Neuroethics (2012) 5:285–294
DOI 10.1007/s12152-011-9118-4

ORIGINAL PAPER

Explaining, or Sustaining, the Status Quo? The Potentially Self-Fulfilling Effects of 'Hardwired' Accounts of Sex Differences

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Received: 8 December 2010 / Accepted: 4 May 2011 / Published online: 22 June 2011

Abstract In this article I flesh out support for observations that scientific accounts of social groups can influence the very groups and mental phenomena under investigation. The controversial hypothesis that there are hardwired differences between the brains of males and females that contribute to sex differences in gender-typed behaviour is common in both the scientific and popular media. Here I present evidence that such claims, quite independently of their scientific validity, have scope to sustain the very sex differences they seek to explain. I argue that, while further research is required, such claims can have self-fulfilling effects via their influence on social perception, behaviour and attitudes. The real effects of the products of scientists' research on our minds and society, together with the fact that all scientific hypotheses are subject to dispute and disconfirmation, point to a need for scientists to consider the ethical implications of their work.

Keywords Essentialism · Neuroethics · Gender · Stereotypes

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> A theory about the stars never becomes a part of the being of the stars. A theory about man enters his consciousness, determines his self-understanding, and modifies his very existence.
> AJ Herschel (1965, 8) *Who is man?* (Stanford University Press)

Introduction

Are there hardwired differences between the brains of males and females that at least partially explain sex differences in behaviour and, ultimately, social roles and status?

The influential 'brain organisation' hypothesis of sexual differentiation proposes that foetal testosterone, the average levels of which differ markedly in male and females between the eighth and twenty-fourth weeks of pregnancy, exert permanent influences on the brain and thus gender-typed behaviour, including gender-typed interests and abilities [for a recent summary of this position, see 1]. For example, Baron-Cohen and colleagues [e.g., 2, 3] have proposed that foetal testosterone influences brain development in such a way that lower levels result in a "female brain" that is "predominantly hard-wired for empathy", while higher levels result in a "male brain" that is "predominantly hard-wired for understanding and building systems." [2, p. 1], emphasis removed from original.]

Functional and structural neuroimaging studies also often give rise to claims that male and female brains differ in significant ways [see 4, Table 1]. While many such findings of difference are isolated and apparently post hoc, it is often proposed that male and female brains differ in interconnectedness, with the typical male brain proposed to be more intra-hemispheric in functioning, and the typical female brain more inter-hemispheric. Researchers have speculated that such differences have functional consequences for gender-typed abilities, such as for understanding the thoughts and feelings of others (empathising), understanding physical, technical and other systems (systemising), mathematics and science [3, 5, 6].

Baron-Cohen's Empathising/Systemising hypothesis, and more generally the 'brain organisation' account of sexual differentiation from which it stems, have been critiqued elsewhere [7–10]. These authors have pointed to substantial empirical, methodological and conceptual concerns. These include substantive questions concerning the reliability and origins of behavioural sex differences, the proposed links between foetal testosterone levels and later gender-typed behaviour, the existence of sexual dimorphisms in the brain and their relation to behaviour or cognitive style, and the simplistic conception of development to which these accounts implicitly subscribe. I have also elsewhere summarised important issues regarding the production and interpretation of 'facts' about sex differences in the brain [7, 11].

My purpose here is not to rehearse these critiques but instead to make the case that the presentation of such accounts of sex differences in cognition and behaviour is likely to have self-fulfilling effects. Schwartz [12] has deployed the concept of "idea technology" to convey the point that just as the tangible objects produced by science and technology can affect our lives, so too can the ideas and concepts that science also creates. However, while the material objects of technology generally only impact society when the science behind them is sound, Schwartz notes that scientific ideas may affect individuals' lives and society even when they are false. The scientific investigation of particular social groups is a clear candidate for such effects. Hacking has described "looping" or "feedback effects in cognition and culture", whereby the causal understanding of a particular social group changes the very character of the group, leading to further change in causal understanding [13]. Similarly Choudhury and colleagues, referring specifically to the social impact of neuroscience, have argued that the representation of "brain facts" in the media, policy and lay perceptions influence society in ways that can affect the very mental phenomena under investigation [14].

