Gender and the Science of Difference

Cultural Politics of Contemporary Science and Medicine

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Gendering Science

Contextualizing Historical and Contemporary Pursuits of Difference

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> Clearly, not all women and men are the same. But for many the science is undeniable: powerful hormones and the complex circuitry of the brain do shape our behavior and, therefore, our destiny.
>
> –ABC News, "The Truth behind Women's Brains"

> In analyzing male/female differences, these scientists peer through the prism of everyday culture, using the colors so separated to highlight their questions, design their experiments, and interpret their results. More often than not their hidden agendas, non-conscious and thus unarticulated, bear strong resemblances to broader social agendas.
>
> –Anne Fausto-Sterling, "Gender, Race, and Nation"

During the last ten years, there has been a resurgence of popular interest in the biological differences between women and men. Not surprisingly, given cultural obsessions with the brain, the primary site of these differences is often described as neurological. Books with titles such as *The Female Brain*, *The Essential Difference*, and *Why Men Don't Listen and Women Can't Read Maps*, among others, have been bestsellers as they promise readers knowledge about why men and women think and act differently. Computer metaphors are frequently mobilized so that differences between men's and women's brains are cast as "hardwired," communicating that they are both absolute and unalterable. Men and women are framed as inherently, biologically different, which is meant to explain and naturalize the social and behavioral differences between the sexes that the lay public so easily recounts. We are all familiar with these social and behavioral differences; they are inescapable in our culture: women are more emotional

than are men, men are more sexually motivated than are women, women are listeners while men are problem-solvers, and so on and so forth. What is fascinating is that our society seeks to explain these differences as biological and that we invest vast scientific resources in "proving" that sex is the most powerful predictor of what type of individuals we will become.

Of course, from a scientific perspective, this is an overly simplistic rendering of the state of knowledge about the biological differences between the sexes. Nonetheless, science often plays it both ways. Professional scientists know that the biological *similarities* between men and women are greater than their differences even while they engage in research on those differences. They also know that a great deal of diversity exists within each sex. At the same time, however, scientific press releases by researchers' universities often exaggerate research findings in order to pitch to the media stories that will have broad popular appeal. In other words, while the media may be to blame for some of the representations of the biological differences between the sexes, many scientists are interested in and add to the popularization of such research findings. There are many reasons for this, but one among them is that scientists—those in the natural sciences as well as those in the behavioral and social sciences—want or need to illustrate the broader implications of their research in order to have successful careers.[1]

All of this is to say that it is important to think critically about scientific evidence—where it comes from, how it is generated, and why certain types of research are perceived as valuable. This means two things: first, science needs to be contextualized in a historical framework to understand how the pursuit of knowledge has changed and has remained the same over time and, second, contemporary research needs to be evaluated in the same way as historical examples of science to understand how current social and cultural norms continue to influence scientific inquiry. While the emphasis in this introductory chapter is primarily on the former, the case studies in the rest of the volume concentrate on the latter. Nonetheless, as I will discuss, there is a great deal of continuity between the past and the present.

Science as a Social and Cultural Enterprise

There are multiple ways to think about science and the production of knowledge. One element of science that is often overlooked is that in addition to being a way of understanding the natural world, science is also an institution comprised of individuals who are making decisions about what questions are important, what methods are valid, and how results will be analyzed. In popular culture, science is usually depicted as the process of revealing preexisting Truths about the natural world.[2] Yet facts are produced by individuals who use tools and methods that structure what claims can be made. In other words, as

scientist Ruth Hubbard reminds us, "Facts aren't just out there. Every fact has a factor, a maker . . . [and] making facts is a social enterprise" (1988, 5). This is not to say that these scientific facts don't represent truths about nature; rather, it means that the facts that are created are partial and contingent interpretations of what humans observe. As will become more evident with several examples in the following sections, what scientists observe is often subject to what they already believe is true and is usually in sync with broader society's culture and values.[3]

Just as science is influenced by society, so too does science have an impact on how society is organized and functions. This reciprocal relationship illustrates that science is not a neutral enterprise. For example, Western society has long been characterized as patriarchal, meaning that it is hierarchically organized with men having the dominant position and women the subordinate one. On the ordinary level, this is witnessed through naming norms—children usually have their father's names and women typically take on their husbands' family names.[4] More than just customs, however, patriarchy is largely about power and control. It shapes what roles men and women have in society and our understanding of what each is capable of and what behavior is expected of each.[5] Patriarchal ideas have heavily shaped the pursuit of science, and science has supported the patriarchal system by naturalizing its norms and values. Many scientific pursuits can be labeled androcentric, meaning that knowledge has been constructed with a decidedly male focus or perspective. For instance, in studies of sexuality during the late nineteenth and most of the twentieth centuries, scientists focused their studies of sexual behavior on male animals, presuming that the male of the species (usually mice or rats) had the active role and that the females were passive, a view that mirrored contemporaneous presumptions about human sexuality (see Birke, this volume). It was only when women started entering the laboratory as scientists during the 1970s that female sexual behavior became a focus of investigation and the complexity of female behavior began to be observed (Van den Wijngaard 1995). In short, science tends to support the mainstream values of society, even when those values are sexist.[6]

So how then do we separate out *real,* bona fide differences from sexism or patriarchal values? Some would say that there are empirical differences between men and women that are simply biological and natural and, as a result, are completely apart from culture, politics, and so on. Many immediately argue that the main difference between women and men is that women can have babies while men cannot. Yet, practically speaking, the ability to develop a fetus and give birth is not what makes a person a woman; we wouldn't assert that someone is not a woman because she is infertile. Others point to external genitalia as the clear way to distinguish women from men. While breasts and labia and penises and testicles provide one means of categorizing people, there are, nonetheless,

frequent examples of ambiguous genitalia as well as a great deal of variation in size and shape of both men's and women's parts. Adding to the slipperiness of these seemingly absolute categories of women and men, U.S. society is increasingly more sensitive to the experiences of transgender and transsexual individuals whose identities challenge strict binaries. Despite exceptions that are made, it is rare that we question how absolute our taken-for-granted assumptions about sex differences actually are and—more importantly—why ambiguity in these differences can make us (collectively speaking) nervous. Our cultural investment in these categories is one indication that interest in differences is never simply casual. Moreover, when we make distinctions between men and women, we are generally ascribing *meaning* to any differences identified between the groups.

