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Usability as an Interactional Resource: Deictic Management of Scene Formulation

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Abstract. In this paper, we describe how embodied action, in the form of pointing and other gestures, and personal and spatial indexicals are used to constitute participation frameworks and work sites in an instructional surgery. As a site for both learning and work, the operating room afforded us the opportunity to examine how usability, which is a critical design consideration, can be used as a resource for learning in interaction. In our detailed analysis of the interaction among participants (both co-present and projected) we sought to describe a particular case of how usability was achieved as a relevant consideration for surgical education in the operating room. In doing so, we demonstrate a set of members' methods by which actors establish and provide for the relevance of the projected needs of projected users as part of developing an understanding of their current activity.

Keywords: Personal deictics, spatial deictics, embodied action, pointing, gesture, interaction, collaborative instruction

INTRODUCTION

In certain kinds of vascular surgeries, certain structures called arteriovenous (AV) fistulas are assembled and/or repaired to make it easier for the patient to receive subsequent treatments, such as kidney dialysis. In teaching surgeries, these structures and the uses to which they will be put can become resources for the attending surgeon, resources that are used in the instruction of the resident who is participating in the surgery. Residents who participate in such vascular surgeries are expected to know how such surgeries are performed as well as the reasons for performing such surgeries in the first place. .

Surgeries that are designed to create or repair AV fistulas are distinct from other kinds of surgeries in that the structures that are built in these surgeries have a particular use and are built to be usable by other practitioners in other kinds of treatment settings. Thus, one of the important features of such surgeries is that the usability of the structures so built is of particular concern to the ongoing conduct of the surgical operation. To understand what must be done to create or repair an AV fistula, residents need to understand the anatomical and procedural aspects of the surgery as well as the use to which the fistula will be put. In part, there is a design element that is deeply relevant to the way these surgeries are performed and thus is a matter of practical and instructional importance for attending surgeons in the conduct of AV fistula surgeries. This design element can be described in terms of the usability of the surgically created structure for subsequent users. In the surgery we investigate, the subsequent user is the dialysis nurse.

One important feature of this kind of design work is that it is oriented toward coordinating work being done in the present with work that will take place in other settings and in other times and will involve other workers. The question that concerns us here is how are the projected needs of these other workers made visible in the present or, stated otherwise, how is usability made relevant within concrete practical activity of the ongoing surgery?

Research in CSCL is centrally concerned with learning in settings of joint activity. Joint activity, however, is often directed toward supporting other projected activities in the future; all design work has this character. The projected end user may or may not be a participant in the current activity. The question which concerns us in this paper is how are the needs of the projected user made relevant and visible within situated conversation or, in different terminology, how is usability accomplished as an interactional matter?

DATA

The data presented here comes from a corpus of video-based materials compiled in operating rooms at a teaching hospital affiliated with a medical school with a surgical residency program. This corpus was developed as part of the Deixis Project, a multi-disciplinary undertaking designed to explore how instruction is produced in the context of consequential, joint activity. The three fragments of interest occurred in a surgery undertaken to repair an arteriovenous (AV) fistula. Patients in hemodialysis clinics receive intravenous (IV) taps as a routine part of their ongoing treatment. AV fistulas are created to provide a convenient place for vascular access. The fistula is created by shunting blood from a large artery in the patient's arm or leg into an adjacent vein located near the skin. This has the effect of dramatically increasing both the blood volume and blood pressure in the vein. Over a period of time the vein adapts to this change in volume and pressure by expanding in both diameter and length, a process vascular surgeons refer to as "maturing." The swollen section of the superficial vein then becomes the access point for the dialysis nurse. In the case under study here, the patient had previously undergone surgery to create an AV fistula, but the vein had failed to mature following surgery. The surgery which was observed and described here, therefore, was undertaken to repair a defect created in the first surgery.

The participants in the three excerpts to be described here are Attending, an experienced vascular surgeon with ultimate responsibility for the safe outcome of the surgery being performed and Resident, an advanced surgeon-in-training enrolled in a surgical residency program. The surgery in this case is being largely done by the resident with the attending supervising and assisting.

Technically a fistula refers to a passage or opening between two organs or structures. In this it would presumably refer to the passage created between the (something) artery and the cephalic vein. Participants use the term *fistula*, however, more loosely to refer to the structure produced by the creation of the passage between the two vessels, that is to the matured segment of vein. The thing referred to as the fistula, therefore, becomes what Star and Griesemer (1989) described as a "boundary object" bringing together the work of the vascular surgeons and the work of the nurses in the dialysis clinic.[1]

We examine one surgery in which the attending and the resident connect their work to the future work of other health care workers, specifically the work of the nurses in the dialysis clinic. This occurs at the beginning of the operation prior to making the first incision. The attending is questioning the resident about the goals and strategy of the surgery.

