Visual expertise as embodied practice

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Abstract

This study looks at the practice of thoracic radiology and follows a group of radiologists and radiophysicists in their efforts to find, discuss, and formulate issues or troubles ensuing the implementation of a new radiographic imaging technology. Based in the theoretical tradition of ethnomethodology it examines the local endogenous practices pertaining to the radiologists' expertise in the interpretation of visual representations and tries to explicate the ways in which they draw upon various resources in order to accomplish their professional tasks. As the study is addressing the topic of visual expertise it also aims to do so in terms that acknowledge that all expertise is rooted in embodied practices. The analysis follows a case of what is called the enacted production of radiological reasoning. One of the central features of the described work is the manner in which it is carried out by way of the living present body of an expert. The experienced radiologist interweaves anatomical and technological terminology with visual representations and gestures in such a way that none of these components can be said to be superfluous to the argumentation. As a consequence, we should appreciate gestures and embodied actions as important means through which expertise become organised. These are parts of a repertoire of methods through which the experts learn their profession. In addition, gestures can also become enrolled in the re-negotiation of expertise in the face of new challenges.

Keywords: visual expertise; radiology; ethnomethodology; body; gesture

1.   Introduction

This study looks at practitioners in thoracic radiology. It follows a group of radiologists and radiophysicists in their efforts to *find*, *discuss*, and *formulate* issues or troubles ensuing from the implementation of a new radiographic imaging technology. By foregrounding this case, where professionals grapple to overcome some difficulties in interpreting new forms of radiographs, it becomes possible to examine the matter of visual expertise through a dual lens; it simultaneously presents us with a specialised area of expertise as something *performed* and as something *talked about* by the very same practitioners.

The profession of radiology has typically been described as the technical art of visually perceiving structures and pathologies by way of radiographs. It has been portrayed as a solitary practice where for instance the position of the radiologist's eye in relation to the image can be examined for the ways that it will impact on the detection of pathologies (Kundel, Nodine, & Toto, 1991). In this traditional view of radiological practice, the body plays an intriguingly subordinate role, and expertise in diagnosing x-rays is described as grounded in deep forms of cognitive processing (Lesgold et al. 1988).

When radiology in this way becomes prefaced by its function as visual assessments of representational objects, both the practitioners and their patients seem to figure merely as dis-embodied phantoms. The objective of this study then is to revisit this isolated focus on eyes and perceiving retinas and to bring the body back into the study of visual expertise. The general model of perception as a process where sensation and movement are seen as intrinsically tied to visual understandings of form is itself not new (cf., Myers, 2008). Ideas of this kind have been advanced in the theoretical works of such scholars as Maurice Merleau-Ponty (1962) and James Gibson (1968, 1979). This particular study though, will draw on insights generated within the tradition of ethnomethodology and studies of talk-in-interaction. As will be argued, this means that the analysis seeks to describe the work of the practitioners in its discipline specific details. It looks at the *local endogenous practices* pertaining to the radiologists' expertise in the interpretation of visual representations and the ways in which they draw upon various resources, including the body, in order to accomplish their professional tasks.

2.   Ethnomethodology

Ethnomethodology is a form of social inquiry, "dedicated to explicating the ways in which collectivity members create and maintain a sense of order and intelligibility in social life" (Have, 2004, p. 14). The tradition was founded by Harold Garfinkel in the 50s and 60s and one of his key publications is "Studies in Ethnomethodology" which was published 1967. This book began with a densely phrased description of the enterprise that nevertheless captures much of what then came to be expounded:

> *Ethnomethodological studies analyze everyday activities as members' methods for making those same activities visibly-rational-and-reportable-for-all-practical-purposes, i.e., 'accountable', as organizations of commonplace everyday activities. (Garfinkel, 1967, p. vii)*

Rather than offering a *method* of study, ethnomethodology turns an eye towards the *methods used by members* and makes those into its *object* of study. As a consequence, the analyses are not primarily aimed at generating *new* knowledge. Rather such studies seek to *explicate* what is already known and shared within a targeted group. A possible objection to this restriction in scope could be that analyses of this kind would not amount to much. However, through the close descriptions and detailed accounts provided by the analyses, also non-members can be granted partial access to the inner workings of a practice. In this way the ethnomethodological analysis can also become a form of pedagogy (Garfinkel, 2002).

One feature, central to the focus on members' methods in Garfinkel's (1967) writing, is also the idea of *accountability*. The notion of accountability practices was originally borrowed from the legalities surrounding businesses but in the hands of ethnomethodology it came to be applied to the entirety of social life. The idea here is that members of a practice design their actions, for others, so as to make those actions visible as what they are. For instance, a pedestrian aiming to cross a busy street usually makes sure that this "crossing-the-street" becomes a witnessable thing in the world for others (especially drivers) to see and relate to. It is in this sense that ethnomethodology has come to speak of social life as constituting a "witnessable order". This view embodies a radical methodological departure from other social inquiries that work from a belief in an *underlying* or *hidden* order, that can only be uncovered with the application of specific sociological methods or theoretical concepts (Livingston, 2008). To ethnomethodology, social order is available for all to see and analyse, it is as available to laymen as it is to professionals.

