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Neuroethics, Gender and the Response to Difference

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Abstract This paper examines how the new field of neuroethics is responding to the old problem of difference, particularly to those ideas of biological difference emerging from neuroimaging research that purports to further delineate our understanding of sex and/or gender differences in the brain. As the field develops, it is important to ask what is new about neuroethics compared to bioethics in this regard, and whether the concept of difference is being problematized within broader contexts of power and representation. As a feminist science studies scholar trained in the neurosciences, it seems logical to me that, as a growing field, neuroethics should reach out to the rich bodies of scholarship on the history of medicine, feminist theory and feminist bioethics while attempting to approach discussions of sex, gender and sexuality differences in the brain. What is also clear to me is that feminist scholars need to learn how to engage with neuroimaging studies on sex, gender and sexuality not just to critique, but also to productively contribute to neuroscientific research. The field of neuroethics can potentially provide the appropriate forum for this interdisciplinary engagement and create opportunities for shared perplexity. I suggest three possible points of departure for creating this shared perplexity, namely (i) is difference being measured in the study for the purpose of understanding difference in and of itself, or for the purpose of division?; (ii) is there an appreciation for biological complexity?; and (iii) is it assumed that structural differences can be conveniently translated into functional differences?

Keywords Sex · Gender · Difference · Neuroimaging · Ontology · Epistemology · Materiality · Feminist theory · Feminist ethics · Feminist science studies

In response to new technological advances in the neurosciences, there is a growing concern shared by many scholars regarding the ethical aspects of this research and its possible medical applications. Over the past several years, this concern has emerged into the new field referred to as neuroethics. One of the primary concerns is that new imaging technologies—such as functional magnetic resonance imaging (fMRI)—are being used to explore the mechanisms of brain function and ultimately deliver neuroscientific explanations for human behavior. Potentially, these new technologies will not only monitor brain function but will also offer ways in which chemicals can be used to induce specific functional neurological changes [1–4]. At a time of such seemingly rapid scientific progress, many neuroethicists are concerned with the impacts of these developments on our society and are engaged in developing new principles for guiding neurosciences research.

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In this paper, I am interested in examining how the new field of neuroethics is responding to the old problem of difference, particularly to those ideas of difference that are emerging from neuroimaging research that purport to further delineate our understandings of sex and/or gender differences in the brain. As Steven Jay Gould demonstrated for us years ago in his book *The Mismeasure of Man* [5], the history of neuroscience is fraught with a legacy of scientific practices of difference-making, such as in the field of craniometry, that were not only sexist and racist in their design, but out-and-out misleading in their results. It has taken the work of many other scientists, acting as the neuroethicists of their time, to call out the scientific inaccuracies generated by many of these studies and to address the harmful effects that have resulted from their social uptake. The hope for many of us is that this new field of neuroethics will come with a deep appreciation for this history of science and will also inherit, within its core framework, past traditions of critical engagement with the neurosciences. As the field develops however, it is becoming evident that many of the key theoretical frameworks being applied to neuroethics are being adopted, in a more or less an identical fashion, from within the traditional disciplinary boundaries of bioethics. Therefore, many of the key concerns being raised in neuroethics echo such interests as developing an understanding of human agency, examining the role of moral responsibility and decision-making, and analyzing legal issues of autonomy and self-determination within the context of these newly emerging neurotechnologies. More or less, these problems and concerns foreground mainstream interests (or panics) motivated by our attachment to the liberal humanist subject, and thus prioritize concerns for individual rights and the freedom of choice. But as the field develops, we might want to ask, particularly in the context of sex, gender, and sexuality, what is new about neuroethics? Are we witnessing a more nuanced treatment of 'difference'—one that is capable of problematizing the concept of difference within the broader contexts of power and representation? Or put another way, compared to mainstream bioethics, is the field of neuroethics which is still in its infancy, dealing with issues of difference differently?

In the introduction to his book *Neuroethics: Challenges for the 21st century*, Neil Levy does suggest that there is something new and different about neuroethics. He states that unlike other ethics-driven disciplines such as bioethics and business ethics, neuroethics has the potential to work in a way that "reacts back upon itself" [6: 2]. Levy further states that "[t]he neuroscience of ethics will help us forge the very tools we shall need to make progress on the ethics of neuroscience" [6: 2]. I admire Levy's work and see his use of the extended mind hypothesis, whereby the mind is understood as "the set of mechanisms and resources with which we think, and … is not limited to internal resources made up of neurons and neurotransmitters" [6:29], as being very useful and in line with many feminist perspectives on the body. However, many of us may feel lured by Levy's comments, regarding the potential of neuroethics to react back upon itself, into asking how we can possibly even think about the neuroscience of ethics unless we have first come to some level of understanding and consensus on the ethics of the neurosciences themselves. Engaging in this chicken-or-egg-styled squabble only serves as a decoy. I would agree with Levy in the sense that there is indeed a close relationship between the fields of ethics and neuroscience, but I would also suggest that Levy's statements above might be somewhat misleading. By possessing this sole ability to "react back upon itself," we are left with the impression that there is indeed a novel and innovative current of analysis flowing through the field of neuroethics, and neuroethics alone. I would like to think so. I would like to think that the field of neuroethics is different than the field of bioethics and is making progress by incorporating into this discipline those philosophical approaches to ethics that have previously been marginalized or excluded.

