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Sex differences and neuroethics

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Discussions in neuroethics to date have ignored an ever-increasing neuroscientific lilterature on sex differences in brains. If, indeed, there are significant differences in the brains of men versus women and in the brains of boys versus girls, the ethical and social implications loom very large. I argue that recent neuroscientific findings on sex-based brain differences have significant implications for theories of morality and for our understandings of the neuroscience of moral cognition and behavior.

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Two distinct and yet related fields of research have recently emerged. The first is the subfield of neuroscience that focuses on sex differences. The second is the interdisciplinary field of neuroethics. And yet, in spite of the fact that sex-difference research tends, in general, to be ethically and politically fraught, neuroethicists have had little to say on the ethical and political implications of emerging neuroscientific research on sex differences. This oversight is evidenced in the ways that the specific agendas for the newly burgeoning field of neuroethics have been ''mapped.'' A volume entitled *Neuroethics: Mapping the Field* was an early attempt to delineate and circumscribe the discipline (The Dana Foundation, 2002). And more recently, a volume edited by Judy Illes (2006) and titled *Neuroethics: Defining the Issues in Theory, Practice, and Policy*, further expands and refines the map. While both these volumes make substantial contributions to neuroethics, neither broaches the implications of neuroscientific findings of sex differences for society more generally or for specific neuroethical projects. I propose expanding the neuroethics agenda to incorporate and address issues tied to sex difference research. For if, as some neuroscientists claim, there are significant differences in the brains of men versus women and in the brains of boys versus girls, the ethical and social implications loom very large indeed.

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Adina Roskies provides what I consider to be a very a helpful overview of the neuroethics field as it currently stands. She identifies two main branches of inquiry in neuroethics: the ethics of neuroscience, and the neuroscience of ethics. Within the ethics of neuroscience, there are two subdomains: the *ethics of practice* which "guide[s] our practices of brain research and treatment of neurological disease" and the *ethical implications of neuroscience* which "explores the effects that advances in our understanding of brain function have on our social, moral, and philosophical views" (Roskies, 2006, p. 18). The *neuroscience of ethics*, on the other hand, is "a scientific approach to understanding ethical behavior" (Roskies, 2006, p. 18). When I examine some of the implications of recent neuroscientific research into sex-based brain and cognitive differences, I find myself in all three domains. Perhaps my overlapping approach could be neatly summarized as *feminist neuroethics*.

Feminist approaches to neuroethics could take many forms. Here I emphasize potential oversights of or harms to women's interests tied to recent research in neuroscience. Most feminists, myself included, would agree that women and men are creatures with human brains about which neuroscience has something to say, but they would emphasize in addition that we are also creatures embedded in particular social structures with learned patterns of behavior that contribute to how our brains are organized and shaped. In what follows, I see if a sampling of recent neuroethical theories, proposals, and norms are meant for creatures like us, in particular for biologically-sexed and culturally-gendered creatures like us. I start by briefly reviewing some of the findings and controversies in the neuroscientific literature on sex differences. Next, I outline some of the ways that recent sex-difference research conforms to and perpetuates gender-based biases and stereotypes. I then focus my approach more specifically on ways that sex-difference findings, if true, have implications for recent work in neuroethics and moral psychology. Finally, I propose an agenda for further inquiry in 'feminist neuroethics'.

1. Sex-Based Brain Differences

Objective facts about sex differences are, in general, difficult to come by. Neuroscientific facts about sex differences are no exception. For example, Louann Brizendine (2006) purportedly synthesizes recent findings by neuroscientists and endocrinologists on how women's brains differ from men's in her book *The Female Brain*. From the book's title and its author's credentials in neurobiology, medicine, and psychiatry, it would appear to be a good source on brain-based sex differences. The book has, however, come under both scientific and feminist attack. Two reviewers in *Nature*, one a behavioral neuroscientist and the other a feminist theorist, write that Brizendine's book is "riddled with scientific errors and is misleading about the processes of brain development, the neuroendocrine system, and the nature of sex differences in general." They conclude that *The Female Brain* "disappointingly fails to meet even the most basic standards of scientific accuracy and balance"

(Young & Balaban, 2006, p. 634). Other reviews and discussions by neuroscientists and feminists have been equally if not more critical (see, for example, Fine 2008).