As if physiological differences weren't tricky enough, the politics of the differences between the sexes comes most easily into view when science investigates behavioral patterns that diverge in women and men. These are the differences that are more accurately described as those of *gender* rather than sex, and the controversy lies in the degree to which gendered behaviors are "natural" or inherent to the sexes.[7] For example, women as a group are better nurturers than men are as a group. The question remains, however, whether nurturing behaviors are inherent to women or they are the product of socialization.

In order to make meaning out of documented or perceived gender differences, there are two predominant theoretical positions: *essentialism* and *constructivism.* Essentialism—also known as biological determinism—promotes the view that sex characteristics are natural and determine behavior. From this position, sex and gender are interchangeable concepts and terms. In contrast, constructivism denotes the view that sex has a biological basis while gender is socially constructed and not natural. This latter position arose from the women's movement of the 1960s, when feminists argued that gender differences have historically been mobilized to create and enforce inequalities between men and women in society, but gender norms can be redefined to equalize the sexes.[8] Or to put the two positions in more familiar terms, this is the old "nature versus nurture" debate using more precise terminology.

While many scientists borrow from both ends of the spectrum, there are radical examples of each of these positions. For example, scientists who work in the subdiscipline of sociobiology are known to make extreme claims leveraging evolutionary explanations about the biological basis of gendered behavior. Research in this field seeks genetic answers for why men supposedly prefer young, blond, large-breasted women (i.e., these characteristics are said to be perceived as indicators of women's fertility). On the other end of the spectrum are scientists who claim that even biological differences between the sexes are a function of social norms and customs. For example, studies show that exercise

has more of an impact on physiology (e.g., bone density, muscle mass, metabolic rate) than does sex so that presumed sex differences are quite often not accurate in and of themselves but are instead proxies for differences in amount and types of physical activity (Birke 2001).

There might be evidence that different scientists can drum up to support both positions, but, generally speaking, mainstream Western culture tends to fall closer to the essentialism side of the spectrum. One bit of evidence for this is that as a society, we don't have many qualms about making claims about how men and women are inherently different. Even in a political climate in which people are concerned about being politically correct, it is rarely perceived as wrong to assert that women are inherently not as good at math and science as are men.[9] It should be no surprise then that much science ends up drawing conclusions that are reflective of society's broader beliefs; scientists are part of society, after all.

Does this mean that science is doomed to be biased? While there certainly is science that is biased, most science is conducted in ways that try to rid it of bias. The scientific method is one way to try to structure research so that it is done systematically and conscientiously. While most science is not biased, as such, all science is *interested*. This means that individual scientists, research communities, or nations are invested (and investing) in the research questions. Scientific projects are pursued because they are perceived as important, and this directs what types of knowledge about the world are generated. Good science—in the sense that researchers are following the standards of their field—is designed to prevent that interest from unduly influencing the results of the inquiry.[10] In spite of these efforts, it is impossible for individual researchers to cast off completely their personal and cultural values or even their economic or professional motives. Biologist Anne Fausto-Sterling refers to this as scientists' "blind spots." She explains that "a scientist may fail to see something that is right under his or her nose because currently accepted theory cannot account for the observation" (1992, 10). Research on sex or gender differences is especially complicated when most of the ideas people have about sex and gender tend to be seen as natural and are rarely interrogated. Science, therefore, may not be biased per se, but it is influenced by and contributes to patriarchy. One important goal is to examine how it has done so historically so that we can be more adept at detecting it in contemporary research.

Historical Trajectory of the Science of Difference

The pursuit of knowledge about biological differences between the sexes has a very long history. Although techniques and methods have changed considerably over time, questions about how and why women and men are different have occupied humans over the centuries from ancient philosophers and

Renaissance anatomists to modern-day geneticists. Interestingly, over time, the degree to which women and men have been perceived as different has increased even as more fine-grained details about the biological similarities between the sexes have accrued. The dominant ways of understanding similarities and differences have reflected both the capabilities of science to probe the human body and the historical preoccupations with the roles of men and women in their cultural contexts.

Throughout most of human history, the prevailing view of the sexes was premised on a "one-sex" model, in which females were thought of as imperfect or defective males (Laqueur 1987). Men's and women's reproductive anatomy was perceived as composed of identical structures with women's internal and men's external to the body. Anatomical renderings clearly depicted the organs as identical with the penis and testicles providing the model shape and structure for the vagina and uterus (fig. 1.1). The female body was viewed as inferior because it was thought to have failed in its development to the male form. Specifically, ancient philosophers and anatomists believed that proper human development was dependent on heat: the reproductive organs could only be pushed out of the body with sufficient heat in the developing fetus.[11] Females were understood to be the result of insufficient heat (a "mutilated male") and thus the imperfect sex (Tuana 1989).[12]

Aristotle had a profound influence on knowledge about human anatomy and reproduction, with many components of his model providing the foundation for beliefs about the sexes that went virtually unchallenged from the fourth century B.C.E. until the seventeenth century. In his view, variation in heat between the sexes could explain not only the physical differences in the reproductive organs but also that women are smaller and less muscular than are men. Aristotle further asserted that owing to less heat, women's brains are less developed, which makes women less intelligent and of poorer temperament. In her analysis of Aristotle's theories, philosopher Nancy Tuana framed and quoted his position: "And woman's inferior brain size in turn accounts for much of her defective nature. Woman is 'more jealous, more querulous, more apt to scold and to strike. She is, furthermore, more prone to despondency and less hopeful than the man, more void of shame, more false of speech, more deceptive, and of more retentive memory' " (1989, 148).

