Imagine you are a little mechanical fly, like one of those science fiction creations which finds its way into a human body and sends back images of gushing blood flows and pulsating hearts. Only instead of being deep inside a human body, you happen to find yourself inside the virtual space of a VR simulator used to teach the surgical techniques of minimally invasive surgery. Rather than being swept along in a rush of liquid, you find yourself perched precariously on top of a bouncy, pinkish-white sack that feels slightly like an amusement park jumping castle for children. Your little insect legs, which are mechanical and therefore lack the suction cup feet that would have come in handy here, sink down in a squishy sort of way while you step gingerly over the pinker veins under the translucent surface of the organ. ‘Ahh’, you realise, you are standing on the stomach. From this perch up high in the prostrated abdominal cavity, you can see what you think might be the gall bladder, the liver, and a perfectly round, slightly shiny, blue sphere. The blue sphere looks decidedly out of place. But before you can put your finger (or antennae) on why, exactly, it doesn’t fit in, a thin, narrow and very sharp probe jabs down from above you. You dart out of the way to avoid being skewered and lose what little grip you had on the stomach’s surface, slipping all the way down along its side into the dark and ominous regions below the liver. You are scared. But just at the last moment, just before you crash into the wet bottom of this deep crevice, you remember that as a fly you must have wings, and you begin to beat furiously. Whew. Your fall is broken and you start to lift gently back up into the airy space which is meant to simulate an abdomen inflated for Minimally Invasive Surgery (MIS).

As your little wings bring you back up along the rich, purplish red, cliff-like wall of the liver, you see a grey-green stalagmite also growing upwards from the depths. It looks slightly enlarged at its top, and as you circle around it to investigate you see it starts to ooze a little stone that appears and then drops like a tear from a dew laden leaf. As this tear drops, a giant grey pincher shoots down from the sky above you and opens its jagged, gaping jaws. It is aiming for the gall stone that is tumbling down the neck of the gall bladder and you dart to the left to avoid being picked up by it as well. As you do this you see a large mass of tissue, also sort of pinkish-orangeish-white, in front of you, opposite from the liver’s cliff face and you fly over to see what it can be. It looks like a family sized serving of ham and cheese stuffed canoli pasta stuck end to end and twisted around and back upon itself, but with enough space between the coils for you to squeeze in and check it out. There is a whole bunch of the stuff, and when you alight down on one of the surfaces you see that it is about as squidy and slippery as the stomach was. It’s not so pleasant under your feet, so you take off again and work your way out of the intestinal mass to the outer wall of the intestine. Here you find yourself at the outer limits of your world. Or at least the outer limits of the VR world. Below you the dark, flesh coloured ribcage disappears into shadow. Above you it stretches up to the ceiling of the chest. There is no escape hole for you in sight, but you decide to fly upwards anyway, and back into the centre of the simulation, gliding above the dark upper mesa plateau of the liver which you had earlier been along the side of. As you are working your way across its top toward the light glow of the stomach off in on the horizon, slowly transversing it like an airplane over the western plains.
following the sunset into dusk, another of those out-of-place blue spheres suddenly appears. You stop to take a closer look. The surface of this sphere is smoother than everything else, and doesn’t look organic at all. For one thing, it is perfectly round, like a miniature, planet coloured an unnatural blue. It is almost shiny enough to reflect your image back at you. Almost, but not quite. Which is too bad, because if it had been shiny enough to do that, it would also have been shiny enough to warn you with a reflection of the sharpened probe coming straight for your back. But it isn’t that shiny. You don’t see the probe. It does come straight at you (well, straight at the blue sphere, actually). And *sphekt* you are stabbed through the back with a probe that also causes the blue sphere to magically *puff* into nothingness...

At the instant of that *puff*, however, you are reincarnated, still as a tiny little mechanical fly, into an entirely different simulation. This time you aren’t in a virtual space at all, but in a very real, and very claustrophobic, warm, orange environment. The sky above you now appears to be a yellow, woolly blanket and this time your feet are on a much harder, flesh coloured, cold rubber surface. Looking around, you find yourself on a slightly undulating landscape, and you’re standing on a fairly steep incline. You suspect it might be the a rubber version of a human’s inner thigh and you start to climb upwards toward the summit. It is a big thigh. Working hard to reach the top, you see the strong and defined musculature under your feet spread outward, down the leg, and then, looking the other direction, you see the rest of the human abdomen lying under the blanket. Somewhere up towards where the male nipples would be is a brighter ray of light and you decide to head that way. Starting off in that direction, however, you quickly come to a deep crevice in the flesh coloured surface that runs in a circle all around the abdomen and down to the genital region of the mannequin. You notice that the region which is bounded by this crevice includes a male member which could receive a catheter, and you suspect that the whole lower abdominal region could be lifted out and replaced with a different piece to simulate a woman’s body. You decide not to risk falling into the gaping canyon between you and it (which isn’t actually so gaping, but remember, you are just a little, little fly) and instead you continue along the side of mannequin’s torso up toward the light. You cross the very broad and sturdy chest, which is rising and falling rhythmically under your feet and you hear the sounds of wind blowing somewhere beneath the surface. There is a deep and pulsating noise coming from under the skin as well, like a giant bass drum beating out the march of the half humans. It is a little frightening and you continue more quickly to get out from under the blanket that is trapping in the concophony of sounds. The breast muscles of the mannequin are so strong and well defined that the blanket doesn’t drape close and flat between them and this gap is where the light has been coming from. You use the space to escape into the bright white light of a surgical lamp overhead. You blink a few times and realise that you may have escaped from the thumping of a heart and the whooshing of lungs, but around you now is a whirl of activity from four robed and scrubbed medical professionals and the melodic beep, beep, dee-beeeeeeep of an anaesthesia machine.

