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Situated Neuroscience: Exploring Biologies of Diversity

Gillian Einstein, PhD
University of Toronto

ABSTRACT

In this chapter I describe how exploring the neurobiological effects of an East-African rite of passage, female genital circumcision/mutilation/cutting (FGC), required a feminist approach to understanding the corporeal body and because of this allowed an exploration of embodied effects of this tradition. The focus of my project was on the lived lives of women who have undergone FGC and on the whole body effects of the practice (rather than just the effects on the reproductive system). By studying what is widely considered a human rights question, and by involving Somali women, themselves in order to better understand the context for their FGC, I gained a fuller picture of differences between women's bodies as well as how culture is embodied. In addition, context, reflexivity, situated biological exploration, and ethics took seats at the head of my research table. The result allowed me to open up areas of neuroscience about which the neuroscientific community is vastly ignorant, which importantly includes, the adult female nervous system. The research also opened up new neuroscientific questions as well as allowed re-exploration of questions previously thought answered. In sum, the project provided corporeal evidence for an ever-changing organism and a post-Cartesian view of the body. 'Guideposts' for feminist practices are proposed. Findings from diverse areas of neuroscience provide evidence for the contention that understanding the nervous system both requires and supports a situated approach.

“I think...that we are at the stage when we can just proceed with the project, rather than having to defend it.” (Longino 1992, 338)

PROLOGUE

From the late 1980s to the late 1990s there was a concentrated activity around feminist philosophy of science and the question: could there be a feminist science? (Richardson 2008). During that period, there were exhortations for a replacement of androcentric values with feminist values (Harding 1991) and a replacing of the Kuhnian values for interpreting underdetermined knowledge with feminist ‘virtues’ which assumed a contextualization of any scientific experiment. One important problem with which early feminist approaches to science were concerned were certain assumptions within the methodology, itself. Harding, Longino and others were concerned that if the ‘scientific method’—as in setting out to falsify one’s hypothesis, reducing variables, objectifying oneself and the studied, and producing generalizations that outstrip one’s data based on some epistemological set of values—was not followed, then what resulted would not be science (Harding 1987). More specifically, Longino’s feminist virtues have not been used explicitly by practicing neuroscientists to date, although Sarah Richardson nicely makes the point that when feminist perspectives are used explicitly—as in the research on human sexual differentiation, they can become an important epistemic resource (Richardson 2008).

What has gone forward are trenchant analyses of masculinist science: Barad and physics (1999), Fausto-Sterling and sexual differentiation (2000), Martin and developmental biology (1991), Haraway and immunology (1989), Weasel and immunology (2001), and Wilson and neuroscience (1998). Each has had their own approach, critique, and reinterpretation of the science using feminist approaches. As well, feminist philosophy of science has created a kind of ‘feminist empiricism’ which takes for granted certain research practices and demands that feminist principles prove their effective interaction with the research question at hand (Rouse 1998.) As well, philosophical movements of the last 30 years have subtly been changing what it is to be *interpreted* as science—as has science, itself. Thus, while feminist approaches trouble the idea of classic science—the science one tends to think of when envisioning a classic physics or chemistry experiment—so do many of the current investigations in biology. Thus it is worth exploring whether an explicitly feminist science research program could now go forward as well as of what that might consist.

At the heart of science is the idea that a hypothesis is tested by an experiment designed to disprove the hypothesis by an ‘objective’ observer. This is the ‘scientific method,’ writ large. As Elizabeth Grosz (1986) suggests: “...the conventional assumption that the researcher is a disembodied, rational, sexually indifferent subject—a mind unlocated in space, time or constitutive interrelationships with others, is a status normally attributed only to angels.” (199) Rouse in his review of developments in the history of science in the 20th century writes that there has been within the philosophy community a contemporary widespread rejection of any pre-assumed scientific methodology “...in favor of some form of epistemological naturalism.” (Rouse 1998, 85). By my reading this means that even in the history and philosophy of science which has traditionally defined the theoretical values of the scientific endeavor, ‘good’ science doesn’t rely on a fixed, theoretically based method and the assumption of objectivity, which is impossible to obtain, but adapts the scientific method to the natural problem at hand.

For example, consider any test of a new drug for breast cancer. The constant is the drug and the variable is the cancer. If a potential user group is women of reproductive age then ‘the problem at hand’ requires that the test consider at least four phases of the menstrual cycle (Becker et al., 2005). If a potential user group is pregnant women then the treatment must be tested over nine months of pregnancy. And to achieve a closer approximation one might also want to consider physiological variation with circadian rhythms. Would it, in fact, be good science to not take all this variability into account given the population for which the drug is intended?

The emerging complexities as well as new epistemic developments of each science subspecialty have encouraged a once relatively unitary philosophy of science to subdivide and engage in the particularities of each field. Indeed, the history and philosophy of science has moved from judging an empirical endeavor by the classical picture of physics as science to the particularities of the underlying epistemic structures of different areas of science. Rouse remarks that the project of philosophizing about science as a whole is no longer viewed as useful to the field. In fact:

“The field has grown so rapidly since then that for many philosophers of biology in the United States today, their principal intellectual community consists of biologists and historians, sociologists, and other philosophers of biology rather than philosophers of science in general.” (Rouse 1998, 79)

Thus, a new philosophy of science might allow each field and subfield to have their say, move in their own directions and dictate their own theory. This would mean that neuroscience as biology doesn’t have to be held to the accounts of physics as the ideal in science. On this view of neuroscience then there can be rejection of

“...determinism, intertheoretic reductionism, and essentialism about natural kinds. The world includes multiple kinds of things, which cross-classify. The same things are subject to multiple descriptions, while the discernable regularities at “micro” levels of description are only contingently relevant to whatever regularities are manifest at more macroscopic levels.” (Rouse 1998, 109).

While “quantitatively precise causal regularities” are still important, causality also encompasses a probabilistic causality and it is “...a “promiscuous” realism of multiple and intersecting objectified divisions between natural kinds. Thus, some philosophers of biology even deny the plausibility of causal completeness as an epistemic ideal (Rouse 1998).

So by this approach, even in the philosophy of science, feminist approaches that encompass politics, responsibility, context, variability, diversity, difference—situatedness, are, indeed, good science.ⁱ

Another foundational concept in classic science, the Duhem-Quine thesis, is that hypotheses are underdetermined by the evidence. That is, it is not possible to completely verify or disprove a hypothesis on the results of one or even a series of experiments. All a theory can do is bear on the results relative to the society of the group within which it belongs. Thus, scientific communities make choices about what data they are going to believe or not, often unforced, although supported, by the evidence presented (Rouse 1998). Thus it’s the epistemic community that judges how good the evidence is and based on that, how good the theory about it is. This perspective becomes critically important when considering evidence gleaned by

feminist approaches. Some will be acceptable to the general epistemic community; others may have to wait until there is a critical mass of scientists using these approaches, which may form its own epistemic community as well as change the playing field of other communities. Ultimately, however, their acceptance will depend on whether or not the scientific community to which it belongs accepts the evidence.