ANALYSIS

An AV fistula re-routes blood flow from a peripheral artery directly into a superficial vein, causing the vein to, overtime, grow larger and become a more serviceable access site for the dialysis nurse. The task of designing and fabricating such a site causes the participants to, in the words of Goodwin (2003), invoke and deal with the simultaneous relevance of multiple phenomenal scenes" ----the access site as it appears at the moment and the access site as it must appear at the time of use. Their design work is undertaken to accommodate the needs of a member not currently present (the dialysis nurse).

Personal Deictics

The exchange between the resident and the attending involves the use of a question sequence common in classroom recitation. A question is asked the answer to which is already known by the interrogator, silence in the place where a student response would be relevant, the teacher re-formulates, etc. The question "What's missing?" is difficult because the universe of possible answers is so unbounded.

```
1    A:      So (.) this cephalic vei::n has a conspicuous
2            pulse in it (.) but what's missing
3            (4.0)
4    R:      I::z u::hb
5            (2.8)
6    R:      ⌈What's missing
```

[1] Many examples of such "boundary objects" can be seen in modern medical practice. Consider the practices of coordination employed by radiologists, surgeons, and pathologists in performing a simple breast biopsy. Prior to surgery, radiographic images are produced which demarcate the regions of tissue in question. A barbed needle is sometimes inserted by the radiologist to provide guidance to the surgeon in locating and defining this region. When the sample of tissue is excised, the surgeon may attach sutures to the specimen to display to the pathologist the orientation of the excised tissue with the patient's body. Is is only this mass of non-descript tissue that makes the tortuous journey across the boundaries of these different communities of practice.

In response to R's difficulties putting forward an adequate response, A initiates an alternative organization of inquiry. This new organization of inquiry serves to indicate that R's response is locally inadequate and, in its organization, introduces an alternative organization of relevancies by invoking a non-present but consequentially relevant actor for consideration, i.e., the dialysis nurse:

```
7    A:    ⌊Lets lets lets lets lets lets just say you're
8          the dialysis nurse
9    R:    Right=
10   A:    Okay (1.0) and you wanna (.) stick a needle in
11         this
12   R:    Mm mhm=
13   A:    =Okay (2.0) Where↑ (.) are you gonna put that
14         needle
```

Let's examine the participant deictics in these two extended utterances from A. Note the shift from the "you're the dialysis nurse" (second person, temporally and physically present) to "where are you" (second person projected temporally and spatially to the dialysis clinic at some point in the future).

```
15   R:    Well you know where the vein is but you don't
16         know where the artery i::s
```

A's question calls for R to answer as a dialysis nurse faced with the task of cannulating this patient, not in a projected state, but with the patient's arm in its current state. R's response is interesting in light of it's use of participant deictics. We see two parallel uses of the second-person personal pronoun *you*, but in neither case does it work as a conventional second-person pronoun. (If the binding was the speaker's interlocutor, the utterance would border on insubordinate.) 'You' can be used colloquially as an indefinite, third-person pronoun and that appears to be what is happening here. (Note that the third-person pro-term 'one' can be substituted syntactically for 'you' in both places.)

```
17   A:    We- we- we're actually don't even ⌈care about
18   R:                                     ⌊kxhmm
19   A:    the artery .hhh I mean (.) we- (2.0) we've got
20         this got this cephalic vein
21   R:    Mm mhm
```

A produces an assessment of R's response in lines 17, 19 and 20. The organization of this assessment suggests that R's response is being assessed in anatomical terms and thus invokes their shared participatory framework as surgeons in the scene.

```
22   A:    Now think about it now .hhh (.) and you're the
23         dialysis nurse and over the next (.) five years
24         you're gonna be putting needles in this thing
25   R:    Mm mhm=
```

However, to provide R with the warrant for A's assessment, A redeploys the use of the dialysis nurse, this time reconstituting the nurse's projected action, i.e., "you wanna stick a needle in this" (line 10), as an expectably ongoing and repeatable set of actions that are projected into the future, i.e., "over the next (.) five years you're gonna be putting needles in this thing" (lines 23 and 24). This escalation to a projected future history of repeated actions serves to emphasize the consequentiality of the current surgical procedure and thereby emphasize the urgency that R display a proper understanding of the purpose of this surgery.

```
26   A:    =Okay so we want it to mature, we know the
27         cephalic vein goes from here↑ (1.2) to here.
28         ⌈So fr'm here all the way up to here (.) oka:y↑
29   R:    ⌊Mm mhm
30   A:    ⌈So
31   R:    ⌊Right
32         (2.0)
33   A:    What are we missing
34   R:    The in between
35   A:    Yeah we're missing the in between right (.)
```

```
36          exactly
37          (1.0)
38  A:      We're missing this ↑who::le leng[th here okay so
39  R:                                    [Mm mhm
40  A:      .hhh sump'n is wro::ng
```