You contemplate the thick neck you are about to ascend to get an overview perched on the mannequin’s chin, and mull over how muscular the whole body is. As you fly up and circling around above the nose and mouth, you see a pair of dark eyes with expanding pupils below a horizon of brown, painted-on hair. Looking back over where you had come from you see the outline of the mannequin’s body under the yellow blanket all the way down to his feet. The mannequin’s arms are outside of the blanket, laying at its side, and you notice one of the students who is dressed up like a doctor press a doorbell-like button connected to the mannequin’s right thumb. When the button is pressed the thumb jolts with an automatic reflex and the students confer with each other about this response. You see another student reach close to you and feel for a pulse on the mannequin’s neck while the third is picking up a clear plastic tube laying on the medicine trolley behind the mannequin’s head. Then you notice someone standing off in the corner just observing the whole scene, who is not wearing medical clothing and does not seem to be interested in touching the body. You hear her direct a question to the instructor in the room.

“Is there a girl mannequin, too?” she asks.
“The abdomen is removable and there is a female replacement part, but it doesn’t really matter. It’s not important for what we are simulating,” the teacher responds.

You see the girl nod and then the teacher asks one of the students to check the heart rate, breathing rate, and temperature statistics. At this point you could have started to wonder why the teacher would say that it doesn’t matter that the simulation is being run on a male body, a body that would look pretty male even if the female abdomen was in place. You could start to wonder why critique against the universal male of medical practice hadn’t reached this simulation centre, or was a least being ignored, since the VR space you had previously been in was also modelled on a male body. You could start to wonder about the reasons behind the use of the male body as the simulator norm or about the potential effects this norm has on the students training on them. Buy you don’t. Remember, at this point you have a brain the size of a fruit fly.

Since your wings are getting tired - it is hot under the bright lights directed onto the mannequin - you gently lower yourself down to rest on the pinkish upper lip. However, just before you come in for a landing the clear plastic tube you had seen the student reach for earlier appears above you. The mannequin is grabbed below the chin, its jaw is tilted upwards and back, and the tube is shoved into the gaping mouth. And since you were in the way, you are shoved inside, as well. You find yourself pushed into a dark and narrow passageway. After a momentary pause in which you try to get your bearings and figure out how to get back outside of the body, another, smaller, tube comes careening down the intubated airway. It, too, pushes you further, deeper into the throat, past the turn-off to the lungs and right straight through the trachea into the stomach area. Suddenly a burst of air rushes past you and you hear it create bubbles in the digestive liquid of the stomach. You hear the muffled voice of one of the students still outside the body say something about bubbling and wrong place and suddenly the tube disappears back up the piping and is redirected into the lung region. You, however, are not lucky enough to grab onto the tube before it disappears and, since the violence of the ramming rod had taken a bad toll on your delicate structure, it isn’t long before the darkness of the mannequin’s inside is accompanied by the silence of your death.

But never fear; you’re not really dead. This time you awake to find yourself at the opening of another medical simulator. You are on the outer rim of a hole that is located between two stubs which you suspect are supposed to represent thighs. Only this time the thighs aren’t tan and muscular. In fact, they barely exist. And there is no yellow sheet over the body, just another bright light shining down from behind the student sitting between the leg stubs, with his gloved left hand poised in front of you. You think you know where this is going, but before you can move out of the way the student’s middle and index finger catch your back leg and drag you along into the hole. You don’t go nearly as deep inside the body this time, and rather quickly you are shoved up against something firm and round. The fingers slide around this cylindrical object, dragging you along as they probe its outside to check the shape and surface structure. Then they push deeper down and into the simulator in order to get under the pear shaped structure meant to represent a uterus. When they are in the right position they suddenly press upwards. You, being trapped between the fingers and the uterus, are also pressed upwards into the squidgey mass. Suddenly you feel something else against your back, a hard little sensor that is registering the movements of the fingers and where they are pressing. It hurts, but you are still alive.

After the fingers have squeegeed you along the bottom surface of the uterus like a bug on a windshield, to make sure there are no bumps or other unusual growths on it (and that all the sensors have been touched), the fingers release pressure on the organ and slide to the right. Your foot has punctured the rubber glove on the index finger and become stuck there, so you are dragged along as well. Soon you are being squeezed between the gloved fingers of the student’s left hand pressing upward and his right hand pressing downward from on top of the simulator’s pelvic region. However, you are not the only thing being squeezed. It feels like there is another floating body next to you, something slightly smaller than an
eyeball with another hard little sensor attached to it. Once that sensor has been felt by the fingers, they and you move left to the other side of the uterus and try to find the same thing there. For some reason, that seems to be more difficult and the hands inside and outside the uterus press together over and over again without too much luck. After the fourth or fifth time they give up and the left hand’s fingers pull back out of the dark area and drag you with them into the light. What a relief, you think. But you’ve relaxed too soon. With one deft motion the rubber glove you are caught on is peeled off inside-out, it traps you inside, and the whole bundle is tossed into a garbage bin labelled ‘medical waste’.

