Talking about Space with Space:

Describing Environments in ASL

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Spatial discourse—talking about space—usually involves adopting a particular perspective on the scene or environment being described. For example, an addressee may be taken on a mental tour of an environment, as in this example from Linde and Labov's study of New Yorker's descriptions of their apartments: "As you open the door, you are in a small five-by-five room which is a small closet. When you get past there, you're in what we call the foyer. . . . If you keep walking in that same direction, you're confronted by two rooms in front of you . . . large living room which is about twelve by twenty on the left side. And on the right side, straight ahead of you again, is a dining room which is not too big" (1975, 929). Taylor and Tversky (1992, 1996) characterize this style of discourse as utilizing a *route perspective* in which landmarks and motion through the environment are described with respect to a viewer (usually "you" in English) using viewer-relational terms such as "left" and "right."

This type of perspective is contrasted with what Taylor and Tversky call a *survey perspective* in which the perspective is from above (a bird's-eye view); landmarks are described with respect to other landmarks, cardinal direction terms are used (e.g., north, south); and existential and stative verbs are used, rather than verbs of motion. The following is an excerpt from an apartment description from Linde and Labov that adopts

a survey perspective: "The main entrance opens into a medium-sized foyer. Leading off the foyer is an archway to the living room which is the furthermost west room in the apartment. It's connected to a large dining room through double sliding doors. The dining room also connects with the foyer and main hall through two small arches. The rest of the rooms in the apartment all lead off this main hall which runs in an east-west direction" (1975, 927).

Do users of American Sign Language (ASL) describe environments using these same discourse styles? If so, do they make the same perspective choices that English speakers do? It is possible that language modality may influence perspective choice, given the different affordances of vision versus audition. Unlike spoken languages, ASL uses physical space to describe spatial relations. That is, locations within signing space can function topographically to represent locations within a real or imagined world. What are the consequences of this system for perspective choice? Does the nature of signing space change, depending on perspective choice? We investigate these questions by studying how ASL signers describe different types of environments.

To investigate the determinants of perspective choice for English speakers, Taylor and Tversky (1996) gave subjects maps of either a large-scale environment (a town) or a small-scale environment (a convention center). They asked the subjects to memorize the maps (see figure 1) and then write a description of the environment so that someone reading the description could find all of the landmarks. Taylor and Tversky found that English speakers more often adopted a survey perspective when describing the town, and a route perspective when describing the convention center. The following are excerpts from written English descriptions:

> Survey (town): North of town are the White Mtns. and east of town is the White River, which flows south from the White Mtns. The main road by town runs in the east-west directions and crosses the White River.
> Route (convention center): You enter from the southeast corner of the building. As you come in, turn right. To your right will be the "personal computers" room. Continue until you're forced to make a left. The "stereo components" room will be in front of you as you turn left. (Taylor and Tversky 1996, 379)

Taylor and Tversky proposed that choice of perspective is partially dependent upon the characteristics of the environment, with single paths
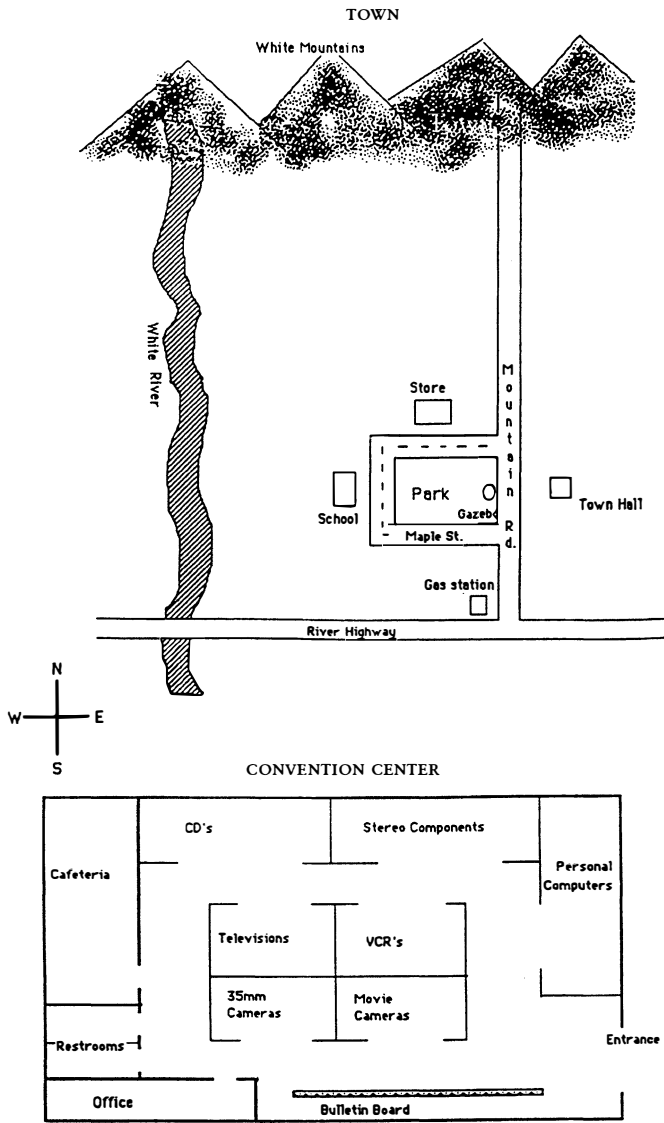
TOWN

White Mountains

White River

Mountain Rd.

Store

Park

Gazebo

School

Maple St.

Town Hall

Gas station

River Highway

N
W — E
S

CONVENTION CENTER

CD's

Stereo Components

Cafeteria

Personal
Computers

Televisions

VCR's

35mm
Cameras

Movie
Cameras

Restrooms

Entrance

Office

Bulletin Board

FIGURE 1. *Maps of the Town (top) and the Convention Center (bottom). Reprinted by permission of the publisher, from "Spatial mental models derived from survey and route descriptions," by Holly Taylor and Barbara Tversky* (Journal of Memory and Languages, *1992*) *31: 261–92.*

and size-equivalent landmarks encouraging a route rather than a survey perspective. To investigate whether ASL signers make similar perspective choices and to study the nature of these spatial descriptions in sign language, we presented ASL signers with the maps used by Taylor and Tversky and asked them to describe the environment shown on the map.