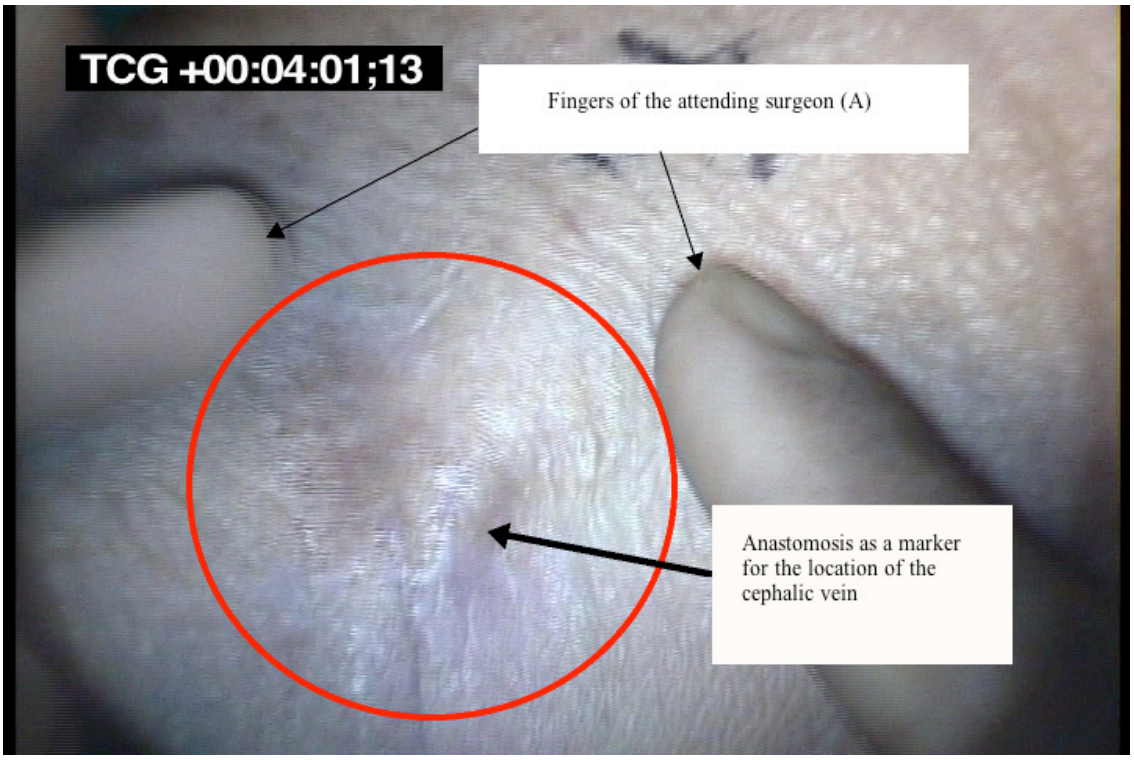
Lines 26 and 27 mark a shift from producing an explanatory scaffold by animating the dialysis nurse to a return to the student-teacher organization of interaction. The tokens "Okay so" in line 26 constitute the transition from consideration of the expected future history of how this procedure's outcome will be used to current consideration of the surgical scene. This implicitly re-invokes the "known-answer" queries that had been addressed to the resident earlier and to which the resident had not yet produced an adequate response. In order to adequately describe how this last section of the transcripted interaction allows the resident's response at line 34 to be treated as an adequate response, we must consider, in addition to the personal deictics, the spatial deictics deployed by the participants. It is only with respect to the actual surgical site and the anatomical structures constituted through spatial deictics that it is possible to recover how the resident's response can be seen as adequate.

Spatial Deictics

The previous discussion focuses on how the attending surgeon and the resident orient to each other in the production of a response to the attending surgeon's query. However, there is another set of resources of which A and R both make use and which constitute the proper domain of their collaborative work, the patient's arm. As we will see, the attending surgeon makes use of the patient's arm in ways that constitute it as three different structures of reference. The first is the patient's arm in it's current state. The second is the patient's arm as it should have become as a result of the prior surgery and the third is the patient's arm as it will become upon successful completion of the current surgery. The resources represented by the patient's arm provide points of reference in terms of the surgery to be performed, the cephalic vein, and the stenosis causing the diminished blood flow from the anastomosis to the cephalic vein. These are essentially locations and structures located in space to which the participants refer as they proceed to understand the circumstances of the surgery.

In order to produce the attending surgeon's initial query at lines 1 and 2, and an adequate response to that query, both the attending and the resident make use of the patient's arm as a semiotic and referential resource to instantiate the patient's arm as 1) the site of what should have been achieved in a prior surgery, 2) the current pre-operative site of inspection, instruction and surgery, and 3) as the post-operative arm they expect to achieve at some point in the future after the successful completion of the surgery. Constituting the observed pre-operative site as the post-operative arm made it relevant and possible for the participants to invoke the absent actor, i.e., the dialysis nurse, who at some point in the future will make use of the matured vein that is the expected result of the surgery that is yet to be performed. Likewise, referring to the dialysis nurse was part of the way that the attending could constitute the current pre-operative site as the post-operative arm it was to become. By orienting to the arm, through gesture and talk, in ways that project what that arm will become for the dialysis nurse at some point in the future, the surgeons invoke a sense of the arm's expected and projected future usability as a resource for performing dialysis. In other words, the attending surgeon's work is to demonstrate through his instructional actions the usability requirements that inform their current surgical work by "showing" how the arm will be used in the future.