Interestingly, this has already happened in some scientific epistemic communities. Richardson chronicles how feminist ideas of gender have in fact infiltrated the epistemic community of biologists who study sex determination and how this, in turn, has modified their playing field. Geneticists studying sex determination have admitted to how wanting a reduced theory has clouded their thinking. They are aware that sexual differentiationⁱⁱ in females might not simply be due to an *absence* of testis determining factor located on the SRY gene of the short arm of the Y-chromosome—or ‘default pathway’ as it has become known. In fact, the reason we have not identified ‘agency’ for female sexual differentiation is because the female pathway needs further study. In other words, sex determination for XX and XY may not just be a matter of the presence or absence of a genetic switch. She quotes Reed and Graves’ introduction to the conference volume:

“[W]e are gradually getting *an uneasy feeling* that [the genetic switch being on the Y-chromosome] is flawed. The history of studies of sexual differentiation exemplifies the truism to “seek simplicity, then distrust it.”...[We] were *not prepared* for the ambiguities and difficulties that would follow in trying to interpret the role of SRY in aberrant phenotypes...” (Richardson 2008, 29)

As well, a number of key geneticists are beginning to acknowledge that there is no simple definition of sex—that there are diversities of human identities and practices within which models of sex need to be *contextualized* as well as with phenotype and identity. One scientist goes so far as to say that he has realized that sex is on a spectrum. Richardson attributes this sea change in perspective to: 1) activism from outside the field; 2) the authority of a practicing geneticist who is feminist; and 3) the data, themselves (Richardson 2008).

Critically important is to have theories that match the entity under study. Rouse points out that

“*Mechanics, astronomy, anatomy, and pneumostatics enjoyed unprecedented success beginning in the 17th century not because scientists finally began to do experiments, observe, and abide by the results, but because they happened upon theories to guide their research whose terms actually matched up reasonably well with the entities that were causally efficacious in the domains they studied.*” (Rouse 1998, 82)

This raises the important point that to study a constantly changing biology, such as women’s during their reproductive lives, using static methods is not properly aligning the approach with the nature of the ‘kind’ under study. Questions must dictate methodologies. Thus, methodologies for studying women’s biologies must be such that they can reflect change, variation, and the particularities that a given question might encompass. P.B. Medawar recognized this about biology, in general, as early as 1969:

“*Biologists work very close to the frontier between bewilderment and understanding. Biology is complex, messy and richly various, like real life; it travels faster nowadays than physics or chemistry (which is just as well, since it has so much farther to go), and it travels nearer to the ground. It should therefore*

give us a specially direct and immediate insight into science in the making.”
(Medawar 1969, 1)

Taken together, while early feminist inquiry into what a feminist science would be did not result explicitly in the feminist doing of science, it did go hand-in-hand with changes in science and the epistemologies of science, which changed the playing field substantially enough that alternative approaches to science are now within the epistemic fold. This opens the gates substantially wide for feminist approaches to be brought to bear on projects taking an empirical approach.

INTRODUCTION

Doing a feminist neuroscience

This then raises the question of what it would be to *do* feminist neuroscience?

In order to tease apart the various strands of this question what follows is an account of a project to understand the neurobiological effects of female genital circumcision/mutilation/cutting (FGC), a traditional North east and west African ceremony that in its most extreme examples requires excision of the clitoris (Clitoridectomy), cutting off the labia minora (Excision), cutting the labia majora (Excision) and suturing the labia majora together to make a small hole from which urine and menstrual blood can flow (Infibulation) (WHO 2010, WHO 1998). The project was approached from an explicitly feminist perspective asking what it would be to do neuroscientific research that would be commensurate with feminist epistemologies. To my mind this would be research into the nervous system that would give voice to areas of research previously silenced, uncover pockets of ignorance—not just ‘knowledge gaps’, turn expectations about the essentialism of biology on its head, and contribute meaningfully to women’s lives in all their varieties: a short agenda.

Taking to heart Sandra Harding’s view:

“Thus meditation on the method question in feminism leads us to the recognition that feminism is fundamentally a moral and political movement for the emancipation of women. We can see now that this constitutes not a problem for the social science and biology that is directed by this morals and politics, but its greatest strength.” (Harding 1987, 30)

And PB Medawar’s admonition:

“If politics is the art of the possible, research is surely the art of the soluble.”
(1969, 97)

And, Harding’s conclusion:

“The search for a distinctive feminist method of inquiry is not a fruitful one.”
(Harding 1987, 30)

I asked the question:

Are their neurobiological effects of the traditional practice of Female Genital Circumcision/Mutilation/Cutting (FGC)? My hypothesis was, yes there are (Einstein 2008). Furthermore, the result of the involvement of the central nervous system (CNS) would be to

embody the tradition affecting the way women with FGC walked, carried themselves, and generally, experienced the world through their bodies thus, in effect, embodying their culture. I wondered specifically if the purpose of the tradition was to instantiate a corporeal difference in the CNS between male and female that wasn't present without the procedure.ⁱⁱⁱ

The challenge was to devise an experimental paradigm that would lead me to at least, a partial answer—or enough understanding that I could in good faith, design further experiments—or not.

The research project

FGC has been highly contested as a human rights issue and a feminist cause (Obermeyer 2005). It has been most commonly studied either from the ethnographic or the biomedical perspectives. When studied biomedically, the focus has been on reproductive health (WHO 2006, Obermeyer 2005).

Ignorance: No one had approached the repercussions from a neurobiological perspective, which is surprising because nerve and muscle are being cut—in fact, one could view it as an amputation. Using neuroscientific understandings of the plasticity of the adult primate nervous system, and the roles of experience and steroid hormones to effect that plasticity one might expect that cutting the genitalia would have long lasting, whole body effects via central nervous system (CNS) rewiring. From this perspective, one would expect antero- and retrograde degeneration of nerve pathways, possible nerve sprouting, and changes in somatosensory cortex which would lead to potentially chronic pain, referred sensation potentially to the leg and foot, and phantom clitoris (Einstein 2008).

Oppose the essentialist body: Such neurobiological changes of the genitals would also lead to experiential changes affecting the sensation of touch on different body regions, the sound and sense of peeing^{iv}, how one walks^v, sits and carries oneself. These experiential changes would then become instantiated as the 'normal' (and perhaps, desirable) body. Changes to the central nervous system would also have the effect of making it very difficult, at least in context, of imagining any other way of being.

Contribute meaningfully to women's lives: Toronto is home to upwards to 200,000 Somali-Canadians, a demographic fact, which made pursuing the neurobiological repercussions of FGC possible. Somalis still practice FGC in their natal land with upwards to 98% practicing excision and infibulation, which they call, Pharonic circumcision. Therefore, I could assume safely at the outset that any Somali-Canadian woman who had immigrated to Canada would have Pharonic FGC^{vi}. These numbers made it possible for me to restrict the 'experiment' to one cultural group^{vii} practicing the same form of body modification for the same reasons and roughly at the same age.

Since I would be relying on the Somali community to participate, before designing or planning an experiment, I wanted to find out if members of the Somali community who had FGC thought this was a salient question. So I went to a talk by an Somali activist midwife in the Toronto Community, told her my idea, and asked her what she thought of it.

Did the idea of pain and referred sensation ring true to her from both her own experience and the experience of other Somali women?

