Manuscript prepared for submission to

*Language in Society*

**When Up is Down and Down is Up: Body Orientation, Proximity and Gestures as Resources**

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**Running Head:** When Up is Down
When Up is Down and Down is Up: Body Orientation, Proximity and Gestures as Resources

ABSTRACT

This article is concerned with understanding situations in which speakers talk in the presence of scientific inscriptions (lectures in science classes, public presentations). Drawing on extensive video materials accumulated in middle and high school science classrooms and university lectures, we develop a framework for the resources speakers make available to their audience for understanding what the talk is all about. We distinguish three situations according to the nature of reference to the phenomenon talked about: (a) talk is about phenomenon but mediated by reference to a two-dimensional inscription, (b) talk is about phenomenon but mediated by reference to a three-dimensional inscription, and (c) talk is directly about phenomenon. Associated with these three situations are different body orientations, distances to inscriptions, and types of gestures. When speakers laminate talk characteristic of two different types of situations, up can become down and down can become up, potentially leading to confusing statements.

KEYWORDS: Gesture, orientation, spatial arrangements, body movement
Language, gesture, cognitive style, and many aspects of spatial behavior, come to
form a coherent and distinctive complex. (Levinson 1997: 125)

Anyone having taught a lecture course and subsequently tested students on what they
have learned has probably found him/herself facing unsuccessful students who explained
that ‘it all made sense during the lecture’ but that they understand when they ‘studied
from their notes’. There are possibly many explanations for the students’ failure. One
might ask, however, whether the actual lectures provided resources for understanding that
students do not find in their notes, usually consisting of copies of blackboard content and
transcriptions of the lecturer’s utterances. Such a question is legitimate given the
observation that speakers use body orientation and gesture as informational and
utterance-framing resources (e.g. Haviland 1993). In this article, we present a detailed
description of the local resources incorporated by lecturers while they are talking over
and about different types of images (photos, graphs, diagrams, maps, etc.) drawn on
blackboards or projected onto a screen. We describe how the integration of these local
resources involves a very intricate lamination of frames. The key resources discussed in
this article are body orientation, gesture, and spatial arrangement of a speaker with
respect to inscription and audience. Moreover, we develop existing research on the
relation between gesture and language (e.g., Goodwin 1986, McNeill 1992, Kendon
1997) by situating talk within a larger framework that includes space as a critical resource
for understanding the topic of talk (e.g., Goffman 1974, Heath 1986, Kendon 1990).
Introduction

We begin with the fundamental assumption that language, in the sense of the Saussurian *parole* as distinct from *langue*, is only one aspect of a broader phenomenon of human communication (e.g., Clark 1996). Close analysis of everyday talk in formal (e.g., Roth 1996) and informal settings (e.g., Levinson 1983) shows that the meanings of utterances by themselves are underdetermined. Everyday talk (*parole*) is full of ‘mumbles, stumbles, malapropisms, tics, seizures, psychotic symptoms, egregious stupidity, strokes of genius, and the like’ (Rorty 1989: 14) that listeners need to adjust to in order to make sense of what it is the speaker is talking about. However, in communicative encounters, speakers (as listeners) make available to each other many other resources that provide contexts for constraining the meanings of utterances. These resources are fundamentally grounded in the fact that human speakers have bodies: various forms of movements with different parts of the body provide cues on how to understand just what is being said by delimiting the range of possible interpretations. The body is so important to making sense in speech situations that there is a greater likelihood of communicative breakdown and need for conversational repair if visual access is barred or mediated by some technology (e.g., Heath & Luff 1993, Goodwin 1995, Egbert 1996). In this study, we are concerned with lecture-type situations where speakers use a variety of inscriptions and are in view of their audiences so that their gestures, body orientations, and physical placements become important resources for the audience to make sense.

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1 The importance of the body in making sense of speech situations is by no means a universal phenomenon. Rather it seems to reflect an actor-orientation characteristic of Indo-European languages which is distinct from Austronesian languages that are characteristically non-actor oriented (e.g., Senft [1997]).
Lectures remain a pervasive mode of discourse in science courses at all levels of schooling (Roth & Tobin 1996). Nevertheless, lectures remain a little understood phenomenon despite traditional lore that holds they serve to ‘transmit’ information. In the light of recent empirical and theoretical studies of knowing and learning—which suggest that individual beings are closed with respect to information (i.e., signs that have meaning) and have to construct systems of meanings internally (von Glasersfeld 1989)—it comes as little surprise that students of science often find it difficult to make sense of lectures (Roth & Bowen 1999a, 1999b). For example, our previous research shows that many students have difficulties understanding scientific inscriptions (Roth, McGinn & Bowen 1998). In our attempt to understand these difficulties, we began to investigate different contexts in which graphs were used including textbooks and lectures (e.g., Roth, Bowen & McGinn 1999, Roth & Bowen 1999a). It was here that we came to understand the important role of gestures in the presentation of graphical materials. At the same time, we also noted that the relationship between gesture and talk alone could not account for the phenomenon of understanding inscriptions in lectures. This is the starting point for the present study of taking an integrated approach to the phenomenon of communication—including talk, gestures, other body movements, and physical arrangements.

The research reported here adds to understanding communicative processes in lectures. Because of our attention to body movements (gesture) and orientations, we extend the existing literature concerned with these dimensions. Furthermore, our present analysis concerns talk in the presence of inscriptions with referents in the community: utterances may refer to the inscription or, transparently, to the world it stands for.
To set the stage for several detailed analyses of the interaction of speech, gesture and other body movements, we provide a brief survey of the literature on talk related to body movements and spatial arrangements, gestures, and inscriptions. We continue by describing the databases that we analyzed and then present and elaborate our model for lecture talk in the presence of inscriptions.

