Original articles

"…Those could just as well be the Rocky Mountains…"- Consumption, spectacularity and much more in obstetrical ultrasound in Rio de Janeiro at the turn of the century[R,1]

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Abstract

This work calls upon the so called ANT (actor-network theory) to approach the obstetric ultrasound technology as an 'indispensable' technology in prenatal monitoring in Rio de Janeiro at the turn of the 21st century. It does not envisage to build an exhaustive list but rather to perform a set of heterogeneous elements which by acting in juxtaposition configure the specificity of the studied technology, allowing for its delimitation and naming.

The hybrid elements that are presented here - equipment, didacticism, assurance, oracle, affections, prestige, market, media, pathology, purification – are configured and understood as agents or actants which simultaneously are: 1) natural but without previously established forms that are already out there to be 'simply' discovered (not "things-in-themselves"); 2) collective but not social if this adjective refers to belonging to an exclusive world of relations of "humans-among-themselves"; and yet 3) narrated but not constituted solely by discourse.

The purpose of this work is to perform a distance from the tradition of the great a priori dividers which predominate in the studies of the so-called modern knowledge in the last few centuries: natural x social, public x private, heart x mind, science x belief, human x non-human, male x female, macro x micro, local x global. Our special interest is that, to the extent that this distance is obtained, other landscapes can be reached by Brazilian and Latin American STS (science-technology-society studies) – there, to say it somewhat crudely, that which exists is that which acts, and only hybrids have the capacity to act. The next step of this work, here indicated but not completed, is to study where the actions that configure the above elements take place and by which means (material vehicles) they communicate, articulate and act one upon other among themselves.

Key words

actor-network theory; ultrasound; technology; Rio de Janeiro; hybrids; Latin American STS

"The simple act of recording anything on paper is already an immense transformation that requires as much skill and just as much artifice as painting a landscape or setting up some elaborate biochemical reaction. No scholar should find humiliating the task of sticking to description. This is, on the contrary, the highest and rarest achievement." (Latour, 2005:136-7)

Introduction

The use of ultrasound technology applied to obstetrics increased significantly in Rio de Janeiro during the 1990s, acquiring meanings beyond its strict medical application, such as those of spectacle and consumption. This article answers the question as to "how this state of affairs is constructed, maintained and instigated?", showing that, since the 1990s, ultrasonography has become widely disseminated and stabilized as an 'indispensable' technology for prenatal monitoring in Rio de Janeiro. This has occurred simultaneously with the construction, in the same place and period, of a technological frame in which heterogeneous elements such as sound waves, authority, prestige, electronics, prejudices, visual devices, theories, family, medical congresses, software, fear, self-esteem, and the market, amongst many others, are juxtaposed, mutually supporting or sometimes opposing each other. A precarious, temporary construction is constituted, that is in constant movement, but sufficiently stable to enable a collectivity to share inscriptions in equipment (in this case images on computer screens), and confidently extract efficient patterns of action and behavior from them. To this end we make sociotechnical use of the ethnographic material[2] produced for a doctoral thesis (CHAZAN, 2005)[3], employing an approach based on actor-network theory[4]. Nearly 200 obstetrical ultrasonographies were accompanied in three private clinics – here called A, B and C – in Rio de Janeiro in 2003. In each clinic the research focused on the work of one of the doctors. During intervals the observer interacted with the doctors in the reports' room. The pregnant women were at various stages of pregnancy.

The story first, the explanation later

Most academic work adopt methodological procedures that reject or avoid the type of intervention or "immediate" effect obtained by fairy tales such as "Alice in Wonderland" or jokes. A joke that requires explanation is no good. An approach based on actor-network theory seeks to obtain this kind of intervention or effect highlighting that "a good description does not require an explanation":

"You should panic only if your actors were not as well constantly (framing, finding a typology, comparing, explaining, generalizing), actively, reflexively, obsessively. They, too, compare; they, too, produce typologies; they, too, design standards; they, too, spread their machines as well as their organizations, their ideologies, their states of mind. Why would you be the one doing the intelligent stuff while they act like a bunch of morons? What they do to expand, to relate, to compare, to organize is what you have to describe as well. It's not another layer that you would have to add to 'mere description'. Don't try to shift from description to explanation: simply *go on with* the description. What your own ideas are about your company is of no interest whatsoever compared to how this bit of the company itself has managed to spread" (Latour, 2005:149-150) (emphasis in the original)

It is not a matter of establishing here whether "a network *is there* or not" in the technology of obstetrical ultrasound in Rio de Janeiro at the turn of the century. The actornetwork theory is better compared to a pencil. One does not have to draw a pencil with a pencil, and this is not an issue here; though certainly we are not saying that to use a pencil for drawing is the same thing as using another tool, such as, for instance, a plotter with all its embodied theories and practices. With its emphasis on description and its commitment to the specifics of a material flux, the actor-network theory can not be properly applied to anything and does not allow for more or less standard reproduction of previous research works since with it, if successfully, one can provide "no structuralist explanation". (Latour, 2005:155)

The description first, the explanation later. However, when, where, for what and for whom an explanation will pledge itself necessary? Which distribution does it call for? It is not our purpose to focus this question here, however, to open the broadest possibilities of propositions to answer it, reaching the limits of available resources and participant researchers, is the political contribution that works such as this one can offer. Facing a description that is void of explanation, if an explanation is explicitly added to it, the stage is more easily set for a serious entrance of the political question: what or whom does the added explanation or rationality reject or is prejudiced in favor of?

Methodologically, in this quite specific study, we did not seek to draw up an exhaustive list of the heterogeneous elements that constituted obstetrical ultrasound in Rio de Janeiro at this time

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146

(which, strictly speaking, would be meaningless for actor-network theory), but rather aimed to gather sufficient elements to approach and configure a dynamic. This dynamic evidences that the result of a medical exam does not stabilize itself because it is the bearer of a "scientific objectivity" that separates it from society (in the way that the law of gravity is regarded as being separate from society), but for rather a different reason: it becomes reliable knowledge precisely insofar as the heterogeneous relations between these elements that are also heterogeneous stabilize themselves precariously and temporarily.