She leaned in closely while I explained what I thought might happen, listening very intently, and a look of recognition flooded her face and physical expression. Leaning toward me she said that

she thought it was a very interesting idea and that she, herself, had chronic leg pain that worsened in cold weather—to me one of the possible signs of neuropathic pain as a long term outcome of FGC.

I then talked with a colleague who does community-based research (CBR) with the Ethiopian and Tamil communities in Toronto about how to make contact with the Somali community more broadly. This led to a meeting of three Somali community health workers at a Toronto community health centre. I described my ideas to them and asked their opinions. They all had the same intent expressions as the previous activist and one reported that she, too, had leg pain. As did the activist midwife they felt it was a valid question that could have important findings for their Community. They especially liked the fact that it focused on their brains and not their genitalia and felt that the question of chronic pain was particularly important. They agreed to help design the study as well as to recruit participants for the study. Their response, stories, and willingness to help were validating—a far different feeling than having one's colleagues affirm that one's project is the next logical step.

These three women plus the original woman I had consulted became my community advisory board (CAG), continuing partners in the study even after giving it the intellectual 'green light.' The CAG was the critical component of the study's success because without this group I would have had a paltry understanding of the perspectives with which participants came to the study. Without the CAG as interpreters (figuratively and literally) it would have been very difficult to square my own understanding of the corporeal consequences of FGC with the important meanings that FGC held for them. For example, even in a culture that decried the tradition (Canada), many women still felt it carried social capital. As well, all felt it made them more beautiful. However, they were also curious as to what it was like for uncircumcised women. One member of the CAG in a joking moment even told me that I was not very generous and why wouldn't I lend her my clitoris for a few weeks?

Choose methods that adequately reflect the intricacies of the question: Since at the time I began there was no physiological literature indicating that the CNS of women with FGC might be affected, it seemed to me that the first step was to demonstrate that there might be changes. I set out to gain by **external** methods whatever evidence I could that the CNS might be affected.

But how, *from the outside*, could I determine that there might be nervous system effects *inside*? Here are some of the ways I thought about:

1. I could ask participants directly;
2. I could administer standardized instruments;
3. I could carry out neurological tests of function or thresholds of sensation.

Given that I was: 1) outside the culture; 2) asking about a tradition that had been portrayed as shameful to discuss; 3) relatively certain from my reading that although there is a word for pain in Somali, it referred to sickness so great that one would be incapacitated; and 4) most people feel it is important to convey themselves as healthy, competent and strong to those in power I decided to use all three approaches.

One was qualitative from the first person perspective and would hopefully tell me *what it is like* for them. One was a third person perspective, quantitative and standardized to reveal a mean across a population—or, *how it appears*. The physiological measure could be either depending on whether it was averaged across a population or compared to the other two accounts of the same person. When used non-quantitatively, the

physiological measure could be thought about as allowing the body to speak and as such, was also first person. I hoped that triangulating what I learned from each approach across individual women would provide insight about the individual repercussions for each participant. This juxtaposition of methods across individuals was the paradigm for the study.^{viii}

Engage in reciprocity: Every aspect of the study design was reviewed by the CAG, from the issue of pain and referred sensation to all of the instruments—qualitative and quantitative. Some instruments, such as those used to assess sexual trauma, were thrown out (even though grant reviewers asked for them) because the CAG felt that since parents had sacrificed mightily to obtain circumcisions for their daughters and did it out of love, questions suggesting sexual trauma would be offensive to participants. Some instruments were modified because they were too wordy or unintelligible. We spent many sessions going over visual aids that a biomedical illustrator had made in order to have inoffensive images of the body only to throw them out because we were finally informed that, “Somalis like to talk.” Others were deemed fine and we went forward. We threw out the idea of having a ‘thorough’ neurological work-up both because it would add too much time to the quantitative session, already two hours long.

All the chosen approaches were pre-piloted on members of the CAG and modifications made based on their relative failure and success. Through this piloting I decided to throw-out the semi-structured interview and substitute a fully qualitative interview because the semi-structured version did not allow women to tell their stories in a way that did justice to the stories themselves. Through this exchange of ideas I also learned that while at the outset I hadn’t wanted to pathologize FGC by making the study about pain, what was important to the CAG was for us to focus more on pain than on overall bodily sensation. Because pain is so culturally dependent, it became apparent that it was important to give the body a voice as well and to explore how different narratives about pain aligned.

The study design

After discussing, testing, and revising instruments with the CAG, I piloted the paradigm on three members of the Community. After some further modification I went forward with recruitment and the two sessions, qualitative and quantitative interviews, for fourteen participants.

Each participant was invited to come to one of the GTA community health centers, ordinarily providing services to Somali-Canadians. The first session consisted of a qualitative interview in which they were asked to talk about their circumcision, their current daily lives, and in what parts of their bodies they felt pain or pleasure, sensitivity or numbness. They were then invited back for a second session in which they were asked about their medical history, given some questions about pain, and participated in a physical exam for pain of the vulvar region. They could come back for the questionnaires without being physically tested and half the women did. The other half also consented to what is called, ‘quantitative sensory testing’ (QST) of their external vulvar region. The QST made it possible to determine each individual’s threshold to pain at four regions of their vulva. We learned some important, and probably generalizable neuroscience from the study that will take us further in asking deeper questions about how the CNS is affected by other corporeal modifications and plays a role in the embodiment of culture.

Note that from a classic scientific perspective, the study design has two limitations: 1) there is a serious disconnect between the numbers usual for qualitative studies and those required for quantitative study^{ix} and 2) there was no control group.^x I dealt with both of these by analyzing all the data as a within subjects design.^{xi}

Study findings

My study found that women who have had FGC do have experiences and test results that suggest that the practice does have effects on the nervous system and on the body as a whole. These include: 1) referred sites of pleasure with the breast and neck being the most pleasurable part of the body for many women; 2) regular times of extreme exhaustion—perhaps one might even say, pain—around their periods when they might not be able to pick up their children and/or be in bed for a week; 3) many sites of pain on their bodies—backs, abdomen, and legs—with McGill pain ratings on a scale of 0-10 of five or higher; 4) regions of their vulva with pressure-pain thresholds as low as those of women who avail themselves of vulvar pain clinics. These physiological findings were embedded in the daily lives of the study participants. For example, with these corporeal manifestations women continue to lead extremely busy lives—up at dawn and not in bed until after 11 PM. They described taking care of their families and often working outside the home. In the face of being acutely aware of their new country's perspective on their bodies and the tradition they embodied, most participants were proud of what they had endured for their culture. Some even wished they could give it to their daughters although they had no intention of doing so. Most also said that they will never forget their circumcision and that it was the most painful experience they have ever had. Being currently citizens of a country in which the medical system was not set up to deliver babies from bodies like theirs, many had faced an ignorant and at best, insensitive, medical system during one of their most vulnerable life moments highlighting their embodied cultural differences.

