Knowing and reproducing the body

Simulating the patient, simulating the patient's experience

When simulators are used to supplement and even replace training on patients, the patient's participation in medical practice is silenced. Can the patient's experience of medical practice be incorporated into simulators designed to teach medicine? And if so, how? My work with a gynaecological simulator has been raising some interesting questions about this.

Ericka Johnson

is a researcher at the Department of Technology and Social Change, Linköping University, where she studies technology and gender in practice. She is currently working on an interdisciplinary project with partners from the fields of gender studies and gynaecology, which looks at the design, construction, use and misuse of a gynaecological simulator. In 2005/06 she is a fellow at the Institute for Advanced Studies on Science, Technology and Society (IAS-STS), Graz.

E-mail: johnson@sts.tugraz.at

Anatomy and practice, or what is medical knowledge of the patient

What is being simulated in patient simulators? Although a large variety of medical simulators exist, their introduction to medical education tends to bring up a standard discussion of validity (or "fidelity", "realism" and "authenticity"; the terms are used loosely and slightly interchangeably). The usual worry is whether or not simulators actually represent the real body and if they are really teaching medical procedures correctly; no one wants medical students to spend their time training on a false model of the body or practicing an incorrect procedure and then damage patients when they transfer their knowledge and skills to an actual patient.

Medical debates about simulator validity have focused around how well the body is modelled, with the understood subtext being how realistic the representation of the human anatomy is. This drive for reality has enrolled high tech solutions to modelling bodies. For example, virtual reality simulators use data from the visible human project to construct organs and internal volumes which mimic an actual body, and information and communication technologies are being integrated into models which send signals and responses back to the users. Simulator developers use visual representations and tangible examples of the anatomy to source and support their models of the body, everything from traditional anatomies to advanced imaging technologies like MRI and CT scans. However, one of the primary considerations used to evaluate the simulators is how well the simulation recreates the experience of medical practice. When calibrating and evaluating a simulator, medical experts often test how well the simulator mimics the "real thing", where the real thing is the practice of a medical procedure. The medical simulator community relies on "objective" representations of the body as evidence of the validity of their simulators, but their actual evaluation criteria often draw on knowledge about and clinical experience of medical practice.

The heart of this conflict between what a simulator is and what it represents is really a discussion of ontology and epistemology, of what is known and how it is known, something often discussed and debated in the fields of Science, Technology, Medicine & Society and Feminist Science Studies (as elsewhere). Questions are raised about how knowledge is created in situated practice, whether knowledge can be considered a phenomenon rather than a representation of an ontologically separate truth, and if it is best analysed through how the world is experienced, including a respect for the way technologies can shape the phenomena we know (Barad 1996, Mol 2002, Suchman 2000). Applying these critiques of knowledge production to the development of medical simulators highlights questions about how evidence of the body is created and maintained. Acknowledging and exploring these issues can also have significant consequences for how we build the simulators that our future doctors are going to be practicing on. Let me give you an example. The simulator I have been studying recently is a table top mannequin of the female pelvis. Inside, it is equipped with rubber models of the female reproductive organs, upon which are attached small pressure sensors. When a student practices giving a pelvic exam on the simulator, these sensors monitor if the student has touched specific organs during the exam and with what amount of pressure. A visual image of their pressure score is presented on the screen of

the laptop computer attached to the simulator.

The pelvic simulator

As its body, the simulator uses an older, plastic model of the female anatomy which has been adapted to make space for the sensors. When I interviewed the inventor of the simulator, she reflected over this, saying, "I was thinking abstractly that it didn't have to be a mannequin, it could be some glob, some amorphous glob that you put your hand in a black hole [that] reshapes itself into either a spleen or a pelvis or whatever, and the bigger element of it was the visual feedback that you got *so you had an understanding of what you did compared to what the quote unquote experts do"* (italics added). To the simulator's inventor, the important aspect was not how realistically the mannequin mimicked the human body. Instead, she was focused on the way the simulator represented a practice, the experts examining the pelvis, and how information about that expert practice could be relayed to the person using the simulator. Her reflection betrays a concern for the practice of using the simulator in relation to the practice of experts, rather than an attempt to create an artefact which mimics the female anatomy.

Replicating the feel of fat

The inventor's concept of an "amorphous glob" whose primary task is to provide feedback on what the experts do indicates she was thinking in terms of practice rather than ways to recreate the body. The modeller's design of the fat pad also demonstrates an appreciation for the intra-action between the doctor and the patient body in creating medical knowledge of the obese body.

The pelvic simulator is shipped with an insertable "fat pad" that can be placed underneath the skin of the abdomen to allow students to practice examining obese women. This fat pad is a two centimetre thick silicon insert. To use it, the skin of the abdomen is removed from the simulator, the fat pad is inserted above the uterus and ovaries in the pelvic cavity, and then the skin is put back in place. This is done because a significant amount of the pelvic exam involves pressing upward with the hand that has been inserted into the woman's vagina while simultaneously pressing downwards with the other hand from on top of the abdomen, and then trying to feel parts of the anatomy between the hands (see figure). It is difficult, for example, to feel the ovaries between one's hands if the patient being examined is significantly over weight. And obese patients are becoming more and more common, so new doctors are taught to examine them, as well.