As evidence of men's greater heat, Aristotle claimed that male fetuses develop more quickly than female ones and that the greater number of male babies born with birth defects is caused by an excess in heat in those developing fetuses. At the same time, however, Aristotle set himself up for a problem. If heat speeds development, how then does his theory explain why girls reach puberty faster than do boys? He circularly explains that because females are colder they need less time to reach their own (inferior) perfection, sexual maturity. Tuana explains that "we can see from such inconsistencies in Aristotle's

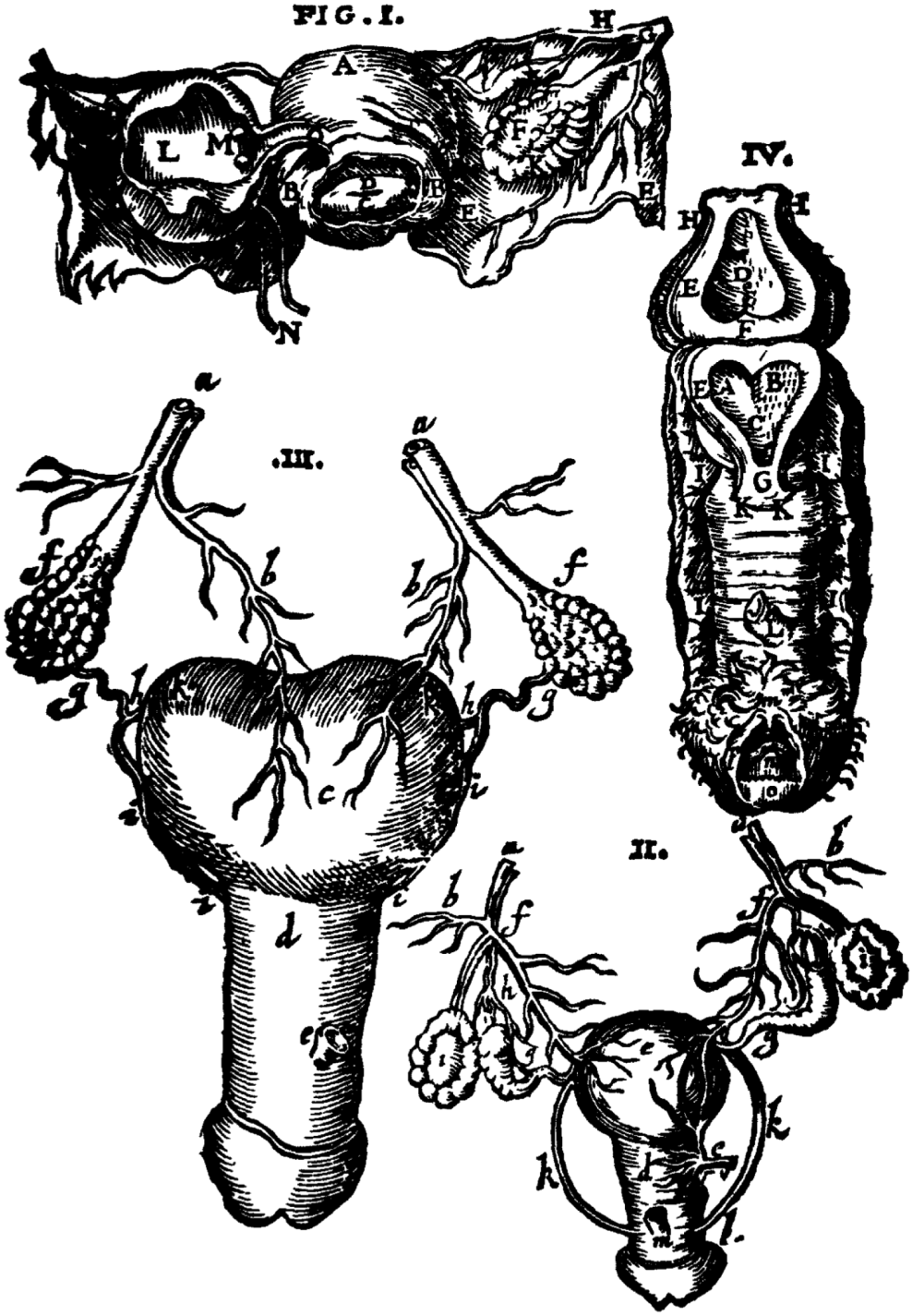

FIGURE 1.1 Representation of female anatomy as an internal version of male anatomy.

Source: N. Tuana, "The Weaker Seed: The Sexist Bias of Reproductive Theory," in *Feminism and Science*, edited by N. Tuana (Bloomington: Indiana University Press, 1989), 155.

theory that the doctrine that the female sex was inferior to the male was not a premise to be proved or justified, but was rather an implicit belief underlying Aristotle's development of his biological theory" (1989, 153).

Aristotle left it to his successors to explain why females have less heat than do males. Several hundred years later, in the second century, Galen "solved" the riddle. Through a creative representation of anatomy, Galen explained that it was the configuration of veins and arteries that control the amount of heat given to the developing fetus. Given cultural conceptions associated with the right (good) and left (sinister) during his time, Galen claimed that heat is associated with the flow of "pure" blood through the arteries on the right side of the body and that the lack of heat is a result of "impure" blood in veins on the left side of the body. The side of the father's body from which the "seed" came then determined the sex of the fetus. For instance, seed originating from the right testicle would by consequence lead to a male offspring, and seed originating from the left testicle would become female offspring. Galen's explanation is fascinating because it leverages a sophisticated understanding of the role of veins and arteries for delivering blood while being physiologically inaccurate: veins and arteries are not each located only on one side of the body. In spite of this amazing technical flaw, Galen's anatomical model continued to be the accepted explanation for sex differences for hundreds of years (until the seventeenth century). Tuana provides an explanation for the longevity of this false belief in spite of the evidence to the contrary:

> Anatomists persistently held to the view that the female seed was defective because of the impurity of the blood that fed it. Although careful attention to the actual structure of the veins and arteries of the testicles and ovaries would refute this view, anatomists continued to overlook this error. . . . It is perhaps not surprising that even an anatomist as careful as Vesalius would perpetuate such an error. The scientific theory he had inherited demanded this "fact." The belief that female seed arose from the "serous, salty, and acrid" blood of the left testes was the only viable explanation of the perceived differences between women and men. (1989, 161)

Science and technology studies (STS) scholar Nelly Oudshoorn (1994) has explained in her analysis of the gendered nature of science that these failures of observation were part of the dominance of the "one-sex" model. Anatomists were actively dissecting male and female bodies during the centuries, but they were not looking for differences between men and women or to challenge dominant theories of reproduction. Oudshoorn states, "The stress on similarities, representing the female body as just a gradation of one basic male type, was inextricably intertwined with patriarchal thinking, reflecting the values of an

overwhelmingly male public world in which 'man is the measure of all things, and woman does not exist as an ontologically distinct category'" (1994, 6).