METHOD

Forty signers participated in the study (mean age = 25 years). Twenty-seven signers had deaf families and learned ASL from birth. Ten signers learned ASL prior to age seven, and three acquired ASL prior to age fourteen. Thirty-eight signers were deaf at birth or became deaf before one year of age, and two signers became deaf at or before age three. Signers participated in the study at Gallaudet University, the Salk Institute, California State University at Northridge, or at Deaf Community Services in San Diego.

Half of the subjects were given the map of the town, and half were given the map of the convention center (see figure 1). They were asked to study the map until they had memorized it. Signers were told to describe the environment so that if someone unfamiliar with the area were shown the videotape of their description, they would know what the environment (town or convention center) looked like and where all the landmarks were. The instructions were given in ASL by a Deaf native signer.

RESULTS AND ANALYSIS

We first examine the determinants of perspective choice for ASL signers compared to English speakers. We then compare spatial language in English and ASL, focusing on lexical spatial terms. Finally, we propose that ASL signers utilize one of two different spatial formats, depending on whether a route or a survey perspective is chosen.

Perspective Choice

Each description was judged as adopting either a route perspective, a survey perspective, or a mixed perspective. Two Deaf native signers were asked to decide if the description felt more like a "tour," a bird's-eye view description, or a mixture of both. They were also given examples of writ-

ten English route and survey descriptions from Taylor and Tversky (1996). The ASL coders agreed on 88 percent of judgments; the English coders in the Taylor and Tversky study initially agreed on 83 percent of judgments. When disagreements occurred, the signers discussed the description and came to an agreement. The results are shown in table 1. The English data are from Taylor and Tversky (1996).

The results indicate that the perspectives adopted by ASL signers when describing these environments differed from those of English subjects.ᵉ ASL signers were significantly more likely to adopt a survey perspective when describing the convention center, whereas English subjects preferred a route perspective ($X^2 = 10.72, p < .01$). For the town, English and ASL subjects did not differ significantly in perspective choice (both preferring survey perspectives).

Why do ASL signers prefer to provide descriptions using a survey perspective? One possibility is that signers prefer survey perspectives in general, perhaps because signing space can be used so effectively to represent a map. That is, subjects can locate landmarks on a horizontal plane in signing space in a manner that is isomorphic to the locations of landmarks on a map (in fact, this is how signing space is utilized for survey perspectives). Another possibility is that ASL signers, but not English speakers, were strongly influenced by the nature of the task. The fact that signers studied a map may have influenced how they structured signing space within their description. A mental representation of the map may be more easily expressed using a horizontal plane in signing space with a fixed "bird's-eye view" vantage point, and this type of spatial format is more compatible with a survey perspective. English speakers were apparently not subject to such linguistic preferences.

However, ASL signers appear to choose either route or mixed descriptions when describing environments that they have actually experienced. In a pilot study, we asked eight ASL signers to describe their houses and five ASL signers to describe the locations of the dormitories on the Gallaudet campus. Only one person produced a description with a survey perspective. Thus, the difference between English speakers and ASL signers does not appear to be due to a general preference for ASL signers to adopt a survey perspective.

1. Evidence from spoken English descriptions collected by Taylor and Tversky indicates that the difference in the pattern of perspective choice still holds when English descriptions are spoken rather than written.

TABLE I. *Perspective Choice by ASL Signers and English Speakers*

	Route	Mixed	Survey	Total Number of Participants
Convention Center				
English	10	10	3	23
ASL	3	5	12	20
Town				
English	2	10	10	22
ASL	7	4	9	20

Given that ASL signers and English speakers differ in perspective choice for the same environment, Taylor and Tversky's (1996) claim that the nature of the environment determines perspective choice must be qualified. The nature of the linguistic system may also influence which spatial perspective is chosen.

Comparing ASL and English Language Use

It is possible that the differences between ASL and English regarding perspective choice are due to differences in linguistic judgment criteria used by the ASL judges and by Taylor and Tversky. To determine whether similar language was used by ASL and English subjects, we examined the use of motion verbs and spatial terms. Although ASL signers tended to rely on classifier constructions and the topographic use of signing space in their environment descriptions, signers did produce some lexical spatial terms. We compare the use of these terms with their English counterparts.

Taylor and Tversky found that English route descriptions contained significantly more "active" verbs (primarily motion verbs) and more terms that related a landmark to the viewer (e.g., *left/right*); whereas English survey descriptions contained more "stative" verbs (i.e., existential verbs) and more relational terms that related a landmark to the environment (e.g., *north, south*). Because stative verbs such as the copula (forms of *to be*) or verbs like *stand* or *lie* are rarely (if ever) used to express locative relations in ASL, we did not attempt to count these verb forms in ASL.

MOTION VERBS

ASL expresses motion with both classifier predicates and lexical verbs such as DRIVE, PASS, or WALK. We counted the occurrence of these verb types for each ASL description. Following the English pattern, ASL route descriptions contained significantly more motion verbs than survey de-

scriptions ($t(30) = 4.4$, $p < .01$). The mean number of motion verbs for each discourse category is shown in table 2.

The most frequent motion verbs were DRIVE, VEHICLE-MOVE (using the ASL vehicle classifier), PASS, CROSS (as in "cross over the river"), and TURN-LEFT/RIGHT.[2] These verbs were most often used in route descriptions of the town. Motion verbs were rarely found in survey descriptions, but the verb ENTER was frequently used at the beginning of both route and survey descriptions of the convention center. The classifier predicate WALK (using either the 1 handshape or V handshape) was occasionally used in a mixed or route description of the convention center.

USAGE OF THE LEXICAL RELATIONAL TERMS
LEFT/RIGHT

Signers providing route descriptions of environments were significantly more likely to use the ASL signs LEFT/RIGHT (or LEFT-TURN/RIGHT-TURN) than signers producing survey descriptions ($t(30) = 4.01$, $p < .01$). The use of these terms was rare, however, even within route descriptions (see table 2). On average, ASL signers only used one lexical relational term per description ($x = 1.25$, s.d. $= 3.35$).[3] In contrast, English speakers used an average of 7.5 lexical relational terms per description (derived from table 3 in Tversky and Taylor 1996).

