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ORIGINAL PAPER

Hardwired for Sexism? Approaches to Sex/Gender in Neuroscience

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Abstract Evidence has long suggested that 'hardwiring' is a poor metaphor for brain development. But the metaphor may be an apt one for the dominant paradigm for researching sex differences, which pushes most neuroscience studies of sex/gender inexorably towards the 'discovery' of sex/gender differences, and makes contemporary gender structures appear natural and inevitable. The argument we forward in this paper is twofold. In the first part of the paper, we address the dominant 'hardwiring' paradigm of sex/gender research in contemporary neuroscience, which is built on broad consensus that there are important 'original' sex differences in brain structure and function, organized by sex-differentiating prenatal hormone exposures. We explain why this consensus is both unscientific and unethical. In the second part of the paper, we sketch an alternative research program focused not on the origins of sex/gender differences but on variability and plasticity of brain/behavior. We argue that interventional experiments based on this approach will address more tractable questions, and lead to much more satisfactory results than the brain organization paradigm can provide.

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Introduction

Gender theorists and some feminist scientists approach gender as a multi-level and complex structure that shapes human relations and perceptions, cognition, and institutions, including the research questions and methods used in science [1–3]. Neuroscientists, on the other hand, typically approach gender as a status or a collection of characteristics that male versus female people (and sometimes other animals) have, and the goal of many neuroscience studies is to add to an ever-growing catalogue of male–female differences—both what they are, and how they arise (e.g., [4], vii). Disagreements over the nature of gender are unlikely to be resolved anytime soon, but we suggest that whether understood as a cultural frame or as an individual cognitive structure, gender is so powerful that it is difficult to get a useful purchase on how it operates. It is a bit like the sun: there is a limit to what we can learn by looking straight at it, and we might just go blind trying. Thus, we argue that a more sophisticated and ethical approach to understanding sex/gender in the brain and behavior will require the somewhat paradoxical strategy of turning away from sex/gender differences in our research.

In most of this paper, we use the composite term 'sex/gender', which will be unfamiliar and perhaps even jarring to some readers, especially those who have

worked hard to ensure that complex social phenomena related to masculinity and femininity (gender) are not simply reduced to or confused with aspects of the physical body that can be designated as "male" or "female" (sex). We nonetheless favor this composite term when discussing neuroscientific investigations into male–female differences or similarities in patterns of brain structure or function. While conceptual differences between the two are important, 'sex' and 'gender' are, in practical terms, inseparable. Numerous empirical studies demonstrate the problematic task of distinguishing between sex and gender in practice [5–8]. The patterning of life experiences according to social structures of gender has material effects on the body [5, 9, 10]. These effects show up, in turn, as biologically based 'sex differences'. Feminist epidemiologists, biologists, and other scientists increasingly replace the discrete concepts of 'sex' and 'gender' with more complex formulations, such as Nancy Krieger's notions of 'biologic expressions of gender' and 'gendered expressions of biology' [11]. Thus, we adopt the term 'sex/gender' as suggested by Kaiser and colleagues, who observed that 'sex is not a pure bodily and material fact, but is deeply interwoven with social and cultural constructions of gender' ([12], 49). With this composite term, we hope to underscore the importance of problematizing bodily as well as behavioral and psychological attributions of female/feminine and male/masculine.

In the next part of the paper, we address the dominant paradigm of sex/gender differences in contemporary neuroscience. This consists of a broad consensus that there are important 'original' sex differences in brain structure and function, organized by sex-differentiating prenatal hormone exposures (the 'hardwiring' paradigm). This paradigm shapes the work of both those who frame sex/gender differences as sweeping and largely independent of socialization, as well as those who emphasize the role of gender socialization in amplifying male–female distinctions [13, 14]. But we argue that this consensus is both unscientific and far from politically neutral. Evidence has long suggested that 'hardwiring' is a poor metaphor for brain development. But the metaphor may be an apt one for the dominant research paradigm, which pushes inexorably towards the 'discovery' of sex/gender differences, and makes contemporary gender structures appear to be natural and inevitable. In the last section, we begin to elaborate an alternative research program. While the question of origins can't be studied experimentally in humans, it is possible to design experiments to address questions of variability and plasticity, an approach that we argue has much greater promise from both scientific and ethical perspectives.

