Chapter 5

The Confluence of Space and Language in Signed Languages

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Expressed by hands and face rather than by voice, and perceived by eye rather than by ear, signed languages have evolved in a completely different biological medium from spoken languages. Used primarily by deaf people throughout the world, they have arisen as autonomous languages not derived from spoken language and are passed down from one generation of deaf people to the next (Klima and Bellugi 1979; Wilbur 1987). Deaf children with deaf parents acquire sign language in much the same way that hearing children acquire spoken language (Newport and Meier 1985; Meier 1991). Sign languages are rich and complex linguistic systems that manifest the universal properties found in all human languages (Lillo-Martin 1991).

In this chapter, I will explore a unique aspect of sign languages: the linguistic use of physical space. Because they directly use space to linguistically express spatial locations, object orientation, and point of view, sign languages can provide important insight into the relation between linguistic and spatial representations. Four major topics will be examined: how space functions as part of a linguistic system (American Sign Language) at various grammatical levels; the relative efficiency of signed and spoken languages for overt spatial description tasks; the impact of a visually based linguistic system on performance with nonlinguistic tasks; and finally, aspects of the neurolinguistics of sign language.

5.1 Multifunctionality of Space in Signed Languages

In this section, I describe several linguistic functions of space in American Sign Language (ASL). The list is not exhaustive (for example, I do not discuss the use of space to create discourse frames; see Winston 1995), but the discussion should illustrate how spatial contrasts permeate the linguistic structure of sign language. Although the discussion is limited to ASL, other signed languages are likely to share most of the spatial properties discussed here.

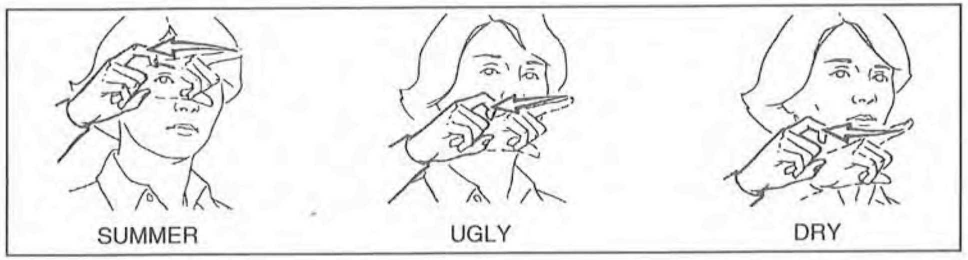


Figure 5.1
Example of a phonological contrast in ASL. These signs differ only in the location of their articulation.

5.1.1 Phonological Contrasts

Spatial distinctions function at the sublexical level in signed languages to indicate phonological contrasts. Sign phonology does not involve sound patternings or vocally based features, but linguists have recently broadened the term *phonology* to mean the "patterning of the formational units of the expression system of a natural language" (Coulter and Anderson 1993, 5). Location is one of the formational units of sign language phonology, claimed to be somewhat analogous to consonants in spoken language (see Sandler 1989). For example, the ASL signs SUMMER, UGLY, and DRY[1] differ only in where they are articulated on the body, as shown in figure 5.1.

At the purely phonological level, the location of a sign is articulatory and does not carry any specific meaning. Where a sign is articulated is stored in the lexicon as part of its phonological representation.[2] Sign languages differ with respect to the phonotactic constraints they place on possible sign locations or combinations of locations. For example, in ASL no one-handed signs are articulated by contacting the contralateral side of the face (Battison 1978). For all signed languages, whether a sign is made with the right or left hand is not distinctive (left-handers and right-handers produce the same signs—what is distinctive is a contrast between a dominant and nondominant hand). Furthermore, I have found no phonological contrasts in ASL that involve left-right in signing space. That is, there are no phonological minimal pairs that are distinguished solely on the basis of whether the signs are articulated on the right or left side of signing space. Such left-right distinctions appear to be reserved for the referential and topographic functions of space within the discourse structure, syntax, and morphology of ASL (see below). For a recent and comprehensive review of the nature of phonological structure in sign language, see Corina and Sandler (1993).

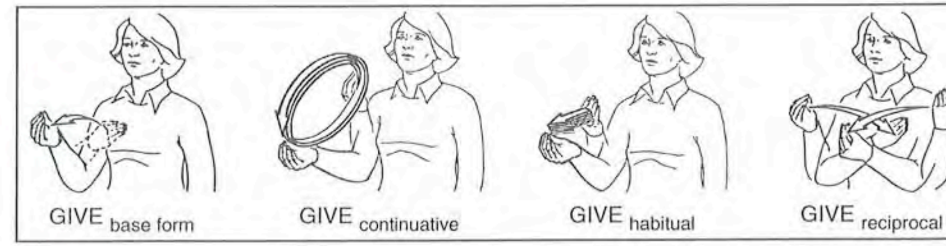


Figure 5.2
Examples of nonconcatenative morphology in ASL.