**Body Movement, Spatial Arrangement and Talk**

There is strong neuroscientific evidence of the interrelation of cognitive processes and bodily movement (Rizzolatti, Fadiga, Fogassi & Gallese 1997). It is therefore not surprising that studies on interaction show speech and body movements as coordinated phenomena (Kendon 1990). That is, whenever people are co-present in the sense that they can mutually perceive each other, they are inevitably sources of information for one another (Kendon 1988b). Yet, this information does not only come in the form of utterances. Rather, as Goffman (1974) illustrates, a multiplicity of cues serves to regulate, bound, articulate and qualify a story line or an appropriate ‘directional track’. Moreover, not only do speakers provide such cues to the listener but listeners also provide information to speakers. Thus, Kendon (1990) provides evidence that the listeners’ body movements and gestures are coordinated with those of speakers. In one detailed example, the interaction between two speakers, B and T, has been described in the following way:

> When B is moving, his movements are coordinated with T’s movements and speech and … in their form these movements amount in part to a ‘mirror image’ of T’s movements: as T leans back in his chair, B leans back and lifts his head then B moves his right arm to the right, just as T moves his left arm to the left,
and he follows this with a headcock to the right, just as T cocks his head to the left. (Kendon 1990: 100)

Speakers (and listeners) make available to each other resources (body movements, gestures) that allow coordination of speech in particular and the entire interaction more generally. Consequently, body movements and gestures allow interacting individuals to coordinate their expectations and, thereby, develop and maintain a smooth running of the encounter (Bavelas, Chovil, Coates & Roe 1995).

When speakers talk about artifacts that are present in the situation, group size and physical arrangement of people and artifacts provide affordances to orientation and gaze that are different from similar conversations where such artifacts are absent (e.g., Luff & Heath 1993, Hutchins 1995). The presence of artifacts mediates between individuals with differing interests, tasks, expertise and goals. The spatial arrangement of the speaker (i.e. as either lector, member of audience, or participant within a group) with respect to the inscription is a critical variable in the way speakers are orientated, and therefore in the types of resources they can make available to listeners for making sense (Roth 1996, Roth McGinn Woszczyna and Boutonné 1999).

In the present study, we are concerned with understanding communication in classrooms. With a traditional arrangement that divides teacher/presenter from student/audience, classrooms have a spatial organization that requires participants to actively engage in and maintain in order to count as a participant. But the mainline story is not dealt with in the same way as, for example, a dinner conversation or service encounter (e.g., M. Goodwin 1996). In the traditional classroom, individuals separately attend to an unchanging focus whereas in the dinner conversation, the topic is jointly
created and developed. As part of the ecology of conversational interaction participants
must be oriented appropriately. How the interacting participants enter into and maintain
spatial and orientational arrangements has been the topic of studies of formation systems
(Kendon 1990). Here we are concerned with a formation system characterized by a
speaker who faces an audience and limited verbal interactions.

**Gestures and Talk**

Gestures constitute a subset of body movements that have become a topic of research
in their own right. This is largely because gestures have come to be recognized as a
central feature in human communication (Bavelas 1994) and across cultures (Kendon
1997). Furthermore, anthropological studies suggest that gestures are not just aspects of
communicative acts but that they are deep features of cognition (Haviland 1993, Widlok
1997). Microgenetic studies in school science laboratories confirm that some gestures
emerge from the manipulation of objects, movements which later reappear as iconic
gestures when students are asked to describe and explain what they have done and
observed.

There are different types of gestures ranging from involuntary gesticulations that
accompany speech, to grammatically structured sign languages (Kendon 1988a). Here,
we are concerned with two particular forms of gesticulations, deictic and iconic gestures.
Iconic gestures draw their communicative strength from a perceptual similarity with the
phenomenon simultaneously encoded in speech. For example, McNeill (1992) reports on
subjects that quickly move their own index and middle finger while they narrate an
incident from a story in which a cartoon character is running. Deictic gestures are used to
point out features in the environment, to indicate directions, or to establish and maintain
narrative geographies that become taken as shared so that speakers can make subsequent use of them without employing words (e.g., Haviland 1993).

*Inscriptions and Talk*

There have been a considerable number of studies on gestures in situations where people talk about experiences or retell stories (e.g., reviews by Kendon [1997]). In contrast, there have been far fewer studies on gestures in situations where the speaker talks in the presence of a relevant artifact. Among the artifacts that are central to conversations in science, inscriptions are of particular importance (e.g., Latour 1987). Inscriptions such as photographs, maps, charts, diagrams and graphs are of particular importance to smooth functioning of collective activity among scientists or engineers (e.g., Amann & Knorr-Cetina 1990, Henderson 1991) and constitute a pervasive means of scientific communication. For example, a survey of 6 high school science textbooks (~4,500 pages sampled) and 5 research journals in ecology (~2,500 pages sampled) showed that there are about 1.4 inscriptions per page and no statistically detectable difference between the two types of publications (Roth, Bowen & McGinn 1999). Furthermore, inscriptions are also frequently used in scientific laboratory talk and during lectures. The existing research includes studies of physicists talking about diagrams on the chalkboard (Ochs, Gonzales & Jacoby 1996), of a professor giving lectures in an undergraduate ecology course (Roth & Bowen 1999a), and of students talking in the presence of diagrams representing scientific phenomena (Roth 2000).

One of the important features of these studies provides important clues as to how gestures evolve as communicative resources. Deictic [pointing] gestures aid in making salient particular objects or features. Iconic gestures also make features salient and are
perhaps more efficient at it than deictic gestures because the added motion component enhances the comprehension of topological features.

Another important finding described by Ochs, Jacoby and Gonzales (1994) is that scientists can be understood as journeying through the representations that they are talking over and about. The presence of the inscription provides a ground against which scientists ‘create an intertextual space in which the identities of scientist-as-subject and constructed-scientific-world-as-object are deconstructed and reconstructed as a single blended entity’ (Ochs et al. 1994: 152). That is, physicists can be said to talk and travel through a graphic space.

STUDY CONTEXT

In this paper, we explore cases where speakers talk about scientific topics in the presence of inscriptions as they occur in various science-related contexts. We focus on ‘lecturers’, that is, we focus on situations where one speaker talking about a scientific issue addresses a larger mostly listening audience. Our data sources derive from studies originally designed to investigate the learning of science in three distinct populations: grade 7 students studying water and its ecology, undergraduate students enrolled in an introductory ecology course, and future elementary teachers enrolled in a physics course. In all three contexts, speakers drew on a large number of inscriptions as part of their teaching. For example, there was a mean of 25 inscriptions per lecture in the ecology course. In each case, we had available videotapes of all lessons pertaining to the course or unit (3 hours per week over a period of 3 or 4 months).

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2 Readers will find more information about the original intents for each study and the findings with respect to cognition and learning in the following publications: grade 7 (Roth, Masciotra & Boyd 1999),
In each study, the videotapes were transcribed within hours to a few days on a word by word basis, but without pause length or overlaps. The transcriptions of episodes with apparent theoretical appeal were then enhanced to include those features common to conversational analysis. That is, the enhanced transcriptions included the extent of pauses, overlaps, stresses, and so forth. In addition, representations of the focal situations (e.g., artifacts, drawings, etc.) over and about which conversations took place were included in the transcripts. In this paper, these representations are developed from video stills of the actual presentation. Because the videotapes were recorded at a rate of 30 frames per second, timing of gestures and speech and the coordination between the two channels is accurate to within one frame or 33 milliseconds.