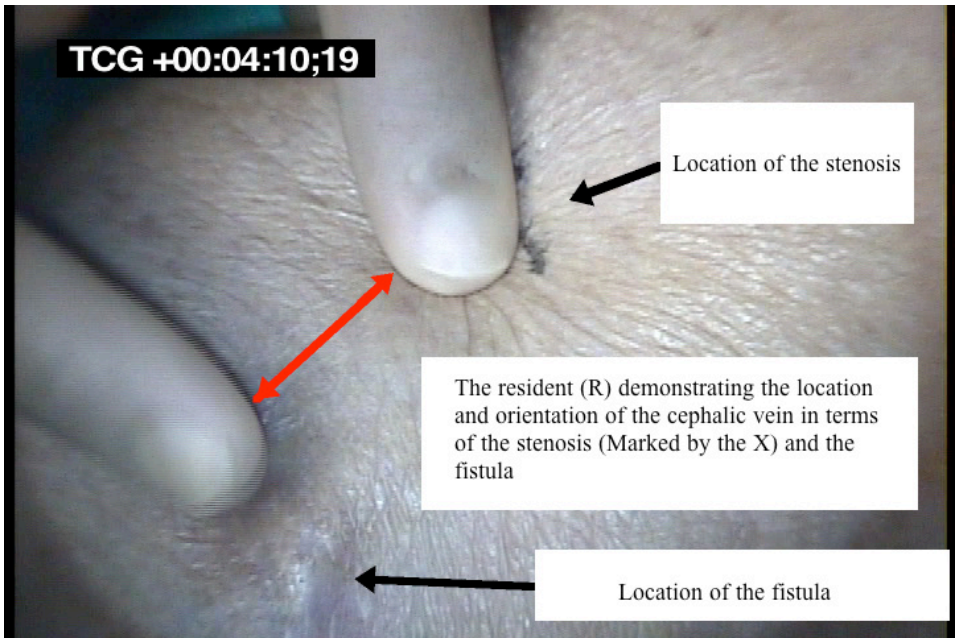
Typically, reference to spatial referents involves the use of spatial indexicals like 'here' and 'there' as well as pointing and other locative gestures. "A central locus for the act of pointing is a situation that contains at least two participants, one of whom is attempting to establish a particular space as a shared focus for the organization of cognition and action" (Goodwin 2003b, p. 219). This interaction is precisely such a circumstance. In this circumstance, talk and gesture are both deployed effectively and in a mutually informing manner to establish both the current condition of the patient's arm and it's projected post-operative condition as the work site for a different kind of activity. The pointing and deictic work done by both the attending and the resident as they discuss the site serves to constitute the patient's arm as 1) the site of what should have been achieved in a prior surgery, 2) the current pre-operative site of inspection, instruction and surgery, and 3) as the post-operative arm they expect to achieve at some point in the future after the successful completion of the surgery.



1 A: So (.) this cephalic vei::n has a conspicuous
2 pulse in it (.) but what's missing

At this point, A is pointing to and thereby identifying an anatomical structure of particular relevance to the current surgery by pointing to its location on the patient's arm. The actual vein is not immediately observable, but there are sufficient indicators (the skin discoloration, the raised skin, etc.) to provide evidence to inferentially identify the vein and its location where it was initially joined to an artery in a prior surgery.

During the four second silence (line 3), the resident moves his hand into a position that permits him to point to the location identified by the attending surgeon. As the resident starts to produce a response in line 4, he brings his left hand into position to point to the locatin of the stenosis (the narrowing in the vein that produces blocks the flow of blood) on the patient marked with an X, as shown below. In performing this action, the resident demonstrated the location and orientation of the cephalic vein in terms of the stenosis (marked by the X) and and the fistula.



```
3            (4.0)
4    R:      I::z u::hb
5            (2.8)
6    R:      ⌈What's missing
```