Perhaps a better and more neutral source for an overview of sex-based brain differences can be found in Doreen Kimura's *Sex and Cognition* (1999) and relatively recent *Scientific American* (2002) article on the same topic. Kimura is well-respected by her neuroscientific colleagues; she is careful with her interpretations of the data; and she attempts to avoid overstating or oversimplifying the conclusions that she draws on brain-based sex differences. Kimura summarizes some of the most significant behavior-based sex differences and attributes these differences to differing brain organizations. She writes:

> We know . . . from observations of both humans and nonhumans that males are more aggressive than females, that young males engage in more rough-and-tumble play than females and that females are more nurturing. We also know that in general males are better at a variety of spatial or navigational tasks . . . . Perhaps the most important factor in the differentiation of males and females and indeed in differentiating individuals within a sex is the level of exposure to various sex hormones early in life . . . . These lifelong effects of early exposure to sex hormones are characterized as 'organizational' because they appear to alter brain function permanently during a critical period in prenatal or early postnatal development. (2002, pp. 32–33)

In addition to the differences summarized above, some neuroscientists, including Kimura, have concluded that women differ from men in certain types of social and emotional tasks. According to their neuroscientific findings, women appear to be consistently better than men at reading facial and body expressions (Kimura, 1999, p. 89).[1] In separate studies including one conducted at Harvard University by William Killgore, Mika Oki, and Deborah Yurgelun-Todd (2001), researchers report finding that the ways in which the hind, mid, and forebrain are wired together and balanced are quite different in males and females. They theorize that these differences affect how and the degree to which emotions feed into higher-level cognitive judgments. Those conducting the Harvard study conclude "that adolescent maturation may involve sexually dimorphic development of prefrontal cortex-amygdala circuits involved in affective processing" (Killgore et al., 2001, p. 433). In other words, the suggestion is that men and women differ in how emotions feed into the making of judgments, with women's emotions being more effectively integrated into their judgments than are men's.

It thus appears, based on research conducted on both human and nonhuman brains, that at least some of the stereotypical traits associated with women are being "located" in women's brains by neuroscientists. Women's brains are more nurturing, more socially attuned, more empathetic, and so on. As a philosopher, I am not in a direct position to evaluate the quality of the science in these and similar studies. There is, nonetheless, cause for skepticism concerning at least some of the conclusions being drawn by neuroscientists on these and related sex differences, especially in relation to humans. Most neuroscientific findings on human brains are based on fMRI scans. There are many critics, including neuroscientists themselves,

who are skeptical of the kinds of conclusions that are being drawn about human brain-based cognition based solely on the averaging of fMRI data.[2] In addition, how fMRI data is analyzed continues to change as new data analysis techniques emerge. In a recent conversation with a neuropsychologist, I was informed, for example, that the Harvard study referenced above contains outdated data analysis methods and actually shows nothing about the causal mechanisms involved in linking emotional centers to judgment-making centers of the brain.[3] When researchers add in the well-known difficulties of separating nature from nurture to those of correctly interpreting fMRI data, it becomes very difficult to make progress on how, exactly, women's brains are wired differently from men's, whether these wiring differences are a result of nature or nurture, and what, if anything, these differences mean for women's and men's cognitive styles and potentials.

It is also quite clear that women's brains are, on average, much more similar to men's brains than they are different, that any average differences found are usually quite slight, and that normal deviations within each sex are quite large. Doreen Kimura notes, for example, that "it is important to keep in mind that some of the average sex differences in cognition vary from slight to quite large and that men and women overlap enormously on many cognitive tests that show average differences .... On the whole, variation between men and women tends to be smaller than deviations within each sex" (Kimura, 2002, p. 34). Nonetheless, she asserts in the very next sentence that "very large differences between the groups do exist" (Kimura, 2002, p. 34). Presumably, the thought is that in some cases the average differences are sufficiently large such that they are not overwhelmed by the within-sex variation. For example, there appear to be very large differences between men and women in their levels of visual-spatial targeting ability. Thus, men are significantly better at throwing darts (Kimura, 1999, 32–32).

2. Feminist Approaches to Sex-Based Neuroscientific Research

Although few, if any, feminist ethicists have as yet specialized in critiquing neuroscientific claims of sex differences such as those made by Kimura, some scientists themselves have taken critical stances on science-based sex difference research. Cordelia Fine, a neuroscientist who now refers to herself as a 'critical neuroscientist', argues that Brizendine's *The Female Brain* and other publications like it are examples of "neurosexism". She writes, "unfortunately, scientific accuracy and common sense are often casualties in the ugly rush to cloak old-fashioned sexism in the respectable and authoritative language of neuroscience" (Fine, 2008). Fine fails to give us guidance, however, on how best to respond to or critically evaluate the more scientific and careful work being conducted by sex-difference researchers such as Kimura.