Heterogeneous elements and their heterogeneous relations

1) Equipment

In the three clinic lights are dimmed during the exam. Operating the apparatus requires the coordination of various distinct motor and cognitive activities. The operator uses his left hand to "pilot" the machine, a piece of equipment that occupies a considerable part of the exam room and looks like a plane's control panel, with its many switches and luminous buttons. With his right hand, he moves the transducer[5] on the pregnant woman's abdomen or inside her vagina. There is always a monitor in front of him showing images (inscriptions) made by the relation between the probe and the body in the apparatus which, in turn, are component heterogeneous elements of the technological frame we are describing/listing. The operator also performs measurements and writes the names of the selected parts of the images on the screen, typing on a keyboard or pressing some controls. The equipment then automatically calculates various medical parameters, such as fetal weight and height, fetal and maternal cardiac rate, intra-cerebral fetal blood flow, gestational age, etc.

In December 1992, the Federal Council of Medicine decided that only doctors could perform ultrasonography in Brazil[6] . The doctor who carries out the exam decides what structures should be focused on during the course of the exam. In the field of diagnostic medicine's own terms, it is an 'operator-dependent' technology. The relation between the ultrasonographer and the client necessarily involves physical proximity, mediated by the computer screen and by the ultrasound transducer which, either slides directly on a gel that is spread on the abdomen or the pelvis, or is introduced into the woman's vagina, protected by discardable condoms. A lot of talking usually takes place during the session.

The proximity and density of the interaction occasioned by the use of this equipment creates a situation that favors the monitoring of the countless constructions in which heterogeneous (techno-scientific [things, equipment, "natural laws"], socio-political [people, institutions, customs], discursive [words and images]) elements are juxtaposed, mutually supporting or opposing each other, in the precarious stabilization of what we have called the technological frame that constitutes obstetrical ultrasound technology in Rio de Janeiro during this period.

2) Didacticism

The ultrasonographer's activity harbors a didactic undertaking. Pregnant women are first of all taught to see and afterwards to like what they see: the inscriptions, gray and fleeting figures or images that perform their 'babies' in the world. This lesson is an alliance of the equipment where the inscription is produced, the doctor's authority, the pregnant woman and possibly relatives and friends, even if there is sometimes a certain unwillingness or even resistance. The doctor's knowledge gains in authority precisely insofar as the pregnant woman becomes convinced of the correspondence between what he says, the images that appear on the screen and the referents in her body. The doctor's words are like captions that tell the pregnant woman what she is seeing on the monitor. Without the captions the images are meaningless, and without the images it would be easy to contest the doctor's words.

> G: Wow!... It's difficult... [to see]
> Dr. Henrique: [Laughing] You have to believe... [They all laugh]
> P: I think it must be easier to learn Japanese... These images... you have to make a hell of an effort to understand what's going on! (Clinic A).

> Dr. Henrique: Look at the lip... [shows P] you have to use your imagination...
> P: Ok, I understand... [Surprised] There has to be an <u>eye</u>... I would spend ages without seeing a thing [Tries hard to see] is that the hand on top? [Dr. Henrique says yes. The fetus' face appears, moving its mouth, all of them can see]. (Clinic A).

Dr. Lucia, in clinic B used various, quite colloquial, didactical comparisons, in order to make the images intelligible to the pregnant women:

> Dr. Lucia: [Pointing at the monitor with her finger] The head... the cephalic mass... this thing

here that looks like a butterfly... (Clinic B).

Dr. Lucia: Just look at that, the heart... can you see it? [G smiles, fetal heartbeats can be heard, Dr. Lucia seeks an image]. The tummy... and... Look! Look! The little willy... [shows] the scrotal bag and the little willy...
P: His ID...
Dr. Lucia: Looks like a tortoise... [indeed it looks like a tortoise in a children's cartoon]. (Clinic B).

Dr. Silvio, in clinic C, on the other hand, often used medical jargon even with lay clients, giving his explanations a more scientific character – and, on certain occasions psychologized one – than observed in the case of other professionals. It was common for him to explain how the image was obtained and defend scientific and technological progress, trying, however, to distinguish between what 'the fetus is' and the image that appeared on the screen:

Dr. Silvio: Here's the head [image of a cephalic slice], the top [makes a gesture]... as if the head were being sliced... ultrasound does not show an image of the baby as he really is... it slices the mother... slices the baby... a 2D ultrasound image is composed of slices of the baby... not to be confused with the image of the face, because I want to see the orbits... see inside the baby... slicing... Important: what the image corresponds to... it's not the same as the baby, its little face, people say... 'looks like a little skull!'... (Clinic C).

Dr. Silvio: [Treats the couple to a long explanation about 3D technology] That's the trouble with 3D... It doesn't look good because it comes from 2D images, and can't show the whole baby, because one can never obtain equal points, with the same reflection... It's a question of physics. What one sees in 3D is in fact only a virtual image... [Shows them] Here's the image of the face... at this stage it's just skin and bone... it opened its mouth... (Clinic C).

Learning results in a process that is articulated with the visual socialization equipment based on the vision (s) of the doctor (s) that inform the visions of pregnant women, who thus, along with their partners and sometimes their relatives and friends, acquire the ability to spontaneously identify anatomical structures on their own:

G: Perfectly normal, isn't he?
Dr. Henrique: [Doesn't reply and continues the exam] Here's the inside of the head [measures a parameter].
G: The cerebellum....
Dr. Henrique [Somewhat surprised] You're an expert! (Clinic A).

Four weeks later, this same woman, accompanied by her two sisters, seems to want to guide them with her newfound visual competencies:

G: [Observes the monitor] He opened his mouth [To those accompanying the pregnant woman] You have never seen [ultrasound]?... (...) The cerebellum... [G seems very happy at both showing off the image of her fetus and her new visual culture].
Dr. Henrique: [The same as last time] You're an expert! (Clinic A).