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The main use of these three simulators in Sweden is occurring in teaching hospitals, and the primary push has been to use them with medical students who are concurrently taking traditional courses in the fields for which the simulators have been designed: surgery, anaesthesiology, and gynaecology. You are more likely to encounter them if you are a medical student at a stage in your education when you would be interested (or at least ought to be) in the anatomical parts the simulator represents and the medical practices usually conducted on those parts.

Use of the simulators generally occurs in small groups. Both the surgical simulator and the gynaecological simulator provide the working space for practices that typically require only one doctor (and a cadre of nurses and other support staff, whose work is not directly provided for or accommodated in the design of the simulators, but that is another story) and these can be used by a student who is supervised by a trained professional in much the same way that apprentice/master teaching would occur if the simulator was a real patient. The difference being, of course, that the student can try things out for herself on the simulator at a much earlier stage in her training without risking the health or comfort of the patient, and without the need to keep up the professional mask in front of the patient. (Though the need to have a professional mask in front of the instructor still exists, as Haas and Shafer (1987) would surely agree.) The anaesthesiology simulator (the full body mannequin) facilitates more co-operative work, and it is generally used with groups of three to four students and an instructor. The students in these groups take on the various roles of medical professionals in the operating room, and practice the work done by the anaesthesiologist as well as the anaesthesiology nurse and operating room nurse, thereby training both the technical practices of anaesthesiology and the communication which occurs between the actors involved in an operation.

Much has been made of the importance of managing the professional mask or performance in front of patients and other professionals (Thelander 2001; Haas & Shaffir 1987:104-6), but displaying competence is also done through the material practices of knowledge explication and mystification. At the same time that a web of mystery must be spun around the knowledge which medical professionals possess in order to set them apart as professionals, there is the need to display and standardise the knowledge that students, must master in order to be accepted from within and outside of the cadre of medical practitioners. Traditionally it has been through clinical practice students learn how to conduct themselves as doctors in front of patients and their peers. But the teaching of theoretical knowledge of the body’s anatomy and physiology has generally relied on various representational technologies: plaster, plastic or wax models, illustrated anatomy textbooks, or even dissected cadavers. Crossing the bridge between a theoretical knowledge of the body and the ability to practice medical techniques on the body is not always easy, and it is at that gap, the bridge between theoretical and practical teaching, that medical simulators are being used as a substitute for the unsuspecting patient-guinea pig.

As mentioned, medical simulators join sketches, etchings, cadavers, and plaster models used to represent the body in the service of standardising medical knowledge. But, while the use of simulators in medical training is a hot new area according to the medical and computer science literature being written about the three high-tech anatomical models I described above and others like them, representing the human body for medical educational purposes is nothing new. The main difference is that the simulators are
Specifically designed to be used to teach medical practices, rather than theoretical knowledge. The simulators function as a platform for practice in ‘real’ time, rather than being a timeless and still representation of the body.

If this chapter was a bit closer to cultural studies or a history of medical visualisation technologies, I could rely on the inclusion of fascinating medical images from the last couple of millennia to catch and hold your attention. As the author, I could pause in my analysis and let you pour over Enlightenment pictures of human insides and outsides, sensual images with round and attractive bodies reclining on settees and draped in alluring poses like the 18th century portraits of naked women hanging in any of the national galleries in Europe, except that in these sketches the abdominal skin is slit and peeled back to reveal the underlying muscle structures, intestines, or organs. I could wet your appetite to read further by showing you sketches of the male and female ‘private parts’ and let you draw conclusions about what sort of experiences (and models) must have been necessary for the artists to render a pair of ovaries inside an abdomen as nearly identical to the male testes hanging outside between the legs. I could show you these time capsules of past medical understandings because the use of visual imagery to substitute for real bodies in medicine is not new, and analysing it has shown how western medicine has represented and taught the body differently through time (See Jordanova’s 1999; Laqueur 1990). Simulators carry on this tradition of representing the body to medical students and professionals, while adding the ability for students to feel and recreate practices upon the technology. But they also join modern and historical anatomical sketches and models in revealing medical understandings of the body.

Parallels between the simulators and the more established use of anatomical drawings can be drawn on several levels. The most obvious is that both traditions rely on a often stated claim to represent the actual, living body and a desire to be as truthfully realistic (or valid, to use the currently fashionable term) as possible. In anatomical sketches, the visual was the raison d’être (Jordanova 1999:183), while in the current simulators the visual combines with the tactile, so that advances in computer graphics are integrated into systems which also rely on physical mannequins or virtual reality models ‘felt’ through haptic feedback technologies. To achieve this validity to the living body some the models used for the creation of both simulators and traditional anatomical schema have been dead bodies. Jordanova details eighteenth century processes used to prepare cadavers for dissection and artistic reproduction, from the use of wax filled veins to the drawing of decaying tissue as if it was still wet and glistening (Jordanova: 1999:189). Today’s high-tech version of the hospital basement cadaver is a set of bodies which have been frozen, sliced, scanned and digitally rendered into computer models of the human body as part of the visible human project, which first modelled the body of a white, middle aged male, then a post-menopausal white woman, then eventually another woman still in her reproductive years (See Waldby 2000; Cartwright 1998a). The first data set, that of the man, was used in the development of the surgical simulator described at the beginning of this chapter.

