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STRUCTURE AND ACQUISITION OF VERBS OF MOTION AND LOCATION IN AMERICAN SIGN LANGUAGE

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SAN DIEGO

Structure and Acquisition of Verbs of Motion and Location in American Sign Language

A dissertation submitted in partial satisfaction

of the requirements for the degree Doctor of Philosophy

in Psychology

by

Ted Supalla

Committee in charge:

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Professor Edward S. Klima
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1982

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PUBLICATIONS

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FIELDS OF STUDY

Major Field: Psycholinguistics

ABSTRACT OF THE DISSERTATION

Structure and Acquisition
of Verbs of Motion and Location
in American Sign Language

by

Ted Supalla

Doctor of Philosophy in Psychology

University of California, San Diego, 1982

Professor Jean M. Mandler, Co-Chair

Professor Ursula Bellugi, Co-Chair

Previous investigators have suggested that verbs of motion and location in American Sign Language (ASL) are strikingly different from words in spoken languages. In spoken languages, words are typically composed of components (morphemes), each of which is discretely different from the others. In contrast, they claim, verbs of motion and location in American Sign Language are "mimetic," globally imitating real-world movement and spatial relations. On this view, certain "words" in ASL are wholistic and analogue in form, not componential and discrete. If this claim were correct, it would suggest that ASL was strikingly different from any spoken language, and therefore that modality was a significant contributor to language structure.

However, evidence is presented here for the counterclaim that in fact ASL verbs of motion, like words of spoken language, are componential and discrete. One part of this evidence is a detailed

linguistic analysis of ASL verbs of motion and location, in which the range of grammatical forms is accounted for by a limited set of morphological components, each of which is discretely different from the others. These components are somewhat different from those of spoken language, in that they are transparently related to their meanings, and they are combined with one another in a largely simultaneous rather than sequential fashion. But in the more important sense they are like the components of spoken language, in that they form a combinatorial set out of which the stock of verbs is constructed.

A second part of the evidence for this counterclaim is an analysis of the acquisition of verbs of motion by young deaf children acquiring ASL as a native language. Young children produce verbs of motion not wholistically, but component by component: Over development, they acquire control of components one by one. Moreover, at middle stages of the acquisition process they often produce individual components sequentially rather than simultaneously. These phenomena suggest that the young child, as the linguistic analysis would predict, reveals componential organization and mastery of the verbs.

This evidence, along with other literature on ASL, supports the claim that discreteness and componentiality are properties of language generally, and not properties of auditory-vocal language in particular.

OVERVIEW

The first part of this thesis examines the structure of a language developed in a visual/manual mode (American Sign Language), where the resources available in the mode are restructured into linguistic devices. The thesis will concentrate in particular on morphology, the internal structure of the sign in ASL, and most particularly on morphology in verbs of motion and location. The reason for this concentration on verbs of motion and location is because they appear at first look, and have been suggested by previous investigators, to be the least restructured from the nonlinguistic resources available in the modality, and therefore the most different from words in spoken languages. I will argue, however, that verbs of motion and location in ASL are in fact highly linguistically structured, and are structured in ways quite like words of spoken languages.

The second part of the thesis examines the acquisition of this system by young children. This examination has two aims: First, the patterns of acquisition of ASL verbs of motion and location in part support the claims of the linguistic analysis, demonstrating that children organize these signs from the beginning in terms of discrete morphemes which are highly structured in relation to one another. Second, these patterns of acquisition shed further light on, and extend, our understanding of the acquisition of spoken languages. The thesis ends with a discussion of the conclusions and implications of the study from both these points of view.

CHAPTER 1: THE LINGUISTIC DESCRIPTION OF ASL VERBS

1. Review of grammatical devices in ASL

ASL sentences are composed of verbs and nouns with few function words (Fischer, 1974; Friedman, 1975). In normal dialogue, reference points for nouns are established in the signing space, either by producing the noun at this location in the space or by pointing to the location after signing the noun in a neutral location. The verbs that have been studied by previous investigators (see especially Fischer, 1973b; Fischer & Gough, 1978) fall into three subgroups: One subgroup are those verbs which are signed on the body and do not themselves get articulated in space (e.g., the verb LIKE, shown in Figure 1); for these verbs, the sign order of the clause is SVO, and the SVO order itself is relied on to cue the argument roles of the verb. A second subgroup are those known as locational verbs. Locational verbs incorporate the reference point of one of the noun arguments; that is, they are produced in the location of the reference point of that noun (e.g., FIND, shown in Figure 2, is produced with the hand in the reference place of the patient). A third subgroup, directional verbs, incorporate several reference points to mark the relationships among several noun arguments (e.g., CHOOSE, shown in Figure 3, is the same in form as FIND, except that in CHOOSE the movement is travels from a reference point representing the source or patient to another reference point representing the goal or agent).

For both locational and directional verbs, although SVO is the basic order, word order is relatively free since the movement of the

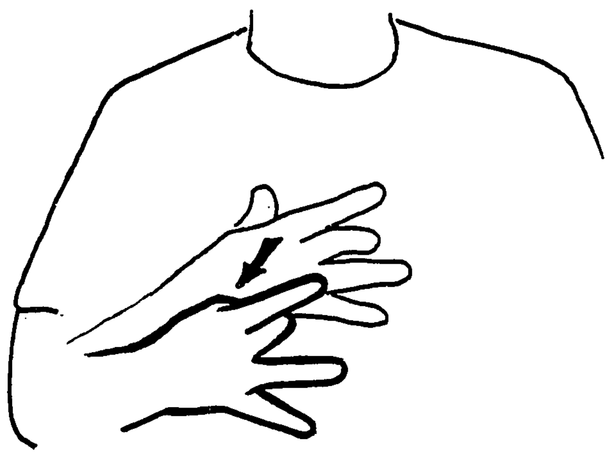


Figure 1. LIKE

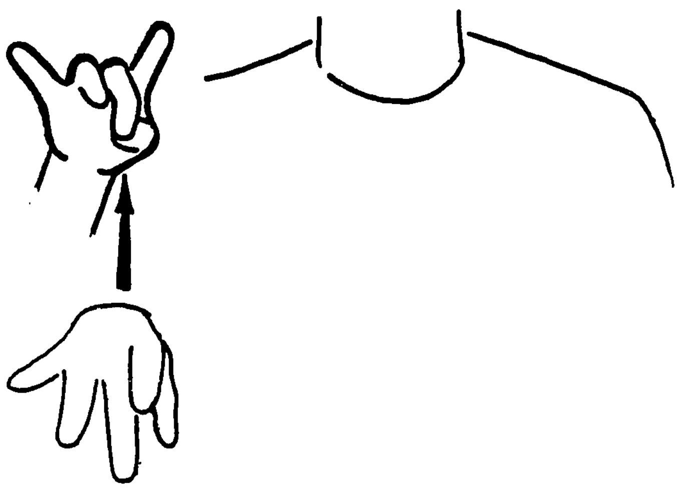


Figure 2. FIND

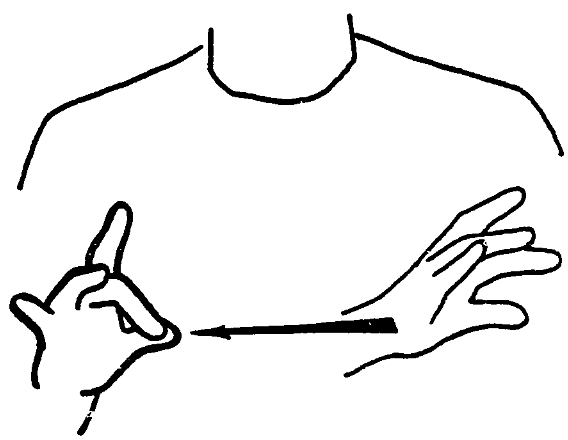


Figure 3. CHOOSE

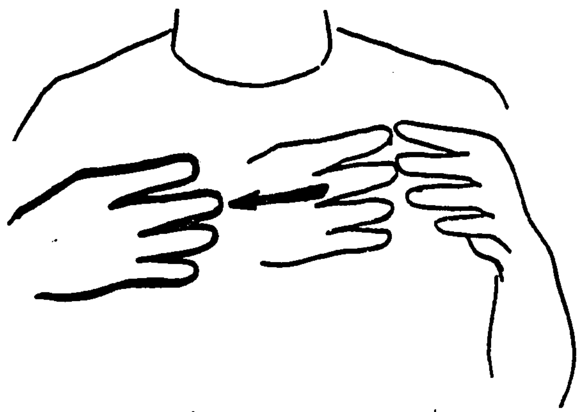
verb between the noun reference points is used instead to mark the grammatical relationships among the nouns (Fischer, 1974). For example, "the girl hit the boy" is contrasted with "the boy hit the girl" as follows: the two nouns (GIRL and BOY) are first established in space (in either order), and the movement of the verb HIT (a directional verb), from the location of the boy to the location of the girl or vice versa, will establish which is the agent or subject, and which is the patient or object. If the girl is the agent, the verb moves from the reference point established for GIRL to that established for BOY; if the boy is the agent, the direction is reversed. Friedman (1975) and Lacy (in progress) suggest that the arguments of the initial point and the end point are better described as subject and object, respectively, than as agent and patient.

The verbs described thus far in the literature, as reviewed above, are what I will refer to as "frozen" verbs, those whose stems include no internal morphology (particularly, no morphemes which act as classifiers representing semantic or shape characteristics of the noun arguments). There is yet another kind of verb for which OSV is the preferred order (Liddell, 1977). Liddell suggests that OSV is used when the object noun is a location rather than a true direct object. However, I would argue that this order is used when a base hand is established in space in which the shape of the hand acts as a classifier for the semantic category or shape of the object (see also Coulter, 1979).[1] In such a case, the object is signed first, the subject is signed next, and finally the verb moves with respect to the base hand object to reflect the action on the object. For example, a car crashing through a fence is signed as follows: FENCE CAR VEHICLE-MOVE-THRU-FENCE. This sentence is shown in Figure 4. After FENCE is signed, the base hand for this sign remains in place, and the verb moves through this base hand.

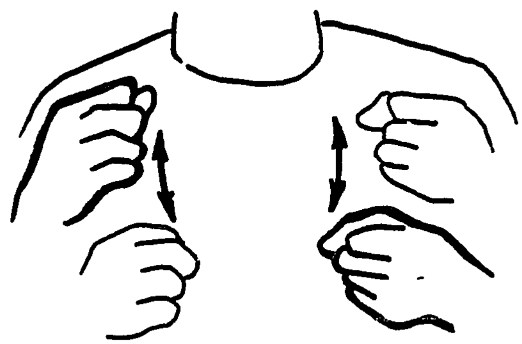
In sum, ASL has two ways of marking grammatical relationships between elements of a proposition, word order and spatial devices. As Fischer (1974) has pointed out, these two types of devices in ASL bear the same kind of inverse relationship to one another that word order and inflections bear to one another in spoken languages; word order is most restricted when there are no other case marking devices, but is free to be used for pragmatic purposes when other devices are employed. In ASL the type of verb determines which way will be used for a particular sentence. If the verb does not incorporate any features of the noun arguments, SVO order determines grammatical relationships. On the other hand, if the verb incorporates features of the noun arguments, word order is relatively freer; and, with verbs that include classifiers as well as reference points, OSV order is used.

2. Review of morphology in ASL

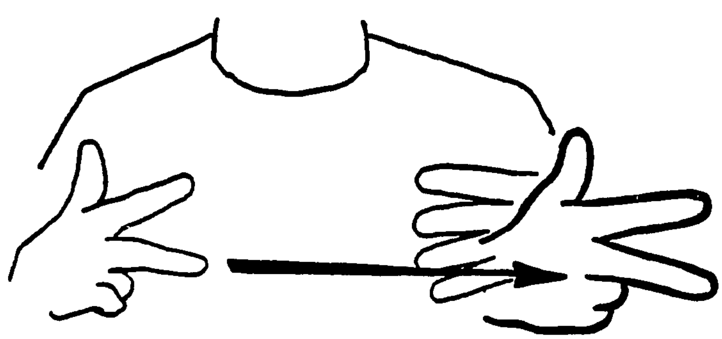
The previous section has described morphemes of verbs in ASL which serve to locate the nouns and the verb in grammatical space and to mark the grammatical relationships among the nouns. Research on ASL morphology has also investigated inflectional morphology for marking aspect and distribution on verbs, and pluralization on nouns (Fischer, 1973a; Fischer & Gough, 1978; Supalla & Newport, 1978; Klima, Bellugi et al., 1979), as well as derivational morphology which distinguishes verb stems from related noun stems (Supalla & Newport, 1978). The basic



4a. FENCE



4b. CAR



4c. VEHICLE-MOVE-THRU-FENCE

Figure 4. ASL sentence for "a car crashing through a fence"

findings of this research are that, first, noun stems are distinct from verb stems in morphemic form, and, second, that these stems can each undergo a variety of inflectional processes which apply in an ordered and recursive fashion. In this sense ASL morphology is like that of spoken languages of the world.

However, the literature has presented a rather different view of one particular domain in ASL, that of verbs of motion and location. Some ASL verbs of motion and location are like those signs described above, "frozen" signs which are highly frequent, standardized in form across signers, and listed in standard dictionaries of ASL as single-morpheme stems (e.g., the citation forms for FALL, MOVE, HIT). In contrast, though, there is another type of verb of motion and location in ASL which has been described as highly mimetic in form. These verbs (if indeed they deserve to be called "verbs") appear to be formed by moving a handshape representing an object in a path which mirrors that which the object takes in the real world (DeMatteo, 1977; Cohen, Namir & Schlesinger, 1977; Klima, Bellugi et al., 1979). On this description, these "mimetic depictions" of motion are not constructed from a limited set of discrete morphemes, but rather are built on an analogue use of movement and space, mapping in a continuous fashion motion and spatial relations in the world (DeMatteo, 1977).

There are actually two claims implicit in this view: The first is that "mimetic" verbs of motion and location are wholistic in organization, rather than componential as are words in spoken language. That is, if these verbs mirror movement through space in the real world, they must be global mimes of such movement; in contrast, words of spoken language are composed of independent internal components (that is, morphemes) which combine in rule-governed ways to form a word. The second claim is that the forms vary in continuous, analogue fashion, rather than taking on discrete values which limit the number of possible forms. In contrast, the units of spoken language can occur in only a limited number of discrete values; each form thereby represents a category along some real-world continuum (e.g., singular vs. plural; straight vs. turn). Meaning distinctions within the discrete categories can be expressed only by phrases, and not by continuous variations in the basic stock of morphemes.

If these claims were true, they would suggest that modality could contribute quite radically to the possible structuring of a language: language in the gestural modality could, on this view, be organized very differently from language in the auditory-vocal mode, with the latter building its lexical stems by combining discrete component forms but the former building at least certain of its lexical stems by wholistic, analogue mappings from the continuous variations in the referent.

As I will detail, however, the claim is incorrect. In certain ways, the morphology of ASL, particularly the verb morphology, is indeed unique as compared to that of any spoken language. For one thing, the verb form is constructed from morphemes (handshape, movement, base point, etc.) which are combined simultaneously, e.g.:

$$\begin{bmatrix} \begin{bmatrix} \begin{bmatrix}\text{root morpheme}\end{bmatrix} \\ \text{morpheme} \end{bmatrix} \\ \text{morpheme} \end{bmatrix}$$

In contrast, spoken languages ordinarily have morphemes added sequentially to the root, e.g.:

[morpheme][root morpheme][morpheme]

though to be sure there are at least rough analogies in spoken language to the simultaneous organization of root and stem (e.g., English goose/geese, and more generally, infix structure in such languages as Hebrew). Second, the individual morphemes of ASL, unlike those of spoken languages, have some transparent relations to their meanings.

But in crucial ways ASL morphology is very like that of the spoken languages. Most importantly, according to my thesis, the verb forms in ASL, like those in spoken languages, are combinations of a finite set of discrete units. That is, they are both componential and discrete. The remarkable fact is that this is true of ASL despite the fact that the visual/gestural mode in principle would permit more continuous, analogue forms that would have clear meaning interpretations. But ASL, being in the important senses an instance of a humanly possible language, has universal design features in common with all human languages. Most importantly: Human linguistic systems are digital, not analogue, a fact independent of the peripheral resources (mouth and ear, or hand and eye) that are used to create the forms.

Preliminary claims to this effect have been made by Coulter (1977) and, in a preliminary linguistic analysis on which this thesis expands, by myself and my collaborator, Elissa Newport (Supalla, 1978a, 1978b; Newport, 1981, 1982; Newport and Supalla, 1980). In the sections below I describe in detail the linguistic analysis underlying this counterclaim. What I will demonstrate is that a linguistic analysis in terms of a limited number of possible verb forms, each componential and consisting of a set of morphemes whose possible values are limited and discretely different from one another, is adequate to describe verbs of motion and location in ASL. In subsequent chapters I will consider evidence from the acquisition and production of ASL that provides psychological support for this analysis.

3. Verbs of motion and location in ASL

3.1 Preliminary remarks.

A verb stem in a spoken language is composed of roots and derivational morphemes. Each of these is physically realized as a unit or sequence of phonological units, such as a syllable. For example, in the word transport, both the root (port, meaning "to carry") and the derivational morpheme (trans, meaning "across") are realized as single syllables. But in, e.g., circumnavigate, the derivational prefix, circum (meaning "around"), is two syllables long. For other words of English, such as wreath (a circle of flowers) and its verb form wreathe (to put a circle of flowers around), the derivational morpheme (that changes the noun to a verb) is just a single phonetic feature (voicing, of th).

ASL has similar roots and derivational morphemes, but in ASL verbs of motion and location they are most often physically realized as single phonetic features. These morphemes are organized into two basic groups: movement and articulators. The verb stem consists of articulators (e.g., the hands) moving through space relative to each other or to a stationary articulator. According to my analysis, the general structure of this stem involves one or more movement roots, each with possible movement affixes, and each with obligatory handshape, hand placement, and hand orientation affixes. We begin by describing movement.

3.2 Movement

Movement within my analysis is both componentially organized and composed of morphemes which can take on only discrete values. Movement involves change in one of the three articulation parameters: location, orientation and shape. A movement contains a single unit of articulation features in one parameter. Each movement may be combined either simultaneously or sequentially with another movement according to the constraints discussed below; this latter movement may come either from the same parameter or from a different parameter.

3.2a. Basic movement roots. The basic movement roots possible in verbs of motion and location in ASL are listed in Table 1. These basic roots are in fact constructed from a set of morphological features:

1) The roots divide into three types: Stative roots have a hold movement, that is they are stationary in space. Contact roots have a minimal contacting movement, which involves a very small movement in space. Active roots involve motion. Table 2 shows the inventory of predicate types which correspond to these types of roots: predicates of existence for the stative roots, predicates of location for the contact roots, and predicates of motion for the active roots.