The pregnant women that managed to translate the images on their own were evidently pleased with their new abilities, which met the approval of the professionals, with all of them allied to the equipment and to one another, and providing each other with mutual support in this didactic undertaking:

Dr. Silvio: [Performs the measurements] Measuring the head... is important, provides data on the baby's proportionality. (...) [The image of the profile appears again, he measures the nucal translucency (NT)] In front of the nose... one of the hands.
G: I can see... I'm becoming an expert in ultrasound... [smiles, looks attentively at the TV. P looks carefully].
Dr. Silvio: The patient can identify the image herself... before, she only knew it was a baby because I said so... (Clinic C).[7]

In the Doppler exam, for example, the doctor traces a line over the image on the screen, using a mouse built into the machine, affirming that what can be seen there is the pulsation of the umbilical chord. That is, the professional delineates a part of the screen that is full of inscriptions, highlights an image and proposes (and the proposal is accepted, a crucial step if it is to be stabilized as a fact) that the curve visualized and highlighted by her on the screen be identified as the flow of blood from the mother to the fetus.

In the three clinics there was a permissiveness that created an atmosphere in which pregnant women as well as relatives and friends felt perfectly at ease to ask questions,

complain and joke about what appeared on the monitor screen, given that they were unable to understand the nature of those images. This behavior – it should be emphasized – exemplifies the specific configuration of obstetrical ultrasound's technological frame compared with the frameworks that are regarded as being similar, such as those of other medical imaging exams or general ultrasound, where this kind of attitude would be seen as a faux pas, or at the very least, as inappropriate within a medical ethos:

P: [Addressing Dr. Lucia] Are all parents as big a nuisance as I am?
Dr. Lucia: Do you think you're a nuisance?
P: I ask a lot of questions… [justifying himself] But I only ask about what I don't know. For me [laughs and points at the screen] those could just as well be the Rocky Mountains… I don't understand a thing… Everything ok for a normal birth? (Clinic B).

P: [In a complaining voice] I haven't the faintest idea…
G: Neither have I.
Dr. Silvio: [Explains] There's a pile of things in front…
(Clinic C).

This relaxed atmosphere and lack of medical formalism, this permissiveness, which is also a heterogeneous element, is performed by the didacticism which relates heterogeneously with other elements in the stabilization of ultrasound technology as an indispensable tool in the monitoring of pregnancy.

3) Reassurance

Another heterogeneous element in the construction of the technological frame that constitutes ultrasound is the act of reassuring the pregnant woman and/or relatives and friends. Although reassurance and didacticism are usually mutually reinforcing elements, this is not always the case. The expressions "*Everything's fine… Full marks for this little baby*", "*That's great*" or "*Everything's ok*" can be heard all the time during exams in which a fetal pathology has not been detected. In most cases they are part of the didactical undertaking, constituting explanatory captions for the figures that reinforce the normality of the pregnancy, with the pregnant woman, in most cases, inclined to admit that they correspond to the way she feels. All the elements – probe, computer, screen, images, captions, the theories of physics and biology embedded in the equipment, the medical discourse, didacticism,

reassurance, the others which we will bring out below, and many others that a researcher may conceive – are juxtaposed in the constitution of the reference framework that permits the stabilization of ultrasonography as a technoscience, a science that produces and reproduces reliable knowledges about the pregnant woman, fetus and pregnancy.

Grandmother: [Addressing Dr. Henrique] She was very nervous.
Dr. Henrique: [Shows] Look at that little hand… everything's ok.
G: I was nervous, you know…
Dr. Henrique: But I said everything's ok…
G: [Thoughtful] Amazing… how technology…
(Clinic A).

G: The second time around you take things easier, I'll be completing nine weeks… I thought: 'must go [and do the exam], it's almost time to do nucal translucency'… must see if it's twins… and I only relax after the ultrasound… (Clinic C).

The doctors were very conscious of the importance of words, of the captions, as well as the stances that reassured the pregnant women:

Dr. Silvio comments: "*You have to say everything's alright many times. I found the following pattern* [laughs]: *if I say that everything's alright only twice* [during the exam], *they think that it's only* 20% *alright, if I say this five times, then it's* 50% *alright. So I have to say everything's alright ten times. Then they go away confident that everything's* 100% *alright.*" (Clinic C).

However, in cases in which there were indications of fetal pathology or circulatory problems harming the fetus, didacticism and reassurance not only failed to reinforce each other but were actually in opposition. In these cases the image of the anomaly remained in the background, with the doctor recording the image to attach it to the report that would be seen by the pregnant woman's obstetrician, but not spending much time explaining it or showing it to the pregnant woman. When requested, the doctors observed did not refuse to show it but never took the initiative to do so. Thus the anomaly (which is another heterogeneous element defined in the reference framework that this study constructs) upsets the mutual reinforcement between the didacticism-reassurance elements. On these occasions the doctor uses words that are not captions of the image in which he can see the anomaly. In this case one can see a variation in, a deviation from,

or a reconfiguration of the ultrasonography's technological frame. In this reconfiguration the elements related to didacticism are absent, become less important, or are mobilized, as we shall see, to place the anomaly at a distance. One may observe that reconfigurations of the technological framework, precisely insofar as they may become less precarious and more stable, they make their effects more obdurate. As the technological framework is an actor-network, that is, it acts and cannot be distinguished from obstetrical ultrasound technology during this period in Rio de Janeiro, any change in the frame changes both the technology and ultrasound. For example, it is not difficult to perceive that there is a tendency to reduce the duration of each session if the didactical activities are eliminated, and how this modifies the whole ultrasound exam by modifying the environment in which the exams are performed, the layout of the equipment[8] in the room, the relation between the doctor-operator and the pregnant woman, the duration of each exam, the design of the equipment, and consequently the whole economy of obstetrical ultrasonography.