The citation forms of LEFT and RIGHT are shown in figure 2. The sign LEFT is unusual in that is articulated by the left hand when produced in isolation as a citation form. This may be the only sign in which handedness is specified within the lexicon. Within a discourse, the signs LEFT and RIGHT can be articulated with respect to distinct locations in the plane of signing space to indicate left or right from a particular vantage point. For example, some signers described the Maple Street "loop" of the town with a lexical relational term, but they articulated the sign with respect to a "loop" in signing space on their left side (matching the left-side location of the loop on the map (see figure 1a). Figure 3 illustrates such an example.[4] The sign RIGHT-TURN is actually articulated on the left side of

2. Underlining indicates an initialized sign.

3. Both native and near-native signers used these lexical spatial terms. None of the three late signers did.

4. Where possible, sign illustrations were taken directly from the subject's videotape (figures 3, 5a, 7, 8, 9, 10). In other cases, a model signer reproduced the subject's description for illustration (figures 5b, 6).

TABLE 2. *Mean Number of ASL Motion Verbs and Relational Terms per Discourse Type*

	Route (N = 10)	Mixed (N = 8)	Survey (N = 22)
Motion verbs	9.1 (8.0)[a]	3.8 (2.8)	1.5 (1.2)[b]
LEFT/RIGHT signs	3.7 (4.2)	1.3 (1.6)	0.14 (0.35)
NORTH, SOUTH, EAST, WEST signs	1.2 (2.1)	0.75 (1.4)	1.0 (1.8)

[a] Standard deviations are given in parentheses.
[b] Significant difference between Route and Survey descriptions ($p < .01$).

signing space, and the movement is outward from the body, rather than toward the right (compare figure 2 with figure 3). Thus, the motion direction of lexical relational signs is not necessarily specified with respect to the signer's own left and right. Rather, the movement of the sign can specify a left or right direction from a particular vantage point indicated within the plane of signing space (in this case, the first corner of Maple Street). Such spatial manipulations of relational terms appear to be only possible when signing space performs a "diagrammatic" function and is not "viewer-centered" (see below).
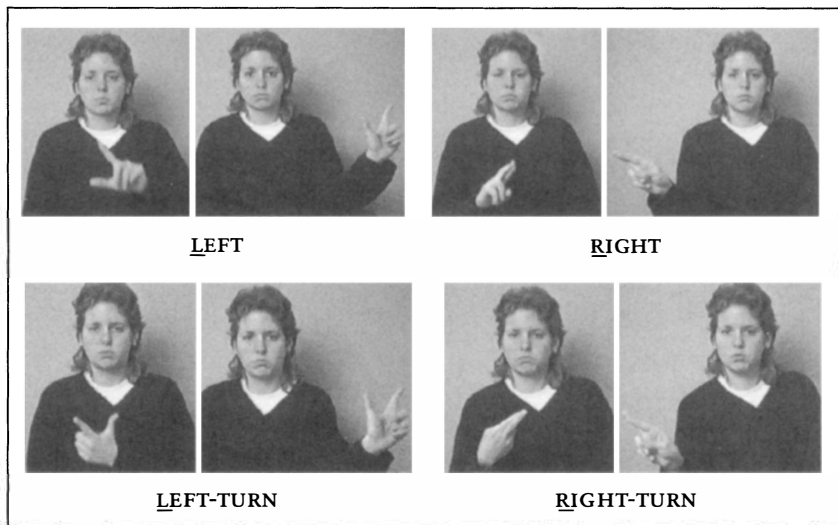

FIGURE 2. *Illustration of Citation Forms for Lexical Viewer-Relational Terms. For paired pictures, the picture on the left shows the beginning of the sign, and the picture on the right shows the end of the sign.*
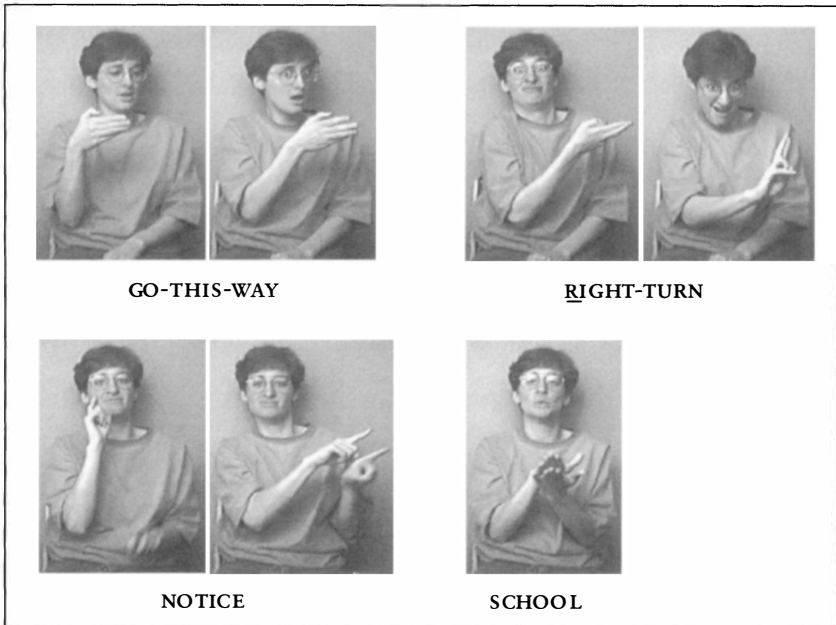
FIGURE 3. *Illustration of a Lexical Relational Term Articulated in Diagrammatic Space. English translation: "If you go this way and turn right, you will see a school . . . "*

USAGE OF NORTH, SOUTH, EAST, WEST

Unlike their usage in English, ASL cardinal directions did not differ for survey and route descriptions, but this may be due to a floor effect, because signers produced so few cardinal direction signs. The citation forms are shown in figure 4. Like the relational signs in citation form, the cardinal direction signs appear to be specified in the lexicon with respect to the left-right body axis. For example, the sign WEST is specified as moving toward the 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 whose direction of motion changes depending upon the handedness of the signer.