Supporting this point, Tuana (1989) notes that several anatomists documented inconsistencies between the standard physiological model of the time and their own observations, but they did not seem to understand the implications of their observations. In other words, it was not ignorance of anatomy that contributed to these scientific views but the cultural beliefs of the time about the relationship of men and women being premised on hierarchy, not difference.

In spite of the power of patriarchal thinking, Galen's model could not be sustained forever. With the spirit of experimentation as part of the scientific revolution, tools were developed to extend scientists' powers of observation. The invention of calculating machines, measuring devices, telescopes, microscopes, and so on changed the way that or degree to which nature could be understood. As improvements were made to microscopes, the visibility of cells came into focus, so that spermatozoa could be observed for the first time during the seventeenth century.[13] This "discovery" catalyzed a new science of embryology that could document the mechanics of reproduction at the cellular level and led to contemporary understanding of the roles of men and women in reproduction. It was through these changes in the methods, techniques, and subsequent findings of scientific inquiry that by the eighteenth century the one-sex model was replaced with an alternate patriarchal version of two distinct sexes.

With the emphasis on difference becoming the dominant way of perceiving the sexes in the eighteenth century, scientists began exploring and documenting differences in men's and women's bones, blood vessels, hair, sweat, and brains (Schiebinger 1989). The study of difference between the sexes became utterly pervasive. As part of the process of making new types of distinctions between the sexes, radical naturalizations of *femininity* began to occur within science as well as society at large. For instance, the belief that much of women's behavior (i.e., that which distinguishes their roles in society from men's roles) is natural began to be explained in terms of biological or physiological functions. This view continues to shape scientific inquiry, but the claims have not been static. Specifically, the site of the "essence" of femininity has shifted over time from the womb (uterus) in the eighteenth century to the ovaries in the nineteenth century to hormones in the twentieth century to the brain in the twenty-first century (Oudshoorn 1994). Women continued to be perceived as inferior to men, but no longer because they were seen as imperfect males; rather, the multiple biological differences that were identified cast them as weaker, more vulnerable, and so on.

Two lines of investigation about the differences between women and men have especially occupied scientists for the past two centuries: intelligence and

sexuality. In examining the history of intelligence research, it is hardly an exaggeration to claim that scientists have sought measures of intelligence that yield the results they know *a priori* to be "true". In the nineteenth century, the newly established science of craniometry made inferences about intelligence by making measurements of the skull and brain. Women's brains were found to weigh on average five ounces less than men's brains.[14] The initial analyses performed were crude measures of absolute cranial capacity or brain weight. As philosopher Judith Genova explained, "Picturing the brain as a container and intelligence as some kind of vital fluid, [researchers] concluded that woman's smaller vessel could only hold less knowledge. Women were doomed to be less intelligent than men; their anatomy, wherever one looked, prevented it [from being otherwise]" (1988, 101).

This mode of measurement did not last for long when it became clear that other animals, such as elephants, have larger brains than do humans, and the idea that other animals could be more intelligent than humans was perceived as absurd or impossible. Scientists began experimenting with measurements: brain size in relation to body size, height, thigh-bone weight, and cranial height. Each of these measurements was in turn rejected because the results did not come out right: advantaging women in some cases or non-white peoples in other cases.

What guided the search for the "accurate" measurement was the certainty that the results would mirror the assumptions the researchers' held about the innate intelligence of the sexes or of racial and ethnic groups. These assumptions—or in some cases outright prejudices—were often right at the surface. Scientist Stephen Jay Gould conducted an examination of craniometry findings published in the nineteenth century and found a remarkable passage written by one of the leading scientists:

> "[Women's] inferiority is so obvious that no one can contest it for a moment; only its degree is worth discussion. All psychologists who have studied the intelligence of women, as well as poets and novelists, recognize today that they represent the most inferior forms of human evolution and that they are closer to children and savages than to an adult, civilized man. They excel in fickleness, inconstancy, absence of thought and logic, and incapacity to reason. Without doubt there exist some distinguished women, very superior to the average man, but they are as exceptional as the birth of any monstrosity, as, for example, of a gorilla with two heads; consequently, we may neglect them entirely." (Gustave Le Bon 1879, quoted in Gould 1992, 155)

Analysis of craniometry provides a perfect example of how closely linked social norms and cultural values are with scientific endeavors. Other types of research on intelligence have tended to exhibit far subtler manifestations of such bias.

Nonetheless, IQ and aptitude tests (like the SAT or GRE exams) have long been criticized for historically advantaging the affluent and white men while acting as a tool of discrimination against disenfranchised minority groups.

Twentieth-century research in psychology, neuroscience, and other related fields has likewise been used to "prove" that cognitive differences between men and women are inherent, naturalizing gender differences. Genova (1988) has explicitly associated the brain research of the 1970s and 1980s with craniometry because of its flagrant sexist agenda. The science being conducted during those decades focused in large part on hemispheric specialization and lateralization studies. Most of us know that research by the more colloquial terms of being "right brained" or "left brained." What is quite interesting about the history of this type of research is that the side of the brain that was assigned to each sex actually switched as expectations of gendered attributes and skills evolved during the same time period. Women were initially thought to be intuitive and holistic thinkers while men were said to be the logical and analytic ones. Today, however, women are said to be left-brain dominant, which means that they excel with verbal and analytic ability and process only one item at a time; men are said to be right-brain dominant, which means that they excel with spatial tasks, are more holistic, and can process multiple items simultaneously. In puzzling why the types of patterns of thinking that we attribute to the sexes would be reversed, it probably has to do with two trends that were occurring during the same time period: women began to enter the workforce in greater numbers as a result of the women's liberation movement and a new emphasis was being placed on creativity for professional and personal success. Genova writes,