Before proceeding further, it is worth addressing how sexuality, the realm of erotic desires and practices, fits with sex and gender. Ideas about sexuality—including but going beyond sexual orientation—play a major role in dominant ideas about sex/gender differences. In science as in popular culture, sex, gender, and sexuality are frequently merged into the simple composite "sex": a package deal, with both the origin and the ultimate purpose being reproduction. (Note that research has repeatedly demonstrated that heterosexuals in the contemporary U.S. context interpret "having sex" to be synonymous with penile-vaginal intercourse [15, 16]). In this framework, if one part of the "package" is atypical, it is frequently assumed that the other parts will also be atypical. Moreover, since sex is conceived as a binary, male/female phenomenon, being "not typical for males" is generally read as being feminine, and being "not typical for females" is read as masculine. Since the late nineteenth century, same-sex desires have been viewed through this lens, and homosexuals of both sexes have been understood to be intermediate sexual types, whose "cross-sex" desires are grounded in some kind of "cross-sex" physicality—most often the brain or the hormones [17–19]. Brain organization research builds upon this way of conceptualizing sex, and uses these presumed links between (bodily) sex, (behavioral and psychological) gender, and sexuality to construct research hypotheses. We do not endorse this "package" view of sex, gender, and sexuality, but it is necessary to grasp it in order to understand the logic of brain organization research hypotheses that we describe below.

The 'Hardwired' Paradigm

Scientific Shortcomings

At present, neuroscientific research on sex/gender in humans has stalled on sterile approaches encouraged by the dominant brain organization paradigm, which holds that steroid hormones at a critical period of fetal development give rise to permanent structural and

functional sex/gender differences in the brain and behavior [4, 20, 21]. The paradigm, known colloquially as 'hardwiring', has moved beyond the level of theory to be treated as a simple fact of human development [22].

And yet there are many compelling reasons to reject this 'fact', beginning with flaws in the developmental model that draw incorrect parallels between genitals and other reproductive structures, on the one hand, and the brain, on the other. According to the classic paradigm of Alfred Jost [23], a minimum level of androgens—specifically testosterone—is necessary to direct development away from the default 'female' pathway to develop the male phenotype. In 1959, William Young and his colleagues applied Jost's model to brain development [24]. They differentiated between the initial 'organizing' effect of hormones, which are understood to permanently determine the character of the brain and behavior as masculine or feminine, and the 'activating' effects, which essentially determine the level of later activity or expression. Multiple discontinuities suggest that this initially-promising extension of Jost's paradigm to the brain is greatly limited. The brain is far less dimorphic than genitals in virtually all species studied, and behavior even less so [25–27]. Moreover, behaviors that are reliably sex-differentiated in some species are not sex-differentiated in others, even in closely-related species (e.g., spatial ability [28], tendency to monogamy vs. polygamy [29], and parenting behavior [30]). Genitals—at least in most vertebrates—do have a developmental moment at which an irreversible commitment to a male or female form takes place, while data on brain development indicates far longer developmental periods and extraordinary plasticity, raising doubts about the usefulness of the organization/activation distinction [31]. There is also far less continuity across species in terms of the specific relationships between steroid hormones and neurobehavioral development or function than between steroids and genital development [32–35].

The hardwiring paradigm seems to offer an answer to the common question of how it is that widespread sex/gender differences in the brain and behavior arise. Yet that question already presupposes that sex/gender differences are in fact pronounced and wide-ranging, while the reality is quite a bit more complex. In spite of the much-trumpeted 'female brain' and 'male brain', the brain simply cannot be 'sexed' as genitals can. Imagine that one were to take scientific photographs of the genitals of 1000 human adults, and present these photos to a team of judges without any other contextual cues as to the sex/gender of the individual to whom the genitals belong. Even if our judges were ordinary people with no special training or insights, it would be possible to sort the photographs into 'male' versus 'female' piles with almost 100% accuracy. This is not to suggest that there is no intra-sex variety in genital size and shape, but in a group of only 1000 people, it will be possible to clearly place almost all human genitals into one of two main types. Human brains are another matter entirely. Consider first the issue of brain structure. Some scientists claim that there are no clear-cut structural differences, others claim that there are some subtle average differences, and still others claim that sex/gender differences in the brain are dramatic [1, 21, 36]. When important co-variates such as brain weight are controlled, and the specific meaning of 'difference' is not glossed in a way that equates aspects such as cell number and regional volume, the only structural difference that has been independently replicated is in INAH-3, a tiny cell group in the hypothalamus that is larger in men than in women [37–40]. The situation is even murkier when we add the question of function. While we may speculate that INAH-3 may be related to some aspect of sexual function, no one really knows what the area does—it may be related to something as mundane and 'non-psychological' as menstruation or erectile function.