Anne Fausto-Sterling, a biologist, has authored two significant books that take a feminist perspective on biological theories about men and women. Her first book on the topic, *Myths of Gender*, came out in 1985 (updated second edition in 1992) prior

to much of the recent explosion in neuroscientific research, but remains surprisingly relevant today. She emphasizes that:

> If sex differences in cognition exist at all they are quite small, and the question of their possible origins remains unanswered. Nevertheless, the claim of difference has been and continues to be used to avoid facing up to very real problems in our educational system and has provided a rationale for discrimination against women in the workplace. (Fausto-Sterling, 1992, p. 14)

One of the examples she uses to help make her point is research on sex differences in cognition conducted and published by Robert Lehke in the 1970's. Lehke claimed to offer a biological explanation for why there are fewer intellectually precocious women than men. He hypothesized that ''a number of genes relating to intellectual ability reside on the X-chromosome and that, because of the peculiarities of chromosomal inheritance, X-linkage means that males will exhibit greater variability in intelligence'' (Lehke, 1992, p. 18). The implications of this greater variability are that there are more boys than girls institutionalized for cognitive deficits but also more boys than girls who are intellectual geniuses. Despite a number of critics who point out that his data could be interpreted any number of ways and could exist for any number of cultural as opposed to biological reasons, he did ''not feel that [he] must apologize for the fact that certain implications of the theory may seem. . .to be derogatory to women'' and claimed that he ''could not, with scientific objectivity, have changed the final result'' (as quoted by Fausto-Sterling, 1992, p. 22). Needless to say, Fausto-Sterling questioned the neutrality of Lehke's findings and conclusions.

In her most recent book, *Sexing the Body* (2000), Fausto-Sterling updates the neuroscientific findings on sex-based differences in the brain, but writes, ''I continue to insist that scientists do not simply read nature to find truths to apply in the social world. Instead, they use truths taken from our social relationships to structure, read, and interpret the natural'' (2000, p. 116). And of course, these purported scientific truths are even more distorted in the light of our social relations when the popular media gets hold of them. Sex-based neuroscientific findings are misstated and overstated in ways that only exacerbate political implications, providing purportedly scientific explanations for women's special abilities to nurture and empathize, and inabilities to think mathematically and scientifically.

Kimura is totally undaunted by such feminist concerns. In the introduction to her book, she defends the science she does and heats up the debate by accusing Fausto-Sterling of bias against biological explanations. She criticizes the view that because there are such high social consequences for sex- and race-based theories of difference, there should be a higher standard of evidence for scientific theories about sex- or race-based cognitive differences. She writes that, ''this is objectionable and absurd. The rules of evidence and the stringency of statistical evaluation must be the same for all findings. Facts are neutral'' (Kimura, 1992, p. 8). Surely, Kimura doesn't mean by 'facts are neutral' that they do not matter for the well-being of different social groups. The obvious case is research into racial differences, especially

in intelligence. Defenders of that work also say the facts are neutral; but then use those facts, for example, to press against the utility of early childhood education programs for minorities; others are even more extreme (Gould, 1981; Jensen, 1969, 1982).

Kimura also shouldn't think that all evidential claims are on the same footing. A five percent chance of being wrong might be unimportant in some cases, while a five percent chance of being wrong might be crucial in others. It may be a 'fact' ascertainable by standard statistical tools, that a medical treatment will not result in my getting a headache (with only a five percent chance of error); and it may be a 'fact' ascertainable by standard statistical tools, that a medical treatment will not result in my enduring a painful death (with only a five percent chance of error). How we should regard those 'facts' is quite different, however. I may be unwilling to risk the latter treatment, but may well risk the former. The question now becomes whether the 'facts' are sufficiently secure that we are willing, or not willing, to act on them. And that depends on the social costs, in part. The question is how certain we *need* to be, given the likely consequences of accepting or rejecting a view.

Even if scientists become fully convinced and entirely certain that significant sex-based differences exist, questions remain concerning the causes. If men are more skilled than women at throwing darts, undoubtedly there would be differences between men and women in the neurophysiologies underlying this skill, but the causes of these differences could be many; e.g., boys may spend more time throwing things or men may spend more time in bars. And if women are found to be more empathetic than men on average, how much of this is attributable to the care-giving and nurturing roles that are culturally assigned to them?

