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Learner Articulation as Interactional Achievement: Studying the Conversation of Gesture

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Learner articulation, studied under a variety of names (e.g., self-explanation, self-directed, and generative summarization), has been shown to contribute to new learning. Whereas prior research has focused on measuring the effects of various forms of articulation on learning outcomes, this article focuses on how such articulation may be accomplished, moment to moment and turn by turn, in learning settings. It documents some of the ways in which participants use their bodies and, in particular, their hands while displaying what they know. It presents fine-grained analyses of 3 videotaped fragments of naturally occurring interaction among medical teachers and students participating in tutorial meetings in a problem-based learning curriculum. Within these 3 exhibits evidence was found of *recipient design* with regard to gesture production and *recipient response* with reference to its performance. Also found was evidence of gesture reuse as a mechanism for cohesion across turns at talk and as a display of mutual understanding. This article represents a preliminary step toward a more general program of research focusing on sense-making practices in learning settings. Extending an understanding of how such practices are accomplished interactionally is a crucial step toward eventually being able to give an adequate account of what makes any exemplary form of instruction effective.

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> There exists thus a field of conduct … which in its nature may be classed gesture. It consists of the beginnings of those actions which call out instinctive responses from other forms. And the beginnings of acts call out responses which lead to readjustments of acts which have been commenced, and these readjustments lead to still other beginnings of responses which again call out still other readjustments. Thus there is a conversation of gesture. Mead (1910, p. 398)

There is a growing consensus that giving voice to one's understandings contributes in important ways to learning. A variety of instructional activities, based on this premise, have been proposed, including learner-generated elaboration (Hamilton, 1989), self-directed (Brown, Day, & Jones, 1983) and generative (Wittrock & Alesandrini, 1990) summarization, constructive interaction (Miyake, 1986), collective comprehension activity (Hatano & Inagaki, 1991), peer collaboration (Crook, 1994), self-explanation (Bielaczyc, Pirolli, & Brown, 1995; Chi, Bassok, Lewis, Reiman, & Glaser, 1989; Chi, de Leeuw, Chiu, & LaVancher, 1994; Coleman, 1998; Ploetzner, Dillenbourg, Preier, & Traum, 1999; Renkl, 1997), classroom (Forman & Larreamendy-Joerns, 1998) and elaborative explanations (Webb, 1989), construction of explanatory answers (Pressley et al., 1992), and reflective discourse (van Zee & Minstrell, 1997). All of these activities were designed to create opportunities for learners to say what they know—or, to use a more general term, to foster *learner articulation.*

Learner articulation has been described as having two different but potentially interrelated meanings: "the act of giving utterance … to force a cohesive explanation" and "the action … of jointing or interrelating … of concepts and relationships" (Koschmann, Kelson, Feltovich, & Barrows, 1996, p. 93). This first aspect of learner articulation, giving utterance, addresses the process of putting one's ideas into words. It is this sense of linguistic formulation, rather than the more technical sense of phonetic production, that is relevant when we write of articulation in the context of learning. This aspect of learner articulation is fundamental to all of the instructional activities thought to contribute to improved understanding and listed in the previous paragraph. The jointing or interrelating of concepts, however, is also crucial to some, if not all, of these activities.[1] The idea of jointing derives from the special sense in which anatomists use the term *articulation,* that is, to fit elements together to form an integrated whole. In this metaphoric sense, articulation involves not only putting ideas into words but also the bringing together and fitting together of words (and hence ideas) in the process. Thus, the term *learner articulation*, as we use it here, accommodates the notion that learners may achieve new understandings, through the process of combining ideas, in the course of expressing them.

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[1]See, for example, the discussion of the constructive aspects of self-explanation by Chi et al. (1994).

It is not obvious why articulation should necessarily benefit learning. If one assumes a simple transmission model of instruction, why should the playing back of information received lead to new learning? When learning is viewed as a purely occult mental process amenable only to indirect study, we are left at an impasse, with no means of resolving the puzzle of the learner-articulation effect. Studying interaction in contexts of collaborative problem solving, however, allows us to gain some purchase on this problem. In effect it allows us to study learning directly as an interactional rather than a mental phenomenon. Our project becomes one of documenting how learners *do* articulation. We focus on one specific aspect of this problem: how learners use their hands and bodies in the process of displaying their understandings. We begin by examining earlier research on gesture and learning.

PRIOR RESEARCH ON GESTURE AND LEARNING

Kendon (1987) defined *gestures* as "bodily movements that are clearly part and parcel of the individual's openly acknowledged intention to convey meaning" (p. 71) and, as such, are "*treated* as intentionally communicative by coparticipants" (p. 71). He made a further distinction among gestures that function as complete utterances in their own right, which he termed *autonomous* or *emblematic* gestures, and gesticulation "that seems to be bound up with [speech] as a part of the total utterance" (p. 75). In this article we use the term *gesture* to refer to the spontaneous use of hands and, more generally, bodies, that occurs as a normal part of face-to-face interaction, and we investigate how learners use gesture in articulating their knowledge.

Much prior research on the role of gesture in learner articulation has focused on what gesture reveals about learners' understanding. It is, therefore, in keeping with the first definition of learner articulation as giving utterance to a cohesive definition. For example, work conducted by Goldin-Meadow and her colleagues examined children's explanations in various reasoning tasks (Church & Goldin-Meadow, 1986; Church, Schonert-Reichl, Goodman, Kelly, & Ayman-Nolley, 1995; Goldin-Meadow, Wein, & Chang, 1992). In Goldin-Meadow, Alibali, and Church (1993), *gesture* is described as "a window into the mind of the child in transition" (p. 295).

Goldin-Meadow et al. (1993) defined *transition* as a "bridge between two rule-governed knowledge states" (p. 279); that is, "an advance from an inadequate yet systematic understanding of a concept to a more adequate, systematic understanding" (p. 279). They theorized that the discordancy between talk and gesture reflects the fact that gesture provides "a vehicle … better suited to capturing a child's understanding of a problem than is speech" (p. 292). Children in transition, by this theory, may be thought to be of two minds with respect to the problem at hand, and their talk and associated gestures provide windows into both. In one se-

ries of studies (Church & Goldin-Meadow, 1986; Church et al., 1995), children were asked to rationalize their judgments in a Piagetian conservation task. The researchers found that (a) the children often used gesture as a part of their explanation; (b) these gestures conveyed meaning, both to the experimenters and, in a later study, to naive observers (Goldin-Meadow et al., 1992); and (c) the information embedded in these gestures was in some cases discordant or mismatched with the information conveyed verbally (Church & Goldin-Meadow, 1986). In more recent work, Roth (2000) examined gesture–speech mismatch in science-related explanations produced by high school students.

Other studies have treated gesture not only as an external manifestation of understanding but also as reflecting a constructive process of connection making. Such a view is more consistent with the second definition of learner articulation as a jointing or interrelating of concepts. Crowder (1996), for example, described *explanatory sense making* as "the process of explaining observed phenomena through coordination of theory and evidence" (p. 174). She investigated students' use of gesture in an elementary classroom, choosing as a unit of analysis *student performances,* which she defined as "a child's response to a given question or speaking task posed by a teacher or another child" (Crowder & Newman, 1993, p. 354). Crowder made an analytic distinction between two forms of classroom science talk: descriptive talk about science, and a form of explanation she described as *running models.* Although the former represents a more stable mode of recitation, the latter involves "explaining in-the-moment" (p. 201) or "explaining to self" (p. 205). In that such forms of explanation consist of "talk that has not been thought out prior to its expression" (Ochs, 1979, p. 55), they entail extensive "planning-in-the-moment" (Crowder, 1996, p. 204). As a result, they are often unpolished and marked by breaks, restarts, and self-correction. In such situations, however, learners appear to achieve "conceptual glimmerings that outstrip scientific vocabulary" (Crowder & Newman, 1993, p. 371).

Crowder's (1996) and Crowder and Newman's (1993) studies were important in directing our attention to the constitutive nature of gesture use in learner articulation. By limiting her frame of analysis to the performances of individual gesturers, however, her studies presented a potentially restricted view of how gesture is used in learner articulation. In this article we examine how gesture serves as one of several interactional resources available to participants engaged in joint sense making. In so doing, we offer empirical evidence for what might be termed, borrowing a phrase from Mead (1910), the *conversation of gesture*. We show that gestures are more than auxiliary communicative devices—they are actions that shape and help reflexively constitute a social order that cannot be separated from the understandings that interactionally emerge through teaching–learning processes (LeBaron & Streeck, 2000). We argue that studying the conversation of gesture can contribute in important ways to an understanding of how participants *do* learner articulation.