When pressed, most describe aches and pains and some, periods of weeks around menses when they were in such pain that they went to bed and it hurt to pick up their children. Like other researchers, we found that Somali women in Diaspora who have FGC have pain-filled narratives (Johansen 2002, Tiilikinen 2001, Einstein unpublished results). For example, those immigrating to Finland characterize it as painful to wear so many clothes in the winter and to walk on ice (Tiilikinen 2001)^{xii}. However, my study's participants regularly brushed off the importance of their pains and stated that they are in good health and feel that these aches and pains are normal. They did not have an illness identity. It would be difficult to describe any of the fourteen participants as having post-traumatic stress in the sense that while they will always remember the event of FGC, it is not an intrusive memory. Finally, while no one reported having vulvar pain, when I carried out quantitative sensory testing of the vulvar region on a subset of the women, all had regions of the vulva with extremely low pressure-pain thresholds that were commensurate with those of Canadian women who sought medical help specifically for relief of vulvar pain.

Thus, in their physiologies and their attitudes toward them, the participants of my study had embodied their culture.

EMERGENT PRINCIPLES

I found that unlike some studies, this study required constant, reciprocal interaction with participants as well as a constant interrogation of my methods and what I was learning in a more iterative fashion than is standard practice in a scientific experiment. Thus in addition to 'experimental' findings, there were also some research principles that emerged. I suggest that these might be helpful for further pursuit of a 'feminist' neuroscience.

New approaches can be made out of 'old' methods

I did not set out to develop new methods but because I wanted to know how women with FGC felt both socially and physiologically about their FGC, I had to develop my own approaches to studying it. Since I was triangulating between methods, I also felt strongly that each method should follow the standard in its own field as closely possible. This required collaboration with experts in those methods from other fields as well as a constant checking of the data to ensure that it is being collected and analyzed in a way commensurate with each methodology. But it also means that one field (i.e., social science) is not subordinated or used in the service of the other (i.e., biological science) and especially, that one isn't privileged over the other. As well it means that one of my collaborators from the social sciences could look at the qualitative data and it would be rich enough for them to write a solely qualitative paper on the results.

Cobbling together methods from the social sciences and the biological sciences was disconcerting for some (i.e., grant reviewers). Because often these methods are viewed as philosophically antithetical—positivist v. constructivist approaches—with a physiological measure it raised for them concerns about a potential unintelligibility of the results. However, I would argue that neuroscience, especially affective neuroscience, really must ask (however it can) the organism being studied what it is *like* for them. After all, we are trying to learn something about the experience—which presumably doesn't only take place in the brain, and is textured by context. Even if a third person method (like *in vivo* imaging) reveals a different interpretation than what a participant says *it is like* for them, the discontinuity (or continuity) should be important to our further understanding.

Of practical concern is the question of, “When does one have enough participants?” which is answered differently for the two methodologies. In a quantitative study if the variation is high and the effect small, one would need large numbers of participants. On the other hand traditionally, when listening closely to themes across individual stories, the numbers can be much lower. Melding these two numerical needs *is* a challenge but one that reveals a deeper understanding of the reasons for variation from a mean. This is especially important to delve into if science is to tell us something real about biology in all its variation. What seemed most revealing is to use a within subject design and compare the different measures across a single person treating each measure as a different perspective on the same question, rendering quantitative methods as qualitative.

There is also the possibility that if melding two diametrically opposed methods takes off, some interested statistician will come along and invent a statistical approach to deal with this.

The body has no independent parts

Underlying my original research question was the unstated intent to demonstrate showing how when one part of the body was removed, it affects the entire body via the nervous system.^{xiii} Since the scientific revolution we have been depending on the model of body as machine with independent parts or systems, to shape experimentation and cure. This has led to some remarkable advances in medicine: women do not have to die in childbirth anymore, if an organ is cancerous, it can be removed to life-saving effect, clogged veins can be reamed out like a sewer line to prevent the death of heart muscle, hearts, lungs, and kidney can be replaced to life-gifting effect. In other words, life can be wrested from death in the case of acute corporeal problems (Einstein & Shildrick 2009). But a wrench has been thrown into this ‘body as machine’ metaphor. After the problem is fixed, other problems pop-up. Just like taking one’s car into the mechanic; the gearshift is fixed but the air conditioning is damaged in the process. While the patient is saved, other parts of the body are compromised. In the best of cases such as a curing cancer, acute becomes chronic. In the worst of cases, surgery induces other problems such as

neuropathic pain or, phantom breast after mastectomy (Dijkstra 2007, Smith, Bourne, & Squair 1999); 'occult' incontinence after treatment for pelvic floor prolapse (Reena, Kekre, & Kekre 2007), or depression and cognitive decline after coronary artery bypass surgery, affectionately known as, 'pump head' (Newman et. al. 2001).

Because the nervous system is an integrator of and integrated with the entire body and the world, as discussed previously, it's not possible to take it out of any body system's picture. But this is the case for all of what we consider 'discrete' body systems. None of them really are independent of the other; the idea that they are is a fiction that works in the worst-case scenario but it is not a truth to rely on. Freud knew this when he saw other parts of the body being recruited in the service of the emotions or, the nervous system (Taylor 2006). Thus, a practice that affects one part of the body will be owned by the entire body or, embodied through the interconnections of all body systems and the environment.

Many areas of neuroscience are already coming to this conclusion. For example, circadian biology unites nervous, cardiovascular, musculoskeletal, and reproductive systems (Moore 1997). Stress biology unites nervous, endocrine, cardiovascular, and immune systems (McEwen & Seeman 1999). Social contexts and behaviors affect sex steroid hormone expression (van Anders & Watson 2006; van Anders 2010). How can one be damaged, removed, or repaired without affecting all?

We now have corporeal phenomena that are not very well studied by Cartesian, non-contextual approaches of the classic scientific method. For example, we know that the biology of stress is not separable into cause and effect and we have developed theories that call on integrated body systems to explain a reverberating system e.g., the hypothalamic-pituitary-adrenal (HPA) axis. We know that the mammalian body has biological rhythms and the study of circadian rhythms is an account of the cyclicity of physiological response depending on time of day, light, and dark (Moore 1997). These are only partially understood by the old 'scientific method'/biomedical model.

As well we have dis-eases not well understood either by the classic biomedical model, which rests on Cartesian separabilities of body systems. Might another view, one of the body as comprising inseparable systems *whose interactions and reciprocities need to be understood*, be a view that might help us in better treating chronic dis-orders? We need a more fluid and dynamic biomedical research paradigm to add to our research tools, providing more flexibility in gaining an understanding of the corporeal body.

"Feminists have stakes in a successor science project that offers a more adequate, richer, better account of a world, in order to live in it well and in critical, reflexive relation to our own as well as others' practices of domination and the unequal parts of privilege and oppression that make up all positions." (Haraway 1988, 579)

Corporeal hierarchies of power can be reduced

In the Cartesian model of the human body there has been a noticeable disconnect between the rest of the corporeal body and the brain. On this view, even if mind equals brain and thus, is meat, the brain still sits privileged atop our polarized body with other body systems arrayed like arms, legs, and trunk on a marionette's strings—to be pulled and moved by the brain. Information comes in. The brain processes it. An action is generated and then carried out by the peripheral nervous system. The rest of the body responds. On this view, the brain is the CEO of

the body. Second—and perhaps because of this—the body itself has not been considered knowledgeable and thus, has not been thought to have its own narrative (Grosz 1994).