Knowing that supposedly 'neutral facts' about sex differences have had, and most likely will continue to have, harmful consequences for women, how should feminists respond to sex-difference research, including that being done by Kimura herself? I don't think they can ignore it. Nor can they prevent it. This is at least one reason they should not ignore it. Another reason is that the research into sex differences may yield important insights. Nonetheless, at the very least, they should encourage Kimura and others engaged in sex difference research to be more aware of the cultural assumptions and biases that surround sex differences. The researchers themselves, be they men or women, need to know that they hold implicit sex-based biases of their own. They should educate themselves on what some of these biases are, in order to avoid skewing their research questions and misinterpreting their results. In addition, they should be more explicit about the limitations of fMRI. Finally, they should be very careful in how they word and where they publish their experimental results, knowing that findings of even very slight average differences in men's versus women's brains are likely to be used to promote patriarchal and sexist ends.

There are plenty of examples that show the hijacking of neuroscientific research on sex differences for political purposes. Leonard Sax, both a psychologist and family physician who is a leader in the movement for single-sex education, recently wrote a well-received book entitled, *Why Gender Matters: What Parents and Teachers Need to*

Know about the Emerging Science of Sex Differences (2005). This book has, in turn, been referred to by *New York Times* columnist David Brooks (2006), a *Time Magazine* cover story (2005), and Stanley Kurtz in the *National Review Online* (2005). Of special interest to many in the media were Sax's neuroscientifically-informed theories on boys' emotional development. Sax writes:

> [In seven-year olds], the part of the brain that does the talking, up in the cerebral cortex, has few direct connections to the part of the brain where the emotion is occurring, down in the amygdala. In adolescence, a larger fraction of the brain activity associated with negative emotion moves up to the cerebral cortex. That's the same division of the brain associated with our higher cognitive functions—reflection, reasoning, language, and the like. So, the seventeen-year-old is able to explain why she is feeling sad in great detail and without much difficulty (if she wants to). But that change occurs only in girls. In boys the locus of brain activity associated with negative emotion remains stuck in the amygdala. In boys there is no change associated with maturation. Asking a seventeen-year-old boy to talk about why he's feeling glum may be about as productive as asking a six-year-old boy the same question. (2005, p. 29)

Sax refers to many of the neuroscientific findings mentioned earlier in my paper, but when he makes such assertions as, ''in boys . . . negative emotions remain 'stuck' in the amygdala,'' he greatly exaggerates and misinterprets the actual findings in order to bolster his single-sex-education agenda.[4]

Another academic whose use of neuroscientific findings on sex-based differences has led to distortion and misuse is Steven Goldberg, a sociologist at City College of New York. He has written two books entitled, *Why Men Rule—A Theory of Male Dominance* (1993), and *The Inevitability of Patriarchy: Why the Biological Difference Between Men and Women Always Produces Male Domination* (1973). The titles speak for themselves. Goldberg appeals to neuro-endocrinological evidence to argue that men are biologically destined to dominate, while women are biologically destined to hold the more nurturing and less dominant roles in society. He emphasizes that these biological differences don't imply that one sex is superior to the other—the two sexes are merely different from each other. Nonetheless, it should come as no surprise that the purportedly scientific conclusions drawn in his books are used to bolster strong political agendas. These agendas promote ''traditional'' social and family structures in which men hold the positions of power and heterosexual men marry and dominate heterosexual women. His writings have been quoted, for example, on the website for NARTH: National Association for Research and Therapy of Homosexuality (www.narth.com) and on numerous other pro-traditional family and self-proclaimed anti-feminist sites.

Scientists cannot be held responsible for how others contort and misuse their findings. And I am not advocating that they avoid sex difference research entirely. I encourage it. Nonetheless, they should be aware of how their research is being used and should enter the public discussion as much as possible to correct misuses and misinterpretations of their findings. Scientists are both researchers and citizens.

3. Implications of Sex-Difference Findings for Neuroethics

Much as scientific findings are never neutral in the way that Kimura and most other neuroscientists hope; much as fMRI-based research on brain-based sex differences is difficult to interpret and pin down; and much as the biologically-based brain differences between men and women may be slight; there is no denying that starting in the womb, males and females have differing hormones and differing hormone levels. And there is no denying that hormones play a significant role in brain development, organization, and functioning. So I trust that neuroscientists will continue to find sex-based brain differences of various sorts and to report their findings in neuroscientific journals. I also trust that, on average, some brain-based sex differences in cognition and emotion exist. Feminist neuroethics suggests we explore the differences and what they mean.

