Interactional Validity: Assessing technologies to support embodied activities

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Abstract
In this brief paper we discuss how we may draw upon workplace studies to inform the ways we assess innovative technologies to support embodied interaction. In particular, we discuss the challenges of designing quasi-naturalistic experiments to assess systems to support distributed embodied interaction.

Keywords
Embodiment, interaction analysis, CSCW, media spaces

ACM Classification Keywords
H5.3. Information interfaces and presentation (e.g., HCI): Computer-supported cooperative work. H4.3.

Introduction
Over the past 20 years a wide variety of technologies have been designed to support embodied activities in some way. Typically problems emerge when trying to assess such systems whether these are media spaces, collaborative virtual environments (CVEs) or robots that serve as proxies; particularly when evaluating the extent to which they support or undermine embodied action [2, 4, 6]. One common way to assess these technologies is through the quasi-naturalistic experiment [9]. This is where participants engage in an open-ended task or set of activities using the prototype technology. These tasks are video-recorded and the

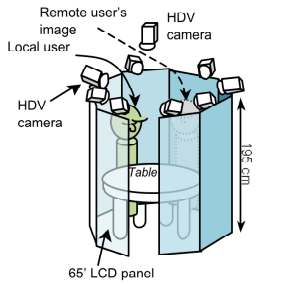



Figure 1
Top: a diagram of one t-Room. Bottom: an image from the Tokyo t-Room where the embodiment of a participant in Kyoto can be seen on the right.

experiments provide materials for the detailed qualitative analysis of embodied conduct through or with the technology. These experiments have been a powerful way to understand how talk and visual conduct, and in some cases, the manipulation of physical artefacts, are co-ordinated when mediated through a new technology. Although the outcomes of such studies are frequently reported [2, 4, 6], their design is little discussed.
naturalistic experiment to assess one technology to support embodied interaction. We discuss how an analytic orientation needs to inform both our analysis of everyday embodied action but also the ways we assess innovative technologies to support it. We consider these issues with respect to recent efforts to evaluate one particular technology: a high-fidelity communication system to support distributed embodied action, called t-Room.

Supporting distributed embodied action

Recently, with high definition video, large screens and image calibration techniques, it is possible to present real-time life-sized images ('embodiments') of co-participants with little delay even when these may be many kilometers apart. T-Room (see Figure 1) is one such high fidelity system. A single t-Room consists of eight modules (called Monoliths) that consist of a camera and a large screen. As well as presenting embodiments of co-participants the Monoliths can be used to present digital contents such as moving images. Given its ability to capture and present a rich form of 'co-presence' t-Rooms (when linked through high bandwidth connections) would seem to offer appropriate capabilities for a Virtual Research Environment (VRE) – environments to support collaboration between researchers from different specialties, between distinct disciplines and across national boundaries. However, it is unclear how to undertake an assessment of the technology. There are practical problems. Each t-Room is large and located in Japan at two sites 250km apart. There are also problems finding appropriate participants for an assessment which needs to be undertaken away from their worksite and tied to materials relevant for them to investigate and explore.

These are familiar problems for researchers investigating novel and complex technologies. Quasi-naturalistic experiments are one solution to these. For the case at hand, studies of the practices of researchers might suggest how we might design an appropriate experiment to assess t-Room. We draw from what might seem a rather unusual and perhaps distinctive research setting – that of classicists - who, as part of their scholarly work, analyse ancient manuscripts written on wooden tablets, papyri and other materials.

Analysing images in collaboration

Classicists use a variety of means to reveal the contents of a text, and recently have begun to utilize complex image processing techniques to make the texts more visible. These ancient texts can be difficult to interpret for a range of reasons: not only do scribes have different forms of handwriting but letter forms change over time. The practice of interpretation therefore relies on a constant shifting back and forth between analyzing a particular mark, considering what a letter might be, what word it may be part of, and reading the text as a whole [1]. As different specialisms are required to make sense of a text classicists frequently analyse them collaboratively. By displaying digital images of the (enhanced) texts on a large screen