2) For each of these three types, there is a displaced and an anchored form. Anchored roots are those which maintain a single set of

Table 1

Basic movement roots
and their morphological features

Root	Displacement	Parameter	Shape
Stative	displaced	location	linear tracing arc tracing circular tracing
	anchored		hold
Contact	displaced	location	linear stamping arc stamping circular stamping
	anchored		contact
Active	displaced	location	linear path arc path circular path
	anchored	orientation	end pivot midpivot
		form	spread bend flat bend round change diameter

Table 2

Predicate types corresponding to the types of movement roots

Predicate	Root	Displacement anchored	displaced
Existence	Stative	hold	tracing
Location	Contact	contact	stamping
Motion	Active	change of orientation form	change of location

features in the location parameter, that is, they are fixed to a given point in space. For the stative root, this is a simple hold, with no movement at all, and means "be stationary." For example, a flat, horizontal B-handshape (see below for a discussion of handshape) held motionless in the signing space represents a stationary flat object. Similarly, the anchored contact root is a simple contact movement, in which there is an extremely brief movement (as if to contact something) before the hand stops at a specified place. This root is found in all verbs of location. For example, a flat, horizontal B-handshape with the contact movement means "there is a flat object (in some location)."

In contrast, these same roots have displaced forms. Displaced roots are those which change features in the location parameter, that is they move from one place to another. For the stative root, this is what is known as tracing (Mandel, 1977; Supalla, 1978a). For the contact root this is what is known as stamping (Mandel, 1977). For the active root, there are several other features involved as well:

3) The active displaced roots all vary in location but may have three different values of shape: linear, arc, and circular. In the linear root, the hand moves through a straight path, with the meaning "move straight"; in the arc root, the hand moves through an arc-shaped path, with the meaning "move in arc," or "jump"; and in the circular root, the hand moves in a circle, with the meaning "move in circle."

4) In contrast, the active anchored root may involve either change of orientation or change of form. A change of features in the orientation parameter results in a pivot movement. The precise form of this movement depends on the pivot axis of the hand: endpivot is a

change of orientation around one end of the hand, with the meaning "swing," while midpivot is a change of orientation around the midpoint of the hand, with the meaning "rotate." A change of features in the handshape parameter occurs in several types of change of form: e.g., spread, bend-flat (i.e., fold), bend-round, and change-diameter. In each of these, one set of features of the articulators specifying attributes of the noun argument (see later section on handshape) is replaced by another set, reflecting a change of attributes of the noun argument.

In sum, there is a small set of simple movement roots formed from a yet smaller set of movement features. Each of these roots bears some transparent relationship to its meaning; but, significantly, they are quite limited in number, each representing a category of movements. Movement cannot be varied in a continuous, analogue way to represent the infinite number of motions possible in the world.

3.2b. Segmentation of movement. The roots described above can occur within a verb of motion or location only according to the constraints of a hierarchical organization within a set of sequential movement units. The basic sequential units of movement are organized as shown in Table 3. A movement in an ASL verb of motion or location can consist of a series of units Point A + Path A-B + Point B + Path B-C + Point C... For simplicity of explanation, let us consider just the sequence of units A + A-B + B. Each point (e.g., A or B) can take one or a sequence of movement roots which have no displacement, i.e., are anchored at this point. In contrast, each path (e.g., A-B) can take only one movement root, which must have displacement.

Table 3

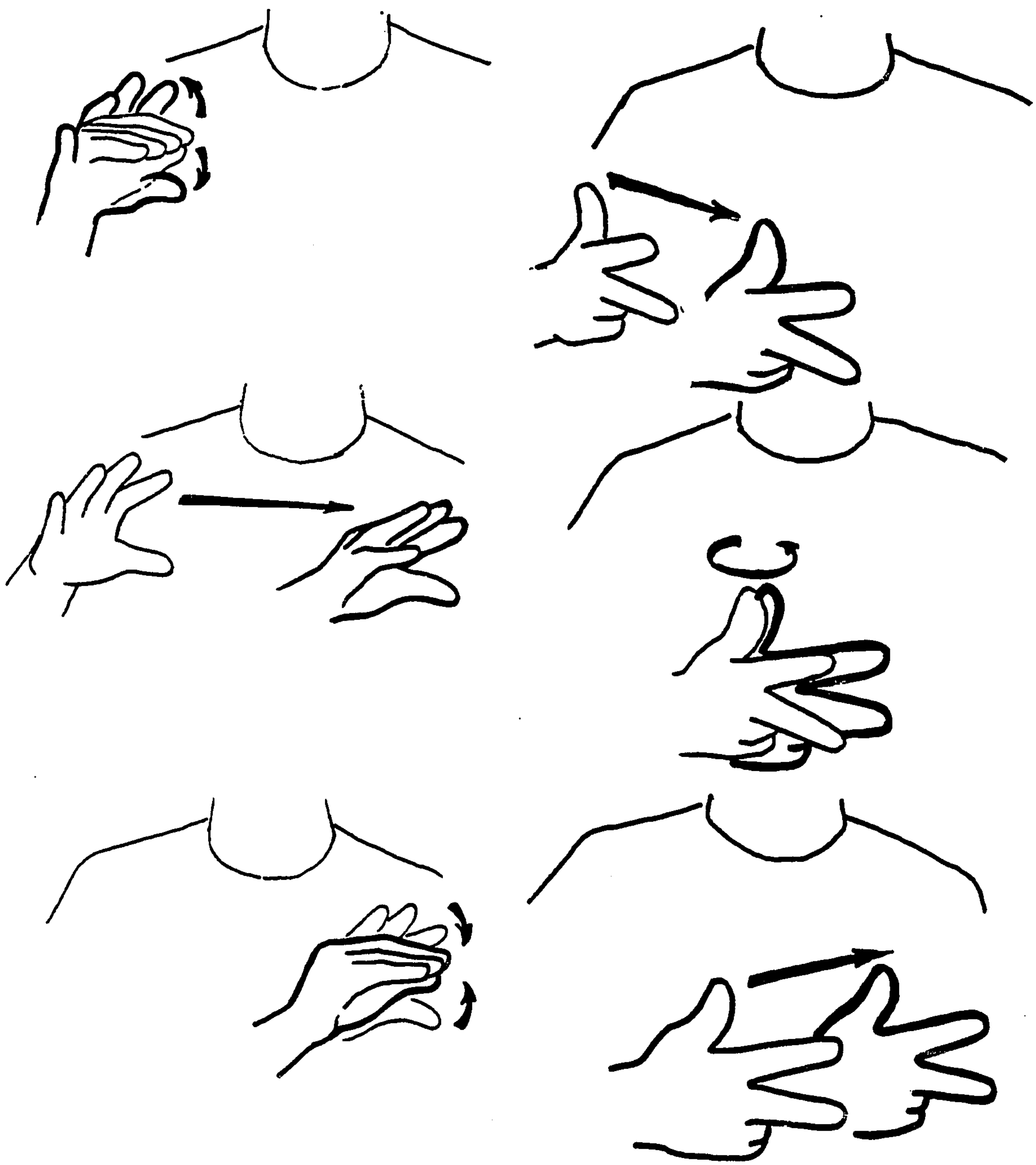
Sequential units of movement
and basic roots which may occur at each

Point A	+	Path A–B	+	Point B
stative		linear		stative
contact		arc		contact
end-pivot		circular		end-pivot
mid-pivot				mid-pivot
spread				spread
bend-flat				bend-flat
bend-round				bend-round
change-diameter				change-diameter

The simplest movements, then, are those which involve only one movement unit, either a point A or a path A-B, and which involve only one movement root at this point or path. For example, any of the anchored roots may occur alone at a point in space: e.g., stative (BE-STATIONARY), contact (BE-LOCATED), endpivot (SWING), midpivot (ROTATE), bend-flat (FOLD), etc. Similarly, any of the displaced roots may occur alone along a path through space: e.g., tracing (BE-SHAPED-X), linear (MOVE-STRAIGHT), arc (MOVE-IN-ARC), etc.

In complex verbs representing complex events, roots may be combined in sequence according to the A + A-B + B structure. For example, in the verb FLASHLIGHT-BEAM-GOES-ON-THEN-MOVES-THEN-GOES-OFF shown in Figure 5, there is an anchored root (open spread) at point A, followed by a displaced root (linear) from A to B, followed by an anchored root (close spread) at point B. A more common example of the sequential structure of complex movements occurs in the verb TURN, where roots occur only in the units A-B + B + B-C (points A and C are unmarked in this verb). For TURN, as shown in the right half of Figure 5, a linear root (from A to B) is combined sequentially with a midpivot root (at B) and then another linear root (from B to C).

These sequential forms in complex verbs vary in the degree to which the sequential units merge with one another: Movement in each root may be kept intact without any interference from neighboring roots (i.e., agglutinative). On the other hand, some root combinations may become well-merged (i.e., fused), with sequential movements overlapped or shingled. This is the case in the verb TURN, where the pivot movement is assimilated into the final linear movement. In the case of



5a. FLASHLIGHT-BEAM-GOES-ON THEN-MOVES-THEN-GOES-OFF

5b. TURN

Figure 5. Two sequences of roots

well-merged combinations, the resulting form may be more appropriately analysed as a single morphemic unit rather than as several separate roots.

3.2c. Hierarchy of movement forms. Within the movement units described above, movements may be combined with one another simultaneously according to certain hierarchical constraints. By hierarchy, I mean to suggest that there are series of levels of morphemes, with the decisions made at the lower levels determining the morphemic possibilities available at higher levels. This hierarchy applies to each of the sequential units described above.

In the previous section I described movement forms in which there is a single movement root at each unit. When other movements occur simultaneously within this unit, the first assignment must be that of the basic root, as in single movement root forms; however, these roots can then receive simultaneous affixes. The affixes are movements which are derived with the same set of articulation features that characterize basic roots, but with additional features specified as well. Table 4 presents the set of additional features which may be added to the roots to form an inventory of secondary movements; these secondary movements may then be affixed to the basic movement roots.

That is, the affixes, like the basic roots, are movements involving changes in location, orientation or shape parameters. Unlike the basic roots, however, the affixes must additionally be specified in terms of how they are affixed to the basic root: Degree of change involves one of two morphemes specifying whether the affixes change features maximally (i.e., fully, like the active roots) or only

Table 4

Features of secondary movement affixes

Degree of change	Directionality of change	Frequency of change
maximum (unmarked)	unidirectional (unmarked)	single (unmarked) repeated
	contradirectional	single repeated
	bidirectional	single repeated
minimum	unidirectional	single repeated
	contradirectional	single repeated
	bidirectional	single repeated

minimally (like the minimal change of the contact root). Directionality of change involves one of three morphemes specifying whether the affix movement is unidirectional (moving in one direction only), bidirectional (moving back and forth from the middle of its path), or contradirectional (moving back and forth from one end of its path). Finally, frequency of change involves one of two morphemes specifying whether the movement is single (and therefore superimposed on the whole basic root) or repeated (and therefore nested as a repeated movement within the basic root).

While the basic roots represent the basic predicate of movement, the affixes represent the manner of movement. Figure 6 presents several examples: first, a linear basic root with a repeated, mini contra-linear affix nested within it (MOVE-STRAIGHT-WITH-SMALL-JUMPS, i.e., hop); and, second, a linear root with a repeated, mini bi-linear affix nested within it (MOVE-STRAIGHT-RANDOMLY). The third and fourth examples are the same root with affixes in maxi rather than mini form. These affixes can be added to other basic roots in comparable fashion.

These simultaneous combinations of affixed movements are therefore quite limited in number, form, and unit of secondary movement. Moreover, not all of the possible combinations of these features are grammatical; a precise description of these limitations requires further research. Any marking of affixes of manner of movement in a complex event beyond these limitations must be marked on a separate, subsequent verb (that is, serial verbs may refer together to a single complex event, with one verb carrying some of the relevant affixes and another verb carrying other of the affixes).

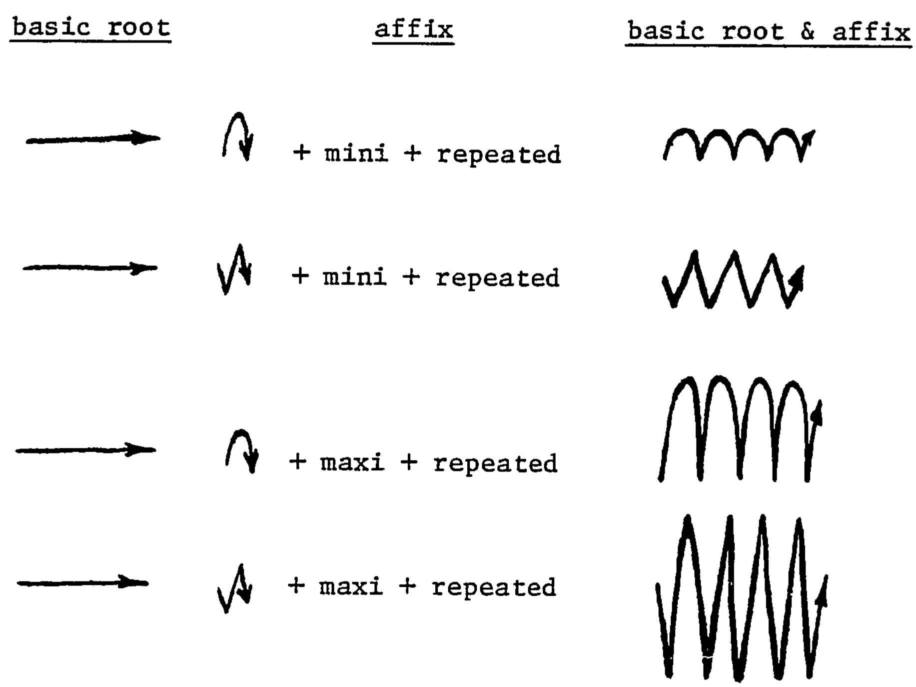


Figure 6. Some examples of simultaneous combinations of affixed movements

In sum, a given verb of motion or location may consist of a set of basic roots organized in series in constrained ways, with a limited number of affixes attached to certain of these roots. Although this organization permits a large number of possible movement forms, both simple and complex, it is much more constrained than is in principle possible for the representation of movement through space; moreover, it is interestingly organized in terms of small sets of units, each of which consists of a small number of discretely different possibilities, and which are organized hierarchically and segmentally in relation to one another. All the movement forms which can be produced by the human articulators but which cannot be generated by this movement system are either ungrammatical or are not distinguished semantically or phonologically from the forms herein described.

Thus far I have described only movement. Obviously, movement is not visible without an articulator doing the moving. In the next section I turn to the morphemic description of the articulators in terms of their shape and orientation. In the subsequent section I will consider how the articulators are placed with respect to the movement.

3.3 Articulator as a noun agreement marker

Each noun involved in an event of motion or location has an agreement marker in the verb of motion or location. This agreement marker is represented by an articulator whose form is determined by morphophonological specifications of the signer's hands, body, and surrounding space. The movement morphemes discussed above then combine with the articulator morphemes to form the stem of the verb.

The articulator morphemes differ from the movement morphemes in that they represent the classification and location of nouns rather than the predicates of nouns. The movement and articulator morphemes are, however, similar in structure in certain ways: I have noted that movement is composed of components combined in restricted ways with one another. The noun agreement markers are likewise structured in terms of components.

As has been noted many times in the ASL literature, there are two ways in which the articulators are used in verbs. First, the articulator may be active, that is, it may move across space. Second, it may be stative, remaining in one place as the active articulator moves. In ASL phonological descriptions the stative articulator has been called the base hand, while the active articulator has been called the active hand. Within the morphological structure of verbs of motion and location, as stated above, these complexes (that is, a moving articulator and a stationary articulator) are multi-morphemic. They each consist of sets of articulator morphemes which are affixed to the movement morphemes described in the previous section. The active and stative articulators are alike in being composed of sets of morphemes agreeing with the nouns involved in an event; they differ in that the active articulator is affixed to an active movement stem, while the stative articulator is affixed to a stative movement stem.

In the first case, that of the active articulator, the articulator is a noun agreement marker for the central, or moving, object (the C.O.), or the instrument holding or moving this object. (The former is true for intransitive verbs of motion; the latter for transitive verbs of motion.) This marker is affixed to the active root of the verb stem, and the stem plus the C.O. marker represent the action of the central object. In surface form, this combination thus appears as an active articulator, that is, a hand or other body part moving across space. This active articulator moves with respect to other articulators in the signing space.

In the second case, that of the stative articulator, the articulator is a noun agreement marker for a secondary object (S.O.) with which the central object interacts. This marker is affixed to a stative root in the verb stem, and the stem plus the S.O. marker represent the location of the secondary object. In surface form, this combination thus appears as a stative articulator, that is, a hand or other body part stationary in space. Several stative articulators may be placed around the movement path of the active articulator within a stretch of discourse, each representing a different object in the event. Because of the limited articulation resources available to the signer, however, (that is, having only two hands and one body), there are severe limitations on how many, and the conditions under which, secondary objects have agreement markers in a given verb; these limitations and the priority rules that govern the appearance of markers in a verb will be discussed in a later section.

When the active root involves orientation or shape changes, a segmental description of the internal morphemes of the active articulator is required. In such cases, certain internal morphemes in the noun agreement marker are replaced by other morphemes throughout the movement segment. Thus each sequential component of the active articulator is dependent on each individual movement segment, and therefore the active articulator must be a root affix. In contrast, the stative articulator does not change in features throughout the verb; its internal morphemes therefore do not require sequential organization but rather are combined simultaneously into a noun agreement marker which is affixed to the whole stem.

3.3a. Marking systems. The number of noun agreement markers found in the surface form of the verb is constrained by the anatomy of the signer. The signer's body provides the resources for the markers, but the selection of the resources available to the signer is restricted by a morphological organization, in which each body part is specialized in the meaning it can represent. These resources are organized into two separate marking systems.