We randomly selected two videotapes from each of the three data sets. Using a classification scheme developed for the detailed analysis of scientific inscriptions in high school and university textbooks and scientific journals in ecology (Roth, Bowen et al. 1999), we counted the total number of inscriptions. Table 1 shows the frequency of inscriptions in each set of videotapes. The relatively high number of inscriptions with depth information in the middle school (grade 7) class is due to the prevalence of photographs and naturalistic drawings. This finding is consistent with the distribution of photographs in pre-college textbooks on the one hand, and college textbooks and scientific literature, on the other (Roth, Bowen et al. 1999). Although there are many situations where physicists use diagrams to draw and plot phenomena in three dimensions, the introductory course in physics for elementary teachers had relatively few.

![Insert Table 1 about here](image-url)
Making sense of talk and inscriptions in scientific contexts requires an understanding of the scientific domain. Our research shows that scientists, though frequently treated as experts in the psychological literature, experience difficulties in making sense of inscriptions, even though these may be from an introductory textbook into their field (Roth and Bowen 2001). We therefore chose all of our examples from the presentations of environmental activists in a grade 7 curriculum on water and its ecology. Our analyses pertain to repeated presentations given by environmental activists to the students (with the same features showing up in our videotapes of presentations to other audiences).

SCIENTIFIC LECTURES WITH INSCRIPTIONS

Inscriptions

Past theoretical and empirical work on inscriptions in scientific practice (Latour 1999, Roth & Bowen 1999c) showed that one can characterize inscriptions in terms of their level of abstraction or distance from lived experience. At one end there is the lived experience of world as inhabited space; toward the other end, inscriptions become increasingly abstract as situational details are dropped (Figure 1). Although scientific research begins with quite tangible manipulation of worldly objects, it is designed to produce increasingly context-independent inscriptions. In the process, ‘gratuitous detail’, which provides an illusion of continuity with lived experience (e.g. Myers 1990) is left out in favor of increasing generalizability.

It turns out that this continuum is not simply reflexive of the unfolding of scientific research but also that it is central to human cognition and communicative interactions. On
the one hand, inscriptions with high levels of realism (photos, naturalistic drawings) include much detail that makes it easier for people to see connections with the lived world than when they interpret highly abstract graphs (e.g., Roth & Bowen 1999a). On the other hand, the very detail of realistic inscription not only increases the resources for making sense but also the interpretive flexibility and uncertainty about just what is that the reader is asked to attended to (e.g., Bastide 1990).

As we analyzed the videotaped lectures, we began to realize that the different types of inscriptions were associated with different types of gestures and body orientations. Scenic and aerial photos and maps provide much more detail, often requiring speakers to provide additional resources to assist the audience in locating relevant features; only minimal assistance is noticed in situations where the inscription is constituted by a relatively small number of features such as Cartesian line graphs and other statistical graphing techniques. On the other hand, scenic photographs and other diagrams characterized by illusionary third dimensions (perspective views) provide a new context for the use of gestures. In the following sub-section, we provide an analysis of space and associated gestures as these arose from our analysis of the data. We then provide several detailed analyses of videotape excerpts to show the relationships between talk, gesture, and orientation during science lectures.

A Model of Talk, Gesture, and Body Orientations

Any present situation requires that a speaker be situated in a space that is both immediate and local. Within this locally anchored immediate space, speakers have available different ways to refer to entities including naming entities or their properties (‘the red one’), using verbal deixis (e.g., this, that, here, there) or enacting gestural deixis
(pointing, gestural sign) (e.g., Haviland 1993, Goodwin 1996). In addition to locally anchored immediate space, speech events also establish interactional spaces defined by the configuration and orientation of coparticipants. Although the intersection of action and attention hemispheres of speaker and listener constitute the interactional space, the speaker’s (frontal) hemisphere is of particular importance to the interaction (Haviland in press). In certain instances, however, locally anchored space may be used to anchor a narrated space, that is, a space associated with a different locale evoked in the narrative.

In the course of our analyses we realized that the physical arrangement of audience, speaker, and inscription is associated with a preference for the speaker’s orientation and positioning with respect to the specific referents of utterances (Figure 2). The gestures associated with different positions and orientations are different in nature and have different functions. We distinguish three cases: (a) speaker talks about phenomena mediated by inscriptions in which two dimensions are salient (2-D flat); (b) speaker directly talks about phenomena without reference to inscription (2-D or 3-D); and (c) speaker talks about phenomena mediated by inscriptions in which perspective is introduced (virtual 3-D). (In addition, Figure 2d shows how additional perspective is created by the movement of the speaker creating the illusion of walking ‘into’ the 3-D image.)

**Inscriptions with Two Salient Dimensions**

First, when the talk is about the inscription per se, speakers are oriented to the right quarter defined by the audience-speaker-inscription axis (Figure 2a). Gestures are predominantly of pointing (deictic) nature and, with few exceptions, are enacted with the right hand. (The geometry is inverted when the speaker faces in the opposite direction.)
Speakers point to or circle specific features (with the expectation that the audience picks out what the relevant entity is) or follow some feature along a more or less recognizable boundary (e.g., road, forested area, or gravel pit). In this case, there is a reflexive relation between the gesture and the inscription in the sense that the speaker’s gesture is motivated by some feature of the inscription while at the same time the gesture motivates the observer’s gaze to search for the feature.

In this situation, the speaker is oriented to the inscription, which itself is anchored in local space. That is, the inscription is tied to local space so that speakers may orient the audience using the relative coordinate terms such as ‘up’, ‘down’, ‘left’, and ‘right’ which have the same meaning and orientation if they refer to other objects in the room. Also tied to this orientation are compass points such that north and south correspond to ‘up’ and ‘down’, respectively. Thus, there are instances where a speaker refers to a town lying beyond the reach of the map as ‘further up there’ (pointing to about 1 o’clock, toward ceiling) or ‘further down, to the south of there’ (pointing to 6 o’clock, to floor).