5.1.2 Morphological Inflection

In many spoken languages, morphologically complex words are formed by adding prefixes or suffixes to a word stem. In ASL and other signed languages, complex forms are most often created by nesting a sign stem within dynamic movement contours and planes in space. Figure 5.2 illustrates the base form GIVE along with several inflected forms. ASL has many verbal inflections that convey temporal information about the action denoted by the verb, for example, whether the action was habitual, iterative, or continual. Generally, these distinctions are marked by different movement patterns overlaid onto a sign stem. This type of morphological encoding contrasts with the primarily linear affixation found in spoken languages. For spoken languages, simultaneous affixation processes such as templatic morphology (e.g., in the Semitic languages), infixation, or reduplication are relatively rare. Signed languages, by contrast, prefer nonconcatenative processes such as reduplication; and prefixation and suffixation are rare. Sign languages' preference for simultaneously producing affixes and stems may have its origin in the visual-manual modality.

For example, the articulators for speech (the tongue, lips, jaw) can move quite rapidly, producing easily perceived distinctions on the order of every 50–200 milliseconds. In contrast, the major articulators for sign (the hands) move relatively slowly such that the duration of an isolated sign is about 1,000 milliseconds; the duration of an average spoken word is more like 500 milliseconds. If language processing in real time has equal timing constraints for spoken and signed languages, then there is strong pressure for signed languages to express more distinctions simultaneously. The articulatory pressures seem to work in concert with the differing capacities of the visual and auditory systems for expressing simultaneous versus sequential information. That is, the visual system is well suited for simultaneously perceiving a large amount of information, whereas the auditory system seems particularly adept at perceiving fast temporal distinctions. Thus both sign and speech have exploited the advantages of their respective modalities.

"The dog bites the cat."

Figure 5.3
Example of the sentential use of space in ASL. Nominals (*cat, dog*) are first associated with spatial loci through indexation. The direction of the movement of the verb (BITE) indicates the grammatical role of subject and object.

5.1.3 Coreference and Anaphora

Another hypothesized universal use of space within sign languages is for referential functions. In ASL and other sign languages, nominals can be associated with locations in signing space. This association can be established by "indexing" or pointing to a location in space after producing a lexical sign, as shown in figure 5.3. Another device for establishing the nominal-locus association is to articulate the nominal sign(s) at a particular location or by eye gaze toward that location. In figure 5.3, the nominal DOG is associated with a spatial locus on the signer's left and CAT is associated with a locus on the signer's right. The verb BITE moves between these locations identifying the subject and object of the sentence "[The dog] bites [the cat]." BITE belongs to a subset of ASL verbs termed *agreeing* verbs[3] whose movement and/or orientation signal grammatical role. ASL pronouns also make use of established associations between nominals and spatial loci. A pronominal sign directed toward a specific locus refers back to the nominal associated with that locus. Further description of coreference and anaphora in ASL can be found in Lillo-Martin (1991) and Padden (1988).

Recently, there has been some controversy within sign linguistics concerning whether space itself performs a syntactic function in ASL. Liddell (1993, 1994, 1995) has argued that spatial loci are not morphemic. He proposes that space in sentences like those illustrated in figure 5.3 is being used deictically rather than anaphorically. That is, the signer deictically points to a locus in the same way he would point to a physically present person. In contrast, other researchers have argued that these spatial loci are agreement morphemes or clitics that are attached to pronouns and verbs (e.g., Janis 1995; Padden 1990). As evidence for his position, Liddell (1993, 1995) argues that just as there is an unlimited number of spatial positions in which a

physically present referent could be located, there also appears to be an unlimited number of potential locations within signing space (both vertically and horizontally) toward which a verb or pronominal form can be directed (see also Lillo-Martin and Klima 1990). If this is the case, then location specifications are not listable or categorizable and therefore cannot be agreement morphemes or clitics. The syntactic role of subject or object is assigned, not by the spatial loci, but either by word order or by the orientation or the temporal end points of the verb itself.[4] According to this view, the particular location at which a verb begins or ends serves to identify the *referent* of the subject and object roles. The space itself, Liddell has argued, is not part of a syntactic representation; rather, space is used nonmorphemically and deictically (much as deictic gesture is used when accompanying speech). This hypothesis is quite radical, and many of the details have not been worked out. For example, even if space itself does not perform a syntactic function, it does perform both a referential and a locative function within the language (see Emmorey, Corina, and Bellugi 1995). The association of a nominal with a particular location in space needs to be part of the linguistic representation at some level in order to express coreference relations between a proform and its antecedent. If this association is not part of the linguistic representation, then there must be an extremely intimate mixing of linguistic structure and nonlinguistic representations of space.