This general approach is immensely useful when studying a vast array of social situations and actions. Nevertheless, when we move into domains of *specialised* professional practice some methodological complications arise. First of all, professional actions such as operations on and in a physical or symbolic environment are social in a special sense. When for instance a dentist is clearing out a root-canal with a file, the physical actions are done as parts of a medical procedure and are primarily done to do that job. Simultaneously, those same actions are also accountable actions within the medical practice of root canal treatments. As the manual domain-specific operations are executed they become witnessable by other practitioners. This means that if those actions are carried out incorrectly (according to the standards upheld by the profession) they can be called out, reprimanded or made into a case of medical malpractice. The upshot here is that some forms of professional conduct may chiefly be designed for, and thus accessible to, other professionals. This condition can make the study of expert performance and reasoning more difficult (for a further discussion see Lynch, 1993).

There are different ways that this methodological difficulty has been managed. In their studies of archaeological excavations (Goodwin, 1994), architectural reasoning (Lymer, 2010) or gallbladder surgery (Koschmann, LeBaron, Goodwin, & Feltovich, 2011) the authors all chose to focus on *educational* settings, arrangements where skilled practitioners were instructing students in the professional forms of seeing and reasoning. In these settings the important things to be seen and known as professional objects became articulated and thereby also rendered available for an overhearing analyst. Another possibility is instead that the analyst becomes a skilled member of the practice. In this tradition we find the highly detailed and most insightful analyses of such practices as improvised jazz (Sudnow, 1978), mathematical proving (Livingston, 1999) and the organisation of turn-taking in surfing (Liberman, 2015). In these latter studies, the authors can be seen adhering to what Garfinkel (2002) termed the "unique adequacy requirement of method", the policy dictating that an analyst must also be *competent* in the very methods that he or she is studying.

While the present study is adopting neither of these two approaches in any traditional sense the case to be analysed has nevertheless been selected and worked on with the above-mentioned complications in mind. Any analyst interested in the expertise pertaining to radiology is presented with a daunting challenge due to the obscurity of the work—as part of an ordinary day's work the practice of assessing radiographs is typically carried out in solitude. For this reason, the analysis presented here will focus on a specially organised meeting where a group of radiologists met with a group of radiophysicists to talk about their current skills in detecting *pulmonary nodules*[2] and some possible limitations of those skills. Thus, the visual expertise within the group of radiologists was itself a topic for the discussion.

Whereas this situation presented more talk than would a solitary reading of radiographs, its analysis would still require some competency in the radiological matters discussed. In order to make any such analysis possible the author has collaborated with the group of radiologists and radiophysicists to the extent of doing joint analyses and co-authoring papers over several years. This form of research can be seen as an example of what Garfinkel (2002) calls "hybrid studies of work", a form of study that focuses on member's

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[2] A pulmonary nodule is a small round or oval-shaped growth in the lung which is possibly malignant.

methods in its discipline-specific details. Grounded in the experience of this and other inter-disciplinary collaborations it is also suggested here that the requirement of unique adequacy could be somewhat reconsidered. Rather than standing as a requirement pertaining to each and every individual it is perhaps better to consider the competency of the analysing collaborative or research team as a whole. The circumstances that brought about this specific collaboration and the studied situation will be addressed after some notes on the study of embodied interaction.

2.1   Studying knowledge and the body

There is a growing body of ethnomethodological studies that address interaction in everyday and workplace settings that also attend to embodied and material aspects of the communicative situations. As argued by Charles Goodwin (2000) traditional analytic and disciplinary boundaries have tended to isolate language from its environment. In order to avoid such separations he has aimed to "provide a systematic framework for investigating the public visibility of the body as a dynamically unfolding, interactively organized locus for the production and display of meaning and action" (2000, p. 1490). Not only are bodies seen as central to the investigation of human action, they are implicated at a fundamental level in the very skills that people come to possess: "As the active body acquires skills, those skills are stored, not as representations in the mind, but as dispositions to respond to the solicitations of the situation" (Streeck, 2015, p. 422). In this way knowledge has a tacit, gestural and even muscular side (Griesemer, 2004), but these aspects are easily neglected once ideas becomes established and mastered on a personal level.