In the space that's left, I turn to a slightly different question. I ask and attempt to answer the following: *if* Kimura's and similar summaries of neuroscientific findings on sex-based brain differences are even close to being correct, and *if* future studies corroborate and further refine these findings, what are some of the implications for recent research on the neuroscientific underpinnings of moral behavior and cognition? Although studies on "moral brains" have burgeoned in recent years, little to nothing has been said about potential differences between women's and men's moral judgments and behaviors in the light of neuroscientific findings on sex differences. Questions they could be asking, but are not, include: Are women more empathetic, on average, than men? If empathy is important to morality, does this mean women are, on average, more moral than men? If men's judgments are more emotionally detached, on average, than women's, and if Kant was right that emotional detachment is important to making rational moral judgments, does this mean men are, on average, more moral than women? More substantively: in the light of what we are learning about the role that hormones play in shaping cognition and behavior, how do differences in men's and women's hormone levels affect their moral judgments and behaviors? Do differing levels and types of hormones absolve men and women in differing ways and degrees, of moral responsibility for their actions? What role does testosterone play in aggression and thus in the committing of violent crimes? Are more men than women in prison because their "moral brains" differ in fundamental ways?

Let me begin to show the relevance of some of these questions to neuroethics by examining recent neuroethical discussions of moral responsibility. As neuroscientists learn more about the brain processes involved in decision making and behaviors, they should be able to tell us to what degree various types of "normal" and "abnormal" psychologies can control and thus be held responsible for what they do. Our courts, for example, currently recognize that certain types of psychopathologies or extreme emotional states absolve, at least to some degree, those who commit crimes of responsibility for those crimes. Whom should we blame, whom should we imprison, whom should we treat, and whom should we institutionalize? Patricia Churchland (2006) has suggested that in determining moral responsibility, we focus

in on the concept of 'being in control'. By this she means we should focus on the degree to which someone is able to ''inhibit inappropriate impulses, to maintain goals, to balance long-and short-term values, to consider and evaluate the consequences of a planned action, and to resist being 'carried away by emotion'" (Churchland, 2006, p. 11). She suggests that neuroscientists attempt to determine various parameters of the normal profile of being in control and then delineate an n-dimensional space using these parameters to delineate the ''in-control'' space (Churchland, 2006, p. 13). These parameters could include connectivity patterns between various areas of the brain, patterns of neurotransmitter release and uptake, and levels of various hormones. She allows somewhat for variability, and suggests that the ''in-control volume of the control-space is rather large relative to the not-in-control space, suggesting that different brains may be in control by virtue of somewhat different values of the parameters''(Churchland, 2006, p. 14). The center of this space would be the prototype of a normal in-control person and the ''fuzzy borders'' of this space verge on a person's bordering on being out-of-control. Finally, she notes that a particular brain may ''drift'' in and out of the 'in-control' space, ''as a function of changes in a parameter such as hormone levels'' (Churchland, 2006, p. 14). What isn't clear in this account is how sex differences, especially in hormone levels and types, feed into delineating and centering the normal in-control space.

Since Churchland does not advocate for separate and distinct ''normal'' in-control spaces for men and women, she implies that all sex-based brain differences would be incorporated in the ''rather large'' normal space. But where should this ''normal space'' be centered? If there are relevant sex-based brain differences, which sex's brain is considered the prototype for being in control? Of most significance here, I think, is using hormone levels as a parameter for the ''normal'' space. Quite clearly, men's and women's hormone types, levels, and degrees of fluxuation differ significantly. What hormone types and levels make up the prototype for this particular parameter? And which hormone types and levels are at best borderline? For example are the brains of pre-menstrual women destined always to be borderline if not out-of-control? Do we allow for more fluxuation of testosterone in the ''normal'' zone than we do estrogen? How do we even compare these sorts of differences? And even if we decide to have two prototypes: one for male brains and one for female brains, where should *these* control spaces be centered? What's the ''just-right'' level for testosterone and estrogen in ''in-control'' men and in women? I suggest that, at the very least, women's and men's ''in-control'' spaces be viewed as two distinct sex-based spaces; and that each of these ''normal'' spaces be drawn as large as possible to accommodate the wide ranges of hormonal fluctuations that occur in both men and women. Even here we run into great complexities when we remember that transgendered individuals are often on large dosages of hormones and that not everyone fits into one of two biological sexes.

Let's now expand our focus and examine Churchland's proposal in the light of currently existing social practices and structures. Historically, women have been viewed as both rightfully controlled by men and less in-control than men. Even today, they hold fewer controlling positions of power than men do. In the past, when

women resisted being under the complete control of men, they were often diagnosed by ''scientists'' as hysterical, or literally insane. It is worth noticing what ''hysterical'' meant. It was first and foremost attached to women. And as many know, the treatment was hysterectomies. The history of mental institutions is rife with examples of men who institutionalized wives or daughters simply because of their perceived disobedience (see, for example, Riff, 2004). Even today, a common retaliatory strategy by those in power against whistleblowers is referred to as the ''nuts and sluts'' strategy. Label the resister insane and if the resister is a woman, also a slut. Either way, you deny that their claims come from someone who is in control and deserving of moral recognition (see DesAutels, 2008).