My goal in this paper is to flesh out the evidence for this proposed influence for claims about hardwired sex differences. I focus primarily on claims of the type that the female brain is hardwired for empathising while the male brain is hardwired for systemising. First, I review the evidence that gender stereotypes influence perception and behaviour. Then, I explore the contribution of accounts of hardwired sex differences to these effects. Finally, I point to areas that require further research, while noting that the available data already indicate cause for ethical concerns.

Stereotypes and Minds

It is a tenet of cultural and social psychology that the psyche is "not a discrete entity packed in the brain. Rather, it is a structure of psychological processes that are shaped by and thus closely attuned to the culture that surrounds them." [15, p. xiii] With regards to the social category of gender, the structure of the psychological processes begins to be shaped from early infancy, as children begin to acquire the "cultural correlates" of gender [16]. By the time they start school, children have acquired considerable knowledge of gender stereotypes, that is, knowledge of the traits, activities and occupations typically associated with the two sexes [17]. Baron-Cohen's description of the "female brain" as hardwired to empathise reflects gender stereotypes of females as communal (that is, concerned for others as well as self) and people-focused, but males as agentic (that is, self-asserting, individualistic, ambitious) and object-focused [18]. The hypothesis that the "male brain" is hardwired to systemise is in keeping with the stereotype of men as more logical and analytic than females, and better suited to scientific and technical occupations [19]. In addition to culturally-shared descriptive beliefs about the sexes, research has also identified culturally-shared gender prescriptions and proscriptions—normative beliefs about how men and women *should* behave. For example, communal

behaviour is particularly strongly prescribed for women, while agentic behaviour is more strongly prescribed for men [18].

Even if individuals do not explicitly endorse gender stereotypes their contents can nonetheless influence perception, judgment and behaviour when activated by gender-relevant cues in the immediate social environment. Essential to understanding how such cues can influence social perception and behaviour is the concept that, as Bargh and Williams [20, p. 1] summarise it:

> Much of social life is experienced through mental processes that are not intended and about which one is fairly oblivious. These processes are automatically triggered by features of the immediate social environment, such as the group memberships of other people, the qualities of their behavior, and features of social situations (e.g., norms, one's relative power).

Thus, stimuli and events automatically activate a pattern of associations that "fill in information, quickly and automatically, about the characteristics that previously have been observed or affective reactions that previously have been experienced, in situations that resemble the current one." [21, p. 110]. Characteristics stereotypically associated with such stimuli become activated, and thus more accessible to consciousness, potentially influencing social perception and behaviour [22].

Social Perception

Perhaps the most obvious gender-related stimuli furnished by our social environments are people themselves whom, almost invariably, we automatically categorise as male or female. The biasing effect this can have on perception was demonstrated in a particularly striking way by Nelson and colleagues, who presented participants with a series of photographs of men and women, and asked them to estimate their heights [23]. Even though, on average, the men and women were of equal height (every man was matched with a woman of the same height), the men were perceived as significantly taller. This bias persisted despite encouragement by the experimenter not to treat sex as being diagnostic of height, and despite the offer of financial reward for more accurate, unbiased judgments.

Unsurprisingly, studies in which the judgments to be made are of less objective qualities than height also find evidence of gender bias. In 'baby X' studies researchers present the same infant as either male or female, and see how this affects the behaviour and perception of participants. Such studies typically find that people offer different toys to infants [24] and perceive their behaviour differently [25], depending on whether they have been told the infant is male or female, and in line with gender stereotypes. It might be argued that parents, with their more detailed knowledge of their infants, would not show the same bias. However, Mondschein and colleagues found no sex differences in the crawling ability and risk-taking behaviour of eleven-month-old infants. Yet mothers of girls under-estimated both crawling ability and risk-taking, while these were over-estimated by mothers of boys [26]. Similarly, Clearfield and Nelson [27] found that mothers conversed and interacted more with female infants and toddlers, despite the lack of any discernable sex differences in the children's responsiveness to their mother's speech or physical closeness.