In sessions where the aim was to assess fetal anatomic structures and there was prior data indicating some probability of the existence of malformations, or even when some fetal abnormality had already been detected, doctors used to alternate the quest for images of the anomaly with others, such as those related to fetal sex (we will return to this below), the profile or other normal anatomical structures of the fetus, evidently as a way of relaxing the atmosphere. They were usually successful, making the pregnant woman smile. Exhibiting these "normal" structures was, thus, one of the tools used to circumvent the anguish present at the session. Professionals are quite familiar with the possibility of using images for this purpose. As a doctor in clinic A informed: "The patients come in looking grim, one shows them the fetus' profile and their mood changes straightaway… they become all smiles."

[The couple is looking very solemn today].
Dr. Henrique seeks images of the fetal heart, which is apparently normal. Shows the couple the cardiac chambers, saying that this exam excludes the possibility of 90% of known cardiac pathologies. The couple remains silent (…) Dr. Henrique then shows the fetus' profile, G smiles. (Clinic A).

Thus when dealing with anomalies, the images no longer took center stage but were not absent, and the doctor's words recomposed the alliance between didacticism and reassurance creating a space where the anomaly was placed at a distance, in brackets so to speak. Occasionally explanations about technology were mustered for this purpose:

[A previous exam had detected a labial cleft[9] in the fetus, but the pregnant woman had not been informed. The couple wanted to "do 3D"].
Dr. Silvio: [The first images appear, he shows] Thorax… little heart…the little head down here [shows only a cephalic slice image]… little leg up here… you already know what it is?...
G: It's a boy... (...)
Dr. Silvio: The fetus moves a lot…it's difficult…the heartbeats…140 beats a minute…[Dr. Silvio quickly shows an image of the face in 2D and returns to the profile. In the image the hand goes to the mouth and just at that moment the doctor, unlike what he always does, changes to 3D]. His hand is in front now… Well, I'm afraid I won't be able to show you… for two reasons. The image is very limited, he moves a lot and is not facing us… He's very small to do 3D. Besides I'd like to explain… 3D reconstructs the image, using computational graphics… to do this I need certain technical conditions… because it's a problem promising something you can't deliver…
G: [Clearly anxious] But he's alright, isn't he?
Dr. Silvio: [Clearly embarrassed] Well…there's a little more amniotic fluid…
G: And is that bad?
Dr. Silvio: No…I'll include this information in the exam results… (Clinic C).

In the precarious stabilization of the technological frame, as we will continue to show, the weight of the participation of each element changes dynamically and discontinuities may occur, but there is also continuity – in this case, the reaffirmation of elements such as the value of technology for the production of truths, the professional's status, the medicalization of pregnancy and the incitement to consume obstetrical ultrasound for pregnancy management.

4) Oracle

An activity that is highly valued by pregnant women and those that accompany them, and which is often instigated by professionals,

is the determination of fetal sex[10]. From there onwards, more than a caption, or a label that highlights part of the image as something that disengages itself from the rest of the body being examined, a Christian name enters the stage and, together with pre-existing notions regarding gender, subjectivizes the fetus and anticipates the 'baby's' social existence, producing a kind of virtual birth for those present at the session. Here one verifies the fusion of sound waves, didacticism, prestige, electronic, visual instruments, theories, family, medical congresses, software, self-esteem, markets, amongst many others, configuring the pregnant woman who arrives for an ultrasonography saying: "*I miss her* [the fetus] *so much*! *It's two months since I last saw her*!" (Woman in the 20th week of pregnancy, clinic A).

The determination of fetal sex is different from other diagnostic issues. In various situations it was possible to observe that the usually much demanded information about fetal sex was used by the professional to create a kind of suspense, provoking the pregnant woman and/or the person accompanying her regarding existing possibilities and desires, or with respect to prior probabilistic information that could be refuted. For example, although in discursive terms Dr. Henrique was critical in relation to exaggerated curiosity and anxiety regarding the determination of fetal sex, it was possible to observe in practice that in some situations he was the one who subtly instigated curiosity.

An attendant hands a file to Henrique, who mumbles: "*Hmmm... last period 12/23... 12 weeks... will want to see the sex...* [grumbling] *I won't see! I won't be able to see, the patient is fat!*" He seems irritated. When entering the exam room, the pregnant woman informs that she has had a circlage and has come to see how she is. The doctor asks her if she has other children. G informs that the first was premature; in the case of the second a circlage was performed and the baby was born "*in the proper time*" (...) Dr. Henrique asks casually: "*So let's see the sex?... the colon [of the uterus] looks fine...*" (Clinic A).[11]

Far from criticizing this kind of curiosity, Dr. Lucia, whenever possible, actually dedicated herself with great enthusiasm to the task of determining fetal sex, whether from a probabilistic point of view – up to the 14th week – or when the formed genitalia could already be seen[12]. Another aspect that was observed involving the revelation of fetal sex, was the moment chosen to provide the information, which revealed a subtle way of exercising of power.

G: [The first images appear] Ah-ha!... [All laugh] Marcos or Lena?... [Looking at the TV] It's almost three weeks since I last did an exam, because of the placentary bleeding. I used to do one every week... (...) [Speaking to Dr. Silvio] Isn't it possible to find out [the sex]?... [Is it] on the right side or the left side?
Dr. Silvio: Now it's on the left side... just in the right position... [Remains silent for a moment]. Let's define this straightaway... this little thing [shows with the cursor] here... linear, is her little wee-wee. (Clinic C).

In such cases the image itself usually took second place and verbal information became more important, reaffirming the doctor's power – strictly speaking the only person authorized to caption the images and provide the much sought after information. The discrepancies observed indicate that in the restricted circle of fellow doctors, the links between the equipment and the theoretically more 'serious' activity of detecting anomalies prevailed, and information about gender was not of much importance. However, in the broader circle of clients, the reference framework was reconfigured to make determination of fetal sex a 'respectable' item. The action of the market element, where the determination of fetal sex can be a more 'spontaneous' mass consumption product (service), can be perceived here. For the doctor-scientist, the body of the pregnant mother is a place that should be minutely observed, and for the doctor-manager, in this case, the inside of a pregnant woman's body is a place of affections.