All indications are that human brains are not "sex dimorphic"—they do not occur in two distinct forms. There may indeed be differences in the *average size* of specific regions between men's and women's brains [41], and many activation studies suggest that there are average differences in the way that men and women "recruit" different regions of the brain when performing emotional and cognitive tasks (see review in [21]). In fact, with new methods for measuring small regions in living brains, and statistical approaches that allow the detection of increasingly subtle differences between groups, it seems likely that more such average differences will be reported. But these differences are unlike genital differences in two key ways: 1) they are perceptible only at the group level, rather than being distinct forms that can be identified in individuals; and 2) there is no reason to assume that these differences do not arise, at least in part, from gendered patterns of social roles and

behaviors—that is, brain differences may *result* from the very characteristics that are supposedly "hard-wired" into the brain in the first place. The point is not that there are "no sex differences" in the brain, but instead is that the analogy from genitals to brains is extremely misleading.

Another misleading aspect of the hardwiring paradigm is the way it is fueled by systematically omitting evidence that the behavioral patterns that follow early hormone exposures can and do change. As early as 1969, it was known that many of the 'organizing' effects of hormones are not actually permanent, but are easily modifiable by experience. In a little-cited study by researchers at UCLA, for example, scientists found that allowing an androgenized female rat to have just 2 h to adapt to a stud male *completely eliminated* the behavioral effects of prenatal testosterone injections [42]. Subsequent experiments have shown a great many of the sex-typed behaviors that are supposedly permanently organized by prenatal hormones can be dramatically modified or even reversed by simple and relatively short term behavioral interventions such as neonatal handling [43], early exposure to pups (in rats) [44], and sexual experience [45], to cite just a few examples.

There are two sorts of evidence available to indicate that sexed/gendered traits presumably organized by early hormones in humans are likewise impermanent. The first sort involves group-level data indicating both variability and change in the shape of sex/gender differences in cognitive abilities, occupational interests, educational interests and attainment, and even sexual orientation [46–52]. Although indirect, such data bear on the notion of 'permanent' sex/gender differences by undermining the clarity of the classification of traits themselves as masculine or feminine. Put simply, it is difficult to see how early hormones could direct the brain towards masculine or feminine cognitive or affective phenotypes, when the masculinity or femininity of the phenotypes in question is a moving target. The second sort is recent data on individual-level capacity for change in supposedly permanent traits, even in adulthood. Particularly dramatic evidence involves the most reliably observed sex/gender difference in cognitive skill: mental rotation ability, which consistently favors males [53]. For instance, in a study conducted among women and men college undergraduates, Feng et al. [54] found that just 10 h of training on an action video game virtually eliminated the sex/gender difference in spatial attention and simultaneously decreased the sex/gender disparity in mental rotation ability, a higher-level process in spatial cognition, with women benefiting more than men. In contrast, control participants who played a non-action game showed no improvement.

Finally, the idea that the human brain is 'hard-wired' for sex/gender can never be settled by experiments. Scientists simply cannot randomly assign human fetuses to different hormone exposures in order to determine how these affect subsequent structure and function. Instead, we must rely on various quasi-experimental designs that search for correlations between sex/gender-linked behaviors, on the one hand, and indications of early steroid hormone exposures, on the other. But evaluating quasi-experiments requires a different approach than evaluating experiments. Because we cannot control the variables, we have to do a very careful and comprehensive appraisal that places all the evidence from multiple study designs into the same picture. Different designs have different strengths and weaknesses, so it is critical to avoid piecemeal evaluation of the multiple research streams, determining whether they 'add up' to some overall positive findings, on balance [22].

In the following paragraphs we briefly review evidence that the dominant paradigm is not well-supported empirically, which has been much more fully addressed elsewhere [22]. Here, we focus on the lack of data triangulation across study types. Brain organization studies can be broadly divided into two types. The first type is cohort studies—those that begin with some knowledge about early hormone exposures, and investigate whether categories of exposure correlate with categories of later brain function. The cohort studies comprise many studies of people with unusual hormone exposures, as from the condition congenital adrenal hyperplasia [55–57], as well as studies of offspring from hormone-treated pregnancies (e.g., [58, 59]), and some more recent studies that track proxy measures of fetal hormones in non-clinical populations [60]. The second type is case–control studies—those that begin with some knowledge about the behavioral or functional phenotype (the presumed outcome of the brain organization process), and work backwards to search for evidence that distinct phenotypes correlate with distinct hor-

mones on the front end of development. The case control studies almost entirely comprise within-sex/gender comparisons of sexual minorities and cisgender (i.e., non-transgender) heterosexuals [38, 61–63].