Laboratory studies of 'paper people' in employment simulations provide further evidence that gender stereotypes influence social perception in ways that are apparently unintended and unnoticed [for recent reviews see 28, 29]. Research has identified a number of ways in which this may occur, including less favourable evaluations of the qualifications of female candidates [for reviews see 30, 31], a shifting of the importance of evaluative criteria to favour the sex-typical candidate [32–34], higher confirmatory standards for a female applicant to be seen to fulfil the necessary criteria [35], and especially negative evaluations of mothers [36, 37, 38]. Research has also identified 'backlash effects', whereby women are penalised socially and economically for behaving in ways that defy gender prescriptions. Laboratory work finds evidence of backlash effects in hiring, salary negotiations, promotion and evaluation [e.g., 39–45].

The activation of gender stereotypes can also influence not just how we perceive others, but also our selves. Priming gender has been found to influence, in stereotype-consistent fashion, people's self-assessments of gender-typed abilities (like mathematics and verbal ability) [46, 47]. Gender priming has also be found to reduce women's expressed

interest in male-typed occupations and activities like engineering, leadership roles, and mathematics [48–50]. Moreover, people's self-perceptions are also influenced by what (they think) socially close or important others think of them. Thus if B's opinion of A is stereotypic, and B is in some way important to A, then A's self-perception and possibly even behaviour will be "tuned" to become consistent with B's perceived view [51–53]. Furthermore, Correll [54] has found that 'gendering' a novel task as male-typed (that is, performed better by men) reduces women's ratings of both their ability on the task, and interest in supposedly related occupations.

Stereotype Threat

"Stereotype threat" [55] refers to the detrimental effect on performance of a social context that highlights a relevant negative stereotype about one's social group (e.g., the stereotype that women are bad at math, during a math test). Typically, researchers investigate the effect of stereotype threat by comparing performance in threat and non-threat conditions. In threat conditions a gender stereotype may be referred to explicitly, or may simply rely on participants' awareness of this culturally shared knowledge. Thus researchers who investigate the effects of stereotype threat on mathematical performance need not refer explicitly to the stereotype of men as superior in this domain. In non-threat conditions a gender-typed task is presented in a gender-neutral fashion, or the gender stereotype is presented as irrelevant (e.g., "no gender differences are found on this test").

Research suggests that a primary mechanism by which stereotype threat disrupts performance is that attempts to suppress negative thoughts, negative self-relevant stereotypes and anxiety place extra demands on self-regulatory processes [56]. Recent meta-analyses suggest that the detrimental effects on performance are not trivial. Walton and Spencer found that stereotype threat effects on performance led to an underestimation of women's ability of 19 to 21 points on the SAT Math (compared with a general population gender gap of 34 points) [57]. Another recent meta-analysis found an effect approximately twice as great as this for women taking difficult maths tests. These effects are greatest in women who have some investment in doing well in this domain [58]. The degree of undermining of ability indicated by these meta-analyses suggests that stereotype threat effects are likely to be of real practical significance in competitive and demanding educational and workplace settings. Moreover, recent research has found evidence that stereotype threat can also impair women's ability to learn gender-typed material (chemistry and mathematics) [59, 60], suggesting that pervasive stereotype threat may disadvantage females chronically, not just in test situations. Thus the real-world impact of stereotype threat effects should not be dismissed, especially given arguments that gender gaps arise out of small, subtle but—over time—significant accumulation of male advantage/female disadvantage [61, 62].

There is also growing evidence that gender stereotypes can trigger spurious female superiority on female-typed tasks. Early studies using the "empathic accuracy" test (in which participants infer the thoughts and feelings of another person from a video-recording of a recent interaction with them) failed to find sex differences overall [63, 64], suggesting that males and females have equivalent cognitive empathy abilities [although a modest female advantage is observed using other tests; see 63]. However, when the test form was changed slightly to ask participants to rate the accuracy of their empathic judgments, female performance was enhanced [for meta-analysis see 65]. Ickes [64] suggested that this small change reminded women of the gender stereotype of feminine social sensitivity. Similarly, other studies have found under-performance in men relative to females when tests are presented as being easier for women, but no difference when they are presented more neutrally [66, 67]. Likewise, Horgan and Smith [68] found that both sexes were disadvantaged when a test of interpersonal skills was framed as being relevant for an occupation traditionally associated with the other sex (interrogating for the military versus social work).