DATA AND OBSERVATIONS

Learner articulation depends on communicative behaviors that can be heard and seen by participants and researchers alike. Through detailed analysis of video recordings it is possible to identify specific features of learner articulation—vocal and visual behaviors that are individually coordinated and socially organized to make sense. The methods used here, then, derive from the family of analytic traditions devoted to the study of naturally occurring speech and movement (see Duranti, 1997). These traditions include interaction analysis (Jordan & Henderson, 1995), video analysis (e.g., Heath, 1986), conversation analysis (Atkinson & Heritage, 1984; Drew & Heritage, 1992; C. Goodwin, 1981), and context analysis (Kendon, 1990; Scheflen, 1974).

Koschmann, Glenn, and Conlee (2000) examined how participants in a learner-directed method of instruction known as *problem-based learning* (PBL) made their understandings visible to themselves and their peers. In a PBL curriculum, students collaboratively explore a series of authentically constructed problems, identify deficiencies in their collective understanding (*learning issues*), and independently research these matters in a self-directed manner (Barrows, 1994). Articulation has been identified as a critical component of participation in a PBL curriculum. It has been argued, for example, that "participation in the PBL process dictates that students continuously put their ideas before the group" (Koschmann et al., 1996, p. 102). For this reason, PBL meetings provide an ideal setting for studying the ways in which learners use gesture while articulating newly acquired knowledge.

We present and analyze three videotaped fragments, taken from a data corpus of over 140 hr of PBL meetings recorded at a midwestern U.S. medical school. We use the transcription conventions developed by Gail Jefferson (see Atkinson & Heritage, 1984), which are summarized in Appendix A. Full transcripts for the three analyzed fragments can be found in Appendixes B, C, and D.[2] Participants' names have been altered.

Exhibit 1: "Where Is the Hippocampus?"

Description of data. Our first videotaped fragment was extracted from a longer segment[3] involving second-year medical students and a faculty facilitator (Coach). The participants sat around a table, oriented toward each other and vari-

[2]Digitized video for the three fragments can be found on the CD–ROM distributed with this issue. Copies of the video can also be accessed at the Talkbank Web site (www.talkbank.org).

[3]The fragment described here is part of a longer 6-min segment that was described by multiple analysts in a special issue of *Discourse Processes* (Koschmann, 1999). Previously published descriptions of gesture use within this fragment can be found in Lemke (1999) and Hall (1999).

ous medical texts (see Figure 1). After a query from Coach (line 1; see Appendix B), participants collaboratively formulated the location of the hippocampus, a brain structure. Norman self-selected (line 4) to respond to Coach's query and used an anatomical flipchart on the opposite end of the room as a visual resource (see Figure 1). Maria made multiple efforts to amend Norman's formulation, the third of which (lines 15 and 16) was coordinated with an analytically interesting gesture, which is the focus of our analysis.

15 Maria: S'like- if: you lift up that little temporal lobe,
16 it's on the inside.

Maria's use of "s'like" framed her comment (and its associated gesture) as metaphor. Concurrent with the utterance of this first syllable, Maria raised her right hand from below the table. As she said "lift," she executed a pinching motion using her thumb and index finger (see Figures 2a and 2b). She then forcefully lifted her arm above her head with her elbow held high, at the same time pitching her head slightly backward. At the completion of this motion, and coincident with the word "that," she twisted her hand counterclockwise exposing the inside of the hand (see

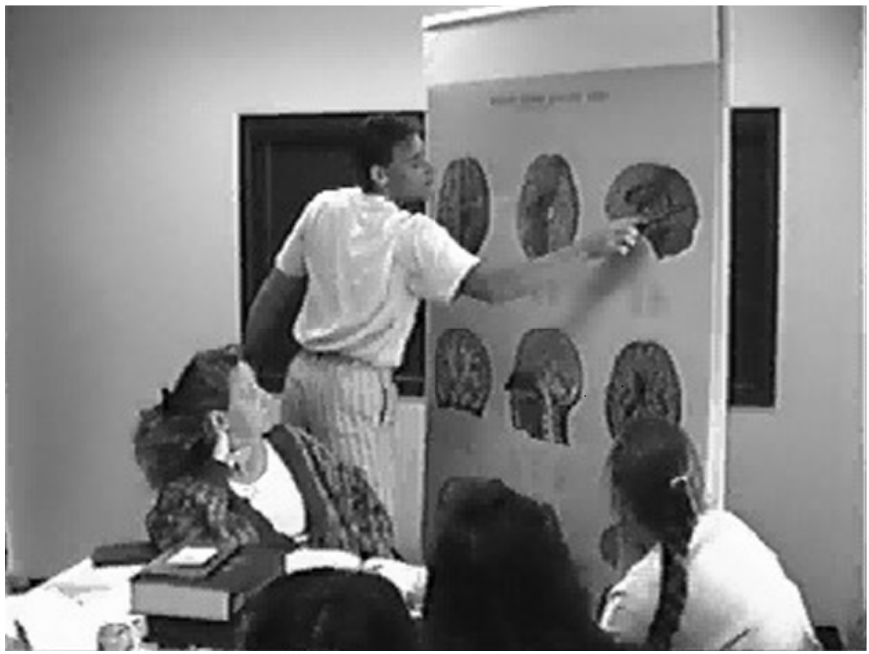

FIGURE 1 Setting for the "Where is the hippocampus?" fragment. A key for identifying participants can be found in Appendix B.

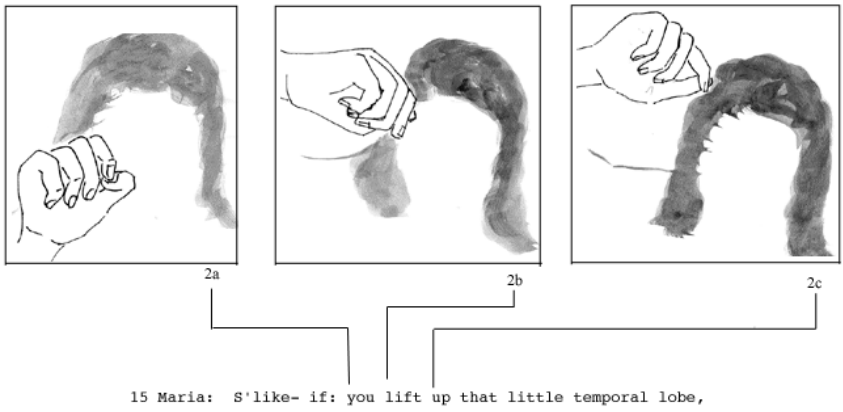

FIGURE 2 Coordination of gesture and speech in Maria's formulation of the location of the hippocampus.

Figure 2c). She then returned the hand below the table but almost immediately raised it again to perform a second gesture synchronized with the word "on." The gesture was performed with a closed hand that was twisted on the second syllable of "inside." Although the gesture was made clearly visible to her audience, Maria was turned away from the camera at this moment and, as a consequence, our view of this second gesture is partially blocked. Our comments pertain to Maria's first gesture.

Maria's utterance and associated gesture called on her listeners to make a shift between the two-dimensional representations of the flipchart (which Norman had referenced) and the three-dimensional representation of the metaphorical brain suggested by her first gesture. Her gesture, in effect, acted out a projected dissection of her own cerebral cortex.[4] What is remarkable about this shift in orientation is how unremarkably it was treated by her coparticipants. No one appeared confused or startled by this change in orientation. Instead, Coach (line 17) seamlessly mapped Maria's description back onto the flipchart atlas by redirecting the attention of the group toward an alternate section where Norman (with the help of another student, Lill) was then able to successfully locate—on the flipchart—the region specified by Maria. Her gesture provides us with an elegant example of the situated nature of gesture production.

Observations. A striking feature of Maria's gesture is the degree to which it can be seen as recipient designed. Sacks, Schegloff, and Jefferson (1974) described *recipient design* as the "multitude of respects in which the talk by a party in

[4]This metaphoric description was suggested by Hall (1999).

a conversation is constructed or designed in ways which display an orientation and sensitivity to the particular other(s) who are co-participants" (p. 727). They analyzed the ways in which speakers use recipient design in "word selection, topic selection, admissibility and ordering of sequences, options and obligations for starting and terminating conversations, etc." (p. 727). Schegloff (1972) observed that

> if one looks to the places in conversation where an object (including persons) or activity is identified (or as I shall call it, "formulated"), then one can notice that there is a set of alternative formulations for each such object or activity, all the formulations being, in some sense, correct (e.g., each allowing under some circumstances "retrieval" of the same referent). (p. 80)

Schegloff (1972) described two bases for selecting a particular formulation: *membership* and *location analysis*. Membership analysis requires consideration of "the categories … of the society of which the hearer(s), in the first instance, but also the speaker are members" (p. 88). Location analysis, on the other hand, arises from "an analysis of [the speaker's] location and the location of his co-conversationalist(s), and of the objects whose location is being formulated" (p. 83). Sacks et al. (1974) described recipient design in lexical construction. As we show here, however, recipient design also enters into gestural performance.

