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ABSTRACT

In this paper, we describe how usability provides the indexical ground upon which design work in a surgery is achieved. Indexical and deictic referential practices are used 1) to constitute participation frameworks and work sites in an instructional surgery and 2) to encode and manage participants' differential access to the relevancies and background knowledge required for the achievement of a successful surgical outcome. 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 produced as a relevant consideration for surgical education in the operating room. In doing so, we demonstrate a set of members' methods by which actors worked to establish and provide for the relevance of the anticipated needs of projected users as part of developing an understanding of their current activity.

USABILITY AND DEIXIS

Usability is a term that has a specific sense in the world of HCI. According to the Usability Professionals' Association (2004), it refers to "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (ISO 9241-11). But where is usability to be located? Is it something built into a product or is it something that can only be found in the emergent practices of the user in interaction with a designed artifact? The definition could be read in either way. If one takes seriously, however, the claim that "technology does not exist independent of it's use" (LeBaron, 2002), then it becomes clear that usability cannot be an attribute of a thing, but rather must be a relation between a user and an artifact as embodied within a set of practices.

The notion of usability as a relation between user and artifact has implications for the design of products, artifacts, technologies, etc., which are designed for others to use. First and foremost, that relationship between user and artifact is presumably one that the designer both envisions and constitutes as her design work. Another design consideration that concerns us here in this analysis is that, when designing an artifact for use, it is occasionally the case that a designer must "custom" design an artifact for use in a particular and local circumstance. The specificity of design and construction in such cases derives from the local conditions and circumstances in and for which the designed artifact is to be used at some future time. The design work in such cases involves recognizing and envisioning what is or may be called for in a given local circumstance of use, presumably the to-be-designed artifact and its features that do not yet exist.

As we will see, when usability, as embodied practices, is invoked as a relevant design and instructional consideration, reference to subsequent embodied practices of use of the designed artifact and to the features and organization of the designed artifact for which usability is a consideration becomes relevant as well. How that reference is actually achieved shapes a designer's orientation to the designed artifact and to its end-user. In short, the work of design invokes sets of alternative and relevant perspectives, participants, and practices and the relations among them, in terms of past, present and future circumstances of design and use. Importantly, particular referential practices deployed in the design process with respect to these relevancies do the work of situating designers with respect to their work and with respect to end users and their work.

For designers and users both, though in different ways and with different consequences, the organization of referential practice with respect to the usability of designed artifacts involves deixis and indexical reference. In the design and development process, different participants have different orientations and perspectives on the work being done. These differences are organized and encoded into an emergently coherent field of action on an ongoing basis by participants in the design process. This emergently coherent field of action is what Hanks refers to as the indexical ground of deictic reference (Hanks 1992). In this paper, we will examine one circumstance in which usability provides the indexical ground for what are seen by participants as relevant design considerations in the repair and construction of an arteriovenous fistula.

Treating usability as a relation between a user and an artifact as embodied within a set of practices has important implications for how we might go about designing for usability. In particular, by examining usability as the indexical ground upon which design

work is accomplished, we can see how a senior attending surgeon and a resident surgeon can have different perspectives on and different access to their ongoing design work as it is accomplished in ways that allow for reciprocity and the coordination of their ongoing actions. For this special issue focusing on learning and work, we will attend to a particular aspect of designing for usability, that is the question of how one might go about introducing a newcomer to the work of designing for usability. Designers, in the ongoing accomplishment of their work, regularly concern themselves with what they take to be the needs of end users. One of our interests here is in the ways that these "needs" are constituted as design considerations in and as the ongoing work of design. Stated in another way, we are interested in how future usability is made relevant as a contingent and situated achievement of ongoing interaction among participants in the design process.