I think what is necessary to point out however, as other scholars have done, is that all ethics-amalgamated disciplines, including bioethics and the newly fashioned field of neuroethics, have always reacted back upon themselves—neuroethics is not unique in this sense. One could suggest for instance that business ethics has always been about more than just the ethics of business practices. In fact, what we are witnessing now, with the birth of these new ethics-hyphenated disciplines is perhaps a more generalized effect of the "business of ethics." Very much like traditional bioethics, from the very start, neuroethics has been implicated in much more than simply providing an analysis of new technologies such as

neuroimaging. As Margrit Shildrick [7] has noted in relation to bioethics,

> As a disciplinary practice in its own right, however, bioethics does much more than regulate the parameters of biomedical technologies: it is fully implicated in the inscription of the very body it seeks to describe, and ostensibly to protect. [7: 214]

If we follow Shildrick's argument here, we would need to start thinking about the ways in which scholarship in neuroethics itself is always already implicated in the ways we come to study or "know" the body, or more specifically, know the brain. Even though the co-embedded qualities of ethics and neuroscience are similarly highlighted, Levy's message rings a slightly different tone here. By suggesting that the "neuroscience of ethics will help us forge the very tools we shall need to make progress on the ethics of neuroscience" [6: 2], Levy is foregrounding the primacy of the neuroscientific technologies and suggesting that the scientific discoveries of neuroscience will be fully implicated in the very body of the field of neuroethics, or the ethics of neuroscience. Apart from a possible slippage into technological determinism and other ontological tensions that surface from this statement, what is important here to me is the sentiment that the neuroscience of ethics will help us "*forge"* the very tools we need for neuroethics. It is unclear what "tools" Levy is alluding to, but regardless of what these tools are, it is interesting to note that "to forge" means both to give form or shape to, as well as to fashion a counterfeit. Despite their promise and wonder, we should be carefully aware of the power and primacy being granted to the new "tools" of neuroscience, and should look more closely at the definition and boundaries being set within the field of neuroethics.

In a way, we may have James Watson to thank for the birth of these recent *trans*-ethical disciplines such as neuroethics, and the boundary-making practices that accompany the growth of these fields. The co-discoverer of the structure of DNA, former head of the Human Genome Project (HGP) and as of late, self-professed champion of a new eugenics movement [8], has also been credited with "invent[ing] (*sic*) ELSA, the study of the ethical, legal, and social aspects of genomics" [9]. Using the HGP framework, many other fields, including the neurosciences, have modeled their own ELSA-inspired strategic franchises [10]. There are however several reasons to question the motivations behind the creation of such ethics committees as perhaps being insincere, or counterfeit. The hesitations are valid, as Watson himself has suggested that the purpose of creating ELSA was not to engage productively with the ethical dilemmas that surfaced from the progress of the HGP but rather to be able "to preempt the critics" [11–13]. Therefore, instead of becoming entangled in a debate to settle whether or not the neurosciences should precede ethics or ethics should precede the neurosciences, I think it would be worthwhile for us to start with the understanding, as Shildrick [7] also suggests, that all ethics-based disciplines feed back onto themselves. Neuroethicists must begin their projects with an awareness of this complicity. This admission I think may allow us to pursue a different set of questions.

As a feminist science studies scholar trained in the neurosciences, much of what I do involves pursuing different sets of questions that allow for interdisciplinary dialogue. It seems logical to me therefore that as a growing field, neuroethics should reach out to the rich bodies of scholarship on the history of medicine, feminist theory and feminist bioethics when attempting to approach the issues of sex, gender and sexuality differences in the brain. What is also clear to me, however, is that feminists in the humanities and social sciences need to learn how to engage with the neurosciences and neuroimaging technologies in new ways. Feminist philosophers of science and science studies scholars such as Isabelle Stengers, Donna Haraway, Karen Barad, and Elizabeth Wilson in their own ways have all called upon feminists to make more collaborative engagements with the sciences [14–17]. Feminists need to learn how to read neuroimaging studies on sex, gender and sexuality not just to critique the work and dismiss the research, but to productively contribute to the direction of neuroscience research through discussions on ontology, epistemology and materiality. The field of neuroethics can potentially provide the appropriate forum for this engagement. The emphasis here is on developing the ability to contribute to the field of neuroethics and to move towards what the philosopher of science Isabelle Stengers refers to as moments of "shared perplexity" [14] with the scientists who conduct the neuroscientific research. How can we learn to read together? How can we learn to ask questions

together? Returning to my interest in the problem of difference in the developing field of neuroethics, what follows here is my attempt to create a space for shared perplexity while approaching some recent scientific papers on the differences of sex, gender and sexuality in the brain. I suggest posing three questions as possible points of departure, namely (i) is difference being measured in the study for the purpose of understanding difference in and of itself, or is it being measured for the purpose of division?; (ii) does the study demonstrate an appreciation for biological complexity, or in other words, is there enough difference?; and (iii) does the study assume that structural differences can be conveniently translated into functional differences?

