantomime there are only physiological restrictions on the space used differentially in conveying a message. To mime opening a door, putting on a boot, or picking apples off a tree, a person may walk around, reach down to his feet, or extend his arms high above his head. By contrast, ASL signs in citation form are made within a highly restricted space defined by the top of the head, the waist, and the reach of the arms from side to side (with elbows bent). Figure 2.12 shows the region in which signs are made. In the production of a list of signs the hands do not reach high above the head or below the waist or outward to the full extension of the arms.

One of the criterial properties of each ASL sign is that it moves with respect to specific loci within the signing space. This locational dimension of a sign, its PA, is defined in the DASL in terms of the location of the hand(s) in movement with respect to the body. The location of a sign may be the place toward which, from which, or on or near which it moves.

Some signs are made in contact with parts of the body (LIAR is made on the chin, SLEEP on the cheek, PLEASE on the torso), or in contact with a nonmoving hand (as HARD is), or in specific areas within the neutral space in front of the body (DECIDE, SWEETHEART, WANT).

Figure 2.12 The region in which signs are made.



According to Stokoe's analysis there are 12 different PA primes that minimally distinguish different pairs of signs (see figure 2.13). On the face the following differentiations are made: the upper brow, the mid-face region, the lower face, the cheek, and the whole face. Other distinct PAS are the neck, the trunk, the upper arm, the lower arm, the wrist, the second hand (in various configurations). The final locus is described as the neutral space in front of the torso and in DASL is not considered as differentiated.

Although the PA identified as the neutral space in front of the signer's torso is regarded in DASL as a single location (differentiated by height distinctions only, such as near the face or with forearm prominent), it can in fact be usefully viewed as an articulated space with distinguishable loci. The neutral space can be thought of as partitioned into mutually intersecting orthogonal planes, horizontal, vertical (frontal), and sagittal (the plane of bilateral symmetry), which are loci for the movement of signs and could be considered as distinct places of articulation (see figure 2.14). (Whereas, in miming, the hands can move freely in space to depict action realistically, in the production of citation-form signs the hands move with respect to rectilin-

Figure 2.13 Distinct Places of Articulation (symbols are those used to represent prime values in the DASL).

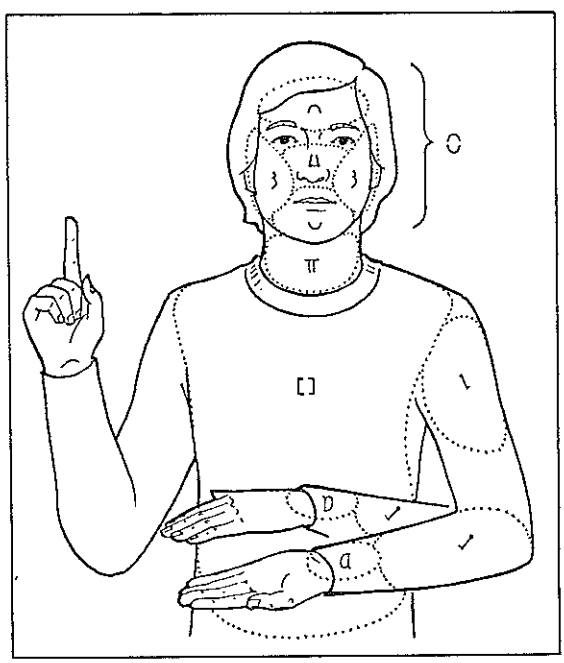
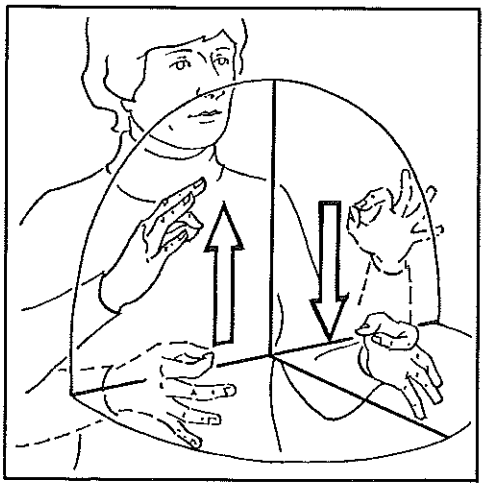
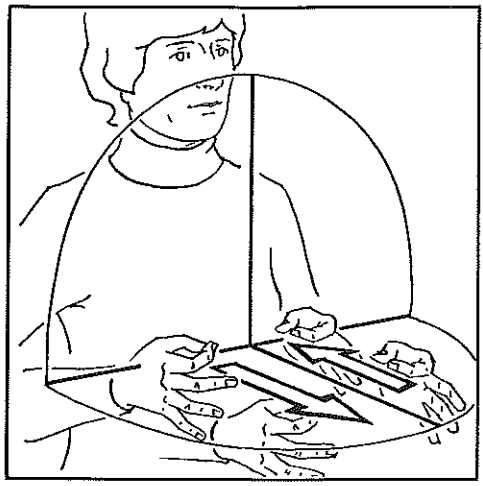