There is some evidence that social-contextual influences on people's motivation to perform well on such tasks may contribute to, or even create, sex differences in performance. Men's empathic accuracy performance matched that of women when participants were paid for correct answers [69], was increased by information claiming that good performance in this domain is associated with romantic and sexual success [70], and was decreased by a

motivational, affiliative based need to conform to the social norms of masculinity [71].

Summary

The data reviewed above make a compelling case that gender stereotypes influence social perception, self-perception and gender-typed behaviour in self-fulfilling ways. Baron-Cohen [72], however, has recently argued against such a conclusion. He suggests we should regard the social manipulations that reduce or eliminate gender gaps as "forms of intervention" that alleviate "spontaneous" sex differences [72, p. 904]. He thus claims that to conclude that social-contextual factors cause behavioural sex differences is fallacious, analogous to concluding that since aspirin can alleviate a headache, headaches are caused by lack of aspirin. However, such an interpretation requires us to hold the rather implausible thesis that the brief and simple manipulations used in such experiments (such as telling participants that no gender differences are found in a particular test) can significantly influence performance, yet the cultural beliefs and expectations about gender that are thoroughly embedded in our culture have no effect [73].

What are the Effects of Claims of Hardwired Sex Differences?

Scientific claims about hardwired sex differences are part of the culture that interacts with our minds. These ideas do not remain contained within the scientific literature, but are disseminated to the public [with wildly varying degrees of accuracy - see 7] in popular books and articles. 'Brain facts' may enjoy an especially persuasive effect on public attitudes thanks to neuroscience's "seductive allure" and apparent epistemic authority [74, 75], and the way that neuroscience findings tend to be presented in the popular media [76]. What are the psychological effects of suggestions made in the public domain that, for example, sex differences in empathic skills, or achievement in science, mathematics, philosophy or information technology can be at least partially attributed to the effects of foetal testosterone on the brain [77–80]? Of course in order to answer this question it's necessary to clarify the comparison—effect compared with what?—since there is no such thing as a "neutral" environment. It is often the case that sex accounts for a trivial amount of the variance in a behaviour. Some therefore might consider the appropriate comparison to be an article that discusses the same domain (e.g., mathematical skill, or empathising ability) but that explores the contribution of, say, socio-economic or cross-cultural factors.

However, the more conservative comparison, and the one made in experimental studies, is with information that still draws attention to gender as a social division and differences between the sexes, but that emphasises 'environmental' versus 'biological' contributions. The latter are generally taken to indicate a degree of inevitability and fixedness to sex differences, found by Haslam and colleagues to be an important component of essentialist beliefs about gender [81].

So what do such studies find? First, preliminary evidence suggests that it may be the spontaneous assumption that gender differences are 'biologically' caused that underlies the detrimental effects of stereotype threat. To date, two stereotype threat studies have compared the effects of information claiming that gender differences in mathematical ability are due to genetic versus environmental factors. Both found that normal stereotype threat effects were seen only when it was claimed that the gender gap in maths performance was due to genetic factors [82, 83]. Moreover, it has been found that people's belief about intellectual ability in general—whether it is a fixed entity (a 'gift') or incremental ('earned')—influences persistence and motivation, with those subscribing to an entity view coping less well with setbacks. The idea that males are hardwired to be superior at maths or science reinforces the idea both that such abilities are fixed (or 'gifted') rather than earned, and that this 'gift' is bestowed primarily on males [84]. Interestingly, an intervention study that challenged the 'fixed' view of intelligence in seventh grade students eliminated the gender gap in maths performance on a standardized test observed in the control, non-intervention group [85].

Second, both the endorsement of 'biological' explanations of gender differences, and exposure to biological accounts, have been associated with greater endorsement of gender stereotypes [86, 87] and more stereotypical self-perception [88]. This is merely one

example of a general tendency for biological essentialist beliefs to be associated with endorsement of a wide variety of social stereotypes [89]. Effects on self-perception and behaviour are yet to be established: the effects on the self-ratings of, and actual, empathic abilities of men whose wives have just read *The Female Brain* [90], the blurb of which claims that "a man can't seem to spot an emotion unless someone cries or threatens bodily harm", have yet to be investigated. However, the data reviewed earlier suggest that such effects may occur via influence on both the individual's self-perception and his or her perception of close others' beliefs about them.