Secondly, both anatomical sketches and medical simulators were and are being used to turn the knowledge and the practices of the medical profession into material representations, and thereby legitimating anatomical understanding (for example, that the female reproductive system mirrors the male, it’s just inside out (Laqueur 1990)) and medical practices (like the introduction and propagation of MIS techniques for various types of surgical interventions). Jordanova acknowledges that the use of visual display once played a stronger legitimating role than it does now (Jordanova 1998:216-5), since medical schools, teaching hospitals, and licensing boards have today taken over much of ensuring training and professionalisation for the medical community. A century ago, however, anatomical sketches represented facts about the body, more for others in the medical community than for the patients (Jordanova 1995:208-9). Today simulators are taking on this role of creating and representing medical knowledge for the medical community. Simulators can be read as an attempt to articulate and reinforce indisputably through visual and tangible proof that the knowledge and local practices of a particular community (minimally invasive surgery, gynaecological pelvic exams or anaesthesia) are truths. As teaching tools, the
Simulators serve to standardise the practices being taught on them. For example, while students may not be aware of this, simulators like the minimally invasive surgical simulator are working as missionaries for an innovation in surgical procedures (keyhole surgery) which is relatively new, as well introducing specific surgical tools into the technical repertoire of a new generation of medical professionals. It can also be used to spread knowledge about (and the benefits of) keyhole surgery to older practitioners by working as a demonstration tool in the hospital, and, potentially, it could be used as a testing tool to ensure a certain standard of practice by surgeons employed at the hospital, both legitimating the individual surgeon’s practice for the peer group and potential clients.

A third parallel that can be drawn is that as assertions of ‘reality’ or ‘fact,’ both anatomical drawings and simulators stand open to an analysis of the underlying values and understandings they simultaneously represent and reproduce, as well as practice oriented understandings of how the patient and medical professional interact. For, while the medical discourse of ‘validity’ of the simulators attempts to underline their realism, the simulators are still representations of the body conceptualised and thereby stand open to an analysis of that conceptualisation, just as earlier anatomical representations have done. In discussion her work with images, Jordanova makes the point that, “Once it can be agreed that naturalism and realism must be analysed and not taken for granted, as too many works dealing with medical images still do, then attention can be turned to cultural motifs and historically-specific themes” (Jordanova 1999:201). Turning my attention to the ‘cultural motives and historically specific themes’ in the modern medical simulators has uncovered some very historical, un-modern ideas behind their construction, and an example of modern subject’s ability to integrate multiple understanding of the human in practice.

**Patient bodies, simulators and senses**

There are a number of levels at which an analysis of the medical practices and understanding embodies in the simulators could focus. One of the more obvious starting points is the way the medical practitioner is constructed by the machine, and how, thereby, the simulators reflect the different senses which are more or less important in various medical fields. Related to this is the articulation of the understood patient-body which is reified in the simulation. The practices enacted with the help of these various machines construct very different doctors and patients.

In the Minimally Invasive Surgery simulator there is an attempt to make the computer graphics that display the images of the interior of the body on the video screen realistic to the point of unrealistic realism; even though the ‘space’ created by the machine underneath the surgical cloth is three dimensional and the probes and pinchers need to be manoeuvred through this three dimensional space, the images on the screen which the student is looking at are more or less two dimensional, which replicate the two dimensional images ‘real’ surgeons receive on the video screen from the fibre optic camera used during MIS procedures. Limited visuals, which the student must be able to translate from 2D to 3D, are reproduced in the simulator. The surgical simulator’s selling point is not the computer graphics, though they are good. It is the haptic feedback to the handles of the surgical instruments. Through a series of little, computerised motors the simulator creates varying resistance on the handles in order to simulate for the medical student what it feels like to bump up against the squishy stomach or collide with the significantly firmer liver. Using the simulator means learning how to make steady, co-ordinated movements, to manoeuvre in a crowded space with potentially damage-inducing instruments. It also means learning how to manipulate the optic inside the ‘body’ with one’s hand in order to create the right visual on the screen, and then translate it into a workable understanding of an anatomical space. The tactile ‘seeing with one’s hands’ as well as the seeing 3-D out of a 2-D image are the sense requirements of MIS that have been built into the simulator.

The simulators can also be read for the image of ‘the body’ in the various fields of medicine, as the patient bodies they represent are very different in each of the cases. In the Minimally Invasive Surgery simulator, the body is the interior of a knee, shoulder or abdomen; the internal configuration of bones, tissues and
organs which need to be worked upon, avoided or approached with the instruments. The worked-upon body also includes the video screen (computer monitor) and the instrument handles which stick up out of the green surgical cloth covering the haptic motors, but the patient’s head, his temperature or heart rate, or the pallor of his skin is not part of the simulation because it is not part of the patient-body necessary for minimally invasive surgery, as it is defined by the MIS surgeon who have helped in the development of the simulator.