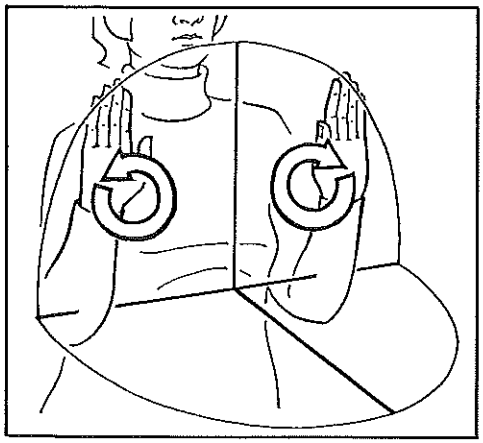
Figure 2.14 Pairs of signs differentiated by the planes that are their loci of movement.



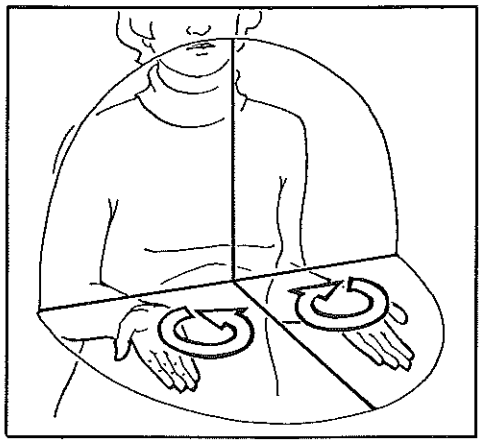
JUDGE



EXPLAIN



SUNDAY



HERE

ear planes in space.) Some pairs of signs are differentiated primarily in terms of the planes that are their loci, as are the pairs JUDGE and EXPLAIN, SUNDAY and HERE (see figure 2.14).

When signs in ASL are classified according to their PA (following their listing in DASL), they are fairly evenly divided between signs made in the neutral space in front of the body (37 percent), signs made with one hand acting on the other (25 percent), and signs made on the rest of the body (37 percent).

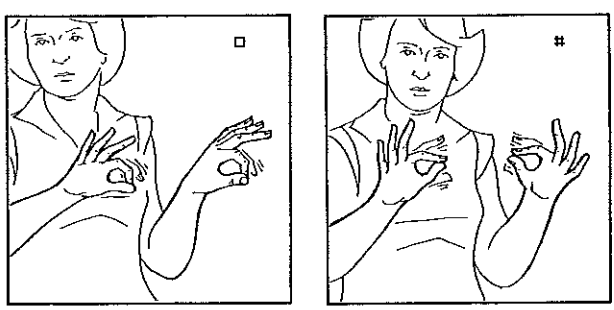
Movement

The third major parameter of sign structure, movement (MOV), is the most complex dimension and has been the most difficult to analyze. We noted that in forming HCS the hands are highly articulate and capable of assuming a vast array of distinguishable static shapes; the hands and arms are even more versatile in producing distinguishable movements and movement contours in space. But just as the formational system of ASL limits the number of HCS to a relatively few out of all the physical possibilities, so does that system restrict the set of movement types. If the movements of signs are compared as global wholes, the differing shapes, tempos, directions, oscillations, and dynamics of the motions appear extremely rich and varied; nevertheless, the MOV parameter of signs can be described in terms of distinct MOV components (in the DASL Stokoe proposed 24 different MOV primes) which can occur singly, in sequence, or simultaneously within single monomorphemic signs. Let us consider some single movement components, organized according to general articulatory categories (as shown in figures 2.15 through 2.19) used in signs with an /F/ handshape and DASL movement symbols.

Hand-internal movement. For some signs the movements consist of various articulations of the fingers. The fingers may wiggle or bend, or they may open or close into larger or smaller shapes. The sign HATE is made with a repeated opening of the index finger and thumb; the sign STICKY, by contrast, is made with a repeated closing of the same fingers (figure 2.15).