Third, there is evidence that a stronger weighting of genetic influence on behaviour is associated with greater moral tolerance of the social status quo. Keller [91] found that endorsement of genetic determinism was associated with greater modern sexism (that is, denial that sexism continues to exist, an antagonistic attitude towards feminist demands, and resentment towards policies such as affirmative action). Likewise, Dambrun and colleagues found that endorsement of the legitimacy of the social hierarchy decreased in students taking a psychology course (with a focus on social, situational and environmental contributors to behaviour), but not in biology students, despite similar attitudes at the outset of the study [92]. This change was mediated by a decreased belief in genetic determinism.

It has been argued that the belief that differences between social groups are biologically essential naturalises inequality and serves a system-justifying function, both in general [93] and specifically in relation to gender [94]. Supporting such a motivated system-justifying basis for biological essentialist accounts of gender, Morton and colleagues found links between essentialist beliefs and sexism in men only, and only when women were presented as gaining ground on men. Conversely, Morton and colleagues also showed that scientific claims about gender influenced endorsement of hierarchy legitimizing beliefs and attitudes. They found that people shown scientific claims that males and females are hardwired to be different (compared with those told that such ideas are under scientific debate) expressed more confidence that society treats women fairly, and less confidence that the status quo was likely to change. Furthermore, male participants were more supportive of sex discrimination in the workplace after reading such material [95].

A Call for Further Work

The work reviewed above supports the idea that scientific accounts of sex differences in cognition and behaviour can influence the very mental phenomena under investigation [13, 14] and, independently of their truth, affect people's lives and society in self-fulfilling ways [12]. Haslam [96] has argued that essentialist thinking about social groups can have detrimental effects via both the perception of differences between social groups and the validity of social stereotypes, as well as via beliefs about the fixedness and naturalness of group differences. As he summarises it, "essentialism deepens social divides, making differences appear large, unbridgeable, inevitable, unchangeable, and ordained by nature." Future research could be usefully targeted at exploring further the effects of belief in, or claims of, hardwired sex differences on perception, self-perception and behaviour, and the mechanisms by which such effects come about.

For example, do such beliefs or claims increase gender bias in evaluations of others, and/or backlash effects against women who violate gender prescriptions? If so, this is of considerable concern given the current popularity of corporate gender diversity training programs based on the notion of hardwired sex differences [e.g., 97]. Do such claims result in more stereotypical perception and socialization of children by parents and teachers? If so, again, this would be worrisome given the rising influence of supposedly 'brain-based' educational strategies recommended to schools [98, 99]. Do such claims reduce support for and/or optimism about programs to increase female participation in traditionally male domains? Do such claims affect heterosexual spouses' expectations of their partner's role in domestic labour [see 100]? Do such claims influence self-perception of ability and interest in gender-typed domains? The evidence reviewed above suggests a number of plausible candidate mechanisms for such effects. These include the increased endorsement of gender stereotypes chronically, the short-term activation of gender stereotypes, reduced motivation to control for

bias, increased complacency regarding the status quo, and the changed perception of descriptive and/or prescriptive social norms.

As a final point, the available research even as it currently stands is sufficient for ethical alarm bells to be sounded. Biological essentialist accounts of sex differences have a long and sorry history, in which scientific claims about male/female difference, later discarded, serve to explain, legitimate and reinforce the status quo [see 101–103]. As with any scientific conjecture, the brain organisation hypothesis and claims about sex differences in the brain and their relation to behaviour are subject to debate and disconfirmation. And, as noted in the introduction, substantial concerns have been addressed regarding the validity of the conclusions that have been drawn from the available evidence [7, 9, 10]. This raises important questions regarding the ethical responsibilities of scientists given their contribution to the real effects, outlined here, that the products of their research have on our minds and society.

Acknowledgment The author thanks Nick Haslam for his valuable feedback on an earlier draft of this article.

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