In relation to medical practice, "bodies" become implicated in a multitude of ways. Stefan Hirschauer (1991) has for instance addressed the link between physicians, patients' bodies, and anatomical representations by looking at the work done during surgery. He argues that surgeons have to acquire two bodies in their education: their own trained body and the abstract body as learnt from textbooks and other representations. When learning about anatomy Griesemer sees the origin of ideas to lie much "in the coordination of the senses, particularly sight and touch" (2004, p. 440). This interest for the relationship between hands and object in surgery has also shifted the focus of the observation "away from visual and cognitive models toward a focus on what happens at the interface of hands and instruments" (Prentice, 2005, p. 840). At this interface, gestures can play different important roles (Kendon, 1997). Streeck (2009) has distinguished what he calls six "ecologies of gesture" and two of these are most relevant in this context. First that gestures can select and elaborate features and significances of the *world within sight* and thereby orient participants to the visible environment beyond the reach of the hands. Second, that gestures can evoke phenomena that *are not present* and depict imaginary and abstract worlds.

In a study of how brain neuroscientists work with digital fMRI scans Alac (2008) discusses how the 'seeing' of images is an embodied process that is achieved through a coordination of the visual information generated by the technical instruments with the world of meaningful actions and practical problem solving. In this work "Gesture, talk and the manipulation of the digital screen function together as techniques for managing perception" (2008, p. 493). Furthermore, as "the gestures participate in the interpretive act as an embodied enactment of the process of change" (p. 494) Alac argues that the neuroscientists display a way of seeing images that involves the hands as well as the eyes.

A much similar argument is presented by Slack, Hartswood, Procter, and Rouncefield (2007) in their study of the diagnostic work of mammography. The authors characterize the reading of mammograms as "lived work" which is encompassed by "the arrangement of mammograms, gesturing and pointing to features on mammograms, manipulating mammograms, and annotations" (2007, p. 176). They stress the importance of appreciating the social nature of the work and the embodied nature of reading and annotation. When the studied experts, in their practices of seeing/reading mammograms, incorporate such things as hands, pencils and gestures one should note that "these techniques are not ad hoc workarounds but repertoires of manipulations that are an integral part of the embodied practice of realizing phenomena as what they accountably are" (2007, p. 182).

In relation to how professionals acquire skills during training, Koschmann and LeBaron (2002) investigated learners in various medical professions and their use of gestures in articulating their knowledge. The authors distinguish two ways that the notion of "articulating knowledge" can be conceived. First, gestures can be seen to reveal something about the learner's current understanding. On the other hand, gesture can be treated "not only as an external manifestation of understanding but also as reflecting a constructive process of connection making" (2002, p. 252). It is with this latter view in mind that we turn to the present study and its interest in how gestures can become active means through which visual expertise is built and enacted—how gestures are performed in the service of sense making (cf., Koschmann, LeBaron, Goodwin, Zemel, & Dunnington, 2007), both for self and others.

3. Background to the studied setting

The analysed material stems from a collaborative research project carried out in radiology and radiation physics. On a general level, the project was addressing how advancements in imaging technologies were challenging existing forms of expertise and thereby imposing the development of new criteria and methods of interpretation. More specifically, the empirical material concerns the work following the introduction of a new radiographic technology, called *tomosynthesis*.

At the time of its implementation, tomosynthesis was recognized to have considerable advantages over ordinary chest radiography. In a first study, it was shown that the detection of pulmonary nodules was significantly higher for tomosynthesis than for chest radiography when used by experienced thoracic radiologists (Vikgren et al., 2008). On the other hand, compared to the technology of computed tomography (CT), chest tomosynthesis has a limited depth resolution, which was considered a disadvantage for interpreting pathologies (Johnsson et al., 2010). Furthermore, since tomosynthesis at that time was a new technology, the knowledge of how to best analyse the resulting images was limited. As a response to this new situation, a subsequent study was arranged. In this study, six observers analysed the same group of tomosynthesis cases (n. 89) for presence of pulmonary nodules in two reading sessions, with the purpose of measuring the difference in performance due to learning with feedback between the two sessions. The reading sessions were separated by a collective review session, at which the observers were given feedback on their analyses on an additional set of tomosynthesis cases (n. 25). The collective session also served the purpose of identifying pitfalls and formulating suggestions on how to avoid them (Asplund et al., 2011; Rystedt, Ivarsson, Asplund, Johnsson, & Båth, 2011). The present investigation will focus on the interaction between the participants during the collective review session.

3.1 Recording and data processing

The review session lasted for almost six hours and was recorded with two cameras. A primary high definition camera was aimed at two projector screens set side-by-side displaying tomosynthesis and CT images. In order to help discriminate between the voices of the active participants at the session, a secondary standard definition camera was also installed and aimed at the group. Originally, the view provided by this camera was not intended to be included in the analysis. Nevertheless, after the fact, this recording was found to display a number of interesting features and was subjected to further analysis.