Women are much more likely than men to be stereotyped as ''hormonal'' and irrational. Hormones supposedly rage in women when they are pre-menstrual, menstrual, post-menstrual, pregnant, post-partum, pre-menopausal, and post-menopausal. Women are viewed as being more cognitively swayed by hormone levels and as more likely to be outside the norm when there are variations. They are expected, nonetheless, to be less aggressive than men, and so behavior that is within the ''normal'' range for men is clearly off the charts for women. Although the folk vaguely know that testosterone levels in men vary to some degree and also affect control and responsibility, generally, it is the women who are viewed as subject to hormone levels.

I do not wish to discourage further pursuit of brain-based understandings of being in control. Instead, the agenda I wish to promote is a more cautious research program, one that is sensitive to individual variation and to sex-based differences, environmental and biological, that shape the brains being observed. At the very least, neuroethicists need to take this social backdrop into account in order to avoid confusing social stereotypes with neuroscientific generalizations about what is 'normal'. I would also hope those neuroethicists attempting to follow through on Patricia Churchland's proposal take variability within humans, within sex groups and within individuals very seriously. Even if they do, my concern remains, that attempts to center and circumscribe even quite large neural in-control-spaces privilege those whose spaces fall in the center and quite literally morally marginalize those at the margins.

Much more could be said about Patricia Churchland's proposal, but in the interests of space, I move now to recent neuroscientific discussions of the role that emotions play in the making of moral judgments. One way to better understand this role is to examine brain disorders such as those of high-functioning autists and psychopaths or those with certain types of brain damage. For example, Adina Roskies (2006) suggests that emotions play a role in the moral psychologies of ''normals'' by appealing to the Phinneas Gage case and others like it that involve ventromedial frontal (VM) damage to the brain. Past studies purported to show that VM patients make the same moral judgments that ''normals'' make, but it has recently been discovered that the judgments tend to differ in VM patients and ''normals'' in high-affect versus low-affect situations. In other words, VM patients respond differently

than ''normals'' to situations that evoke emotional responses in normals. Roskies concludes that in

> normal people, emotion plays an important role in modulating reasoning about morality . . . the affective component is most strongly harnessed in situations in which we imagine ourselves personally and physically involved in what can be thought of as an emotionally charged situation . . . . VM patients illustrate an important feature of the functional organization of the neural systems that subserve judgment in moral situations. They show that this emotional-motivational component can be dissociated from the process of reasoning and judgment. (2006, p. 28)

Roskies' suggestion that areas of a normal brain tied to emotion feed into the areas of the brain that make moral judgments is, she claims, ''consistent with recent findings from neuroimaging, documenting the involvement of systems known to be important in emotional responses during moral reasoning tasks'' (2006, p. 29).

I do not particularly want to contest Roskies' conclusions. However, including a discussion of sex differences, whatever they are, would enrich her project. As with Churchland, Roskies makes no mention of potential sex differences in the role that emotional responses play in higher cognitive functions such as the making of judgments. Recall, as I've reported, the Harvard study that purports to show that the cerebral cortex connects differently in women and in men to the part of the brain where the emotions are occurring. In fact, the claim is that men are less likely than women to bring emotions into certain higher-level cognitive activities. No doubt such claims need to be verified and refined, but if they are true, they could have a significant impact on the role that emotions play when women make moral judgments about high-affect situations versus when men make moral judgments about high-affect situations.

On a topic related to that of Roskies, Kent Kiehl has recently summarized the neuroscientific findings on criminal psychopaths. Criminal psychopaths are of special interest to moral psychologists because, as described by Kiehl, they have a ''profound lack of empathy and guilt or remorse, shallow affect, irresponsibility, and poor behavioral controls'' (Kiehl, 2008, p. 119). He notes that patients with damage to orbital frontal regions such as those described above by Roskies show similar impairments as those found in psychopaths, but that ''the two disorders differ in many respects'' (Kiehl, 2008, p. 125) and that criminal psychopaths appear to have disturbances in additional brain regions. He points to recent cognitive neuroscience studies of affective processing that show dysfunctional or hypofunctional areas of the temporolimbic system including ''the amygdala, parahippocampal regions, the anterior superior temporal gyrus, the rostral and caudal anterior cingulate, and the posterior cingulate'' (Kiehl, 2008, p. 143). Behaviors also differ to some degree between VM patients and psychopaths: criminal psychopaths are more likely than VM patients to exhibit instrumental aggression and callousness to the suffering of others (Kiehl, 2008, p. 124). Although Keil mentions studies performed exclusively on male psychopaths and on ''boys with psychopathic tendencies'' (2008, p. 125), he doesn't directly address sex differences either in numbers of psychopaths or types of