R's hesitations and utterances in lines 3 through 6 are coupled with his pointing work, shown above. not having been able to produce an adequate response. The pointing work seems designed to demonstrate that he is working to understand the question as a way of responding to it. When he cannot describe for A "what's missing", R withdraws his hands. The act of withdrawal actually embodies not only R's problem producing an answer but also serves to indicate to A that R not only has not but cannot answer the question as posed. With the removal of his hands, R demonstrates in an embodied way that he is unable to respond adequately to the query as produced. This makes relevant the possibility that an alternative organization of inquiry might provide R with the resources needed to identify "what's missing".

```
7    A:      ⌊Lets lets lets lets lets lets just say you're
8            the dialysis nurse
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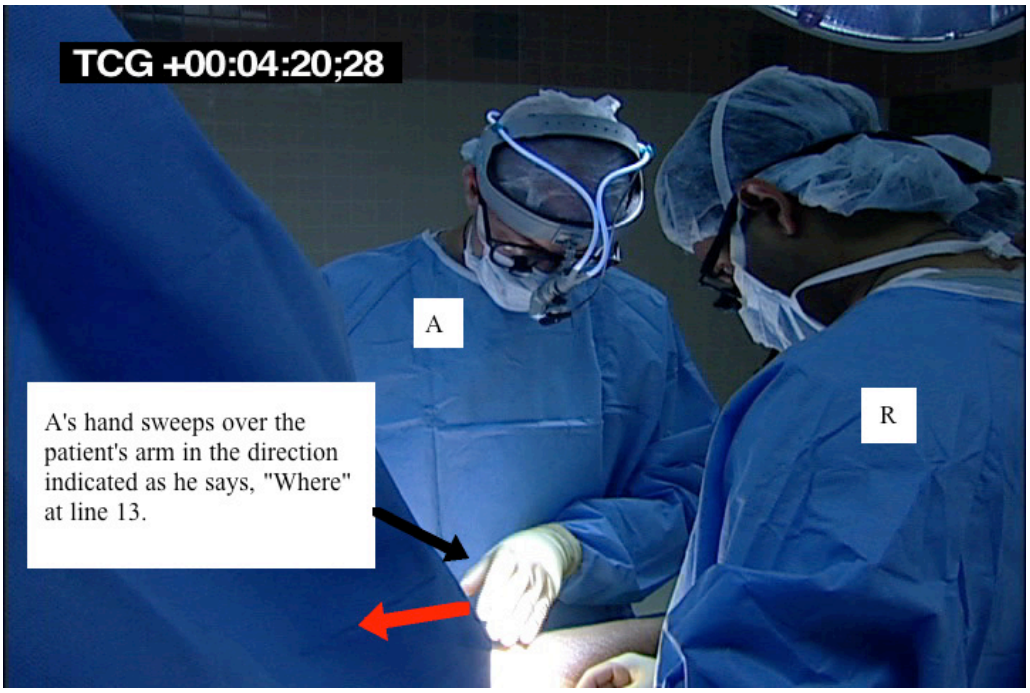
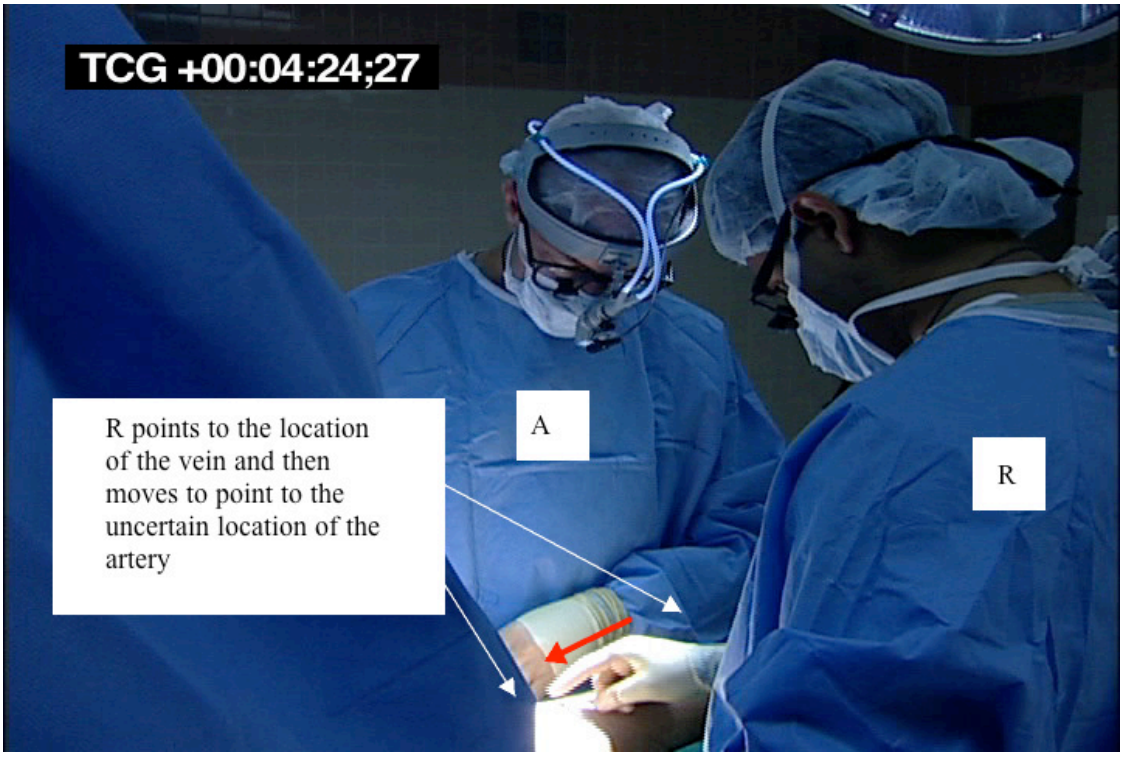
A initiates an alternate organization of inquiry in lines 7 and 8. This utterance is produced as A pats R's right hand (which, up to that point, had still maintained its pointing shape) and further removes it from the observable area of investigation. This action seems to 'wipe the slate clean', allowing A to reconstitute the worksite itself, i.e. the patient's arm, as a locus of alternative inquiry, thereby removing any vestige of the prior query's implicit organization of the features of the patient's arm. With his gesture work and by invoking the absent dialysis nurse, A's deictic work is designed to transform the patient's observed pre-operative arm into what it will become a few weeks after the completion of the current surgery as a site for dialysis.