5.1.4 Locative Expressions

The spatial positions associated with referents can also convey locative information about the referent. For example, the phrase DOG INDEX$_a$ shown in figure 5.3 could be interpreted as "the dog is there on my left," but such an interpretation is not required by the grammar. Under the nonlocative reading, INDEX simply establishes a reference relation between DOG and a spatial locus that happens to be on the signer's left. To ensure a locative reading, signers may add a specific facial expression (e.g., spread tight lips with eye gaze to the locus), produced simultaneously with the INDEX sign. Furthermore, ASL has a set of classifier forms for conveying specific locative information, which can be embedded in locative and motion predicates; for these predicates, signing space is most often interpreted as corresponding to a physical location in real (or imagined) space. The use of space to directly represent spatial relations stands in marked contrast to spoken languages, in which spatial information must be recovered from an acoustic signal that does not map onto the information content in a one-to-one correspondence. In locative expressions in ASL, the identity of each object is provided by a lexical sign (e.g., TABLE, T-V, CHAIR); the location of the objects, their orientation, and their spatial relation vis-à-vis one another are indicated by where the appropriate accompanying classifier sign is articulated in the space in front of the signer. The flat B handshape is

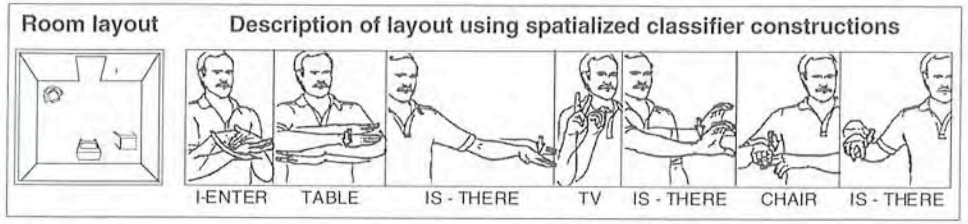


Figure 5.4
Example of an ASL spatial description using classifier constructions.

the classifier handshape for rectangular, flat-topped, surface-prominent objects like tables or sheets of paper. The C handshape is the classifier handshape for bulky boxlike objects like televisions or microwaves. The bent V is the classifier handshape for squat, "legged" objects like chairs, small animals, and seated people.

Flat B handshape: 

C handshape: 

Bent V handshape: 

These handshapes occur in verbs that express the spatial relation of one object to another and the manner and direction of motion (for moving objects/people). Figure 5.4 illustrates an ASL description of the room that is sketched at the far left. An English translation of the ASL description would be "I enter the room; there is a table to my left, a TV on the far side, and a chair to my right." Where English uses separate words to express such spatial relations, ASL uses the actual visual layout displayed by the array of classifier signs to express the spatial relations of the objects.

Landau and Jackendoff (1993) have recently argued that languages universally encode very little information about object shape in their locative closed-class vocabulary (e.g., prepositions) compared to the amount of spatial detail they encode in object names (see also Landau, chapter 8, this volume). As one can surmise from our discussion and from figure 5.4, ASL appears to have a rich representation of shape in its locative expressions. Like the locational predicates in Tzeltal (Brown 1991; Levinson 1992a), ASL verbs of location incorporate detailed information about the shape of objects. It is unclear whether these languages are counterexamples to Landau and Jackendoff's claims for two reasons. First, both Tzeltal and ASL express locative information through verbal predicates that form an open-class category, unlike prepositions (although the morphemes that make up these verbal predicates belong to a closed class). The distinction may hinge on whether these forms are considered grammaticized closed-class elements or not (see also Talmy 1988). Second, in ASL the *degree* of shape detail is less in classifier forms than in object names. For example, the flat B handshape classifier is used for both TABLE and for PAPER—the count nouns encode more detailed shape information about these objects than the classifier form. Thus, although the contrast is much less striking in ASL than in English, it still appears to hold.

Figure 5.5
Final classifier configuration of either (2a) or (2b).

Talmy (1983) has proposed several universal features that are associated with the figure object (i.e., the located object) and with the reference object or ground. For example, the figure tends to be smaller and more movable than the ground object. This asymmetry can be seen in the following sentences (from Talmy 1983):[5]

(1) a. The bike is near the house.
b. ?The house is near the bike.

In English, the figure occurs first, and the ground is specified by the object of the preposition. When a large unmovable entity such as a house is expressed as the figure, the sentence is semantically odd. This same asymmetry between figure and ground objects occurs in ASL, except that the syntactic order of the figure and ground is reversed compared to English, as shown in (2a) and (2b) (the subscripts indicate locations in space). In these examples, the classifier in the first phrase is held in space (indicated by the extended line) during the articulation of the second phrase (produced with one hand). In this way, the classifier handshape representing the figure can be located with respect to the classifier handshape representing the ground object, as illustrated in figure 5.5 (the signer's left hand shows the classifier form for

HOUSE; her right hand shows the classifier form for BIKE). The final classifier configuration is the same for either (2a) or (2b)—what differs is phrasal order.