The early determination (before actual visibility) of fetal sex was highly valued by the clientele. Dr. Silvio gave the observer his reasons for doing this using a scientific-managerial medical rationale:

[He] says that he has a 94% success rate in determining fetal sex 'using' the nucal translucency exam. He informs that he was heavily criticized for doing this by colleagues at a recent medical congress, and a final consensus was reached not to reveal the sex during this exam, "*because of the psychological problems that could be caused by error*". He explains that he started doing this after noticing that pregnant women were 'fleeing' from the NT exam at 12 weeks and leaving it until the 14th or 15th week, when the parameter is not so reliable

as an indicator of genetic anomalies. So he started *"using the early determination of sex as a lure to encourage pregnant women do the NT exam at the right time"*. (Clinic C).

However, what circulated as information among pregnant women was more like the following:

G: Good God! I wouldn't be able to stand [not knowing the fetal sex]… I made an appointment to do the nucal translucency with you because of your reputation… [Corrects herself] It's not that I don't like you… but your past record helped… you did all my daughter's exams… I trust you fully… but your reputation… [The doctor is visibly pleased with these compliments]. (Clinic C).

5) Affections

Another constituent heterogeneous element of obstetrical ultrasound's reference framework are the affections it mediates. One of them, for example, makes the pregnant woman find that what she sees 'is beautiful'. The male and female doctors observed declared explicitly that their aim was to 'improve the mother's relation with her baby', and believed that ultrasound was a good way of achieving this. Dr. Henrique put a great deal of effort into obtaining the pregnant woman's wonder at, and appreciation of this revelation, and, within limits, would take the time necessary to achieve the desired result. He would redouble efforts if the pregnant woman showed little reaction to what she was seeing, or when she was not happy with the images of her fetus which – one may say in passing – were often strange or even macabre. Dr. Silvio did not seem to be especially bothered by this, explicitly recognizing the bizarre nature of certain images and the impact they made:

G: [Clearly disturbed] This picture down here [to the right of an image of the fetus' face, strange], is that his face all squashed?
Dr. Silvio: No… those are the structures in front…
G: I'd rather not see that picture!
Dr. Silvio: Well… I only keep the good photos. I abort when the image is poor… otherwise, instead of being a help, it becomes a hindrance…/
G:/…nightmare…/
Dr. Silvio:/…there are colleagues of mine who find everything cute… (Clinic C).

When patients showed they didn't like the image obtained – usually one of the face – Dr. Henrique, unlike Dr. Silvio, would often focus immediately on other parts of the fetus' body that were less subject to esthetic appreciation, such as the feet, hands, bladder – always shown and named using diminutive forms – fetal sex or the profile, that usually elicited favorable reactions.

Dr. Henrique: Look, how cute…
G: No, I don't think so… That big nose!
After finishing this exam, Dr. Henrique comments with me: *"She found the fetus ugly! That's rare… they always find it beautiful"*. (Clinic A).

The pregnant women's satisfaction also depended on the acceptance of the presence of visitors in the exam room. The latter were often a pretty varied group: partners, grandparents, friends, sons and daughters, including children:[13]

The first images appear on the screen, and when the fetal profile appears the two boys cry out together: *"Look! Look! Just look at her! Juliana! Uhhh!"* Both are thrilled; I'm surprised at how easily they identify the image (…) They keep on watching the screen. While the images are passing, the oldest asks: *"Where is she? She's disappeared?"*, and straight afterwards identifies a new profile image: *"Look! She opened her mouth!!! Hi, Ju! Look!!!! Her little hand!!! Aiii! Bye Bye!"* All the comments reflect what appears on the screen. As we leave the room I remarked on how fast the boys identified the images on the screen, and Dr. Henrique tells me that he has already observed this in other children, attributing this skill to their experience with computers and videogames. (Clinic A).

Pregnant women often become serious and enthusiastic 'students' who are keen to learn about the new visual codes and to acquire medicalized information about pregnancy – an enthusiasm that is levered by pregnant women's affective investment in their fetuses, and enhanced by the images that are translated by the doctors or by the women themselves. This informal learning process evidences a marked reconfiguration of the technology and experience of pregnancy, to the extent that visuality – which in the past was only present in the changes in the 'external' forms of the pregnant woman's body – has acquired an important role during pregnancy. During a session in which the fetus being examined measured 5 centimeters:

[The first images appear, greatly enlarged on the TV screen].
Grandmother [A]: Oh, my God! He's already <u>enormous</u>!
G: [Speaking to A] Didn't you see?
A: [Without taking her eyes off the screen] Just the photo… he's enormous!
P: [Standing up, anxious, speaking to Dr. Silvio] 3D,

do you have it here?
Dr. Silvio: Yes, of course…
G: [Speaking to P and A] You see him just as he is…
A: [Still flabbergasted] He's enormous… just look at that! (Clinic C).

P: Now he has his back to us. Wow! He moves around a lot!... He's already doing somersaults inside there… [The image momentarily becomes more confused].
G: **And now we don't even know where he is...**
Dr. Silvio: [Extracting photos from the machine] Documenting here…
P: [Replying to G's comment] He's in your belly… (Clinic C).

6) Prestige

Another situation in which affections – but in this case on the doctor's side – play a crucial role in the course of a session, occurs when the pregnant woman and/or partner were particularly impressed by the images or the technology and the professional spent longer than usual 'showing the baby', changing to 3D images without being asked to do so, and without charging for this separately, as would be standard practice in an articulation of mutual support with the market element. Changing the type of image shown was the strategy most often used by Dr. Henrique when seeking to impress pregnant women and/or relatives and friends present in the room, who were somewhat listless, and possibly – at the beginning of the ethnographic research – the observer herself. From time to time, as a joke, this doctor would produce interferences in the 3D image, changing, for example, the background color from the usual sepia to blue - in the case of male fetuses-, or to pink for female ones. Another interference consisted of 'cropping' or 'rotating' the image, using the equipment's switches, to highlight some specific aspect or 'improve' the image by making it more intelligible.