Maria's lifting gesture assumed a shared understanding of what a temporal lobe is, where it is located (i.e., in the brain), and the fact that it can be lifted away from the rest of the brain. Her gesture would hold little meaning for an audience unfamiliar with these aspects of human neuroanatomy. We might refer to it, therefore, as an *insider gesture*[5] because it presumes certain forms of special knowledge shared by the speaker and audience. The use of insider gestures is related to recipient design in that the gesture provides evidence of the sort of membership analysis described by Schegloff (1972).

We also see evidence that Maria, in her gestural performance, was attending to certain aspects of the local situation; that is, she was engaging in what Schegloff (1972) described as *location analysis*. In the first place, her three-dimensional performance was made recognizable against the temporal and spatial backdrop of Norman's two-dimensional charting. Her gesture depended on his earlier pointing and the still-visible representation on the flipchart to resolve the indexical reference to "that little temporal lobe" and to make clear with relation to what "on the inside" was referring. In the second place, her gesture used her own present (but not visible) brain as an object to orient her audience to the three-dimensional location she was attempting to specify by, in effect, gesturally lifting her own temporal lobe. The sense of her gesture depended not only on the action of her hand, how-

[5]An insider gesture should not be confused with an *insider perspective,* as described by McNeill (1992) and Crowder (1996).

ever, but also on the presence of her own body as a relevant backdrop for this performance.

Hutchins and Palen (1997) provided a rich account of how gestures participate in what they referred to as a "multilayered representation" (p. 35). Gestures both draw on and elaborate the complex of semiotic resources used in practical sense making. Hutchins and Palen described how *deictic* gestures (i.e., points) acquire their determinate sense by virtue of being superimposed on relevant aspects of the material environment. Similar observations have been made by C. Goodwin (2002), Hindmarsh and Heath (2000), LeBaron and Streeck (2000), and Streeck (1996).

Maria's lifting gesture differs, however, from these earlier accounts of situated gesture use in that the material environment against which her gesture is juxtaposed are aspects of her own body. The action, therefore, is performed by the hand, but its meaning resides in a larger context that embraces salient features of the material environment, especially the speaker's corporal form. Some researchers (e.g., Beach & LeBaron, 2002; Heath, 1986, 1988) have examined the diectic gestures of patients who bring attention to their bodies during medical examinations. By contrast, Maria's gestures are *iconic* (see McNeill, 1992, for a description of gesture types) representations of her hidden (albeit proximate) gray matter.

Because the performance of a gesture is recipient designed, its meaning is inherently situation bound. Our ability as analysts to make sense of the exchange and, in particular, what is being accomplished by Maria's gesture depends crucially on our access to the material and social context within which it was produced. This exhibit illustrates how speakers' talk and gestures furnish clues that "engage their recipient's common sense knowledge of the world, their recipient-designed mutual knowledge, and their orientation to the occasion of the conversation" (Schegloff, 1988, p. 444). Said another way, it reveals certain ways in which knowledge takes an embodied form.

Exhibit 2: "Serial X-Ray"

Description of data. As was the case with the first exhibit, our second videotaped fragment was extracted from a longer segment of interaction.[6] It was recorded in a different PBL meeting with a different group of participants. Similar to the previous exhibit, the students and tutor (Coach) sat at a table containing notes, textbooks, and materials relevant to the case under discussion (see Figure 3). As the fragment began, participants were discussing the possible risks of performing an abdominal computerized tomography (CT) scan on a young female patient. Many gestures were performed over the course of this discussion as the topic repeatedly shifted

[6]A description of the extended segment was provided by Koschmann, Glenn, & Conlee (2000).

FIGURE 3 Setting for the "serial X-ray" fragment. A key for identifying participants can be found in Appendix C.

from potential risks, to differences between conventional X-rays and CT scans, to an attempt to estimate the differences in radiation exposure between a conventional X-ray and a CT scan. Our analysis focuses on an exchange between Joel and Jackie (lines 12–21).

First, Joel offered a refinement of Coach's question, showing an understanding at least sufficient to pursue the line of inquiry:

12 Joel: ↑What is the dosage (0.4) relative (.) from uh normal
13 X-ray to a CT¿

While raising the difference between an X-ray and CT scan, Joel partitioned the use of his hands. During his 0.4-sec pause, Joel lifted his right hand (see Figure 4a). Immediately prior to the word "X-ray," he lifted his left hand into his gesture space and thereby associated it with "X-ray" (see Figure 4b). Then he said "CT" and at the same time jerked his right hand (already lifted) and thereby linked it with "CT" (see Figure 4c). Altogether, Joel associated his opposing hands with the concepts being contrasted. His hands were used metaphorically, held in front of him like

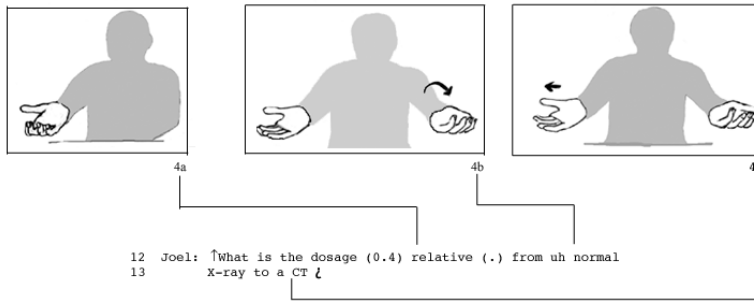

FIGURE 4 Coordination of gesture and speech in Joel's contrasting of normal X-ray and CT scans.

containers to hold ideas, in a manner reminiscent of McNeill's (1992) discussion of the conduit metaphor in gesture.

After posing a question (lines 12 and 13), Joel self-selected to answer it. His next utterance involved a complex sequence of gestures, including a "slicing" gesture that was coordinated with a knowledge claim about CT scans being "serial":

14 Joel: CT is serial CT °is it° serial X-rays >is it not<?

At the same time that Joel said "serial CT, " he gestured with his right hand, which was already associated with the notion of CT scan. He rotated his right hand 90° clockwise into a vertical position with his thumb pointing upward (see Figure 5c). He then executed a chopping motion in a plane parallel to his body (see Figure 5d). His third and final movement began with Joel raising his right hand within the plane constructed in the previous movement (see Figure 5e), but this time as the

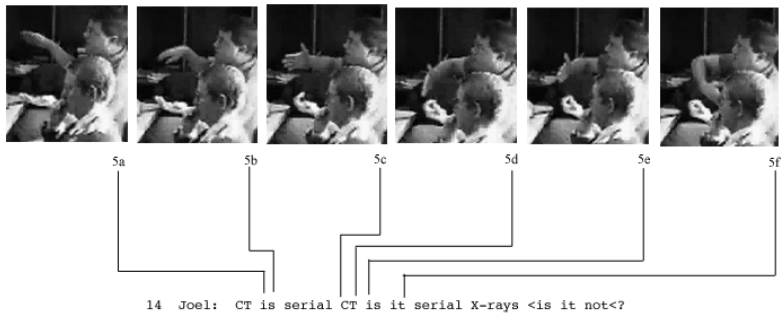

FIGURE 5 Coordination of gesture and speech in Joel's formulation of a CT scan.

hand was dropped it was drawn toward his body (see Figure 5f). Eventually, his right hand was retired to his lap.

Converting his statement into an interrogative form by adding "is it not?" Joel softened his assertion and at the same time made a next speaker relevant. By directing his gaze toward Jackie, Joel nominated her as the next speaker or respondent to his display of knowledge. Coach and Patrick both ratified this nomination by turning their attention in Jackie's direction, and Patrick pointed toward her using the pinky of his right hand. On cue, Jackie responded through vocal and gestural behaviors that recognizably built on Joel's contribution.

16 Jackie: Right you're taking slices so naturally if you
17 do: (0.4) two views of an abdomen (0.4) with u:h
18 plane film (0.2) and you do: (0.5) fifteen with (.) uh
19 Ctee (.) °I mean° but I don (.) I don't know (.)
20 I can't remember (.)the relative dosage for
21 one slice of CT versus (one)

From the outset, Jackie positioned herself as aligned with Joel regarding the issue at hand. The statement "Right you're taking slices," however, was an endorsement not merely of what Joel said but also of what he gestured. As Jackie enunciated "taking slices" she reproduced Joel's CT gesture (see Figure 6)—making three slicing down strokes—and she used her right hand, consistent with Joel's earlier partitioning. Joel answers (albeit silently) with an abbreviated version of this same gesture (see Figure 6c).[7]

As Joel did with his compare–contrast gesture, Jackie gesturally set up a contrast between two ideas. As she began the phrase "the relative dosage," she raised both hands off the table. With the enunciation of "relative," she pushed both hands down as though playing on a keyboard (see Figure 7a) and then lowered them to the table. However, when she started the phrase "one slice of CT," she raised and then dropped her right hand only (see Figure 7b). As she began the contrast ("versus [one]"), she repeated this movement with her left hand (see Figure 7c). In so doing, she reproduced Joel's association of the right hand with the concept of CT scans and the left hand with conventional X-rays. Jackie's compare–contrast gesture differed from Joel's, however, in that hers was performed with the hands palm down, as though the two concepts were objects on the table rather than things balanced in the hands. The conversation continued, but this exposition will suffice for our current purposes.