By holding up a mirror to the growing field of neuroethics, we can make the first steps towards recognizing how the concept of difference for instance, and how issues of power and the politics of representation might make their way into our ethical engagements. It is with some reluctance that I gesture towards calling this a feminist neuroethics, but I do want to jointly call upon the feminist practices of reflexivity, diffraction and shared perplexity in the interest of expanding the current boundaries of the field of neuroethics. The understanding here is that our ethical engagements actually have a hand in bringing form to a materiality of the brain that we wish to know and is part of the apparatus [16]. In other words, how we understand and interpret and work with difference in neuroethics will have a hand in the material differences of sex, gender and sexuality that are produced and that we come to know through neuroscience. This is the innovative current of analysis and the "something new and different" about neuroethics that I would like to pursue. The ontological implications of our ethical orientations are brought to the fore here.

From Somatic Limits to Feminist Materialism: Chasing Difference in Neuroethics

In his essay "Brainhood, anthropological figure of modernity" (2009), Fernando Vidal refers to neuroethics as an "energetically self-promoting field" that "has thrived on hype" [18:8]. Through a careful tracking of historical developments that have lead us to perceive our personhood through our cerebral subjectivity, or what he calls "brainhood," Vidal demonstrates how the brain "consensually emerged as the somatic limit of the self" [18:21]. He suggests that as an anthropological figure inherent to modernity, the concept of the brain as "self" can be traced from the late 17th century writings of John Locke to more recent claims that "we are our brains" made by neuroscientists such as Michael Gazzaniga and Vilayanur Ramachandran. Vidal states,

> [W]hether ontological or methodological, the belief in brain-self consubstantiality seems to have impelled brain research. The idea that 'we are our brains' is not a corollary of neuroscientific advances, but a prerequisite of neuroscientific investigation. This is not a normative, but a historical observation that makes sense of brainhood without justifying it or lending it support as an ideology of the self [18:7].

Vidal also suggests that the field of neuroethics, as it has developed thus far, has supported the work of those who would benefit from the assumption that we are cerebral subjects. Echoing a critical analysis and social constructivist view shared by many STS and feminist science studies scholars, Vidal further argues,

> Going entirely along with the neuroscientists, neuroethicists seem to consider the sciences as having 'social implications' or an 'impact' on society, rather than as being themselves intrinsically social activities that prosper largely through strategies embedded in the social fabric; this view reproduces the belief that humans have a biological self on which culture and intersubjectivity are somehow tacked [14:10].

For almost three decades now, scholarship in feminist science studies has also questioned the notion of a 'biological self' as well as the idea that we are simply our brains. Feminists have diligently attempted to articulate those "strategies embedded in the social fabric" that have been used to justify the neuroscientifically-based discrimination and oppression of those biological or cerebral selves whose brains have been deemed different (a difference marked with inferiority) due to their gender, race, sexual orientation, disability or class [19–25]. Like Vidal, these feminists have argued from the get go that the sciences, including neuroscience, are intrinsically social activities, and through their critiques of

neuroscience, they have attempted to bring the many embedded social biases to light. The history of this engagement however seems to have been lost or has not significantly entered into the new discussions of neuroethics.

For instance, in an 2008 article entitled "Women's Neuroethics: Why Sex Matters for Neuroethics" [26] that originated out of the Neuroethics Affinity Group of the American Society for Bioethics and Humanities, the authors of the brief report call for closer attention to the neuroscience of sex differences. The authors should be commended for bringing issues of sex and gender differences in neuroscience research into mainstream discussions of neuroethics. Judy Illes, in a commentary preceding the article, states that "the report is a snapshot of these authors' first iteration of the concept of women's neuroethics" and "[l]ike lit torches in a juggling act, there are many directions that this project can go [27:1]. One of these directions however includes falling prey to what Vidal might see as a primacy being afforded to the neurosciences. The authors state:

> Why should we pay special attention to the neuroscience of sex differences? Perhaps the most important reason is that this work will prove important for contested ideas about the so-called nature of human nature… Atlhough the question of how and why women and men are different is an old one, neuroscience's use of cutting-edge technology—coupled with a growing reliance on science to shed light on complex human behavior—increases the likelihood that this work will leap to the forefront of public discussion and debate about social equality… New technology brings new hope that our more modern and sophisticated techniques will shed reliable and valuable light on sex differences [26: 1–2].

Vidal's claim that most neuroethicists today overlook the intrinsic social activities of neuroscience is evident in the above statements. However, the authors do go on to state their support for the inclusion of "feminist and social studies of science [that] have demonstrated how scientific research, questions, and constructs reflect contemporary presuppositions and beliefs about gender" [26]:2] in these neuroethics discussions, even if as an afterthought. Their main focus seems to be to develop a women's neuroethics that has the ability to respond to the dissemination of neuroscientific research on sex differences. In a climate of neuroscience research that supports cerebral subjectivity as well as the idea of the brain as 'self,' a call for increased attention to finding dichotomous differences between the brains of men and women may also unfortunately result in bolstering what Cordelia Fine (2007) has flagged as the popular new genre of neurosexism [28]. I have commented elsewhere on why I think that even though there would be some areas of overlap, the project of developing a "women's neuroethics" is not the same as working towards a feminist neuroethics [29]. I do however give these authors credit for showing an interest in creating spaces of shared perplexity between neuroscience, neuroethics and feminist science studies.