As with the relational signs, signers can alter the direction of motion of cardinal direction signs to indicate direction with respect to locations mapped out in signing space. Figure 5 provides two examples. In both, the signers are describing the town. In example A, the signer is describing driving east on River Highway, and she produces the sign EAST away from

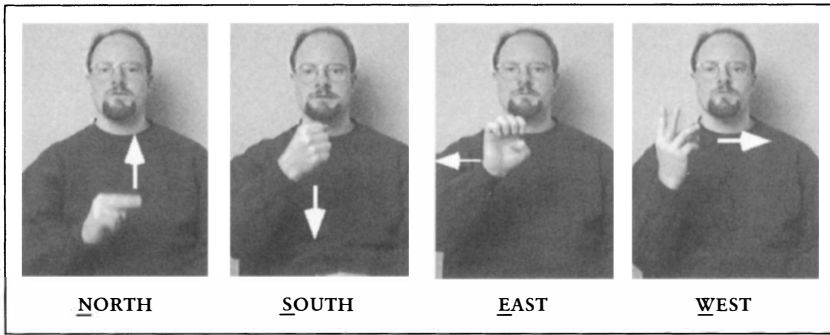|			
NORTH	SOUTH	EAST	WEST

FIGURE 4. *Illustration of the Citation Forms of Cardinal Direction Signs.*

her body indicating the direction of the road as it stretches in front of her. In example B, the signer is using space to map locations in the town on a horizontal plane. As in example A, the signer has "shifted" the orientation of the actual map (shown in figure 1a) with respect to signing space so that River Highway is described as a path traced outward and away from the signer (not shown in figure 5b). After describing the corner gas station, the signer traces the path of Mountain Road horizontally in signing space, and then articulates the sign NORTH along the same path (see figure 5b).

Summary

Our analysis indicates that adopting a survey or route perspective when describing an environment leads to similar linguistic choices for ASL signers and English speakers. That is, for descriptions with a route perspective, both English speakers and ASL signers produce more motion verbs and more viewer-relational terms (e.g., *left* or *right*), compared to descriptions with a survey perspective. Thus, the *lexical* encoding of spatial perspective within a discourse is similar for both ASL and English. ASL signers can, however, "spatialize" relational terms by producing them at locations within signing space that represent positions in the environment being described (rather than positions relative to the signer herself). Furthermore, lexical encoding does not appear to be the primary mechanism for expressing spatial perspective (as attested by the relative rarity of these terms). Rather, signers structure signing space in various ways to convey a route or a survey perspective. We next examine this aspect of spatial language that is unique to signed languages.
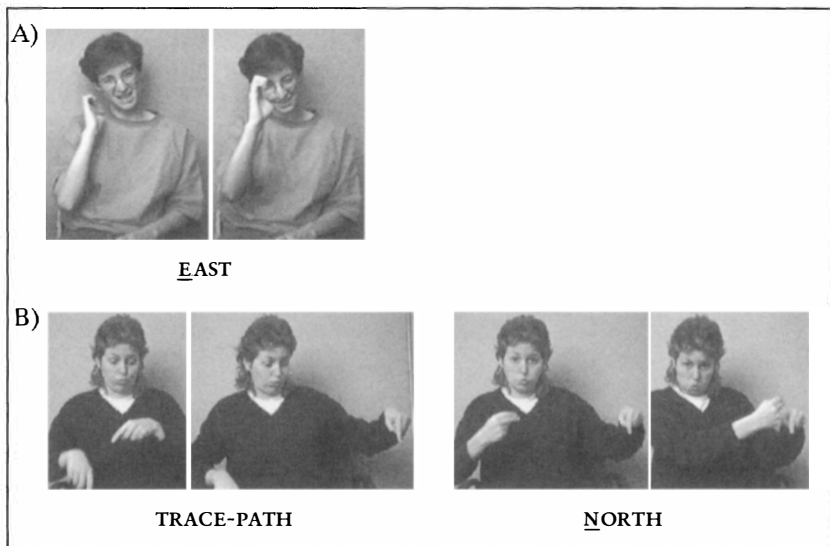
FIGURE 5. *Illustration of Cardinal Directional Terms in (A) Viewer Space and (B) Diagrammatic Space. English translation (A): "Go east." English translation (B): "(Mountain Road) stretches north along here."*

PERSPECTIVE TYPE AND SPATIAL FORMAT

We use the term *spatial format* to mean the topographic structure of signing space used to express locations and spatial relations between objects. When a survey perspective was adopted, signers most often used a type of spatial format within signing space that we have termed *diagrammatic space*: 91 percent of landmarks within survey descriptions were located using diagrammatic space. When a route perspective was adopted, signers most often used a format that we have termed *viewer space*: 88 percent of landmarks within route descriptions were located using this format. Our analysis of the data revealed a number of properties associated with each spatial format, as shown in table 3.

Diagrammatic space is somewhat analogous to Liddell's (1994, 1995) notion of *token space* and to Schick's (1990) *model space*. Model space is characterized as "an abstract, model scale in which all objects are construed as miniatures of their actual referents" (Schick 1990, 32). Liddell (1995, 33) describes tokens as "conceptual entities given a manifestation in physical space," and states that "the space tokens inhabit is limited to the size of physical space ahead of the signer in which the hands may be located while signing." Diagrammatic space is also so limited, and under

TABLE 3. *Characteristics of Diagrammatic and Viewer Space*

Diagrammatic Space	Viewer Space
Signing space represents a map-like model of the environment	Signing space reflects an individual's view of the environment at a particular point in time and space
Space can have either a 2-D "map" format or a 3-D "model" format	Signing space is 3-D (normal-sized scale)
The vantage point does not change (generally a bird's-eye view)	Vantage point can change (except for "gaze-tour" descriptions)
Relatively low horizontal signing space or a vertical plane	Relatively high horizontal signing space

Liddell's analysis, signers could conceptualize tokens as representing objects and landmarks within a description of an environment. However, tokens are hypothesized to be three-dimensional entities, and our data contain some examples in which the spatial format is two-dimensional, representing a map with points and lines. For example, one signer used the vertical plane to trace a square representing the Maple Street loop, and the school, park, and store were located with points (see figure 6). This two-dimensional example contrasts with a similar three-dimensional example in which the signer uses the horizontal plane to trace the outline of the corridor in the convention center (see figure 7). At the beginning of this excerpt, the signer indicated that the plane in signing space was conceptualized as three dimensional by using B-handshape classifiers to specify the box-shape of the center group of rooms. The pointing signs then used by this signer indicated the locations of the entrances of four center rooms, rather than the location of the rooms themselves.