As was suggested above, we will frame our analysis using Hanks' (1992) notion of the "indexical ground of deictic reference." Deictics are the linguistic elements that tie an utterance to its setting. As Hanks describes it, they are the "juncture between grammar and context" (ibid, p. 47). Because of its important contributions to the coordination and conduct of cooperative work, deixis has received considerable attention in the literature on workplace studies (see, for example, Goodwin & Goodwin, 1996; Hindmarsh & Heath, 2000a, 2000b) Cooperative work rests upon forms of interaction dedicated to the local production of sense and mutual intelligibility in the performance of work-related tasks. Deictic tokens are one resource employed by participants in carrying out this interactional effort. In particular, deictic tokens allow for actors to reference the immediate features of their interactional environment and to project referential objects that have already been or have as yet to be achieved..

For Hanks (1992), the term *deixis* suggests ways that actors use linguistic and other embodied actions and resources to produce and use "referential indexicals" (p. 48). Examples of linguistic referential indexicals typically include terms such as "this," "that," "here," etc., whose specific sense is determined locally by interlocutors and whose shared sense is established interactionally among interlocutors in terms of a shared "indexical ground" (Hanks 1992). This indexical ground often remains implicit but provides the basis by which interlocutors develop a shared understanding of the deictic references being made. Hanks uses the metaphor of the Gestaltists' figure and ground to discuss what deictic reference brings into relief. This figure and ground relationship is continually changing within interaction. .Deixis, then, is the way that actors make specific reference to persons objects, artifacts, and actions that are locally relevant in terms of a shared set of background understandings, orientations and perspectives. Furthermore, it is this shared set of background understandings, orientations and perspectives that make these references intelligible to interactants. This indexical ground provides, among other things, 1) that to which the deictic references are referring, 2) the different relations actors have to those referred objects, artifacts or actions, and 3) different relations actors have to each other as implicated by and expressed in terms of those deictic references.

There are different kinds of deictic references, cast against the background of shared indexical ground, by which actors locally organize their interaction. These include spatial, temporal, object and personal deictic references. Spatial deictics are used to locate persons, objects and actions in terms of such relevancies as location, proximity and spatial orientation. In a similar way, temporal deictics are used to locate persons, object

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and actions in terms of temporal relevancies such as past, present and future (in conventional Western terms). Object deictics involves identifying objects relevant to the local interaction. In a similar manner, personal deictics involve identification of relevant actors. This may include participants who are locally present as well as those who are not. This also is used to socially situate participants in terms of shared understandings about and relevancies affiliated with conferred identities established through the use of personal deictics.

Thus, through the uses of personal, spatial and temporal deictic reference, participants are able to allocate, invoke and establish relevant features of their local interaction over a variety of locations, times and actors. These deictic practices allow for what Hanks (1992) refers to as foregrounding and backgrounding of particular relevancies by actors in a scene. Deixis is part of the "tool kit" by which actors make selectively available features of the situated social world in which their actions are embedded.

We selected what we believe is a perspicuous setting in which a newcomer learns to design for usability to examine how the practical work of designing for usability is carried out. In our case, we examine how two surgeons design and construct in and for a particular patient's body an anatomical object, an arteriovenous fistula (AV fistula, see below), that will facilitate subsequent kidney dialysis for that patient. What makes our case interesting is that there is a senior or Attending surgeon and a junior or Residnet surgeon engaged in the work of the surgery and the work of instruction. The Attending's task is to supervise the performance of the surgery to a safe and successful conclusion and also to train the Resident in the design process and the surgical procedures in

constructing the to-be-designed object. In this circumstance in which an actor is engaged in both design and instruction, reference to the embodied practices of use and to the features and organization of the artifact situate the Attending and the Resident with respect to each other, the design and construction process, the patient, the intended user of the designed artifact, and the designed artifact itself. The problem faced by the Attending is to use local indexical resources to instruct the Resident with respect to 1) an object that does not yet exist, 2) the object's future use and 3) the requirements of the future user so that the Resident can come to competently envision what must be done to design and build an AV fistula that will subsequently mature into a structure for a dialysis nurse to use at a later time. Because neither the AV fistula nor the dialysis nurse are present, we argue that personal and spatial deictics are particularly important for how this gets done.

