

Hormone troubles: Feminist analyses of contemporary neurosciences

Social Studies of Science

43(5) 780–791

© The Author(s) 2013

Reprints and permissions:

sagepub.co.uk/journalsPermissions.nav

DOI: 10.1177/0306312713488843

sss.sagepub.com



Svenja Matusall

MINDLab and The Interacting Minds Centre, Aarhus University, Aarhus, Denmark

Jill Fisher (ed.), *Gender and the Science of Difference* (New Brunswick, NJ: Rutgers University Press, 2011), 272 pp., \$26.95/€24.99/£23.50 (pbk). ISBN 9780813550473

Cordelia Fine, *Delusions of Gender: The Real Science behind Sex Differences* (New York: W.W. Norton, 2010), 338 pp., \$16.95/€20.99/£14.95. ISBN 9780393068382

Rebecca Jordan-Young, *Brain Storm: The Flaws in the Science of Sex Differences* (Cambridge, MA: Harvard University Press, 2010), 408 pp., \$19.95/€27.99/£8.99. ISBN 9780674063518

Robyn Bluhm, Anne Jaap Jacobson and Heidi Lene Maibom (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science* (New York: Palgrave Macmillan, 2012), 296 pp., \$90.00/€72.99/£55.00. ISBN 9780230296732

[D]espite the many recent insights of brain research, this organ remains a vast unknown, a perfect medium on which to project, even unwittingly, assumptions about gender. (Fausto-Sterling, 2000: 118)

Feminist critique of biological gender research, 1979

In the 20th century, women's biology no longer prevented their access to the public sphere. Research on sex differences was conducted with fewer discriminatory undertones, but gender normative assumptions were still asserted in fields such as political leadership (men are more aggressive) and the hard sciences (men are more rational). Reflecting these developments, Susan Leigh Star (1979) contended 30 years ago that

Corresponding author:

Svenja Matusall, The Interacting Minds Centre, Aarhus University, Jens Chr. Skous Vej 4, Building 1483, 3rd floor, 8000 Aarhus, Denmark.

Email: s.matusall@hum.au.dk

nearly all the articles on sex differences in brain asymmetry ... are based on a network of interlocking assumptions which have no foundation in observed or observable reality, but which are sexist, political, reductionist and dangerous. They are epistemologically connected closely with other research in the area of sex differences which has called upon 'biology', or upon what writers agree to be biology, to 'prove' things they would like to believe about women and men. (pp. 113–114)

On a methodological level, Star (1979) pointed out that while some observations that are purported to demonstrate a biological basis of gender differences might be 'accurate, precise, and repeatable' (p. 114), researchers often ignore explanatory variables such as the participant's training and education or experimenters' expectations. On an epistemological level, she stressed that the division in male and female subjects in itself may serve to reify and maintain this culturally created dichotomy. Moreover, the complex relationship between nature and nurture is often simplified in sex research that interprets anything having a biological correlate to be innate (Star, 1979: 119–123).

Other authors writing in the same volume on biological gender research (Hubbard and Lowe, 1979) stressed that the nature–nurture debate is not easily solved by focusing on one side or the other because both sides are entangled (e.g. Lowe and Hubbard, 1979: 95). Ruth Bleier (1979) claimed that not only is it flawed to make inferences about the effects of hormones on behaviour from animal studies to humans, but also that the animal studies themselves cannot be seen as yielding unambiguous results (pp. 51–54). All three of these articles stressed that such studies serve a certain social purpose of maintaining status quo of a patriarchal order and do not take place 'in a social and economic vacuum' (Lowe and Hubbard, 1979: 106). The authors agreed that sex research is influenced by the political interest of maintaining the patriarchal order by inscribing differences between men and women. That is, differences in the characteristics, skills and behaviours of men and women are assumed to be rooted in biology, particularly in hormones and brain structure, reifying and taking for granted gender dichotomies and heterosexual normativity.