Another doctor was particularly sensitive to clients' compliments regarding his clinic's technology and, sometimes, the didacticism included comments about technological progress, or – in the case of clients whose previous pregnancies had been monitored by him –, comparisons between current and past possibilities.

Dr. Silvio: [Speaking to G] Equipment has improved (...) [He compares images obtained from the first machines with current ones]. Today the fetus is studied technically, and for the mother it's easier to understand and less virtual… when your son will see your grandson… I see in the case of my children… I only have only a few photos of myself when I was a child. They... it's very important because it's part of our life… (Clinic C).

The satisfaction of pregnant women with the clinics and their 'loyalty' to certain professionals are significantly characteristic aspects of the universe observed. A doctor reveals: "*I have had patients who said to me: 'You're the one who's my doctor, who shows me my baby, the obstetrician only measures and weighs me'…*" (Clinic A). Though attitudes vary between professionals, a common feature was a kind of complicity between pregnant women and ultrasound doctors:

P: I have a friend who did the exam here with you and was very satisfied... that's why we came…
Dr. Lucia: [Laughing] What a responsibility!
G: [Laughs] It's true... She came here… (Clinic B)

Dr. Lucia: Really? I did your exam only the other day! But it wasn't here, was it?
G: No… it was in the downtown clinic… I'll follow you anywhere... (Clinic B).

The warm and informal way this doctor treated pregnant women certainly played an important role in assuring this 'loyalty'. It was common to for her to come into the exam room with a big smile, and asking: "*How many babies do we have here?*", and being greeted with laughter by those who were in the room. In the other two clinics – besides the doctor-patient contact –, the modern equipment was also an important factor, and this was absolutely not the case in Clinic B.

7) Market

As we hope to have made clear, the heterogeneous element constituted by the market, is articulated with the others to a greater or lesser degree, reinforcing or opposing – always on a provisional basis – the other constituent elements of the technological frame. Generally speaking one may consider that clinic A attends mainly middle and upper-middle class clients, clinic B, middle and lower-middle class people, and clinic C the upper-middle and upper class. This is not a strict division as the socio-economic profile of pregnant women was not researched. The classification was based on observation of the women's clothing and language, besides the location of the clinics. Clinic A was located in the city's West Zone, an ascending middle strata area, clinic B in the North Zone, where lower income groups live, and clinic A was located in the South Zone, an up-market area of Rio de Janeiro. In clinic A, exams lasted an average of 20 to 30 minutes; in clinic B, between 10 and 15

minutes, and in clinic C exams took 40 minutes to one hour.[14] The market aspect could be perceived in the fact that those that pay more expect to receive a better level of service. On the other hand the loyalty of pregnant women to a doctor articulated by prestige acts in certain configurations against a market mechanism that considers that the relation between doctor and clinic terminates after each exam has been paid for. In the three clinics professionals were remunerated according to their 'productivity', which means that the less time they spend performing the exam the more they earn. This arrangement highlights the importance of everything that occurred during the exam over and above the strict ultrasound diagnosis.

8) Media

The media acts strongly as a constituent element of the technological frame, publicizing and promoting fetal ultrasound as an indispensable exam in the monitoring of pregnancy. During the period of observation, two articles about ultrasound in pregnancy were published in different magazines specialized in pregnancy/children, and each one focused on one of the clinics – B and C – in which the ethnography was being developed. The article about clinic B focused its headquarters, which had more modern equipment than the branch that was being observed. In both articles there were photographs of the doctors, a pregnant woman and the equipment, and the text included declarations of professionals that worked in the respective clinics. Clinic C had a press officer, as revealed by the statement of accounts fixed to the notice-board. Programs about various types of pregnancy and birth – from the most 'natural' to the most technologized – are often shown on television. Another source of information for pregnant women is the Internet, to which most of them – at least from clinics A and C – probably had access. The media has a robust relation with the market. That is, so-called 'scientific' information, put into circulation outside more controlled circuits where scientific knowledge is constructed, but usually without being objected to by these circuits, is 'marketed' to the general public and become common currency in the ethnographed universe.

An effect that is worthy of note, and results from the reinforcement links between didacticism and the media, consists of the fact that in the three clinics, the pregnant women, in the great majority of cases, arrived to do the exams already informed about them, requesting explanations that showed that they were relatively knowledgeable about what they could offer. Publicizing this kind of information contributes significantly to strengthening the perception that pregnancy is a 'medical matter', supported by high technology or, in other terms, to reinforcing pregnancy's medicalization and 'technologization'
.

9) Pathology

Although strongly stimulated by professionals, as we have already observed, the didactical procedure and its result – the 'visual socialization' of the pregnant women or their relative and friends – were not always comfortable. As we have already commented, anomalies, for example, enter the scene in opposition to didacticism. They strengthen the divisions that engender a controlled space of access that is a stronghold of specialists. The level of tension in the room rose considerably when pregnant women were able to perceive the existence of a pathology and inquired about this before the professional had found a suitable way to communicate this fact. The few moments of this kind witnessed by the research were extremely difficult for both parties – clients and doctors, and also painful for the observer.[15]

But this does not mean that the actors always respect the boundaries of the controlled spaces that anomalies and purification (analyzed below) tend to erect. The emotional support provided by the ultrasonographer, that, in difficult situations, abandoned the specialist's space in the past, was mentioned by more than one pregnant woman, returning with a new pregnancy:

> G: I did the exam with you during another pregnancy... I wasn't very lucky... at the time you said something that comforted me a lot... that it was a seed that would not grow…
> Dr. Silvio: When things don't start well... it's good to have a second chance... (Clinic C).