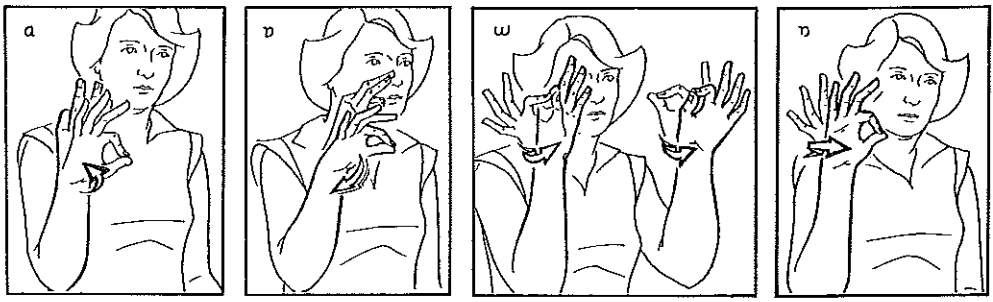
Wrist. Some signs are made with supinating, pronating, twisting, nodding, or rotating actions of the wrist. The sign FRANCE, for instance, is made with a supinating action (turning the wrist palm-side

Figure 2.15 Hand internal movements.



HATE (opening) STICKY (closing)

Figure 2.16 Wrist movements.



FRANCE (supinate) GRAPES (pronate) LOOKING (twist) PREACHER (nod)

up); the sign GRAPES, with a repeated pronating action (turning the wrist palm-side down); the mimetic sign LOOKING is made with an oscillation of the wrist (twisting movement); the sign PREACHER is made with a nodding of the wrist (figure 2.16).

Directional movement. The movement in some signs entails moving the hand(s) along paths in space; though the physical possibilities of such movement are virtually limitless, in fact such directional movements in ASL are attracted to lines in orthogonal planes in the neutral space. The sign GHOST is made with movement straight upward, DECIDE with movement straight downward, JUDGE with the hands moving alternately down and up, DESCRIBE with the hands moving alternately to and fro, and NOTHING-TO-IT with the hands moving simultaneously from side to side. These movements are made with respect to horizontal, vertical, and bilateral planes in neutral space (figure 2.17).

Circular movement. The movements of some signs have a circular shape, which can be created in a variety of ways: the whole manual articulator from shoulder to hand may be used to form a circular path within a plane; the forearm may pivot from the elbow, or the hand may swivel at the wrist. Circular action is illustrated in FRIDAY and CO-OPERATE (figure 2.18).

Interaction. Some signs are made with movements in which the two hands (or the hand and body) interact. In EXACT, the two hands approach each other; in EXCHANGE, the hands interchange; in VOTE, one hand is inserted into the other; in FLUNK, one hand makes contact with the other; in MEAT, one hand grasps the other; in DIPLOMA, the hands separate (see figure 2.19).

These illustrate most of the distinct values listed in the DASL. But these single movement components by no means fully describe the movement of signs. Signs with clusters of movement components are illustrated in figures 2.20, 2.21, and 2.22, again with /F/ handshapes.

Figure 2.17 Directional movements.