In order for the radiologists to properly carry out their work, of making discernments on the screens, the ambient light in the room had to be kept at a minimum. For the purposes of the recording, this resulted in dark and grainy video images that are difficult to print as stills on a page. When viewed this way, the embodied behaviours of the participants are easily lost. Thus, the very phenomenon that this study seeks to explore evades a simple re-presentation. In order to overcome this analytic problem the events have been represented in a sequence of drawings. This is something that has now become common practice in many

video studies (e.g., Goodwin, 2007b; Lindwall & Ekström, 2012; Melander & Sahlström, 2009). Rather than simply tracing the images provided by the video stills, the processing here has proceeded in a more roundabout way. After transcription (ELAN), episodes selected for further analysis have been digitally re-enacted using 3D modelling software (Poser). Poser is a virtual film studio that centres on depicting the human figure in three-dimensional form. It allows for the recreation of some features of the setting, but primarily lets the user control the bodies of digital mannequins by way of their orientations, gestures and gazes. The outputted renderings have later been retouched (Photoshop) and compiled together with the transcribed talk (InDesign).

Aside from proffering visually clear output, this procedure has had two main analytic advantages. First, there is an analogy to how the transcription of spoken interaction compels the analyst to focus on details of the talk that would not be attended to under normal conditions. By engaging in the exact replication of body postures, the flexing of joints, the placement of limbs and the like, the analyst can get a handle on the situation that the simple tracing of outlines cannot offer. The three dimensions of the recorded bodies are momentarily recovered in the process. The second advantage works mostly in benefit of the reader. The images selected for presentation are not necessarily tethered to the camera view. If a different angle provides a better view of an unfolding action, it can be selected effortlessly, and, thereby help the reader to get a better understanding of the events as they took place. Whereas the original video is still understood as the primary data (the transcripts and) the images should be seen in their capacity as *analytic representations—*on a par with the textual analysis itself.

4.   Analysis

In order to begin with the analysis, the relation between the studied session and ordinary practice have to be clarified. During an ordinary day's work, the major task facing the radiologists typically concerns diagnostic work in clinical practice and their formulation of recommendations tailored to referring physicians. In line with this characterisation, the efforts undertaken during the review session could be understood as diagnostic work of a *second order*. The things to be diagnosed not only had to do with suspected nodules, but also most centrally concerned errors in the *work of finding* nodules. Out of this exploration, recommendations informing further first order diagnostic work had to be formulated. In the materials, both of these aspects can be discerned. In some instances, the participants work towards the formulation of what things accountably *are* (as anatomical structures). In yet other instances there are attempts at formulating difficulties pertaining to the very *process of diagnosis*—difficulties thus instigated by the new technology. As will become evident, these two processes of diagnostic reasoning are closely connected, and, to a varying degree, involve interesting forms of embodied conduct.

The episode that we will examine in detail mainly follows an extended argument made by one of the senior radiologists. In order to enhance the readability of the 42 seconds long sequence the transcripts have been segmented into a number of figures (1–7). The labelling of these is merely meant to provide some clues as regards the evolving topic of the talk-in-interaction. It should also be noted that the separate images represent one continuous sequence with no omissions at the joints.
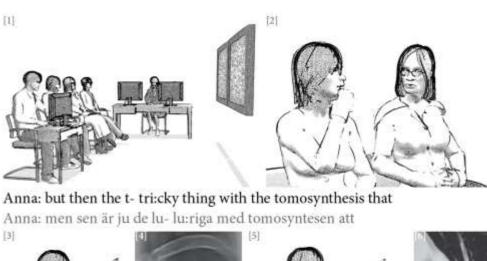
4.1   The tricky thing

Just prior to the sequence, the group has been discussing some general features of the technology of tomosynthesis and the potential benefits of discovering centrally placed tumours with patients that also have

pleural plaques[3]. This part of the discussion is concluded with the notion that such a prospect will very much depend on the location of the pathology. At this point the radiologist Anna opens up a somewhat different, but still related, point in relation to the specific materials that are currently displayed on the screens.

As will be clear, on the topical level this stretch of talk is replete with the reported troubles of perception and understanding. In the short sequence examined here, the expression "to perceive" occurs no less than three times, and "to understand" is set up as a contrast to "believe". The example is thus an endogenous formulation that speaks about some perceptual difficulties generated by the introduction of the new technology. The visual expertise of radiological diagnosis is thus both being demonstrated here and made into the very topic for the discussion.