Gender brain science today

Much has happened in the 30 years since these critical examinations of sex research from feminist perspectives. The notion of neuroplasticity opened space for studying environmental influence on the brain. New technologies allowed for more detailed studies of living brains and investigations of function rather than structure. Gender studies challenged assumptions of heteronormativity as well as dichotomies between genders; women's and lesbian, gay, bisexual, transgender (LGBT) movements gained increasingly more rights, visibility and freedom. Women's share of higher academic degrees increased dramatically, as did their share of the job market. Last but not least, the history and social studies of science showed the historical, economic, cultural and social situatedness of scientific knowledge and challenged the claim of objectivity. Have these developments changed the way sex and gender are represented in the neurosciences? A brief overview of contemporary contributions to the literature critiquing brain sex research will reveal that this has not proved to be the case.

If anything, research on biological differences between women and men seems to have become more entrenched in mainstream psychology and neuroscience; in a corresponding move, the rhetoric for popularising such differences seems to have become more confident. At the same time, however, feminist critics of these approaches continue to maintain that the differences inscribed in the brain are highly dependent on the point in time and space from which these claims are made (see, for instance, Fisher, 2011; Grossi and Fine, 2012; Jordan-Young, 2011). Scholars from various disciplines, ranging from neuroscience and psychology to history, philosophy and sociology have undertaken the (sometimes not even so difficult) task of scrutinising how social facts about gender are re-inscribed into the seemingly stable matter of brains and biology, thus deconstructing myths of 'neurosexism' (Fine, 2010). The critique today is thus similar to that 30 years ago: a historically specific patriarchal social order is explained by human evolution, the strong focus on biology ignores possible interdependences with the social world, weak results are generalised, context is mainly ignored, and overall, the research in this area still maintains dichotomies. These critiques will be explicated in the following.

Critique I: historical blindness

Ironically, gender brain research often remains stubbornly ahistorical even when referring to a Palaeolithic past of mythical status. It builds on research in its own area without taking into account its entanglements with socio-historical developments. Yet an awareness of these entanglements would increase understanding of current research and debates in, for instance, the case of notions of femininity and masculinity in brain organisation research (BOR). Rebecca Jordan-Young (2011: 109), working in the fields of psychology and science studies, points out that most scientists working in BOR take these concepts as a stable given. However, this is problematic for two reasons. First, in the decades since their emergence, second wave feminism, LGBT movements and the sexual revolution have brought to the surface questions about 'normal' sexuality and what it means to be female or male (Jordan-Young, 2011: 109–110). Second, Jordan-Young (2011) shows – and this is perhaps the most important insight from her study – that even within BOR, notions of femininity and masculinity have changed over the past decades. In the 1960s and 1970s, men were seen as active, polygamous and sex centred, while women were seen as passive, monogamous and family centered. Moreover, a person could only have either male or female character traits. This changed during the 1980s when female sexuality was perceived to be active too and a person could have components of both, male and female sexualities. These conceptual changes are masked by scientists' certainty about what male and female means today (on which they will not agree among each other by the way) (pp. 108–143). Cordelia Fine (2010), a psychologist who conducted a thorough study of gender brain research, makes a similar point that by neglecting social and historical factors, gender brain research ignores a crucial confounding point: gender relations change much faster than mere biological evolution would allow. For instance, she argues, historical shifts in occupational gender relations such as the transformation from former masculine domains like schoolteachers or secretaries into feminine domains 'don't lend themselves especially well to explanations in terms of genes and hormones' (Fine, 2010: 119).

Theories of hormones and genes are often linked to evolutionary explanations. Yet, as biologist Sigrid Schmitz (2006: 208) points out, theories about human evolution are always highly influenced by the socio-historical conditions in which they emerge. Contemporary categories of men and women living in heterosexual, monogamous families have become the dominant perspective from which the past is often interpreted. However, as Leslie Rogers (2011) argues in her contribution to Fisher (2011), because neither brains nor behaviour leave fossil records, such explanations of gendered behaviour can only be storytelling (p. 30). Evolutionary just-so stories are even applied to very recent phenomena such as colour preferences. Psychologists speculate about the genetic origin of gendered colour preference even though gendered colour codes as currently expressed are not more than 50 years old, and their introduction can be interpreted as a response to the concern that masculinity and femininity were not rooted in biology but had to be acquired (Fine, 2010: 208–209). Deterministic explanations of human psychology are also at odds with recent research in neuroplasticity, which stresses the impact that physical, social and cultural environments as well as life experiences and individual behaviour have on brain structure. The brain changes throughout the entire life, and in its course, experiences become biology (e.g. Einstein, 2012; Jordan-Young, 2011: 286–291; Rogers, 2011: 37; Roy, 2012: 188–191).