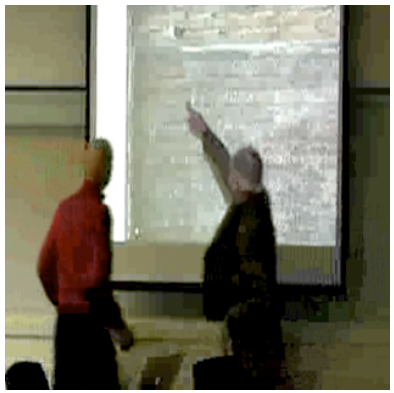

Figure 2
Two classicists analyzing an enhanced image of an ancient tablet

they can not only identify particular features but also animate these, for example by reproducing how a word or letter might have been written by a scribe living hundreds of years ago. Hence the classicists not only need to understand the visual elements of an image, they need to reveal the material qualities of the physical object, and how it was manipulated. The classicists display these through their own embodied conduct, through their talk and visual conduct, when presenting their analyses to colleagues (See Fig 2).

Although these seem to be very distinctive practices there are numerous research settings where participants analyse complex materials collaboratively, not only in the humanities, but also in social sciences (in data sessions for example [3]) and in scientific domains, when complex images, scans, x-rays are analysed by colleagues [5]. In such domains, through their talk, visual conduct, bodily movement, and gaze direction participants animate their understandings of complex images.

A Quasi-naturalistic Experiment: Analysing Hitchcock

Certain challenges emerged when we sought to develop a quasi-naturalistic experiment to assess the t-Room system. It is recognized that some 'ecological validity' is required for assessments of this kind. However, as appropriate participants are unlikely to be involved, it is hard to design a task where the participants could engage in similar analytic practices, even if they had appropriate materials to consider.

For assessing technologies to support embodied interaction a number of tasks have emerged that typically require little expertise from the participants. Perhaps most notably the 'room design' task, in slightly different forms, has been used to assess media spaces, CVEs and human-robot interaction [2, 4, 6]. It focuses on activities related to design, planning and navigation and has proved useful when assessing the problems participants face when trying to co-ordinate distributed activities. Tasks such as these provide opportunities for participants through their talk, embodied interaction, and visual conduct to refer to objects and features in both their own and their colleagues' environments (achieved typically through pointing). By providing opportunities where the co-ordination of such activity can be analysed these can reveal how a technology may support or undermine the accomplishment of referential activities in mediated spaces.

In the case of t-Room, we required participants to undertake analytic work which would involve more than a pair of participants identifying features in an image or solving a generic problem. The tasks needed to be engaging so that an entire group of say four people, would participate in them most of the time. Moreover, as in the everyday setting that motivated the study, the form of participation in the activity of each of the participants could shift from moment-to-moment. Most critically, the participants would need to be able, through their own and 'presented' embodiments, to discuss their interpretations of an image, display their understandings and contribute to their colleagues' analysis of the materials. The tasks therefore needed to have an 'interactional validity', they needed to be able to allow for conduct that resonated with the everyday conduct of those who might use the system.

Drawing particularly from our analysis of classicists' practices we developed a number of tasks that involve



Figure 3
Participants engaging in the quasi-naturalistic experiment, identifying objects in a scene from a moving image using t-Room in Kyoto (top) and Tokyo (bottom)

identifying objects from within complex scenes, locating features in dynamic images and reasoning about what is being viewed. These require the participants to: (i) analyse complex images together, (ii) engage in forms of referential activity other than simple pointing; (iii) develop interpretations that relied on matters that were not directly visible in the images; and (iv) juxtaposing details of physical documents with the images. Because the tasks could not require a particular kind of professional expertise from the participants, we designed a task based around the analysis of clips from films of Alfred Hitchcock. The activities the participants were asked to do range from trying to find Hitchcock within a clip, counting people who are looking at a particular feature, discovering the order in which a sequence of actions happens and mapping out the environment in which a scene takes place. The activities mirrored the collaborative research meetings we observed (see Figure 3). These quasi-naturalistic experiments facilitated an analysis of how, even despite particular transformations to the appearance and ordering of their activities, particular kinds of embodied action could be supported through the distributed technology (details in [8]).

Summary

In designing the quasi-naturalistic experiments we draw upon a similar analytic framework to understand embodied conduct as adopted in naturalistic studies of everyday action [7]. These provide rich data, even revealing how participants through their visual and vocal conduct animate features of physical objects. It is less clear however, how quasi-naturalistic experiments can assess other aspects of haptic and tactile conduct. This is perhaps not surprising as, despite recent concern in the social sciences with the sociology of the object and the body, such initiatives seem to provide few resources for assessing the qualities of embodied interaction.

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