I proposed to look at the effect of cutting the genitals on the rest of the body via their connection with the CNS. This led to some interesting conceptual ramifications. First, it meant that *the rest of the body affects the CNS*. While it could be argued that it was in someone's brain to do the circumcision, one important outcome of the circumcision to the peripheral body affected the brain. There does exist strong evidence of this flattening of the hierarchy. For example, amputations lead to a rewiring of neural circuits and the brain's response, which leads to the phantom limb phenomena (Ramachandran 1998). Further, tumors of the adrenal gland can lead to psychosis by flooding the brain with glucocorticoids (Levenson 2006). The development of the testes leads to the production of androgens and estrogens, which in turn shape the development of the brain in utero (Einstein 2007). Further to this point, the brain isn't the only nervous system the body has. Other nervous systems are hard at work interacting and being affected by the rest of the body. The spinal circuits and the peripheral nervous system—nerves, receptors, and far-flung neurons—as in the retina, dorsal column nuclei and enteric nervous system—all contribute to what the cerebral cortex 'knows.'

This underscores the point that body, brain, and society are in a reciprocal relationship mutually affecting each other. Activity in the world affects the body and these effects may or may not make their way to the brain but they still instantiate themselves in response, memory, language, and thought. Literally then, *the world writes on the whole body*. The Cartesian model of an unknowing and inchoate body with the brain in charge deflates.

In addition, I found that when asked, the body told us something different than the narrative produced by the brain. Women did not report genital pain but their genitals responded as if in pain. This says to me that the parts of the body other than the brain have knowledge and when given the opportunity, will speak.

Sexed bodies can be studied without essentializing reproduction

As a biologist, I believe that the body is sexed. There is a biological pathway to sexual differentiation and while it does not always produce idealized female and male bodies (Fausto-Sterling, 2000), it does play a role in establishing nervous system circuits involved (and not involved) in reproduction and shapes other tissues such as bone, heart, muscle, and immune response (Einstein 2007). Taken together these differences lead to overlapping bimodal distributions of phenotype. Societies tend to push the means of these bimodal curves as 'the normal' and disguise the variation but while the notion of sex may well be socially constructed (Hird 2004, Fausto-Sterling 2000) it has biological manifestations that in themselves have wide-ranging consequences for the organism.

As a feminist, I have a strong reaction to the phenotypic differences as constituting 'essential' differences between female and male and have tried to move the idea of women's health away from these as the focus (Einstein & Shildrick 2009). However, in the project under discussion, I was asking questions about bodies that I assumed to be the bodies of women and, at first glance my question seemed placed at the essentialist core—the clitoris, ovaries, uterus, and breasts with the question redefined through the reproductive system's connections to the nervous system.^{xiv} Via these connections the genitals are no longer the focus of the question—not essential—to the way the body ultimately feels or to the subjectivity of the person.

This actually became an advantage that was profound for the CAG and the project participants because for such a long time the gaze has been on their genitals alone—in fact, not just for women with FGC but, for women in general. The move to link the genitals with the CNS took the genital experience and moved it into the brain. In fact, I was able to start out the conversation with each woman by saying that I was not interested in her genitals; I was interested in her brain. Redirecting the questions from the genitals—a site of silence in cultures practicing FGC—to the brain—a site not previously considered, but privileged in the popular imaginary allowed participants to talk about their circumcision as well as placing the topic in, what for them was a respectful space. It means that when I go back to the Community to tell them about my findings, I will not be talking about ‘what FGC did to their genitals and reproductive health’ but about effects on the CNS, how it can change and that sometimes that change leads to pain or hypersensitivity. This is a completely different conversation than has been previously had about FGC. It encompasses the whole body and, as such, women’s whole lives.

Biological diversity within categories can be revealed

Myra Hird rightfully points out a disjunction between the intraspecies differences humans delight in studying in non-human animals and the tight rein kept on diversity among humans, sexual and otherwise (Hird 2004). Patricia Gowaty cites evolutionary biology as a space in which human diversity *should* be studied:

“The evolutionist in me argues with essentialist feminists and likewise with some evolutionary biologist that attention to fixed, invariant, and universal differences among women and men is likely to miss the mark most of the time. ...First, the diversity and variation among individuals is one of the most impressive of human ‘universals’, and anyone seeking a unified theory of human nature must account for the impressive variation among, between, and within individuals...” (Gowaty 1997, 6-7)

Anne Fausto-Sterling has neatly described how variations in sunlight produce diverse musculoskeletal systems (Fausto-Sterling 2008; 2003). Donna Mergler has shown how location and diet influence cognitions (Mergler 2002).

Linda McDowell suggests that Harding’s feminist standpoint theory is a place from which to start understanding difference.

“She [Harding] sets out the arguments for the construction of knowledge that recognizes differences between women—on the basis of class, age, ethnicity, sexuality and culture—in an epistemology of ‘permanent partiality’. This knowledge is thus forced to grapple with questions of difference.” (McDowell 1992, 412)

This is especially the case for the nervous system for which the old notion of the brain as fixed and static is no longer a tenable explanation for the observable plasticity of neural structures over a lifetime. Neural circuits change depending on our particular experience in the world. We really are all different. In fact what has served as the normative ideal is only imagined—constructed if you will. In order to fully understand human biology we will have to start from the assumption that we are all different, and then determine how much of a difference makes a difference for a given body. A biology of human diversities will underscore the full range of human kinds and how normative standards of corporeality does a disservice to all bodies.

Neuroscience can be situated

As a practicing scientist, I think of 'situatedness' much like Grosz's moibus strip with an inside and an outside and seamless transition into the other (Grosz 1994). There is my particular place as female, Caucasian, Jew, American, professor, neuroscientist, aging, partner, daughter, mother, with all my politics, etc. There is the particularities of the population that I am studying: female, African, Muslim, Somali-Canadian, once doctors or professors or students, under 45 years, partner, sister, mother, with all their politics, etc. Harding's 'robust reflexivity' forces me to think of all these with their diversion and intersections. Reflexivity forces me to think about how all of these interact to affect the study^{xv}.

Situating the Participants: Certainly in studying people, if one acknowledges, contextual influences, the response to stimuli and measurable behaviors of experimental participants must be influenced by a participant's interaction with the investigator and their feelings about being investigated. To not acknowledge this is to turn a blind eye to the obvious and therefore to ignore an important scientific pitfall. For example, the famous memory patient, Henry M., performed much better on language tasks when studied in nursing home—his own environment—than he did when taken out of his context and studied in a psychology lab (Skotko et. al. 2005). Keeping in mind how a participant might be responding to the environment and factoring this into any interpretation of findings is a kind of second-person perspective and keeping this in mind was important. For example, anyone interacting with participants were made aware of modesty requirements for Somali women's dress. I always wore long sleeves and a long skirt or slacks when interviewing. Individual women felt differently about having another member of the Somali community present during either of the interviews and participants always had the option of having a Somali interpreter present or not or for the second interview, a Somali health care worker present or not. The qualitative interviews were carried out in an informal setting, around a small table with fruit and tea. Quantitative interviews and testing were administered in a small examination room, which was part of the same health care centre. As has been thoroughly considered by the qualitative interviewing literature, I can only assume that these environments and people made a difference to comfort level and hence responses of each participant (Broom et al. 2009, Manderson et al. 2006, Pini 2005).