3.3a1. Hand markers. One marking system includes the hands and arms arranged in a variety of hand interactions and handshapes. There is a limited number of discretely different handshapes for such markers, each with its own meaning. Each hand may be used independently as a marker, for example to represent a small, round object (e.g., a coin), as shown in Figure 7. With this type of one-handed marker, two hands are used to refer to separate nouns, as shown in Figure 8, where the two hands represent two small, round objects (e.g., two coins). In contrast, some markers involve the two hands used as a pair, functioning together as a single marker referring to one noun. In this latter case the sign involves non-independent paired active hands. An example is the two-handed classifier

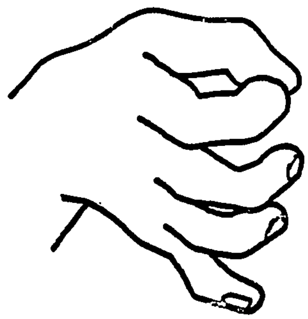


Figure 7. One-handed marker representing
a small, round object

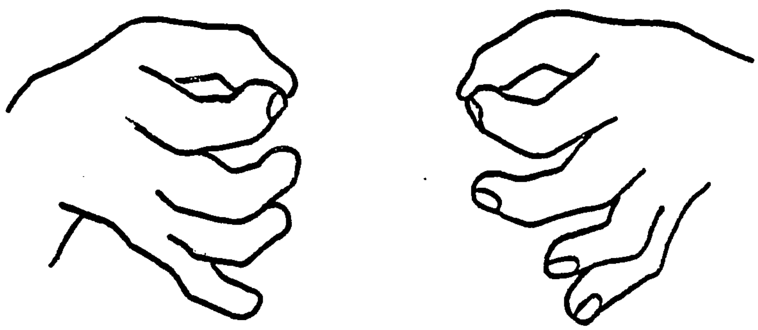


Figure 8. Two one-handed markers representing
two small, round objects

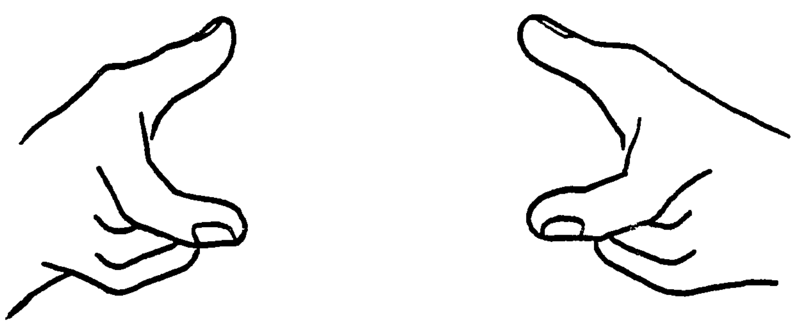


Figure 9. Two-handed marker representing
a large, round object

representing a large, round object (e.g., a plate), as shown in Figure 9.

There are, however, circumstances under which a two-handed marker is produced with one hand deleted in surface production; this occurs, for instance, whenever a two-handed marker is combined in a single verb with a one-handed marker. For example, the hull classifier incorporates two hands identical in handshape and facing each other (see Figure 10). This classifier is used for a variety of boats with hulls. Another classifier may be combined with this classifier, for example where the combination refers to a sailboat (see Figure 11). The second classifier, as shown in this figure, is a single-handed B-handshape referring to the shape of the sail (i.e., wide and flat). To form the combination, one hand is deleted from the hull classifier. The result is that the combined classifier for sailboat, as used in the verb GO-BY-SAILBOAT, is a two-handed classifier, composed of two independent classifiers (one referring to the hull and another referring to the sail), in which both hands may be active.

There are other circumstances as well in which one hand of a two-handed classifier is deleted: when a single-handed base marker is combined with a two-handed active marker, when a two-handed base marker is combined with a single-handed active marker, or even when a two-handed base marker is combined with a two-handed active marker. In any of these situations, one hand is deleted from the two-handed marker(s).

For the first example above, where the result is one non-independent paired-hands classifier, this rule (delete one hand) is sufficient to describe the resulting surface form. But other rules are

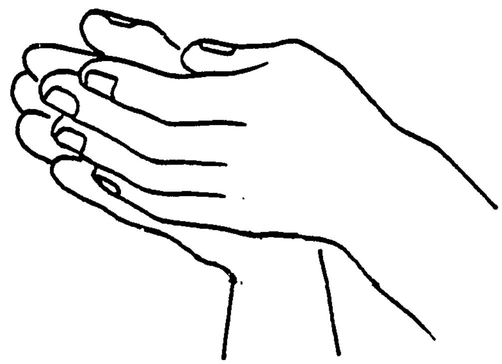


Figure 10. Hull classifier

Figure 11. Combined classifier for sailboat

necessary to govern the deletion when two independent hands are involved. For example, suppose the sailboat marker is used as a base marker. If the verb requires focusing on the hull, as in the case of describing a cannonball hitting the hull, one can only delete the flat B-hand but not the hand from the hull classifier. In contrast, to represent a cannonball hitting the sail instead, one deletes the hull classifier but not the B-hand. (Note: In all of these cases, the deletion occurs in the verb itself, but the full, undeleted form of the basehand classifier must be signed alone, as a locative verb with a contact root (meaning e.g., there is a sailboat), prior to this verb. These serialization rules, including statements of priorities of appearance in a single verb, will be discussed further in later sections.)

3.3a2. Body markers. The second marking system is composed of various components of the signer's body that can function as noun markers. For example, the signer's body can be used as a marker to refer to the body of the referent object, as in the verb TOY-CAR-RUN-OVER-SOMEONE'S-BODY, where a vehicle classifier moves across the signer's body (see Figure 12). In this case the body is used as a base articulator. Alternatively, specific locations on the body, like the eyes, nose or mouth, can be used to mark these attributes on the referent object.

There are several restrictions in using the body marking system. First, the body marker can be used only when the noun referent is animate. That is, no body part is allowed to be used to refer to inanimate objects such as a car or a house (unless the car or house is

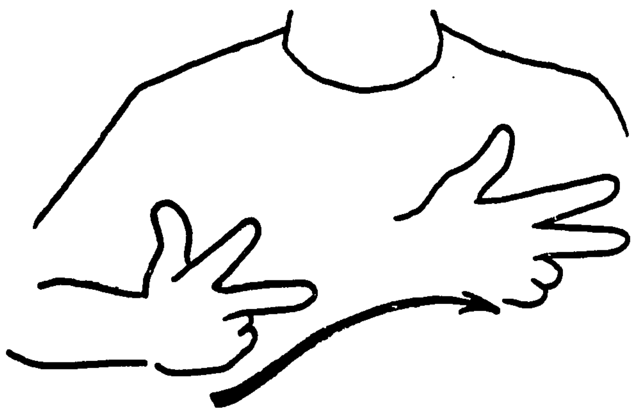


Figure 12. TOY-CAR-RUN-OVER-SOMEONE'S-BODY

Figure 13. NOD-HEAD

conceived of as animate, as in a Walt Disney version of a car as an animate hero of an action).

Second, when a body marker is incorporated into a verb, it can mark only one referent object (although various locations on the body can be combined to refer to various attributes of the same referent object). If subsequent verbs refer to another referent object, the signer must shift his body to a new place in the signing space in order to use it as another body marker; a second referent object cannot be marked by the body marker in the same location, even when nouns prior to the verbs make the distinctions between the two referents clear to the listener.

Third, if the body is used as an active articulator (as opposed to a base articulator), the hand articulator must be added to mark the noun as well. For example, in the sign NOD-HEAD shown in Figure 13, the nodding of the signer's head is obligatorily accompanied by a nodding of the S-handshape (a classifier for _head_).

3.3b. _Inventory of classifiers for an articulator_. Each noun agreement marker (i.e., articulator) includes internal morphemes that refer to the object class for the noun. There are different ways in which the object class may be referred to. As mentioned above, the body may be used to refer to an animate object. Alternatively, the hand may be formed into different handshapes, each referring to a different object class. As noted by Frishberg (1975), Kegl & Wilbur (1976) and Supalla (1978a), these handshapes function similarly to certain types of morphemes in spoken languages that linguists have called _classifiers_.

A classifier is a morpheme that marks certain characteristics of an object. Some classifiers mark the visual-geometric characteristics of the object, for example as round or straight. Other classifiers mark the abstract semantic category of the object, for example human or animal. Yet other classifiers refer to the object indirectly, by means of marking an instrument that manipulates the object, for example as a handgrip on the object. Allan (1977) collected a list of classifiers found in spoken languages around the world. Classifiers in ASL fall into the same categories.

Different classifiers may be used with the same noun in ASL, as in spoken languages, to focus on different characteristics of the referent object. For example, to talk about a boat moving, one could use either the hull classifier as shown in Figure 10 or the vehicle classifier (see Figure 14). One noun may share some classifiers but not all with other nouns. A sailboat shares both the classifiers above with a rowboat but not with a rubber raft (which can be referred to only by a classifier based on its shape, which is flat). Yet the sailboat cannot be marked with an instrument classifier of rowing the boat, which the rowboat and raft share. So each noun has its own inventory of classifiers. Several classifiers may be interchanged throughout the discourse, for the same noun.

At the same time, the selection of classifiers from a noun's inventory is restricted by several factors such as the semantic role of the noun in the event. The noun may be an agent, instrument or patient in the event. In each case, there is a different constraint on selecting classifiers from the inventory. That is, if the moving object

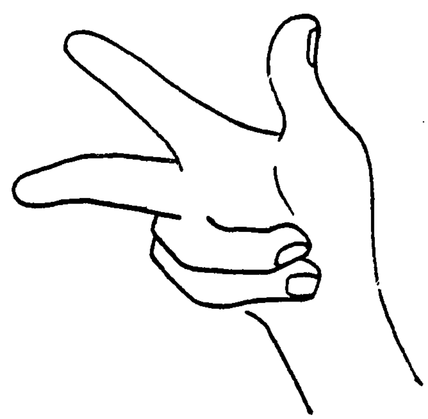


Figure 14. Vehicle Classifier

is self-propelled, a different set of classifiers is allowed to refer it than when the object is instead propelled by something else. For example, the instrument classifier used for driving the car is prohibited for the noun car when it is moving by itself without a driver. It is also prohibited when the focus is on the whole car rather than on the driver, even when the car is being driven.

There are some constraints on which classifiers can be combined with each other. The reference scale must be consistent across several classifiers when they are combined. For example, the animal classifier (i.e., V̈ handshape) can be placed on the top of the signer's head to refer to an event in which a bird is physically located on a human being. But this combination is not allowed if the animal classifier is used to refer to a bird sitting on another bird (unless the second bird is huge relative to the size of the first). Similarly, a vehicle classifier cannot be combined with the signer's body unless the body refers to a giant like King Kong, or unless the handshape refers to a toy car. In all of these cases, there are constraints on the combination of classifiers that have to do with the relative sizes of the referent nouns.

3.3c. Morphophonology of classifiers.

3.3c1. Size and shape specifiers (SASSes). A kind of classifier system particularly relevant to the verbs of motion and location are what have been called size and shape specifiers (henceforth: SASSes) (Newport and Bellugi, 1978). The use of these bears much of the responsibility for the mimetic appearance of the verbs of motion and location.

Each SASS actually consists not of a single handshape morpheme, but of a group of simultaneous hand-part morphemes: each finger as well as the thumb and forearm is a possible morpheme which can combine in specifiable ways to form a handshape (Supalla, 1978a).

Shape is contrasted in two groups of SASSes. One group share the morpheme straight, while the other group share the morpheme round. The hand is extended straight in the first group, while it is curved in the second group. Then they are marked with a morphological value of size (i.e., ± forearm for the straight SASSes and the degree of openness of the hand for the round SASSes). Within these two groups, the SASSes differ formationally as to whether the index finger (and, for the round shapes, the thumb) occur alone; or whether the middle finger or the full hand are involved as well; the meanings of these forms differ correspondingly (i.e., as variations in width for the straight SASSes and in depth for the round SASSes). In addition, there are morphological values of arrangement which must be marked on the SASSes as well (i.e., solid vs intervals vs spreadness). Here the hand is marked either by keeping the fingers together to represent solidity of surface, or by spreading the fingers to represent lines branched out in the straight SASSes and spherical shape in the round SASSes.

This organization is presented in terms of features in Table 5. Some example SASSes are illustrated in Figure 15.

3.3c2. Semantic classifiers. As compared to the SASSes, there is another group of classifiers which is somewhat more abstract in terms of representing objects. The handshapes here seem not to be derived from morphemic handparts as are the SASSes. Although they seem

Table 5

Organization of SASSes

Shape	Straight			Round		
Arrangement	Solid	Parallel	Spreading	Solid	Spherical	Conical
Width/depth	thin narrow wide	one two plural	one two plural	thin shallow deep		
Size	long			compact small normal large larger		

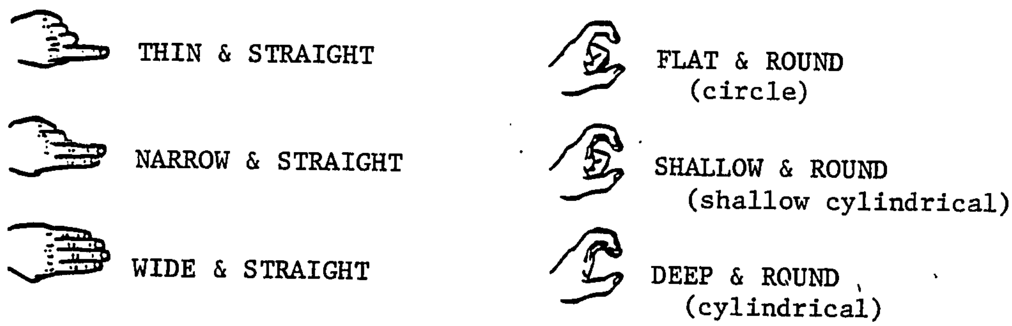


Figure 15. Some examples of SASSes

to have originated as SASSes, they are no longer analyzed as multi-morphemic, as they are no longer based on references to the visual-geometric parts of the object. Instead they refer to objects on the basis of the semantic categories the objects belong to. For instance, a tree is referred to by a classifier in which the forearm is combined with the spread hand. One can recognize this shape as an outline of a conventional tree, but this classifier can be used to refer to trees of different shapes (e.g., palm trees or pine trees). Thus, this classifier refers abstractly to the semantic category of trees. However, some abstract classifiers are related to each other in terms of higher levels of semantic categories. For example, the human classifier and the animal classifier share a meaning component that represents a higher level semantic category: animate thing.[2] So the abstract classifiers are organized into a hierarchy on the basis of the semantic characteristics shared across the classifiers. Table 6 presents this hierarchy, while Figure 16 illustrates these classifiers.

3.3c3. General comments on the morphophonology of classifiers. There are several marker affixes that may be added to either type of classifier to refer to the deformity of the object. One affix is a broken morpheme, which would bend the handshape in the classifier. For example, the tree classifier affixed with this morpheme would be bent at the wrist to refer to a broken tree. Similarly, a thin and straight SASS (Z-handshape) plus the broken affix (i.e., X-handshape) would refer, for example, to a broken pencil. Another affix is a wrecked morpheme, in which the handshape of the classifier would be warped as a whole rather than in an individual handpart as in

Table 6

Organization of semantic classifiers

Semantic Categories
Animate
human
animal
Inanimate
machine
vehicle
airplane
tree

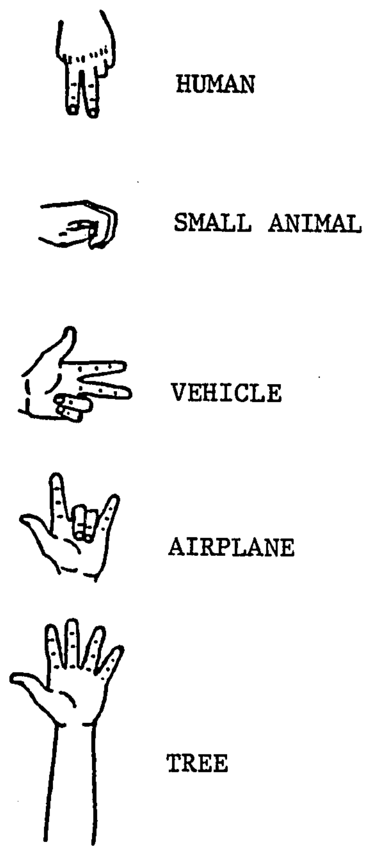


Figure 16. Some examples of semantic classifiers

the broken affix. The tree classifier with the wrecked affix added would have all the fingers bent to various degrees to refer to a deformed tree (e.g., dried-up or dead tree).

Summarizing, SASSes represent visual-geometric attributes of the referent object through internal morphological handparts. In contrast, although the abstract semantic classifiers may have discernible origins in representing visual-geometric parts of objects, in current usage the entire handshape of abstract semantic classifiers is a single morpheme.

3.3d. Classifier orientations. Two other sets of internal morphemes involve the orientations of the noun markers to represent the bearings of the referent objects. Moreover, a third set of morphemes can be affixed to either of the two kinds of orientation morpheme. Table 7 outlines these morphemes as described below.

3.3d1. The first set of bearing morphemes represents the orientation with respect to the external world. There are several such morphemes possible for each kind of classifier. Each of the semantic classifiers has an unmarked orientation which indicates that the referent object is upright. For example, the airplane classifier has an unmarked orientation with the palm facing downward to refer to the uprightness of the airplane, and marked orientations to refer to front down or side down. Three different morphemes are available for the straight SASSes, which contrast in orientation in relation to ground (i.e., vertical, horizontal with the flat side down, and horizontal with the edge down).

3.3d2. The other set of orientation morphemes represents the orientation with respect to the movement path. There are several

Table 7

Orientation morphemes for classifiers

Example Classifiers	Orientation: To external world	Orientation: To path
HUMAN, ANIMAL, VEHICLE, AIRPLANE	upright(unmarked) front side down side down	forward (unmarked) head forward side forward
TREE, STRAIGHT-THIN	vertical horizonital	top forward side forward
STRAIGHT-NARROW, STRAIGHT-WIDE	vertical flat side down edge down	top forward flat side forward edge forward
ROUND, CYLINDRICAL	round side down flat side down	round side forward flat side down

specific morphemes of this type, depending on the type of classifier it applies to. There is an unmarked orientation for the semantic classifier (i.e., forward) and two alternate morphemes (i.e., head forward or side forward). For example, the verb AIRPLANE-MOVE has the airplane classifier moving with the fingers forward, while AIRPLANE-MOVE-SIDEWAYS has the same movement and classifier features except that the fingers are sideways with respect to the movement path. For the straight SASSes there are three morphemes: tip forward, flat forward, and edge forward. In contrast, there are two morphemes for the round SASSes: flat side forward and round side forward.

3.3d3. There is another group of morphemes that can be affixed to any of the above orientation morphemes. One is the opposite affix (180° rotation), which reverses whatever orientation feature it is affixed to. For instance, to sign an upside down airplane, the orientation of the airplane classifier with respect to the ground would be marked with the opposite affix to orient it with its palm facing upward. For the airplane moving backward, the opposite affix would reverse the path orientation so that the airplane classifier moves backward.