In other words, these two broad sets of studies involve studying either unusual inputs (i.e., unusual prenatal hormone exposures) or unusual 'outcomes'—that is, studies that compare people with psychosexual phenotypes that are considered distinctive, such as heterosexuals compared to homosexuals. In epidemiology, where quasi-experimental or observational studies are the norm, it is well-recognized that causal associations are only established when evidence from substantially different research designs converges [64]. Figure 1 shows the various associations that are examined in the cohort (solid arrows) and case–control (dashed arrows) studies bearing on the brain organization or 'hardwiring' paradigm in humans. For the paradigm to be well-supported, evidence from the different designs should allow us to trace one or more complete paths from early hormone exposures, through specific psychosexual traits, and back again to early hormone exposures.

In fact, however, it is not possible to trace such complete loops, because these two types of studies give us irreconcilable data, with different designs showing associations between different specific behavioral domains, and contradicting dose–response expectations. The following figures summarize the evidence for various 2-way associations between prenatal hormones and 5 broad domains of traits that are hypothetically sex-differentiated by hormones, as well as between these various traits.

Figure 2 shows the associations for genetic females. At first glance, it seems that there is one complete 'loop' of evidence supporting this paradigm, which relies especially on evidence from girls and women with congenital adrenal hyperplasia (CAH). Yet there are important problems with building the brain

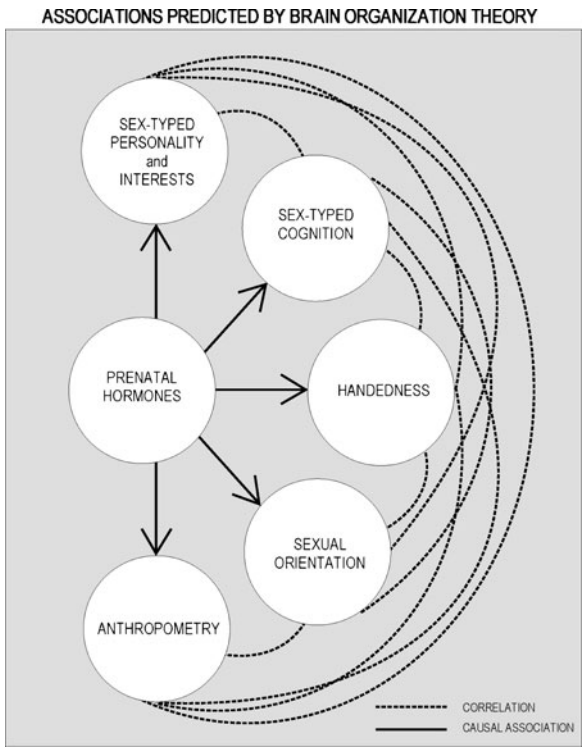

Fig. 1 Associations *predicted* by brain organization theory. Reprinted by permission of the publisher from BRAIN STORM: THE FLAWS IN THE SCIENCE OF SEX DIFFERENCES by Rebecca M. Jordan-Young, p. 177, Cambridge, MA: Harvard University Press, Copyright © 2010 by the President and Fellows of Harvard College