In a study about embodiment and corporeality, there is also no doubt that the body's physiology comes to the study from a particular place which in turn, shapes its response to the measure. Thus, historically situating participants is also important. For example, most of the participants in our study were from wealthy, educated families in Somalia. They came to Canada as part of the first immigration in the late 1980's/early 1990s. Most were abroad visiting, studying or working when the war broke out and they simply never went home. They are healthy, engaged, energetic women with a particular sense of their place in the world. This is a very different body than those of lesser socioeconomic status, less schooling, and less privilege who had to continue to live in war-torn Somalia and who then left only to end up in refugee camps in Tanzania with eventual immigration to North America. And the meanings of their circumcision and the body on which it is played out are likely very different. We will only know this when we make intra-Somali comparisons in all their differences of class, country or city location when they had their circumcision, when and how they immigrated, whether they are being interviewed in Diaspora or their natal country.

There is also the very real question of geographic situation; how this study would go if it were carried out in Somalia with participating women being still in a country in which their FGC is validated—indeed, honored? Would they have pain? This is important to test for any further validity of the research findings. Certainly any claims will have to be located to Somali women between the ages of 18 and 45 who live in the Greater Toronto Area. Even standard

neuroscientific methodologies demonstrate the necessity of restricting one's claims. Look at any paper using functional magnetic resonance imaging to explore a brain response to stimulation and if individual scans are figured one sees a plethora of data showing successful and functional brain individualities. As Michael Gazzaniga pointed out in one of his series of three distinguished lectures at Harvard University, "Feeling Free in a Mechanistic World: Where the Brain Meets the Law (April 22, 2010), no normative standard fit for legal evidence is really possible from a brain scan since there is so much variation between human brains.

Thus, in spite of the fact that we are all women immigrants to Canada and most born children, there was very little overlap in our situatedness. For example, the group of women I interviewed had a major change in socioeconomic and social status when they immigrated; I did not. Furthermore, when my body was encountered by the biomedical system, it was what was expected. It was very clear in our interactions that I was privileged and that whereas, they had once been, they were aware that in the world's view, they were not. As one of the women in my group told me, "Halima's father was the wealthiest man in Mogadishu." Or, another woman told me, "I was the first woman medical student at the University; now we are nothing." Or as another woman essentially told a Norwegian researcher, "We didn't know we were black until we came to Norway." (Johansen, 2002)

Within all of this, I also chose to situate the participants as colleagues. I felt that they had all the knowledge about their circumcision, their histories, and their bodies and I was very grateful that they were committed to helping those without FGC to learn something generalizable from women with FGC. From my perspective, we were situated as equal partners in the study—in fact I felt they held most of the power—and the study would have failed without this assumption. In this sense I felt that we were all neuroscientists working on this project. We just had different knowledges about the nervous system with theirs being an invaluable first-person account.

Situating the Researcher. With respect to Sandra Harding's call for a science with, 'robust reflexivity,' it was important to the study that I be reflexive about the study, its affects on me, and its potential affects on the participants. To walk in to the next interview without acknowledging the study's effects on me would have led to a muddying of the interactions. There were many days that I returned from the community health centre and just sat in a chair and stared at the wall I was so drained. The power of the women's stories, their pride, sorrows, and struggles made me feel so privileged and just plain lucky in my life. While I was able to overcome my initial reactions to the descriptions of the practice of FGC by coming to understand how much it meant to the women and their culture, it still left me deeply affected and was disturbing to my own sexual life.

Situating the Study: I also needed to be reflexive about my expectations for the study and question many of my assumptions about what a 'scientific' study *should* be like. This led to many encounters with my expectations, my culture, and my beliefs about what is scientific. As McDowell states as she contemplates a feminist geography:

"...there has been a challenge to the argument in conventional methods manuals that involvement with and participation in the lives of those who are being investigated 'biases' the results. In the collection of 'data', for example, it is not assumed that the researcher is objective or value-free, nor is she assumed to stay 'at a distance' from her subjects. As women interviewing women, commonalities of experience should be recognized and become part of a mutual exchange of views." (McDowell 1992, 405) In order to stay 'true' to the experience of my participants, I had to question my own sense of what a 'clinical' study was about. How could I—

given my strengths and weaknesses—make the study work? And I believe that with the particular participants I involved, it would have been extremely disrespectful, and downright rude, to treat them like observable objects. There could be no air of objectification about the study. For example, any belief that each participant came in as unknowledgeable as the last about the study had to be altered. In fact realizing that the participants were talking about the study amongst themselves was quite a moment (we were in a large, metropolitan centre after all, not a village)—at which point I had to turn the surprise back on myself and wonder what kind of a society did I live in that I could expect to recruit participants from the public and depend on them *not* talking to each other. The study had to work with this conversation between participants.

Situating what is important to participants: Asking participants what matters to them is both a source of agency and a way of uncovering important scientific ignorance that is a result of assumptions and prejudices of biomedicine. When carrying out a study of reproductive health in Lebanese women living in three different disadvantaged Beirut neighborhoods the researchers asked participants to rank their health concerns. Participants ranked musculoskeletal health as their number one concern; mental health as number two and reproductive health (the focus of the study) as number nine (Zurayk et al. 2007). I honestly do not believe I could have recruited anyone to another reproductive health study about women with FGC. It was important to the success of recruitment to study what was germane to participants. By trying to understand something about the CNS from the outside and therefore, pain, I learned that pain was both an unspoken problem for Somali women in Toronto and something that they wanted to understand. Therefore, they said to me that this study, unlike others in which they had participated, would “go somewhere” because it was about *their* pain.

All of this had to be thought about, tacitly acknowledged, and negotiated in both the qualitative interview and the physical exam otherwise we would not have been able to even gather data.

GUIDEPOSTS TO FEMINIST NEUROSCIENCE PRACTICE

Based on these emergent principles, and without hardening any practices in stone, I would like to suggest some guideposts to practice that in concert might add up to a feminist neuroscience. In doing so I prefer to not refer to these guideposts collectively as a ‘gender analysis’ because that is large and all encompassing as well as often used *in contrast* to biology. Instead I choose to just lay out the details of approach that one might or might not use for a given question. These are not hard and fast rules—neither is this a complete list. Rather what follows are things to think about as one asks questions and designs experiments. Hopefully, these guideposts can be applied to standard questions to yield new answers as well as lead to novel questions. Key is a spirit of commitment to the question, itself, as well as the opportunity to reveal ignorance and presuppositions embedded in current neuroscientific practice.