```
9    R:      Right=
10   A:      Okay (1.0) and you wanna (.) stick a needle in
11           this
12   R:      Mm mhm=
13   A:      =Okay (2.0) Where↑ (.) are you gonna put that
14           needle
```

Having gesturally established the relevance of an alternative perspective on the arm, A then proceeds to build an inquiry at lines 13 and 14 above based on what might be called the arm in its expected future state. The query itself is sensible only under the assumption that R has animated the dialysis nurse as a participant in the ongoing interaction at A's prompting.

Any answer to the the query in line 13 would be treated as the answer provided by a dialysis nurse who would see the post-operative arm and the matured vein as the site of his work. By asking R to animate this persona, A not only makes it possible for R to view the patient's arm in terms of an alternative set of relevancies, but also makes it possible for R speak *as the dialysis nurse* to indicate what both *will be* of relevance in the future and what is currently relevant for the surgery. The actual response in lines 15 and 16 below are ambiguous at best.




```
15   R:      Well you know where the vein is but you don't
16           know where the artery i::s
```

R responds to A's query by pointing to the location of the vein and to an alternative location for where the artery might be located. The spatial deictic work done by the pointing and the projected objects these gestures were designed to locate are ambiguous as answers to A's query. There are a number of possibilities. The vein and the artery referenced in talk and gesture may be considered to be features of the arm in its current pre-operative state or may refer to features of the arm as it is projected to be. The ambiguity is made problematic by the problematic status of the reference to the artery in line 16. The artery, as a relevant referent, is properly an object of surgical interest in the construction of the fistula and is not typically of concern to the dialysis nurse whose task is to insert two needles into what will become the matured vein. It may be the case that R is resisting A's attempt to cast him in the role of a dialysis nurse and is speaking in terms of surgical relevancies for the production of the fistula. It may be that R is simply unable to respond adequately even from the perspective of a dialysis nurse and is casting about to produce some kind of response other than, "I don't know."