The Full Patient Simulator is used to train anaesthesiology students and emergency response teams. It is supposed to simulate a patient’s physiological responses to anaesthesiology practices and pharmaceuticals both in a healthy state and during unexpected complications like heart attacks. The practice of anaesthesiologists relies on interpreting the patient’s physical condition through both the physical body and the read-outs of ECG machine connected to the body. The simulator is supposed to allow students to do both of these with the mannequin and the ECG machine it is attached to. It has a heart rate which can be read from a screen, felt in the pulse points and heard through the stethoscope. The patient’s pupils can shrink and dilate in response to medications administered during a practice. The patient’s muscle reflexes can be tested through electric shock applied to the thumb just like with a real patient, and the intubation procedure can be carried out, which means the students can really shove (with difficulty, as they also encounter in real patients) the tracheal guide and tube down the trachea and into the stomach (accidentally) or into the lung passages (correctly). And then the anaesthesiologist can use the respirator and hand pump to ‘breathe’ for the patient when the muscle reflexes have been numbed and the patient is anaesthetised. The breathing can be ‘heard’ from the surface of the patient’s chest with a stethoscope, listening for the sound of air bubbles if the tube has ended up in the stomach region or breath in the lungs if the tube is correctly inserted. But the interior of the patient is not anatomically correct. Rather it is designed to give the correct external signals on the patient’s body and on the machine read-outs to the anaesthesiology team so that can interpret their actions and the body’s responses correctly. This interpretation relies on the medical student’s ability to observe the patient through sight and sound, to interact with the body and interpret its responses, both directly and through the mediating ECG machine, and so the simulator creates a body that can communicate through the same channels a real body would, but which doesn’t represent the underlying anatomy a real body has. The technology of the full patient mannequin is creating a certain type of body: the anaesthesiology patient-body.

An ‘anatomically correct’ interior is more important for the female pelvic region simulator, e-Pelvis. The outside of the ‘body’ doesn’t really look like a human patient, and a replication of patient responses or the physiological body functions of the interior organs represented is not included. This is because the simulator is designed to teach students how to conduct a manual gynaecological exam, something they are taught (in part by the simulator) occurs inside the female body, not with the patient’s exterior, and not with the patient herself. Instead, the size, shape, and position of the uterus and ovaries have been represented, and these have been fitted with sensors to ‘read’ if the student touches the correct spots on the anatomy during the exam. The ability to sense shapes and surface structures with the doctor’s fingers is what the simulator is trying to convey. There are not any knees for the medical student to make eye contact or avoid eye contact with during more or less ‘embarrassing’ procedures (See Heath 1986). Rather, the simulator represents the part of the body and the elements in it which are examined by the specialist’s hands, which says as much about the understanding of what a gynaecological exam is as it does about the simulator.

A reading of the gynaecology patient-body from the e-Pelvis is equally interesting. The simulator shows that, for practices like pelvic exams, the patient-body is the pelvic region with internal reproductive organs, but not the sexual organs located on the outside of the body (for an analysis of the medical relationship to the oft disappearing clitoris in anatomies, see Moore and Clarke 1995). And like the surgical simulator which facilitates practices localised in specific body parts, the rest of the body is not
represented with this e-pelvis simulator either. As we have seen above, a simulator can be a tool to materialise, or reify, elements of medical practice, including concepts of the patient. In the case of the e-pelvis, the simulator serves the gynaecological community both as a venue to practice pelvic exams and to define ‘their’ area of activity for newcomers (students) to the community.

Of course, the e-pelvis is not coming up with the idea of a locus of appropriate action by itself. While it does serve to marginalise the ‘woman’ from the medical procedure conducted on the ‘female body’ (read the reproductive organs), it has been created and is used to reflect a pre-existing idea. It can be useful, however, as a tool bring those ideas into sharper focus, both for the medical practitioners using the simulator and others, like us, who are analysing it. Seeing this idea of the appropriate patient-body so clearly represented in the technology used for teaching medical practices and concepts helps to shine a light on the conceptual understandings of the body that has led to the development of other medical technologies and techniques which have been criticised for reducing the female patient to the visual images of her internal reproductive organs. This underlying concept of the body is found in the use of ultra sound to extract and recreate on a monitor the ‘body’ quite separate from the woman laying on the examination table during pre-natal exams and egg harvesting (see: Cartwright 1998; Cussins 1998a) and in the way practices of reproductive technologies have dissolved the unity of foetus and mother, involving instead discrete elements like eggs, fertilised or not, embryos, wombs, and petri dishes (Martin 1992:19-20; Cussins 1998b). When we see the concept of the gynaecological patient-body reified in a pelvic exam simulator, the situations described in many of the critiques of reproductive medicine practices become more understandable – not less disturbing, but a little more contextualised in the understandings of the patient held by the field.

In the surgical simulator and the e-pelvis, the patient is reduced to a non-interactive body part, which can also be read as commentary on the role of the patient allocated within those fields. Interestingly, in contrast, during use of the full patient simulator with students, the simulator was ‘animated’ through a ventriloquist style attempt on the part of the teacher, who was trying to get the students to verbally interact with the patient as they would before and after an operation, which is another method important to ‘reading’ the patient during anaestheiology. The patient-body which is reified in each of these three simulators reflects at an understanding of the patient in the respective fields. In doing so, the simulators then function as a visible and touchable tool to teach new doctors these discipline-specific understandings.