> Once again men are viewed as natively equipped to do the truly inspired work. Women's cold, analytical, rational powers can only make them plodding amateurs in the creative game. Whatever the task, determinists will argue that men's holistic skills will assure them more efficient, more penetrating discoveries. The current attack on women, then, is confined to a kind of intelligence, it is specifically aimed at keeping them out of the world of science and trivializing their achievements in any field as routine and studied. . . . At last, it has been granted that women have the stuff, just not the right stuff. (1988, 103)

The perennial problem of research on difference is present here: the vast majority of the data supports the point that there is a great deal of overlap in how men's and women's brains function, but the differences command all the attention. Still, if one accepts that gender can be mapped onto different uses of the brain, the assumption that information processing is a proxy for intelligence is tenuous at best, especially when some types of highly valued activities require different types of information processing.[15] In spite of these obstacles to establishing the "truth" about the innate effects of sex on the brain, research on

the gendered nature of cognition is still a major area of scholarship (see Wassmann, this volume).

Another area of science that has explicitly mobilized sex and gender differences has been research on sexuality. Just as the one-sex model presumed essential biological similarity between women and men, so too was there a belief that men's and women's sexuality was not so much divergent but different only by degree (men having more heat and all). At the same time that the one-sex model was replaced in the eighteenth century, opening up science to investigate the difference between men and women down to the cellular level, new norms and expectations began to govern women's sexual comportment. Historian Carol Groneman asserts,

> Well into the eighteenth century, both popular notions and medical understanding retained vestiges of the belief that women were as passionate, lewd, and lascivious as men were. . . . And yet by the nineteenth century, an ideology was firmly established: women by nature were less sexually desirous than men; the wifely and maternal role dominated their identity. . . . Profoundly suspicious of passion, Enlightenment and post-Revolutionary writers argued that women had less sexual desire than men and thus were uniquely suited to be a civilizing force; male passion would be controlled by the strength of woman's moral virtue. (1995, 225–226)[16]

Thus, women's sexuality and men's sexuality were placed on opposite ends of a spectrum.

Of course, individual women's experiences or expressions of sexuality did not necessarily reflect the cultural change. Medical science began to investigate women's deviations from the "norm" of feminine modesty, diagnosing the behavior as a new disease: nymphomania.[17] The women perceived to be most at risk were adolescents, especially blonds, and widows. As the type of women susceptible to nymphomania might suggest, the primary cure recommended to women was marriage. Should marriage not reduce women's "passions," physicians prescribed cold baths, vaginal borax douches, and abstention from red meats and alcohol. In cases of affluent women, especially wives caught masturbating or engaging in homosexual behavior, surgical options were presented, which included clitoridectomy (female circumcision) or oophorectomy (female castration through removal of the ovaries) (Barker-Benfield 1975). These more extreme interventions were justified by physicians because the medical belief was that nymphomania would lead to complete derangement of the mind and surgery on the genitals would help protect the brain from the disease.

The nineteenth-century pathologization and medicalization of sexuality was not confined to nymphomania. Scientific inquiry into the causes of and cures for homosexuality reflected the social and cultural angst about "contrary sexual

instinct" when "homosexuals came to symbolize sterility, madness, and decadence in the late Victorian period" (Terry 1995, 132). During this time, homosexuality was seen as a constitutional predisposition, or, in other words, an *innate* characteristic that was simultaneously biological, psychological, and moral. There were competing explanations for why homosexuality occurred, including evolutionary causes, stress of industrial life, and gender confusion.[18]

As research on homosexuality continued into the first half of the twentieth century, explanations about its biological basis fell out of favor to be replaced by explanations about purely psychological causes. This shift in understanding about homosexuality made research into finding a treatment or cure for it more logical; it also led to fears that homosexuals were trying to "recruit" young men into their ranks, motivating some to want to identify, expose, and contain homosexuals. Cultural studies scholar Jennifer Terry describes the details of the Sex Variant study from the 1930s to 1950s led by a gynecologist to "devise a checklist of visible characteristics that could assist physicians in identifying homosexuals" (1995, 139). The study subjected forty male and forty female homosexual volunteers to a battery of psychological and physical examinations with the idea that homosexual behavior would leave clear signs of deviance on the body. The results of the study were that homosexuality is more psychological than physical. The researchers were dispirited because they found no distinct signs of homosexuality on the body that could provide evidence to physicians seeking to diagnose it.[19]

Scientific consensus in the middle of the twentieth century about the psychological basis for homosexuality was temporary; researchers continued to seek biological explanations. Specifically, the search for a "gay" gene has been a major area of genetics research. Other areas of investigation include research into brain structure, cognitive abilities, pheromones, fingerprints, length and girth of various body parts (e.g., limbs, feet, fingers, penis), and the auditory system (on the latter, see Spanier and Horowitz, this volume). From this list alone, there are unmistakable similarities between the search for a measure of homosexuality today with the search for a measure of intelligence in the nineteenth century. This type of scientific fishing expedition makes it clear that certain types of science are not just a phenomenon of the past, but that the same questions about difference preoccupy researchers in similar ways for similar purposes. The question then is not just how is science the same now as it is was in centuries past, but in what particular ways is it different today? And what do those differences suggest about our cultural moment?

Current Cultural Context of Science

Much rich scholarship has illustrated how past cultures of science were infused with patriarchal norms and values that influenced the kinds of research that

was conducted and the interpretation of findings about differences between men and women. I have touched on only a few examples here. While the gendered values of past science may be easier for present-day observers to detect, it does not imply that current science is any less influenced by the broader social and cultural contexts in which contemporary research takes place.