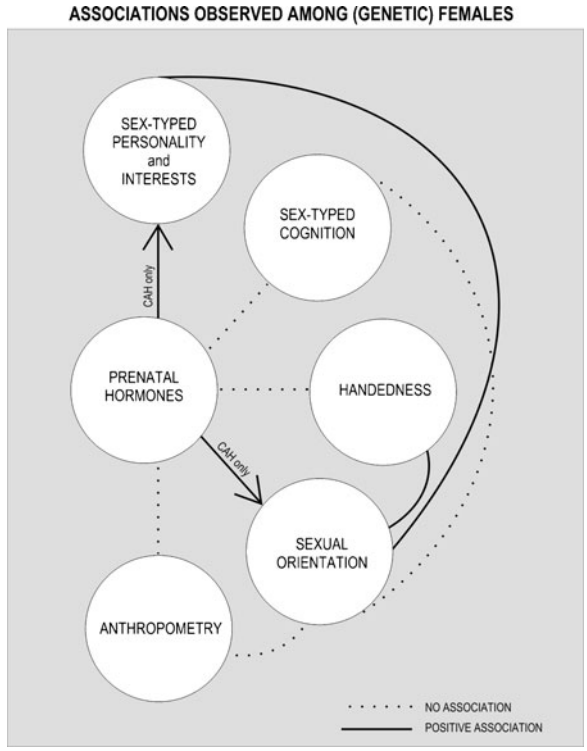

Fig. 2 Associations *observed* among (genetic) females. Reprinted and adapted by permission of the publisher from BRAIN STORM: THE FLAWS IN THE SCIENCE OF SEX DIFFERENCES by Rebecca M. Jordan-Young, p. 190, Cambridge, MA: Harvard University Press, Copyright © 2010 by the President and Fellows of Harvard College

organization paradigm on this case. In spite of the fact that they have the highest prenatal androgen exposures of any known group of human females (and in spite of common claims that there are differences in other domains), only childhood toy preferences and adult sexual orientation are consistently different in girls and women with CAH compared to unaffected women and girls. Moreover, the much-touted increase in same-sex orientation among women with CAH is generally limited to fantasy or attraction, while rates of actual same-sex behavior are only slightly elevated, if at all, especially when women with CAH are compared to women in the general population [50, 65, 66] rather than to their own same-sex relatives [56, 67–69]. The possible exception to this pattern is women with CAH who were initially assigned as male, in whom same-sex behavior and identity do seem to be elevated above population rates [68].

Even these differences cannot be conclusively attributed to hormones, in part because CAH has wide-ranging effects on post-natal physiology (e.g., disrupted synthesis of mood-regulating hormones; short stature; and high rates of obesity, cystic acne, hirsutism, and male-pattern baldness) [70–72]. As a group, girls with CAH also have very unusual rearing experiences and extremely intrusive medical interventions and monitoring, due both to concerns about 'virilization' and to the difficulty of achieving hormone control in the condition [73]. Note, too, that we emphatically disagree with the implicit perspective that both preference for so-called "boys' toys" and sexual orientation to women is a "suboptimal" outcome of psychosexual development in genetic females. Therefore, even as we draw attention to a wide range of factors that seem as likely as hormones to affect psychosexual development, we note that an additional problematic aspect of the "hardwiring" paradigm is that it encourages comparisons that implicitly, and sometimes explicitly, pathologize gender-atypical behaviors and desires.

Notably, no behavioral differences are found in the only other group of girls and women who are known to have been exposed to high levels of 'masculinizing' hormones in utero, namely those exposed to diethylstilbestrol (DES), a synthetic estrogen with androgenic properties in most species studied [74, 75]. In particular, in spite of some early reports that DES-exposed women were more likely than unexposed comparison woman to be left-handed [76–78] or lesbian or bisexual [79, 80], these associations could not be replicated when repeated with more appropriate comparison groups, including the only large, longitudinal cohort study of psychosexuality and DES exposure, which included nearly 4,000 DES-exposed women [75].

Figure 3 shows the observed associations among genetic males. Here, there is an even greater dissociation between evidence from research designs that begin by comparing people with different psychosexual profiles (case–control designs), on the one hand, studies of hormone-exposed subjects (cohort designs), on the other. In particular, no cohort design shows a consistent correlation between prenatal androgens and *any* aspect of psychosexuality in genetic males [22].

Ethical Shortcomings

For all the reasons outlined above, the hardwiring paradigm is plainly unscientific; it is at odds with