One important feature of this kind of design work is that it is oriented toward coordinating the work being done in the present (i.e. the surgery) with work that will take place in other settings and in other times and will involve other workers (i.e. the administration of kidney dialysis). This concern for usability in other scenes is related to the phenomena of embedded contexts (Goodwin, 2003) in which actors use "resources in the present scene to make visible absent phenomena" (pp. 344-345). Goodwin (2003) demonstrates various ways that this is done. One way involves the use of spatial features of the current scene as the "local metric" (p. 344) by which an absent scene is made available to interlocutors. Another way that Goodwin describes involves the use of talk from other scenes (not necessarily quoted talk) that is deployed as a way of producing, managing and sustaining reference to and the relevance of multiple scenes in a current

interaction. In our data, we see how personal, temporal and spatial deictics, articulated in terms of usability and the actions performed by others in other scenes and at other times, can also be used as a strategy for producing embedded contexts.

Thus designing for usability necessarily involves entertaining discussions about people (i.e., users) and things (i.e. artifacts) that may not be present in the local scene of interaction in which the design work is being done. It is this discussion that foregrounds these non-present people and things and makes them locally available to current participants. In our data, the Attending foregrounds the relevance of "what is missing here," bringing that which is missing, i.e. the dialysis nurse and the matured AV fistula, into relief as a way of both invoking and establishing shared indexical ground with the Resident. Our project is to document how this was achieved.

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DATA

Vascular Surgery as Design Work

To explore this question, we examine data from a vascular surgery. In certain kinds of vascular surgeries, structures called arteriovenous (AV) fistulas are assembled and/or repaired to make it easier for a dialysis nurse to subsequently administer kidney dialysis to the surgical patient. In "teaching surgeries," i.e. surgeries in which a Resident surgeon is being trained, these structures and the uses to which they will be put can become both pedagogical and design resources for the Attending (A) or senior surgeon and the Resident (R) who is participating in the surgery.

Surgeries that are designed to create or repair AV fistulas are distinct from other kinds of surgeries in that the participants in the surgery (medical staff and the patient)

recognize that these surgically achieved structures have a particular intended use; they are built to be usable by other health care providers 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 anatomical structure for subsequent health care providers. In the surgery we investigate, the subsequent health care provider invoked by the attending surgeon is the dialysis nurse.

The use of personal deictics is especially interesting when a current participant in a scene animates, or is asked to animate, a relevant but absent future user. In such circumstances, the relevant formation of and management of alternative identities can become a relevant issue for participants. In these data, we see that the resident resists the attending surgeon's efforts to use personal deictics to animate a dialysis nurse. Thus, identity and participation can be relevant considerations in the use and production of embedded contexts (Goodwin 2003).

Video Recordings

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[1], a multi-disciplinary undertaking designed to explore how instruction is produced in the context of consequential, joint activity.

Ethnographic Background

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 and the entry point for the patient. In the case under study, 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.

Technically a fistula refers to a passage or opening between two organs or structures. In this case, 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," an object that establishes a connections with and a boundary between vascular surgery and

kidney dialysis by bringing together the work of the vascular surgeons and the work of the nurses in the dialysis clinic.[2]

The participants in the excerpts we examine are "Attending" (A), an experienced vascular surgeon with ultimate responsibility for the safe outcome of the surgery being performed and "Resident" (R), an advanced surgeon-in-training enrolled in a surgical residency program. The surgery in this case is being done largely by R with A supervising and assisting. This interaction in which A and R discuss what they are going to do in terms of future use occurs at the beginning of the operation, prior to making the first incision.