Narration

Second, when the talk is about the thing re-presented in the inscription but absent from the local space, there is a preference for orientations to the left quarter of the audience-speaker-inscription axis (Figure 2b). Speakers physically move away from the inscriptions, thereby providing potential resources to their audiences that the talk is about something other than the inscriptions. (Whether the audience actually uses such movements as resources to make sense of talk needs to be tested experimentally.) Iconic gestures, most often involving both hands, are associated with this orientation. As the
When up is down examples in Table 2 show, iconic gestures are associated with and embody both verb and noun meanings. In this situation, orientation terms and gestures are relative to the hemisphere of the speaker. For example, one speaker standing sideways to the audience utters ‘the farm lies over there to the right’ accompanied by a sweeping gesture to her ‘right’, although from the audience perspective, the gesture is away rather than to the right. Thus, during narration, the space is anchored to and defined by the speaker’s body.

The two orientation-gesture configurations are featured in Figures 3a and b when the speaker identifies the ‘height of the lands’ top of a mountain (Fig. 3a); the speaker subsequently talks about a potential oil spill in this location although it is not perceptually available (Fig. 3b). The depictions are associated with the following transcript.  

01 So * say, say something happened up in the heights of land,  
    Continuously points to the ‘heights’ as in fig. 3a but turns  

02 the head waters of this area *, like  
    head toward audience. She turns her body.  

03 * a, like an * oil spill.  
    Spilling gesture in fig. 3b.  

In the first part of this episode (lines 01–02), the speaker is clearly oriented toward the photograph behind her. She turns her head in the direction of the audience toward the end of line 02 and then, with the first occurrence of “like” shifts her entire body into a position in narrative space as depicted in Fig. 3b to produce the utterance about the oil spill.
spill (line 03). The gesture in narrative space is iconic, depicting the spilling of a liquid over the rim of a container. (The other hand enacted a mirror image of the gesture.) As it was, the gesture was already completed before the speaker verbally refers to the ‘oil spill’, leading some researchers on gestures to advance the hypothesis that gesture facilitates speech production (e.g. Butterworth & Hadar 1989).

In our database, there is only one instance where the same iconic two-hand gesture is being used to make salient an aspect of the inscription and to refer to the entity it stands for (Figure 3c). This instance pertains to the gestures in which the speaker used two arms to highlight the confluence of two tributaries into the main stem of the creek. The spoken context for the gesture toward the inscription behind her is depicted on the left in Fig. 3c and occurred in the following context.

04 It has at that point * two parts that are draining into what’s

* Gesture of two tributaries, fig 3c on left

05 called the main stem… And this is basically * the area

* Points to main stem * Gesture of two tributaries, fig 3c on left

06 where the creeks * are coming… Graham is coming this

* Gesture of two tributaries, fig 3c on left

07 way and Hagan is coming down that way….

* Follows each tributary with finger in extended pointing gesture

This episode is part of the presentation where the speaker wants to communicate what a watershed is. She does this in pointing to all the creeks that empty into the same main stem. She uses the same gesture three times to show the coming together of the two tributary creeks (lines 04, 05, 06) separated by deictic gestures to other features. The
gesture is oriented to the graphic, the hands making salient the creeks on the map behind the speaker.

After having pointed to and outlined the tributary creeks, their confluence, and the main stem on the map, the speaker visibly rotated her body to face the audience. Now being in narrative space, she produces a gesture that articulates two tributaries again that eventually come together (shown in the joining of her two hands) and continuing as one creek (two hands, moving away from her).

08 * So this is basically a drainage area that is collecting all
  Body and arm position as in fig. 3c on left, but slight ‘pumping’

09 water that is coming down * and it is all funneling down
  motion of both arms       hands are approaching and touching

10 through the streams and ultimately into Saanich inlet.
  Hands joined move forward and away from speaker’s body.

The accompanying gesture in Fig. 3c (line 08) helps to establish that a watershed is a drainage area. She then brings the two hands together in a downward and forward motion as if showing two creeks that flow downward, near each other and eventually join to continue together (lines 09–10). Thus, the speaker sets up a narrative space where the heights forming a watershed transform into the two arms of a creek until they combine into one. The three-dimensionality of narrative space allows her to articulate the topology of ‘coming down’ and ‘funneling’, which cannot be shown in words. In this case, there is elevation information as the arms slowly descend and continue to do so to the mouth of the creek. That is, iconic gestures in narrative space essentially exploit three dimensions
whereas gestures in graphic space normally limit themselves to the two dimensions spanned by the inscription.

**Inscriptions with Depth Information**

Scenic photographs are inscriptions that provide the viewer with depth information despite their two-dimensional surface. Figure 2c shows that the previously preferred separation of narration and graphic spaces changes such as to overlap in this situation. Here, the apparent third dimension can be exploited by speakers in the sense that gestures can be seen as occurring in and pertaining to the virtual space in front of and behind the surface on which the inscription appears (Figure 2d). For example, as the speaker refers to the creek in front of a scenic photograph (Figure 3d), she not only moves horizontally and vertically but she also moves her hand closer to the screen. Her gesture enacts a creek that is flowing from her current position to the distant back where the creek disappears in the forest. These two gestures appeared in the context of the following talk.

11 And this is, again if you are driving just north of Brentwood,

*Oriented toward the image*

12 you’ll see *Hagan Creek* running down through the

*Points to creek [fig 3d, right] close, then orients back to audience*

13 valley *this is the main stem and just into Saanich*

*Points again and begins movement ‘into’ the image*

14 *Inlet which is* *right here.*

*to end where the creek disappears [fig 3d, left]*

At the beginning of this episode (line 11) the speaker is oriented toward the image and speaks hesitatively as if thinking about how to describe the location where the
photograph was taken. After identifying how to get there (‘driving just north of Brentwood’) she enounces the creek by name (line 12) while pointing to a location in the foreground of the image thereby assisting the audience to interpret a potentially confusing image. As she points again to the creek (line 13), she draws on the three-dimensionality of local space as a resource by moving both along the creek and simultaneously bringing the hand closer to the screen (Fig. 3d, left). That is, she situates herself with respect to the virtual third dimension of the image and moves (walking, gesturing) in a way that enhances the illusion of this added dimension. (We provide an overhead perspective that provides the depth information in a subsequent example.) The speaker thereby orients herself such that the narrative space virtually extends the inscription into local space. The associated gestures are also a blended version of the earlier discussed types.