3.4 Placement of articulator

In previous sections I have described the articulators and their movements (or absences of movement). However, these descriptions so far have been of movement in the abstract, without specifying where in the signing space the movements or static placements occur. This section describes the morphemic system which places the moving and static articulators in the signing space.

Such a system is composed of noun placement morphemes that locate a reference point for each noun agreement marker in relation to a reference frame, as well as in relation to the other noun markers. The reference frame is a collection of the points available to the signer for use as reference points. Each component of the frame (i.e., each reference point) is specialized in meaning and thus functions as a morpheme representing the location of the object referred to by the noun. Just as articulator handshape is determined by agreement with class of the noun, reference points are determined by agreement with the location of the noun.

The noun placement morpheme for each stative root of a verb stem places the stative articulator agreeing with the appropriate noun (e.g., the ground or secondary object) somewhere in the reference frame. The noun placement morpheme for the active root of a verb stem instead places the path of the active articulator in relation to the stative articulators (or in the reference frame, in the case where there is no stative root in the verb stem). An independent locative morpheme must then be affixed to each noun placement morpheme to specify the locative relation (e.g., at, on, in, above, below or beside) between the articulators.

3.4a. Reference frame. The reference frame is an obligatory part of the verb. It serves as a framework of reference points for the noun agreements involved in the verb stem. The available resources for the reference frame are organized into two separate systems: the real reference system and the abstract reference system. The resources in these two systems contrast in the dimension of scale. Every reference point in the real reference system is analogue to the world, and thus the distances between such points are analogue to those of the world in scale, even when the reference is made on a location outside of the signer's reach. In contrast, every point in the abstract reference system is arbitrary, and the distances between such points are relative in scale.

For example, suppose a signer uses a classifier for a chair across the room from himself, and moves the classifier hand from a point along the line from himself to the current location of the chair (say, on his left), to another point in space (say, on his right). If the signer uses the real reference system (signalled, for example, by pointing to the actual chair before performing the verb), this motion means that the chair moves from its current real-world location to a specific real-world location on the signer's right, along the line from the signer to where he moved the classifier. In contrast, if the signer uses the abstract reference system (signalled, for example, by not pointing to the actual chair), the motion means that some chair moves from one location to another (with the specific real-world locations, and the metric distances, left unspecified). The choice between these two systems involves selections of articulators and their placements according to principles discussed below.

The real reference system includes three sets of resources: the signer's <u>body</u>, the <u>inner space</u> within his reach, and the <u>outer space</u> outside of his reach. Each set has its own set of components or reference points, which include all possible locations as well as the actual objects found in the domain. The abstract reference system is more limited in resources, as it includes only the neutral space in front of the signer. Furthermore, this latter system prohibits use of actual objects as references unless the signer brings them into this restricted area.

Noun placement is therefore more free in terms of location in the real reference system. Yet even here each location is restricted in meaning. That is, each possible reference point in the real reference system is "frozen" in meaning, as it functions as a morpheme referring to the noun's location in the real world. For example, the horizontal plane in the inner space in front of the signer may refer to the top surface of a table, while the horizontal plane above the signer's head may be used to refer to a ceiling. The floor the signer is standing on is outside of his reach (and thus is part of the outer space) but can be used to refer to the ground.

In contrast to the real reference system, each component in the abstract reference frame may vary in meaning. The least marked form of the verb will reflect the action of the central object by having the active articulator moving around in neutral space. The horizontal plane in the middle of this area (i.e., the neutral plane) will represent the ground in the event and may itself be optionally marked with a base hand in the B-handshape.

However, this is not the only set of relationships possible in the abstract reference frame: the arbitrary nature of the relation between form and meaning in the abstract reference frame also allows one to reorient the reference frame. For instance, the verb may be marked so that a vertical plane in neutral space functions as the morpheme for ground (as in the case where an agent looks at the earth from an airplane, and the flat surface of the earth is marked by a vertical plane facing the signer). Such manipulations are not allowed in the real reference system, due to the "frozen" relationship between form (i.e., location) and meaning.

The choice of reference systems is determined by the particular noun classification morphemes (articulators) and noun placement morphemes (locations) selected by the signer to mark noun agreements in the verb. Such morphemes determine the resources available to the signer, with the two independent reference systems allowing him to construct several independent surface forms of the verb to represent the same meaning. For example, when the signer is required to mark noun agreement with an animate noun, the real reference system provides his own body as the morpheme; and the reference frame is expanded to real-world scale, which in turn provides all the resources of the environment to be used as morphemes. To represent a rabbit hopping, one can produce a sign which has the two hands in B-handshapes, bent to represent paws, and which has the upper body bouncing up and down. This is illustrated in Figure 17. In contrast, the abstract reference system provides the signer with a different set of resources to be used as articulators and locations. To mark an animate object, the signer would place a hand articulator in neutral space. Within this reference system a rabbit hopping would be represented by the animal classifier ($\ddot{V}$-handshape) moved with the same up and down bounce as above. This is illustrated in Figure 18.

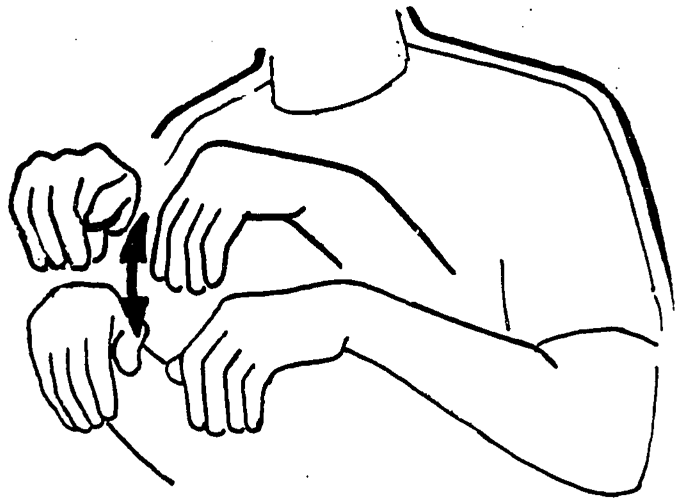


Figure 17. ANIMAL-HOP in real reference system
(with body articulator)

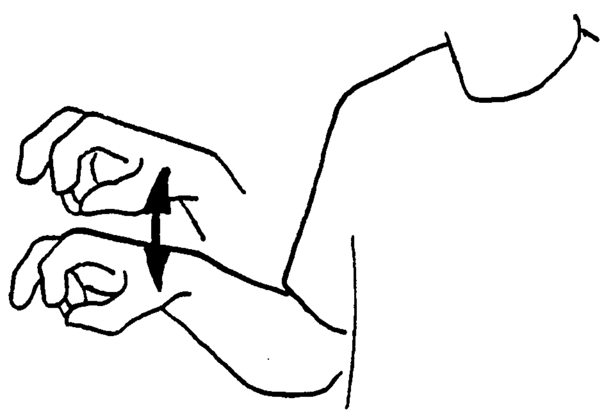


Figure 18. ANIMAL-HOP in abstract reference system
(with hand articulator)

Which of these reference systems is chosen has to do with obligatory agreements between the reference system and other portions of the verb morphology. There is a requirement for consistency of scale between the articulators and the reference system. For example, if one uses a hand articulator to represent an animate object in neutral space in the abstract reference system, its size is not specified. However, if the same hand articulator is used in the real system, size of the object is specified relative to the articulators marking other objects. If a body marker is used to refer to King Kong, then the hand would refer to a relatively smaller (therefore normal-sized) object like a human or an elephant; in contrast, if the body marker is used to refer to a normal-sized human, then the hand would refer to a very small object, like a fly. A related issue, that of agreement in scale between the articulators, was discussed in previous sections. The additional point here is that scale agreement also applies to the reference system, so that scale on distances between referent objects as well as sizes of those objects are all interdependent.

3.4b. Noun placement. As discussed above, the verb stem consists of one or more roots. Each of these must be marked for noun agreement. Each stative root is marked with noun placement morphemes for the ground or the secondary object involved in the event (that is, each stative root marks a location with respect to which the action occurs). These roots in combination form the reference frame. The active root in the stem includes a different set of noun placement morphemes which refer to the central noun in the event (that is, the active root morphemes locate the movement path in the reference frame).

In both cases, then, the noun placement morphemes are locative components. In this section I describe how these components and their combinations form locations and paths in the verb.

The first set of noun placement morphemes found in the stative root includes one of four location morphemes: Two of these location morphemes are used to establish a base plane somewhere in the reference frame to refer to a surface of a secondary object in one case, or to the ground in the other case. A third location morpheme is used to establish a base point in the reference frame which refers to the location of the whole secondary object. The last location morpheme is an unmarked one that refers to the absence of a substance in the location; this is used to locate the active articulator to represent that the central object is suspended in midair, underwater, or in a vacuum.

Orientation affixes may be added to the first of the two location morphemes to represent the orientation of the base plane: an unmarked affix would leave the base plane in a horizontal orientation, while two marked affixes would instead place the base plane in a vertical or diagonal orientation in relation to the reference frame. For the latter, there are several possible contrasts in degree of slantedness (e.g., unmarked, slant toward horizontal axis, slant toward vertical axis) that are marked by further affixes.

When two or more stative roots occur in the stem, there are two ways of combining these roots. The roots may share one location. In this case, the combination includes two independent location morphemes selected from the set discussed above. But there are some combinatorial restrictions. For example, the empty point cannot be combined with other location morphemes in one location. Furthermore, two base planes cannot be combined. These restrictions leave two possible combinations: base point + base point or base point + base plane. These combinations require another set of noun placement morphemes that deals with the locative relationship between the two components. There are five of these locative morphemes: at, in, at-top, at-side, and at-bottom; and two orientation morphemes: outside vs. inside. The orientation morphemes must be affixed to the last three location morphemes whenever the object is hollow.

The other way of combining stative roots is if each root is in a separate location. There are no combinatorial constraints on selecting and combining location morphemes here, but there are more complex locative morphemes involved for each combination. First, there are three locative morphemes that contrast in the orientation relations between the locations: above, beside, and below. For each kind of locative morpheme there is then an affix that marks the distance between the two locations as unmarked, minimum, or maximum.

Noun placement for the active root in the verb stem is more complex. It includes the components discussed above (i.e., location, locative, orientation, and distance), as well as other components establishing the movement path of the active root in the reference frame. Furthermore, there are independent morphemes specifying the interaction of the active root and the stative root in terms of location and locative relationships.

Different noun placement sub-systems of morphemes exist for each group of active roots: contact roots, displaced roots, and anchored roots. Each group requires its own set of morphemes to locate and orient the movement. The movement contrasts across these three groups in terms of the articulation features that involve changes of location through space.

Contact roots (BE-LOCATED) include noun placement morphemes to mark the location of the contact root as well as the locative relationship and orientation between the contact root and the stative root (the latter representing the ground or secondary object). The location of the contact root is made in three ways: a location in the reference frame by itself, the location shared with some stative roots, or the location adjacent to some stative roots. For each of the latter two kinds of location, there are specific sets of locative morphemes, similar to those dealing with the locative relationship between stative roots. The orientation of the location is contrasted in two levels, with three orientation contrasts (vertical, horizontal, and diagonal) and two direction contrasts (up, down).

The displaced roots (MOVE) involve a different set of morphemes to govern the placement of the movement path in the reference frame. They share the same three location morpheme contrasts discussed earlier for the contact roots. But there are four possible base positions in the latter two location morphemes; these base positions are possible locations of the stative root in relation to the path.

The first level of the base position morphemes would either place the whole path at the location of the stative root, or position some part of the path at this location. For the latter case, one morpheme at another level would put one end of the path at the location, while another morpheme places the middle part of the path at the location. The third level of morphemes then specifies the direction of path in relation to the end location, depending on whether the location represents the source (the initial point of the path) or the goal (the final point of the path). For the former, the active articulator departs from the location; for the latter, the active articulator moves toward the location.

For each combination of the location of the active root's path and the base position of the stative root, the same hierarchy of locative morphemes discussed above applies to the locative relationship between the active root and the stative root. The first level of locative morphemes marks the locative relation of the path to the base location (base or plane). One morpheme puts the active articulator at the base location; another morpheme instead places it inside the base location; while a third morpheme puts the path adjacent to the base location. If no such morpheme is affixed, then the active articulator is placed ahead or behind the base marker (i.e., from or to).

The next level of morphemes specifies the orientation of the adjacent location to the active articulator: at the top side of the base location or at the bottom side of the base location. If no such morpheme is added, then the active articulator would be at the side of the base location. The last level of morphemes marks the distance from the adjacent path to the base location: right next to the base location vs. far from the base location. Distance, like the other morphemes, is thus varying discretely from minimum distance to maximum distance. If no such morpheme is marked, the active marker is placed on the base marker (i.e., no distance apart).

As an example of the features described above, Figure 19 presents the possible base locations at and adjacent to a linear movement path.

As the description shows, the interaction of movement and locations in the verb are organized into a limited number of possible positions around the movement path that can be marked as a location. We have called these locations base points and base planes. The set of all such base locations for a given root is called the base grid system.

All of the above are required if there are stative roots occuring along with the movement root. If the verb stem is marked with no stative root, there would be no base grid system in the reference frame. A different set of noun placement morphemes is then required to locate the active root, those governing the direction of the path as well as its position in relation to the reference frame. Such variations in movement are organized as a hierarchy of components: 1) position of path's initial part, 2) path orientation, 3) absolute direction, and 4) position of the path's final part.

The first set of these morphemes locates the beginning of the movement path in relation to the reference frame. This location has an arbitrary meaning, since there is no interaction with any base location. The movement path in this sense is relative in location, but in actual practice signers tend to orient the reference frame according to real-world dimensions. For example, for an object floating in a vacuum

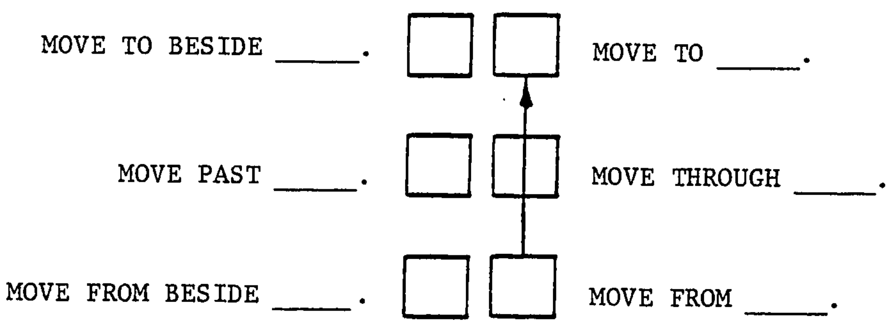


Figure 19. Some possible base locations at and adjacent to a linear movement path

somewhere in the universe, the signer would hold the articulator representing the object in orientation to his own real-world orientations.

The second set of these morphemes marks the orientation of the path as either perpendicular or diagonal to the horizontal axis of the signer. If the orientation is unmarked, the path is parallel to the horizontal axis of the signer. Path direction is then marked by the third set of morphemes, as the positive (e.g., up) vs. the negative direction (e.g., down). No direction morpheme is marked for the horizontal path, as its direction is determined by phonological features (i.e., relative direction from a relative initial position to a relative final position). The fourth set of these morphemes deals with the final part of the path, which for the displaced root must be placed somewhere other than the location marked as the initial position. This morpheme is also arbitrary. This system also allows the signer to place the path in the reference frame without any reference to a base grid system. The noun placement system for the anchored root is similar to the system for the displaced root, except that the anchored point in the movement path requires special placement morphemes. However, these additional components are organized in the same way that the other morphemes are organized.

3.5 Syntactic structure and the verb stem

In sum, the verb stem is composed of interactions of articulators and locations whose values are chosen from the available morphological resources and combined according to the rules of the ASL morphological system. This system organizes the resources into several hierarchies of morphemes as described above: 1) the movement root, 2) movement affixes, 3) noun agreement affixes, 4) noun classification affixes, and 5) noun placement affixes.

Each movement root refers to the underlying predicate (existence, location, or motion) of the noun, while movement affixes reflect the manner of this predicate. Although in principle the modality would seem to offer the possibility of infinite numbers of wholistically organized movements, ASL permits only a small number of movement components, organized in a highly grammaticized way.

The articulator(s) (or location, for stative roots) marks noun agreement. The shape of the articulator reflects the classification of the noun, while the placement of the articulator refers to the locative relationships of the noun. In principle, this structure even as it is grammaticized in the modality would seem to allow the signer to create an infinite number of noun agreements in the verb stem: the description given thus far places no limit on the number of such agreement markers. However, resources available to the signer within the language are in fact more limited than the above description suggests. The morphological system involves linguistic constraints on combining roots to mark noun agreements, constraints which stem from the limited resources of the human body itself. These constraints in turn dictate related facts of the syntax of sentences in which the verbs appear.

Due to the limit on the number of hands and body parts available as articulators (or locations), the morphological system dictates a priority order on the noun agreements marked simultaneously into the verb stem; those noun agreements falling too low on the priority order to be marked as simultaneous morphemes within the verb stem must be marked on separate, sequentially produced verbs.

These limits and their associated priorities represent another central reason why an actional-iconic gesture system cannot be incorporated wholesale and unsystematically into a signed language. The hand and body can make only a limited number of distinctions simultaneously; others have to be made later. If this time sequence were to be interpreted literally (as it is in the natural mimetic situation), this would obviously limit static description to the properties simultaneously signable, given the bodily resources. On the contrary, however, the abstract ASL system, like any language, can make and mark distinctions between "real" time or place and "signed" time and place. Paradoxically, then, the linguistic constraints remove constraints on thoughts that can be expressed.

The formal constraints are as follows: As has been implicit in my description previously, there are three types of objects potentially involved in a verb of motion: a central object, a secondary object, and a ground. (The central object is the focused, moving object; the secondary object is an object with respect to which the central object moves; and the ground is a background surface on which the motion occurs. Talmy (1975), in a description of the syntax and semantics of verbs of motion in spoken languages, calls the central object "the figure"; he calls both the secondary object and the ground "the ground.") The central object in the event represented by the verb is obligatorily marked in the active root. A secondary object, if there is one, is marked in a stative root. The ground is optionally marked in another stative root. However, all of this is subject to whether there are available articulators.

The following describes the surface verb forms if all articulators are hand articulators:

If the central object marker is one-handed and if there is no secondary object, the ground is optionally marked by the base hand as a simultaneous morpheme of the verb. However, if the central object marker requires two hands, the ground may be marked by the base hand in a separate verb of location preceding the verb of motion, with its location (without any marker) becoming a simultaneous morpheme of the verb of motion (i.e., as a base point).