Analysis

An AV fistula re-routes blood flow from a peripheral artery directly into a superficial vein, causing the vein, overtime, to grow larger and become a more serviceable access site for the work done by dialysis nurses. The task of designing and fabricating such a site causes the surgeons, in the words of Goodwin (2003), to 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 future time of subsequent use. Their design work is undertaken to anticipate and accommodate future use and thus is guided by the projected needs of a relevant actor not currently present, in our case, the dialysis nurse. The instructional problem faced by A in the conduct of the surgery is to make evident to R just what the projected needs of the dialysis nurse are. In our analysis, we demonstrate the indexical and deictic organization of the methods used by A and the R to accomplish their current design work in terms of the subsequent usability of the AV fistula. In order to convey the appropriate design considerations, A

uses locally available resources to 1) invoke an artifact that is not yet present in the scene, viz. the AV fistula, 2) a future user of that artifact who is not present in the scene, viz. the dialysis nurse, and 3) provide resources and opportunities for R to discover what the missing and as-yet-to-be-constructed AV fistula must become.

We present the analysis in two parts, first in terms of personal deictics and then in terms of spatial deictics. In both cases, temporal deictic considerations are relevant as well. As is evident from the data, personal, temporal and spatial indexical referencing is an integral part of the ongoing interaction. We consider personal and spatial deixis separately for convenience of presentation only. In the first instance, personal deictics takes up the question of how A makes present to R the absent but relevant future user, i.e. the dialysis nurse. The specific methods by which A makes reference to this relevant but absent future user of the fistula is organized through the use of personal deictics. As we will see, A invites R to enact or animate the perspective of the dialysis nurse who is not actually present in the local interactional scene of the surgery but whose perspective, interests and actions are considered relevant to the local interaction and the ongoing design work of the surgery.

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Spatial deictics, on the other hand, refers to the way that A and R make specific reference to their current work site, i.e. the patient's arm and the AV fistula as the boundary object they are tasked to design and construct. The patient's arm may be treated as a site of past and current surgical activity, and as a site of future use (i.e. kidney dialysis) for the purposes of properly specifying the current work that needs to be done. By invoking the dialysis nurse in a way that invited R to articulate the nurse's perspective on the AV fistula that has yet to be constructed, A seeks to provide R with the

opportunity to anticipate and articulate specific medical and design considerations relevant to the dialysis nurse as the anticipated future user of the fistula. This is of particular significance because the surgery itself is designed to allow for the production of the fistula, and it is this fistula as a boundary object (in the sense discussed above) that provides for the relevance and organization of the personal and spatial deictic work achieved during this part of the surgery.

The indexical ground is not synchronic, but instead potentially extends indefinitely into the past and future. Spoken English provides multiple resources for indexing temporal relationships including special deictic tokens such as *now* and *then*, verb tense, etc. Given that designing for usability necessitates projecting future use, one might expect extensive and explicit use of temporal deictic markers in this situation. However, in the fragment we examined, temporal deixis was achieved implicitly by invoking a projected sequential organization of future practices, outcomes and actors. Thus, as we will see, temporal deictic reference was achieved by invoking the dialysis nurse (personal deixis) and the actions of that nurse with respect to the anticipated future state of the arm (spatial deixis) without explicitly resorting to temporal markers, verb tense, etc. Thus, in what follows, we discuss temporal deixis in light of these other forms of deictic work.

Referencing the Missing User through Personal Deictics

We begin our analysis as A and R are preparing the surgical site prior to the first incision. In the interaction between A and R, A does some initial work that is designed to assess what R knows about the surgery they are about to perform. Specifically, the exchange between R and A involves the use of a question sequence common in

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classroom recitation in which a question, i.e. "What's missing" (line 2), is asked, the answer to which is already known by the interrogator. When there is silence or an inadequate response in the place where an appropriate student response would be relevant (as in lines 3-5), the teacher re-formulates the query (as in line 6), etc.

```
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
```