Laminations

So far we have seen that the nature of gestures is linked to the orientation and topic of the talk. If the talk and gesture are about an inscription, the orientation is also toward the inscription. If talk and gesture are about entities not directly available in the inscription, the preferred orientation is toward the audience (narrative space). However, because maps and aerial photographs refer to tangible things available to experience (creeks, buildings, roads, mountains, parks), there is a potential for a lamination of talk and gesture about a feature in the two dimensional inscription and talk about the actual entities referred to. As the episode in Figure 4 shows, this may lead to strange situations where ‘up’ is actually ‘down’ and ‘down’ is ‘up’, or where a gesture and inscription make salient a horizontal feature associated with talk about ‘down’ (cf. Figure 6 and associated discussion).
In this episode, the speaker has projected an aerial photograph onto the screen. Her body and gaze are oriented to the aerial photograph. After having identified for the audience the location of familiar landmarks, she first locates and then traces a creek (‘Graham’). As her finger traces the creek downward, she describes the creek as ‘flowing all through here and down’. But she completes the sentence by saying ‘up to the headwaters’. In the same way, she traced the creek and described it as ‘going up’ but completed the phrase by saying ‘down the valley’. Here, then, ‘down’ is ‘up’ and ‘up’ is ‘down’. Oriented toward the inscription—which is orientationally aligned with local space—the speaker’s references pertain to the aerial photograph: the gesture is downward coinciding at some point with its verbal analog ‘down’. However, in the narrative space pertaining to the lived experience (and to some extent the linguistic field of the term itself), driving to the headwaters from the nearby village means going notably uphill. ‘Down’ pertaining to the inscription anchored in local space is ‘up’ in narrative space. That is, in those (few) situations where the speaker does not provide the audience with body orientation as a resource for understanding the referents of ‘up’ and ‘down’, they ended up making potentially confusing statements when graphic and narrative space became laminated.

Gesturally, references to maps and aerial photographs are aligned with particular features in the two dimensions spanned by the inscription, which does not afford a simultaneous gesturing of differences in elevation. In the left panel of Figure 3c, the left arm gestures up, which corresponds to down in terms of elevation. In the right panel of Figure 3c, however, the gesture shows the same confluence of the two creeks, now
featuring differences from higher to lower elevations. At the same time, being in narrative space, the gestures no longer preserve cardinal directions. Rather, the gestures provide an image of the relative changes in the direction of the creek and its tributaries prior to and after the point of confluence.

GESTURE, ORIENTATION, AND TALK IN LECTURES WITH INSCRIPTIONS

In this section, we take a closer look at several episodes to illustrate how speakers coordinate their actions within and across the different spaces.

Inscriptions without Depth Information

This sequence is part of an episode in which the speaker attempts to orient the audience toward the creek that is the topic of the presentation. The creek is part of the community in which the audience (grade 7 students) lives. Prior to the episode, the speaker has already pointed to several points on the map and associated them with particular landmarks known by the students (e.g., ‘Mount Newton’, ‘Centennial Park’, and ‘gravel pit’). The presentation then moves to identify the location of the creek with respect to the already identified landmarks. Coincidentally, a bridge crosses the creek near its mouth: as it becomes clear afterward, the speaker traces the creek from the mouth to its headwaters.

The sequence begins when the speaker points to the road that leads out of the village; her finger follows the road (on the aerial photo) while talking about ‘driving along West Saanich Road’ (Figure 5a-b). At this point, the speaker’s talk becomes halting. In a smooth motion she turns her body away from the map so that her left side is profiled to the audience and her right side is profiled to the map. With her head turns slightly down
and towards the audience she brings her arms and gaze into a position parallel to the inscription until her hands are in front of her face; she bends her knees and straightens them out thereby providing a hint of a body going through a dip. From there, she moves the hands on a trajectory downward and away, then leveling off (Figure 5c-e) while uttering ‘through’ and filling the subsequent pause with ‘hm’. The gesture repeats as the speaker names a location ‘Tsartlip Band Reserve’ (Figure 5f-g). As she utters ‘you start to head downhill’, she sets up the same gesture again, but completes it with her right hand only (Figure 5k). The speaker orients both head and hand back to the inscription pointing at the line that denotes the creek (Figure 5k). Following the represented episode, she talks about a farm next to the road just described. Here too, the speaker orients herself as in the middle section to be seen broadside by the audience (Figure 5c) and moves her outstretched right arm from the line defined by her body center outward covering about 90 degrees. This gesture is continuous with the earlier experience of driving downhill, where the audience would then find the farm and its land stretched out along the creek to the right hand side of the driver.

Hand, arm, and head are oriented toward the inscription so that the orientation is toward the inscription in the first part of the episode (Figure 5a-b). Only the right hand is engaged in gesturing. However, the speaker does not just point out a particular feature but does so in terms of the description of an experience: ‘driving along West Saanich Road’. That is, gestures make salient the topological quality of the graphic space that is central to the ongoing narration. By shifting orientations from graphic space to local space the speaker is able to strategically laminate the topological affordances of gestural with
graphic information in order to overcome the limitations of each and further enliven her narrative.

In the middle section of the episode, the speaker moves into and remains at the limit of narration space (Figure 5c-h). Despite the preference in narrative space of orienting further towards the audience, the particular concept gestured is more easily visible in the side view presented. Using both hands, the speaker renders the experience of driving through the reserve where the road descends to the bottom of a valley carved by the creek. There is a three-fold gestural rendering of driving downhill before the speaker describes the phenomenon verbally. Such delays between gestural and verbal renderings are not normally observed among competent speakers (e.g. McNeill 1985) but may occur when a speaker seeks for words (i.e. during ‘lexical search’ [Butterworth & Hadar 1989]) or when a narrative is constructed for the first time (e.g. Beattie & Coughlan 1998).

We can understand the middle part (Figure 5c-h, i) as an elaboration of locating the creek, which the speaker begins by identifying West Saanich Road (Figure 5a-b) and completes by pointing to the creek (Figure 5k). The elaboration occurs in terms of driving along West Saanich Road, which passes through the reservation. When we actually take the drive, we find the road descending through the entire reserve until we reach the creek, from where the road goes considerably uphill again. The situation depicted in Figure 5i can be seen as a transitional stage between the two spaces. The shoulder position is back in the same position where it was prior to entering narrated space and gesture is restricted to the right hand.

The speaker’s move from an orientation toward the graphic into a narrative mode and an associated shift in orientation and distance to the inscription has the potential to allow
the audience to find the referent of the road, as represented on the map, in terms of their own experience of driving along West Saanich Road and through the Tsartlip Band Reserve. If the audience recalls such a drive, they would find themselves at the bottom of the hill at the creek.