If the central object marker is one-handed and if there is a secondary object, and if the secondary object marker is one-handed, the secondary object is marked by the base hand as a simultaneous morpheme of the verb; if the secondary object marker is two-handed, the secondary object is marked by the base hand in a separate verb of location preceding the verb of motion, and one hand of the base hand continues to be held in place as a simultaneous morpheme of the verb of motion. If the central object marker is two-handed and if there is a secondary object, the secondary object is marked by the base hand in a separate verb of location preceding the verb of motion, and its location (without any marker) becomes a simultaneous morpheme of the verb of motion (i.e., as a base point of the verb). In all of these cases, the ground is optionally marked in a preceding verb, with only its location but never its marker as a simultaneous morpheme of the verb of motion.

If the central object marker is two-handed, both the secondary object and the ground must be marked in preceding verbs, with both their locations, but not their markers, as simultaneous morphemes of the verb of motion.

In short, the priorities for appearance as markers in the verb of motion are: central object, secondary object, ground. All may be marked as base points in the verb, but only those for which hand articulators are available may be marked with surface handshapes. These facts suggest that when hand articulators are unavailable on the verb of motion, the appropriate hand markers are deleted from the verb of motion but appear in prior verbs instead. In the case of sequential verbs for the three, they will appear in the reverse order of the priorities (that is, ground, followed by secondary object, followed by central object in the verb of motion). These syntactic facts suggest that the sequential verbs derive from features which are copied in an ordered fashion from the verb of motion as they are deleted from it.

Further support for this view comes from the fact that, if the body rather than the hands is used as a marker for any of the objects, more of the structure may then appear on the surface as part of the simultaneous verb of motion. (The latter occurs only on the condition that the linguistic restrictions of the body marker are observed, namely that the referent object is animate and that it agrees in scale with the other markers.)

To summarize: An investigation of representations of motion and location in American Sign Language suggests that the ASL system is strikingly far from a mimetic representation of motion and location in the world. As is the case for all natural languages, events in the world are represented in highly grammaticized formats, through a discrete and limited number of component forms which are combined with one another in linguistically organized and constrained ways. This is true of the morphology of verbs of motion and location, as well as of the associated syntax.

Footnotes for Chapter 1

1. Many frozen verbs have handshapes which can function as classifier morphemes in the language but which do not do so within that verb in its particular sentence. For example, the frozen verb SIT includes a classifier in the active hand for <u>human</u> and a classifier in the base hand for <u>straight-narrow-object</u>; but, when used as a frozen verb, these morphemes are not functional, so that SIT can be used in its frozen form to refer to sitting on a ball or a raft and not just a straight, narrow object. Under these circumstances, as described above, the normal order is SVO and not OSV. It is only when the base hand of the verb is functioning as a classifier for the object that the object must be signed before the verb.

2. As is conventional in linguistics (but not in psychology), <u>animate</u> includes animals but not plants.

CHAPTER 2: THE ACQUISITION OF ASPECTS OF ASL MORPHOLOGY

1. Research questions and design

Now that I have described the morphology of verbs of motion and location in ASL, I begin discussion of how children learning ASL acquire this morphology. After I set out the problem and describe the procedures and outcomes of these developmental studies, I will describe how ASL affects its learners and how the learners affect ASL.

Before describing the experiment itself, I want to say what it is about learning the ASL morphology that is interesting, for students of language learning.

I have shown in the preceding linguistic analysis that ASL morphology is very complex compared to a language like English. There are many interacting subsystems, all of which interact in the signing of a single verb. All taken together produce a certain sign at each point in time. To say this another way, the sign physically produced at a given instant is not the product of one of the morphological features, but of many as they come together, largely simultaneously, at that moment. So we see there are two kinds of complexity from the ASL morphology. The first is that there are many subsystems to be learned. The second is that there are rules for combining them at each point during the signed sentence.

The question in this chapter is how children learning ASL as a first language acquire all this complexity. They never see, when watching their parents sign ASL, the various systems done one by one. They see the whole system put together, the outcome of their rule-governed combination. I see three possibilities for how the children might react to what they see, then:

(a) Mimetic depiction: The children will see something that looks much like a good pantomime, if they watch ASL signing of sentences with verbs of movement and location. Many adult analysts, as I described in the prior chapter, look at such ASL signing and believe they are seeing global mimetic depictions, attempts to pantomime the movement and location concepts in a quick, but fairly true to life, way. If even adult linguists make this error, perhaps children do. In other words, on this hypothesis, the children do not at first see the many interacting subsystems at all. Rather, they see wholistic pantomimes. If that is what the children see in ASL when first exposed to it, we should expect them to produce just this: an attempt to mimic the movements and locations they are trying to express. We would know this if the children's signing was "globally" like the adults', but perhaps a little less crisp and a little more pantomimic. To many this has seemed like a commonsense prediction. But as I will show, the results will not support this prediction. Moreover, an extensive prior literature on the acquisition of other aspects of ASL morphology (Fischer, 1973b; Newport & Ashbrook, 1977; Kantor, 1977; Ellenberger & Steyaert, 1978; Hoffmeister, 1978; Newport & Supalla, 1980; Newport, 1981; Bellugi & Klima, 1982; and Meier, 1982, for perhaps the most detailed examination of this issue) likewise does not support this prediction. This in itself is very good evidence, I will claim, about how learners approach language learning tasks. They do not approach them in many ways that seem commonsensical to adults.

(b) Learning the subcomponents one at a time: Perhaps the children do discover early on the various subcomponents of the morphological system. This means that they extract from what they see that there are separate systems, even though, in the ASL signing they watch, the subcomponents appear all "on top of each other," many done simultaneously. We could expect, on this hypothesis, that one or a few such subcomponents will be discovered first, others later. This will be obvious from tests of their production of the various subcomponents in my experiments. As I will show, this hypothesis-- sequential, rather than simultaneous, learning of the subcomponents-- will be seen in ASL development here, as it has been in prior work on ASL and spoken language acquisition. The older the learner, the more of them he will know.

(c) Learning to combine the subcomponents: One more problem is learning to put the subcomponents together, even when you know them. In the adult language, the subcomponents are put together "on line" in a series of rapid and critical integrations. They flow together over time. Some of them happen simultaneously, in fact, and thus the output is a combination of their separate contributions to a single gesture. We could predict that even when the children know the subcomponents, they may have trouble performing them in combination and in controlling the combination rules. In this case, we can predict that children will produce the components that they know in sequence, even though they have never seen them done that way. The children have seen the subcomponents only signed together. They may produce them one after the other. This is my third prediction.

This third prediction deserves a little more discussion, because it will turn out to be true (see experiments below) and because it is related to other findings in the literature of language learning. Very often investigators of language learning have shown that the child produces things which he never heard in just that way. One case is the overregularization of the _-ed_ ending in English. Another case very relevant here is from Bellugi's early work (Bellugi, 1967). She showed that some children produce only full verbal auxiliaries (e.g., _will_) even though the mothers were producing over 90% contracted auxiliaries in their speech to the children (e.g., _-ll_, as in _shall_ or _will_). It is as though the children first learned the lexical item _will_ and also its use in the syntax of sentences. Later, in a separate step, the child learned how it may contract. (This is like my hypothesis (b) above). But another reason for the two-stage appearance of contracted _-ll_ might have to do with the current hypothesis (c). The child might know the word _will_, its syntax, and that it contracts, but he may not be able to juggle all these factors quickly and errorlessly when he starts to talk. So one property may get left out of his speech. This is related to phenomena of reduction discussed by Bloom (1970), as well as to the inability of the child to perform subject-auxiliary inversion only in wh-questions as discussed by Klima & Bellugi (1966).

(d) _Summary of acquisition predictions_. My predictions have to do with these three hypotheses. The first hypothesis I cannot speak to most directly from my own data on verbs of motion and location. Perhaps the child does go through an early stage where he just mimics wholistically what he sees. But my experiments require the child to perform elicited productions. As I will state below, the very youngest subject, who could be in such a stage, could not deal with the tests and so produced no useable data. However, as stated above, my observations of spontaneous signing, as well as other data in the literature on ASL acquisition, suggest quite strongly that this is not the case.

My hypotheses for the current data have to do most centrally with later steps in learning. At these later times, I predict that the various components come into the child's speech at different times (hypothesis b). Most interestingly, I predict that the child's signing looks different from, not just simpler than, adult signing for a second reason. This reason is that, even when the child knows many of the morphological subcomponents, he cannot integrate them together during signing, and so sometimes produces them in a sequence, one after the other. Thus he makes ASL sentences that look very different from the adult sentences he observes his parents to make. Learning is partly a matter of getting everything integrated "on line" to produce the partly simultaneous adult outcomes. Practice, as well as maturation, are assumed to be required for this rapid, skilled processing of the information into the smoothed adult performances.

My test case is ASL, in this thesis. But I believe the implications of these findings are very general. The young child, in acquiring aspects of a language which could be viewed wholistically and mimetically, in fact organizes his knowledge in terms of components. This suggests rather strongly that the componential patterns found in the acquisition of spoken as well as signed languages arises from biases in this direction from the learner.

2. Materials

Since complex verbs of motion and location are somewhat rare in spontaneous conversation, systematic tests have been developed to test the children's production and comprehension of these verbs. In this thesis I report only the test of production of verbs of motion; the tests of comprehension of verbs of motion, and of production and comprehension of verbs of location, will be reported in future work.[1]

The test of production for verbs of motion (VMP) is composed of 120 test items, each an animated film of moving objects. The filmed scenes are shown one at a time to the child, who is asked after each film to say what happened, in ASL.

The items are constructed so that roughly an equal number of items test each morpheme of interest, with the morphemes tested on the different parameters (e.g., handshape and movement) combined in a counterbalanced fashion. (That is, for example, a given handshape will be tested in several items, with these items differing from one another in the accompanying movement, orientation, etc.) Thus each morpheme is tested in a carefully controlled variety of morphemic contexts. The items are presented in random order.

Each of the 120 test items involves a single central prop moving in controlled ways. Fifty-four of these items also involve a secondary static prop. Seventy-two of the items include a surface (i.e., ground) which the central prop moves across, and on which the secondary prop is stationed.

The motions of the central props in the test situations are selected on the basis of the morpheme contrasts of movement, form, and direction. Five movement roots (linear, arc, turn, mid-pivot, and end-pivot) are tested in four types of combination (single, simultaneous, nested, and sequential) with eight movement affixes (jump, bounce, fall, roll, rotate, open, close, wreck) and five directional affixes (unmarked, up, down, uphill and downhill). (See Appendix 1 for the list of frequencies of all the morphemes tested). These movements are produced on film by conventional animation techniques. The props are filmed one frame at a time with incremental changes in the central prop's positions across frames. The illusion of motion is created when the film is projected at 18 frames per second. The motion is varied across different items testing the same movement morpheme (i.e., the random path morpheme is tested by a variety of zig-zag paths of the central props, and the turn morpheme is tested by a variety of degrees of turn paths of the central prop).

The locations of the secondary props in the test situations are placed on the basis of the morpheme contrasts in the base grid system. The placement of the secondary prop is determined by two sets of morpheme contrasts: the position of the base marker and the locative relationship between the base marker and the active marker. The base positions are contrasted by manipulating the position of the secondary prop relative to the central prop (e.g., central prop moving away from secondary prop, moving past secondary prop, or moving to secondary prop). These test items are also contrasted in terms of how the central prop is located in relation to the secondary prop (e.g., central prop moving from on, in, or ahead of secondary prop; moving over, through, or past secondary prop; moving to on, in, or behind secondary prop).

Appendix 2 shows the frequencies of combinations of base position and locative morphemes in the VMP test.

A collection of toy people, animals, vehicles, furniture, small artifacts such as a pencil and a cup, and some geometric shapes are used as props in the VMP test. They are selected on the basis of contrasts of handshape morphemes in which ten classifier handshapes are tested. Five are semantic classifiers (human, animal, vehicle, airplane, tree), and five are SASSes (three straight SASSes (STRAIGHT-THIN, STRAIGHT-NARROW, STRAIGHT-WIDE) and two round SASSes (ROUND, CYLINDRICAL)). Each handshape is tested as the active marker in a sign and as the base marker, with roughly an equal number of items of each type (see Appendix 3 for complete listings).

The props are selected to induce the subject to incorporate target handshapes in their verb responses. The props are varied across different items testing the same classifier so that both prototypical and nonprototypical objects within each category are tested. No prop is repeated within the VMP test except for three cases in which the central and the secondary prop are identical. (See Appendix 4 for complete listings.)

The test items are also contrasted as to the orientation of the central and secondary props. Two sets of orientation morphemes are tested: orientation with respect to the external world, and orientation with respect to the movement path. For instance, the central prop may stand upright or upside down or lie horizontally while it moves forward or backward on its movement path. As for the secondary prop, it may stand upright, upside down, or lie horizontally while its top, front end, back end, or side is facing the movement path.

3. Procedure

The test was presented to four child subjects whom the experimenter had visited monthly at their homes as part of a longitudinal study project. The very youngest subject (13 months at the first visit) could not be induced to respond sensibly to the test materials. Hence, her data were not analyzable, and I will mention her no more. There are, therefore, three subjects in the experiment to be reported.

All three are congenitally deaf children with deaf parents who use ASL as the language of the home. Randy (5 years, 6 months when first tested) and Anne (3 years, 6 months when first tested) are siblings whose mother is second-generation deaf (and acquired ASL during infancy from her deaf parents) and whose father is first-generation deaf (and acquired ASL at around ten years of age from peers at school). Jane (4 years, 0 months when first tested, whose sibling was the very young child whose data were dropped from the analysis) has both parents who are first-generation deaf; her mother acquired ASL at around four years of age from an older deaf sister, while her father acquired ASL at around the age of six from peers at school.

The experimenter met with each child two times every month for six months to administer the test. For each month, one session was followed by a second one within the next few days. Each session was one hour long and included informal spontaneous play with toys and books, as well as the VMP test and three other tests (see footnote 1 for a brief description of the other tests). The interaction between the child and the experimenter was videotaped throughout spontaneous play and tests. All subjects were familiar with the experimenter and the videotaping set-up from several months of previous visits during a longitudinal study of spontaneous signing. All children gave every evidence of enjoying the play and testing throughout the six months span of the testing period.

The test was divided into six sets: each set includes one sixth of the test items described above with morpheme combinations counterbalanced and randomized within as well as across the six sets of tests. Since there are six sets of tests, all sets had been seen by each child after the first three months and were repeated in the same manner for the last three months (with some minor modifications of order of stimuli were switched around and extra stimuli were removed).

The VMP test was given first and required an average of ten minutes for the child to complete 20 items. The other tests were presented subsequently (requiring about twenty minutes altogether), followed by spontaneous play for the remainder of the hour.

4. Results

4.0 Overview

The results of the VMP tests are reported in this section, on a number of dimensions, having to do with both the effects of stimulus differences, and the effects of development of the child learner.

4.1 Coding system for the results

A coding system was developed for these findings, to allow me to examine the three subjects' responses to the VMP test stimuli. Each response is coded in three steps. First, the child's utterance is searched for any presence of a verb form. If no verb is found in this utterance (or if the child fails to respond at all to the stimulus), a record is made to indicate omission of verb and the coding is stopped.

Otherwise, when a verb (or a series of verbs) is found, a second step is required. Now a decision is made on the status of the verb, as to whether it is a novel or a frozen verb. The verb is identified as a frozen verb when it is identical in form to a highly frequent, standardized citation form in which the internal components of the verb bear no meaningful relationships to components of the event (that is, when the internal components are not functioning as morphemes). For example, if the child views an apple falling from a tree in a straight downward path and produces the highly frequent citation form FALL (formationally, a human classifier beginning at a flat wide surface and moving in a simultaneous arc + midpivot), the response would be coded as a frozen sign. (This is analogous to using the English word blackboard as a frozen, internally unanalyzed form to refer to a green chalkboard.) The decision that a response is a frozen sign, rather than a morphologically analyzed but mistaken sign, is made on the basis of the extensive mismatch between the form and its referent, as well as on the coder's native intuitions about which signs are highly frequent frozen signs in the adult language. Roughly, frozen signs are those which appear in standard dictionaries of ASL. A frozen verb would additionally be labelled in the coding system with an English gloss for this frozen verb.

When this condition is not met (when the verb is not identical to a citation form), the verb is instead coded as a novel verb. Novel verbs are those which are morphologically productive. A novel verb will contrast with some citation forms in one or several of the following: movement, active handshape, base handshape, base location.

If the verb is novel, one more coding step is required. The novel verb response is compared to the target (adult) morphemes specified for the stimulus in three morphological subsystems: C.O. marker, S.O. marker, and S.O. placement. If a component of the verb response is matched with the target morpheme, this will be scored as correct. If not matched, the subject's choice will be recorded as a replacement. These criteria are established on the basis of the linguistic work described above, in which certain components are specified as obligatory. If the subject fails to produce such a component, one that I consider established for ASL on the basis of my linguistic work, the failure is recorded as omission of the target morpheme.

Once these three steps are completed, the coding is considered complete for purposes of the present study. A coding and analysis of the morphemes associated with movement are not included in this thesis but will be presented in future work.

4.2 Likelihood of response

To examine the data obtained in the VMP tests, it is critical first to consider how efficient the test stimuli are in inducing the young subject to respond with a verb of motion. Table 8 shows the number of test items presented to each subject across the two

Table 8

Number of stimuli, verb responses, and verb response omissions across the subjects

Subject	Age	Stimuli presented	Verb responses		Verb omissions	
		#	#	%	#	%
A_1	3;6-3;8	119	100	(.84)	19	(.16)
A_2	3;9-3;11	120	109	(.91)	11	(.09)
J_1	4;0-4;2	103	101	(.98)	2	(.02)
J_2	4;3-4;5	120	116	(.97)	4	(.03)
R_1	5;6-5;8	120	119	(.99)	1	(.01)
R_2	5;9-5;11	120	118	(.98)	2	(.02)

three-month spans. The table also gives the frequencies and the probabilities of each subject's responses. The failure to respond with a verb form to the film stimulus is somewhat frequent (16% of the time) in the first three-month span for the youngest child (aged 3;6 - 3;8). These are not cases where the subject fails to respond at all. That rarely happened. Rather, she on some occasions simply labelled individual objects in the film with lexical nouns. Her verb omissions decreased to 9% of the time in the repeated tests given in the next three months. Verb omissions are even less frequent for the two older children.

The difference in performance between the youngest child and the two older children may be due to some effect of complexity in the stimuli. The stimuli were selected on the basis of certain morpheme contrasts to be tested, as stated above. Thus they vary in the number of objects involved (i.e., central object shown alone or with secondary object), type of movement in the central object and classification of the objects. Furthermore, certain objects as well as some events as a whole may not have been familiar to the child. Such variables may not only affect the child's performance in producing verbs of motion but also may affect her selection and combinations of individual morphemes to create such verbs. So it is important to keep in mind that such variation of complexity and familiarity may play some role in the differing performance of children of the different ages.