Some argue that feminism has influenced culture and science to the point where women are no longer perceived as inferior (Bellafante 1998). Some even argue that, if anything, there is a tone of man bashing that might even imply that there is a social belief in *men's* inferiority. For instance, an ABC News *20/20* episode that aired in 2006 claiming to investigate, as titled, "The Truth Behind Women's Brains" seemed to send the message that women's brains just might be superior to men's brains:

> Girls . . . mature faster than boys, and girls' brains are as much as two years ahead during puberty. In fact, neuro-imaging shows that, early on, the typical teen girl has a stronger connection between the areas of the brain that control impulse—the amygdala—and judgment—the prefrontal cortex. It may not be until late adolescence or their early twenties that boys' brains catch up to their girl peers. "To know that they're smarter than us by two years—it's a gap, it really is," said John Bessolo, one of the students in Dr. Brizendine's high school group. "They are the superior beings of the brain." (ABC News 2006)

Some commentators perceive this description of women's brain function as a feminist position and are encouraged by it.[20] They have argued that what is different about this neuroscience research from past scientific paradigms is that the research is not out to prove the inferiority of women and will likely be more reflective of "true" differences between the sexes. Even when women are cast as potentially *superior,* the hardwired "differences" are unmistakably gendered in highly problematic ways. As part of the *20/20* segment, effects of pregnancy and motherhood on the brain were highlighted:

> During pregnancy, these powerful hormones literally hijack a mother's brain circuits. She first becomes sleepy, hungry, and nauseous. Soon, the hormones oxytocin and prolactin intensely focus her maternal brain on the safety, and the needs of her child often to the detriment of everything else. . . . Triggered by hormones, a mother's brain becomes a virtual GPS systems [*sic*] for tracking and protecting her young. . . . A similarly dramatic hormonal effect is experienced when mothers breastfeed. As she nurses, oxytocin, the feel-good hormone, marinates a mother's brain. Many women say they are awash in feelings of warmth and pleasure. . . . For many women, their child-centric behavior not only compromises

> their relationships, but also their jobs. Hormonally tethered to their child the interest of some mothers to return to work is often challenging. (ABC News 2006)

This hardly seems like an argument that will have positive implications for women because it normalizes traditional patriarchal assumptions that women's place is in the home, with children. It is also critical to note that research like this has been under fire. There have been numerous inquiries into the veracity of the findings being reported in news coverage like this as well as the research on which it is based (see Rogers, this volume).[21]

What does the popularity of this type of research about women's brains mean, then, for the relationship between science and cultural views of gender? Is this type of science merely an outlier that has received a lot of media attention? Or is it symptomatic of an underlying current in our culture? Both are probably true; it can be thought of best as representing the tension around women's issues in the United States as a result of the cultural context of postfeminism. *Postfeminism* is the term that refers to the view that feminism is obsolete because the battles it was fighting have been won. The postfeminist position is that in the past women did not have the same opportunities as did men, but because of the success of past women's movements, men and women are equal today. In the United States, there are very few employment opportunities from which women are explicitly denied, and women are excelling in college and entering graduate school in record numbers. Women today have many more choices than did generations before them.[22]

Postfeminism attempts to explain away any remnants of inequality between the sexes. For instance, the structural inequalities that persistently disadvantage women, such as the 20 percent less that women receive in pay than their male counterparts, are perceived as individual problems that require only individual solutions: if someone doesn't like her job, she should get another one; or women just don't choose to put in as many hours as do men. Postfeminism can also be thought of as an apolitical, have-it-all, or superwoman feminism: the job, the family, and the consumer products to stay young and attractive (Tasker and Negra 2007).[23] The absence of an analogue discourse of super*men* who also do it all, contributing at work and home, is either invisible or naturalized. This means that there is a paradox at the heart of postfeminism in which there is a simultaneous critique and reinforcement of sexism through a celebration of the choices women should and do have and an ignoring of the obligations from which men are excused.

If postfeminism is a major part of the cultural context of U.S. society today, what are its effects on science? This has yet to be documented in a systematic way, but the cultural politics of postfeminism could mean that there are fewer checks on scientific inquiry. For instance, it appears that it is no longer

threatening to talk about the biological differences between the sexes because of the "equality" that has been achieved. Unlike in the 1960s and 1970s, there appears to be little controversial or offensive today about claiming that women are biologically fated to feminine gender roles. A belief that sexism has been eradicated likely means that we are not as attuned to perceiving sexism when and where it is mobilized. Moreover, it is unlikely that women entering the sciences today will have the same transformative effects on the scientific agenda as did the women who became scientists in the 1960s and 1970s.[24] Those early women scientists changed the questions that were being asked and the methods that were being used for collecting data. Women entering science in the 2000s and 2010s who subscribe to postfeminist views of society may be more likely to follow the male-dominated status quo in science than to offer new perspectives in their fields.[25] For instance, it may indeed be a symptom of postfeminism that no one stops to question the sexism inherent in research or the sexist implications of the findings. The purpose of this volume is to pause and consider how contemporary science mobilizes sex and gender in ways that reflect patriarchal—if not sexist—thinking about the roles of women and men in society.

Book Overview

This volume is organized into four parts that contain critical analyses of different aspects of contemporary science and medicine. Part 1, "Investigating Difference," includes three chapters that carefully examine claims that are being made by scientists today about the biological differences between men and women and between heterosexuals and homosexuals. The chapters tackle a range of scientific activity, representing research on genetics, neuroscience, and physiology. In her chapter "Sex Differences Are Not Hardwired," Lesley J. Rogers analyzes common types of explanations mobilized in the sciences for the causes of sex differences. She illustrates the flaws in some of these frameworks by refuting the scientific evidence or the conclusions drawn, and she argues for an alternative approach to understanding difference that embraces complexity in lieu of essentialism. For instance, she explores the literature documenting sex differences in infants' behavior to show that the socialization process begins at birth and cannot be dismissed as having no impact on sex differences. Bonnie B. Spanier and Jessica D. Horowitz question the conclusions that scientists make about the biological basis of homosexuality in "Looking for Difference? Methodology Is in the Eye of the Beholder." Drawing upon a case study of auditory research that purports to have found differences in ear emissions based on gender and sexual orientation, they offer a valuable mapping of the conceptual errors scientists are prone to make in their interpretations of data. Turning to brain imaging, Claudia Wassmann discusses research on

sex-based differences in mathematical and cognitive abilities as well as emotional responses in "Evaluating Threat, Solving Mazes, and Having the Blues." She persuasively shows the ways in which brain-imaging studies reiterate and reinforce common gender stereotypes through the questions that researchers ask about differences in men's and women's brain functions.