psychopaths. Nonetheless, according to Scott O. Lilienfeld and Hal Arkowitz, ''most psychopaths are male, although the reasons for this sex difference are unknown'' (Lilienfeld & Arkowitz, 2007). From what little is known about the few women who are psychopaths, it appears that female psychopaths generally behave less aggressively than their male counterparts. Clearly, much more research needs to be done. But if there are significant sex differences both in the numbers and types of psychopathic behaviors, why is this so, and what does this tell us about the normal moral brains of men versus women? We return to the issue of 'normal'. If men and women differ in the ways that and degrees to which emotions such as aggression feed into moral judgments, which sex is viewed as prototypical of moral judging and which sex borders, at best, on being abnormal? Which sex is deemed to be more prototypically moral overall?

Just as we did with Patricia Churchland's neural-based theory of being 'in control', we can also examine Roskies' neural-based theory of making moral judgments in the light of our past and current social understandings and practices. If indeed it turns out that women's brains are, on average, better at integrating emotions into their moral judgments, and we judge those who are able to feed their emotions into their judgments as prototypically moral, we might decide that on average, women are more morally competent than men. This isn't a new idea, by any means. In the late 1800's and well into the 20th century, in the United States, women were viewed as being more naturally moral than men and the social expectation was that women should be the guardians of moral virtue. Women were also expected to be the primary educators of children in the moral virtues while men engaged in science, politics, and business. If contemporary society judges that women are, in general, more moral than men, this places women in a double bind. Certainly being moral is a good thing! But men have a history of oppressing even those whom they judge to be more moral than them. And this social judgment allows men to behave badly while leaving the moral work to those for whom morality is more 'natural'. If, on the other hand, society decides that men are more moral than women, this is all the more reason to control women and make decisions for them. Hence the double bind.

As my third and final example of recent neuroethics discussions that would be enriched by addressing implications of sex-based brain differences, I turn to a piece on the implications of neuroscientific advancements for education written by Kimberly Sheridan, Elena Zinchenko, and Howard Gardner (2006). In this piece, they argue for establishing a new educational subfield, 'neuroeducation', in which professionals are ''adequately trained to handle the challenges posed by neurocognitive advances'' (Sheridan et al., 2006, p. 273) The types of issues such professionals might face include needing to educationally accommodate neurological reports based on the fMRI data of their particular students and needing to modify curricula more generally to take into account new understandings of the brain and how it learns (e.g., how brains learn fractions). I find it highly unlikely that our schools will be able to afford modifying curricula for each student's particular brain. And even if schools could afford it, there are serious impracticalities. We would have to put each student

in a scanner, and children don't do well in scanners. On the other hand, if neuroscientific studies are finding that there are significant sex-based differences in how girls' and boys' brains are organized, in the developmental timing of shared structures, and in learning when faced with external stressors, educationally accommodating boys versus girls is much more feasible. Curricular design and classroom environments are both at stake here. We would need to revisit the importance of single-sex education or of single-sex tracks or groupings within co-educational institutions.

And let's step back, once again, to think about sex-based neural differences in developing children in the light of society's practices and structures. One worry I have is that by focusing on educating children's brains, we'll understress both the role that internalized societal expectations play in cognition and the variety of types of cognitive styles that result in becoming good mathematicians and scientists. If as Harvard's ex-president proposed, we look to sex-based brain differences to explain why so few women choose careers in math and science, we may miss the social pressures contributing to this phenomenon. For example, in 1995 Calude Steele and Josh Aronson studied what they termed stereotype threats. Such threats occur when we worry about being judged in terms of a negative stereotype or confirming a group-based stereotype because of our behaviors. Later studies showed, more specifically, that women taking mathematics tests tended to do more poorly than men on the high-level questions only when their gender had been commented upon prior to their taking the test (Spencer, Steele, & Quinn, 1999). So, if you are a woman student striving to succeed in math or science, especially in time-pressured situations, then there is the additional concern that poor performance could be taken as confirmation of the stereotype that women aren't good at math and science. The researchers concluded that when stereotype threat is at work, fewer women will have high scores, and their scores will under-predict their achievement. A follow-up study by Toni Schmader (2002) suggests that women's problem-solving performance can be improved by acknowledging stereotype threat. But notice how when neuroscientists find slight average differences between men and women in visual-spacial tasks, and when the role of visual-spacial intelligence is tied to one's ability to solve certain math and science problems, the media tends then to simply report that men are better than women at math and science. The very stereotype that affects women's performance is further reinforced. Once again, we don't want to blame the scientist for the confusions of the popular media. We also still don't know whether such differences are because of nature or nurture. Some researchers suggest that boys develop slightly better math reasoning on average not because of innate brain differences, but because they appear to use spatial strategies more often than women (see Gallagher et al., 2000; Geary, 1996). When all students are instructed to use spatial strategies, the sex-based differences narrow considerably (Geary, 1996).