When a signer uses diagrammatic space within a stretch of discourse, the vantage point is fixed and represents a "bird's-eye view" of the horizontal signing space. For example, figure 8 shows the pointing signs used by one subject to indicate the locations of the outer rooms of the convention center. The locations within signing space map isomorphically to the locations of the rooms on the convention center map (figure 1b). This particular signer is unusual because she did not rotate the map. That is, most signers (80 percent) "shifted" the map so that the entrance was located at the chest and the bulletin board extended outward on the left of signing space. This pattern may reflect a convention for spatial descriptions of buildings (and rooms) in ASL: position a main entrance at the front of the body.
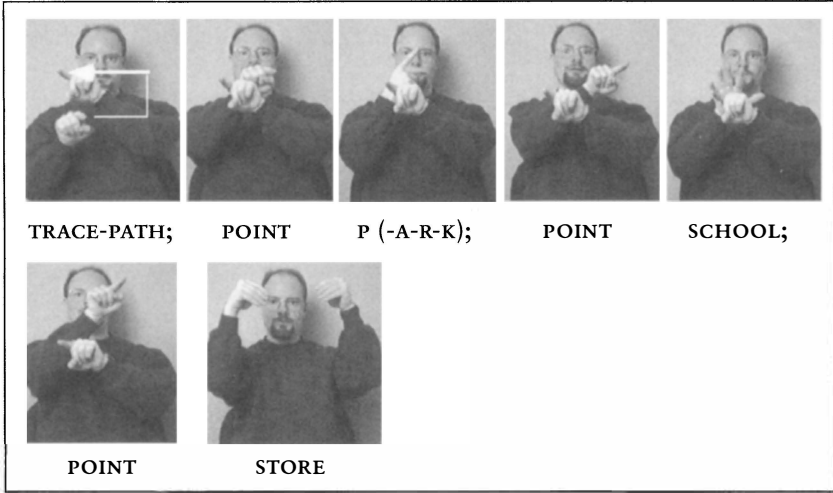
FIGURE 6. *Illustration of the Use of the Vertical Plane in Signing Space. English translation: "(The street) is like this. Here's a park; here's a school; and here's a store."*
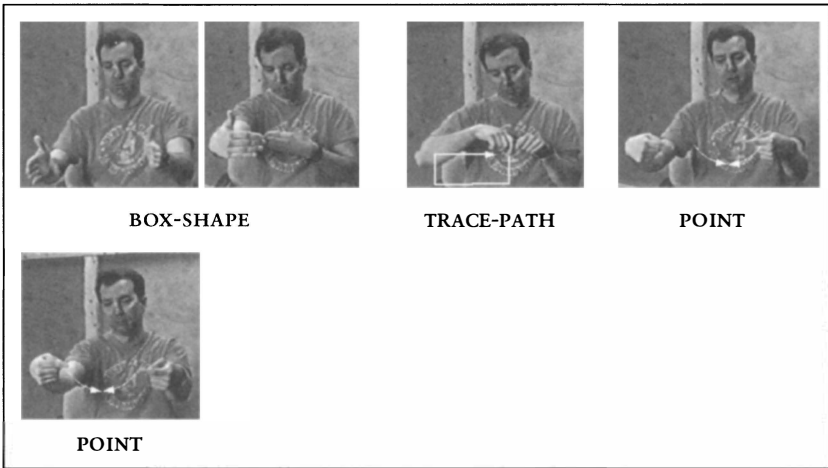

FIGURE 7. *Illustration of the Use of Horizontal Signing Space. English translation: "(The central rooms) form a box. (The corridor) is like this. (The room entrances) are here and here."*

Viewer space is similar to *surrogate space* described by Liddell (1994, 1995) and *real-world space* described by Schick (1990). We argue against the term real-world space because it implies the actual physical space surrounding the signer, rather than indicating a larger scale, as intended by Schick. It is important to distinguish between real space and
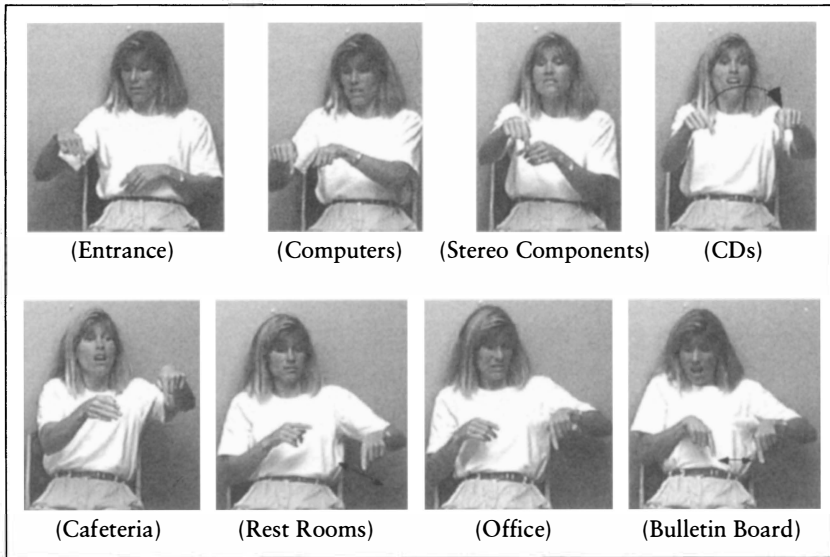
FIGURE 8. *Illustration of Pointing Signs Used in a Survey Description of the Outer Rooms of the Convention Center. The rooms associated with the pointing signs are given in parentheses. The intervening lexical signs are not shown, and the lexical and pointing signs for the inner rooms are also omitted.*

viewer space because in the first case the signer actually sees the environment being described, and in the second, the environment is conceptualized as present and observable. According to Liddell (1994), surrogates are characterized as invisible, normal-sized entities with body features (head to toe), and they are conceptualized as in the environment. When signers adopt a route perspective to describe an environment, the signer describes the environment as if he or she were actually moving through it. Under Liddell's analysis, the surrogate within this type of description coincides with the signer's body (i.e., it occupies the same physical space as the signer's body). We adopt the term viewer space rather than surrogate space because it is the environment, rather than a surrogate, which is conceptualized as present. Signers describe the environment as if they were viewing the landmarks and other elements within the scene. Signers know that their addressee cannot see the environment, and therefore the description is not the same as if both discourse participants were simultaneously observing the environment. Such a description would be quite different, and signers would utilize what we term *shared space* (Emmorey, Klima, and Hickok 1998), but this discourse situation will not be discussed here.