Critique 2: hormones, genitals and gender roles?

In their review of Louann Brizendine's (2006) *The Female Brain*, Rebecca Young and Evan Balaban (2006: 634) assert that sex differences are drawn so sharply that men and women almost appear to be different species. Moreover, the biological evidence is presented as if it would precede differences in behaviour while possible interdependences are neglected.

Brizendine's pop-science contribution is just one example for a general trend, as Jordan-Young (2011) shows in her monograph. She identifies the basic idea of BOR as follows: notwithstanding chromosomal sex, if the hormonal environment in utero is male-typical, we end up with male-looking genitals and masculine psychological traits such as erotic orientation towards women, and cognitive patterns and interests. The same applies for a female-typical milieu in utero, which leads to female-looking genitals and feminine psychological traits (p. 39). Jordan-Young (2011) emphasises the political impact of this research by observing that

(f)rom a division of labor in reproductive intercourse itself, to a reproduction of labor in families, and so on, the core assumption of brain organization theory is that masculinity and femininity are package deals with reproductive sexuality at the core. (pp. 39–40).

Yet, she argues, several reasons mitigate against transferring the well-established effect of androgens in the development of genitalia to the development of sexual personalities. First, brains develop much more slowly than genitalia, and their development depends on interactions with other people and the environment – as does psychological and behavioural femininity or masculinity. Second, Jordan-Young (2011) points out that human brains cannot reliably be sorted into male and female brains because at the

individual levels they are too similar. Moreover, she remarks that behaviours and traits are not as easily gendered as genitalia are sexed, despite efforts attempting to do so. Third, she maintains that the overlap of male and female cognitive skills is much larger than the difference between them, which makes it almost impossible to speak of male and female brains as categories. Finally, animal models for brain and psychological development are more problematic than such models for genital development because less similarity across species can be established in brain structure than in the structure of genitalia. The same is true for behaviours, desires, personalities and sexual behaviour, all of which are domains in which fewer cross-species similarities exist (pp. 48–52).

In her critique of the overly simplistic uses of animal studies, Jordan-Young (2011) is joined by two contributions in Jill Fisher's (2011) volume *Gender and the Science of Difference*. Lynda Birke (2011) reflects on the specific conditions in which laboratory rats live and how these social circumstances influence animal behaviour, which is then widely interpreted as gender-specific behaviour in the literature (pp. 101–103). She suggests that feminist science should take a different perspective by acknowledging that laboratory animals, too, have a social life that influences their biology (p. 104). Angela Willey and Sara Giordano (2011) ask 'Why Do Voles Fall in Love?' in their review of monogamy research in prairie voles. They argue that using voles as models for human social behaviour 'marks the consolidation of an implicit cultural consensus about monogamy as somehow fundamental to what makes the human human' (p. 109). They observe that beliefs about binary sex roles are embedded so deeply in research on monogamy that this research reproduces these beliefs. They also deconstruct research on social effects of the hormones oxytocin and vasopressin as deeply embedded in cultural beliefs about motherhood, pair bonding and heteronormativity (p. 120).

Critique 2a: Intersex. A particularly sensitive issue in the BOR discourse is how intersex syndromes are traced in specific prenatal hormonal environments. As Jordan-Young (2011) maintains, in cases of intersex, these hormonal differences are particularly entangled with social factors such as increased medical surveillance, surgeries or parental expectations. This entanglement makes it difficult to point out the determining factors for behaviour and psychological traits associated with specific intersex conditions (p. 78). In a discussion of early childhood treatment of such conditions, Iain Morland (2011) points out that defining external genitalia as intersex is an effect of social expectations, rather than of physical evidence (p. 148). Morland discusses intersex as a problem of gender (in the eyes of the medical establishment) versus a problem of trauma (in the eyes of activists) and argues that by treating it as a problem of gender that has to be surgically solved, a problem of trauma is created.