Observations. In this exchange we observe certain interactional features relevant to two issues discussed in the literature devoted to the study of gesture,

[7]It is widely held (cf. McNeill, 1992; Schegloff, 1984) that gestures are principally produced by speakers and only rarely by listeners. However, many examples of a recipient-produced gesture, such as Joel's gesture here, can be found in this data corpus.

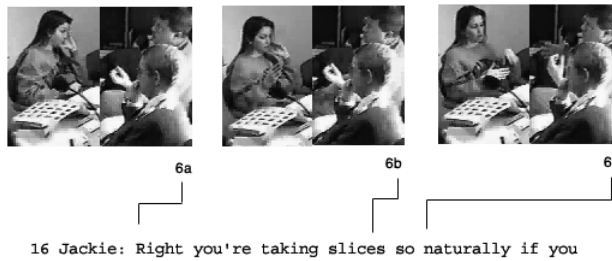

FIGURE 6 Coordination of gesture and speech in Jackie's formulation of a CT scan.

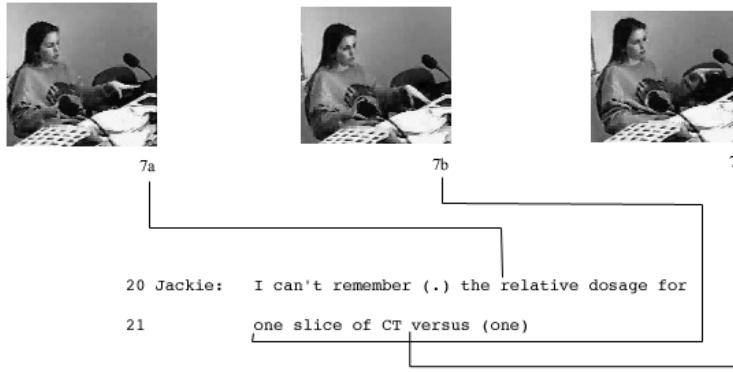

FIGURE 7 Jackie contrasts the amount of radiation exposure one receives from a conventional X-ray to that received from a CT-scan.

namely, *recipient response* and *gestural cohesion*. Both are important to the development of our understanding of gesture as a conversational phenomenon.

In practical situations it is often difficult to tease apart the contribution of gesture, talk, and the other semiotic resources used in the construction of meaning. Indeed, some researchers (Krauss, Morrel-Samuels, & Colasante, 1991; Rimé, 1983) have gone so far as to argue that gesture has no unique communicative role. C. Goodwin (1986) proposed that claims to the effect that "gesture is in some way consequential for recipients" (p. 30) must be grounded on clear evidence of what he termed *recipient response* (p. 30), that is, "by responses to the gestures as events

in themselves" (p. 30). Studying the ways in which hearers respond to a gesture is a special instance of a more general research strategy widely used in conversation analysis research and known as *sequential analysis* (cf. C. Goodwin, 1981; Sacks, 1992). Sequential analysis seeks grounds for interpreting social action by examining the ways in which the action is subsequently treated by participants. C. Goodwin's (1986) call for an analysis of recipient response, therefore, is a call for a sequential analysis of gestural displays.

When one examines the unfolding interaction here, one sees clear evidence of recipient response. Jackie's "Right you're taking slices" (line 16) put into words something that Joel had communicated only through gesture. His CT-scan gesture not only supported what he contributed lexically, but it also extended it semantically. Joel's gestural response to Jackie's reproduction of his own prior slicing gesture is an example of what de Fornel (1992) referred to as a *return gesture* (p. 163). It is a visible action on the part of a recipient to a gesture to both acknowledge and display attentiveness to it. Both Joel's return gesture and Jackie's allusion to Joel's previous gesture constitute evidence for recipient response under the criterion proposed by C. Goodwin (1986).

A second issue, highly relevant to the role of gesture in learner articulation, has to do with gestural cohesion. Halliday and Hasan (1976) used the term *cohesion* to describe the various mechanisms by which linkages are constructed across units of discourse. Among these, they included the *lexical cohesion* that is achieved through simple repetition of a textual element across separated units of text. McNeill and Levy (1993) provided examples of how gesture can also be used to produce a form of *gestural cohesion*. They described how the hand with which a gesture is performed, the space within which a gesture is produced, or the form of the gesture itself can contribute to topical cohesion across turns at talk.

The examples provided by McNeill and Levy (1993) apply only to gestural cohesion across units of talk produced by a single speaker. Other researchers have described how gestures are repeated across different speaker's turns as talk. Von Raffler-Engel (1986), for example, described how certain gestures could, on occasion, be transferred from speaker to listener. LeBaron (1998) studied professional architects interacting with clients during several meetings over a 6-month period and found that certain hand gestures initially performed by the architects were subsequently appropriated by the clients. We see here in the exchange between Joel and Jackie how reproduction of a previously performed gesture can link together elements of a conversation. Jackie's reuse of Joel's slicing gesture can be seen to connect her discussion of CT scans back to his. Furthermore, by applying Joel's convention of associating the right hand with CT scans and the left hand with conventional X-rays, she created a link back to Joel's prior discussion. As another example of gestural cohesion, consider when Joel earlier self-selected to answer his own question (line 14). He chained together his just completed compare–contrast gesture with what became in his second utterance an iconic gesture for a CT scan.

By performing the latter gesture with his right hand he exploited the distinction constructed in his prior utterance. In all three examples, the repetition of a gesture or one feature of a gesture served to tie together sequential pieces of the unfolding conversation.

Earlier we cited evidence for recipient design in gesture performance as one justification for the need to study gesture conversationally. Recipient response and gestural cohesion similarly argue for adopting a frame of analysis that goes beyond an examination of the gesture (and gesturer) in isolation. The meaning of a gesture resides not in the gesture itself but in its relationship to preceding (and succeeding) forms of visible and vocal interaction. All three issues (recipient design, recipient response, and gestural cohesion), therefore, highlight the importance of including the social and material environment, as well as the conversational history, in the analysis of gestural performance. To this point, however, we have examined these issues only with regard to extracted exchanges. In the next exhibit we explore the use of gesture in a more elaborate segment of interaction.

Exhibit 3: "Can You Define *Thrills*?"

Description of data. Our final fragment involves two groups of participants communicating by means of a videoconferencing system: one a group of graduate nursing students, the other a group of first-year medical students.[8] Although the groups were physically separated by 180 miles, they were brought together virtually as one televised image that all participants could see and hear. In the recording, the PBL facilitator (again identified as Coach) and three medical students appeared in the picture-in-picture window on the lower right of the screen (see Figure 8). At both locations, participants sat in a semicircle around a large table so that they could easily orient toward each other, toward a common paper-based case simulation (one copy at each site), and toward the videoconferencing equipment (camera and monitor) that enabled communication with the remote group. Because all participants had to orient toward their local cameras in order to see and be seen by the participants at the remote site, this teleconferenced meeting provided an excellent setting for studying the ways in which people use their hands and bodies while articulating their knowledge.

The 8 participants explored a particular clinical case by reading and discussing a specially formatted, text-based simulation (Distlehorst & Barrows, 1982). The case involved an elderly female patient being examined after an incident in which she briefly lost consciousness. The participants encountered the technical term *thrills* while reading the results of a cardiovascular exam, setting the stage for an

[8]The fragment analyzed here represents an example of a complete "knowledge display segment" as described by Koschmann et al. (2000). We have previously described this particular segment (LeBaron & Koschmann, in press).

FIGURE 8 Setting for the "can you define *thrills*?" fragment. A key for identifying participants can be found in Appendix D.

interval of knowledge display. Jack, one of the medical students, turned the term *thrills* into a question that Bill, one of the nursing students, self-selected to answer:

1 Jack: Can you defi:ne thrills
2 (1.0)
3 Bill: Thri:ll is what you fee:l (.) like is: (.) ya could
4 (0.4)

After a brief pause, Bill self-selected to respond to Jack's query. Prior to speaking, he lifted his left hand to his chin. As he looked up to speak, he brought this hand forward and wiggled his fingers repeatedly (see Figure 9a). By coordinating this gesture with the lexical affiliate *feel,* Bill's gesture was made recognizable as a sort of tactile representation—that is, his moving fingers were performing the behavior and hence the experience of feeling with the hand.