The question "What's missing?" presents R with particular kinds of difficulties because the formulation of the question offers very few resources by which R can identify what A could see and treat as an adeqiate appropriate response.[3] This difficulty is made manifest at lines 3 through 6. In response to R's difficulties in putting forward an adequate response, A initiates an alternative organization of inquiry. This new organization of inquiry or alternative way of framing the problem (lines 7 through 14) accomplishes a variety of things. First, it serves to indicate that R's response to the initial question was locally inadequate. The transition to an alternative way of framing the problem provides R with 1) different kinds of resources from which an appropriate response could be designed and 2) another opportunity to produce a 'correct' response for A. The formulation of the reframed problem invokes a non-present but consequentially relevant actor for consideration, i.e., the dialysis nurse, as a way of indicating the kind of response A would like R to produce:

```
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
```

Examining the personal deictics in these two extended utterances from A, we can note a shift from the "you're the dialysis nurse" (second person, temporally and physically present) to "where are you gonna put that needle" (second person projected temporally into the future and spatially into a dialysis clinic). This organization of personal reference displays that personal deictics can be used as a method of establishing a mutual orientation to actors and actions that are relevant to the current circumstances but that are temporally and spatially dislocated by provisionally assigning the identity of an absent but relevant actor to one who is present. Thus, we can see that A's question calls for R to 1) temporarily and in very circumscribed ways suspend his participation in the interaction as resident surgeon and 2) answer A's question *as the 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.

'Going to *x*' is an idiomatic English construction for projecting future action. It's use in line 13 represents one of only two places in this fragment in which temporal indexing is done explicitly. For the most part, then, temporality is addressed in other ways. By asking the resident to respond as the dialysis nurse, future use is evoked by implication, based on the shared understanding that a dialysis nurse will be working with this patient's arm at some point in the future. So even though statements like, "Okay (1.0) and you wanna (.) stick a needle in this" (lines 10-11) are expressed in the present

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tense, they are heard as projecting future action. Personal deictic reference ("you wanna") is doing temporal deictic work, therefore.

R's response (lines 15-16) is interesting in light of its use of participant deictics and in terms of the use of surgical rather than nursing relevances:

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

In this case, R's use of 'you' and the relevant category terms "vein" and "artery" ambiguously positions R with respect to the absent but relevant dialysis nurse. In particular, R's response is framed in anatomical terms that are relevant for the surgery they are about to perform but are not necessarily relevant to a dialysis nurse. By framing his response in surgically relevant anatomical terms rather than in terms of the relevant concerns of the dialysis nurse as user, R appears to be resisting A's effort to get him to to temporarily suspend his identity as the resident surgeon in the scene and adopt the perspective of the dialysis nurse. The adequacy of the response to the question "where are you gonna put that needle", where 'you' refers to R cast in the particpation framework of the dialysis nurse, is now a matter for assessment by A at lines 17, 19 and 20:

```
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
```

The anatomical framework proposed in R's response invokes a surgical orientation to the scene and seeks to reestablish R's participation *as a surgeon* rather than *as the*

dialysis nurse. A is now faced with the problem of attending to and assessing R's response on it's own terms, not in terms of usability (as displayed in his initial query) but in terms of surgical anatomy. There are a number of issues that arise at this point for A. First of all, A's assessment treats R's response as inadequate from the perspective of usability and from an anatomical and surgical perspective as well. This is indicated by A's dismissal of the R's reference to the artery as irrelevant: "We- we- we're actually don't even care about the artery" (lines 17 through 19). A then refers to the "cephalic vein" (line 20), which serves to correct the anatomical imprecision of R's response and also establishes the cephalic vein as a possibly relevant boundary object linking the current actions of the surgeons to the projected actions of the dialysis nurse. R's response token at line 21 is a masterful stroke of ambiguity in that it serves to acknowledge A's assessment and repair of R's response without acknowledging, attending to or taking up the task of animating the perspective of the dialysis nurse.