While Jordan-Young and Morland discuss the political elements of intersex discourses mainly from the perspective of medical treatment and surveillance, Cynthia Kraus (2012) observes a growing alliance between activists fighting for intersex rights and neuroscientists arguing for a brain-based sex theory, and thus a model of innate sex differences rather than differences as products of socialisation (pp. 206–207). She argues for a strong social science perspective in this debate and suggests that one intervention from the social sciences could be to complicate matters by making conflicts explicit, for instance,

those about brain organisation theory and how it may or may not serve the cause of inter-sex rights (p. 211).

Critique 3: lateralisation

Closely related to the critique of hormone–behaviour links is the critique of gendered brain lateralisation. Neurologist Norman Geschwind (Geschwind and Behan, 1982: 5099) proposed a theory according to which high levels of foetal testosterone inhibit the growth in the left brain hemisphere. He and others, most prominently autism researcher Simon Baron-Cohen (2003: 105), argue that testosterone exposure leads to a priority of the right hemisphere, which is involved in systemising and spatial ability, while the left hemisphere is involved in language skills and the ability to empathise. The monolateral activation in men results in stronger local activation in specific tasks, reflected by the popular belief that men can only do one thing at a time. The female brain, a result of less prenatal testosterone exposure, is characterised by inter-hemispheric connectivity (pp. 105–111). Morphometric studies suggest that the corpus callosum, the structure connecting the two hemispheres, is bigger in women than in men (Baron-Cohen et al., 2005: 819–820).

The theory of bigger corpora callosa in women, however, has been subject to scientific disputes that have been carefully analysed by biologist Anne Fausto-Sterling (2000). She describes the corpus callosum as being embedded in a knotted web of knowledge that '[links] the underrepresentation of women in science with hormones, patterns of cognition, how best to educate boys and girls, homosexuality, left versus right handedness, and women's intuition' (Fausto-Sterling, 2000: 119). She concludes that no agreement exists about what the corpus callosum actually is, what belongs to it and what it does not, what influence left versus right handedness has and whether it shows significant differences between genders or not (Fausto-Sterling, 2000: 126–130, 138–140). Moreover, the corpus callosum may change over time due to factors such as experience, health or age. Fausto-Sterling (2000) emphasises that differences found in corpora callosa are only of statistical relevance, that they depend on sample size and are at least in part linked to political debates (pp. 144–145).

Ten years on, Fine (2010) observes that despite growing evidence against it, the theory of gender differences in corpus callosum size and lateralisation is still dominant in fields such as language research. After reviewing research in lateralisation, she drily concludes, '(n)onexistent sex differences in language lateralisation, mediated by nonexistent sex differences in corpus callosum structure, are widely believed to explain nonexistent sex differences in language skills' (Fine, 2010: 138).

Critique 4: context is ignored

Much research in hormone–behaviour links is conducted with children and women with congenital adrenal hyperplasia (CAH), one of the most common intersex conditions (Jordan-Young, 2011: 47). Due to the high androgen exposures during gestation, these children are considered to be particularly suited for research in hormone–behaviour links. One significant environmental factor that is often ignored in interpreting research

with CAH children is the medical surveillance they face. This might include close genital inspection, questions about gender identity, and informing both children and their parents about future fertility. In all likelihood, such treatment has considerable effects not only on how children perceive themselves but also on how parents, who are taught that their children are not 'normal', treat them (Fine, 2010: 239–240). Fine (2010) notes that even children who are categorised as either boys or girls at birth are subject to environmental factors and expectations of their (gendered) behaviour, even before they are born (pp. 192–194). Because these expectations are at work from the moment the sex of the child is known, it is not possible to distinguish between biological and environmental factors. However, inscribing behavioural differences between genders in biology, in this case in brains that are hard-wired by prenatal hormone exposure, tends to neglect influences of non-biological factors and to see the relationship between biology and culture as a one-way street rather than a feedback loop.