4.3 Type of verb response.

I have proposed in Chapter 1 and in Supalla (1978b) that verbs of motion in ASL vary across a continuum from novel, nonconventionalized verb forms to high frequency frozen, or standardized, verbs and that the novel verb must be processed in terms of combination of morphemes, while the frozen verb is instead processed as a single-morpheme unit. This would suggest that the child may acquire the frozen and novel verbs in different ways. The novel forms, morphologically the more complex, would be acquired relatively late. The late acquisition of the novel verbs was first reported by Newport and Ashbrook (1977). They found in their data for children signing spontaneously that these children first produced strings of nouns and verbs in which the verb form tended to be of the frozen type. However, it is possible that in the spontaneous signing of young children the contexts for using complex verbs do not often arise. Thus the Newport and Ashbrook findings do not make a full case for saying the novel verbs are developmentally later than the frozen verbs. It is the purpose of the present work to set up situations in which the child's production of novel verbs can be tested systematically.

The frequencies and percentages of the subjects' verb responses in each of the two categories (frozen verb vs novel verb) are listed in Table 9. As the Table shows, the child is likely to produce a novel verb depicting the event in the stimuli an average of 95% of the time. (This in itself helps confirm the efficiency of the stimuli to elicit such novel verb forms). Consequently, the data show low production of frozen verbs. The rate is 8% for the youngest child, and even lower percentages for the two older subjects.

This is not necessarily in contradiction to Newport & Ashbrook (1977), however, since their subjects were much younger, and since their

Table 9

Number of total verb responses, and number and proportion of frozen vs. novel verb responses

Subject	Age	Total verb responses #	Frozen verbs #	Frozen verbs %	Novel verbs #	Novel verbs %
A_1	3;6-3;8	100	8	(.08)	92	(.92)
A_2	3;9-3;11	109	9	(.08)	100	(.92)
J_1	4;0-4;2	101	4	(.04)	97	(.96)
J_2	4;3-4;5	116	3	(.03)	113	(.97)
R_1	5;6-5;8	119	2	(.02)	117	(.98)
R_2	5;9-5;11	118	3	(.03)	115	(.97)

point was that the child was producing single-morpheme, uninflected forms of the verb at the earliest stages. This issue will be examined with regard to the morphology of verbs of motion and location throughout the remainder of the results.

4.4 Acquisition of combining noun agreements

The children's mastery of the noun marking system was tested by inducing them to select and combine noun markers to refer to objects involved in an event. The data presented in Tables 10 and 11 show some patterns of development of the use of noun markers in the three children across the six age spans. Only the novel verbs depicting the event are included, for only these include a noun marker for the central object (C.O.). Each novel verb includes an active marker due to the fact that the active marker and the movement root in the verb are interdependent. Neither morpheme could exist by itself without the other.

In contrast, the ground marker and secondary object (S.O.) markers are morphemes which can be produced independently. According to the linguistic rules discussed in the previous chapter, it is obligatory to add the S.O. marker to the verb whenever a secondary object is involved in the event. Otherwise, the ground marker may be added.

Table 10 show that, for novel verb responses to stimuli requiring only a C.O., children produce it alone most of the time throughout development. Table 11 shows that, for responses to stimuli requiring a C.O. plus a S.O., the youngest child has a low rate of success in marking the S.O.; but success increases dramatically with age (.46 to .81). Moreover, as shown in Table 12, when the S.O. marker does appear, at first it often appears separately from the verb of motion,

Table 10

Number and proportion of verb responses which have active hand only vs. active and base hands, for stimuli with only a central object

Subject	Age	Verb responses #	AH_{co} # %	$AH_{co} + BH_{so}$ # %	$AH_{co} + BH_{gd}$ # %
A_1	3;6-3;8	53	52 (.98)		1 (.02)
A_2	3;9-3;11	60	57 (.95)	1 (.02)	2 (.03)
J_1	4;0-4;2	54	49 (.91)	1 (.01)	5 (.08)
J_2	4;3-4;5	63	47 (.75)	7 (.11)	9 (.14)
R_1	5;6-5;8	65	50 (.77)	6 (.09)	9 (.14)
R_2	5;9-5;11	64	60 (.94)	2 (.03)	2 (.03)

Table 11

Number and proportion of verb responses
which have active hand only vs. active and base hands,
for stimuli with a central object and a secondary object

Subject	Age	Verb responses #	AH_{co} # (%)	$AH_{co} + BH_{so}$ # (%)	$AH_{co} + BH_{gd}$ # (%)
A_1	3;6-3;8	46	24 (.52)	21 (.46)	1 (.02)
A_2	3;9-3;11	49	24 (.49)	23 (.47)	2 (.04)
J_1	4;0-4;2	47	31 (.66)	15 (.32)	1 (.02)
J_2	4;3-4;5	53	16 (.30)	37 (.70)	
R_1	5;6-5;8	54	11 (.20)	39 (.73)	4 (.07)
R_2	5;9-5;11	54	8 (.15)	44 (.81)	2 (.04)

Table 12

Number and proportion of responses with an S.O. marker which have the S.O. marker simultaneous with vs. separate from the C.O. marker

Subject	Age	S.O. responses #	Simultaneous # %	Separate # %
A_1	3;6-3;8	21	16 (.76)	5 (.24)
A_2	3;9-3;11	23	19 (.83)	4 (.17)
J_1	4;0-4;2	15	13 (.87)	2 (.13)
J_2	4;3-4;5	37	36 (.97)	1 (.03)
R_1	5;6-5;8	39	38 (.97)	1 (.03)
R_2	5;9-5;11	44	44 (1.00)	

either (1) as an independent lexical item or (2) as an active noun marker in a separate verb of location, as well as simultaneously with the central object (C.O.) marker in the verb of motion, as it should be. $Anne_1$ produced a separate S.O. marker 24% of the time. It is only later in development that children become consistent in combining the S.O. marker simultaneously with the C.O. marker (100% of the time for $Randy_2$).

Incidentally, it should be noted that there are some occasions where the subjects added the S.O. markers in their verb responses to certain stimuli where no S.O. is presented (see the fifth column in Table 10). This happens often with $Jane_2$ and $Randy_1$, who added a base hand marking the S.O. rather than the ground in 11% and 9% of the responses.

The difference in mastery of the C.O. marker and the S.O. marker can be attributed to the nature of these two morphemes. As the C.O. marker is interdependent with the active root, this must be mastered early (that is, by definition, it must appear as soon as an active root appears). Its early mastery is thus a necessary, and therefore unremarkable, finding. But the S.O. marker could in principle be mastered either early or late. In contrast to the C.O. marker, the S.O. marker is independent of the active root, and occurs in the adult language not on all verbs of motion, but conditionally on the the presence of a secondary object. It is well known that the early use of morphemes depends in part on the regularity of their use in the adult language (Slobin, 1973). The late mastery of the S.O. marker can thus be attributed to its conditional, rather than unconditionally obligatory, status. This finding is in line with related findings in spoken language that obligatory morphemes are learned earlier than optional ones.

As for the ground markers, the linguistic rules allow one to mark the ground only when there is no S.O. in the event. There is a slow increase in its use throughout development -- from .02 to .14, then a sudden decrease to .03 in Randy_2. (See the last column in Table 10). The same pattern shows up even after the artifact of two active hands used as C.O. marker is controlled by eliminating these responses from the counts for correct ground markers in the data of the three children.

There are relatively few occasions when the subject violates the priority rules. In such cases, the subject marks the ground rather than the S.O. when both are present in the stimulus. This violation increases a little from .02 in Anne_1 to .07 in Randy_1, then decreases to .04 in Randy_2 (See the last column in Table 11). This overall success in marking a secondary object in preference to the ground when both are present in the event may be due to nonlinguistic biases (that is, a nonlinguistic predisposition to attend to objects over backgrounds), or to the early mastery of linguistic priority rules.

Tables 13 and 14 summarize the rate of omission for the S.O. marker and the causes of this omission. Altogether, over 50% of the responses which should have a S.O. marker omit this marker for Anne_1, Anne_2, and Jane_1. Simple omission is quite high in these younger children, who simply failed to add any base hand to the active hand marking the central object. The older children omit the S.O. marker much less often. When they do, they show some more frequent

Table 13

Number and proportion of responses to stimuli with a secondary object which omit an S.O. marker

Subject	Age	Total responses #	BH_{SO} omissions #	%
A_1	3;6-3;8	46	25	(.54)
A_2	3;9-3;11	49	26	(.53)
J_1	4;0-4;2	47	32	(.68)
J_2	4;3-4;5	53	16	(.30)
R_1	5;6-5;8	54	15	(.28)
R_2	5;9-5;11	54	10	(.19)

Table 14

Number and proportion of responses omitting an S.O. marker which are simple omissions vs. omissions due to interference from a two-handed active hand or from a ground marker

Subject	Age	Total omissions	Simple omissions		Interference			
					by 2AH		by BH_{gd}	
		#	#	%	#	%	#	%
A_1	3;6-3;8	25	21	(.84)	3	(.12)	1	(.04)
A_2	3;9-3;11	26	22	(.85)	2	(.08)	2	(.08)
J_1	4;0-4;2	32	31	(.97)	---		1	(.03)
J_2	4;3-4;5	16	11	(.69)	5	(.31)	---	
R_1	5;6-5;8	15	10	(.67)	1	(.07)	4	(.26)
R_2	5;9-5;11	10	7	(.70)	1	(.10)	2	(.20)

interference from using two active hands for marking the C.O. or from using the basehand to refer to the ground instead, but the predominance of their omissions are still simple failures to use a base hand at all.

4.5 <u>Acquisition of the classifier system</u>

To select a classifier as a noun marker for an object, the learner must acquire the system of morphophonological features by which different classifiers are derived. Each object is assigned an inventory of classifiers, each referring to an aspect of the meaning of the object (i.e., its semantic category and its size and shape). This system was discussed in the previous chapter. Here I ask how the young child acquires the system.

The VMP test allows us to examine acquisition of ten target classifiers, each of which contrasts with the others in a specific number of morphemes. The subject is induced to produce one of these classifiers in response to the prop presented in the stimulus film. Appendix 4 lists the collection of props used in the VMP test as central objects (C.O.s). Only the classifier used as the active marker (i.e., that for a moving C.O.) is examined in this work. The various target classifiers are each tested by a number of different items over the test, with an unequal number of items across the active marker classifiers ranging from 7 to 19 per classifier.

The classifier used as a secondary object (S.O.) marker is not analyzed due to many factors that are not controlled in the VMP test. For instance, the S.O. marker is often absent in the younger children's responses, but this cannot be interpreted to show that the child is not able to produce a classifier referring to that object; rather, it could be the case that the child has learned the classifier morphemes but not the morphemes involved in the noun marker for the S.O. In contrast, the C.O. marker is an obligatory part of the novel verb, and thus some classifier referring to the central object is always present in the child's response.

Other factors involve interaction effects in combining the C.O. and S.O. classifiers. The selection of one classifier for either the C.O. or the S.O. may not be independent of the selection of the other, as indeed our preliminary observations indicated. For example, if the classifier selected for the C.O. is a body marker, it is likely that the subject will select a body marker for the S.O.

Furthermore, there is one critical issue that is not dealt with in this work but may confound an analysis of acquisition of the C.O. classifier if data are included from signs involving S.O.s as well. Once we assume that the C.O. classifier choice interacts with the S.O. classifier choice, we can ask questions regarding the dominance of one classifier over the other. The research literature implies dominance of the C.O. classifier over the S.O. classifier. Our preliminary observations, however, suggest that the facts are otherwise. The complexity and familiarity of the classifier play important roles in determining the dominance of the two classifiers. For instance, we observed that when the S.O. marker is morphologically more simple, the child is more likely to select a correct classifier for it, replacing the C.O. classifier with something else. Our observations also show that if the S.O. classifier is more familiar to the child, he will select it over the C.O. classifier. This would suggest that the dominance of selection of the two classifiers is independent of the dominance of the two hands used to mark the classifiers. Rather, the effect is that the subject cannot choose both at once, and so selects the most familiar one, be it C.O. or S.O.

Such issues are not examined directly in this work. But the possibility of confounding artifacts in the data has been prevented by the counterbalancing of C.O. and S.O. props in the stimuli, where both props vary in complexity and familiarity equally over the whole stimulus set.

4.5a. Classifier selection violations for intransitive verb targets. The stimuli in the VMP test are constructed to elicit only intransitive verbs of motion. In these, the selection of the classifier is restricted to only those that refer directly to the moving object. Classifiers referring to the instrument moving the object are not allowed (since there is no such instrument in the films). Table 15 shows that the rate of violation of this syntactic rule across the three children is low. Most often, all subjects succeed in complying with this rule and produce a classifier for the object itself. Errors involve producing a body marker for an instrument (the hand), which is appropriate only when an animate agent is moving the object with its hand. The highest rate of error was made by $Jane_2$ (17% of the time).

4.5b. Overall classifier patterns for intransitive verbs. To examine how the child selects a classifier for the novel intransitive verb of motion, we will first look at the overall pattern of C.O. classifiers selected by the children. Table 16 shows that $Anne_1$ predominantly started either by selecting the target classifier or

Table 15

Number and proportion of novel verb responses which are produced as intransitive vs. transitive verbs of motion

Subject	Age	Total novel verb responses #	Intransitives #	Intransitives %	Transitives #	Transitives %
A_1	3;6-3;8	92	91	(.99)	1	(.01)
A_2	3;9-3;11	100	92	(.92)	8	(.08)
J_1	4;0-4;2	97	91	(.94)	6	(.06)
J_2	4;3-4;5	113	94	(.83)	19	(.17)
R_1	5;6-5;8	117	105	(.90)	12	(.10)
R_2	5;9-5;11	115	109	(.95)	6	(.05)

Table 16

Number and proportion of intransitive verb responses with C.O. classifiers of various types

Subject	Age	Total intransitive verbs	Semantic or SASS	Primi-tive	Path	Self Body	Wrong
		#	# %	# %	# %	# %	# %
A_1	3;6-3;8	91	35(.39)	32(.35)	8(.09)	1(.01)	15(.16)
A_2	3;9-3;11	92	56(.61)	24(.26)	3(.03)	1(.01)	8(.09)
J_1	4;0-4;2	91	48(.53)	29(.32)	5(.05)		9(.10)
J_2	4;3-4;5	94	61(.65)	18(.19)	3(.03)	1(.01)	11(.12)
R_1	5;6-5;8	105	88(.84)	11(.10)	1(.01)		5(.05)
R_2	5;9-5;11	109	85(.78)	4(.04)	1(.01)	4(.04)	15(.14)

replacing it with a primitive marker (a less marked handshape in which a flat B-hand or an index finger Z-hand is used). The selection of a target classifier which is either completely or partially correct (the latter is when some but not all of the target morphemes are correct) increases steadily with age, from .39 to .78. A substantial portion of these selections involve partially correct responses. At the same time the selection of a primitive marker decreases steadily from .35 to .04.

Another common alternate classifier produced by the children is the path marker, in which the tip of the index finger is used to mark the path without any marking of the object class. $Anne_1$ used this type of marker at the rate of .09, but this rate decreases for older subjects and is almost zero for $Randy_2$. The self body marker (in which the children use their bodies as articulators to play the role of the object) is less common for all three children.

Yet another type of response is the choice of a wrong response, in which the child chooses a classifier for an incorrect category or constructs an incorrect marker by using the handshape from a frozen sign rather from the morphological system. Such wrong responses occur at the rate of .16 for $Anne_1$ and remain rather consistent in rate over age. The breakdown of these wrong responses into their component types is presented in Table 17. For further discussion, see section 4.5e. Replacements.

4.5c. Semantic classifiers. The examination of the acquisition of the individual classifiers shows some differences in patterns of development across the three children. Table 18 divides the children's responses to the semantic classifier targets into three sets.

Table 17

Number and proportion of wrong C.O. classifiers in various categories of error type

Subject	Age	Wrong replacements	Wrong category		Wrong shape		Fhs		Copying from BH	
		#	#	%	#	%	#	%	#	%
A_1	3;6-3;8	15	5	(.33)	3	(.20)	7	(.47)		
A_2	3;9-3;11	8	1	(.12)			7	(.88)		
J_1	4;0-4;2	9	4	(.44)			5	(.56)		
J_2	4;3-4;5	11	2	(.18)	3	(.27)	6	(.55)		
R_1	5;6-5;8	5	1	(.20)			4	(.80)		
R_2	5;9-5;11	15	2	(.13)	4	(.27)	8	(.53)	1	(.07)

Table 18

Number of stimuli presented
for semantic classifier targets
and number and proportion of novel verb responses
which fall in various classifier categories

S	Stim #	Novel Resp #	Correct or Partial # %	Primitive # %	Path Marker # %	Body or Instr # %	Wrong # %	Fhs # %
ANIMATE (V and V)								
A_1	28	22	8(.36)	7(.32)	1(.05)	1(.05)	2(.09)	3(.14)
A_2	28	22	14(.64)	4(.18)	1(.05)	1(.05)		2(.09)
J_1	24	22	13(.59)	6(.27)	1(.05)	1(.05)		1(.05)
J_2	28	28	17(.61)	2(.07)	1(.04)	6(.21)		2(.07)
R_1	28	25	24(.96)					1(.04)
R_2	28	25	20(.80)		1(.04)	4(.16)		
MACHINE (3 and ILY)								
A_1	22	18	12(.67)	4(.22)	1(.06)			1(.06)
A_2	22	21	14(.67)	6(.29)			1(.05)	
J_1	20	16	4(.25)	7(.44)	1(.06)		3(.19)	1(.06)
J_2	22	21	10(.48)	7(.33)		2(.10)	2(.10)	
R_1	22	22	18(.82)	3(.14)		1(.05)		
R_2	22	22	18(.82)	2(.09)		1(.05)		1(.05)
TREE (5-arm)								
A_1	7	5		4(.80)				1(.20)
A_2	7	5	3(.60)					2(.40)
J_1	5	5		4(.80)		1(.20)		
J_2	7	5		3(.60)	1(.20)	1(.20)		
R_1	7	7	5(.71)	1(.14)		1(.14)		
R_2	7	7	7(1.00)					

The first set includes the responses to the V (human) and V̈ (non-human animate) classifier targets, which are related by the meaning "animacy." The second set includes responses to the 3 (vehicle) and ILY (airplane) targets, which share the meaning "propelled inanimacy," or "machine." The third set includes the responses to the tree classifier targets.