10) Purification

The heterogeneous element constituted by purification[16] – the setting up of a controlled place/scenario as a privileged locus for the construction of scientific knowledge – the laboratory – acts in the technological referential framework in articulation with the other elements. We highlight the equipment, congresses and the exam reports. The equipment juxtaposes the elements that assure the controlled replication of inscriptions (images). The production and consolidation of ultrasonographers' credibility with obstetricians is engineered in part through clinic professionals' presence in congresses, the publication of obstetrical ultrasound manuals and their participation in professional associations, and in the daily routine of clinics, when

communication by telephone occurs between the ultrasound specialist and the obstetrician – both in cases in which anomalies are found and also to confirm normality in cases where the existence of problems was suspected. An articulation involving purification that deserves special attention is the writing of reports. This is a task on the border between the reclusive or laboratorial space of the specialist and the practice of life's infinite open space, that occurs in the interface between the purified images (hard, obdurate) images of the ultrasonographic devices and their captions. The great majority of pregnant women read the report that is delivered together with the photographs taken during the exam. The information it contains should be set out in such a way as to inform the obstetrician about findings that may be worthy of medical attention and, at the same time, not alarm the pregnant woman excessively who, certainly – especially in cases in which there is some preoccupation or suspected anomaly – will read the report. Another element that may be taken into consideration when writing the report, is the possibility of inducing the obstetrician to perform a cesarean section, which is strongly criticized by some of the professionals observed.

With a little bit of theory

Actor-network theory undoes the epistemological division that creates and separates the modern categories of Nature ("things-in-themselves") and Society ("men-amongst-themselves")[17] that underpin the currently popular and still dominant idea of "scientific objectivity", making way for a new understanding of different areas of knowledge, especially scientific and technological knowledge. We have presented a list of heterogeneous elements and relations that constitute a technological frame. The heterogeneous elements that we presented above are forms that configure themselves and are configured, in this case, by those who speak and write, that is, by the researchers.

These elements are also *propositions*[18] that will be modified, accepted or not, by the other heterogeneous elements of the network or, more precisely, of the actor-network that is called "obstetric ultra-sound technology in Rio de Janeiro at the turn of the century." A *proposition* or a configuration is an action that allows for pointing, detaching, denoting and nominating an entity, that is, discovering, inventing, creating, constructing and turning a form into an element about, and with which, one can speak or write amid the flux where there were no previous forms. A *proposition*

or a configuration may become *obdurate* as a (provisionally) stable entity, or not. Each of the elements that we have configured below is not a property of some fundamental essences, be they of the bodies or of the souls, but instead each element is a mediator of the heterogeneous juxtaposition itself, of the proper assembly of things[19] – provided that the assembly lasts, of course. Above, we have presented ten heterogeneous elements detached / configured / proposed as we intermingled with ultrasound, physicians, fetuses, pregnant women and their accompanying parties in Rio de Janeiro in 2003: equipment, didacticism, assurance, oracle, affections, prestige, market, media, pathology, purification. These elements, as we hope to have made clear, are not completely arbitrary or undefined, but neither can they be defined with increasing precision on their borders, and they certainly convey the effects of our choices. They might even be others, and very likely would be different, if the researchers were different. They are not unique and even less determined. These elements are propositions, candidates to entities, which we have detached and created to propose an "empirical ontology,"[20] that is, to populate with entities (facts, objects) a world or a reality where there are no previous forms (entities, facts, objects), in this case, the world of "science-technology-society-Rio de Janeiro-turn of the century," starting from the practices that we have met there. These elements are provisional. They have been proposed to talk (and write) about the flux and to situate ourselves in it. However, we intend to show these elements can, starting from the fragile propositions in this article, become robust and modify themselves through *translations*, and, undertaking these transformations, obdurate themselves sufficiently to constitute at least the greater part of a collective including not only researchers, readers, pregnant women and their relatives and friends, but also cells, fetuses, light, semiconductors, electrons, take them as *articulators* and *localizers* (Latour, 2005:193) in the constitution of a complex unity that we have here denominated obstetric ultrasound technology in Rio de Janeiro at the turn of the century. As this list unfolds, the heterogeneous elements also establish links and articulate themselves in a heterogeneous way, constituting a technological frame in which ultrasound stabilizes itself provisionally as an indispensable artifact in pre-natal monitoring. This technological frame and obstetrical ultrasound in Rio de Janeiro in 2003, consubstantiated themselves.[21]

Final comments

Based on ethnographic material produced by observation in private imaging clinics in Rio de Janeiro, we discussed how obstetrical ultrasound established itself in the city in recent years. Adopting an actor-network approach, we described a framework of heterogeneous elements that imbricate dynamically in constantly reconfigured relations that are also heterogeneous and dependent on the here and now of each action. We sought to clarify that: 1) the obstetrical ultrasound technology in Rio de Janeiro that we focused on cannot, as an actor-network, be distinguished from this dynamic and complex framework that is permanently reconfiguring itself; the framework and the technology are the 'same', so to speak, the same actor-network – they consubstantiate themselves; 2) although in a state of permanent reconfiguration in each place and moment, this framework has sufficient continuity for a complex unit (paraphrasing John Law – 'a unit that is more than one and less than many') to be provisionally accepted with a relative degree of consensus and be called obstetrical ultrasound, a 'unique' entity that spread, constructs reliable knowledge and has become indispensable in pre-natal monitoring in Rio de Janeiro.

Finally it should be emphasized that the narrative we present is not, nor does it intend to be, neutral. Neutrality, as a concept based on an illuminist conception of techno-science, is a practical, theoretical and methodological impossibility. Ultrasound technology, in any of its countless (re-)configurations, contains decisions, choices and options (inseparably technical, economic and political) that its constituent elements, everything and all those that constitute the heterogeneous elements exercise, independently of questions of conscience. And we also, the authors, take decisions and make choices in the 'translation' of obstetrical ultrasound that is found herein, just as you, the reader will have contributed your choices when reading this text. We are part of it. All knowledge is situated (HARAWAY, 2000). It is no longer possible to maintain the "God's eye trick" until recently practiced by an all-seeing science that was seen by nobody.