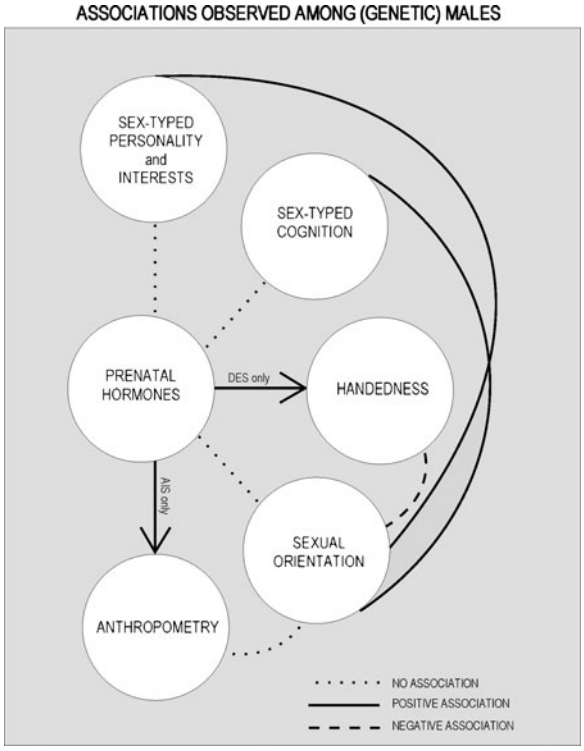

Fig. 3 Associations *observed* among (genetic) males. Reprinted by permission of the publisher from BRAIN STORM: THE FLAWS IN THE SCIENCE OF SEX DIFFERENCES by Rebecca M. Jordan-Young, p. 191, Cambridge, MA: Harvard University Press, Copyright © 2010 by the President and Fellows of Harvard College

many kinds of evidence both about the nature of traits and about the actual observed associations between early hormones and sex/gender in humans. Given this, continued use of the hardwiring metaphor is also unethical.

The hardwiring paradigm locks neuroscience studies of sex/gender into a framework that implies permanence for any randomly observed correlations between sex/gender, on the one hand, and brain structure or function, on the other. It encourages ongoing material and social investment in the primacy and irreducibility of sex/gender differences. In particular, the notion of innate sex differences has led both lay observers and some scientists to suggest that social policies directed towards gender equity in education, occupation, or other aspects of social life are either useless or actually damaging [81–83].

Hardwiring is an unethical metaphor because it says 'what is, must be'. That would be scientifically unsatisfying even if sex/gender were simply a domain of difference, rather than a domain of power relations and marked inequalities. But the continued existence of sex/gender inequalities adds an additional problem. The hardwiring paradigm erases the effect of the social world in producing sex/gender differences, so that sex/gender hierarchies appear natural. Neuroscientific explanations of sex/gender differences have added a new allure to an old fashioned sexism [84]. The endorsement by neuroscientists of innate accounts of differences has inevitably reinforced the *status quo* and non-interventional policies. This has been amplified also by the popularization of these ideas in the press. In a study that appeared in 2004, Victoria Brescoll and Marienne LaFrance examined 290 articles taken from 29 US newspapers which reflected, more or less explicitly, whether the cause of a given sex/gender difference was innate or acquired. These authors found that the ideology of the newspaper—established by taking into consideration its political view on a selection of issues (i.e., presidential endorsement and whether women should be admitted to military academies)—influenced the way in which the scientific research was addressed. More specifically, conservative newspapers were more inclined to attribute sex differences to biological cause than were liberal newspapers. Moreover, Brescoll and LaFrance [85] further demonstrated that the type of explanation endorsed by the newspaper influenced the beliefs of the readers.

As Cordelia Fine [86], we [87] and others have documented, scientists who double as popularizers of the sexed brain knit more than a few elaborations and conjectures together with neuroscientific facts to support the hardwiring paradigm [13, 88, 89]. But we suggest that even careful studies of sex/gender differences, at this time, may be missing the point. Rather than continuing to build and revise the list of differences (which are inevitable so long as social life is pervasively structured by gender), the question to ask now is *why* is it that we want to know about sex/gender differences? What do we wish to do with or about them? We write this, with humility and some concern, as scientist-critics who have both written books reviewing sex/gender difference research, for audiences that we hope will be broad. So we aren't picking on others here, but raising concerns about where we hope that we might all go from here, most productively.

Where Should We Go Next?

We close by considering the messages we convey by continuing to invest our scientific resources in extending, revising, or refining the catalogue of sex/gender differences. One very strong message is that sex/gender differences are crucial fundamental facts, that simply knowing about them in minute detail will guide us in important ways. Together with the pervasive belief that such differences are original, essential—that is, innate—this catalogue of differences distracts us from the extensive evidence on how the shape of sex/gender differences changes across both time and place, and can be altered by both natural experiences and deliberate interventions.

If we want to know about sex/gender differences because we are interested in empirically-grounded understanding of human development and potential, we can look in two promising directions. First, we can focus directly on plasticity, instead of using it as background information against which we interpret findings of difference. We might build on Feng et al's video game intervention (described above, [54]) by identifying some skills and traits that we can agree are desirable, and for which there seem to be reliable sex/gender differences at some point in the lifespan—mental rotation is a good example, but there are others like strong contextual verbal ability or empathy. Why not decide that we want to cultivate these skills or traits, and encourage creative research designs that

would help us to establish effective strategies for doing so? Likewise, we could build upon experiments that show how invoking either positive or negative stereotypes can stimulate sex/gender differences as large as those that are usually taken to be innate [49].