Inscriptions with Depth Information

**Transitions**

Despite their flatness, scenic photographs provide cues for understanding in terms of our normal experience of viewing a landscape. When we liken the photograph to a window onto the world, it is easy to understand that speakers can create additional resources that make use of a third dimension. In the present episode, the speaker intends to provide her audience with a better understanding of the landscape around the creek by projecting a scenic photograph (Figure 6). The speaker begins placing herself with respect to the depicted landscape: her utterance ‘we are standing on the southern, on the southeastern one [part of valley] here’ is accompanied by a gesture in which both arms form a circular shape (Figure 6a). The underarms are parallel to the ground, suggestive of the spot from which she had taken the photograph. This spot is in front of the screen, which opens up a space that can be seen as continuing within the photo. This spatial interpretation of the situation becomes even more salient in the moments that follow (Figure 6b-e).

Having opened a narrative space anchored by her current position and the depth cues by the photograph, the speaker then makes the creek come alive in a gesture that evokes
an S-shaped meander (Figure 6b-d). As the hand reaches the screen (Figure 6e), it turns and moves parallel to the image at a constant height and follows a ridge (Figure 6f-h) while the utterance evokes a creek as flowing downward (‘and it’s flowing down into the valley’). Figure 7 makes these movements into the depth of local space even more apparent. In the beginning and corresponding to Fig. 6b, the shoulders are oriented toward the screen and the right hand is partially covered. The hand then moves away from the body as the arm stretches out, turns to be almost parallel to the overall trajectory (dotted-line arrow in fig. 7) and, begins to bend as it almost touches the screen (corresponding to Fig. 6f). In the meantime, the shoulders have rotated to be oriented further toward the audience and stay in this position as the speaker walks parallel to the image (trajectory indicated by broken-line arrow in fig. 7). Throughout this section, the speaker is oriented toward the inscription but the first gesture (Figure 6b-e) is typical for orientation during narrative whereas the second gesture (Figure 6e-h) goes with the orientation and distance during orientation toward the inscription.

Here, in the narrative space opened up by the speaker’s positioning and the scenic photograph, the gesture evokes a creek as a three-dimensional feature of the land. Narrative space overlaps with the space normally associated with talk over and about inscriptions. In contrast to the conversations analyzed in other research where cardinal directions are preserved in narrative space (e.g., Haviland 1993), our speaker preserves relative positions and directions.

The gesture that articulates the flowing creek bears a visual similarity with the shape of the creek on a map: the gesture is iconic. On the other hand, there is a contrast between
the verbal and gestural information made available in the last part of the episode. While the finger tracks a visibly horizontal feature (Figure 6f-h), the utterance evokes a creek that is ‘flowing down in the valley’. The gesture is no longer iconic to the content of the utterance (i.e., ‘flowing down’). Here, as in Figure 4, seemingly contradictory claims are made as two spaces are laminated. The speaker’s gesture, anchored to the inscriptions, follows and makes salient (from an audience perspective) one feature, which is seemingly contradicted by the utterance. However, the utterance pertains to narrative space where in fact the creek is flowing down.

**Shifting Spaces**

Shifting also exists in the case of inscriptions with perceived depth information: in fact, it appears necessary whenever the speaker talks about something that is not directly available from the inscription (photograph) itself. In the following example, the speaker asks the audience (grade 7 students) whether they know what a watershed is. As there is no response, she asks for the next slide, a scenic photograph featuring mountain ranges around a lake. Here, too, the speaker travels between the two spaces but with notable differences when compared to the other inscriptions.

The scenic photo provides the view of a valley stretching from somewhere below the speaker into the background. With eyes and left arm/hand oriented toward the photograph, She communicates where the water flows in the watershed depicted (Figure 8a-b). Here, the hand, palm facing the floor, moves downward against the mountain, beginning at the top and down to the lake. It is not merely a gesture following a vertical
feature in the photograph, but provides an image of water that comes down over an extended area (flat palm).

Because the inscription is anchored in local (lived) space, ‘one watershed [is] flowing this way’ and the downward gesture communicates water flowing downhill on the slopes of the mountain against which the gesture is seen. However, the gesture that works to show that the waters from the visible mountain ranges flow into the lake and therefore forms ‘one watershed’ does not work for another watershed that is not perceptually available. At first, she brings up the right hand to the mountaintop similar to Figure 8a. Then there is a small gesture in which the hand very quickly waves down and right as she utters ‘what’s the other watershed’ (Figure 8c). She finally shows ‘flowing on the other side’ by means of a gesture typical for narration space (Figure 8d-e). Associated with this change is the use of both hands, and an orientation (eye, right hand) away from and parallel to the screen.

Here, the speaker defines two watersheds in terms of how the water flows. The two parts of the sentence are structurally equivalent: ‘what’s one watershed’ and ‘what’s the other watershed’. However, there is a difference in terms of the gesture. In the first instance, the gesture can be seen in a space continuous with the photograph: the right hand moves from the top of the mountain range down to the lake, the palm facing the ground throughout the gesture. The utterance ‘this way’ and the downward gesture in the context of the photo are continuous. On the other hand, there is no parallel to this with respect to ‘what’s the other side’ in the second definition. Rather, ‘what’s the other side’ was gesturally identified by a gesture that made use of the three-dimensionality of local space. To show this, we resolved the episode around Fig. 8c to allow the microanalysis of
the gesture depicted in Figure 9. The first line of the figure shows how the hand rises to
the mountaintop and then begins to bend so that the fingers are parallel similar to the way
they had been just prior to Fig. 8a. Then, rather than moving down as previously (Fig.
8b), the hand moves to the right (as seen from the audience) and down and rotates 90
degrees into the direction of the screen. Viewed in real time, the gesture creates the
impression of a mountain slope directed away from the audience and into the picture. The
speaker then orients herself away from the screen, brings up her second hand, and brings
both of them down in the way we would see it on a side view image of a hill (Figure 8d-
e). That is, ‘flowing down the other side’ cannot be gestured against the photo in the way
she had done with the visible watershed.