However, rather than raising this as a general type of problem (which the cognitively associated terms could suggest) it is cast as a "setting's trouble", a form of problem that builds on, and refers to, the knowledge and practices shared by parties to that setting. Still, as we will see, the articulation of this trouble is not straightforward, nor is it done by mere talk. Anna commences by, what the sociologist Doug Maynard calls, an "embodied telling of a seeing" (2006, p. 107).
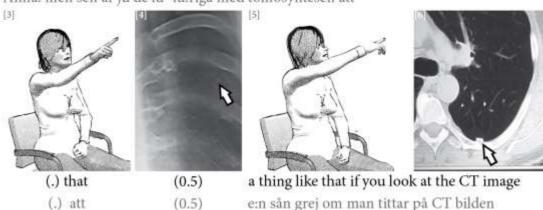

Anna: but then the t- tri:cky thing with the tomosynthesis that
Anna: men sen är ju de lu- lu:riga med tomosyntesen att

(.) that   (0.5)   a thing like that if you look at the CT image
(.) att   (0.5)   e:n sån grej om man tittar på CT bilden

Figure 1. Establishing the referential grounds.

Anna starts her contribution with the word "but", a disjunction marker which could be heard as making a slight shift in topic in relation to previous talk. What follows is the formulation of this topic, i.e. "the tricky thing with tomosynthesis". This initial characterization of a trouble, functions as a preface to a telling (Sacks, 1974) and thus as a "prospective indexical" (Goodwin, 1996), an indexical expression whose referent is to be specified in ensuing talk.

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[3] Pleural plaques are characterised by areas of fibrous thickenings on the lining of the lungs. Although benign (not cancerous) they are the most common indication of significant exposure to asbestos.

The group sits across from two separate projector screens set side-by-side, one showing the CT and the other the tomosynthesis data. In [1-3] Anna's attention is directed at the rightmost screen showing the tomosynthesis image [4] and she also makes a brief, but fully extended, pointing gesture towards this screen [3].

Next, [5] there is a shift in direction: topically, bodily and referentially. She moves her already extended arm to the left so to point at the adjacent projector screen [6]. The words "a thing like that" also begins to specify the indexical referent more precisely.

From the recording it is evident that the two objects pointed to here are both regarded as visible and publically available for everyone present at the session. The very *finding* of those objects is not the primary concern in this instance. However, it should be acknowledged that this was not always the case. The issue of discovering possible pathologies is a prerequisite for any subsequent diagnostic work and the increase in detection rates was also one of the critical features of tomosynthesis (Vikgren et al., 2008).

In this short passage, the two referential objects pointed to in succession (here marked by the added arrows in the tomosynthesis section image [4] as well as the CT counterpart [6]) become unified in that they are treated as denoting a single physical structure situated elsewhere. This "thing" is a previously discussed pathology: A plaque with a pleural basis[4].

[7] Anna: then it is (0.6)

Maria:

Anna: så ligger den ju (0.6)

[8] in the <u>centre</u> of the left lung (0.2) [right.

  [m

<u>mitt</u> i vänster lunga (0.2) [å så va.

  [m

[9] Anna: and the particular thing about the de:pth
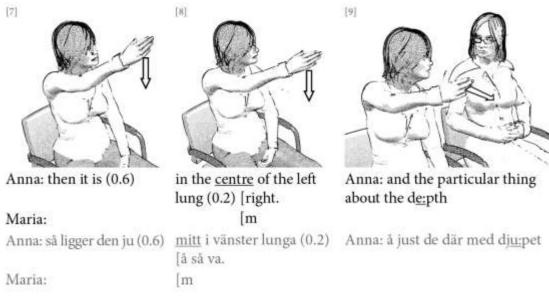
Anna: å just de där med dju:pet

Figure 2. Representing digital manipulations.

With the arm extended towards the CT screen and her hand held flat, Anna makes two cutting or slicing movements. Although done at a distance, this gesture builds on and gives meaning to a specific structure of the environment, namely the CT image [6]. It is an environmentally coupled gesture (Goodwin, 2007a) which is done to indicate a cutting across the visible plaque [7]–[8]. Furthermore, this gesture follows the anatomical plane known as the sagittal plane which roughly divides the patient's left and right sides. Her comment speaks about what-we-all-see in this image, as the object being in the centre of the lung [8]. Through the response token from Maria ("m"), there is confirmation that the argument is being followed thus far.

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[4] Although pathological, a plaque is not a pulmonary nodule and mistaking it for one, as some of the radiologists had done, constitutes a case of a "false positive." The ensuing reasoning exhibited here is aimed at minimizing such mistakes in the future.