Part 2, "Animal Obsessions," examines the ways in which human gender assumptions are inflected in research on nonhuman animals. The three chapters in this section include narratives of animal sexuality, but the analytic interest here is the attention that scientists and the media give to the behavior of nonhuman animals to represent taken-for-granted truths about human sexuality. In "Telling the Rat What to Do," Lynda Birke explains not only how researchers' assumptions about sex differences direct their hypotheses and observations, but also how laboratory animals' behavior and physiology are altered by their living conditions. She shows how purposeful breeding and laboratory contexts (such as being segregated by sex) tend to reinforce the assumptions that scientists have about animals' sex differences. Angela Willey and Sara Giordano's chapter, " 'Why Do Voles Fall in Love?' " returns our attention to research being conducting on the brain but with a twist. In their examination of monogamy gene research, they find "love" is a gendered story that gets written onto prairie vole behavior. In their fascinating account, they document how monogamy research positions only male behavior as being of interest because of assumptions that female monogamy is more "natural." In another case of concern with "aberrant" behavior, K. Smilla Ebeling and Bonnie B. Spanier explore popular interest in the question articulated in their chapter's title: "What Made Those Penguins Gay?" Zoos have long been sites of popular science and education through representations that they provide of the animal kingdom. Ebeling and Spanier trace the controversies and interventions that resulted from the politicization of media attention in the mid-2000s to "gay" penguins at German and U.S. zoos.

Part 3, "Categorizing Bodies," analyzes how scientific frameworks grapple with bodies that do not fit traditional sex and/or gender binaries. Both chapters in this section show how ambiguous bodies are defined and understood in ways that harm or disrespect the individuals who inhabit them. In "Intersex Treatment and the Promise of Trauma," Iain Morland describes the relationship between medical and psychological models of gender formation and the medical management of intersex. Exploring how knowledge about intersex is produced, he disturbingly illustrates the trauma caused to intersex individuals in order to minimize the parents' and physicians' cultural anxiety about children born with ambiguous genitalia. Sel J. Hwahng's chapter, "The Western 'Lesbian' Agenda and the Appropriation of Non-Western Transmasculine People," focuses on social science researchers' construction of knowledge about sex and gender through their treatment of anatomically female, transmasculine

bodies. The chapter carefully documents the difficulty for researchers in thinking about and separating gender identities from biological bodies, especially when defining non-Western people through the lens of Western constructions of gender and sexuality.

Part 4, "Medical Interventions," examines the medical management of bodies that are constructed as "abnormal" as a result of gender expectations for those bodies. The three chapters in this section illustrate the medical imperative to intervene even when medical knowledge is absent, contradictory, or unfounded. In "Facial Feminization and the Theory of Facial Sex Difference," Heather Laine Talley investigates cosmetic surgery designed for male-to-female transsexuals. Analyzing the way the procedures are framed by surgeons as a way to correct "disfigured" faces, she reveals the process of "sexing" the face that occurs by defining what counts as "female" and "male" facial characteristics. Shirlene Badger's chapter, "The Proportions of Fat in Genetics of Obesity Research," concentrates on an entirely different context: a clinic conducting a study on the genetics of childhood obesity. Badger traces the scientific and personal narratives that are told to explain the causes of obesity, and she explores the gendered and familial meanings that parents and children in the study ascribe to fat. Finally, Emily Wentzell examines the medical management of erectile dysfunction (ED) in Mexico in "Making Male Sexuality." She describes how cultural and medical beliefs about gender and sexuality become fused in the treatment of ED in ways that differ unexpectedly from the medical model north of the border.

Together the essays in this volume depict contemporary science and medicine as gendered institutions that reflect society's cultural values. While there are doubtless many other areas of current scientific research that could be analyzed in this vein, this collection assembles examples that challenge the myth that contemporary science is value-free. More scholarship needs to be done to study explicitly the other types of cultural values at work in the modern research enterprise, such as how beliefs in ethnic/racial and class differences and hierarchies shape scientific practice. Nonetheless, scrutinizing scientific claims about the differences between women and men is an important place to begin because these assertions are especially prone to be mistaken for obvious truths.

NOTES

1. This is most obvious when it comes to securing funding for research. For example, the National Science Foundation, one of the U.S. federal government's primary sources of grant support for the sciences, requires scientists to include in their applications for research funds a statement detailing the "broader impacts" of the proposed research. The degree to which scientists can demonstrate the importance and relevance of their research will determine to some extent how successful they will be at receiving public funds.

2. Carolyn Merchant writes about the scientific revolution and the imagery connected with new methods of experimentation being used to uncover the secrets of nature: "In the seventeenth century . . . Francis Bacon (1561–1626) sets forth the need for prying into nature's nooks and crannies in searching out her secrets for human improvement" (1990, 33). These metaphors of scientific inquiry have contributed to the current sense that unknown facts are merely waiting for discovery.
3. There are, of course, examples in the history of science of dramatic departures from the status quo in observations, such as Copernicus's assertion in the sixteenth century that, contrary to the dominant belief at the time, it is the Earth that revolves around the Sun.
4. While it is becoming more common for women to retain their birth names when they marry, the vast majority of women still take their husband's last name. For example, one study estimated that more than 80 percent of U.S. women who are college graduates change their names when they marry (Goldin and Shim 2004), and the percentage of women who have not graduated from college who change their names is likely much larger.
5. What is important to understand about patriarchy is that it is a system, not just individuals. This means that it cannot be reduced to the people who participate in it. Because it is a system, it permeates our culture, is represented in our institutions, and structures our relationships. As a result, patriarchy is durable and tenacious even when individuals challenge the system (Johnson 2005).
6. While the focus of this volume is not explicitly on race or the construction of racial differences, science has also supported racist categorizations of different groups of people. Examples of science being used to "prove" racial inferiority can be found in American, European, and Japanese contexts and were often mobilized to justify slavery, colonization, or harsh treatment of ethnic minorities. See Fausto-Sterling 1995; Harding 1993; Terazawa 2005.
7. There are many ways to define gender. For the purposes of this discussion, gender can be thought of as the social practices that create and maintain distinctions between women and men. That these distinctions have been the fabric of inequality between men and women is not random or accidental, which is evinced by the way in which these distinctions become embedded in institutions and the rules of social interaction.
8. This idea gave rise to the "gender-neutral" childrearing movement, which focused on eliminating the gendered messages that children receive about differences between girls and boys and between women and men. The 1970s cult classic *Free to Be . . . You and Me* is an example of a television program and audio recording that challenged the traditional messages about gender that children receive.
9. There is one example where a claim of this sort quickly did become political. Former Harvard president (and economic advisor to U.S. president Barack Obama) Larry Summers made the remark in a speech that women do not have the same levels of scientific and mathematical aptitude as do men. The speech created quite the furor, leading to Summers's resignation from Harvard.
10. Defining "good science" can be a tricky endeavor because research can be technically correct but still problematic. For instance, clinical trials designed by the pharmaceutical industry to test their new products are good science in the sense that they follow the norms and standards of scientific practice, but studies are nonetheless designed so as to cast the drug in the best possible light (Fisher 2009). Sometimes it is not a