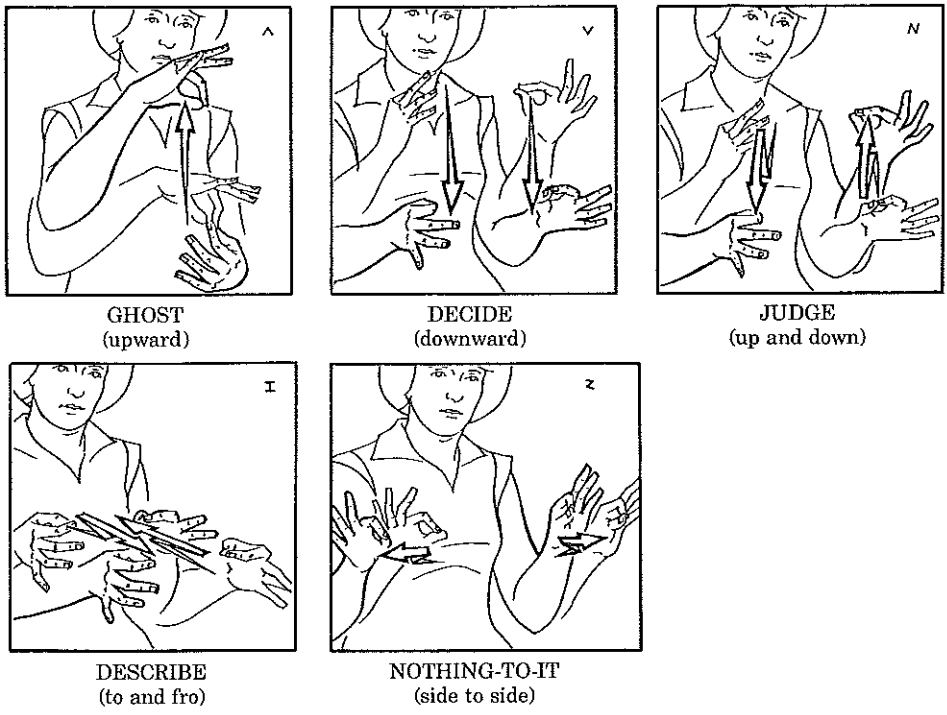
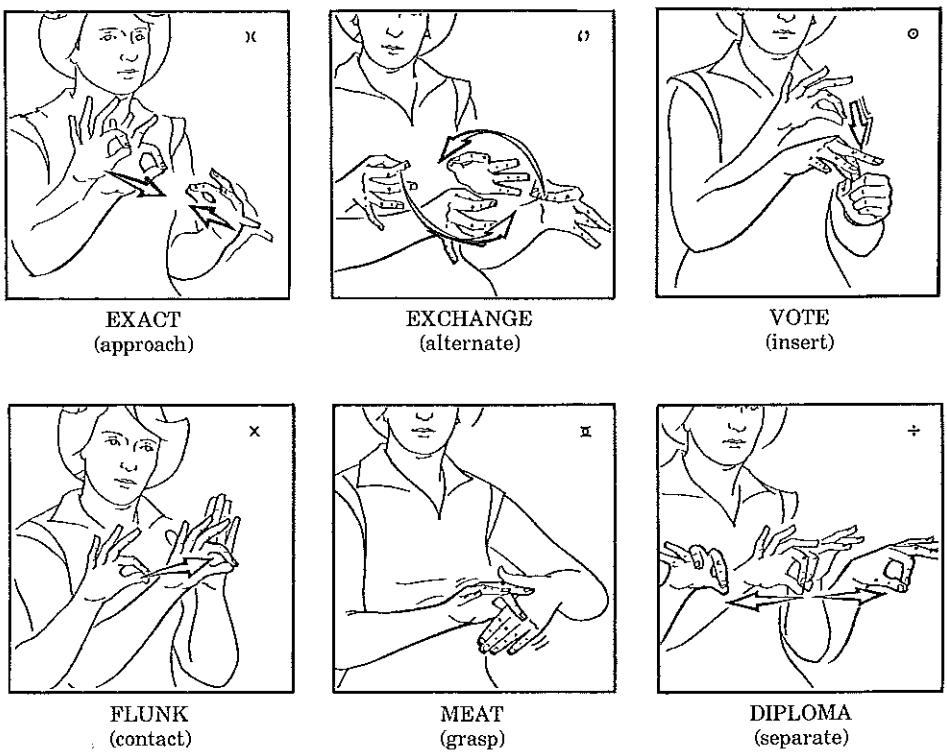


Figure 2.18 Circular movements.

Simultaneous clusters. In DASL notation, some signs have one movement component above the other, indicating that the two movements are performed simultaneously. Thus, the symbol for downward movement (v) and contactual action (x) written one above the other

Figure 2.19 Interacting movements.



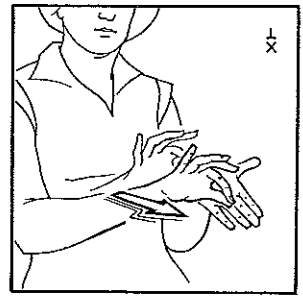
($\overset{\vee}{\times}$) indicate that the hand moves downward while in contact with a place of articulation. In other words, it grazes, or brushes, downward. Other such simultaneous clusters of movement components include circling while in contact, wrist twisting while in contact, opening while moving toward the body, grasping while moving downward.

Figure 2.20 illustrates some signs with movements described as simultaneously occurring movement components. CAT can be described as movement to the side while in contact (a brushing); the sign COUNT, as a movement away from signer while in contact (again a brushing); the sign TRANSLATE, as rotation of the wrists while maintaining contact; the sign DISCONNECT, as opening of the fingers while separating. The sign TEA is described as circling action while inserted (tips of the index finger and thumb are inserted into the base hand); the sign LANGUAGE, as twisting of the wrists while separating.

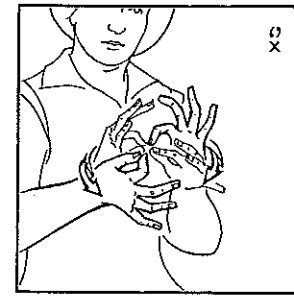
In later chapters we shall address the question of whether these signs are correctly described as simultaneous clusters of movement components and whether our understanding of their operation under

Figure 2.20 Signs described with simultaneous movement components.