Selection of either the V or the V̈ classifier is approximately equal in frequency to the selection of a primitive marker for the youngest child (.36 vs. .32, respectively) to refer to an animate object. The pattern changes across development. The older the child is, the less he chooses to use a primitive marker and the more he chooses the correct semantic classifier. The two animate classifiers are used 80% of the time for $Randy_2$, who did not use any primitive markers at all. The accuracy in distinguishing between these two related classifiers increases across age. The error rate of confusing these two (counted as partially correct) decreases from .25 to .15 as we move from oldest to youngest subject.

As the children get older, they also start to use the body marker more and more. It is rare for Anne to select such a morpheme across the whole six months. Body classifiers are almost never used by her for inanimate objects. This is also true for both Jane and Randy in their first three months, but this changes in the next three months. $Jane_2$ used a body classifier 21% of the time, while $Randy_2$ elected to use it 16% of the time.

As for the "propelled inanimate" classifiers (3 and ILY), the data show the younger children to be more successful in selecting the 3 and ILY classifiers than the V and V̈ classifiers (67% vs. 36% for

$Anne_1$). More details of order of mastery of individual classifiers will be discussed later. There are a few occasions where the child confuses 3 and ILY classifiers (counted as partially correct), but these errors occur only when the subjects replace ILY with a 3 classifier. This might imply that the 3 classifier is learned first and the child overgeneralizes it to other cases where some meaning of "machine" is involved. But there are other possible explanations, such as the frequency of 3 vs. ILY classifiers, or semantic factors such as whether the object is moving on the ground rather than flying in midair. $Anne_1$ occasionally replaces either classifier with a primitive marker (22% of the time). The replacement rate increases to 44% for $Jane_1$, but then decreases to 9% for $Randy_1$. The high rate of replacement by Jane can be explained by the fact that she had not yet learned the ILY classifier. This classifier is absent in her morphology, so she marks airplanes with primitive classifiers.

The tree classifier is tested only seven times in the VMP test, but the data show it to be learned late, as compared to the other four semantic classifiers with which it does not share any meaning. $Anne_1$ does not produce any tree classifier in her first three months. She instead marks the C.O. either by using a primitive classifier or by borrowing the handshape from the noun TREE (even including a base hand) and moving the whole form around. Her performance changes drastically in the next three months, where she succeeds in using a tree classifier 60% of the time. However, she continues to borrow the handshape from the noun TREE during this period, but no longer uses any primitive classifier. Jane seems not to have acquired the tree classifier at all.

Instead, she replaces it with a primitive classifier. The difference between these two children shows the pattern of acquisition to be (1) a primitive classifier, then (2) a whole form of the noun sign, and finally (3) the tree classifier.

In contrast, $Randy_1$ is highly successful with the tree classifier, with a success rate of 71%. In the next three months, Randy starts to manipulate handpart morphemes to produce novel handshapes, as if he now recognizes the independence of the handparts in the tree classifier. He combines a Z-handshape with a bent arm to refer to a palm tree, and combines a wreck morpheme to the tree classifier to refer to a dried-up tree.

To establish the order of acquisition of the five individual semantic classifiers, I compared the rate of success for each subject in selecting the correct classifier across the five target clasifier conditions (see Table 19). The comparisons show that the order of mastery is not consistent among the three children. Anne and Jane are consistent in mastery of the five semantic classifiers across the two three-month spans, but Randy reverses this order of mastery. But as for the comparison across the subjects, Anne and Randy are more similar in order of mastery. They both master the airplane and human classifiers, followed by the vehicle classifier and then the animal classifier. They are different only with respect to the tree classifier, which is worst for Anne but one of the best mastered by Randy. Jane, the middle child, is more different from the other two. She masters the animate classifiers (V and V̈) first and then the inanimate classifiers (3 and ILY). She does not master the tree classifier. These differences may

Table 19

Rank orders of correctness and proportion correct for five semantic classifiers

Subject	Age	Human # %	Animal # %	Vehicle # %	Airplane # %	Tree # %
A_1	3;6-3;8	2 (.53)	4 (.07)	3 (.40)	1 (.86)	5 (.00)
A_2	3;9-3;11	2 (.62)	5 (.40)	3 (.54)	1 (.86)	4 (.43)
J_1	4;0-4;2	1 (.66)	2 (.34)	4 (.15)	3 (.29)	5 (.00)
J_2	4;3-4;5	1 (.85)	2 (.50)	3 (.48)	4 (.43)	5 (.00)
R_1	5;6-5;8	1 (.92)	3.5(.80)	3.5(.80)	2 (.86)	5 (.71)
R_2	5;9-5;11	3 (.92)	5 (.54)	4 (.73)	1.5(1.00)	1.5(1.00)

be attributed to the variance of input in the environments. Anne and Randy are siblings while Jane is from another family. Perhaps the ordinary topics of conversation in the two homes differed somewhat.

4.5d. SASSes. Table 20 categorizes the subjects' responses to two groups of SASSes (straight SASSes vs. round SASSes) on the basis of the classifier selected to refer to the central object. Six stimuli were omitted from this analysis because they were potentially ambiguous between requiring a semantic classifier and requiring a straight SASS. (These stimuli were films of such things as a paper glider, a lawnmower, and a toy wagon.)

The data show that the performance remains about the same across age in selecting a correct straight SASS (.44 in $Anne_1$ vs. .52 in $Randy_1$), while the accuracy in selecting a round SASS increases drastically across age (.23 in $Anne_1$ vs. .81 in $Randy_1$). This is despite the fact that $Anne_1$ starts off better with the straight SASSes (.44 for straight SASSes vs. .23 for round SASSes).

This pattern would suggest that the round morpheme is easier for the child to learn than the straight morpheme, but the data may be confounded by the ambiguity between the round SASSes and the instrumental classifier in "holding a round object". Both share the same handshape, and it is possible that the score for the round SASS target may be a total of instrumental classifiers and round SASSes. There is no such ambiguity with the straight SASS, since the instrumental classifier of "holding a flat object" is distinct in form from the straight SASS. (Although one may have trouble distinguishing a straight SASS from a primitive classifier, still one can establish

Table 20

Number of stimuli presented
for SASS targets
and number and proportion of novel verb responses
which fall in various classifier categories

S	Stim	Novel Resp	Correct or Partial	Primi- tive	Path Marker	Body or Instr	Wrong	Fhs
	#	#	# %	# %	# %	# %	# %	# %
STRAIGHT (Z, H, B)								
A_1	25	18	8(.44)	7(.39)			2(.11)	1(.06)
A_2	25	21	10(.48)	3(.14)	1(.05)	4(.19)		3(.14)
J_1	20	19	13(.68)	4(.21)		2(.11)		
J_2	25	24	14(.58)	2(.08)		4(.17)	2(.08)	2(.08)
R_1	25	25	14(.56)	4(.16)		6(.24)		1(.04)
R_2	25	23	12(.52)	1(.04)		4(.17)	2(.08)	4(.17)
ROUND (Z^c, B^c)								
A_1	31	22	5(.23)	9(.41)	6(.27)		1(.05)	1(.05)
A_2	32	26	14(.54)	10(.38)	1(.04)	1(.04)		
J_1	28	26	13(.50)	6(.23)	3(.12)	1(.04)		3(.12)
J_2	32	27	17(.63)	3(.11)	1(.04)	3(.11)	1(.04)	2(.07)
R_1	32	33	26(.79)	2(.06)	1(.03)	2(.06)		2(.06)
R_2	32	31	25(.81)				3(.10)	3(.10)

criteria for distinguishing these two types of classifiers. See section 4.5e. Replacements.)

The early acquisition of round SASSes may be attributed to any of several factors: (1) because it is mimetic, an instrument classifier may be easy to learn, (2) one classifier form may be easier to learn than than two kinds of classifier forms, or (3) the finding may be an artifact of summing instrument classifiers and round SASSes. To test these possibilities, we can sum straight SASS responses and instrument classifier responses to the straight SASS target and see if the total score is similar to that of the round SASS targets. Table 21 compares the total score for straight SASS targets to the scores of the round SASSes across all subjects. No difference is found in performance across these two groups of SASS targets, suggesting that the apparent difference was a scoring artifact.

The correct and partially correct SASS responses for the straight SASS targets are broken down in Table 22 in order to examine how the child learns to select and combine the width morpheme with the straight morpheme to produce a SASS. The data show that the Z classifier (STRAIGHT-THIN) is better acquired by $Anne_1$ and $Jane_1$, while the B classifier (STRAIGHT-WIDE) is likely for $Anne_1$ to be replaced by a primitive classifier. There is no confusion across all subjects between the Z and B targets.

As for the H targets (STRAIGHT-NARROW), the three children often produce partial errors, but the error pattern changes across age. The younger children replace it with either a Z or B classifier. The older children instead tend to choose a Z classifier for H targets. The

Table 21

Number and proportion of
straight + instrumental responses to straight targets
vs. round responses to round targets

Subject	Straight + instrumental #	%	Round #	%
A_1	8	(.44)	5	(.23)
A_2	14	(.67)	14	(.54)
J_1	15	(.79)	12	(.46)
J_2	18	(.75)	17	(.63)
R_1	20	(.80)	26	(.79)
R_2	16	(.70)	25	(.81)

Table 22

Proportion of Straight SASS responses which are correct vs. replacements, for each target SASS

S	Z targets			H targets			B targets		
	correct	replaced		correct	replaced		correct	replaced	
		by H	by B		by Z	by B		by Z	by H
A_1	1.00			.20	.40	.40	--		
A_2	1.00			.00	.67	.33	1.00		
J_1	1.00			.40	.20	.40	1.00		
J_2	1.00			.33	.67		1.00		
R_1	1.00			.40	.60		1.00		
R_2	1.00			.25	.75		1.00		

latter pattern suggests that the older children distinguish Z and B classifiers on the basis of the two width morphemes, thin and wide, while they are late in acquiring the third width morpheme, narrow, which they replace with a thin morpheme. They are able occasionally to respond with the H classifier. The patterns of acquisition here show that the child first acquires the straight morpheme, but he confuses the width morphemes. It is only later that he masters the width morphemes, in the order Z (thin), B (wide), and finally H (narrow) morphemes.

To examine how the child learns to select and combine morphemes for the round SASSes, Table 23 breaks down the correct and partially correct SASS responses to the round SASS targets. The data show many partial errors among the three children. They are all consistent in selecting the round morpheme rather than the straight morpheme, but their selection of the size and depth morphemes are not consistent. Either morpheme may be replaced with a wrong one, although the confusions are made only in certain situations, as in the case where the depth morphemes are almost always confused whenever the target classifier is Zc (CIRCLE).

In sum, across the two groups of target SASSes, there is almost no confusion of shape morphemes -- round vs. straight. This suggests that the shape morpheme is learned first. For the straight SASSes, the width morpheme is learned next. For the round SASSes, no preference is shown in learning the size vs. depth morphemes first. Significantly, the children's responses suggest that they are acquiring these morphologically complex classifiers morpheme by morpheme, rather than producing a wholistic representation of the object.

Table 23

Proportion of round SASS responses which are correct vs. replacements, for each target SASS

S	Z^c targets: correct	Z^c replaced by: wrong size	wrong depth	wrong size & depth	B^c targets: correct	B^c replaced by: wrong size	wrong depth	wrong size & depth
A_1	.25		.50	.25			1.00	
A_2	.17		.66	.17	.25	.62	.13	
J_1	.43	.14	.14	.29	.42	.29	.29	
J_2	.33		.50	.17	.60	.40		
R_1	.64	.09	.27		.71		.29	
R_2	.67		.25	.08	.84	.08	.08	

4.5e. Replacements. This section concerns the replacements of target classifiers made by the three children. The data concerning these replacements was presented in Tables 16 and 17 earlier. Here I consider the nature of these replacements in more detail.

There are two kinds of replacement found among the children. One kind is conventional replacements which are also found in adult native signers and are derived through morphological processes of ASL. They can thus be considered acceptable alternate responses. In contrast, the other kind of replacement violates the rules of ASL, as they are not derived through conventional morphological processes but rather through processes outside of the linguistic structure of ASL. Such replacements are therefore considered wrong responses.

The conventional replacements include path markers, body classifiers, and primitive classifiers. The path marker is the least marked classifier in the inventory of ASL classifiers, as it allows the most minimum reference to the object -- that is, merely its existence. Table 16 showed that this classifier is used mostly by the younger children, although its use is restricted to only certain categories of objects. It is used mostly to refer to round objects and sometimes to animate objects and vehicles, but never to objects of straight shape. Fifty percent of the path markers made by $Anne_1$ refer to objects with circular shapes.

Body classifiers are different from other types of classifiers in both the nature of the representation and the resources of the signer. They can correctly refer only to the animate actor in the event. There are two kinds of reference here. The instrument classifier is one kind of body classifier that involves use of the signer's hands in referring to the instrument in the event (i.e., the human hand or animal claw holding something). The object being held is not directly referred to. In contrast, the self classifier requires use of the whole body of the signer to refer to the object directly.

The replacements made by subjects with instrument classifiers (shown in Table 15) are considered errors, since no actor is involved in any of the stimuli of the VMP test except one in which a doll is riding a tricycle. ASL does not permit one to use an instrument classifier to refer to an object when it moves by itself rather than when it is moved by something else. In contrast, the self classifier (Table 16) is an acceptable replacement, but only when used for animate objects. Furthermore, there is a limitation in the signer's use of his body as a morpheme: the body is not allowed to move around in space.

The frequency of use of the two kinds of body classifiers taken together is low but increases with age for Anne and Jane, while it occurs at .10 for Randy. All the children use body classifiers for a variety of objects except for airplanes. But the children often violate the linguistic restriction on use of the instrument classifier, as they use this classifier to refer to an object that is not moved by an instrument but which moves by itself. The self classifier is also used by the children, but here they all succeed in complying with the linguistic restriction that this type of classifier applies only to animate objects. However, they often violate the linguistic constraint on body movement: They move their bodies to the extent that they actually jump or fall down on the floor as if they are imitating what they see on the film.

The primitive classifiers are the most common alternate responses for the three children. However, the frequency counts of such replacements may be confounded by the fact that those forms used for straight SASS targets are ambiguous (i.e., the same handshape for a straight SASS target is either a correct response or a primitive classifier). On the other hand, responses to straight SASS targets which have a relaxed handshape, or whose hand orientation is different than the target orientation, may be primitive classifiers; but they equally well may be an SASS with a mistaken orientation. Primitive classifier usage for SASS straight targets is, however, no higher than for round targets or semantic targets (see Tables 18 and 20). It thus seems reasonable to conclude that primitive classifiers <u>are</u> the most common alternate indeed.

There are several kinds of primitive classifiers, each specialized for objects of certain shapes and orientations. For example, the Z_{horiz} classifier (the index finger held horizontally) refers to long thin objects or to the direction of movement of the object. The B classifier (the flat hand) instead refers to an object with a flat shape; the B_{flat} classifier is used for those with the flat side down, while the B_{edge} classifier is used for upright objects.

The data show that these three primitive classifiers are common among the children. They also show consistency among the children in selecting each of these primitive classifiers. The Z_{horiz} classifier is used by Anne and Jane for any category of object. In contrast, Randy uses it only for wide, flat objects and cylindrical objects. Anne refers to these objects with a B_{flat} classifier. This latter classifier is used mostly for animals, vehicles, and airplanes by all three children. The B_{edge} classifier is more limited in use: It is used mostly for vehicles, although Anne and Jane also use it for narrow and wide flat objects, for cylindrical objects, and for trees. The $B_{vertical}$ classifier is also used by Anne and Jane for trees as well as for circles and cylinders.

The unconventional replacements found in the subjects' responses are of two kinds: borrowing features of frozen signs (called "frozen handshapes," or fhs), and modifying conventional classifiers to create new markers (see Table 17). The first kind involves borrowing of handshape from a frozen sign in three ways: the active handshape only, the base handshape only, or both the active and base handshapes. When either the active handshape or the base handshape alone is borrowed, it may be that the subject realizes the relationship of an individual handshape and a frozen sign to the referent object, but this is not common among the children. More frequently, they borrow both handshapes to mark a single noun without realizing that each represents a different object. For example, Anne occasionally borrows both handshapes of the noun TREE, and uses them as a single noun marker in verbs involving trees, despite the fact that the base hand in the sign TREE represents the ground. The older children tend more often to borrow individual handshapes. For example, Jane on one occasion borrows the H handshape from the noun EGG to refer to a disk-shaped object.

These borrowings are sometimes accompanied by borrowing the movement from the same sign, although this movement has nothing to do with the event in the stimulus film. In this case, the child simply appears to be using the whole sign as a noun marker in the verb. For example, Anne sometimes borrows the whole sign TREE, which includes a twisting movement of the arm rather than just borrowing the handshape. She then moves this whole sign, twisting all the way, to represent the event presented in the film.

The previous examples involve borrowing from noun signs, but there are other cases where the subject borrows features from frozen verbs and locatives. For example, Jane once takes both the active and base handshapes from the verb STAND and uses them as a noun marker, despite the fact that the base hand in this sign refers to the ground, as in the case above with TREE.

Modifying a conventional classifier to create a new classifier occurs only once, in $Randy_2$. For a film in which a wing moves on top of the fuselage of an airplane, Randy starts with the thumb of the airplane classifier bent, and then unbends the thumb to indicate that the airplane now has a wing. This kind of manipulation with classifiers is not part of the productive morphological system of ASL, as the semantic classifiers have no internal morphemes for the signer to manipulate. It is interesting, however, that this occurs in the oldest subject, suggesting that he is beginning to "play" with the morphological system (as adults sometimes do). Alternatively, he may be beginning more generally to analyze semantic classifiers internally, fitting them into the productive internal morphology of SASSes. Further data on the generality of such productions may decide between these alternatives.

4.6 Acquisition of the base grid system

This section describes how the child acquires the base grid system for placing the base marker around the path of the active marker. I proposed in the prior chapter that this system is composed of several independent hierarchies of locative morphological features. This would suggest that the pattern of development of the base grid system should be affected by such an organization; that is, that the hierarchies might be acquired independently.

The VMP test is constructed with two sets of contrasts in the locative relationships between the active marker and the base marker. First, let me consider the placement of the base marker with respect to the path of the active marker. There are three contrasting positions for the base marker along the path: initial position, mid position, and final position. Second, the base position marker is combined with one of five locative orientation morphemes: unmarked, in, beside, on, and above. Appendix 2 lists the 54 stimuli testing these combinations. These test contrasts allow us to examine whether the hierarchy of the base position morphemes affects order of acquisition and whether the base position morphemes are learned independently of the other locative morphemes. Unfortunately, I cannot test the hypothesis of independence directly, since young children will tend to make errors on both systems, and older children will tend to get both systems correct, regardless of whether they are being acquired independently of one another. However, if they are analyzed as independent systems, one should expect some high frequency of errors on one system while performing the other system correctly. In contrast, if they are acquired holistically, there would be no reason to expect such partial successes.