Notes

R. ERRATA: The Editors apologize for versions other than this, the final one, that were published from December the 30th, 2009, to March the 1st, 2010. We appreciate both the authors' and readers' accurate, mindful contribution, which kindly helped us to identify and correct our mistake

1. The authors are grateful to N.C.E. – Núcleo de Computação Eletrônica da U.F.R.J. for its support to this work. Former versions have been presented at the XIII Congresso Brasileiro de Sociologia, VII RAM - Reunião de Antropologia Mercosul, and at the 4S Conference in Montreal, 2007. We also thank the anonymous referee for the useful coments.

2. All names in the examples given are fictitious. Actors' emphases are underlined; authors' emphases are indicated in **boldface type**. Crotchets are used to indicate actions or the observer's comments. The ellipses correspond to pauses in the actors' speech, and the ellipses in brackets show where material has been edited. In the text double inverted commas and italics are used when speeches are quoted, and single inverted commas when the inverted commas are the authors'. In the dialogues we use 'G' to indicate 'pregnant woman' and 'P' to 'partner'.

3. In this thesis the constitution of the fetal person in the course of obstetrical ultrasound exams was studied using the Anthropology of the Person (MAUSS (1938 [1974])) as a theoretical basis.

4. For a presentation of the 'the new directions proposed for the sociology and history of science' since the 1980s see (BIJKER et al., 1987; BIJKER & LAW, 1992). More specifically for actor-network theory, see (LAW & HASSARD, 1999; LATOUR, 2005).

5. The same as probe.

6. One can see that the State is also a constituent heterogeneous element of the technological frame.

7. Nucal translucency (NT): Measurement of a pleat of skin of the nape of the fetus' neck. This exam is carried out between the 11th and 13th week of pregnancy, and together with the measuring of the nasal bone, is the one that generates the most expectations in terms of assessing the risks of the existence of fetal anomalies. The alteration of these two parameters provides a probabilistic indication, which when combined with the risk posed by maternal age, produces an index which represents the rate of risk of that fetus having an anomaly. This rate, compared to the rate of risk of abortion caused by complications arising from the amniocentesis exam, is presented to the pregnant women so that they can decide whether or not to be submitted to this procedure – which is more invasive, and therefore risky, but offers a more precise assessment of chromosome anomalies.

8. In a city, such as Rio de Janeiro, of a country,

such as Brazil, which lives the reality of the so-called "technological dependence" on the countries of the O.E.C.D., it is maybe more difficult to see how changes in habits and customs (said to be social) may travel upstream in the construction of technological artifacts to the point of modifying not only the design of equipments but also the basic theories that support determined technologies or sciences, besides the values and judgments of a collective of humans and machines. It is perhaps an irony that technological dependence established itself in Brazil in alliance with techno-scientific determinism (MARQUES, 2005). However, since equipments and theories in general arrive to be disseminated in Brazil in their already obdurate forms, or at least in forms that are quite more stable than they had previously been in the O.E.C.D. countries where they are usually configured, one can intuitively see how the idea that equipments and theories are techno-scientifically determined can travel further in Brazil than in those countries. The so called techno-scientific determinism is an illusion that stems from the diffusion model of technology, which opposes the translation model. To go further into this issue see publications in the field of Science and Technology Studies, STS (which denotes also science-technology-society), specially Bruno Latour's books (many of them in Portuguese) and his articles, and also those of Michel Callon and John Law. About the body, see especially (MOL, 2002; LATOUR, 2004).

9. A congenital anomaly popularly known as 'leporine lip'.

10. Curiously, amongst themselves doctors strongly criticize this concern. In practice, however, it has been observed that they were the ones who often instigated this curiosity in various ways, a theme that is beyond the scope of this article.

11. Fat absorbs part of the sound waves, resulting in less clear ultrasound images. Circlage is a procedure that consists putting a stitch in the cervix to avoid miscarriage or premature birth.

12. The determination of fetal sex without a margin of error is possible at around the 16th week of pregnancy. In exams that are performed between the 12th and 14th weeks the success rate varies between 70% and 94%, depending on each professional's account, as we shall see below.

13. Given the chaotic situation that often prevailed, it was surprising just how little doctors seemed to get irritated with these situations. During the period of observation, professionals were perceived to be discretely annoyed by this during the exam on only four occasions. They had possibly resigned themselves to the fact as being 'part of the job'. However, after particularly chaotic sessions, it was common for them to complain with the observer about this in no uncertain terms.

14. The exam took much longer in the case of twin pregnancies. In the case of triplets or quadruplets the exam was divided into two separate sessions that took place on different days, in order not to tire the pregnant woman and doctor too much. In Clinic C there were a greater number of multiple gestations than in the other ones.

15. A tense atmosphere was usually related to some existing or potentially unfavorable diagnosis, although this could also be caused by arguing couples. Excessively listless pregnant women - who did not behave as expected, and thus did not fit into ultrasound's consolidated framework– also provoked a reaction, especially on the part of Dr. Henrique, who began to use various resources of the equipment until obtaining some kind of favorable response – that could be in relation to the fetus or the technology itself.

16. For a more complete discussion of this term in the context of Science and Technology Studies see Bruno Latour's books, especially (LATOUR, 1994).

17. For a development of this point see (LATOUR, 1994).

18. In this paragraph we use the words *proposition*, *obdurate*, *entity*, *mediators*, *articulators*, *localizers*, *collective*, and *translation* as in (LATOUR, 2005).

19. "Things" are always hybrids of nature, society, and discourse, if we momentarily recline on the modernist grammar.

20. The expression "ontological politics" may be credited to John Law (1992, 1994, 2002, 2004) and an exemplary work on "empirical ontology" concerning "the way in which (Western, cosmopolitan, allopathic medicine deals with the body and its diseases" can be found in (MOL, 2002). Still on "ontological politics" see also (MOL, 1999).

21. Heterogeneous elements do not suppose an essence. For the actor-network approach one may say that essence is existence and existence is action, and in this sense actor-network theory creates an ontology.

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158

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