Figure 9 illustrates a route description of the convention center and shows the pointing and classifier signs used to indicate the locations of the outer rooms. In contrast to figure 8, the locations in signing space map to what the signer would observe as she describes moving along the corridor. The vantage point is not fixed, but changes with motion through space. For example, the signer indicates that the CD room would be in front of her (as she stands next to the cafeteria), but later she indicates that the personal computer room is in front of her because she has described going around the corner (refer to the convention center map in figure 1). The spatial meaning of signing space *changes* with the description. Now compare the location of these rooms as described by the signer in figure 8; in this case, signing space represents a model of the entire convention center, and the spatial relationship among locations does not change during the description.

Note also the relatively high signing plane used in the description shown in figure 9. Lucas and Valli (1990) hypothesized that signs articulated above the chest can engage a *perspective system,* and that the height of these signs has the meaning "from signer perspective."⁵ For example, they found that when the classifier construction glossed as SURFACE-PASS-UNDER-VEHICLE is signed at eye level versus mid-chest level, it does not indicate the relative height of the surface or vehicle being described. Rather, the height indicates whether the action is being described from the signer's perspective or whether the action is being described more generally, with no reference to the signer.⁵ Our data support and elaborate the findings of Lucas and Valli (1990). When signers described environments as if they were moving through them, they articulated signs at a relatively high plane, thus indicating that the description reflected their own imagined view of the environment. For example, classifier constructions describing the location and contours of the town's White Mountains (e.g., a 5 handshape with fingers wiggling) were articulated at or above the forehead for route descriptions, but at the high-chest level for survey descriptions using the horizontal plane (the high-chest region contrasted with the mid- to low-chest region used to describe street locations in a three-dimensional spatial model).

5. Lucas and Valli (1990) note that the perspective is not necessarily that of the actual signer; rather, the signer may have signaled a referential shift (e.g., by a change in eye gaze), and the perspective is that of the character associated with the shift.
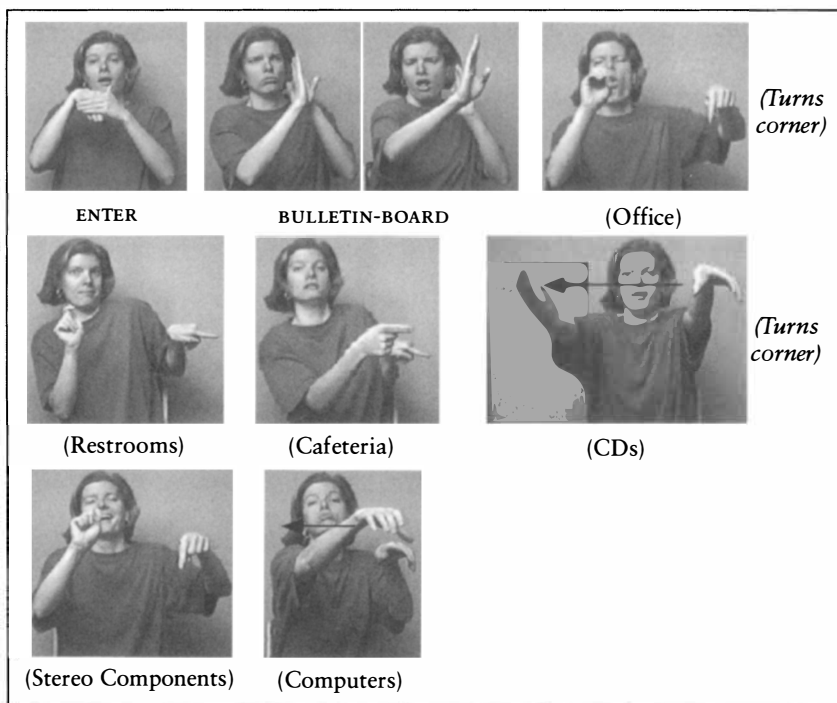
FIGURE 9. *Illustration of Pointing and Other Signs Used in a Route Description of the Outer Rooms of the Convention Center. The rooms associated with the pointing signs are given in parentheses. The intervening lexical signs for the rooms are not shown, and the lexical and pointing signs for the inner rooms are also omitted.*

Shifting between Spatial Formats

The majority of descriptions with a survey perspective (62 percent) used a single spatial format: diagrammatic space. However, descriptions with either a route or a mixed perspective tended to shift at least once between diagrammatic space and viewer space: 80 and 89 percent of descriptions, respectively, contained at least one change of spatial format. Two route descriptions did not contain any spatial format changes, and both used viewer space, as would be expected. One signer produced a description with a mixed perspective that only used diagrammatic space. This description was judged as a mixed rather than as a pure survey perspective because the signer described part of the environment (the entire Maple Street loop) using LEFT-RIGHT relational terms articulated within diagrammatic space. That is, the signs were articulated with respect to a three-dimensional model within signing space, rather than with respect to

the signer's own left and right (see figure 3 for an example). For route descriptions, signers often briefly summarized the boundaries of the town (or the corridor of the convention center) using diagrammatic space, while most of the route descriptions used viewer space to locate landmarks.

Signers did not appear to use explicit markers for shifting between diagrammatic and viewer space. For example, a break or change in eye gaze did not signal a shift in spatial format. In general, for both types of spatial format, signers maintained eye contact while identifying a landmark using a lexical or fingerspelled sign; then, their eye gaze shifted to the hands, as they described the location of landmarks using pointing signs or classifier constructions. Signers can shift very rapidly between these two spatial formats (even within the same sentence) with no overt cues to the shift. Similarly, English speakers do not overtly mark a shift from a route to survey description, for example, "Go left at the gas station, and then north to the White Mountains." For ASL, the lexical signs LEFT/RIGHT or the cardinal direction signs do not necessarily specify the use of a particular spatial format. Relational signs like LEFT or RIGHT can be used with either viewer space (as exemplified by the citation forms in figure 2) or with diagrammatic space (as shown in figure 3). Similarly, the cardinal direction signs can be used with either viewer space, as shown in figure 5a (note the higher plane used for the sign EAST), or with diagrammatic space, as shown in figure 5b.