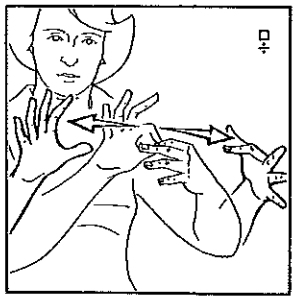
CAT
(movement to side
while in contact)



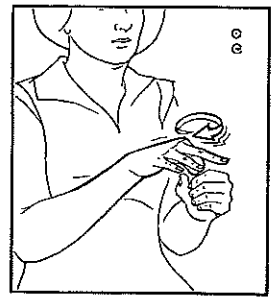
COUNT
(movement away
while in contact)



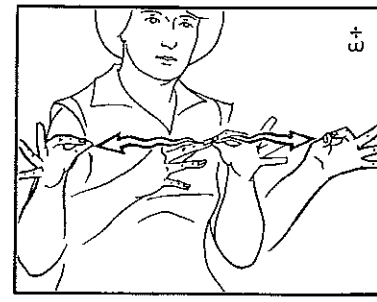
TRANSLATE
(rotate while
in contact)



DISCONNECT
(open while
separating)



TEA
(circle while
inserted)



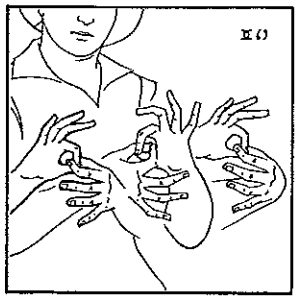
LANGUAGE
(wrist twist
while separating)

modulations sheds any light on the appropriate linguistic description of their movement.

Sequential clusters. In DASL notation, some signs have more than one movement component side by side: a sequential combination, indicating that one action is done first, and a second follows. Figure 2.21 illustrates some ASL signs described as sequential combinations of movement components. CHAIN can be described as grasp, then interchanging action of the hands; the sign INDIAN as contact, then movement toward, then contact; the sign FAMILY as contact, then supination of the wrist, then contact; the sign JOIN as approach, then grasp (see figure 2.21).

Combination clusters and bisegmental signs. Some signs are described as combinations of movement clusters that are sequential as well as simultaneous. The sign STORY is described as grasping action, then separating while opening, the entire cluster repeated (see figure 2.22a). And finally some simplex signs are described as if they were

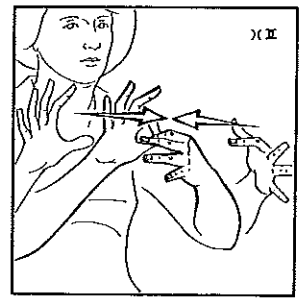
Figure 2.21 Signs described with sequential movement components.



CHAIN
(grasp, then interchange)

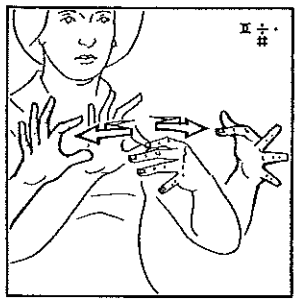
INDIAN
(contact, movement,
then contact)

FAMILY
(contact, movement,
then contact)



JOIN
(approach, then grasp)

Figure 2.22 Signs described with multiple movement clusters.



(a) STORY
(grasp, then separate
while opening)

(b) CIRCUS
(bisegmental sign
with 6 movement components)

two-sign units; with specification for HC, PA, and MOV followed by another specification, as in SPAIN, ROOM, TURKEY. Such bisegmental signs often involve a change in orientation, location, or direction. An example, not listed in DASL, is the sign CIRCUS, which would require six movement symbols for full description in DASL notation: contact, movement downward, contact; a change in location and then contact, movement toward, followed by contact. This sign is illustrated in figure 2.22b.

Other analyses of the movement of signs have been considered. A recent suggestion for reorganizing the movement parameter into simultaneously occurring and many-valued attributes can be found in Friedman (1976). In this analysis, Stokoe's list of movement primes is divided into four mutually exclusive simultaneously occurring multivalued dimensions: interaction, contact, direction, and what we call movement shape (wrist twist, finger bending, and so forth), each sign having only one value for each dimension of movement. Friedman's main addition, details aside, is in her contactual dimension, which describes the nature of the contact by an active hand on a place of articulation on the body; her values in this dimension are continuous contact, holding contact, end contact, beginning contact, double contact, and noncontact. Thus, whereas in DASL, the movement in a sign like HOME (what we call two-touch) requires three sequential components, Friedman considers double contact as one distinct movement type.