Having both secured the attention of the group and established the referential grounds for her further work, Anna returns to the main topic of "the tricky thing". It is now developed into "the particular thing about depth" [9]. While keeping her forearm in place, she turns her wrist so that the back of the hand faces the screens (in terms of the anatomical planes this would be analogous to shifting from the sagittal to the coronal plane), and, as the word "depth" is produced with emphasis, she simultaneously moves the hand away from her. The significance of this gesture should be understood in relation to its material and social environment. As argued by LeBaron and Streeck:

> *it is our contention that gesture — certainly descriptive or 'iconic' gesture — necessarily involves indexical links to the material world, even though these links are rarely established or explicated in the communicative situation itself. Rather, in conversational contexts that are detached from the talked-about world, participants must fill in encyclopaedic knowledge (ranging from universal bodily experiences to highly specific cultural practices) to see and recognize gestures. (LeBaron & Streeck, 2000, p. 131)*

The particular movement made by Anna [9] thus represents a case of such a *highly specific cultural practice*, an action that is most central to professional radiologists. In addition to indicating a movement in the ventral direction (toward the front of the patient) it also resembles one way of navigating in a set of section images. This is one of the central methods through which the sense of volume and location is built. In this way, the gestural action is not simply an embellishment to the talk (Kendon, 1972), rather, it works to indexically tie the meaning of the word "depth" to a material and everyday radiological practice, known and shared amongst the participating radiologists. The gesture becomes part of what Koschmann and colleagues (2007) characterise as a gestural formulation, which in its design displays the speaker's analysis of whom she is addressing; the gesture is selected and shaped because of its presumed recognisability to the members of the setting (Schegloff, 1972).
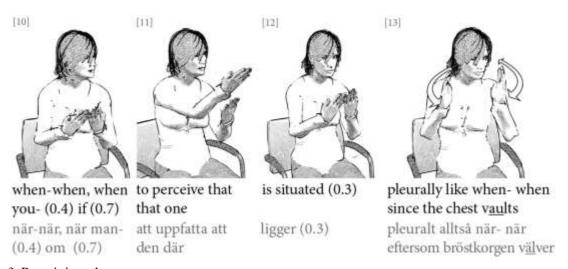

[10]	[11]	[12]	[13]
when-when, when you- (0.4) if (0.7)	to perceive that that one	is situated (0.3)	pleurally like when- when since the chest vaults
när-när, när man- (0.4) om (0.7)	att uppfatta att den där	ligger (0.3)	pleuralt alltså när- när eftersom bröstkorgen välver

Figure 3. Perceiving pleura.

In [10] Anna starts a new construction with "when". This clause begins an attempt to establish the setting for the exposition to come. She keeps her hands flat before her as if reading a plane x-ray or tomosynthesis image. After a couple of cut-of's and pauses she changes the sentence frame and in [11-12] again refers to the tomosynthesis image. She makes a deictic gesture toward the left-hand screen [11], then returns to regarding the flat image [12].

Now the "tricky thing" is related to the act of perceiving the location of the object. The use of the adverb "pleurally" also performs classificatory work: since their search for nodules delimits their interest to objects that are located inside the lung, anything found in the pleura, the layer covering the lung, is to be disregarded in this particular task.

After the clause "to perceive that that one is situated pleurally" there is another try at starting a new clause with "when". Also this time the attempt is abandoned and we get a further qualification of the anatomical basis for the trouble; "since the chest vaults" [13]. Again we find gesturing that is closely coupled with the practice of thoracic radiology. Anna is continuously amalgamating the materials of anatomical and technological concepts, visual representations and embodied gestures alongside her otherwise vernacular talk. The gesture accompanying the entire stretch of talk [in 13] is repeated twice, and, in effect, maps this vaulting feature on to a generalized body. The frame of reference taken is one of an external observer where the object is created before her eyes. But in the visual contrast between the flattened image and the portrayed 3-d object we get an early hint of a complication which becomes articulated next.
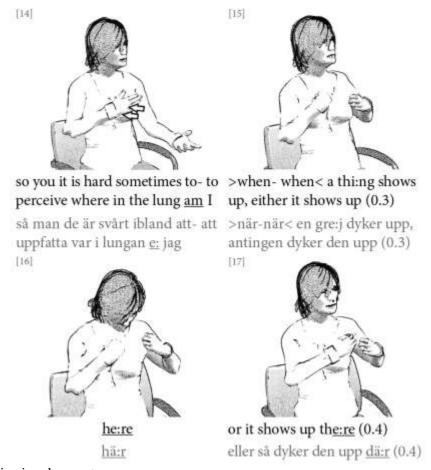

[14]

so you it is hard sometimes to- to
perceive where in the lung am I

så man de är svårt ibland att- att
uppfatta var i lungan e: jag

[15]

>when- when< a thi:ng shows
up, either it shows up (0.3)

>när-när< en gre:j dyker upp,
antingen dyker den upp (0.3)

[16]

he:re

hä:r

[17]

or it shows up the:re (0.4)

eller så dyker den upp dä:r (0.4)

Figure 4. Subjective involvement.

Next, the consequences of this rounded shape of the lung is commented on. The act of perception is again introduced into the talk, and this time it is formatted as reported speech "where in the lung *am* I". Simultaneous to the verbal comment about location Anna taps her chest twice [14]. At this point, *her own body* is enrolled as a new referential ground. She has thereby established a transition in the frame of reference, from that of an external reader of images to that of an idealized patient. In addition to the two screens, and the gesture space in front of her, she is now also designing her comments so that they make sense in relation to her upper body.