Gaze Tours

A gaze-tour description does not describe movement through space; rather, the environment is described from a fixed vantage point from which a signer or speaker views the environment (see Ehrich and Koster 1983). For example, English speakers may provide a gaze-tour description of a doll house by adopting a fixed point of view from the outside and describing the locations of furniture as "in front of" or "to the right" with respect to their outside view of the rooms, rather than as if moving through the rooms (Tversky and Taylor 1996).

For gaze tours in ASL, signers used viewer space, but with a fixed vantage point. For example, some signers began their description of the convention center by describing the location of the bulletin board and the first few rooms as if they were standing at the entrance looking down the hall. Often, but not always, these signers then switched to diagrammatic space for the remainder of the description. One signer's entire description of the

convention center was a gaze tour from the entrance, even though all of the rooms could not actually be seen from this position. In his description, the signer used a relatively high signing plane, and his pointing signs were articulated as if he were pointing to room locations from the entrance. For example, figure 10 shows the classifier sign used to locate the cafeteria with respect to his position at the entrance; this construction could be glossed as OBJECT-LOCATED-ALL-THE-WAY-AT-THE-BACK. For the town, signers occasionally gave gaze-tour descriptions of the Maple Street loop, as if they were standing on the south corner or at the park.

Horizontal versus Vertical Planes

Within diagrammatic space, signers used either a horizontal plane within signing space (as seen in figure 8) or a vertical plane (as illustrated in figure 6). Signers can shift back and forth from a horizontal to a vertical plane, either rapidly (e.g., between sentences) or slowly, for example, changing from the vertical plane to the horizontal plane across one or two sentences.

The horizontal plane can be a true two-dimensional plane, or it can represent a three-dimensional model of space (in which case it is not a true plane). In contrast, the vertical plane appears to be limited to two dimensions. It would be unacceptable to use the vehicle classifier within the vertical plane, for example, indicating that a car traveled around the Maple Street loop using the vertical plane. The vehicle classifier invokes
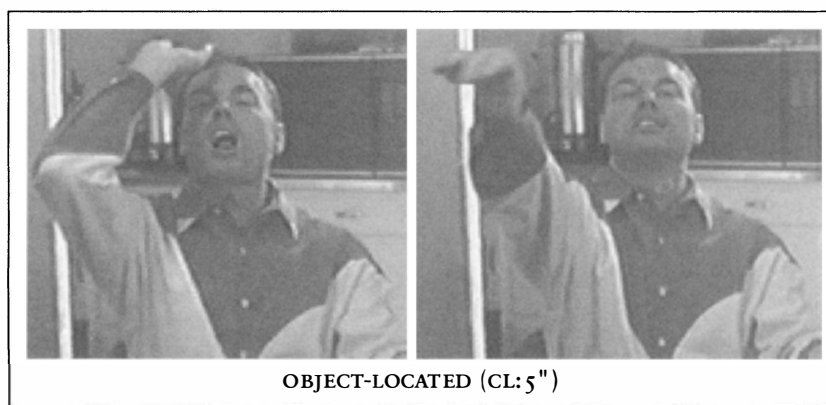

OBJECT-LOCATED (CL:5")

FIGURE 10. *Illustration of a Classifier Sign Used to Locate a Room (the Cafeteria) in a Gaze Tour Description of the Convention Center.*

three-dimensional space because it refers to a three-dimensional object, and the classifier itself has three dimensions that can be referred to (e.g., another classifier handshape can be placed next to or below the vehicle classifier to indicate the location of another object with respect to the car). The vehicle classifier can be articulated with a vertical path in signing space, but such a construction would mean the car was traveling uphill.

Several subjects used the vertical plane to indicate the locations of different landmarks for the town (generally, either the Maple Street loop or the town boundaries: the river, White Mountains, and Mountain Road), and one subject's entire description used the vertical plane. However, *no* subject used this plane when describing the convention center. Neither the perimeter of the convention center nor the four inside rooms were described using a vertical plane. One possible explanation for this is that the rooms and the corridor of the convention center are not easily represented with points and lines, unlike the landmarks and streets of the Town. Furthermore, the sign ROOM was often articulated at various positions within the horizontal plane to specify the location of different rooms. This sign invokes three-dimensional space and cannot be used in the vertical plane. Thus, the fact that the vertical plane is limited to two dimensions may have restricted its use in convention center descriptions.

FRAMES OF REFERENCE AND SPATIAL FORMATS

Sign linguists use the term *frame of reference* to refer to anaphoric reference within a discourse; for example, Lillo-Martin and Klima (1990) describe a fixed versus shifted referential framework (see also Engberg-Pedersen 1993). When describing spatial language, however, linguists and psychologists use "frame of reference" to refer to the spatial coordinate system invoked by a particular lexical item or sentence. Levinson (1996, 138–47) characterizes the three frames of reference that are linguistically distinguished as intrinsic, relative, and absolute.

An *intrinsic frame of reference* involves an object-centered coordinate system, where the coordinates are determined by the "inherent features," sidedness, or facets of the object to be used as the ground (the reference object). English examples: (1) "The man is in front of the house" (meaning at the house's front). In this example, the house is the ground, and the man is the figure (the located object). (2) "The ball is in front of me." In this example, the speaker is the ground and the ball is the figure.

A *relative frame of reference* presupposes a "viewpoint" (given by the location of a perceiver), and a figure and a ground that are both distinct from the viewpoint. Thus, there is a triangulation of three points (the viewpoint, the figure, and the ground), and the coordinates for assigning directions to the figure and ground are fixed on the viewpoint. English example: "The ball is to the left of the tree." In this example, the viewpoint is the speaker (the perceiver of the scene), the ball is the figure, and the tree is the ground.

An *absolute frame of reference* involves fixed bearings ("cardinal directions" or gravity), and the coordinate system is anchored to these fixed bearings with the origin on the ground object. English example: "The ball is to the north of the tree."

Spatial formats in ASL are clearly not the same as frames of reference. Rather they are specific ways of structuring signing space within a discourse. It appears that signers can adopt an intrinsic, a relative, or an absolute frame of reference when using either diagrammatic or viewer space. For example, using diagrammatic space, a signer could indicate that a man was in front of a car by positioning the classifier for upright humans (the 1 handshape) in front of the vehicle classifier (i.e., at the fingertips of the 3 handshape). Such an expression uses the intrinsic reference frame: the ground is the car, and the figure (the man) is located with respect to the features of the car. When viewer space is used with an intrinsic reference frame, the ground would always be the signer (or another character within the discourse if the expression was within a referential shift). For example, the signer could indicate that the car was in front of her, by positioning the vehicle classifier at eye level (see Lucas and Valli 1990); the English translation would be "the car is in front of me."