The gendered simulator
It is easy to see which parts of the human body are of interest to the various fields from examining the simulators and from this gain insight into the varying understandings of the patient-body which exist in different medical fields. One can also examine the simulators for the gendered patient-bodies they represent, in much the same way earlier work (Laqueur 1990; Moore and Clarke 1995; Jordanova 1999) has examined older anatomies (visual textbooks and folios) for what they say about how a body’s sex is conceived.

On the surface, the sex of the simulators seems fairly straightforward. The anatomical volumes presented in the MIS surgical simulator have been modelled from data derived from the male carcass in the virtual human project (see above). The full patient mannequin is modelled on a generic, full-grown male body, and the e-pelvis simulates elements of the female pelvic region. The simulators represent two male and one female bodies.

It would be easy to say of the first two simulators (as has been said about many modern anatomy textbooks) that they are based on the universal male body, and see the third as an anomaly in that pattern. But I’m not sure it is that easy. This chapter started forming in my head while I was conducting fieldwork at a medical simulator centre with professionals who I generally found to be politically correct, gender sensitive, and pedagogically concerned with integrating female students into their practices, as well as
male. I had a hard time reconciling this image I had of the instructors with the blasé answer I got about if there was a female simulator for the anaesthesiology students to work on as well. (“The abdomen is removable and there is a female replacement part, but it doesn’t really matter. It’s not important for what we are simulating.”) I was also trying to figure out why there had never been any mention of the fact that all the simulators in the centre were modelled on male bodies by any of the doctors or nurses I encountered there (the gynaecological simulator was located in another hospital, in a women’s health research centre not in a centre devoted to simulators as such), even though they talked about other aspects of gender and medicine and even though half of the staff, including two of the surgeons in leadership positions, were female. Of course, none of this would have to mean that they had to be concerned about issues of the gendered representation of the simulator, but I still thought it was kind of strange. And even stranger that it would be treated as such a non-issue when I brought it up, myself. That a simulator simulates the male body merely seemed to be the natural state of things, and not something seen as a problem. I wanted to explain to myself how this could be a non-issue for doctors who had otherwise seemed aware of gender issues.

I started to consider the possibility that there was an understanding of sex at work behind the simulators (and the libraries full of anatomies) that differed from my own admittedly binary conception. I started to suspect that, just as understandings of the patient body could differ between specialities, so could the understandings of gender employed in medicine vary between fields and between differently situated practices. And I started to suspect that in the simulator centre where I had been conducting my fieldwork I was encountering the remains of a much older, one-sex body reincarnated in a modern simulator, like a ghost of anatomies past.

It’s been nearly fifteen years since Laqueur came out with his history of the one-sex body and medicine’s transition to the two-sex model during the Enlightenment. In his book, Making Sex (1990), Laqueur explains the one-sex model as relying upon an understanding of the female as a lesser developed version of the male. He documents its presence in anatomical descriptions stretching back to the Greeks and forward until the late seventeenth century (Laqueur 1990: 114, 157-8). In the one-sex model the under-development of the female is embodied in the genital construction. Because the female body has less ‘heat’ her genitals are never pushed outside of the body, so the organs which would have become the male genitals are still inverted and inside. The potential penis and the scrotum are upside down and inside out, hanging in the abdomen disguised as (to use our two-sex model terminology) a vagina and a uterus.

Underneath this medical explanation lies a theoretical understanding of the one-sex body; the female body is the same kind of body as the male body, only with a different anatomical mapping of the genitals. Despite the differences in appearances – or location, or topology – the one-sex model of the body states just that: there is but one sex to the human body. The dissolution of difference between the two sexes is not an ombudsman for equality; the model is hierarchical through positioning the female ‘below’ or as a less developed version of the male. The theory posits that the human body in its most perfect form takes the physical appearance of the male body. But therein lies a linguistic consequence of the one-sex model: calling the ideal type body ‘male’ becomes a misnomer when we use ‘male’ to denote one of the two sexes in the binary relationship we today use to understand sex and gender. The body of the one-sex theory is physically the same as the universal male, but in the practices of anatomical representation, the one-sex model’s ‘male’ also includes, describes and represents the female body. Differences between the two are differences in degree, not differences in kind.

Laqueur discusses the demise of the one sex-model, attributing it at least in part to changes in society which required the sexes be made irreversibly distinct. He discusses the way understandings of social relations, property ownership, and new cultural forms as explicated by Rousseau, Hobbes, and Tocqueville demanded a distinctly binary understanding of sex in order to place women into the social theories of the day. Women became a different thing than men, rather than being underdeveloped men. He
claims that this eventually caused a change in the way medical images and medical understandings represented the male and female. “Gradually the genitals whose position had marked a body’s place on a teleologically male ladder came to be rendered so as to display incommensurable difference.” (Laqueur 1990:158)

His point is that social understandings of the gendered body influenced the interpretation of medical facts even by the medical practitioners themselves. He later shows that discoveries in the field of hormonal and reproduction processes during the early twentieth century were not used to challenge the then dominant ideology of two sexes, even though they could potentially have done so. Instead, science and medicine paid homage to the two sex model, because, as he puts it, “Two incommesurable sexes were, and are, as much the products of culture as was, and is, the one-sex model” (Laqueur 1990:153). Or, in other words, how we understand sex determines how we see it around us. As Oudshoorn has also shown, even when the essence sex moved from the gonads to the hormones with the developments of the field of endocrinology, the difference between male and female was still seen as one of type rather than degree (Oudshoorn 1994: 145f).