In [15], the third attempt at starting with a "when"-construction is brought to its completion. Together with her pointing gestures, it does the job of building a contrast between two locations [15-17]. In the two demonstrations, she is also timing her pointings with the deictic terms "he:re" [16] and "the:re" [17] (Hindmarsh & Heath, 2000). By shifting her gaze to where she is pointing she highlights the gesture for her

interlocutors, but at the same time makes the gesture a tool for her own understanding (LeBaron & Koschmann, 2003).

So, what is the role of her body, and the possible reasons for bringing it into the interaction here? For one thing, it should be seen as doing communicative work in relation to the other participants. It has on the one hand, a rhetorical side, as a developing embodied argument (Mirivel, 2011) which is clearly recipient designed (Schegloff, 1972) for present parties. However, what Anna has to do is not merely to "read" the images at hand and present that reading to her colleagues. In the context of the self-reflective situation set up by the team, she's struggling to express her current understanding of the relation between the unique (for-this-person) three-dimensional space constituted by the patient's body, and how this is first mediated via the imaging technology and later represented in the radiographs. Some of the work of formulating this relationship has a speculative or exploratory quality to it. And in the combination of these two aspects of communication-cum-speculation we find the specific features of the setting. The extensive gesturing carried out by Anna becomes a way of organizing her reasoning so that it is made available to her peers. It thereby takes the form of a provisional radiological reasoning done of and for the setting. Furthermore, it is done not so much to diagnose *this* patient, as to provide materials for generic formulations that speak to the re-negotiation of this group's expertise (for an analysis of this practice see Lymer et al., 2014).

This form of publically oriented professional reasoning is partly done by way of a *subjective involvement* with the graphical materials (cf., Ochs, Gonzales, & Jacoby, 1996). The subjective involvement is accomplished by linguistic as well as gestural means: by grammatically placing herself in the patient's body (e.g., "where in the lung am I" [14]), and, by gesturally positioning the observed structure *as if* this was located in her own body [16] & [17]. The interchangeability of these frames of reference further suggests close links between talk, gesture and the material environment. It is not because the professionals routinely handle the bodies of patients that a physical body is being involved in the argument here—radiologists predominantly work on representational objects. However, here and now Anna's body provides a three-dimensional structure aiding the installation of a specific contrast. In other words, her body is made to double as a scaffold in the developing formulation of *how tomosynthesis depicts volumetric information*.
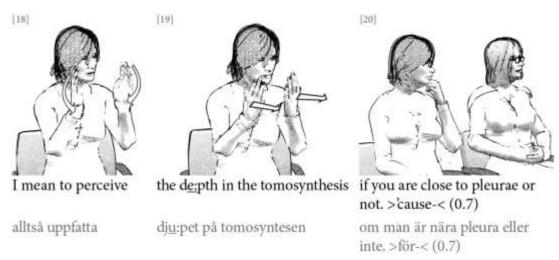

Figure 5. Perceiving depth.

Immediately following the establishment of the two separate locations there is a third iteration speaking about the activity of perceiving [18] and [19]. This time, and in comparison to [9], [11] and [14], the formulation has become more succinct: "to perceive the depth in tomosynthesis". The previous "vaulting" gesture is also reused and laminated with the described problem of perception [18], as is the "depth/ventral" gesture again overlaid with the word "depth" [19]. According to McNeil and Levy (1993), when gestural forms are reused in this way they often mark the reappearance of a particular plot element,

character, or narrative value. Such *gestural cohesion,* as they call it, is thus an aspect of the process of creating and maintaining topical cohesion across turns at talk (McNeill & Levy, 1993). Here we find the two themes of, first, the shape of the thoracic cavity, and, second, the work of navigating in a stack of images to be gesturally reintroduced.

In [20] Anna further qualifies the categorization, or the distinction, that is at stake. Next, she returns to, and elaborates on, the contrast.
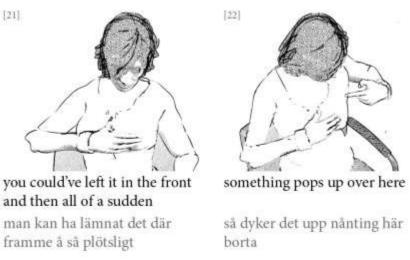

[21]

you could've left it in the front and then all of a sudden

man kan ha lämnat det där framme å så plötsligt

[22]

something pops up over here

så dyker det upp nånting här borta

Figure 6. Creating contrast.