In her bibliographic essay "Whose Brain, Which Ethics?"(2010), Jessica Miller rightly suggests that,

> When it comes to neuroethics, a feminist cannot help but study it under the specter of the history of figuring the male as the rational mind and the female as the irrational body. From a feminist point of view, one of the most important initial questions to ask involves the cultural figuration of the brain itself, and how it is gendered, classed, sexed, and raced [30:622].

Like Vidal, Miller puts forward the idea that many of the issues raised by the birth of neuroethics are not new. Concerned about the boundaries of this newly emerging field, she suggests that given the wide range of concerns and parallels being drawn between neuroethics and other fields of inquiry such as genomics, "the harder question may be where neuroethics ends" [30:619]. Yet, despite the hype and hesitations regarding its scope and boundaries, I think that if feminists are going to participate in the field of neuroethics, the encounter can begin, as both Miller and Vidal suggest, with close attention to the cultural figurations of the brain and to the dominant narratives of the cerebral self, but it cannot simply end with this analysis. In many ways, I think feminists have tired from those critiques of science that begin and end with an analysis of biological reductionism or determinism. Although Vidal justly argues that the brain has become the "somatic limit of the self" [18:21] and cautions against "the brain overclaim syndrome" [18:23], as a feminist trained in neurosci-

ence and molecular biology, I have to ask, so *what do we do with the brain*? It is indeed wrong to continue thinking that humans have a "biological self" onto which culture is somehow tacked, or to think that we are simply our brains. But does this acknowledgement then make it meaningless or laughable to say that humans do have a biology, or that in fact, we do have brains? This tension between cultural inscription and the biological and physical matter of the body, or the brain in this case, is not new within feminist theories of materiality.

Without going into too much detail regarding the ongoing debates within feminist theory on issues of materiality and the body, I think it is appropriate to say that there is now a general sense amongst many feminist theorists who are interested in materiality, that the social constructivist position has focused too much on the cultural and the discursive. One of the arguments they have forwarded here is that the linguistic turn in feminism has in fact failed in many ways by hindering feminists from dealing with the 'real' matter of the body [16, 31, 32]. As such, there has been a call to return to the biological and physical properties of nature. I have commented on this debate elsewhere and have suggested that some feminists (primarily feminist biologists) might think otherwise and argue that engagements with physical or biological matters of the body were never really left behind, at least not by all feminists [33]. In fact some feminists have read this "return" to materiality as a misreading of previous feminist engagements with the body and is a result of a growing anti-postmodern sentiment in feminist theory [34]. Poststructuralists such as Michel Foucault and Gilles Deleuze for instance have always dealt with the material body in their work. In my own work at the intersections of feminism and neuroscience, my orientation to biological matter has been greatly influenced by both the "material-discursive" framework of Donna Haraway and the materiality of Gilles Deleuze. I have attempted to shed some light on questions of subjectivity and biological differences in molecular biology and neuroendocrinology through the context of becoming [33, 35]. I have also attempted to adopt an ethical orientation to the biological matters of the body, to social justice movements in feminism and to neuroscience research using Stengers' political ecology of practices that invites an immanent mode of critique [36]. To a great extent, my approach to working with feminism and the brain resembles what William Connelly calls "neuropolitics." Connelly states,

> By neuropolitics, then, I mean the politics through which cultural life mixes into the composition of body/brain processes. And vice versa. The new neuroscience, while needing augmentation from cultural theory, encourages students of culture to attend to the layered character of thinking; it also alerts us to the critical significance of *technique* in thinking, ethics, and politics [37: xiii].

More recently, drawing upon the work of Deleuze and Guattari, Connelly has also described what he calls an "immanent materiality" to understand the processes of emergent causality associated with mirror neurons [38]. This challenging work requires that we be able to think through the sciences without abandoning the many important lessons learned from social constructivism.

My sense is therefore, that a feminist neuroethics would not be able to remain in that space of mere response to or critique of neuroscientific studies. Feminists would have to learn how to incorporate their ontological and epistemological queries while simultaneously working with, and not against, the materiality of this shared object of knowledge known as the brain. As Sara Ahmed might say, "orientations matter" [34]. In the case of neuroethics, feminists need to bring their political and theoretical orientations to the table or in this case, to the lab bench, and be careful not to dismiss the molecular, cellular, and synaptic elements of the brain. We should not be limited by previously inscribed somatic limits of the self, but work towards creating new prerequisites (such as the shared perplexities I have outlined above) of neuroscientific investigation.

Shared Perplexity #1: Searching for Difference in and of Itself or for the Same Difference?

Similar to bioethical concerns regarding genetics-based scientific advances that are being promoted in the name of a "new eugenics" movement, neuroethicists have a responsibility to pursue some very difficult questions regarding the direction and end-goals of new developments in the neurosciences. With the advent of new and complex neuroimaging

technologies, such as fMRI, we must be cautious and question whether or not what we are witnessing here, for instance, may be the birth of a "new phrenology" movement. Though phrenology has long been dismissed as a pseudo-science, it is crucial for neuroethicists to examine possible links between the *motivations* that were behind the development of phrenology and the more current research agendas involving new neuroimaging technologies such as fMRI. The potential social impacts of these new technologies are too far-reaching to ignore the shared tendency of these two fields for medical and social prognostication based on physical differences.