However, Bill failed to complete a coherent response; that is, he did not produce an utterance that was hearable as complete, and he repeatedly paused during his turn at talk while restarting his utterance several times, in each case changing the trajectory of his explanation. His first restart was marked by the words "like is,"

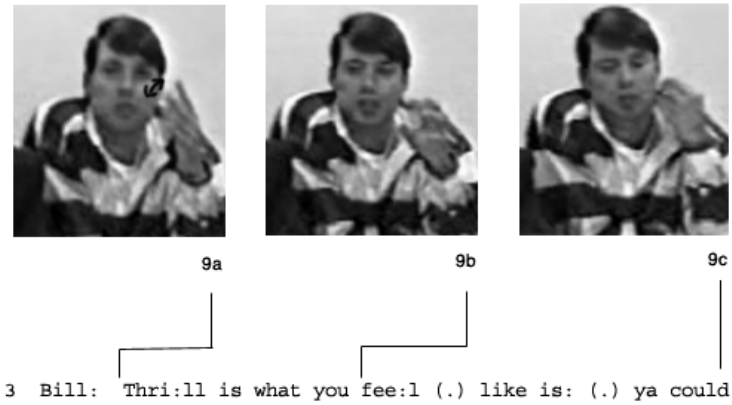

FIGURE 9 Bill's formulation of the meaning of the term *thrill*.

and a second occurred with the words "ya could." Each restart was coordinated with a shift in the shape of his gesturing hand. When Bill said "like is," his fingers stopped wiggling as they came together in a closed and rounded shape (see Figure 9b). As he said "ya could," he formed another gesture as if reaching for something situated on his shoulder (see Figure 9c). As his uncompleted utterance trailed off, however, this gesture devolved into a neck scratch. Thus, Bill's display of understanding came up short. His eye gaze also shifted away from the monitor and off to one side as though withdrawing from the interaction.

Susan (who sat to the immediate right of Bill) picked up where Bill left off. During Bill's utterance, Susan was oriented toward the monitor and, therefore, witnessed the onset and the eventual suspension of Bill's knowledge display. Susan then self-selected to follow him as speaker and stated:

5 Susan: If if you happened to have uh huge murmur (0.4)
6 you could put your hand on (your) chest and
7 ⌈feel it
8 Bill: ⌊feel the upbeat

Unlike Bill's, Susan's formulation was hearable as complete. The syntactic and prosodic structure of her utterance constituted a transition-relevance place (Sacks et al., 1974) after the words "feel it." Moreover, her utterance was coordinated with a recognizably coherent gesture. At the beginning of her utterance (with the words "if- if"), Susan lifted her right hand to her chest, locating it where a heartbeat might be felt; with the words "you could" she lifted her flattened hand a few inches from her chest and then returned it (see Figure 10a). In sum, Susan performed a hand-felt heartbeat, albeit exaggerated in form.

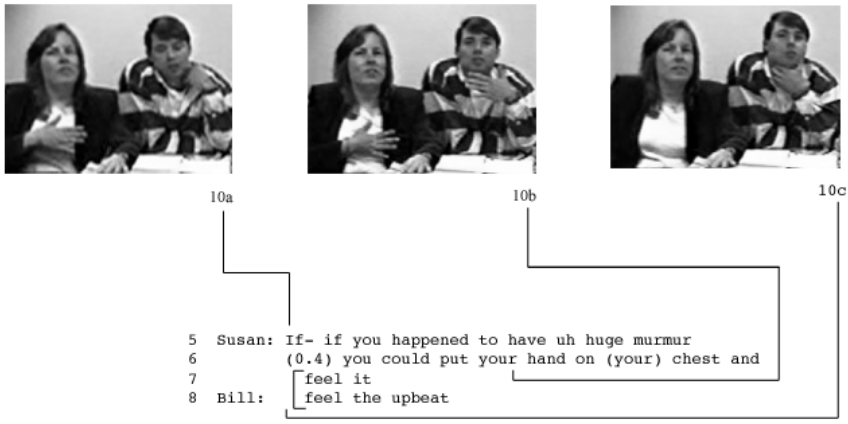

FIGURE 10 Susan and Bill's joint formulation of the clinical sign *murmur.*

Notice Bill's alignment with Susan's knowledge display. Bill collaboratively completed Susan's utterance with the words "feel the upbeat." His collaborative completion evidenced that he heard and understood her description sufficiently to complete it in overlap with her. After scratching his neck, Bill looked toward the monitor where Susan's hand was visibly flattened against her chest, at which point Bill lowered his hand toward his own chest and spread his fingers in a flattened form. In another example of what de Fornel (1992) referred to as a *return gesture*, Bill reproduced Susan's gesture in concert with her (see Figure 10b). Through such vocal and visible displays of alignment, Bill showed that Susan's performance was an appropriate continuation of the knowledge display that he had started.

Continuing their response to Jack's question about thrills, the nursing students coordinated their vocal and visible behaviors in the course of displaying their understanding. After collaboratively completing Susan's description, Bill self-selected again and explained further:

11 Bill: It's like (.) flui:d that's getting caught on
12 somethin' and it's (.) twisting arou:nd the vessel
13 or ar[tery or whatever
14 Jean: [Turbulence
15 Bill: It's tur[bulence yes
16 Jean: [Turbulence

Notice the form and content of Bill's explanation: an utterance-initial hedge (i.e., "it's like"), followed by hesitations (pauses) and nondescript words (e.g., "somethin'" and "whatever"), came together in an extended narrative about blood within the heart getting "caught" and "twisting around"—action words not usually associated with fluids. Bill's utterance would appear to be an example of Crowder's (1996) "explaining in-the-moment" (p. 201), that is, unpolished expressions marked by breaks, restarts, colloquialisms, and self-corrections. Nevertheless, Bill's vocal explanation was coordinated with a hand gesture that was recognizable and evidently consequential.

With his index finger extended, Bill rotated his left hand in the air to represent iconically the movement of fluid swirling within a chamber (see Figure 11). This motion was sustained throughout the utterance produced in lines 11–13. Jean (sitting to Bill's immediately left) observed Bill's gesture (see Figure 11) before speaking the word "turbulence." By speaking in overlap, Jean intervened, behaving as though Bill's vocal expression required immediate vocal assistance. By speaking only after Bill's gestural performance but before the end of his utterance, Jean behaved as though Bill's gesture was instrumental in occasioning her contribution. Goodwin and Goodwin (1986) described some of the ways in which pauses, gestures, and gaze are used by speakers as a means of inviting listeners to collaborate in the search for a word. It is not clear in this instance, however, that Bill was actually engaged in the search for the term *turbulence*. Nonetheless, Jean provided it (line 14), and Bill repeated it (line 15), literally incorporating it into his description of thrills. Through his repetition of Jean's word, Bill treated Jean's in-

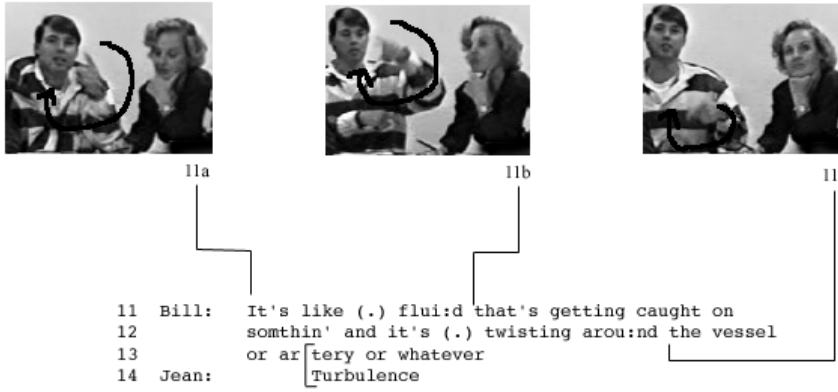

FIGURE 11 Bill and Jean's collaborative description of turbulence in a blood vessel.

terjection as collaborative, and he immediately aligned himself with her contribution to his interactive display of knowledge.

Bill then clarified the difference between a thrill and a murmur (bruit). He began:

17 Bill: You can feel a thri:ll or you can (0.2) auscultate
18 a bruit which you ⌈can hea:r
19 Susan: ⌊or a murmur
20 (0.2)
21 Bill: or a murmur:

Bill reinforced this distinction by using different gestures to illustrate the actions. At the onset of "feel" he fleetingly reproduced Susan's flat-handed gesture for feeling a thrill but, instead of feeling his own heart he pushed his flattened hand away as if touching an imaginary patient (see Figure 12b). His gesture, therefore, connected to but also extended Susan's. Coordinated with the word *hear,* he performed a series of movements that resembled the placing of a stethoscope on the chest of an imaginary patient (see Figures 12c and 12d), a procedure to which physicians refer as *auscultation*.[9] Similar to Maria's gesture in Exhibit 1, Bill's second gesture was an insider gesture; it presumed a certain form of background knowledge on the part of the recipient or recipients.

The last two words of Bill's utterance were overlapped by another speaker. This time it was Susan who interjected to clarify the unfolding knowledge display. Speaking in overlap with Bill, Susan offered a less technical term for *bruit* (line 19). As before, Bill repeated the contribution (line 21) verbatim, thereby registering Susan's collaboration in the articulated response.