With her right hand held vertically at the front of her chest, the first location is specified as "in the front" [21], whereupon she provides the alternate location. Introduced as something surprising she points further back and to the side of the chest. This time she is using her left index finger while the right hand remains flat on the top of her chest [22]. Through this particular configuration of talk, body and embodied action, the contrasting locations have now become publically visible. The contrast being created here revisits the contrast described earlier [15-17] and we see again some recycled gestures. Where the problem before was characterized as one of accurately assessing depth within an imagined image, the problem is here made more vivid by illustrating how the vagaries of the tomosynthetic image could radically skew the evaluation of location in a human body.
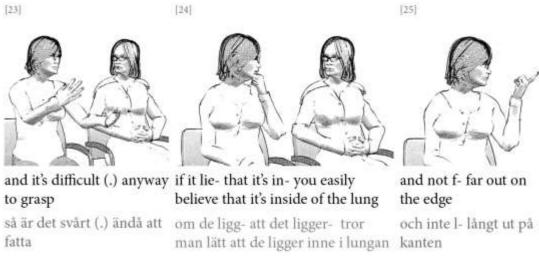

[23]

and it's difficult (.) anyway to grasp

så är det svårt (.) ändå att fatta

[24]

if it lie- that's in- you easily believe that it's inside of the lung

om de ligg- att det ligger- tror man lätt att de ligger inne i lungan

[25]

and not f- far out on the edge

och inte l- långt ut på kanten

Figure 7. Wrapping up.

Finally, in [23-25] Anna summarizes the argument and spells out the trouble in a non-technical terminology. This concludes her extended contribution. Another participant, Lena, adds a comment about using the ribs and when they come into focus as a useful method for determining location. The comment is briefly elaborated and four of the participating radiologists then close this particular discussion on the note that "it is still difficult."

5.   Discussion

The interest of this article has been to address the topic of visual expertise and to do so in terms that acknowledge that all expertise is rooted in embodied practices. To this end the episode discussed above has served as an example of what we can call the enacted production of radiological reasoning. Albeit a special case, the expertise of radiological diagnosis that comes into play here is first *demonstrated* through the actions performed, but it is also *talked about* in the studied discussion. In this talk, terms such as 'seeing', 'understanding' and 'perceiving' figure as members' matters. To quote Slack and his colleagues on this phenomenon:

> *To be sure, members speak of seeing, noticing and other topics that are grist to the mentalists' mill, but we have shown that they do so not in an isolated context (neither behind the skull nor as atomic 'cognisers') but in a manner where terms such as 'seeing', 'noticing' and so on are practical members' achievements, achieved in and through natural language and embodied conduct. (Slack et al., 2007, p. 192)*

These 'practical achievements', or actions, show us a corporeal side of the expertise in interpreting visual representations. Not only are visual phenomena—in this case the existence of a pleurally based plaque—made into something observable and reportable through the deployment of a professional language. One of the central features of the above illustration is the manner in which this work is also carried out by way of the living present body of the expert. The experienced radiologist interweaves anatomical and technological terminology with visual representations and gestures in such a way that none of these components can be said to be superfluous to the argumentation. Furthermore, the sequence encompasses, not gestures as a general phenomenon, but as specialized embodied conduct indexical (i.e. uniquely fitted) to projected images, practical actions, or specific locations in patient-bodies. So, by building on, and referring to, the matters and routines known and shared by the parties to the setting, these gestural actions also work to anchor the meaning of the talk in material and everyday radiological practice. In this capacity, the gestures act as aids in the bridging of interpretative gaps between the radiographic renderings and what those come to mean as professionally relevant objects.

In the studied case these interpretative difficulties have been aggravated, due to the extraordinary situation of the newly introduced radiographic technology of tomosynthesis. However, this situation also allows for several fruitful observations. What is pulled into view are some *transmutations*, or movements from one medium to another, from the technologically mediated body of the patient into formulations of members' understandings. And at this intersection we come very close to what is ordinarily regarded as expertise. We find exhibited *production procedures* through which the body of the patient is coordinated with the skilled body of the practitioner. Without downplaying the relevance of functioning eyes and brains, the approach exemplified here can help us to appreciate gestures and embodied actions as critical means through which visual expertise becomes organised. These are parts of a repertoire of methods through which the radiologists learn their profession, and, as is evident here, they can also become enrolled in the re-negotiation of expertise in the face of new challenges.

Transcription Legend	
(0.5)	Numbers in parentheses indicate silence, represented in tenths of a second.
(.)	A dot in parentheses indicates a "micropause."
-	A hyphen after a word or part of a word indicates a cut-off or self-interruption.
::	Colons are used to indicate the prolongation or stretching of the sounds just proceeding them.
w<u>o</u>rd	Underlining is used to indicate some form of stress or emphasis.
[	Separate left square brackets on two successive lines indicate the onset of overlapping
[	or simultaneous talk.
> <	The combination of "more than" and "less than" symbols indicate that the talk between them is compressed or rushed.

Acknowledgements

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