The moment depicted in Fig. 8c and Fig. 9 constituted the changeover between two
orientations; more specifically, it occurred at the beginning of the second line in Fig. 9
when the arm and hand make use of space to indicate ‘what’s the other side’. The change
in orientation is clearly noticeable in the change of line of sight and arms parallel to the
screen and the introduction of the left arm into the gesticulation process. Furthermore, it
changes the origin from which the speaker speaks. In the first two frames, the perspective
is that of an observer looking from an elevated point over the lake and to the mountains
behind it. In the last two frames, the gesture is no longer to be seen as acting against the
photo, but taking the perspective of a person moving downhill or the perspective of water
flowing downhill. Notice that the gesture is similar to that used to describe what it means
to drive through the Tsartlip Band Reserve (Figure 5).
DISCUSSION

To understand interactions requires a study of the setting and the resources that it makes available to discourse participants for making sense of each other’s utterances and gestures (C. Goodwin 1996). That is, there is a need to move beyond the study of speech and gestures in communication and to include environmental structures and body movements. In this study, we provide an expanded framework of communication to include an aspect of the environment, visually available inscriptions, and the relative position of speakers with respect to audience and inscriptions. Whereas we suggest that the framework allows us to understand communicative situations, we do not claim that speakers consciously attend to producing information such as the differential orientation in space. Rather, such orientations that co-vary with and distinguish different referents are likely to be of the nature of involuntary information, that is, information given off (Kendon 1988b).

A speaker is always located in the local space of the present situation. Furthermore, we know that in focused encounters speaker and listener orient themselves toward each other (Heath 1986). However, the presence of an inscription about which the speaker talks establishes constraints. Here, in situations where the speaker is positioned between audience and inscription, the speaker’s orientation can be parsed into two domains. First, there is an orientation to the inscription. Talk and gesture are relative to the inscription, which may have dimensions that are not continuous with lived experience (abstract concepts). Second, there is an orientation to the referent of the inscription. In the present case, maps and photographs denote a valley near the village where the presentation takes place. It is therefore likely that the audience (grade 7 children, scientists) recognizes
features of the landscape from the description and projects them onto their own experience of the valley. For example, ‘down the slopes of Mt. Newton’ or ‘down through the Tsartlip Band Reserve’ and the associated gestures may allow the audience to associate the present talk with their own lived experience in the valley. In our database, such a relatively clean separation does not exist in the speech component, leading in the case of maps and aerial photographs to a blending of narrative space (Haviland in press) and the space associated with an orientation to the inscription. In these situations, going down (left, right) on the map (graphic space) may coincide with going up in narrated space; similarly, going up on the map (graphic space) may coincide with going down in narrative space. This observation also throws light on a study of Japanese rock climbers that has questioned the absolute value assigned to vertical space as being an overestimation rooted in European conceptualizations of space (Kataoka 1998). Our study questions and relativizes the absolute nature of what is up and what is down.

Oriented to the inscription, the gesture calls attention to a particular feature: In fact, gesture and feature mutually motivate each other. The primary expressive means is not the gesture but the representation to which the gesture refers. The inscription then refers to the world not immediately available to the participants. In narrated space, it is the gesture itself that has a primary role in representing the aspect in the world.

When the illusion of depth is provided by the inscription, such as the scenic photographs studied here, we observe a shift in that the orientations toward inscription and narrative space begin to overlap and blend. It has been noted that physicists who talk over and about inscriptions inhabit a liminal world, situated between the world of perceptually available inscription and the constructed world it indexes (Ochs et al. 1994).
In this *liminal* world, distinctions between subject and object are no longer sharp. In our analysis of this work, the liminal world is largely achieved by the lamination of narrated space and inscription space. For example, physicists talk about being in ‘domain state’, which is a clearly identified shaded area on a graph; getting out of domain state and its graphical representation is associated with the trajectory of a gesture beginning within and moving outside of this area. This domain state is only available in and as of the inscription. In contrast to the research by Ochs et al. (1994, 1996), the world referenced by the inscriptions in the present situation is the everyday lived environment of speaker and audience. It is a world shared, which blends with the local space of the classroom. In the physicists’ case, the constructed world is of a conceptual (symbolic) nature, which is therefore discontinuous with the local space of the lab where the conversations take place.

Speakers’ gestures, when in reference to the inscription, are iconic in the sense that there is a similarity relation easily picked out by the onlooker. The gestures in narration space also portray things and events in terms of a similarity relation, but the directional orientations are not maintained. For example, Meagan repeatedly accompanied her talk about the confluence of Hagan Creek (north arm) and Graham Creek with gestures involving both arms and hands that depict something of the type of ‘two things coming together’ (Figure 3c). When she talked in the direction of the inscription, the arms and hands move in a plane more or less parallel to the map (or aerial photograph): the gesture reproduces the topological relation between the two arms, their confluence, and the joint water flow after the creeks meet. On the other hand, in narrative space, the two creeks, their confluence, and the subsequent joint movement of waters from each occurs in a
plane parallel to the floor (i.e., at a 90° azimuth angle and a rotation of approximately 90° counter clockwise). The orientation of narration space provides a constraint such that they do not preserve the cardinal direction that are preserved by speakers of Guugu Yimithirr.

Our findings with respect to the spatial orientation of speakers are consistent with other recent research on orientation (Levinson 1997). Thus, whereas aboriginal speakers of Guugu Yimithirr and Mayan (Zinacantec) make reference to cardinal directions in absolute terms (Haviland in press), western (Dutch) subjects show a preference for relative orientation (Levinson 1997). In our case, iconic gestures associated with narratives were defined by their location in narration space and relative to speakers’ dominant axes rather than by the actual cardinal directions of the landscape features that they talked about. Furthermore, in the case of scenic photographs, direction indications were anchored to the image and therefore relative to the line of sight rather than anchored to the cardinal directions of local space.

Our research provides evidence that language is not an independent phenomenon but closely tied to social situations and to physical aspects and arrangements of the speech situation. Furthermore, speech is integrated with body orientation (and movements), and gestures. These dimensions are virtually unexplored in the research on interactions in educational settings where there is a emphasize on language. However, this and other research conducted by our team in education settings shows that gestures and other body movements, orientation, and physical arrangements of speaker, listener, and artifacts have considerable influence on the nature and form of the language used. Situations such as lectures where there are few overt interactions between speaker and audience may
constitute the easiest contexts to analyze. There is very little, if anything, known about the interrelation in more complex classroom situations involving teacher and one or more students.