Laqueur’s history of the one-sex and two-sex models shows clearly that, and to a lesser degree, how, the two-sex model has become dominant in North American and European societies. Laqueur focuses his attention on medical anatomies, but the understanding of sex, of male and female as grounded in the sexual difference of the human body, has influenced other fields of science as well. Schiebinger traces its influence in eighteenth century botany and biology (Schiebinger 1993). With time, the idea of sexual difference has become a gender binary, which differs from the one-sex model in a very important way: the male and the female are posited to be mutually exclusive. Faulkner claims this can be traced to the hegemony of heterosexuality in cultures which see male and female as complementary opposites necessary for the unity of marriage. “The need to define masculinity as not femininity, and the fear of the feminine in men, are recurring themes in the masculinity literature, explained in terms of normative heterosexuality.” (Faulkner 2000 781-2) This tendency to define masculinity as that which is not feminine does appear to be just about everywhere once one starts to see it. It shows up in child rearing and the ‘acceptable’ toy choice given to girls and boys like computer games and Barbie dolls (Cassell and Jenkins 1998). It shows up in labour disputes over the introduction of new technologies and subsequent ‘feminization’ of industries (Cockburn 1983), and in the displays of masculine behaviour by female engineers who want to succeed in engineering (Kvande 1999). I can’t even escape it in my English language: masculinity and femininity are constitutive categories in themselves (Butler 1990).

Within the sociology of medicine and technology field, the two-sex has been the conceptual framework against which researchers have revealed the male norm in much of the medical research and practice conducted in Europe and North America. Fausto-Sterling has shown how researchers working with a (binary based) view of male as presence and female as absence produced research results which explained the appearance of male testes in foetuses but entirely avoid the question of female ovarian development (Fausto-Sterling 2001).

The conceptual mutual exclusivity of male and female patient-bodies has created a tendency to focus work on reproduction at the locus of women’s bodies. The predominance of female birth control technologies and the general lack of male contraceptives stems from a view of child bearing as female and the reproductive process as something which happens in the female body instead of in conjunction with the male. This view has led to medical research focused on how the female reproductive organs function, which naturally provides a female working platform for the development of contraceptive methods and technologies (Oudshoorn 2000: 131f). Likewise, there has been a critique (and defence) of the selection of male test subjects for clinical drug trials instead of male and female (Meinert 2001: 306), a practice and a criticism which also starts from a binary understanding of gender.
One field in which the male/not female binary model has recently been radically challenged is the treatment of intersex individuals, babies who are born with an indistinct or multiple gender. In this area the empirical data demands a re-evaluation of the gender paradigm. And while traditional practice has rested upon the surgical and hormonal creation of binary sex from multiple options in intersex babies, this ‘creation’ simultaneously acknowledges that there can exist alternatives, even if the medical practice has traditionally tried to deny this through surgery and hormone treatments. “The belief that gender consists of two exclusive types is maintained and perpetuated by the medical community in the face of incontrovertible physical evidence that this is not mandated by biology” (Kessler 1994 p.232).

The biological challenge to the binary sex paradigm that intersex children present as well as the theoretical discussion about gender vs sex have opened up a space for a discussion of alternative gender options. A bit tongue in cheek, historian of science Fausto-Sterling suggested that perhaps our view of gender needs to be expanded to include five biological sexes (male, female, and three variations on combinations there between), at the same time that she reflects upon a chromatic system of gender presented by Rothblatt which produces 343 shades of gender and anthropological rumours of cultures which recognise three genders instead of two (Fausto-Sterling 2000 p108-9)

If alternatives can exist in our imaginations, and if some people can be writing about them in academic literature, who’s to say that different ways to conceive of gender aren’t already with us in our daily practices? Why can’t a complexity of ways to understand gender silently be floating around in the unarticulated foundations of the material objects which inhabit our world? I brought these last ideas up as examples of alternative sex(gender) paradigms because, after my time at the simulator centre, I started to wonder if the two-sex, binary based understanding of sex, of B is not equal to A in kind, had not entirely managed to replace the one-sex model. I began to wonder if maybe there are traces of the one-sex model left in more places than we realise.

Take, for example, the whipping horse of much (deserved) criticism for using the male body as a stand-in for the female body, Gray’s Anatomy, one of the canonical texts of American medical schools. As Laqueur notes, in it:

“All the surface anatomy is demonstrated by male, though curiously unmuscular, subjects and thereby belies whatever objective claim one might want to make for the advantages of the male body in illustrating surface articulations. […] The female body is presented only to show how it differs from the male.” (Laqueur 1990:167)

The same pattern of representation can be seen in the simulators I have described. The male body is used as the norm and the female body represented only when it differs from the male, and then only in the ‘parts’ which are ‘importantly’ different; the genital insert on the full-patient mannequin and the primary reproductive organs in the e-Pelvis. But the fact that this was unproblematic for the medical professionals I was working with, as is Gray’s natomy for many anatomy courses, made me suspect that the one-sex model is still being used (un-stated, unexplored, unarticulated, and therefore uncontested) as the basis for design of anatomical teaching tools, be it visual anatomies or simulators.