Several neuroscientists have indeed already made these connections and voiced their concerns. For instance, Arthur Toga, Professor of Neurology, director of the Laboratory of Neuro Imaging, and associate director of the Division of Brain Mapping at UCLA, has spent his entire career creating brain atlases and mapping brain structure and function through the use of neuroimaging technologies including positron emission topography (PET) and fMRI. What is most refreshing to hear is Toga's own healthy skepticism for the "tools" of his trade. In a recent talk for the molecular imaging community at Stanford University, Toga stated:

> Is fMRI going to overcome the use of PET techniques in terms of functional imaging? I don't think so because each has something to offer, each has a different limitation and assumption to make in terms of understanding how the brain works. And so perhaps fMRI is the technique du jour, but I don't think it will be the panacea that some try to make it out to be. And I want to say something in a pejorative way about what it is that I do—a lot of what of I do is look at features of the brain to try to identify different characteristics. It's not that far removed from phrenology—honestly. Whether those features are anatomical or those features are functional, we have to recognize that this is really a 39,000-foot view of what's going on in the brain because you cannot see using MR techniques or in vivo techniques anything at the cellular level… What we do—we look at shape and form of morphological structures and although we are not looking at the cranium the way they did 150 years ago, we are still looking at shape and form to try to deduce what it is that is *different* from one group compared to another. [*emphasis added*; 39]

I think we would all agree that neuroscience and neuroimaging technologies have come a long way since the days of phrenology and that the technical aspects of phrenology and fMRI do not resemble one another. But, as Toga points out, where the two do overlap is in their mutual interest in the measurement of shape and form, and ultimately, the comparison of these measurements for the purpose of making distinctions between "different" groups of people. The question to ask, a question whose answer would help to distinguish phrenology from a neurotechnology such as fMRI, is whether we are looking for differences in the brain to understand difference in and of itself through these new neuroimaging technologies, or whether we are looking for differences so that we may once again find a way to divide ourselves into groups. If the answer is to learn to appreciate difference in itself, we can and should proceed, albeit cautiously. If however, the latter is the case, and the motivations for the neuroscientific research are primarily driven by an urge to neatly place people into pre-ordained categories, ones that are heavily marked by institutionalized frameworks of power, the study should be accompanied by a warning label.

Take for instance a series of fMRI experiments that were conducted a few years ago to measure gender differences in brain activation during the exposure to sexual stimuli and/or imagery of sexual and emotional infidelity [40–42]. Most of these papers begin with several binary assumptions that run along the lines that male subjects and female subjects in these studies are necessarily different. Examining our understandings of what exactly constitutes stable "groups" such as males and females to begin with never quite seems to be on the radar in these studies. This general male/female division often portends another common and yet often unmentioned assumption of an unequivocal heterosexuality among the subjects within the study. Researchers from one such study for instance suggested that their fMRI results favor the notion that men and women have different neuropsychological modules to process sexual and emotional infidelity and that there is a neural basis of jealousy-related behaviors predominantly observed in males. The researchers found that during "jealous conditions" men had greater activation in regions associated with

what they called "sexual/aggressive" behaviors said to be regulated in the hypothalamus and amygdala [41]. I find this scientific paper extremely interesting, for it begins by acknowledging the problem of violence against women and of domestic violence on a global scale. This is indeed an extremely important issue that deserves widespread attention and can benefit from both academic and activist points of intervention. The motivation for conducting this particular study however was not to study how this violent behavior is abated by many men (and women) or to learn how the brains of men who have never been violent towards women may look, but rather to contribute to the already preformed hypothesis that there is a neural basis for jealousy-related behaviors that is predominantly observed in males. It also does not measure how acts of jealously are performed or executed differently in different people, including males. In fact, even though the investigators show an interest in understanding the problem of violence against women, the difference that they end up looking for is one that has already been found, time and time again. Unfortunately, and perhaps unintentionally, their results end up reinforcing the idea that men are biologically hardwired for violence, and in turn contributes to a power structure and gender hierarchy that ultimately benefits through this belief.

In other related studies, researchers conducted fMRI experiments in an attempt to understand gender-based differences in sexual arousal and erotic stimuli [40, 43, 44]. Many of these sex-differentiated or gender-based studies are linked to issues of anxiety and/or depression when it comes to female subjects and to economics and risk-taking behaviors for male subjects. We have to ask ourselves while examining these studies, whether the research contributes to social stereotypes that reinforce discrimination based on perceived differences, or whether it moves us a little closer to lifting or destabilizing an oppressive power structure based on our understanding of difference. The assumed binaries in male/female behaviors and reinforcement of socially acceptable gender roles are evident in the epistemological frameworks of many of these studies. Take for instance a recent study that used sexual imagery to understand the male human brain. The research examined the effects of stimulation in male subjects on their financial risk-taking capabilities via visual exposure to pornography [43]. The researchers found that indeed, as they had expected and as ad agency folks have known for several decades without the help of fMRI technology, that "sex sells." As they summarize in their paper,

> These results are consistent with the notion that incidental reward cues influence financial risk taking by altering anticipatory effect, and so identify a neuropsychological mechanism that may underlie effective emotional appeals in financial, marketing, and political domains. [22: 509]

Putting aside the longstanding debates over the politics of pornography that have been ongoing in feminist circles, it is interesting to me to see that the study was conducted only using male subjects. By not including women in the study, the researchers succeeded in once again chasing a well-established stereotype, and not pursuing the possibility of a different difference. When probed as to why women were not also tested in a similar fashion for their financial risk taking capability, a co-author of the article stated in a press release that "the same link could hold true for women, but they didn't test it because it is more difficult to find an erotic image that would appeal to many different heterosexual women compared to heterosexual men" [45].