When the nursing students stopped speaking and turned away from the monitor, showing that their response to Jack's question was complete, Marie (a medical student at the other site) reiterated the emergent understanding. Turning to the other medical students, she said:

26 Marie: Thrill is just the: (.) you're feeling the
27 murmur (.) you can feel it with your ha:nd

[9]Prior work on gesture and talk has focused on the sequential positioning of gestures relative to semantically related lexical elements, sometimes referred to as *lexical affiliates* (Schegloff, 1984, p. 276). Schegloff (1984) wrote that "the critical property of iconic gestures … is that they are pre-positioned relative to their lexical affiliates" (p. 276). Crowder (1996) also discussed the issue of "gestural foreshadowing" (p. 190), and Roth (2000) reported findings that suggested that the latency between gestural performance and subsequent utterance of the affiliated lexical element declines with increasing expertise. The identification of the affiliated lexical element can in some cases be problematic, however. Looking at Bill's turn at talk, for example, how does one choose which lexical element is affiliated with his gesture? If one selects *hear,* then the gesture is not prepositioned but concurrent with its lexical affiliate. On the other hand, if one chooses *ausculatate,* then the gesture follows its lexical affiliate.

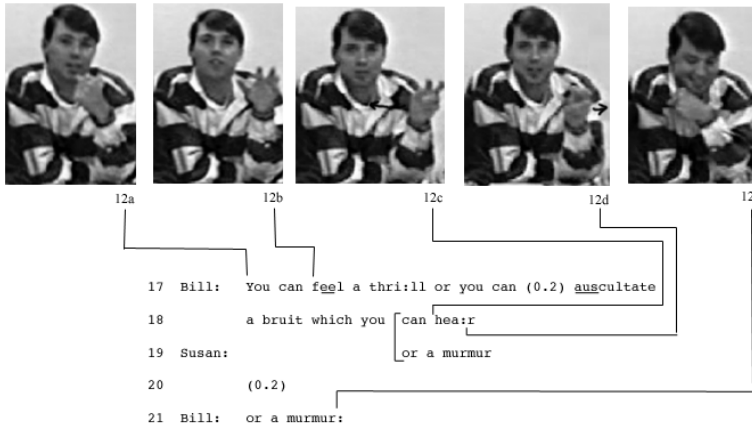

FIGURE 12 Bill's gestural contrast for feeling a thrill and auscultating a bruit.

Marie's recap selectively used vocal and visible behaviors performed by the nursing students. Her words "murmur," "feel," and "hand" were previously spoken by the nursing students. Moreover, Marie coordinated her utterance with hand gestures that unmistakably resembled Susan's (and Bill's) prior performance. With the word "thrill," Marie placed her flattened hand onto her chest; with the word "feeling," she lifted her hand from her chest and then returned it. Her formulation, therefore, appropriated the vocal and visible behaviors that the nursing students provided earlier.

Observations. Jack's question "Can you define *thrills*?" occasioned an interval of knowledge display involving several nursing students who coordinated their vocal and visible behaviors to achieve a joint articulation, which was subsequently reformulated by one of the medical students at the distant location. Multiple participants contributed a necessary part—a key word, a gesture, a phrase—whereby an acceptable whole was eventually composed and knowledge interactively displayed. In the gestures used, one finds evidence of recipient design, recipient response, and gesture used as a means of accomplishing cohesion across turns at talk.

Moerman (1990), in an article entitled "Studying Gesture in Social Context," made a series of observations about gesture (i.e., "Gestures occur in conversations" [p. 16]; "Gestures communicate" [p. 16]; "Interactive events are typically multi-modal" [p. 16]; "Interactive events are typically multi-party" [p. 16]; "Gestures are affiliated to utterances" [p. 17]; "Gestures are interactive phenomena in as much as they serve to regulate co-presence, affect the actions of others, accomplish something in the social world, and so contribute to and partially constitute social ac-

tions" [p. 17]). Although Moerman's points might attract controversy in some circles, our observations in the last exhibit fully support his view of gesture as a form of interactional achievement. Susan's gesture, subsequently taken up by Bill and Marie, became a local semiotic resource for talking about murmurs and thrills. Her gesture (and associated talk) set up a potential misunderstanding, however, that Bill later attempted to rectify. He did so by contrasting a variant of Susan's gesture with a new gesture presumably recognizable to the participants as an enactment of listening (auscultating) with a stethoscope. These gestures both contributed to and constituted the socially organized activity of articulating their knowledge.

From his list of observations, Moerman (1990) developed a set of precepts for the study of gesture as an interactive phenomenon (e.g., gestures should not be studied in isolation from other visible activities; gestures should be viewed as parts of sequences and social moves and, as a result, there should be an analytic focus on "participant's orientation to interactional boundaries" [p. 39]; that one should give full heed to gesture's consequences for "the organization of co-presence and for the performance of social actions" [p. 39]). It is only by carefully following these precepts, Moerman argued, that researchers can give an adequate account of why any particular gesture occurs when it does. We consider his arguments to be entirely consistent with the case made in this article for the need to undertake a careful study of the conversation of gesture.

Our call for a study of the conversation of gesture, however, should not be construed as a suggestion that gestures can be studied as a form of conversation independent of talk. In borrowing the expression "a conversation of gesture" from Mead (1910), we use it to encompass not only the conversation among gestures but also the ways in which gestures themselves engage in conversation with other forms of visible and vocal communicative behavior. We demonstrated in these exhibits how gesture is shaped by the social context within which it is produced. We showed, for instance, how gestural performance is sensitive both to the composition of the audience (recipient design) and to prior interaction (gestural cohesion). At the same time, we showed evidence of the consequentiality of gesture for the development of subsequent understanding (recipient response). We are, therefore, quite in accord with Moerman's (1990) arguments to the effect that gestures are not interpretable as actions in and of themselves but are instead better understood as facets of larger and more extensive forms of social action.

CONCLUSIONS

This study represents a preliminary effort toward improving our understanding of learner articulation as an interactional achievement. Specifically, we provided grounded evidence of certain features of gestural performance (i.e., recipient design, recipient response, and gestural cohesion) within the context of learner articulation. Learner articulation was described previously (Koschmann et al., 1996) as having

two different but potentially interrelated meanings: one of giving utterance and the other of constructing connections or jointing. Our findings with regard to the role of gesture in learner articulation lead us to understand both definitions in new ways.

From a purely cognitive perspective, the act of giving utterance is simply an instrumentality for making visible an internal state of affairs. Giving utterance, however, is also an interactive event and, as Moerman (1990) pointed out, interactive events are typically multimodal. This was amply demonstrated in the three exhibits in which we found numerous examples of interactants actively using their hands and bodies and aspects of the material environment while displaying their understandings. The ways in which gestures are designed for use with particular audiences and within particular conversational contexts offer important evidence for the situated nature of learner articulation. For example, Maria's gestural performance of lifting of her temporal lobe in Exhibit 1, and Bill's demonstration of auscultation in Exhibit 3, both showed how gesture is shaped and informed by its social and material context. Because these situated aspects of gesture use are made visible only in conversational contexts, they argue persuasively for the need to study gestures as interactionally-embedded acts and suggest, by extension, that learner articulation should be approached in the same way.

Like the act of giving utterance, the action of making connections or jointing could also be construed in purely cognitive terms, focusing exclusively on the learner's construction of conceptual linkages. When we adopt a wider frame of reference, however, and examine the establishment of connections across contributions offered by different participants to a conversation, we see the action of jointing in a different light. In the three presented exhibits we found evidence of the ways in which gesture contributes to this process. Interactants responded directly to gestures as semantically laden elements of unfolding discourse (e.g., Jackie's response to Joel's gesture in Exhibit 2). Gesture is clearly more than redundant "communicative behavior," as has been suggested by some authors (e.g., Krauss et al., 1991; Rimé, 1983). Further, it does more than simply contribute to conceptual development; gesture is one of the means by which interactional jointing is achieved. We showed in Exhibits 2 and 3, for instance, how the repetition of gestural forms is an important mechanism for establishing semantic links across turns at talk. Gesture is conversationally consequential, therefore, and contributes in important ways to interactional jointing.

This article focuses on gesture as one component of the doing of teaching and learning and documents some of the ways that participants use their hands and bodies while displaying what they know. It provides grounds for a view of gesture as the embodiment of thinking. Gestures, by this view, are material signs that embody the knowledge being articulated while simultaneously shaping and lending structure to social interaction. Extending our understanding of how this is accomplished is foundational to our understanding of cognition and instruction as intersecting forms of interactional achievement. Much work remains to be done, how-

ever, to carefully document the practices of sense-making in instructional settings. Such work holds the key not only to understanding how learner articulation is accomplished but also to giving an adequate account of what makes exemplary forms of instruction effective.