Lack of context is also problematic in other areas, as several contributions in the volume *Neurofeminism*, edited by Robyn Bluhm, Anne Jaap Jacobson, and Heidi Lene Maibom (2012), point out. Regarding the context of imaging research, Letitia Meynell (2012: 12) deconstructs the 'apparent transparency' of functional magnetic resonance imaging (fMRI) images as 'objects from nowhere', while the process of their production is lost. Such fMRI images, in other words, are constructed rather than simply depicting an already existent 'reality'. Nevertheless, they are granted the status of transparency, making them valid sources in lay discourse about gender differences and implying a clear distinction between male and female brains (Meynell, 2012: 27). Ginger Hoffman (2012) is equally doubtful about neuroscience's ability to say anything meaningful about the constructed quality of gendered brain differences. While she acknowledges some evidence for physical difference between genders, she stresses that in giving meaning to these differences, it is necessary to assume that differences in brain states always imply differences in mental states, an assumption she challenges with the philosophical concept of multiple realisation, arguing that different strategies may lead to the same result (Hoffman, 2012: 31–37). Knowing brain states is not sufficient to understand strategies and intentions, she concludes.

Heidi Maibom (2012) discusses feminist philosopher Carol Gilligan's concept of care ethics, which claims that female morality differs from male morality and is based on care for others (pp. 56–57). Maibom asks about psychological and neuroscientific evidence for higher empathic skills of women and reports that the literature is ambiguous: while some studies show significant differences between genders, others show none. Moreover, while women sometimes report higher levels of empathy than men do, often these self-reports do not resonate with physiological data. This observation leads Maibom (2012) to conclude that for all we know, 'women *claim* to be more empathic than men do, but there is little evidence suggesting that they actually are' (p. 68). In this light, Gilligan's philosophical concept of a female ethic of care may base as much on cultural stereotypes as an ethic that claims to be universal but in reality bases more on values ascribed to men (Maibom, 2012: 70). In this case, physiological data may in fact help to put philosophical concepts into perspective. Maibom's (2012) analysis also shows how concepts of masculinity and femininity guide empathy research, much as Jordan-Young (2011) argues that they guide research in brain organisation theory.

Critique 5: maintaining dichotomies and heteronormativity

Thirty years ago, feminist critics accused gender brain science of reifying gender dichotomies by dividing research participants in male and female groups. This is still common research practice, as neuropsychologist Anelis Kaiser and her colleagues (2009) report in their review of fMRI language research. Since data on gender are collected by default in all experiments, they are often co-examined, even if gender differences are not in the focus of a study. This practice leads to manifesting the dichotomy of male or female as a natural given. But more importantly, it leads to reporting differences while ignoring similarities. That is, if a small difference in one brain area is found, it is reported; however, it is rarely mentioned if the same study found similarity in all other areas investigated. This convention is rooted so deeply in scientific practice that it is not even possible to search for sex or gender similarities in scientific databases (Kaiser et al., 2009: 55). Thus, rather than incorporating evidence of changed gender roles and fluid gender identities, gender brain research continues to reproduce an awareness of differences and dichotomies (see also Spanier and Horowitz, 2011).

Moreover, a certain form of heteronormativity is maintained by the way sexual orientation is investigated. By comparing brains of gay men to those of heterosexual women, and by deploying the hypothesis that male hormone exposure in female foeti and female hormone exposure in male foeti leads to homosexuality, the norm of male desiring female and female desiring male is maintained by assuming that lesbians have male brains and gays have female brains. Yet this is only one possible way among many of framing sexual attraction (Jordan-Young, 2011: 160–161).

Isabelle Dussauge and Anelis Kaiser (2012b: 122) review current imaging research on sexual orientation. They point out that these studies are limited by a 2×2 matrix of gender and sexual orientation (male/female and homosexual/heterosexual) and thus cannot take into account fluidity and plurality of gender and sexual orientation both within individuals and within populations. Moreover, they observe that sexual orientation is measured mono-dimensionally by the degree of attraction to either of two (and only two) genders, not reflecting aspects like what counts as attraction or what sparks it (pp. 136–139). Against such reductionist framings, Dussauge and Kaiser (2012b) argue that brains are much queerer than mainstream neuroscience allows for. However, they see some potential in bringing neuroscientific empiricism and queer issues together and suggest four points for re-queering the brain in the neurosciences: (1) a non-deterministic approach that understands brain function and brain structure as a two-way relationship, (2) a new point of departure for de-essentializing gender and sexual preference to allow for diversity within subjects and populations, (3) re-multiplying gender expressions and sexual desires and (4) self-reflexivity in interpreting results, sticking to what studies actually say and avoiding exaggerations (Dussauge and Kaiser, 2012b: 142–143).