For anyone who has ever been marginalized and/or oppressed in our society for not meeting a certain physical standard, or for anyone who has ever been discriminated or objectified for possessing physical differences that are on the most part beyond their control, or for anyone who has found themselves not resembling what the African American lesbian feminist theorist Audre Lorde had deemed as the mythical norm [46: 116], the way that these stories end is all too familiar. In fact, Lorde was all too aware of issues of materiality and the differences of our biological bodies. Lorde would have asked us to look at the epistemological framework of the scientific inquiry and ask whether the study measures difference for the purpose of dividing people into groups which can then be neatly ordered into positions of privilege or oppression. This she would have seen as a cause for concern. The goal for neuroethicists should be to guide neuroscience research to a different place – so that we do not once again tread that well-beaten path of biological determinism or bring forth a materiality

that is marked by superiority and inferiority. As Lorde also pointed out,

> [W]e have *all* been programmed to respond to the human differences between us with fear and loathing and to handle that difference in one of three ways: ignore it, and if that is not possible, copy it if we think it is dominant, or destroy it if we think it is subordinate. But we have no patterns for relating across our human differences as equals. As a result, those differences have been misnamed and misused in the service of separation and confusion. Certainly there are very real differences between us of race, age and sex. But it is not those differences between us that are separating us. It is rather our refusal to recognize those differences, and to examine the distortions which result from our misnaming them and their effects upon human behavior and expectation. [19: 115]

Neuroethicists have several options. They can for instance engage with the neurosciences in ways that would be expected and make the job of "preempting the critics" easier for the scientists who are working on the other end of these new neurotechnologies. Another option might be however to meet the challenge that Lorde spelled out for us years ago. On the matter of our brains and bodies, there are of course going to be cases of difference in the scientific research. The question is how are we going to learn how to "recognize" these differences and avoid "misnaming" them?

Shared Perplexity #2: Is there Enough Difference?

Just as neuroscientists and neuroethicists have to carefully process how they respond to differences found in the brain between humans, I think that feminist scholars have to learn to pause before they respond to those studies that claim to find sex and/or gender-based differences in the brain. In an effort to find a common ground upon which neuroscientists, neuroethicists and feminists can pose questions of shared perplexity, I want to try to dive further into the concept of difference and not steer away from difference. As I mentioned previously, I think we need to examine whether neuroscientific studies on sex and gender differences show an openness and appreciation for biological complexity. Is there enough difference or only enough to create a binary division? I want to be clear here however that by turning towards difference, in no way do I want to dismiss those feminist critiques of neuroscience that work to highlight the prejudices associated with emphasizing difference as opposed to similarity [47]. Many of these feminist critiques of sex/gender differences in the brain are righty critical of the simple binary distinctions that are made in most scientific studies. Their aim is to complicate our dichotomous categorical tendencies. In a similar vein, my wish is to dive into difference even deeper when dealing with these scientific studies and have the treatment of difference proliferate into "a thousand tiny sexes", to borrow the phrase from feminist theorist Elizabeth Grosz [48]. This proliferative wish stems from a similar position to these feminist critiques, but perhaps from a different angle of diffraction.

Many years ago, while describing the work of Barbara McClintock, Evelyn Fox Keller wrote on McClintock's scientific respect for biological complexity and difference. Through McClintock's research on maize and the molecular process of transpositions, Keller expresses thoughts on biological difference by stating:

> In McClintock's world view, an understanding of nature can come to rest with difference. "Exceptions" are not there to "prove the rule"; they have meaning in and of themselves. In this respect, difference constitutes a principle for ordering the world radically unlike the principle of division or dichotomization… Whereas these oppositions are directed toward a cosmic unity typically excluding or devouring one of the pair, toward a unified, all-encompassing law, respect for difference remains content with multiplicity as an end in itself. And just as the terminus of knowledge implied by difference can be distinguished from that implied by division, so the starting point of knowledge can also be distinguished. Above all, difference, in this world view, does not posit division as an epistemological prerequisite—it does not imply the necessity of hard and fast divisions in nature, or in mind, or in the relation between mind and nature. Division severs connection and imposes distance; the recognition of difference provides a starting point for relatedness [49: 163].

The discussion of sex and gender differences in the brain has garnered a great deal of attention over the last century and a half. As with other neuroscientific interventions that have come before such as craniometry and phrenology, fMRI technologies are being used once again to understand and determine the neural basis of sex and gender differences through the practice of measurement. In many of these studies, the working assumption is firstly, that we need to measure in order to divide people into groups; and secondly, in the particular case of neuroscientific studies on sex and/or gender, that we can and should be able to easily divide the differences produced by our practices of measurement into two, and only two, distinct groups.