Thus, the fat pad is a useful addition for teaching exams with the simulator. However, I was fascinated by the fact that the simulator's pad was made of such a relatively thin layer of silicon. I brought this up with the model's designer, who explained that fat in the body of a patient is at body temperature, and therefore relatively viscous. It is bounded in small capsules that have a tendency to move around inside the body. Thus, when a patient is laying down on her back, as during a pelvic exam, the fat in the abdomen tends to slide downwards, off the peak of the stomach. When examining an obese patient's pelvic region, as the hands press up from inside and down from on top of the abdomen, the fat in that area is gently pushed out of the way. Not all of it, of course, but quite a bit of it. Therefore, the "thin" fat pad gives the feeling that a doctor would have when examining a much larger patient. As the designer said, "When you're going in, and someone's got that much fat it will displace quite a lot […]. Whereas even though that silicon is very soft, it doesn't displace the same way. […] It's a matter of judging what is simulated, or how the simulation will equate with the real life."

This way of thinking about the fat pad of silicon and the fat as it is pushed out of the way in a pelvic exam resonates with the conception of knowledge as constructed in practice. The designer was considering how the simulator would be able to reflect the phenomenon of examining an obese patient, rather than simply creating a fat simulator. The way a doctor experiences the obese patient's body, the practice of creating knowledge about it, is what is simulated, not the body as an ontologically independent object.

Significantly, then, the fat pad is simulating not the actual body of the patient, since it is not made of a gelatinous, viscous substance that moves out of the way and changes shape depending on temperature and position. In the most literal sense of the word, the fat pad is not a "valid" recreation of the body because it does not behave like the body does. What the fat pad is simulating is the phenomena of examining an obese patient. The fat pad is not simulating obesity, it is simulating examining an obese pelvis.

Gynaecological simulator

The patient

This example of the fat pad reveals a simulator designed to simulate the way a patient is experienced by a doctor during a context specific exam. When creating the fat pad, the pelvic simulator designer took into consideration how it feels to examine an obese patient and how the reality of obesity is experienced in the phenomena of knowing the body for a doctor. This phenomenon of knowing, primarily through tactile experience, was then integrated into a simulator which also relies on the sense of feel, using a physically constructed model.

As one begins to understand medical simulations as reconstituted practice (as repli-

cations of how medical professionals experience the body during specific medical procedures) rather than representations of human anatomies, the political importance of whose experience is being represented and reconstituted in the simulation becomes apparent. Medical simulators are often designed through collaborations between computer scientists, engineers and medical doctors. One can start to ponder which experts are involved in defining "valid" medical practices, and whose practices are overlooked. Acknowledging the fundamental role that knowledge as phenomena, as practice, has in their work can strengthen the importance of partnerships between doctors and developers. It emphasises the importance of considered reflection over which experts are appropriate to use in design and testing, and what those specific expertises says about the standardizing of medical practice, in much the same way that printed anatomies standardise and legitimate culturally and historically specific ways to see and conceptualise of the body (see Laqueur 1990, Jordanova 1998, Cartwright 1998).

Significantly, in these work constellations of developers, designers, and medical experts, the patient's experience of a medical practice is not merely silenced or made invisible, it is never even considered. But it could be otherwise, as STS researchers are used to saying. One could imagine a simulator which integrates how patients understand certain medical procedures, which integrates patient-specific phenomena of knowing medical practices.

Returning to gynaecology, interviews with professional patients (women who allow students to practice the pelvic exam on them while also instructing the students in bedside manners) suggest that the professional patients experience the gynaecological exam in ways that are not measured by the pressure sensitive sensors of the pelvic simulator. These women are concerned with how students approach them before the exam, the eye contact that is made during the examination, and the discretion with which certain topics are broached and discussed. And other, physical, aspects of the exam are experienced by the patients, too, besides just the pressure used to find internal organs. For example, the temperature of the examination equipment can be a significant aspect of the patient's experience, but is not recorded at all during the simulation. One could ask how incorporating these issues would change the simulator.

Of course, a simulator can not be a perfect replica of a patient – at least not with the technology being used today and the financial constraints within which simulator designers work. And Barad's theories about the phenomenon of knowing would suggest that reproductions of the anatomy would be insufficient to reproduce realistic knowing practices, anyway. However, even if a simulator can not be perfect, it can be better. Emphasising the importance of experienced medical practice in simulator design creates a discursive space in which to talk about the value of including the patient's experience of medical practice. Hopefully this missing input can be integrated into future simulators, as they rapidly become ubiquitous knowledge (re)production tools within the medical community.

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