The overall shape of sign movements has led us to the conclusion that the basic notion of contact with respect to the body can be extended to apply also to the abstract places of articulation constituted by the planes of the signing space; the same general range of movements occur in precisely the same way, but with respect to the horizontal, vertical, and bilateral planes of the neutral space in front of the signer, as if these were tangible surfaces. The sign EAT has contact on the chin; KNOCK has similar contactual action with respect to a vertical plane of the signing space. HOME has contacts at two points along the cheek; FRENCH-FRIES has contactual action at two points on the horizontal plane of the signing space. WINE has a small circular movement made in contact with the cheek; MONDAY has a small circular movement in the vertical plane of the signing space; and so forth. Thus contacting movement can be made on planes in the signing space in the same way it occurs in contacting the body. This enlarged view of contacts at spatial loci is especially useful in the analysis of inflectional forms (see chapter 12).

We have found that other dimensions of movement that differentiate signs are required for the full description of the language. Many pairs of ASL signs cannot be distinguished by the movement components

identified thus far. The signs FAIRY and SIMPLY are identical in HC and PA, and both are made with iterated movement to contact: both have soft iterated contact, but in SIMPLY the hand and movement exhibit less tension—are more lax—than in FAIRY; they differ not in the *type* of movement, but rather in its *quality*. Other pairs of sign forms are distinguished only by differences in the repetition of the movement: whether or not the movement is iterated, duplicated, made once, alternating. The sign NICE has a single movement; CLEAN is identical but with repeated movement. Some sign pairs are distinguished only by the manner of onset or offset. Supalla and Newport (in press) have shown, for example, that semantically related verb and noun pairs characteristically differ in manner of offset.

Attention to such qualities (tension, repetition, manner, and so on) of the movement of signs is not only important in distinguishing between certain semantically unrelated lexical signs, between variant forms of certain signs, and between certain signs in different lexical categories. Such qualities of movement are significant formational aspects of any lexical sign, for they are crucial in understanding the way signs appear under certain grammatical processes.

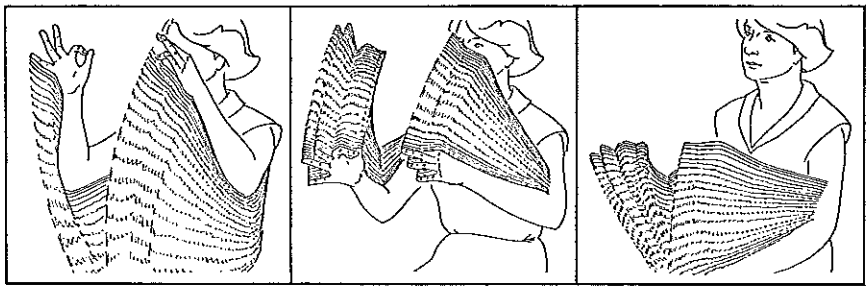
As an example, consider the two signs DECIDE and PREACH, shown in figure 2.23 in strobe drawings displaying their temporal properties. DECIDE has a single downward movement; PREACH appears to have a more complex temporal pattern, the hand moving forward and back several times in succession. Under certain grammatical processes, the single downward movement of DECIDE appears, but the iterated back-and-forth movement of PREACH does not; instead a single forward movement of the sign appears. In general, repeated movement components will reduce under certain processes to single productions of the components. (The form of grammatical processes and their effects on the surface form of lexical items will be examined in chapter 12.)

To fully describe the movement of signs, then, it is necessary to describe not only the components of movements—the movement types—but also the dynamic qualities, manners, and frequencies of those movements. When we view the movement of a sign as consisting of components articulated with certain dynamic qualities, the sign appears as a multidimensional form in space.

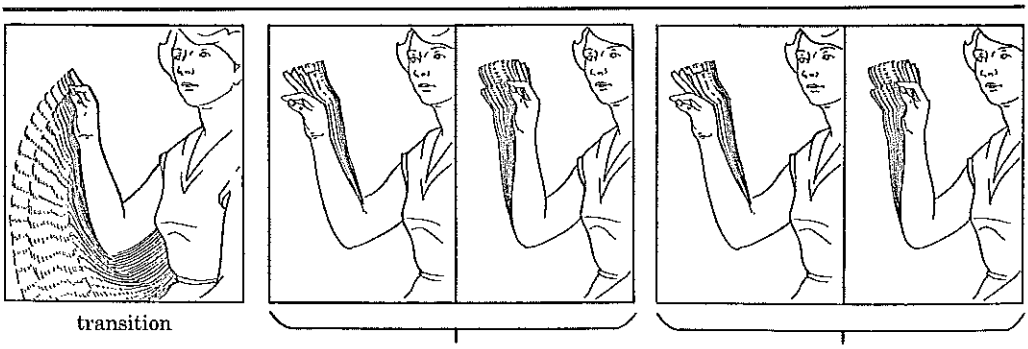
Constraints on Combinations of Parameter Values