To illustrate how we might look at difference in terms of a radical multiplicity rather than a severing tool for dichotomous division, I would like to turn briefly to an fMRI study that was designed to measure brain activation responses in males and females elicited by humor [50]. I have discussed this study elsewhere [35] but would like to highlight a different aspect of it here. The scientific paper begins by stating that "[t]he long trip to Mars or Venus is hardly necessary to see that men and women often perceive the world differently" [50: 16496]. This is a prime example of an epistemological approach to difference where we can see that the "terminus of knowledge implied" most likely ends in that of dichotomous division and not one of radical multiplicity. Having said that, there is in fact another very interesting aspect of this experiment that may work in support of the idea of a radical multiplicity. To bring this to the surface however requires taking a pause to do some deep text diving. In the experiment, both male and female subjects were native English speakers, but of unknown ethnicity, class status, sexual orientation, etc. The subjects were shown a series of cartoons that were predetermined as being "funny" and "unfunny" by a participant group reported to be of similar "age and background" to the experimental subjects [50: 16497]. The subjects then underwent fMRI scanning to measure brain activation that followed in response to these cartoons. It should be pointed out that a main result of the experiment indicated that males and females "share an extensive humor-response strategy" [50: 16496]. The researches make due note of this. However, they go on to further elucidate the few differences they did observe in their study and these differences were then interpreted as gender-correlated responses.

These differences were namely that upon viewing the cartoons, females were found to have greater activation in their left prefrontal cortex, and they also exhibited greater activation in mesolimbic areas such as the nucleus accumbens compared to the male subjects. Based on these fMRI results, the researchers suggested that while men expected the cartoons to be funny from the onset, there was a greater feeling of reward in women because they were not expecting the cartoons to be funny. I find this conclusion made by the researchers quite fascinating and see this difference generated by the study as one that can potentially move us towards a difference of radical multiplicity. I also think that this finding speaks in a significant way to feminist concepts of embodied materiality. I am aware that the difference was generated through, and was initially based upon, a binary division between males and females. I think however that the more interesting question that emerges as a result of this experimental setup, and one that the researchers perhaps unknowingly lead us to, is to ask the question why someone would not expect a joke to be funny. This I think is a well noted difference that is worth exploring and one that cannot be resolved through a "cosmic unity" or "universal law" based on the division of humans through simple binary oppositions. If we posit for a moment that jokes are often funny because they are made at the expense of someone or something else, what comes to count as being funny becomes a multifaceted and complex idea based not on fixed binary group distinctions, but rather on individual contexts, experiences and performative interactions. By turning back to Keller's thoughts and her comments on McClintock's views on biological difference, I see here what might be a genuine respect on the part of the investigators for a difference generated through the combined intra-actions of the measurement apparatus [16]. The next step would be to listen to their own findings and open up to difference more fully.

Shared Perplexity #3: Untethering Structure from Function

Brain research and the study of sex and/or gender already share a long history and in turn as I have

mentioned previously, there is a rich tradition of feminist critiques of science that has engaged with the neurosciences. These studies have revealed the epistemological assumptions and effects of simple binary understandings of sex and gender [19–25]. These previous feminist engagements with the neurosciences can provide important lessons for the examination of current research that attempts to use fMRI and other neuroimaging technologies, including neuromolecular imaging, to try and establish a neurobiological basis for complex behaviors associated with masculinity, femininity, homosexuality, transsexuality and transgender identities. Of particular interest is the way in which behaviors and/or identities associated with human sexuality have been dealt with more recently at the intersection of molecular genetics, neuroscience and other imaging technologies.

In 1990, then president George Bush senior issued a proclamation that declared the decade that followed as the "Decade of the Brain." Indeed, during this period a formidable amount of progress in neuroscience was made, and not all of this progress was due to the new imaging technologies. Advancements at the intersections of molecular genetics and neuroscience also flourished, allowing scientists to formulate new questions regarding neurological function. One of the directions in which this access to new and intimate neurological details grew was in the area of sexuality studies. In a 2004 article in the journal *Nature*, the brain was referred to as "the most important sexual organ" [51]. Scientists began to search for the molecular basis of sexuality and turned to studying non-hormonal (read as genetic) influences on the sexual development of the brain using molecular biology techniques as well as molecular neuroimaging technologies. For instance, the genetics of "gender identity" has now found a new home in the brain, displacing the endocrinological signals originating from the gonads that were thought to be precursors for sexual differentiation [52]. As would be anticipated, scientists have since searched for and found sexually dimorphic gene expression in the brain [53–55]. Many studies are now dedicated to tracking the neuromolecular mechanisms of sex determination that are associated with sexual orientation [56, 57] and intersexuality [58–60]. Advancements in neuromolecular imaging have also led to a search for the genetics of gender identity and sexual orientation [52, 61, 62].

Sharing the sentiments of many neuroethicists, feminists have good reason to show a growing concern for these molecular studies that once again attempt to provide structural evidence, albeit genetic, for the neural basis of sex, gender, sexuality and many other social behaviors for that matter. As the neuroscientist Ruth Bleier stated years ago,

> "[T]he effort to find anatomical differences in the brain of females and males has a long tradition as an explanation for observed differences in social roles and status. The finding of a morphological sex difference in a part of the brain regulating a clearly sex-differentiated function, such as estrous cyclicity in rats or singing in certain birds, does not, however, warrant extrapolations to other species or to more complex behaviors [19: 92]."