- Ask a question about which you are genuinely curious about a problem to which you are genuinely committed;^{xvi}
- Consider it in all its contexts—geography, culture, space, time, and individual biologies;
- Situate yourself and your prejudices with respect to the study;

- Clarify, as best you can, the power issues in your paradigm; try to flatten hierarchies of power;^{xvii}
- Ask the question from multiple perspectives
 - 1) *1st person—find out how the participant feels about the question; what is it like for them?*
 - 2) *2nd person—how does the environment in which the question is being asked and the person asking, affect the participant's account?*
 - 3) *3rd person—how do standardized measurements and physiological responses relate to what the participant is saying—how does it appear?*
- Be reflexive—how is who you are and what you are doing part of the experiment? Can you remove it or your own particularities important to maintain? How are you projecting your own prejudices and human condition on the experimental design, environment, and interpretation?
- Consider the ‘subject’ of your experiment an active partner—explore their agency; marvel at their participation; ask them what they care about;
- Practice reciprocity; bear in mind that the system under study—human or non-human—will has conditions under which it will flourish and conditions under which its growth will be restricted. Giving back by ensuring that it will flourish is opening the doors to more robust response.
- Restrict claims—situated biologies are particular to their context including: culture, geography, experience, sex, gender, etc. On the other hand, don't lose sight of the possibility of learning something general from the particular;
- Display individual data points as well as statistical differences of the mean in order to do justice to individuals and their particular variations;
- Eschew the language of normativity and assume plurality.

DISCUSSION

Upon reviewing earlier approaches to feminist science I believe my approach was very much in the same spirit. First, I tried to redress a wrong born of a Cartesian vision of the body comprised of separable parts. I questioned whether the Cartesian model of the separation of body and mind, which undergirds modern biomedicine, is in fact, an adequate place to start in describing the biologies of women.

I selected *my research project on substantive grounds with my “Personal interests and skills meld[ing], often mysteriously, with collective feminist concerns to determine a particular topic of research...”* (Stacey 1988, 21). *This, in turn, “...guided the research methods employed in its service.”* (Stacey 1988, 21). In doing so I used Harding's ‘radical reflexivity’—at least, radical for a neuroscientist. Her admonition was, in fact, critical to the success of the study:

“A third feature contributing to the power of feminist research is the emerging practice of insisting that the researcher be placed in the same critical plane as the overt subject matter, thereby recovering for scrutiny in the results of research the entire research process. That is, the class, race, culture and gender assumptions, beliefs and behaviors of the researcher her/himself must be placed within the frame of the picture that she/he paints.” (Harding 1987, 29)

In doing so I tried to reduce power structures between researcher and participant by taking simultaneously the views that: a) we all had important knowledges for the project and b) I was being studied as well—if not by the participants, then certainly by myself. Finally, I very much tried to apply a scientific rigor while at the same time ascertaining that the project and the methods were meaningful to those being studied. In a sense, **relational**, in the way that Evelyn Fox Keller described Barbara McClintock studying corn genetics (Keller 1983). In fact, the principles that emerged from my study described earlier are, with the order reversed slightly, very reminiscent of Longino’s feminist scientific virtues: *empirical adequacy, novelty, ontological heterogeneity, mutuality of interaction, applicability to current human needs, and diffusion of power* (Longino 1996).

As is apparent, developing feminist approaches to neuroscience must necessarily be a work in progress. Both we, as scientists, and our subject, the nervous system, are in flux within our reciprocal relationship. As we take a feminist approach to experimental design and interpretation, we change what we know. Which, in turn, changes the types of question we can ask. Some of the project might even look like ‘neuroscience as usual’ because there are many aspects of the nervous system and neurobiological research that are aligned with paradigms of feminist inquiry such as the importance of experience in shaping individual behavior; the situatedness of each nervous system yielding a difference that comes from each lived life.^{xviii} The key is to explicitly carry out these principles in the 1) question; 2) design; 3) methods; and 4) interpretation of the experiment/project.

A particular place that neuroscientists using feminist approaches can make a huge contribution to neuroscience is to identify areas of ignorance. Our commitments to understanding non-normative biologies—for example, the bodies of women—is a place of novelty. As Ruth Hubbard pointed out:

“Feminists are in a good position to analyze what is wrong with science as a social institution and with the knowledge it produces. We recognize that science was begun, and has been practiced, primarily by men from the educated upper classes in Europe and the United States and that it therefore embodies their values and views about how the natural world functions and should function.” (Hubbard 1992, 16)

This is actually a tremendous area of strength for neuroscience in general because instead of being the kind of critique that painstakingly reveals the next small gap in ‘the literature’ it takes us leapfrogging over whole topics to reveal large swaths of ignorance. It opens the doors of real discovery about that which is unknown, ignored, or silenced. As Harding points out:

“Bodies of systematic ignorance always develop alongside bodies of systematic knowledge, since asking one kind of question about natural or social relations can cognitively, technically, or simply pragmatically preclude at that time and place asking certain other kinds of questions.” (Harding 2001, 516)

The politics of feminist approaches allows a questioning of *why we do not know something* (Tuana 2006, Harding 2006). This question can serve as an important source of novel questions and innovative perspectives on our results. Feminist scientists armed with the epistemics of gender theory were able to clearly see that the sex determination story made the Y-chromosome the main actor. Why was there no role for the X-chromosome? Could the SRY gene explain all variations of sexual differentiation (Richardson 2008)? Once this lacuna of ignorance was identified studies assuming female agency in sexual differentiation revealed a number of possible genetic pathways important for XX differentiation (Hughes 2001). This, then, allows feminist scientists to adopt methods and combinations of methods that are in line with their values as feminists (McDowell 1992).

In my own study, as I was developing hypotheses for possible neurobiological outcomes of FGC, one that seemed obvious (previously discussed) was phantom clitoris. According to Ramachandran (1998) the phantom would be activated with stimulation of the body region that's representation in the brain lies near the representation of the clitoris. In trying to determine which body region is represented next to the clitoris it becomes apparent that no one has actually mapped female body regions to their representative neurons in the brain as Wilder Penfield did for the male when he produced the "homunculus" (Einstein 2008, DiNoto et al., forthcoming).^{xix} This is an astonishing area of ignorance to most neuroscientists when it is pointed out to them. It has repercussions for developing therapeutics for women with chronic pain after any surgery as well as leaving empty an entire understanding of a mechanism underlying changes in the sense of one's body during menstruation, menopause, and pregnancy. Explicitly studying the plasticity of female somatosensory cortex due to steroid hormones most certainly will contribute to our understanding of plasticity of the male brain which is also affected by hormonal changes just perhaps not as robustly or with the same pattern (Becker et. al. 2005).

Finally, by engaging in questions that interest us and designing systematic ways of studying complex phenomena, neuroscientists taking feminist approaches may develop entirely new areas of knowledges and methods. The world requires that the particularities of different sciences must be heeded. It does then seem that even in the philosophy of science where science quo science gets studied and confirmed or rejected, positivism, itself, seems to no longer be the epistemological grounding for discovery.