An ASL sign consisting of a single sign unit can be analyzed as a simultaneous composition of a particular hand configuration, a particular locus or place of articulation, and a particular combination of movements. For a full description of a sign that distinguishes it from

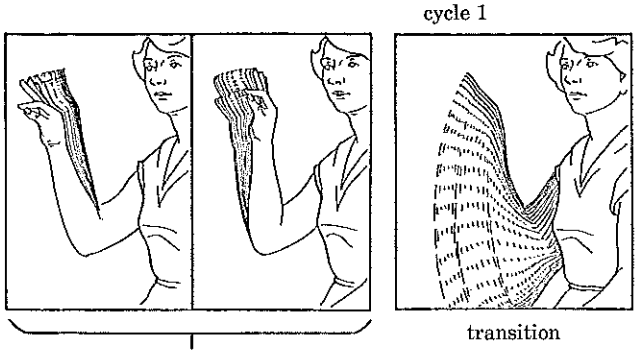
Figure 2.23 (a) The ASL sign DECIDE: Side drawings show transitions to and from the sign; center drawing illustrates the single downward movement of the sign. (b) The ASL sign PREACH: First and last drawings illustrate transitions to and from the sign. In citation form the sign has iterated movement, shown in 3 cycles; each cycle has a forward movement and return.



(a) transition sign transition



transition cycle 1 cycle 2



transition

(b) cycle 3

other signs, its particular contacting region, orientation, and hand arrangement must also be specified, as well as qualities of movement. Each of these formational parameters has only a specific limited number of values that are (or could be) realized in particular signs of ASL.

Any particular spoken language also has a limited number of formational units (phonemes in the structuralist framework, or simultaneous bundles of distinctive features in the transformationalist framework). In spoken language these units, these sound segments, are sequentially arranged and rearranged to form the words of a language; each spoken language has constraints on how its sound elements may combine to yield the allowable morphemes of the language. Such constraints on combinations of sounds in English, for example, specify that English morphemes may begin with up to three (but not more) consonant sounds; furthermore, if the maximum of three is employed, their choice is constrained (the first must be /s/, the second a voiceless stop, and the third a liquid—as in *street* or *splice*).

It is relevant to ask what kinds of constraints on the combination of formational units exist in a sign language. Out of all the possible gestures that could be made with the hands moving in relation to the body, we have described a limited set of sublexical elements, which in combination with each other make up the signs of ASL. Not in American Sign Language, any more than in any spoken language, are all the combinatorial possibilities realizable as possible signs—and of course, only a fraction of the latter appear as actual signs. Some combinations of representatives (primes) of the parameters are simply incompatible for physical reasons; others seem to be excluded on the basis of language-specific patterning in ASL. A complete description of the language would specify the allowable and nonallowable patterns of distribution of the major components of the signs of ASL—the constraints that limit the possible forms that may be used in the language. Although the study of ASL is not yet developed enough to begin such a systematic description, it is possible to exemplify several kinds of constraints that operate on the combination of formational elements into possible ASL sign forms.

One kind of constraint pertains to the relation between the two articulators. Two related constraints have been posited which account for certain observed limitations in the form of two-handed signs: the Symmetry Constraint and the Dominance Constraint (Battison 1974). The Symmetry Constraint applies to that large class of signs made with two hands, both of which are active and moving. Although it is possible for two-handed signs to be made with two different and independent HCS, PAS, and MOVS, in fact we find that in this respect the form of signs is severely constrained. If both hands move independently during a

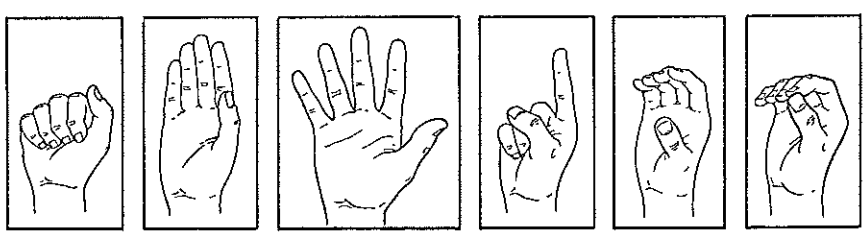
sign's articulation, then the two hands must exhibit identical HCs; the PAs are severely constrained with respect to one another (they must be in the same location or on the same horizontal or vertical plane); and the MOVs of the two hands must be the same (whether performed simultaneously or in alternation). The Symmetry Constraint thus specifies that in a two-handed sign, if both hands move and are active, they must perform roughly the same motor acts.