Behaviors and identities marked by terms related to sex, gender and sexuality are highly nuanced and are invariably multiplicitous. It is clear that feminist scholars, as well as many others, will remain highly skeptical of any study that purports to understand the underlying mechanisms for behavioral differences between men and women based on observed differences in biological structure alone. But the problem is not just that the scientific studies are not rigorous enough to fully appreciate these nuanced and complex identities, but that for some feminists, even though they are aware of issues of materiality and differences in the biological and physical body, these strict identity markers themselves have become somewhat meaningless. For instance, in her attempt to create a feminist poststructuralist bioethical framework, Margrit Shildrick states,

> Starting from the initially self-evident binary concept of sexual difference, progressive feminism has moved on to concede that differences are always multiple, indeterminate, and mobile. The categories of gender, race and class—to name the usual suspects—make little sense as isolated components of any form of embodied identity, but are mutually constructed, albeit in an unfixed relation to each other [63: 17].

So not only is the direct correlative relation between structure and function now no longer tenable, but as many feminists will argue, the idea that a function or behavior (perhaps even perfor-

mance) can easily and directly be associated with any given isolated identity marker such as gender, is also under question. Having said all this, I realize that the chances for generating any kind of moment of shared perplexity amongst neuroscientists, neuroethicists and feminists in this realm will be difficult. Is it possible to respond and engage productively with neuroscientific studies that continue to fasten a secure line between structure and function? I think that this may be the hardest response to sex/gender differences in the brain that neuroethicists and feminists need to learn how to make—but the answer has to be yes.

In her recent edited collection, neuroscientist Gillian Einstein [64] suggests in the introduction to her text that students who are learning about sex differences in the brain should be made aware of the assumptions that are embedded in any scientific field, but particularly in the field of neuroendocrinology. In her list, which is comprised of eight major assumptions, she places "anatomical differences represent functional differences" [64; 1] as the number one assumption made by scientists in the field. I think becoming aware of this assumption is the first step towards untethering structure from function. The point however that feminist neuroscientists are making I think is not to ignore, dismiss or stop trusting biological matter altogether, but rather to search for those scientific research questions and evidence that support a more complex treatment of the relationship between structure and function. These may include studies that trouble the linear flow from a single structure (anatomical, genetic or molecular) to a single function by disturbing the direction of that flow (i.e. function influences structure), as well as those studies that bring to light the evidence of multiple structures related to an isolated function or multiple structures related to an array of functions. In the case of sexual orientation, evidence for the latter possibility has already surfaced. In a recent paper that compares the effects of hormones versus genes on sex differences in the brain and behavior [56], the authors attempt to trouble the "central dogma" of sexual differentiation by providing evidence that independent of hormonal regulation, genetic factors can influence certain neuronal properties. Although there are many other assumptions at work in their scientific inquiry, including a tight adherence to a binary male/female distinction, in the abstract of their article Bocklandt and Vilain state,

> Traditionally, in mammals, sex determination is considered equivalent to gonadal determination. Since the presence or the absence of the testes ultimately determines the phenotype of the external genitalia, sex determination is typically seen as equivalent to testis determination. *But what exactly does sex determine?* The endpoint of sex determination is almost invariably seen as the reproductive structures, which represent the most obvious phenotypic difference between the sexes. One could argue that the most striking differences between males and females are not the anatomy of the genitals, but the size of the gametes-considerably larger in females than males. In fact, there could be many different endpoints to sex determination, leading to differences between the sexes: brain sexual differences, behavioral differences, and susceptibility to disease. [*emphasis added*, [56: 245]

For these neuroscientists, the central dogma in reproductive physiology proves to be far too limiting. For that reason, they choose to question the fixed functional endpoints that have traditionally been held as standard benchmarks in sexual differentiation, and opt to move towards a more proliferative view of functional and sexual difference. We might begin to see glimpses of a moment of shared perplexity generated here between these neuroscientists and those feminist scholars who also choose to view differences as always being "multiple, indeterminate, and mobile." My own thoughts are that once our ontological concerns have been voiced, and our ethical orientations made to matter, the tools and techniques of molecular biology in combination with the practices of becoming molecular [33] have the potential to help us question many assumptions that have been made in the neurosciences and perhaps even motivate us to work more closely and justly with biological differences.

Conclusion

I would put forward the idea that the task at hand then for neuroethicists and feminists alike, is not to argue for the erasure of sex and gender differences or to

critique contemporary neuroscience research or neuroimaging technologies in order to dismiss them. Nor is it sufficient to simply learn how to tolerate such work. In order to learn how to respond to difference differently, movement must be made by neuroscientists, neuroethicists as well as feminists from seeking to secure a position of transcending "truth" to one of shared perplexity and "immanent critique" [36]. This process may involve reorienting ourselves to the matter and world around us, and perhaps, in the process of this reorientation, we will learn how to respond to biological difference from a new location. Depending on the apparatus at play, differences can be made to exist. From a feminist science studies perspective, this understanding has both ontological and epistemological implications, and changes our grasp on materiality. The issue here is not only the politics of measure as such, but also the politics of meaning. Our engagements with the neurosciences must therefore begin with the question of how we bring forth difference, and this in itself is the beginning of an ethical response.

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