(2) a. HOUSE OBJECT-CLASSIFIER$_{a}$ ______________________
BIKE VEHICLE-CLASSIFIER$_{\text{near a}}$

b. ?BIKE VEHICLE-CLASSIFIER$_{a}$ ______________________
HOUSE OBJECT-CLASSIFIER$_{\text{near a}}$

Recently, I asked eight native signers[6] to describe a series of fifty-six pictures depicting simple relations between two objects (e.g., a dog under a chair, a car behind a tree). The signers almost invariably expressed the ground first, and then located the figure with respect to the ground object. This ordering may be an effect of the visual-spatial modality of sign language. For example, to present a scene visually through drawing, the ground tends to be produced first, and then the figure is located within that ground. Thus, when drawing a picture of a cup on a table, one generally would draw the table first and then the cup; rather than draw the cup in midair and then draw the table beneath it.[7] More crosslinguistic work will help determine whether the visual-spatial modality conditions all signed languages to prefer to initially express the ground and then the figure in locative constructions.

Talmy (1983) also argues that prepositions (for languages like English) ascribe particular geometries to figure and ground objects. He presents evidence that all languages characterize the figure's geometry much more simply than the ground. The figure is often conceived of as a simple point, whereas the ground object can have more complex geometric specifications. For example, Talmy argues that the English prepositions *across*, *between*, *along*, and *among* all pick out different ground geometries. At first glance, it appears that there is no such asymmetry in ASL. For example, the classifier construction in (2a) for the ground (the house) does not appear to be more geometrically complex than the figure (the bike) with respect to specifications for shape (indicated by classifier handshape) or for spatial geometry. The locative expression in (2a) does not appear to have a linguistic element that differentially encodes figure and ground geometries in the way that prepositions do in spoken languages. Nonetheless, the grammar of ASL reflects that fact that signers conceive of the figure as a point with respect to a more complex ground. As shown in (3a) and (3b) and illustrated in figure 5.6, expression of the figure can be reduced to a point, but expression of the ground cannot:

(3) a. HOUSE OBJECT-CLASSIFIER$_{a}$ ______________
BIKE POINT$_{\text{near a}}$

b. ?HOUSE POINT$_{a}$ ______________________
BIKE VEHICLE-CLASSIFIER$_{\text{near a}}$

Final classifier construction for (3a).

Final classifier construction for (3b).

Figure 5.6

Thus Talmy's generalization about figure-ground complexity appears to hold even for languages that can use spatial geometry itself to encode spatial relations.

5.1.5 Frames of Reference

ASL can express spatial relations using an intrinsic, relative, or absolute frame of reference (see Levinson, chapter 4, this volume, for discussion of the linguistic and spatial properties of these reference frames).[8] Within a relative frame of reference, scenes are most often described from the perspective of the person who is signing. In this case, the origin of the coordinate system is the viewpoint of the signer. For example, eight ASL signers were asked to describe the picture shown in figure 5.7. All but one indicated that the bowl was on their left with the banana on their right (one signer provided a description of the scene without using signing space in a topographic way, producing the neutral phrase ON S-I-D-E instead). To indicate that the banana was on their right, signers produced the classifier form for bowl on the left side of signing space, and then a classifier form for banana was simultaneously articulated on the right.

Descriptions from the addressee's viewpoint[9] turn out to be more likely in the front-back dimension than in the left-right dimension (the signer's perspective is still the most likely for both dimensions). In describing the picture shown in figure 5.8, five of eight signers preferred their own viewpoint and produced the classifier for banana near the chest with the classifier for bowl articulated away from the chest

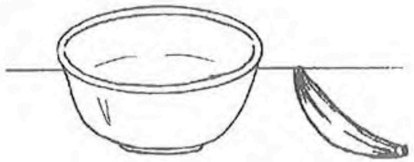
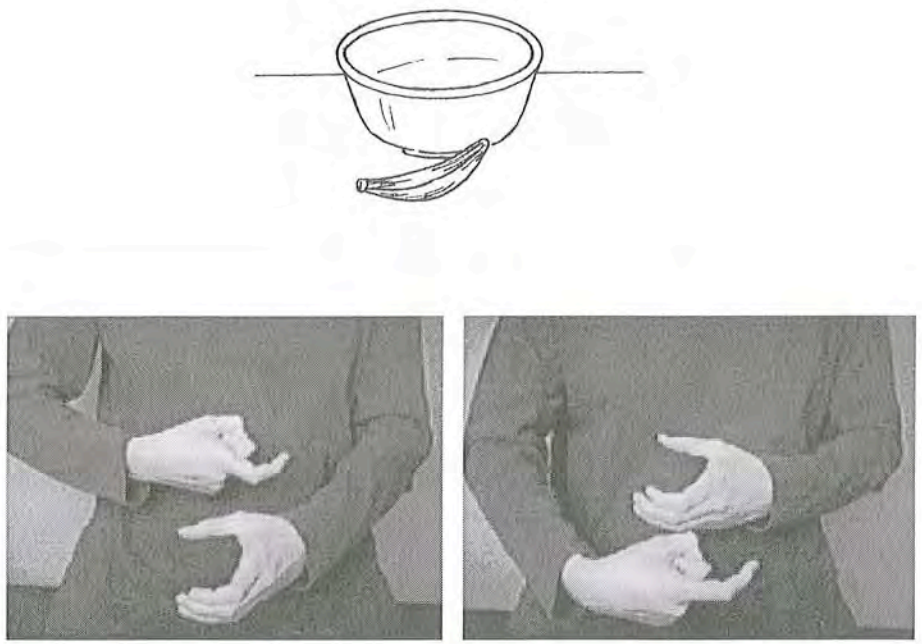


Figure 5.7
Illustration of one of the pictures that signers were asked to describe.