question of what science was done, but what science was undone, what knowledge was intentionally left unproduced (Hess 2007).

11. Up until the nineteenth century, science as we now would think of it was referred to as "natural philosophy." While early natural philosophers observed the physical world, it was not until the scientific revolution (beginning roughly in the sixteenth century) that experimentation with—or manipulation of—the physical world was incorporated into natural philosophy.
12. Nancy Tuana's 1989 piece on this topic ("The Weaker Seed: The Sexist Bias of Reproductive Theory") is a must-read for students interested in the history of science, and I draw extensively from its findings and analysis in this section.
13. Tuana (1989) relates a very interesting history of the perceptions of the roles of sperm and egg cells in contributing to reproduction. During the end of the seventeenth century and through the majority of the eighteenth century, scientists subscribed to the "preformation doctrine" of reproduction, which held that the organism was fully formed and had only to grow to become a person. Before sperm cells were visible under a microscope, scientists presumed that the egg must hold the preformed organism and that contact with male semen initiated its growth. This view was called "ovism." After sperm cells were made visible, some scientists then advocated that sperm held the preformed embryo, which could then grow upon being implanted in a woman's uterus. This view was called "animalculism." The latter view was more palatable to many at the time because ovism seemed to give too great a contribution to women in reproduction, but many fretted about the wastefulness of sperm containing preformed organisms.
14. Of course, the word "average" is critically important here. As with all averages, individual measurements deviate above and below the mean, and there is a fair amount of variability in the size of individual men's and women's brains. Thus, some women's brains weigh more than some men's brains. See Gould (1992) for a detailed analysis on why early measurements of men's and women's brains may have inadvertently introduced bias that accounted for the weight difference between the samples of men's and women's brains used.
15. Moreover, there is very little evidence to support that the sex differences found are innate differences. For instance, cross-cultural research often cannot replicate the findings of the Western world, and the brain is known to be a dynamic organ, not one that is fixed at birth. On this latter point, the brain has an amazing capacity to create new structures and patterns in response to injury or trauma.
16. Carol Groneman (1995) provides a fascinating discussion of how the rise of evangelical Christianity as well as the Industrial Revolution contributed to new mores around women's sexuality.
17. Sexual desire in men continued to be viewed as quite natural in the nineteenth and twentieth centuries. The term "satyriasis" was coined, however, to refer to the male analogue of nymphomania. The illness it represented was nonetheless believed to be much less common, less severe, and less damaging to men than nymphomania was to women (Groneman 1995).
18. Jennifer Terry (1995) describes three competing explanations for homosexuality that circulated in the nineteenth century. In the evolutionary explanation, researchers asserted that homosexuality was evidence of "overspecialization" of the species in which the highest levels of civilization were failing to procreate. This theory was based on the perceived overrepresentation of homosexuals in high society, especially those

who were intellectuals and artists. Other researchers claimed that modern industrial life put too many strains and constraints on individuals and that resulted for some people in the loss of adaptive ability, leading to homosexuality, here seen as a disorder of the brain and nervous system. A third line of research argued that homosexuality was evidence of a "third sex," one in which the female mind was in the male body and resulted in men behaving and appearing feminine. Likewise, lesbians were explained as a masculine mind present in a female body.

19. Alfred Kinsey's research on homosexuality during the same decades of the twentieth century even further raised alarm about the invisibility of homosexuals in society. Kinsey's controversial findings challenged the traditional binary between heterosexuality and homosexuality, suggesting that sexuality is instead a continuum and that people will engage in different types of sexual behaviors along that continuum over the course of their lifetime.
20. In fact, the *20/20* segment was highlighting the book *The Female Brain,* the author of which (Louann Brizendine) self-identifies as a feminist. There are, of course, many different kinds of feminism. Specifically, "difference" feminism—as opposed to liberal feminism—has as its basic tenet that women are naturally more nurturing than are men. It is a feminist position because people who subscribe to this view believe that women should not be disadvantaged or devalued by society for their difference. In the United States, where feminism is often thought of as a "bad" word, difference feminism does not have many subscribers, in part because people who might agree with this position would never identify as feminist. Perhaps Brizendine would categorize herself as this type of feminist.
21. Brizendine, author of *The Female Brain,* has been a particular target of attack as a result of her tendency to misrepresent or rely on seriously flawed science to make her claims.
22. Postfeminism is a cultural phenomenon; and, like much of our cultural beliefs, it is (problematically) based more on affluent and white women's experiences than those of poor women or women of color.
23. Empowerment rhetoric has been appropriated from the 1960s–1970s women's movements, so that empowerment is now seen as an individualized process, one that is best experienced through consumption (Fisher and Ronald 2008; McCaughey and French 2001).
24. In addition to the sexuality studies in which female rodent behavior became an object of scientific interest (Van den Wijngaard 1995), women entering science transformed primatology, biology, and medicine in the 1960s, 1970s, and 1980s (Haraway 1989; Schiebinger 2001).
25. I should clarify that not all women, and not all women entering science today, hold postfeminist views about society. Some of the science doctoral students that I have had the privilege of teaching have had incredibly strong views about the sexism and bias that can still be found in the sciences.

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