Another of my main worries is that focusing on sex-based or even individual brain differences will lead educators to hold a too-narrow view of what types of brains are good at what types of tasks and careers. Even if some groups of people are slightly

better at visual-spacial tasks than others, this doesn't yet tell us if they make better mathematicians or scientists. Peter Medewar, famous for characterizing science as ''the art of the soluble,'' noted about scientists:

> Scientists are people of very dissimilar temperaments doing very different things in very different ways. Among scientists are collectors, classifiers, and compulsive tidiers-up; many are detectives by temperament and many are explorers; some are artists and others artisans. There are poet-scientists and philosopher-scientists and even a few mystics. What sort of mind or temperament can all these people be supposed to have in common? Obligative scientists must be very rare, and most people who are in fact scientists could easily have been something else instead. (1982, p. 116)

There are, indeed, many ways for brains to approach and solve problems, including scientific and philosophical ones.

Just as there are many ways to do science successfully, there are many ways to successfully make moral judgments and live moral lives. One of the most significant brain differences, for example, and much more significant by far than sex-based differences, is left-handed versus right-handed differences. For example, a portion of left-handed people have language functions controlled by the right hemisphere, but there is no evidence that they suffer deficiencies of language use. Similarly, my assumption is that left-handed people can be moral to the same degree as right-handed people even though they use very different parts of their brains for many cognitive tasks; even though various functional parts of their brains are wired together quite differently from right-handers; and even though 'sinister' is defined as 'left-handed'. Human brains are surprisingly plastic and varied. Remember that isolating functional areas of the brain using fMRI techniques involves a very high degree of averaging. These averaged results are often misinterpreted and misused to imply that brains that vary from these averages are somehow abnormal. But variety is normal. Our brains also change as we age, and as we lose certain cognitive capacities, we are amazingly competent at finding new cognitive strategies to make up for our deficits. Older human brains can be just as successful as younger brains at doing science or philosophy or even ethics—they just do it differently.

Owen Flanagan was right when he titled his book on moral psychology, *Varieties of Moral Personality* (1991). As neuroscientists find out more about individual variations in brains and average sex-based brain differences in ''creatures like us,'' it's best to not ignore these variations and differences. Instead, I propose that moral psychologists and neuroethicists take as their task that of delineating a variety of moral personalities, behaviors, and decision-making styles and a variety of social structures and practices in which these personalities are embedded. They must avoid privileging narrow notions of moral decision-making and behavior, and they must avoid singular moral prototypes that banish many of us and our brains to the borders and beyond of these prototypes. There are many styles of cognition, and there are many, many ways to wire moral brains.

4. A Proposed Agenda for Feminist Neuroethics

I end by proposing an agenda for those wishing to further pursue a feminist approach to neuroethics. There is much left to be done. More specifically, I recommend that future efforts be directed towards: (1) critically examining ways that sex-based neuroscientific research is embedded within and contributes to gender-based social biases and injustices; (2) providing guidance for whether or not, and under what conditions, sex-based neuroscientific research should be conducted and disseminated; (3) emphasizing that brain plasticity and variations are to be expected and 'normal'; and (4) developing theories of ''moral brains'' that are informed both by neuroscientific findings (including findings of sex-based differences) and ethical theories (including feminist theories).

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Notes

[1] Kimura refers here to Judith Hall (1984) who surveyed over 50 published studies and found that more than 80% of the studies found women to be better than men at reading social signals, ''though not all sex differences reached a statistically significant level'' (Kimura, 1999, p. 89).

[2] For more on this in lay person's terms, see Michael Shermer (2008).

[3] This study uses a correlation analysis which tells us little about causality. Newer methods for analyzing neuroscientific data can show affective connectivity (personal conversation with neuropsychologist, Dina Schardt, on September 29, 2008, in Bielefeld, Germany).

[4] For more on exactly how and in what ways Leonard Sax misinterpreted the neuroscientific findings on sex differences, see linguist Mark Liberman's detailed online entry on his Language Log, June 24, 2006 entitled, ''Are Men Emotional Children?''

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