```
17   A:      We- we- we're actually don't even ⌈care about
18   R:                                        ⌊kxhmm
19   A:      the artery .hhh I mean (.) we- (2.0) we've got
20           this got this cephalic vein
21   R:      Mm mhm
22   A:      Now think about it now .hhh (.) and you're the
23           dialysis nurse and over the next (.) five years
24           you're gonna be putting needles in this thing
25   R:      Mm mhm=
26   A:      =Okay so (.) we want it to matu::re (0.6) we know the
27           cephalic vein goes from here↑ (1.2) to here.
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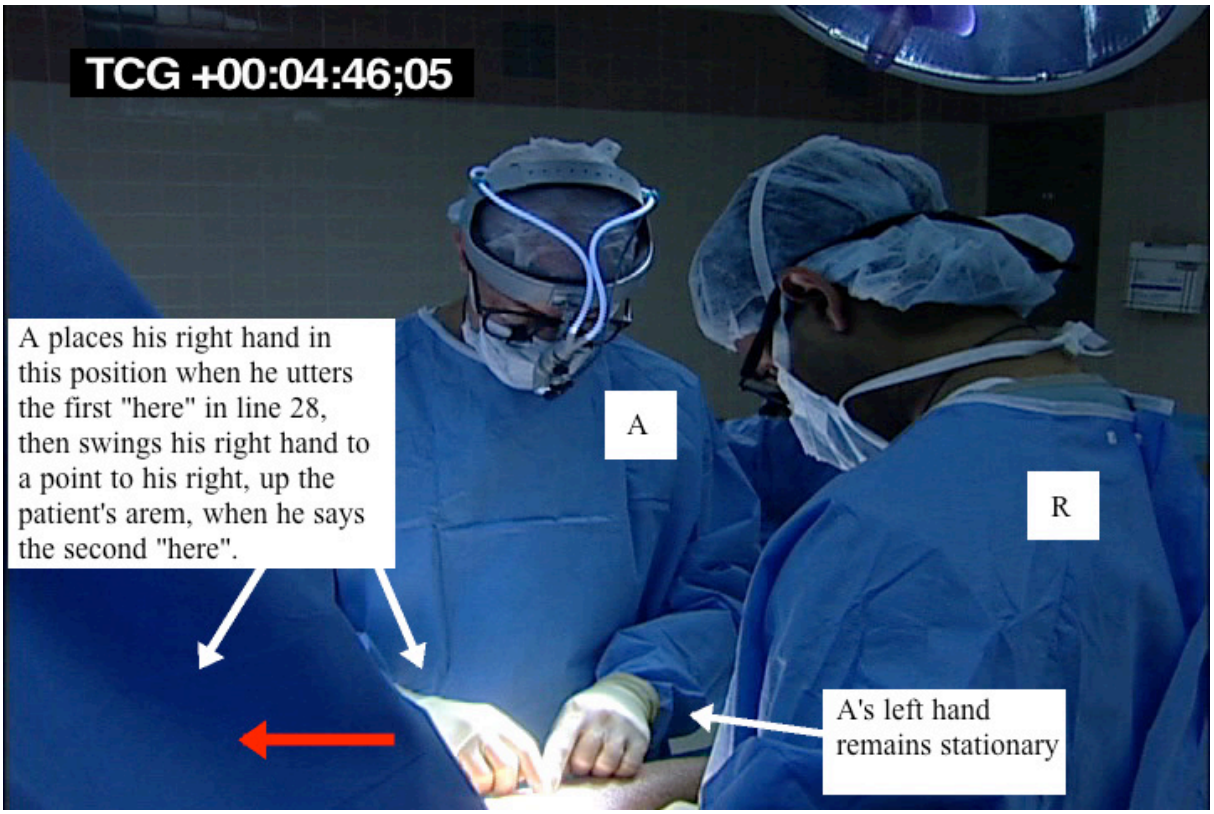
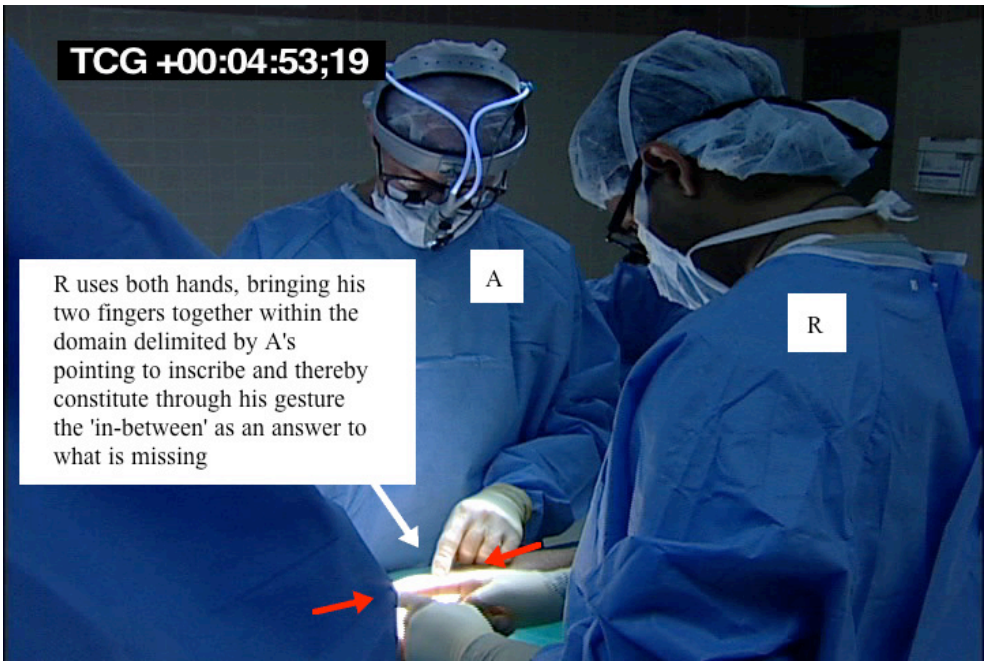



```
28          ⌈So fr'm here all the way up to here (.) oka:y↑
29   R:     ⌊Mm mhm
30   A:     ⌈So
31   R:     ⌊Right
32          (2.0)
33   A:     What are we missing
```