A then works to establish the relevance of dialysis nurse's perspective by once again attempting to place R into the position of animating the perspective of the dialysis nurse (lines 22 through 24). A treats R's response token at line 21 as a mitigated form of resistance. This is evident in the way A respecifies the nurse's projected future action (indicated initially at line 10: "you wanna stick a needle in this") 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):

```
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=
```

This escalation to a projected future history of repeated actions serves to emphasize the consequentiality for the current surgical procedure of the concerns of the dialysis nurse regarding the performance of those projected future actions. This thereby emphasizes the urgency that R take up the perspective of the dialysis nurse, i.e. animate the dialysis nurse for the purposes at hand, and display what the attending surgeon would consider to be a proper understanding of the projected use of the anatomical structure that is the expected outcome of the surgery. In this case, the future projection is both implied ("you're the dialysis nurse") *and* explicit ("gonna be putting"), asserting that this site will not only be put to future use, but also that the use will be sustained. Despite this escalation, R still does not produce a response to A's query and produces only a continuer / acknowledgment token at line 25.

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It is at this point that A abandons any attempt to invite R to take up an alternative participation framework and reverts to a shared surgical framework of participation. This is indicated by the shift in the use of pronouns from "you" to "we" in lines 26 and 27:

```
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 the dialysis nurse's project concerns for usability to a return to the student-teacher organization of interaction in terms of surgical relevancies. 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 R earlier and to which R had not yet produced an adequate response.

At this point in the analysis, it should be evident that the achievement and organization of personal deictics serves to link the actors present in the surgery with actors who at some future time will make use of the fistula produced as a result of this surgery. These future users (the dialysis nurse and the patient as dialysis patient) and the mature fistula itself are linked to the current actors (the attending, the resident and the patient) through the work they are doing.

However, in order to adequately describe how this last section of the transcripted interaction allows R'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 R's response can be seen as adequate.

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Referencing the Missing Artifact through Spatial Deictics

The previous discussion focuses on how A and R orient to each other in order that R come to some understanding of the use to which the AV fistula will be put and how

that use affects the design and construction of the fistula. However, there is another set of resources of which A and R both make use and which also constitutes the proper domain of their collaborative work, i.e. the patient's arm. The resources so constituted as and by the patient's arm provide the indexical ground 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 produce a shared understanding of the circumstances of the surgery.

In order to produce A's initial query at lines 1 and 2, and an adequate response to that query, both A and R 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 A 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, A's instructional work is to make evident what could be termed "the usability

requirements" that inform the current surgical work. These "usability requirements" emerge from the instructional work of calling on R to "show" or account for 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 A and R 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, (see Figure 1).

<<FIGURE 1>>

```
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), R moves his hand into a position that permits him to point to the location identified by A. As R starts to produce a response in line 4, he brings his left hand into position to point to the location 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, R demonstrated the location and orientation of the cephalic vein in terms of the stenosis (marked by the X) and and the fistula, (see Figure 2).

<<FIGURE 2>>

```
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. 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 answered, 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
```

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 spatial deictic work is designed to to do temporal deixis by transforming 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 (see Figure 3).

<<FIGURE 3>>

```
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, future 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 a future user, i.e. the dialysis nurse, as a participant in the ongoing interaction at A's prompting.

Any answer to the query in line 13 would be treated as the answer provided by a dialysis nurse who would be expected to see at a future time 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, (see Figure 4). The actual response in lines 15 and 16 below are ambiguous at best.

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<<FIGURE 4>>

```
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
27        the 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
```

A holds this position, bracketing a region of the patient's arm between the pointing of his left and right hands, (see Figure 5).

<<FIGURE 5>>

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, (see Figure 6). 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.

<<FIGURE 6>>

```
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 produced a "something" to occupy that region of the arm. The first surgery should have made it possible for the cephalic vein in the arm to mature, but 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. A wanted R 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.