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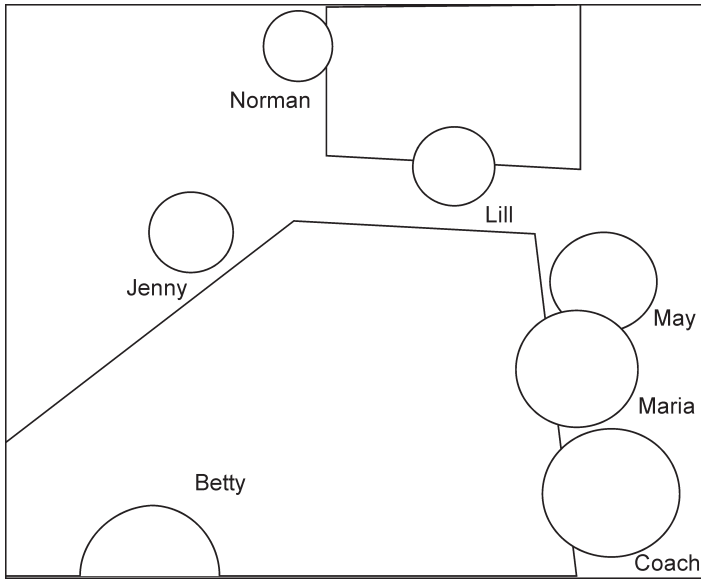
APPENDIX A
Transcription Conventions

Device	*Example*	*Description*
Timing		
Brackets	[ ]	Marks the beginning and end of temporal overlap among utterances produced by two or more speakers.
Equal sign	=	Indicates the end and beginning of two sequential 'latched' utterances that continue without an intervening gap. In some cases, the symbol is used in combination with brackets.
Timed silence	(1.8)	Measured in seconds, a number enclosed in parentheses represents intervals of silence occurring within (i.e., pauses) and between (i.e., gaps or lapses) speakers' turns at talk.
Micropause	(.)	A timed pause of less than 0.2 sec.
Delivery		
Period	.	Indicates a falling pitch or intonational contour at the conclusion of a TCU.
Question mark	?	Rising vocal pitch or intonational contour at the conclusion of a TCU. An inverted mark represents a half rise.
Exclamation point	!	Marks the conclusion of a TCU delivered with emphatic and animated tone.
Comma	,	Indicates a continuing intonation with slight upward or downward contour that may or may not occur at the end of a TCU as in the enunciation of an item in a not yet completed list.
Hyphen	-	An abrupt (glottal) halt occurring within or at the conclusion of a TCU.
Colon(s)	:	A colon indicates sustained enunciation of a syllable vowel, or consonant. Longer enunciation can be marked using two or more colons.
Greater-than and less-than signs	> < < >	Portions of an utterance delivered at a noticeably quicker (> <) or slower (< >) pace than surrounding talk.
Degree signs	° °	Marks speech produced softly or at a lower volume than surrounding talk.
Capitalization		Represents speech delivered more loudly than surrounding talk.
Underlined text		Underscoring indicates stress on a word, syllable, or sound.
Arrows	↑↓	Marks a rise or fall in intonation.
Breath sounds	hhh	Audible expulsion of breath (linguistic aspiration) as in laughter, sighing, etc. When aspiration occurs within a word, it is set off with parentheses.
	(•hh)	Audible inhalation is marked with a preceding dot.
Other		
Parentheses	( )	Text enclosed in parentheses represents transcribed talk for which doubt exists. Empty parentheses represent untranscribed talk or unknown speaker.
Double parentheses	(( ))	Transcript annotations (text italicized).

Note. TCU = turn constructional unit.

APPENDIX B
"Where Is the Hippocampus?"



1	Coach:	Where is the hippocampus
2	Betty:	I don-do we have another picture up there
3		⌈on the
4	Norman:	⌊It's right down the:re[1] (0.2) if you- it's the
5		bottom of this thing.
6		(2.5)[2]
7		(We're) right 'n here[3]
8		(1.0)[4]
9	Maria:	I think ⌈it's un:der that.
10	(Jenny):	⌊(I can't remember)
11	Norman:	It's under that?
12	Maria:	I think it's on the inside.
13	Coach:	It's on the ⌈middle (0.3) middle top.
14	(Jenny):	⌊uhhhh-

[1]Pointing with left (L) hand toward atlas from seat.

[2] Norman rises from chair and moves toward flipchart.

[3]Places forefinger of right (R) hand on chart and twice traces the lower edge of a structure in the sagital section (rightmost, second row).

[4] Norman returns to seat.

15 Maria: [5]S'like- if: you [6]lift[7] up [8]that [9]little temporal
16 lobe, it's [10]on ⌈the inside.
17 Coach: ⌊You can- you can point[11] to it on
18 the middle top.
19 (0.6)
20 Maria: Middle top?[12]
21 Coach: Mm-mmm
22 (1.2)
23 Maria: °Ye:ah its° [13]
24 (3.5)[14]
25 Lill: In here?[15]
26 Maria: ⌈⌈Yeah
27 Coach: ⌊⌊That's it=
28 Norman: =Yeah
29 Maria: ⌈⌈Yeah
30 Coach: ⌊⌊That's it tha:t's the hippocampus
31 (0.5)
32 Coach: An' then you go over one more gyrus and then you're
33 in the temporal lobe.
34 Maria: Ri:ght
35 Coach: So you can also see it on the[16] (0.4) frontal.
36 (1.5)
37 Coach: No: (.) ⌈left second row left
38 Norman: ⌊(There's)
39 (3.3)
40 Norman: (hh hh hh)
41 (1.0)
42 Coach: Where would it be in that section.
43 (1.6)

---

[5]Maria brings R hand from below table to face level with palm down and fingers relaxed.

[6]Forms a pinching shape using the thumb and forefinger of her R hand.

[7]Maria forcefully raises her R hand above her.

[8] Maria rotates her right hand slightly counterclockwise revealing the inside of her hand.

[9] Maria returns her R hand below the table.

[10] Maria performs a gesture again using her R hand before her face.

[11]Points with R hand from seat toward transverse section (middle view, top row).

[12]Lill points toward top of chart from her chair.

[13] Points toward atlas with pen in R hand.

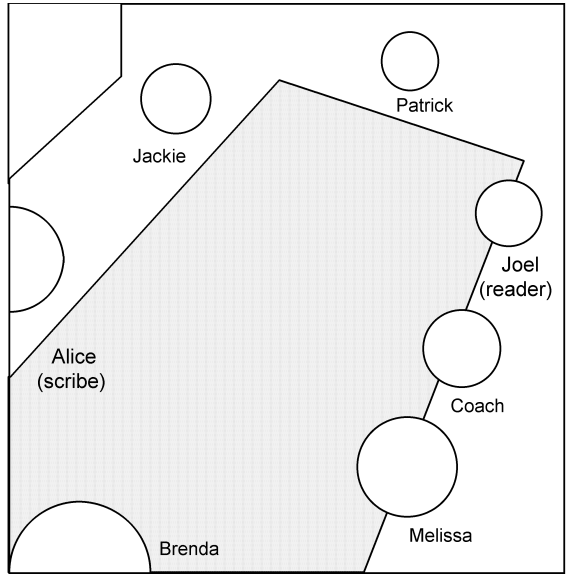
[14]Lill stretches from seat to reach atlas.

[15] Lill runs forefinger of R hand three times along a structure in the transverse section indicated by Coach.

[16]Coach gestures from seat toward the coronal (frontal) section (leftmost view, second row).

44 Lill: °Somewhere in here?°[17]
45 (1.5)
46 Coach: No th:at's white matter.
47 (2.0)
48 Maria: °In that cre⌈vice?°
49 Norman: ⌊Go to the crevice there.
50 (0.5)
51 Norman: That little[18] loop (.) (thing)
52 (0.2)
53 Norman: Yeah.[19]
54 (0.5)
55 Coach: That's it.

APPENDIX C:
"Serial X-Rays"



[17]Runs index finger of R hand twice along edge of structure in the coronal section indicated by Coach.

[18] Norman points with his L index finger and traces a loop shape in the air (behind and hence outside of Lill's line of vision).

[19]Lill again traces with forefinger of her R hand alongside a structure slightly to the right and lower than her previous gesture. This movement is repeated four times.