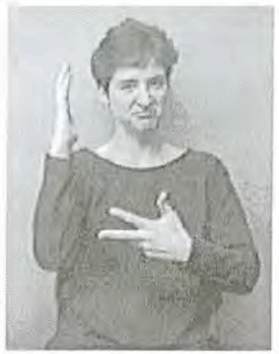
a. Signer's viewpoint (5/8 signers).

b. Addressee's viewpoint (3/8 signers).

Figure 5.8

behind the classifier for banana, as shown in figure 5.8a. This spatial configuration of classifier signs maps directly onto the view presented in figure 5.8 (remember that you as the reader are facing both the signer and the picture). In contrast, three signers described the picture from the addressee's viewpoint, producing the classifier for bowl near the chest and the classifier for banana in line with the bowl but further out in signing space, as shown in figure 5.8b. This configuration would be the spatial arrangement seen by an addressee standing opposite the signer (as you the reader are doing when viewing these figures). There were no overt linguistic cues that indicated which point of view the signer was adopting. However, signers were very consistent in what point of view they adopted. For example, when the signers were shown the reverse of figure 5.8, in which the banana is behind the bowl, all signers reversed their descriptions according to the viewpoint they had selected previously. Note that the lack of an overt marker of point of view, the potential ambiguity, and the consistency within an adopted point of view also occur in English and other spoken languages (see Levelt 1984).

Bananas and bowls do not have intrinsic front/back features, and thus signers could not use an intrinsic frame of reference to describe these pictures. In contrast, cars do have these intrinsic properties, and the classifier form for vehicles encodes intrinsic features: the front of the car is represented roughly by the tips of the index and middle fingers, which are extended. Figures 5.9 and 5.10 illustrate ASL constructions using the vehicle classifier, along with the corresponding pictures of a car in different locations with respect to a tree. Again the majority of signers expressed their own view of the picture. In figures 5.9 and 5.10, the pictured female signer adopts her own perspective (describing the picture as she sees it), while the male signer adopts the addressee's viewpoint. As noted above, lexical signs identifying the referents of the classifier signs are given first. Also as noted, the ground object (the tree) is expressed first and generally held in space while the lexical sign for car is articulated and the vehicle classifier is placed with respect to the classifier for tree. The illustrations in figures 5.9 and 5.10 represent the final classifier construction in the description. As you can see, signers orient the vehicle classifier to indicate the direction the car is facing. Note that the orientation of the car is consistent with the point of view adopted—the vehicle classifier is always oriented toward the tree.[10] The majority of signers described figure 5.9 by placing the vehicle classifier to their left in signing space. Only one signer placed the car on his right and the tree on his left. Again all signers were very consistent in which point of view they adopted, although one signer switched from her own viewpoint in describing figure 5.9 to the addressee's viewpoint for figure 5.10. There were no switches in viewpoint within either the left-right or front-back dimension. Signers were also consistent within the intrinsic frame of



a. Signer's viewpoint (6/7 signers).

b. Addressee's viewpoint (1/7 signers).

a. Signer's viewpoint (5/7 signers).

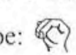
b. Addressee's viewpoint (2/7 signers).

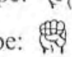
Figures 5.9 and 5.10

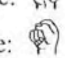
reference, almost always changing the orientation of the vehicle classifier appropriately (e.g., toward the left/right or away from/facing the signer).[11]

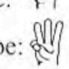
One question of interest is whether signers can escape the relative point of view that is imposed "automatically" by the fact that signers (and addressees) view their own articulators in space and these articulators express locative relations using this space. The answer appears to be that a relative framework is not necessarily entailed in locative expressions in ASL. That is, the expressions shown in figure 5.9a and 5.9b could be interpreted as the rough equivalent of "the tree is in front of the car" without reference to the signer's (or addressee's) viewpoint. The car could actually be in any left-right or front-back relation with respect to the signer—what is critical to the intrinsic expression is that the vehicle classifier is oriented toward (facing) the tree. Thus the intrinsic frame of reference is not dependent upon the relative frame; in ASL these two frames of reference can be expressed simultaneously. That is, linguistic expression within an intrinsic frame occurs via the intrinsic properties of certain classifier forms, and a relative frame can be imposed simultaneously on signing space if a viewpoint is adopted by the signer. Figures 5.9 and 5.10 illustrate such simultaneous expression of reference frames. The linguistic and nonlinguistic factors that influence choice of viewpoint within a relative reference frame have not been determined, although it is likely that several different linguistic and nonlinguistic factors are involved. And just as in English (Levelt 1982a, 1984), frame of reference ambiguities can abound in ASL; further research will determine how addressee and signer viewpoints are established, altered, and disambiguated during discourse. Preliminary evidence suggests that, like English speakers (Schober 1993), "solo" ASL signers (such as those in this study) are less explicit about spatial perspective than signers with conversation partners.