This would mean that the simulators (and the anatomies) are still being materialised out of the ghosts of the one-sex model, which allows deviation for the female reproductive organs but not the whole body. The e-pelvis, viewed against the Full Body Patient and MIS Surgical Simulator, could be read as an material assertion that the practices of anatomy see female as a subset of the human body, a subset with different genitals. In this paradigm the female again becomes different in degree, not in type. Using the one-sex theory of the body, this normative body of which the female is a subset could be called the universal human (not the universal male) because the female is understood to be the same as the universal, but with slight variation in the appearance of genitals. It is this variation which means the female genitals which
need to be represented on their own, in their own simulator, but lacking the rest of the body. It would appear as if, even in modern anatomies and medical simulators, the one-sex body is haunting the medical understanding of the human body, still presenting an image of the variation between male and female as a difference in degree rather than a difference in kind.

Conclusion
Medical simulators can be examined for the clues they hold about medical practices on many levels. They can be read for the information they contain on the patient-body significant to various practices. Just as this patient-body is constructed differently between the various medical practices, so is the gender of the patient-body represented by the simulators (and reproduced by the people using the simulators) both variable and significant. The gendered patient-body can be read in modern simulators in much the same way it has been read in historical anatomies.

Examining the gender of the patient-body presented in the simulators, and the way medical professionals accept it as an uncontested standard, indicates that the simulators still contain traces of the one-sex body model found in pre-enlightenment anatomies, rather than relying on a strict adherence to the modern binary understanding of sex. It has been asserted that the universal subject’s body is same as the male body. It isn’t a surprise, then, that the simulators designed to teach upon and about that body are also male, something which is not seen as problematic by the medical practitioners using them. But, given what we as a social collective know about how this universal has resulted in skewed medical practices, the question becomes, how can the medical community not see this as problematic? I argue that it is because the people who are using the simulators see the male body not as ‘male, not female’ but rather ‘male including female’. Only when female sex organs are interesting to a practice (as in gynaecology) does a simulator need to become ‘female, not male’. When this happens, the ‘female’ simulator consists of the female primary sex organs but not the rest of the body. Even in the case of the full body mannequin, the elements of the mannequin which can potentially be changed to make it female are not the broad shoulders, the thick neck or the muscular thighs; it is the catheter receiving sex organ. Once that is switched from a penis to a vagina, the mannequin is interpreted as a girl. To combine Laqueur, Faulkner, and Lie’s terms, it seems as if the ghost of the one-sex model is haunting these simulators, with the result that analysing them through the prism of binary gender (the B = not A model) is not useful. Rather, the simulators seem to be built upon an understanding of gender in which B (female) is a subset of A, that is to say, A (as universal) includes B, except for a few specific sex organs.

From a feminist point of view this problematic and the consequences it has on women’s health have been well documented. However, recognising the difference is important. It is the one-sex model in the heads of medical professionals that allows them to use the male including female model in their practice without seeing the negative implications it can have on their gendered medical practices because to them they are practising medicine on ‘female’ bodies just as much as on ‘male’.

Seeing these remnant of the one-sex model in modern medical simulators, and seeing them appropriated into medical training uncontested, leads me to suspect that there can concurrently exist different conceptions of sex within the same subject. The medical student who unquestionably practices intubating only on a male mannequin at the simulator centre can simultaneously interact with his or her classmates in the gender-appropriate way. Perhaps one can discern different gender paradigms for professional and personal practice just as one can see unstable paradigms between medical practices. And perhaps there exists variations in how we can understand the gender of the human body in other spheres of practice, too. Perhaps the apparent dominance of a binary gender system is actually masking varied localised practices of gendered understandings.

The consequences of seeing this are two-fold. Firstly, while discovering that the reification of medical knowledge can still be haunted by conceptual paradigms of the past should not come as a surprise to STS
scholars, it none-the-less took me a while to recognise it because I was so blinded by my own understanding of gender as a binary relationship. By being confronted with other paradigms, other conceptual frameworks than the one I was used to working within, I was simultaneously forced to create a more nuanced view of medical practices in general, a view that again underlines the importance of looking closely at localised practices and paying attention to the variety they can contain.

Secondly, and perhaps more importantly, seeing the ghosts of anatomies past in modern simulators and observing the ease with which their reified knowledge is embraced by subjects who also exist in a world of binary sex points to the complexity our subjectivities can embrace. That we (or at least medical students and professionals) can so easily and unremarkably integrate conflicting understandings of sex into more or less seamless medical, pedagogical and social practices belies my attempts as an outsider to tell a simple story of medical simulators and instead forces me to acknowledge the complexity of context (geographical, disciplinary, cultural and historical, to name a few) within which the simulators are enacted into simulations. This makes my job harder, but hopefully it will make the resulting analysis a bit more interesting.

References:


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