In this paper, we have seen how gestural work, combined with both the spatial and personal indexicals in the talk served to constitute a site of activity in at least three ways: 1) as a site of prior activity, 2) as the current site of participation and 3) as a projected site of future use. The data illustrated the way that participants manipulated personal and spatial deictic resources with respect to their situated identities so as to

interactionally motivate a sense of usability and also to constrain the developed articulation of that usability. There was very little use made of explicit temporal deixis, though indexing the future use is a necessary part of designing for usability. As we saw, however, members' shared understanding of the sequential and temporal organization of care giving made it possible for A and R to deploy personal and spatial deixis to pragmatically evoke the future.

In conventional applications, usability is treated as a designed feature of an object or procedure. The activity analyzed in this paper indicates one way that usability is introduced, organized and achieved in the design process as a projected relationship between actors and the objects and procedures they employ in the conduct of specific actions. As we have seen, the practical work of designing for usability is ultimately interactional work carried out with reference to the indexical ground of deixis. This ground involves viewing the current interaction as part of a longer sequence of activities in which there are 1) actors who participate in the current interaction which is understood to be only part of a longer activity sequence, 2) actors who were previously engaged in prior activities that are considered part of the longer activity sequence, and 3) participants who are expected to participate in subsequent activities deemed part of the longer activity sequence. These actors, and their actions, are part of the temporal organization of the activity and thus can be used as deictic resources for establishing indexical ground.

One of the interesting features of this interaction is the way a non-present actor and future user is made relevant to the ongoing current 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 has performed or will perform,

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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 to introduce a non-present actor into the scene is to "become" the absent party by impersonating that actor. The different ways of introducing a non-present actor to an interaction are consequential for the kind of perspectives that their "introduced" 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. For such participation to occur, the presence of the non-present actor must be achieved. 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 animate the identity of the non-present actor. This is precisely what A invites R to do: animate the identity of the dialysis nurse in a way that would allow the dialysis nurse to actively "participate" in the ongoing interaction.

As we have seen, taking on the identity of another actor can be powerfully consequential for how actors manage their identities and their participation in a current scene, especially in circumstances where identity is a relevant concern. A eventually abandoned the effort to have R animate the identity of the dialysis nurse as a way of scaffolding R's understanding of the surgery they were doing. Thus as a pedagogical device, asking an actor to become "someone else," even for the purpose of fostering understanding, actually may be an impediment to participation and understanding when actors are invested in maintaining and sustaining certain specific identities. In circumstances such as this surgery, where actors find it problematic to animate a non-

present actor whose interests are relevant to an ongoing interaction, it may be difficult to fully articulate usability as a design consideration that could affect participants' understandings of and participation in their interaction.

Usability is an inevitable concern and relevance in the conduct of all design work. As such, it is available as a pedagogical resource in circumstances where instruction and design co-occur. Usability becomes relevant to participants in other ways when current work practices involve the design and/or production of an artifact that is relevant to performance of future work practices. Thus, while deixis is ubiquitously a part of workplace practices in terms of the coordination and achievement of ongoing workplace outcomes (e.g. Hindmarsh and Heath, 1999; Hindmarsh and Pilnick 2002), deictic practices are also relevant in different ways when current actors are doing design work for future use. In our data, we have seen that the design of the fistula required that the surgical team make reference to future users who were not present in the scene and to what those future users would treat as relevant future work spaces and practices. This research extends the examination of the performance and management of deictic practices when both current and projected or future workplace settings are relevant and where the future usability of current work is a relevant consideration.

The surgical construction of a proper transfusion site for kidney dialysis in a teaching surgery is just such a circumstance. In this paper, we examined how the actors, in the course of their medical work, tried to constitute 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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References

Button, G. (Ed.). (1993). Technology in working order: Studies of work, interaction, and technology. London: Routledge.

Goffman, E. (1974). *Frame analysis: An essay on the organization of experience*. New York: Harper & Row.

Goodwin, C. (2003a). Embedded context. *Research on Language and Social Interaction*, **36**, 323-350.

Goodwin, C. (2003b). Pointing as Situated Practice. In S. Kito, *Pointing: Where Language, Culture, and Cognition Meet*, Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 217-242.