The Dominance Constraint applies to the class of signs in which one hand acts on the other as a base, that is, as a PA. The active hand may assume any HC and may have any MOV compatible with contact signs. But the base, or nondominant, hand is severely limited with respect to shape: the Dominance Constraint provides that the nonmoving hand must either match the articulator in HC or assume one of a highly restricted set of HCs: /A/, /B/, /5/, /G/, /C/, and /0/ (see figure 2.24). These appear to be the most basic handshapes for other reasons also: they are among the most frequently occurring shapes, accounting for 70 percent of all signs; they are among the first shapes mastered by deaf children acquiring ASL from deaf parents (Boyes-Braem 1973); they function less restrictively than other handshapes; and they are less confusable with one another than are the marked HCs (see chapter 7).[10]

The Symmetry and Dominance Constraints greatly limit the combinatorial possibilities in ASL signs. Given two articulators and a large set of HC values, the potential number of sign forms that could be realized by their combination is very large; in fact, sign forms involving both hands are restricted in ASL to a very narrow set in which the hands are either identical or, if they do exhibit different handshapes, the base handshape is highly restricted.

Another kind of constraint limits the ways in which parameter values may interact. For instance, although innumerable focusing or contacting regions are physically possible with ASL handshapes, only a limited set occurs with any given HC. One kind of evidence for such constraints on possible sign forms comes from studies of initialized signs, which derive from English loan words. One way to create new

Figure 2.24 The six most frequently occurring handshapes.



signs in ASL is to substitute into any existing sign a fingerspelling handshape that stands for the first letter of a corresponding English word (for example, a form of the sign CHANGE made with the fingerspelling "M" handshape has been used as an invented sign for 'modulation'). When an initializing HC is substituted into an existing sign, the contacting region must be appropriate to the newly designated handshape; this sometimes results in a change in the contacting region or orientation. For instance, the sign WORK is made with a fist HC /A/, contacting with the heel of the hand; there is an initialized sign DUTY which substitutes the "D" handshape. Instead of contacting with the heel of the hand, the contacting region is changed to the thumb and fingertip loop of the "D" handshape. Thus the change in HC results in a change in contacting region and provides evidence for the restrictiveness of that parameter.[11]

There are also restrictions within the movement parameter of signs. For instance, signs made with two hands interacting tend to have simple movements (Friedman 1977). There appear to be length and complexity restrictions on the surface form of monomorphemic signs which govern the kinds of movement clusters that occur. Supalla and Newport (in press) have shown that not all manners of onset and offset movement occur with all types of movement; a hold offset, for instance, does not occur with bidirectional movement; repetition of a surface form sign does not occur with extended-path movement or with sharp (rapid, tense) movement or with two-touch movement. There are other kinds of restrictions within the domain of movement of signs: Local movements (hand internal and wrist rotations) can be embedded in directional movements, but directional movements cannot occur with (or be embedded into) other directional movements in uninflected signs; however, such nesting of directional movements within directional movements is consistently used in inflectional patterning.

Our knowledge of constraints on the combination of formational elements in ASL is yet very limited; nevertheless, it is clear that there are restrictions on the formation of the lexical items of ASL. The extent to which the system is constrained at the lexical level, and the extent to which these constraints are characteristic of all sign languages or special to ASL, are not yet known. Further clues to the nature of combinatorial constraints will be discussed in chapters 5, 6, 11, and 12.

Summary

When regarded as a global whole, a sign may display some iconic aspects, revealing its origins in mimicking or depicting some action, shape, or movement of what it originally represented. But however iconic a sign may be, at another level it is a form within a constrained

body of forms (the signs of ASL) that can be decomposed into a small set of distinguishing elements. The formational components of signs represent specific spatial dimensions: configurations of the hands; locations; movement shapes, directions, and qualities; spatial relations and interactions between the hands. A simultaneous combination of a limited set of values from each dimension which can combine only in certain restricted ways creates a multitude of possible sign forms.

Signs exhibit an overall multidimensional organization, not as successive contrastively distinct events through time, but in terms of spatial parameters that coexist within a unit of time. Sign language makes use of the dimensions of the spatial mode, which spoken languages lack, in creating visible shapes moving in space which reveal their mimetic origins yet are systematically and formationally constrained.