"...present knowledge reevaluates the whole character of past practice [and] there is no saying, in advance, how this will go" (Fine 1986a, 149 in Rouse 1998, 106)

CONCLUSION

The time is ripe for renewing the project of feminist science. We have a new crop of students (male and female) who plan to become scientists and who have majored in women and gender studies, and thus, been exposed to feminist philosophy and critiques. It would be impossible for previous work to have not left its mark on current generations (Bordo 1990). In addition, there are those in this generation who explicitly want to *do* feminist science (neuroscientist, immunologist, and biophysicist). As well, we are currently faced with biological and more specifically, neuroscientific problems for which the classic biomedical model and a dualist scientific method cannot provide insight: chronic conditions, disabilities, the role of the environment on biology, and the influence of biological cycles on other bodily changes (Einstein & Shildrick 2009). Classic, positivist science devoid of context will only haltingly allow us to understand the biology of the female body during the reproductive years—or any body that is

subject to changes over time, place, and circumstances. From the neuroscientific perspective, much about behavior is unintelligible if context is not taken into account. The nervous system is exquisitely sensitive and malleable depending on context. For example, even songbirds know what season it is by a sensitivity to light and length of day which once encoded neurally leads to the production of new neurons in nuclei mediating song production (Alvarez-Buylla & Nottebohm 1988). The sensation of pain is embedded in context; furthermore, what might be painful to one person is not to another. What might be painful in one cultural milieu or geography might not be painful in another (Melzack & Wall 1996). In humans, which genes are expressed and which, unexpressed, may depend on early interactions with others and has the capacity to lead to neuropsychiatric behaviors in later life that are threatening to life itself (McGowan et al. 2009).

In these important cases, feminist theory can contribute new methods of study as well as new interpretations. It is no longer a question of ‘redressing masculinist scholarship’ (Stacey 1988) rather it is a matter of finding solutions to currently insoluble problems. To assume that these feminist approaches are themselves unique to something imagined as ‘women’s ways of thinking’ would be a grave mistake. As Longino points out:

“The problems with this approach are, first, that there’s no evidence that women are inclined biologically or culturally to understand the world in these ways; second, that even if they were, we’d still need an argument that these are traits that ought to be valued in theory construction and assessment; and third, that it creates a need to explain the endorsement of these virtues by non-feminists...if the world is such as to be more adequately understood via theories exhibiting these virtues, then they ought to be promoted as general theoretical virtues and not just as feminist.” (Longino 1996, 49)

Can feminist approaches bring us to a different understanding of the natural world—a paradigm shift? I believe they can. But it will require

“...a doctrine of embodied objectivity that accommodates paradoxical and critical feminist science projects: feminist objectivity means quite simply situated knowledge.” (Haraway 1988, 581)

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ENDNOTES

ⁱ For a real understanding of this world biological phenomena are so complex as to disallow reduction to a single variable—even for male bodies. Interestingly this approach has probably curtailed our learning about the subtleties of men’s biologies for some time. At the 2010 meeting of the International Congress for Gender Medicine in her keynote address, Maryann Legato referred to men as having been “mined” for data but their biologies not really studied.

ⁱⁱ Human sexual differentiation comprises the biological steps necessary to transform the developing embryo into a female or male phenotype, or body. This includes the formation of internal and external genitalia as well as laying the endocrinological and neurological scaffolding for reproductive behavior (Einstein 2007, Fausto-Sterling 2000).

ⁱⁱⁱ For details on the neuroscience on this see Einstein 2008. Instantiation involves affecting a change in a grouping of spinal cord neurons that innervate the muscles of the perineum that are interestingly dimorphic in rodents but not so different between female and male humans.

^{iv} Manderson reports that de-infibulated women find the sound of their pee to be foreign and strange (Manderson 2004).

^v This has never been measured but in two personal conversations, one with Janice Boddy and another with Comfort Momoh—both well-steeped in the knowledge of women with FGC—they both report that women with FGC have a special walk.

^{vi} However, this also made the determination of a control group impossible.

^{vii} Of course as I encountered the stories of these Somali women I learned that cultural homogeneity is a myth.

^{viii} There are numerous models on how to design mixed methods research (e.g., Creswell 2009, Medlinger & Cwikel 2008, Morse & Niehaus 2007, Morgan 1998). However, few if any combine physiological measures with qualitative interviewing and none are explicitly feminist with the possible exception of Medlinger & Cwikel (2008). This is discussed at greater length in a manuscript in preparation: Glazer et al., Women’s health and cultural embodiment: Intersecting methods to understand pain in Somali-Canadian women with female genital circumcision/cutting (in preparation).

^{ix} At this writing the qualitative results are still being analyzed and the quantitative results on pain being written up. I am not sure the quantitative study will be accepted for publication with this few participants. The quantitative data will be reported for each person and used as preliminary data for further physiological studies as well as information sessions for the community.

^x I believe is justified because there really is no control group possible. There are scarcely any Somali women who have immigrated to Canada who do not have FGC. There are Somali women born in Canada who do not have FGC but they have been raised in a non-African culture. There are a few Somali women in Somalia without FGC but they live in a culture with very different expectations about the tradition than the countries to which their countrywomen have immigrated. I decided that the triangulation of the methods would serve as an internal control for each participant.

^{xi} I am hoping that in the future, based on the findings gleaned from these limited numbers I will be able to apply the QST and further neurological examination to a larger population and include uncircumcised women as well as women with FGC.

^{xii} However, we wonder: Is walking painful in their natal countries where the climate is warm, clothes are light and loose, families are there to help with life, and having FGC is a point of pride and not shame?

^{xiii} I chose the nervous system as the unifier because I am a neuroscientist. If I were a cardiologist, I would have chosen the cardiovascular system—an immunologist, the immune system.

^{xiv} In a broad sense they are, indeed, part of the nervous system because they have transducers of external information, nerve-muscle connections, and representation in the somatosensory regions of the brain.

^{xv} Even if one doesn't believe they are in the picture, reflexivity could be defined as simply as asking oneself what one expects from the experiment or why one is doing the experiment (both worthwhile intellectual pursuits). It could be carried further by asking even of animal models, "What human attributes am I imposing on these non-human animals?"

^{xvi} Sandra Harding underscores the importance of one's own experience to in formulating and interpreting a question: "Women's [and men's] perspective on our own experiences provide important empirical and theoretical resources for feminist research. Within various different feminist theoretical frameworks, they generate research problems and the hypotheses and concepts that guide research. They also serve as a resource for the design of research projects, the collection and interpretation of data, and the construction of evidence." (Harding 1987, 28)

^{xvii} These three bullets considered together represent Haraway's 'feminist versions of objectivity' (p. 190) according to McDowell (1992). They include "...*limited and situated knowledges, knowledges that are explicit about their positioning, sensitive to the structures of power that construct these multiple positions and committed to making visible the claims of the less powerful.*" (McDowell 1992, 413)

^{xviii} Consider London cab drivers who have larger grey matter volumes of posterior hippocampus (brain regions that play a role in spatial navigation) than bus drivers. Moreover, the cab drivers' right posterior gray matter volume increases with more navigation experience (Maguire et. al. 2006).

^{xix} While there is a growing literature on brain regions that light up with genital stimulation and orgasm (Komisaruk & Whipple 2005; Georgiadis 2006) as well as stimulation of the breast (Rothmund et. al. 2005): 1) none of these have been mapped together to regions of the brain leaving the female somatosensory cortex a hodge-podge of independent sensory regions; 2) we have no idea how these regions grow or shrink with different stages of the ovarian cycle, delivery, nursing, or excision; we have no idea where the internal portion of the clitoris, the ovaries, and uterus are represented (DiNoto, Newman, & Einstein, forthcoming).