The subjects' responses to the above stimuli are categorized in Table 24 in terms of successes and errors on each position morpheme. The data show that when the children begin to use the base marker, they do not always place it in a correct position. The accuracy of placing the marker is 42% correct across all trials for $Anne_1$ but increases over age to 91% for $Randy_2$.

Comparisons of the children's performance for the three morpheme contrasts shows some bias in performance of the younger children. $Anne_1$ scores well on the initial position morpheme, which is selected correctly 75% of the time. The final position morpheme is second best for her, with a success rate of 50%. She does not control the mid position morpheme at all, with a success rate of 0%. She replaces it consistently with an initial position morpheme. In the next three month span, Anne's success with the mid position morpheme increases dramatically to 67%. The initial position morpheme is also the best for Jane in both three month spans, followed by roughly equal accuracy on the mid and final position morphemes. In contrast, all three positions are mastered by Randy, the oldest child, whose success rate is above 85% on all three contrasts.

This pattern of development supports the claim suggested by the linguistic description of the base position morpheme, in which the initial and final position morphemes are derived independently of the mid position morpheme throughout the base position hierarchy. Further

Table 24

Number of responses and proportion correct
for placement of the base marker,
for each of three positions and overall

Subject	initial #	initial %	mid #	mid %	final #	final %	total #	total %
A_1	8	(.75)	5	(.00)	8	(.50)	21	(.42)
A_2	9	(.89)	6	(.67)	8	(.63)	23	(.73)
J_1	6	(1.00)	4	(.75)	5	(.60)	15	(.78)
J_2	10	(.90)	12	(.67)	15	(.73)	37	(.76)
R_1	12	(.83)	15	(.87)	12	(.92)	39	(.87)
R_2	13	(.85)	15	(.93)	16	(.94)	44	(.91)

evidence comes from the error patterns of the younger child, who was biased to select the initial position to replace the mid position morpheme.

With regard to the issue of independence of morphemes in the acquisition of the base grid system, the VMP test allows us to observe how the child learns to combine the locative orientation morpheme with the base position morpheme. Table 25 shows the rates of success and errors on such combinations for only those responses made with simultaneous S.O. markers. The correct combination of the two morphemes occurs 44% of the time for $Anne_1$ and improves over age to 77% for $Randy_2$.

More interesting, the analysis of errors shows a high likelihood of producing one of these morphemes correctly, while the other is incorrect. This pattern occurs in 25% of the items for $Anne_1$, and stays roughly constant over age and subjects. These errors suggest that the locative orientation morpheme is controlled independently of the base position morpheme, and provide evidence for the claim that the base grid system is acquired not as a whole, but in component parts.

There is a possibility that these data are confounded since all the base position and locative orientation contrasts are counterbalanced across 36 stimuli involving simple movement paths but are not for the other 18 stimuli, which include complex movement paths combined with base grid contrasts in limited ways. For example, the FALL paths are combined only with the initial position test targets, while the TURN paths are combined only with the mid and final position targets. Locative orientation contrasts are also not counterbalanced over these

Table 25

Proportion correct for combinations of locative and base position morphemes for responses with S.O. marker in verb of motion (simultaneous S.O.)

Subject	Simultaneous $\frac{AH_{co} + BH_{so}}{\#}$	both morphemes correct %	one morpheme correct %	both morphemes wrong %
A_1	16	(.44)	(.25)	(.31)
A_2	19	(.58)	(.21)	(.21)
J_1	13	(.62)	(.23)	(.15)
J_2	36	(.58)	(.28)	(.14)
R_1	38	(.76)	(.21)	(.03)
R_2	44	(.77)	(.18)	(.05)

paths. Therefore, to prevent any bias in analyzing the subjects' performance, I present the responses only to the counterbalanced 36 stimuli in Table 26. However, the data show much the same patterns.

5. Summary of results and conclusions

First, it is clear that the tests attempting to elicit novel verbs of motion worked: all of the children responded with a verb form most of the time, and in fact all of them responded with a novel (that is, not a frozen) verb most of the time. Of interest, then, is the extent to which they demonstrated sequential mastery of components of the morphology over development, as opposed to performing wholistic attempts at mimetically depicting motion of objects.

Unfortunately, the youngest subject tested did not produce analyzable responses, so the data cover only the developmental period from 3;6 to 5;11. Although the child acquiring English has already mastered much of the morphology by these ages, children acquiring morphologically complex languages (of which ASL is one) are typically still mastering the morphological system throughout this period and beyond (Slobin, in press). This is clearly the case for the acquisition of ASL.

In general, none of the children show evidence of performing wholistic mimetic depictions. The responses were either frozen verbs, or novel verbs in which individual components were mastered independently. The youngest child, Anne, from 3;6 to 3;11 produced approximately 10% frozen verbs. For novel verbs, a marker of the central object was always present. Roughly 25 to 35% of these markers were semantic classifiers or SASSes; but an equal percentage were

Table 26

Proportion correct for combinations of locative and base position morphemes for responses with S.O. marker in verb of motion (simultaneous S.O.), for 36 stimuli with simple movements only

Subject	Simultaneous $\frac{\underline{AH}_{CO} + \underline{BH}_{SO}}{\#}$	both morphemes correct %	one morpheme correct %	both morphemes wrong %
A_1	14	(.50)	(.14)	(.36)
A_2	17	(.54)	(.24)	(.24)
J_1	11	(.64)	(.27)	(.09)
J_2	24	(.54)	(.30)	(.16)
R_1	27	(.81)	(.19)	(.00)
R_2	30	(.77)	(.16)	(.07)

primitive markers, roughly 10 to 16% were wrong (most of these frozen handshapes), and 10% or less were path markers. Semantic classifiers were acquired largely as units over development, while SASSes gave evidence of being mastered in their component parts (that is, partial errors, in which some of the component morphemes were controlled correctly but others were not, were as frequent as 20 to 25% of the SASS productions).

A marker for the secondary object was produced about half of the time when required, with about 75% of these produced simultaneously as part of the verb stem and about 25% produced as a separate noun or verb. Most of the other half of the secondary objects were simply unmarked, with no base hand produced in the sign at all. Virtually none of the responses involved replacing the secondary object marker with a ground marker, suggesting that she controlled the priority rules for markers throughout this period. The base grid and locative system appeared to be acquired componentially, with individual morphemes controlled while others were omitted or incorrect.

The children moved toward the adult pattern on all of these features with age, with Randy, age 5;6 to 5;11, producing only 2 to 3% frozen signs, central object markers with 80 to 85% semantic classifiers or SASSes, 70 to 80% secondary object markers produced where required and produced always simultaneously as part of the verb stem, and base grid and locatives almost always correct.

The frequencies of certain kinds of errors in the youngest child, my observations of even younger children's spontaneous signing, and the literature on ASL acquisition may allow us to infer a series of three stages of signing verbs of motion: First, there appears to be a stage prior to the start of this study during which young children frequently produce relatively unmarked forms of central object classifiers (that is, primitive and path markers), with no representation of a secondary object. Either subsequently or simultaneously they may begin to produce separated markers for the secondary object (e.g., a frozen noun or verb of location). With development, more and more of the agreement morphemes -- for more specific class of the central object, for the secondary object and its location in relation to the central object-- begin to be incorporated into the verb. Classifier morphemes are acquired componentially. And, finally, morphemes related to the secondary object begin to appear as simultaneous rather than separated parts of the verb stem, until the full simultaneous complex is produced.

In short, if this developmental pattern is correct, the child acquiring ASL, like children acquiring spoken languages of comparable structure, begins predominantly with simple, separate lexemes, and only with development acquires morphological structure (see Gleitman & Wanner, 1982; Slobin, 1973, in press; and Newport, 1981, 1982, for related discussions).

6. General conclusions

The acquisition of ASL presents a picture that is much like that observed for spoken languages. However, ASL allows us a new situation, because of the different modality, to see how this abstract picture of learning works itself out in the learning child. As in a spoken language, the child's first step is to acquire a simple set of lexemes, and to learn to produce these in some sequence. The lexemes are acquired over some lengthy period of developmental time by the child, so at any one observation we find that the child knows some of them well, others less well, and still others not at all. This kind of acquisition, rather than first acquisition of a global, undifferentiated attempt to imitate the adult or the event itself, is seen in the first stages of ASL, just as in spoken languages; thus, as I predicted, disconfirmation of hypothesis (a) with which I began is supported by my findings. See particularly Ellenberger & Steyaert, 1978, for related data, and Meier, 1982, and Newport, 1981, for further discussion and detailed disconfirmation of this hypothesis.

In contrast, my hypothesis (b) was supported by the findings. These findings would not be surprising for a spoken language, but since many have thought of ASL, and in particular the morphology of motion and location, as an elaborate mimetic system, it is quite interesting that the first language learners treat it as componential and discrete, at least from the earliest moments that I was able to observe. Strongly supportive evidence for the early componential treatment of movement in verbs of motion comes from an analysis by Newport (1981) and myself (Newport & Supalla, 1980) on pilot data from these same subjects. Newport's analyses of these subjects' elicited productions from ages 2;4 to 5;1 shows that movement in verbs of motion is virtually never mimetic. Rather, the most common early error involves producing one movement morpheme and omitting others. More and more movement morphemes are controlled over development.

In addition to discovering the lexical facts about the language, and some sequential rules, the child must learn to put the pieces of the language together. As I proposed in my hypothesis (c), this looks like very complex learning in the case of ASL, which is not only highly inflected, but has much of the hierarchical morphological structure encoded onto simultaneously performed signs. I predicted that children would not be able to integrate these various morphological components simultaneously, at first, even when the separate components were known. In fact, for example, the high frequency of separated S.O. markers in the youngest child supports this prediction. Again, supporting evidence comes from our preliminary analyses of the acquisition of movement, where complex movement forms requiring simultaneous path and manner or path and direction morphemes are often produced by the young child in sequential rather than simultaneous forms. Further analyses of movement in these subjects, as well as additional subjects, will appear in future work (Newport & Supalla, forthcoming).

As I stated in the description of ASL, even the adult performance becomes sequential just in case so many morphemes are required that there are not enough bodily resources (hands, body) to perform them all at once. What seems to be limited in the adult because of a limit on bodily resources seems to be limited in the child because of a limit on processing resources, in addition to the bodily resources. Because of an inability to integrate all the obligatory physical motions at once, and/or inability to mentally manipulate and combine all of them at once, the child falls back on even more sequential performances than the adult ever produces. But what the child is doing is something that may be deeply (linguistically) similar to what is done in the signing community around him.

Footnotes for Chapter 2

1. In brief, the test of comprehension of verbs of motion presented films of a native signer producing one verb of motion at a time and asked the child to manipulate toy objects to perform the action described by the signer. The test of production of verbs of location presented still color photographs of toy objects in various orientations and spatial relationships to one another and asked the child to describe the picture. The test of comprehension of verbs of location presented films of a native signer producing one verb of location at a time and asked the child to choose one of two still color photographs of toy objects, which differed from one another in exactly one morphemic feature, to match the situation described by the signer. Preliminary analyses of the results of these tests suggest that the results are in line with the findings from the test of production of verbs of motion presented in this thesis.

CHAPTER 3: OVERALL CONCLUSIONS

I began with the claim, in contradiction to that of DeMatteo and others, that verbs of motion and location in ASL are componentially organized, and that the components are a finite set which are discretely different from one another. In part, this claim is based on a linguistic analysis presented in Chapter 1, which, I have argued, can successfully describe the array of possible surface forms found in these verbs. In Chapter 2 I presented evidence from the acquisition of ASL verbs of motion which provides psychological support for this analysis: patterns of ASL acquisition reveal that the children from early stages produce some components of verbs, but omit or make errors on others; moreover, they sometimes produce components sequentially rather than simultaneously. That these productions are themselves componential, and that the components are the same ones proposed in the linguistic analysis, suggests that at least the part of my claim dealing with componentiality is correct.

The claim that each of these components is a form that can take only a finite set of values, each of which is discretely different from the others, is best supported by additional work in progress. In an experiment with adult native users of ASL, Schwartz, Newport, and myself are presenting subjects with an array of stimuli drawn from a real-world continuum and testing whether in fact they produce signs which vary continuously with the form of the stimulus. For example, we have presented subjects with pictures of round dots which vary in size from very small to rather large. The subjects see these pictures one at a time, interspersed with a large number of irrelevant pictures (so that subjects are not made to feel that they _must_ produce gesturally analogue forms to satisfy the experimenter). They are then asked to produce a sign for each. Videotapes of their signs are shown to another group of native signers, who are asked to pick from the continuum of pictures the one which they think the subject was viewing.

If indeed the producing subjects are varying their forms in a continuous, analogue fashion, and if the judging subjects are able to perceive these forms accurately, there should be a significant rank order correlation between the stimulus seen by the producer and the stimulus chosen by the judge. If, on the other hand, as claimed in my linguistic analysis, there are only a small number of size morphemes in ASL which are discretely different from one another, there should be a correlation between producers and judges only across boundaries of two distinct size morphemes; within a category of size, producers and judges should have only a chance relationship with one another.

Pilot results support the latter interpretation: within a category of size, there is essentially a zero correlation between producers and judges. This is not, however, because of the limits of gestural production or perception in general: the same experiment conducted with hearing gesturers and hearing perceivers shows the results that would be predicted by continuous variation. That is, for subjects who use gesture non-linguistically, there is a quite significant correlation between producers and judges, both within an ASL size category and across ASL size categories. We are in the process of extending this experiment to movement as well; at present the results are unknown.

If these early results hold up, they strongly suggest that the hypothesized discrete character of ASL morphology is correct. As Newport (1981, 1982) has discussed, they further suggest that the reason for the discrete character of ASL is _not_ to be found in limitations on perception or production (at least not when productions are one at a time; such limitations may arise when productions are more rapid and when there are multiple signs in sequence). Newport has suggested that there are two other possible reasons for discreteness in language. One is that there is a special character to language in particular, that arises from a specialized language faculty. However, she does not find strong evidence in favor of this hypothesis at the present time. A second reason she suggests is that it is the character of a general learning process, particularly in children, that contributes discreteness and componentiality to language. She suggests that it is the learning and mastery of a large set of forms, which learners seem to be biased to organize in minimally contrasting families, that contributes this character to language.

Whatever the account of these characteristics, the present evidence supports the claim that gestural language, like spoken language, is discrete and componential.

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Appendix 1

List of frequencies for five movement roots, four combination types, eight movement affixes and five directional affixes

<u>Five movement roots:</u>

48 linear
51 arc
12 turn
6 midpivot
3 midpivot

<u>Four types of combinations:</u>

54 single
36 simultaneous
15 nested
15 sequential

<u>Eight movement affixes:</u>

20 jump
6 bounce
10 fall
5 roll
5 rotate
5 open
5 close
5 wreck

<u>Five directional affixes:</u>

90 unmarked
6 up
6 uphill
15 down
6 downhill

Appendix 2

Frequencies of combinations of base position and locative morphemes

<u>Fifty-four combinations of base position and locative morphemes:</u>

- 18 initial positions
  - 10 combined with <u>from on</u>
    - 4 combinations for simple paths
    - 6 combinations for complex paths
  - 4 combined with <u>from in</u>
  - 4 combined with <u>from ahead of</u>

- 18 mid positions
  - 4 combined with <u>over</u>
  - 4 combined with <u>through</u>
  - 10 combined with <u>past</u>
    - 4 combinations for simple paths
    - 6 combinations for complex paths

- 18 final positions
  - 4 combined with <u>to on</u>
  - 4 combined with <u>to in</u>
  - 10 combined with <u>to behind</u>
    - 4 combinations for simple paths
    - 6 combinations for complex paths

Appendix 3

Frequencies of active and base marker contrasts

Five semantic classifiers:

57 tested as active marker
- 13 human
- 15 animal
- 15 vehicle
- 7 airplane
- 7 tree

20 tested as base marker
- 3 human
- 3 animal
- 5 vehicle
- 3 airplane
- 6 tree

Five size-and-shape specifiers:

63 tested as active marker
- 10 STRAIGHT-THIN
- 9 STRAIGHT-NARROW
- 12 STRAIGHT-WIDE
- 13 ROUND
- 19 CYLINDRICAL

34 tested as base marker
- 5 STRAIGHT-THIN
- 6 STRAIGHT-NARROW
- 5 STRAIGHT-WIDE
- 9 ROUND
- 9 CYLINDRICAL

Appendix 4

Collection of props used as central objects

<u>13 human props:</u>

- 3 human dolls with normal physical features
- 2 simple dolls with four limbs
- 5 Fisher-Price dolls with no limbs
- 3 non-human dolls: angel, gingerbread man, robot

<u>15 animal props:</u>

- 11 4-legged: alligator, cow, dog, frog, green alien animal, pig, porcupine, rabbit, sheep, tiger, turtle
- 4 winged: bee, chick, duck, hen

<u>15 vehicle props:</u>

- 2 locomotives
- 3 boats: canoe, sailboat, tugboat
- 6 4-wheeled: forklift, garbage truck, mailtruck, pick-up truck, racer, rescue truck
- 4 others: motorcycle, snowmobile, tractor, tricycle

<u>7 airplane props:</u>

- 4 monoplanes (one repeated twice)
- 2 biplanes
- 1 glider

<u>7 tree props:</u>

- 4 small "real" trees
- 1 cactus
- 2 plastic trees

<u>10 straight-thin props:</u>

- 5 thin objects: nail, q-tip, pencil (shown twice), pipe cleaner
- 5 non-airplanes: flying broom, rubber-tipped dart, paper glider, rocket, spaceship

<u>9 straight-narrow props:</u>

- 9 narrow objects: bandaid, domino, knife, oilpaint brush, piece of paper, rear wing of airplane, ruler, wood block

<u>12 straight-wide props:</u>

- 7 wide objects: forward wing of airplane, book, brick, leaf, house paint brush, piece of fabric, piece of paper
- 2 furniture: bed, table
- 3 non-vehicles: lawnmower, toy wagon, wheelbarrow

<u>13 round props:</u>

- 6 hollow circles: $loop_1$, $loop_2$, $loop_3$, $loop_4$, roll of tape, wreath
- 6 solid circles: ashtray, coin, pea, round piece of paper, movie reel
- 1 crescent: moon

<u>19 cylindrical props:</u>

- 7 hollow cylinders: cardboard pipe, flower pot, hollow log, paper cylinder, paper cup, plumbing pipe, tiolet paper core
- 7 solid cylinders: clay block, hydrant, milk can, metal cylinder, salt shaker, soup can, wood block
- 5 complex-shaped round objects: bone, bottle, cone, floor lamp, tiolet