Finally, ASL signers can use an absolute reference frame by referring to the cardinal points east, west, north, and south. The signs for these directions are articulated as follows: WEST: W handshape, palm in, hand moves toward left[12]; EAST: E handshape, palm out, hand moves toward right; NORTH: N handshape, hand moves up; SOUTH: S handshape, hand moves down.

N handshape: 

E handshape: 

S handshape: 

W handshape: 

These signs are articulated in this manner, regardless of where the person is standing, that is, regardless of true west or north. This situation contrasts sharply with how speakers gesture in cultures which employ absolute systems of reference such as certain Aboriginal cultures in Australia (see Levinson 1992b and chapter 4, this volume). In these cultures, directional gestures are articulated toward cardinal points and vary depending upon where the speaker is oriented.

Although the direction of the citation forms of ASL cardinal signs is fixed, the movement of these signs can be changed to label directions within a "map" created in signing space. For example, the following directions were elicited from two signers describing the layout of a town shown on a map (from Taylor and Tversky 1992):

(4) YOU DRIVE	STRAIGHT	EAST
	right hand traces a path outward from the signer	"e" handshape traces the same path, palm to left

"You drive straight eastward."

(5) UNDERSTAND MOUNTAIN R-D	PATH	NORTH
	right hand traces path toward left, near signer	"n" hand shape traces same path, palm in

"Understand that Mountain Road goes north in this direction."

The signer who uttered (5) then shifted the map, such that north was centered outward from the signer, and the sign NORTH[13] then traced a path similar to the one in (4), that is, centered and outward from the signer. It appears that ASL direction signs are either fixed with respect to the body in their citation form or they are used relative to the space mapped out in front of the signer. As in English, it is the direction words themselves that pick out an absolute framework within which the discourse must be interpreted.

5.1.6 Narrative Perspective

In a narrative, a spatial frame of reference can be associated with a particular character (see discussions of viewpoint in Franklin, Tversky, and Coon 1992; and Tversky, chapter 12, this volume). The frame of reference is relative, and the origin of the coordinate system is the viewpoint of that character in the story. The linguistic mechanisms used to express point of view in signed languages appear to be more explicit than in spoken languages. Both signers and speakers use linguistic devices to indicate whether utterances should be understood as expressing the point of view of the signer/speaker or of another person. Within narrative, "point of view" can mean either a visual perspective or the nonspatial perspective of a character, namely, that character's thoughts, words, or feelings. Spoken languages have several different

devices for expressing either type of perspective: pronominal deixis (e.g., use of *I* vs. *you*), demonstratives (*here*, *there*), syntactic structure (active vs. passive), and literary styles (e.g., "free indirect" discourse). Signed languages use these mechanisms as well, but in addition, point of view (in either sense) can be marked overtly (and often continuously) by a "referential shift." Referential shift is expressed by a slight shift in body position and/or changes in eye gaze, head position, or facial expression (for discussions of this complex phenomenon, see Loew 1983; Engberg-Pedersen 1993; Padden 1986; Lillo-Martin 1995; Poulin and Miller 1995).

The following is an example of a referential shift that would require overt marking of a spatial viewpoint. Suppose a signer were telling a story in which a boy and a girl were facing each other, and to the left of the boy was a tall tree. If the signer wanted to indicate that the boy looked up at the tree, he or she could signal a referential shift, indicating that the following sentence(s) should be understood from the perspective of the boy. To do this, the signer would produce the sign LOOK-AT upward and to the left. If the signer then wanted to shift to the perspective of the girl, he or she would produce the sign LOOK-AT and direct it upward and to the *right*. Signers often express not only a character's attitudinal perspective, but also that character's spatial viewpoint through signs marked for location and/or deixis. Slobin and Hoiting (1994, p. 14) have noted that "directional deixis plays a key role in signed languages, in that a path verb moves not only with respect to source and goal, but also with respect to sender and receiver, as well as with respect to points that may be established in signing space to indicate the locations and viewpoints of protagonists set up in the discourse." That spoken languages express deixis and path through separate elements (either through two verbs or through a satellite expression and a verb) reflects, they suggest, an inherent limitation of spoken languages. That is, spoken language must linearize deictic and path information, rather than express this information simultaneously, as is easily done in signed languages. Deixis is easily expressed in signed languages because words are articulated in the space surrounding the signer, such that "toward" and "away from" can be encoded simply by the direction of motion with respect to the signer or a referential locus in space. I would further hypothesize that this simultaneous expression of deictic and other locative information within the verbs of signed languages may lead to habitual expression of spatial viewpoint within discourse.