Goodwin, C., & Goodwin, M. (1996). Formulating planes: Seeing as a situated activity. In Y. Engeström & D. Middleton (Eds.), *Communication and cognition at work* (pp. 61-95). New York: Cambridge University Press.

Hanks, W. (1990). *Referential practice*. Chicago: U. of Chicago Press.

Hanks, W. (1992). The indexical ground of deictic reference. In A. Duranti & C. Goodwin (Eds.), *Rethinking context: Language as an interactive phenomenon* (pp. 43-76). New York: Cambridge University Press.

Hindmarsh, J. & Pilnick, A. (2002) The tacit order of teamwork: Collaboration and embodied conduct in anesthesia. *The Sociological Quarterly 43(2),* 139-164.

Hindmarsh, J. & Heath, C. (2000a). Embodied reference: A study of deixis in workplace

interaction. *Journal of Pragmatics, 32*, 1855-1878.

Hindmarsh, J. & Heath, C. (2000b). Sharing the tools of the trade - the interactional constitution of workplace objects. *Journal Of Contemporary Ethnography, 29*(5), 523-562.

Holquist, M. (1990). *Dialogism: Bakhtin and his world*. London: Routledge.

Hornbaek, K. (2006). Current practice in measuring usability: Challenges to usability studies and research. *International Journal of Human-Computer Studies (64), 79-102.*

Luff, P., Hindmarsh, J., & Heath, C. (Eds.). (2000). *Workplace studies: Recovering work practice and informing system design*. New York: Cambridge University Press.

Maynard, D. (1992). On clinicians co-implicating recipients' perspective in the delivery of diagnostic news. In P. Drew and J. Heritage (eds.), *Talk at work: Interaction in institutional settings*, Cambridge: Cambridge University Press, 331-358.

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'translations' and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology, 1907-39. Social Studies of Science, 19, 387-420.

Suchman, L., Trigg, R., & Bloomberg, J. (2002). *Working artefacts: Ethnomethods of the prototype.* British Journal of Sociology, 53, 163-179.

Usability.gov, Usability Basics (n.d.). Retrieved May 15, 2005, from http://www.usability.gov/basics/index.html

Formatted: References, Indent: Left: 0", First line: 0", Right: 0", Automatically adjust right indent when grid is defined, Widow/Orphan control, Adjust space between Latin and Asian text, Adjust space between Asian text and numbers

Usability Professionals' Association, What is Usability. (2004). Retrieved May 15, 2005, from http://www.upassoc.org/usability_resources/about_usability/definitions_of_usability.html

Wortham, S. (1996). *Mapping participant deictics: A technique for discovering speakers' footing*. Journal of Pragmatics, **25**, 331-348.

Zimmerman, D. H. (1998). Identity, context and interaction. In C. Antaki and S. Widdicombe (eds.), *Identities in talk*, London: Sage, 87-106.

Endnotes

[1] The data analyzed in this report came from the Southern Illinois University Surgical Education Video Corpus. Further information about this corpus can be found at the website of the Collaboration & Learning Laboratory (http://www.siumed.edu/CaLL/).

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[2] 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. It is only this mass of non-descript tissue that makes the tortuous journey across the boundaries of these different forms of practice.

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[3] The indexical ground for the question "What's missing?" includes assumptions regarding not only the object that is not currently present but also implications regarding the actor or actors for whom the object's absence and presence would be relevant. Thus the question has built into it the problem of identifying the boundary object that links their current work to the subsequent work of a future user. In this case, the boundary object is the AV fistula and the future user is the dialysis nurse.

Figure Captions

Figure 1. Anastamosis marking the location of the cephalic vein.

Figure 2. Resident indicating the location and orientation of the cephalic vein.

Figure 3. Attending surgeon sweeping his hand over the patient's arm.

Figure 4. Resident pointing to locations of the vein and the artery.

Figure 5. Attending surgeon indicating the location of the problem.

Figure 6. Attending inscribing through gesture what is missing.