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Table 1

Frequency and Type of Inscription in Three Contexts

<table>
<thead>
<tr>
<th>Context</th>
<th>Type of Inscription in selected lessons</th>
<th>Total Inscriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-dim</td>
<td>3-dim</td>
</tr>
<tr>
<td>Pre-college</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 7 ecology</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>College</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sophomore ecology</td>
<td>50</td>
<td>5</td>
</tr>
<tr>
<td>Physics for Elementary Teachers</td>
<td>30</td>
<td>0</td>
</tr>
</tbody>
</table>
Table 2

Examples of Verb- and Noun-Related Gestures

<table>
<thead>
<tr>
<th>Word</th>
<th>Gesture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Verb-Gesture Coordination</strong></td>
<td></td>
</tr>
<tr>
<td>Tumbling:</td>
<td><em>Fingers of both hands oriented towards each other, circular movement around axis defined by finger direction.</em></td>
</tr>
<tr>
<td>Meandering:</td>
<td><em>Palms of both hands touching each other, meandering movement of hands away from body.</em></td>
</tr>
<tr>
<td>Absorbing [water into ground]:</td>
<td><em>Both hands form cups, open to ceiling; hands move downward toward the floor.</em></td>
</tr>
<tr>
<td><strong>Noun-Gesture Coordination</strong></td>
<td></td>
</tr>
<tr>
<td>Pavement:</td>
<td><em>Hand with palm toward floor, moving from body center line outward to the side of the body, at level of solar plexus.</em></td>
</tr>
<tr>
<td>Underground:</td>
<td><em>Similar to “pavement” but at level of pelvis.</em></td>
</tr>
<tr>
<td>Watershed:</td>
<td><em>Both arms form near circular shape at shoulder level.</em></td>
</tr>
</tbody>
</table>
Figure 1. Classification of gesture referents in terms of the level of abstraction, i.e., distance of representations from lived experience. Because speakers always inhabit a lived world, talk about and referring to an inscription can coincide with talk about the world—potentially leading to logically incoherent construction which, depending on the situation, may be resolved in a pragmatic manner.

Figure 2. Orientation and gestural space as a function of the type of inscription. a. The inscription is ‘truly’ 2-dimensional (map, aerial photograph). b. The speaker talks about some place or phenomenon without direct reference to the inscription. c. The inscription provides the illusion of three dimensions (scenic photograph). d. In addition to situation (c), speaker movement creates a virtual extension of the 3-dimensional inscription into local space.

Figure 3. Gestures are related to the nature of talk, nature of inscription, and speaker orientation. a. In graphic space, there is a preference for deictic gestures, one-hand (arm) involvement, and head orientation toward inscription; the talk is about the inscription. b. In narration space, there is a preference for iconic gestures (here ‘oil spill’), often involving both hands, and a body orientation toward the audience. c. There is only one instance where the same iconic two-arm gesture is used in both spaces (‘confluence of two creeks’). d. When the inscription simulates a third dimension as in scenic photographs, gestures typical for narration space overlap those typical for graphic space; here, ‘movement into the valley’ corresponds to a movement of the gesture in three dimensions, including in the audience-inscription direction, thereby producing additional resources for interpreting depth.
Figure 4. When is down up? Two discourses get intermingled as Meagan shows where the creek is located on an aerial map (downward) on the map but upward in the landscape (lived experience).

Figure 5. Meagan moves in and out of the two spaces, graphic and lived space. When she is in graphic space, her gestures are clearly oriented to the inscription, here the aerial map. When she moves to narrated space, her body orientation is toward the audience. The gestures have the horizontal and vertical orientations of the lived world—up down, left-right. Graphic space is oriented parallel to the vertical orientation of the inscription.

Figure 6. a. Meagan turns situates herself spatially with respect to the landscape depicted. b-e. The speaker uses a n iconic gesture to show how Graham Creek flows with in the virtual space opened up. f-h. The gesture moves horizontally in graphic space but down in narrated space. There is continuity between narrated space and graphic space, including here the virtual space opened by the scenic photograph.

Figure 7. Overhead view of the situation in Fig. 6b–h. The right hand moves through an S-shaped trajectory (dotted line) as the body slightly rotates and then moves closer to screen (broken line). The hand bends and then follows a horizontal landscape feature in the image projected onto the screen.

Figure 8. In this episode, Meagan attempts to explain the notion of watershed to grade 7 students. a-b. Meagan moves in a combined space where her gestures have referents both in the lived world and the photo. c. Meagan turns to show where the water flows down on the other side. d-e. Meagan turns away from the inscription space and
produces a gesture (with both hands and arms) that shows the flow of water down an incline.

**Figure 9.** Microanalysis of the situation around Fig. 8c. The hand movement depicts information (‘what’s the other watershed’) not available from the image itself. In the first line, the hand rises to the crest of the range in the photograph, and bends so that the fingers are horizontal to the ground. In the second line, the hand moves to the right and down and rotates 90 degrees into the direction of the screen, thereby creating the impression of a slope of the mountain away from the audience and into the picture.
lived  scenic  aerial  map  diagram  graph  ...  \infty
world  photo  photo

low  \quad \text{level of abstraction} \quad \text{high}
Graham is flowing all through here and down up to the headwaters.

**Figure 4.** When is down up? Two discourses get intermingled as Meagan shows where the creek is located on an aerial map (downward) on the map but upward in the landscape (lived experience).
If you are driving along West Saanich Road and you sort of through briefly and slightly bends knees

the Tsartlip Band Reserve and you start to head down hill a little bit and there is a creek…

Figure 5. Meagan moves in and out of the two spaces, graphic and lived space. When she is in graphic space, her gestures are clearly oriented to the inscription, here the aerial map. When she moves to narrated space, her body orientation is toward the audience. The gestures have the horizontal and vertical orientations of the lived world—up down, left-right. Graphic space is oriented parallel to the vertical orientation of the inscription.
We are standing on the southern part, on the south-eastern one here. And Graham is flowing in like this. And it’s flowing right down into the valley.

Figure 6. a. Meagan turns situates herself spatially with respect to the landscape depicted. b-e. The speaker uses an iconic gesture to show how Graham Creek flows within the virtual space opened up. f-h. The gesture moves horizontally in graphic space but down in narrated space. There is continuity between narrated space and graphic space, including here the virtual space opened by the scenic photograph.
Figure 7. Overhead view of the situation in Fig. 6b–h. The right hand moves through an S-shaped trajectory (dotted line) as the body slightly rotates and then moves closer to screen (broken line). The hand bends and then follows a horizontal landscape feature in the image projected onto the screen.
What’s ↑ one watershed flowing ↑ this way and what’s the ↑ other watershed flowing ↑ on the other ↑ side of the land.

**Figure 8.** In this episode, Meagan attempts to explain the notion of watershed to grade 7 students. **a-b.** Meagan moves in a combined space where her gestures have referents both in the lived world and the photo. **c.** Meagan turns to show where the water flows down on the other side. **d-e.** Meagan turns away from the inscription space and produces a gesture (with both hands and arms) that shows the flow of water down an incline.
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