1	Coach:	I mean (.) what is the risk of a CT is there a
2		difference between X (.) uh CT and an ordinary X-ray?
3		(0.2)
4	Patrick:	Yea:h (0.2) uh C-tee I:s (.) um:: (.) in uh[20] pla:ne
5		(0.2)
6	Coach:	Yu:h
7	Patrick:	So:[21] I would think that the CT (1.0) would be: (0.6)
8		instead of just a plain [22]fi:lm (0.4) would be more[23]
9		X-rays being used
10	Joel:	.hhhh
11		(0.5)
12	Joel:	↑What is the dosage (0.4)[24] relative (.) from uh [25]normal
13		X- ray to a [26]CT¿
14	Joel:	⌈⌈[27]CT is ↑serial CT⌉ [28]°is it° serial X-rays >is it [29]not<?
15	Patrick:	⌊⌊(You're)( )[30]⌋
16	Jackie:	Right [31]you're taking slices [32]so naturally if you
17		[33]do: (0.4) [34]two views of an abdomen (0.4) with u:h[35]
18		plane film (0.2) and you do: (0.5) [36]fifteen with (.) uh
19		Ctee (.) ˚I mean˚ but I don (.) I don't know (.)
20		I can't remember (.)the [37]relative dosage for
21		⌈[38]one slice of CT [39]versus (one)
22	Coach:	⌊Wel-wel-wha- (.) think it throu:gh what does the X-ray

---

[20]Patrick slides hand forward and backward with palm down in a plane extending horizontally outward from his body.

[21]Makes a stirring motion by twice rotating R hand with forefinger.

[22]Patrick drops R hand while splaying fingers as if flattening hand onto a horizontal surface.

[23]Repeats prior stirring motion.

[24]Joel throws R hand outward, palm up.

[25]Joel repeats motion with L hand. Jackie begins shaking her head and smiles.

[26] Joel twitches R hand.

[27] Joel performs three swift movements with his R hand.

[28] Joel swings open R hand up and away from body

[29] Joel places R hand in his lap.

[30]Patrick points little finger of R hand toward Jackie.

[31]Jackie repeats Joel's gesture by making three chopping motions with her R hand while sweeping her arm toward her abdomen.

[32]Joel makes two vertical slicing motions, chest high and parallel to body.

[33] Coach shifts forward in seat.

[34]Jackie presents both hands, palms upward, directed to the R side of the gestural space.

[35]Jackie withdraws her hands, her R hand returning to her side and her L hand going to her face.

[36] Jackie makes fleeting movement as if pointing upward with L hand.

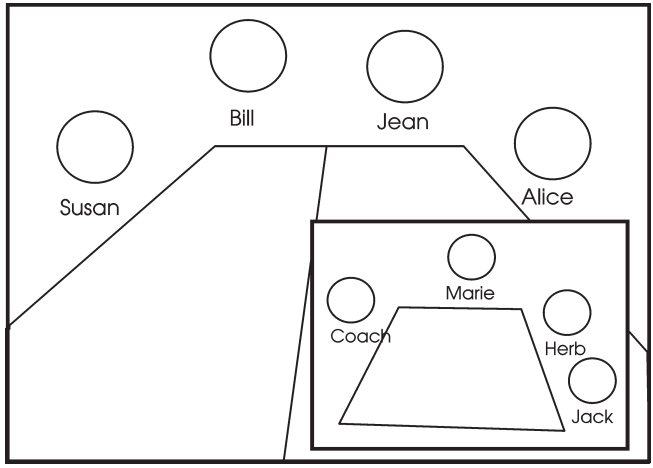
[37]Jackie raises both hands and then brings them down together onto the table top palms downward.

[38]Jackie raises R hand and then drops it to the table.

[39]Jackie repeats gesture with her L hand.

beam have to do: in an ordinary [40]X-ray how much aup (.)
what does ⌈the energy have to do:
Jackie: ⌊[41]Well it's [42]gonna penetrate the [43]who:le (.)
Coach: A::nd
Jackie: body. (.) er I mean[44] whichever where it's coming
⌈through
Coach: ⌊Right
And cha:nge (.) the chemical (.)
constituents ⌈(.) in a film (.) ⌈ri:ght
Jackie: ⌊Hm mm ⌊Hm mm=
Joel: =Hm mm

APPENDIX D:
"Can You Define Thrills?"



Jack: [45]Can you defi:ne thrills
[46](1.0)
Bill: [47]Thri:ll is what you fee:l (.) [48]like is: (.) [49]ya could

40 Patrick initiates and then aborts the stirring gesture made earlier.
[41]Jackie brings both hands to the midline, fingers bent and pointing toward body.
[42] Jackie traces the margin of her ribcage around to both sides.
[43]Jackie withdraws both hands from the gestural space.
[44]Jackie repeats earlier gesture of tracing the base of her ribcage from the midline to her sides.
[45] Jack looks up and toward the monitor. Susan, Bill, Jean, and Alice orient toward case simulation book.
[46] Jean looks up at camera.
[47] Bill wiggles fingers of L hand.
[48] Bill's gesture changes to a grasping form.
[49] Bill's clutches above left shoulder.

4		[50](0.4)
5	Susan:	[51]If if you[52] happened to have[53] uh huge[54] murmur (0.4) you
6		[55]could put your [56]hand on (your) chest and
7		⌈[57]feel it
8	Bill:	⌊feel the upbeat
9	(?):	Right[58]
10		(1.1)
11	Bill:	[59]It's like (.) flui:d [60]that's getting caught on
12		somethin' and it's (.) twisting arou:nd [61]the vessel
13		or ar⌈tery or whatever[62]
14	Jean:	⌊Turbulence
15	Bill:	It's tur⌈bulence yes
16	Jean:	⌊Turbulence
17	Bill:	You can [63]feel a thri:ll or you can (0.2) auscultate
18		a bruit [64]which you ⌈can hea:r
19	Susan:	⌊or a murmur
20		(0.2)
21	Bill:	or a murmur:[65]
22		(0.2)
23	(?):	murmur ((*possibly echoed by conferencing system*))
24	Alice:	((*Alice whispers to Jean*))
25	Jean:	((*Jean whispers to Alice*))

[50] Bill transforms the clutching gesture into a neck scratch.

[51] Susan moves R hand to chest.

[52] Marie begins nodding. Susan holds hand flat over heart area.

[53] Bill looks toward Susan's hand.

[54] Jean looks toward Susan's hand.

[55] Susan lifts flat hand from chest a few inches and returns it to her chest.

[56] Bill reproduces Susan's gesture with his L hand.

[57] Susan withdraws her R hand from view. Bill brings his L hand to his throat.

[58] Jack nods.

[59] Bill swirls forefinger of L hand in counterclockwise circular motion in front of face.

[60] Bill shifts back in seat while sustaining swirling motion with L hand.

[61] Bill lowers hand while continuing swirling motion.

[62] Bill retracts hand.

[63] Bill briefly holds open his L hand.

[64] Bill pinches fingers of L hand together as though holding away a small object and moves hand from side to side.

[65] Bill smiles toward Susan.

26 Marie: Thrill[66] is just [67]the: (.)[68] you're[69] f<u>ee</u>ling[70] the
27 murmur (.) you can f<u>ee</u>l it with your ha:nd[71]

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[66] Marie moves hand toward chest.
[67] Marie places flattened hand over heart area.
[68] Herb and Jack orient away from screen and toward Marie.
[69] Marie lifts flattened hand a few inches from chest.
[70] Marie pats flattened hand on chest.
[71] Jean uses a pencil to point twice toward the text on the table.

This is a listing of major data sets currently available through TalkBank. Currently, these data are stored at CMU. However, in the future, we expect that this list will include data stored at many different sites.

1. Animal communication data including macaque vocalizations and zebra finch song.
2. Classroom discourse corpora from two published special journal issues and additional new contributions.
3. Conversation samples, some in CA format and some in CHAT format.
4. Corpora from the European Science Foundation (ESF) study of second language learners contributed by Wolfgang Klein and colleagues.
5. The FIT corpus of English-speaking learners of Japanese. Transcripts have not yet been linked to audio for this corpus.
6. Corpora focusing on the analysis of gesture.
7. John Haviland's data from Tseltal, Tzotzil and Chol in Chiapas.
8. The database of the IViE project on Intonational Variation in English.
9. The LIDES database of language interaction.
10. The MOVIN database from Johannes Wagner at Southern Denmark University and other CA researchers.
11. The Santa Barbara Corpus of Spoken American English (SBCSAE).
12. Streaming video and audio. With MP3 files on a fast connection, playback begins almost immediately. However, for large video files, you may want to jump right to a specific segment. You can do this using links to video created through JavaScript. Here is an illustration of how to make direct links to video and audio from HTML pages.
13. The TalkBank Switchboard corpus of 36 calls from the larger LDC Switchboard corpus of 2438 calls. These are the calls that have complete discourse and treebank annotations and significant phonetic annotation. The TalkBank project seeks to enrich these annotations with as many new kinds of annotation aspossible, and also to complete the partial phonetic transciption. We hope that interested members of the community will contribute annotations, exemplifying their models on a common set of data. Our thanks to Steven Greenberg (UC Berkeley), Dan Jurafsky (University of Colorado), Joe Picone (Mississippi State), and Elisabeth Shriberg (SRI) for furnishing annotations included in this corpus.
14. Corpora on tutoring and small group discussion.
15. Password protected data.