A second promising direction is to turn our backs on sex/gender differences. Because sex/gender differences are so mesmerizing, and because we ourselves are immersed in the "cultural frame of gender" [2], we may do much better to understand development and plasticity by looking at other kinds of variation, where our models and our interventions are less confounded by the complex and unavoidable overlay of gendered socialization and ingrained research hypotheses. Sex/gender differences exist, but so do differences between groups that we might want to define on many other dimensions—social class, occupation, development index or global region, specific training experiences, to name just a few. And each of these categories are themselves heterogeneous; more research on the ways in which sex/gender patterns in brain and behavior are specific to social class, ethnicity, and nation might provide much more illumination on the concrete mechanisms through which the social world shapes behavior, and even becomes embodied (brain) difference. Suggestive evidence in this direction is available from cross-national and ethnic comparisons of sex/gender difference in math and science tests. For example, both the size and the direction of sex/gender difference vary across ethnic groups. In the U.S., whites show the familiar pattern that boys score slightly higher (d=0.13), whereas Hispanics show no discernable sex/gender difference (d=0.00), and African Americans and Asian Americans show small differences favoring girls (d=−0.02 and d=−0.09, respectively) [90]. Further, in 2008, Guiso et al. analyzed mathematical and reading test scores (from the Programme for International Student Assessment-PISA) of 276,165 male and female adolescents from 40 different countries; in particular, the mathematical gap favoring boys is attenuated, and sometimes even reversed, depending on a measure of sex equity of the country [91]. These and similar findings clearly should remind us that we are not measuring 'biological sex' when we record students' sex/gender. Instead, we are measuring a composite variable that includes sex*ism*, as well as other aspects of social structure and experiences, including regionally- and ethnically-specific modes of 'doing' sex/gender.

Another compelling example of dimensions of difference that might prove more tractable than sex/gender for focused study is Maguire and colleagues fairly recent data on differences in neural structure and even function in a group defined only by occupation—namely, long-term taxicab drivers compared with those who haven't driven cabs [92, 93]. Why not follow Maguire's lead, and think about other occupations that might involve sufficiently distinct tasks that we could trace their effects in actual structural differences or brain activation patterns?

Given pervasive gender socialization and widespread gender segregation in occupation and family responsibilities, it is utterly predictable that we would observe group-level differences between men and women in various cognitive functions. It is frankly somewhat surprising to us that we do not see greater differences and less overlap, and also would not be especially surprising to see more structural differences than there seem to be. What's the big deal? Certainly it makes a huge difference to your daily life and activities whether you are male or female, without question more difference than whether or not you are a taxicab driver. Continuing to treat findings of sex/gender difference as if they are revelations feeds the commitment to and mystification of sex/gender differences, and distracts us from serious science.

Sex/gender is, for most purposes, at best an imperfect proxy of the variables we actually need to understand. Recent analyses by feminist epidemiologists show that studies that treat 'sex difference' as an explanation actually obscure more than they explain [11, 94]. Instead of treating sex/gender as the denominator of difference, it turns out to be far more informative to focus on specific mechanisms (such as hormone activity, body size differences, occupational differences, and co-morbidities) that themselves show meaningful variability within sex/gender groups that are routinely treated as homogenous. Data on differences in neural structure and function in groups that are defined only by occupation and hobbies, including pianists and jugglers, in addition to the aforementioned taxicab drivers [93, 95, 96] offer a useful start for thinking about how pervasive organization of daily tasks and social assignment of appropriate emotion, movement, and affect by gender becomes embodied as measurable 'sex difference'. Most importantly, it provides a ground for thinking about

what we actually wish to do with the information we have about difference and variability. What traits do we value, and might we wish to cultivate?

Steven Rose and colleagues [97] wrote that "In a society in which racism and sexism were absent, the questions of whether whites or men are more or less intelligent than blacks or women would not merely be meaningless—they would not even be asked." It follows that it would be better to abstain (at least for now) from trying to deal with unanswerable questions about origins of sex/gender differences, or to continue building a catalogue of 'differences' when we know that this catalogue is neither stable nor innocent.

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