In sum, signed languages use space in several different linguistic domains, including phonological contrast, coreference, and locatives. The visual-gestural modality of signed languages appears to influence the nature of grammatical encoding by compelling signed languages to prefer nonconcatenative morphological processes (see also Emmorey 1995; Supalla 1991; Gee and Goodhart 1988). Signed languages offer important insight into how different frames of reference are specified linguistically. A unique aspect of the visual-gestural modality may be that intrinsic and relative reference frames can be simultaneously adopted. In addition, shifts in reference are often accompanied by shifts in visual perspective that must be overtly marked on deictic and locative verbs. Although spoken languages also have mechanisms to express deictic and locative relations, what is unique about signed languages is that such relations are directly encoded in space.

5.2 Some Ramifications of the Direct Representation of Space

In the studies reported below, I explore some possible ramifications of the spatial encoding of locative and spatial contrasts for producing spatial descriptions and solving spatial problems. Specifically, I investigate (1) how ASL signers use space to express spatial commands and directions, (2) to what extent signers use lexicalized locatives in spatial directions, (3) whether the use of sign language provides an advantage for certain spatial tasks, and (4) how differences in linguistic encoding between English and ASL affect the nature of spatial commands and directions.

5.2.1 Solving Spatial Puzzles with Spatialized Language

To investigate these questions, ten hearing English speakers and ten deaf ASL native signers were compared using a task in which they had to solve three spatial puzzles by instructing an experimenter[14] where to place blocks of different colors, shapes, and sizes onto a puzzle grid (see figure 5.11). To solve the problem, all blocks must fit within the puzzle outline. The data from English speakers were collected by Mark St. John (1992), and a similar but not identical protocol was used with ASL signers.

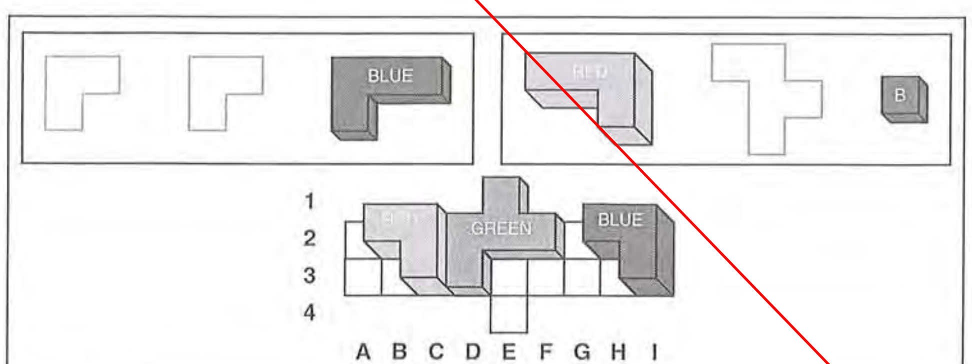


Figure 5.11
Solving a spatial puzzle: Subjects describe how to place blocks on a puzzle grid.

English speakers were instructed to sit on their hands and were not permitted to point to the puzzle or to the pieces. Of course, ASL signers could use their hands, but they were also not permitted to point to the pieces or puzzle. For both signers and speakers, the subject and experimenter sat side by side, such that each had the same visual perspective on the puzzle board.

To explore how speakers and signers use spatial language—encoded in either space or sound—we examined different types of English and ASL instructions. We hypothesized that ASL signers may be able to use signing space as a rough Cartesian coordinate system, and therefore would rely less on the coordinates labeled on the puzzle board. This prediction was confirmed: 67% of the English speakers' commands referred to the puzzle grid, whereas only 28% of the commands given by ASL signers referred to the puzzle coordinates. This difference in grid reference was statistically reliable ($F(1,18) = 9.65$; $p < .01$). The following are sample commands containing references to the puzzle grid given by English speakers:

(6) Take the blue L piece and put it on H1 H2 G2.

(7) Place the red block in 3G H 2G.

(8) Green piece on E1, E2, D2, C2, and D3.

Instead of referring to grid coordinates, ASL signers used space in various ways to indicate the positions on the puzzle board—for example, by tracing a distinctive part of the board in space or by holding the nondominant hand in space, representing a part of the puzzle board (often an edge).

We also compared how signers and speakers identified the puzzle pieces to be placed for a given command (see figure 5.12a). There were no significant differences in how either ASL or English was used to label a particular block. We had hypothesized that signers might make more references to shape because shape is often encoded in classifier handshapes (see discussion above). However, the numerical difference seen in figure 5.12a was not statistically significant. Language did not appear to influence how subjects labeled the puzzle pieces within this task.