A holds this position, bracketing a region of the patient's arm between the pointing of his left and right hands. In doing so, he projects the region that, upon successful completion of the surgery, will come to contain the object he wants R to identify, i.e. the matured vein that is the intended product of the surgery. The extent of the gestured region indicates something about the size of the matured vein, which is a relevant consideration for the current surgery since, as is indicated in lines 22 through 24, this region will be an ongoing worksite for the dialysis nurse and the patient over the next five years. Having established the relevant region, A indexes the region he has defined with his pointing and at line 30, calles on R to indicate what needs to be in the space he has delimited that is not yet present. R responds with an agreement token, "Right", at line 31 but does not elaborate. He does not indicate that there needs to be an object in the region indicated by A's hands nor does he provide a description of that object. This prompts A to recycle his query in line 33.




```
34   R:      The in between
35   A:      Yeah we're missing the in between right (.)
36           exactly
37           (1.0)
38   A:      We're missing this ↑who::le leng⌈th here okay so
39   R:                                      ⌊Mm mhm
40   A:      .hhh sump'n is wro::ng
```

The question, "What are we missing" is made sensible because of A's sustained gesture. A has defined the space delimited by his gesture as a space that is missing something. The sense of an absence is made relevant by the fact that there had been an earlier surgery that was to have made it possible for the cephalic vein in the arm to mature, a surgery which was unsuccessful in achieving this aim. The question calls on R to consider the requirements of a dialysis nurse and assess the pre-operative arm for what would need to be present to satisfy those requirements. R responds to A's query at line 34 with "The in between". As he says this, he uses both hands, bringing his two fingers together within the domain delimited by A's pointing to inscribe and thereby constitute through his gesture the in between as an answer to what is missing. This answer is immediately affirmed in lines 35 and 36 allowing A to then more precisely characterize the extent of the missing structure and conclude that there is "sump'n is wrong" with the current state of the patient's pre-operative arm.

DISCUSSION

The participants co-present in this scene did considerable work to collaboratively produce the description of what was wrong with the patient's arm. What was wrong is that the "in between" was missing, i.e., a matured region of vein that under normal circumstances would have been easily accessible to a dialysis nurse between the upper arm where the vein enters the body and the area above the patient's elbow where the initial anastomosis was constructed. The reason why the vein had not matured was that a stenosis had occurred (at the location on the patient's arm marked by an X) which prevented adequate blood flow to occur and produce the matured vein. The attending surgeon wanted the resident to describe how the current pre-operative arm might look problematic to a dialysis nurse, thereby emphasizing the purpose of the surgery in terms of the subsequent usability of an anatomical artifact that would emerge as the result of a successful surgery.

One of the interesting features of this interaction is the way a non-present actor is made relevant to the ongoing interaction. There are a number of ways that an actor can introduce a non-present actor into an interaction. One way is to simply talk about that actor, describe actions he or she performed, etc. Another way is to invoke the non-present actor by reporting the speech of that actor, as when some says "And John said, "I thought he might have it." In such a case, the actor is animated by a speaker producing talk as that actor's speech. A third way is for a participant in the scene to actually animate the role of the non-present actor, to "become" the absent party. These different ways of introducing a non-present actor to an interaction are

consequential for the kind of perspectives that their presence affords. Presenting a narrative about another person or reporting the speech of a non-present actor provides no way for the non-present actor to actually participate in the ongoing interaction among co-present participants. Such participation requires the presence of the non-present actor. There are only two ways to achieve such participation. One is to make the actual actor present, the other is for one of the co-present actors to take on the role or animate the identity of the non-present actor. This is precisely what the attending surgeon asks the resident to do, animate the identity of the dialysis nurse in a way that would allow the nurse's perspective to actively participate in the ongoing interaction.

In this paper, we have seen how gestural work, combined with both the spatial and personal indexicals in the talk serve to constitute a site of activity in at least three ways, as a site of prior activity, as the current site of participation and as a projected site of usability. It is in the combination of personal and spatial deictics in talk and in embodied action that usability becomes a relevant consideration for co-present participants in the scene. In this way, we can consider usability to be an interactional achievement, produced for consideration as relevant through the interactional work of co-present and non-present actors involved in patient care.

At a more general level, one can argue that we have examined certain methods of instruction involving the production of multiple temporal perspectives and different participation frameworks achieved as part of the accomplishment of joint work. One important way the CSCL can advance and produce meaningful results is to first understand the nature of collaborative learning. To do so can only provide further insight into ways that we can support collaborative learning through the implementation of technological interventions. Thus, collaborative learning of the sort described here is the very kind of activity that needs to be understood in CSCL if the field is to advance.

Usability is an inevitable concern and relevance in the conduct of all design work. The surgical construction of a proper transfusion site for kidney dialysis is no exception. In this paper, we examined how the actors, in the course of their work, constituted the sense and relevance of the usability of the surgically achieved structure they were working to construct. As a site for both learning and work, the operating room afforded us the opportunity to examine how usability, which is a critical design consideration, can be used as a resource for learning in interaction. In our detailed analysis of the interaction among participants (both co-present and projected) we sought to describe a particular case of how usability was achieved as a relevant consideration for surgical education in the operating room. In doing so, we hope we have demonstrated a set of members' methods by which actors establish and provide for the relevance of the projected needs of projected users as part of developing an understanding of their current activity.

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