When viewer space is used within a relative frame of reference, the description is similar, but a figure and ground object are related to each other from the viewpoint of the signer (or other character if within a referential shift). For example, to express the equivalent of "the picture is to the right of the window" using viewer space, a signer would first describe the window on the left of signing space and then the picture on the right, both at eye level—the order of expression indicates which object is figure (described second) and which is ground (described first) (see Emmorey 1996). An example using diagrammatic space and a relative reference frame is shown in figure 11. In this example, the signer describes a man on a hill looking down on a house behind a lake. The viewpoint is that of the man (not the signer), the ground is the lake, and the figure is the house.

The signer is indicating that the house is behind the lake, from the man's viewpoint. The signer is not expressing his own view of the scene—that is, he is not indicating that the man is on his right and that the lake is in the center of view with the house to his left.

Finally, we have already seen examples in which signers specified an absolute frame of reference using cardinal direction signs with either viewer space (figure 5a) or diagrammatic space (figure 5b). However, signers rarely adopted an absolute frame of reference.

For route descriptions using viewer space, signers tended to adopt an intrinsic frame of reference with the signer (that is, the signer as imagined in the environment) as the origin of the coordinate system for locating a figure object. For survey descriptions using diagrammatic space, signers tended to also adopt an intrinsic frame of reference, but the origin of the coordinate system was centered on a ground object. What may be unique to signed languages is that a relative and an intrinsic frame of reference can be expressed *simultaneously* (see Emmorey 1996). For example, adopting a relative frame of reference, a signer could indicate that a car is behind a tree (from the signer's viewpoint). Now suppose that the signer indicates *in the same construction* that the car is facing away (such that the tree is at the car's back), by articulating the vehicle classifier with the palm facing sideways and the fingertips facing outward (away from the signer). In this expression, the intrinsic frame of reference is expressed via the intrinsic properties of the classifier handshape for vehicles (i.e., the fingertips represent the front of the vehicle). The fact that ASL can express two frames of reference simultaneously indicates that spatial reference frames are not mutually exclusive (see also Levinson 1996).

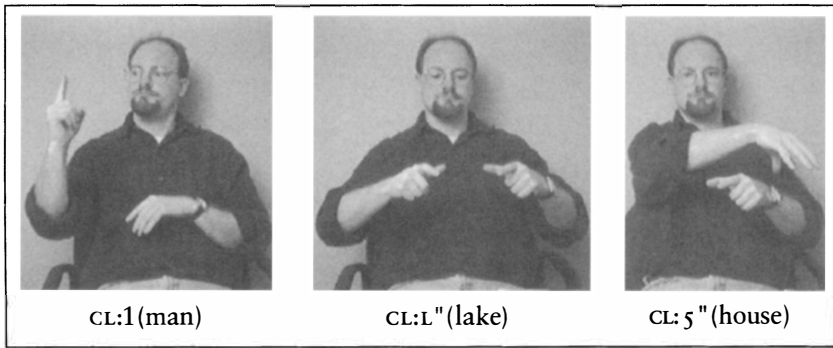CL:1(man)   CL:L"(lake)   CL:5"(house)

FIGURE 11. *Illustration of Discourse with a Relative Frame of Reference Using Diagrammatic Space. The intervening lexical signs are not shown.*

It should also be clear that when a route perspective is adopted for an extended spatial description, it does not necessarily mean that a particular frame of reference has been adopted for that description. For example, motion is not a property of a particular reference frame, but it characterizes route descriptions. Using existential verbs and describing landmarks with respect to each other (rather than with respect to a viewer) characterize survey descriptions but are not properties of reference frames. Descriptions with a route perspective tend to use an intrinsic frame of reference, but are not defined by it. Survey descriptions in English may tend to adopt an absolute reference frame, but only when cardinal directions are used. In contrast, ASL descriptions that adopt a survey perspective rarely involve an absolute frame of reference because signers rarely use cardinal direction signs (see table 2). Instead, either an intrinsic or relative frame of reference is used, and the nature of signing space, as well as existential locative classifier constructions (rather than motion constructions), convey the survey perspective.

SUMMARY

Our study found that ASL signers describe environments with the same discourse styles as English speakers, choosing either a route, survey, or mixed perspective. However, ASL signers did not make the same perspective choices as English speakers. The ASL signers were much more likely to adopt a survey perspective compared to English speakers. We hypothesized that signers were more affected than English speakers by the way the spatial information was acquired (i.e., via a map, rather than through navigation). Specifically, a mental representation of a map is more easily expressed using diagrammatic space because this spatial format is more compatible with a survey perspective. Thus, language modality does appear to have interesting ramifications for perspective choice and the nature of spatial descriptions.

With respect to lexical spatial terms and verbs of motion, English speakers and ASL signers make similar linguistic choices for route versus survey descriptions. However, ASL signers can "spatialize" both viewer-relational terms (LEFT/RIGHT) and cardinal directional terms (NORTH/SOUTH) to correspond with the particular spatial format adopted within a description. Within diagrammatic space, these terms can be ar-

ticulated with respect to the map or model of the environment laid out on a horizontal or vertical plane. Within viewer space, viewer-relational terms are articulated with respect to the signer's body, and cardinal direction terms can be articulated at a higher plane to indicate that the signer (or character within a referential shift) is moving or facing in the direction specified.

Finally, we found that signers structure signing space differently depending on whether they adopt a route or survey perspective. For the viewer spatial format (preferred for route descriptions), signing space reflects a person's view of the environment, has a "normal-size" scale, a changing vantage point (except for gaze tours), and uses a relatively high signing plane. For the diagrammatic spatial format (preferred for survey descriptions), signing space represents a two- or three-dimensional model of the environment, the vantage point is fixed, and a relatively low horizontal or vertical signing plane is used. Spatial formats are independent of spatial frames of reference, and signers can adopt an intrinsic, a relative, or an absolute reference frame when using either diagrammatic or viewer space.

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