There were significant differences, however, in the types of commands used by ASL signers and English speakers (see figure 5.12b). Puzzle commands could be exhaustively divided into three categories: (1) commands referring to a *position* on the puzzle board, (2) commands expressing a *relation* between two pieces, and (3) the *orientation* of a single piece. These categories were able to account for all of the commands given by the twenty subjects. The only difference was that in ASL, two command types could be expressed simultaneously. For example, signers could simultaneously describe the orientation of a piece (through the orientation of a classifier handshape) and that piece's relation to another block through two-handed that underlie the mapping between a linguistic signal (both signed and spoken) and an amodal spatial representation. These are only some of the areas in which the study of sign language could enhance our understanding of the relation between language and space.

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Notes

1. Words in capital letters represent English glosses for ASL signs. The gloss represents the meaning of the unmarked, unmodulated root form of a sign. A subscripted word following a sign gloss indicates that the sign is made with some regular change in form associated with a systematic change in meaning, and thus indicates grammatical morphology in ASL (e.g., $\text{GIVE}_{\textbf{habitual}}$). Multiword glosses connected by hyphens are used when more than one English word is required to translate a single sign (e.g., LOOK-AT). Subscripts are used to indicate spatial loci; nouns, pronouns, and agreeing verbs are marked with a subscript to indicate the loci at which they are signed (e.g. INDEX_a, BITE_b). Classifier forms are abbreviated CL, followed by the handshape of the classifier and a description of the meaning in italics (CL:G—*shape*). Descriptions of how a classifier sign is articulated may be given underneath the gloss. English translations are provided in quotes.

2. Some signs such as personal pronouns may not be specified in the lexicon for location (see Lillo-Martin and Klima 1990; Liddell 1994).

3. Other terms that have been used for these verbs are *indicating* (Liddell 1995) and *inflecting* (Padden 1988).

4. Whether subject is associated with the beginning or end of the verb's movement depends upon the class of verb (cf. "backwards" verbs, Padden 1988; Brentari 1988).

5. Following traditional linguistic typography, a question mark (?) indicates that a sentence is considered marginal; a star (*) indicates that the sentence is unacceptable.

6. In this study, native signers were deaf individuals who were exposed to ASL from birth.

7. The example of drawing was suggested to me by Dan Slobin, who has made similar arguments about scene setting and the effect of modality on signed languages (Slobin and Hoiting 1994).

8. Sign linguists often use "frame of reference" in a nonspatial sense, referring to anaphoric reference in a discourse (see especially Engberg-Pedersen 1993).

9. The addressee is assumed to be facing the signer. Signers described these pictures to a video camera rather than to an actual addressee. In understanding this discussion of point of view in ASL, it might be useful for you the reader to imagine that you and the signer viewed the display from the same vantage point, and now the signer is facing you (the addressee) to describe it.

10. It should be noted that occasionally a signer may ignore the orientation features of the vehicle classifier, say, pointing the vehicle classifier toward the tree classifier, when in actual fact the car is facing away from the tree. This may occur when it is difficult to produce the correct orientation, say, pointing the vehicle classifier to the right with the right hand, palm out (try it).

11. There were only six examples (out of thirty-five) in which a signer ignored the orientation of the car because it was awkward to articulate. Also, signers did not always alternate which hand produced the classifier for TREE, as might be implied by figures 5.9 and 5.10.

12. Except for the sign LEFT, WEST is perhaps the only sign that is specified as moving toward the signer's left rather than toward the "nondominant side." For both left- and right-handers, the sign WEST moves toward the left, and the sign EAST moves toward the right. The direction of movement is fixed with respect to the signer's left and right, unlike other signs. For example, right- and left-handers would articulate the signs illustrated in figure 5.1, which also move across the body, with opposite directions of motion (left to right vs. right to left, respectively). However, there is some change in articulation for left-handers, perhaps due to phonological constraints. For EAST and WEST, the orientation of the palm is reversed: outward for WEST and inward for EAST. This change in palm orientation also occurs when a right-handed signer articulates EAST or WEST with the left hand (switches in hand dominance are phonologically and discourse governed).

13. When the signs NORTH and SOUTH are used to label paths within a spatial map, they often retain some of their upward and downward movement.

14. This study was conducted in collaboration with Shannon Casey; the experimenter was either a native speaker of English (for the English subjects) or a deaf ASL signer (for the deaf subjects).

15. This is not an orientation command but a shape description, namely, a classifier construction in which the shape of the blue puzzle piece is traced in the vertical plane (see figure 5.13 for an example).

16. CORNER is a frozen classifier construction produced with nominal movement (Supalla and Newport 1978). The sign can be articulated at various positions in space to indicate where the corner is located (e.g., top left or bottom right).

17. This study was conducted with Marci Clothier and Stephen McCullough.

18. I thank Mary Peterson for bringing this work to my attention.

19. Poizner and Kegl (1992) also discuss this patient, but use the pseudonym initials A.S.

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