Conclusions: feminist neuroscience?

Dussauge and Kaiser (2012b) are not alone in thinking beyond mere criticism. Rather than simply rejecting research in the neuroscience of sex and gender differences and maintaining the ‘nurture’ side in the nature/nurture conflict, other authors also acknowledge that

research provides some evidence for certain (statistical) differences. On this basis, they productively suggest different readings of the neuroscientific literature on sex differences, allowing for reinterpreting the data and for questioning the epistemology guiding such research in the first place (e.g. Hoffman, 2012; Jordan-Young, 2011; Roy, 2012). These authors set particular hope in investigating interactions between brain and environment in the newly emerging paradigm of neuroplasticity (see above).

Gillian Einstein (2012) goes a step further by suggesting a feminist neuroscience, which she defines as

research into the nervous system that would give voice to areas of research previously silenced, uncover pockets of ignorance, ... turn expectations about the essentialism of biology onto its head, and contribute meaningfully to women's lives in all their varieties. (p. 150)

For this purpose, she conducted a multifaceted study on neurobiological effects of female genital circumcision with members of the Somali community in Toronto. Evaluating the research process, she concludes that it is indeed possible to conduct feminist neuroscientific research and proposes some guidelines for doing so. For example, Einstein (2012: 167) recommends that researchers consider a research question in all its contexts, such as geography, time, space, culture and individual biologies. In addition, researchers should situate themselves and acknowledge their prejudices; detect power structures and try to flatten hierarchies between researchers and study subjects; understand study subjects as knowledgeable partners in the experiment; ask questions from first, second and third person perspectives; restrict claims of study findings; and display individual data points (Einstein, 2012: 167–168). Einstein's study design and guidelines may in fact serve not only for developing a feminist neuroscience but also for generally developing cooperation on eye level between neurosciences and social sciences.

However, the congruence between the contemporary critiques of neuroscience reviewed here and those which were voiced 30 years ago suggests that despite developments within the research field and transformations in other areas of society, gender brain research has not changed much either in terms of epistemology or in the fierce rhetoric with which historically specific gender differences are inscribed into biology. Cordelia Fine (2010) presents a well-written, if not somewhat polemic, overview of psychological and neuroscientific research in gender difference that is easily accessible for a broader audience and is a good introduction to critical reflection on such research. For readers already well versed in the field, however, her book might contain little that is new. Jordan-Young (2011) presents a (sometimes too) detailed study by assembling historical analyses, ethnographic accounts and extensive literature review of BOR, and her book can be read as an invitation for a dialogue between disciplines to enhance research practice on all sides. The editors of the volume *Neurofeminism* (Bluhm et al., 2012) present a coherent collection of scholarship questioning and challenging findings in the neuroscience of sex/gender differences and suggesting promising proposals for both novel research questions and practices. It is the first volume of its kind and, as such, an attempt to see what happens or is possible in the field of feminist neuroscience or feminist science studies of neuroscience. Thus, it is a bit surprising that no reflections on animal and hormone studies, both important fields of contemporary psychological neuroscience, are

included. *Gender and the Science of Difference* (Fisher, 2011) is less coherent than the other discussed volumes, and the reviewer often misses references to the important work that has been done in the field of feminist science studies since the 1970s. An interesting project would have been a reflection on how this critique has or has not had an impact on studying the biology of sex and gender.

The work reviewed here, as well as other recently published research (for instance, Dussauge and Kaiser, 2012a; Karafyllis and Ulshöfer, 2008), shows that feminist critics of contemporary biological and medical research of sex or gender differences are not only countering attacks by spokespeople of determinism quite elegantly, but also (especially the essays collected by Bluhm et al., 2012) opening up new avenues for engaging with neuroscientific research in a productive way, for instance, by situating research in historical and cultural contexts and offering different but equally valid readings of existing data. Now we need scientists willing to engage in the dialogues proposed.

References

- Baron-Cohen S (2003) *The Essential Difference: Male and Female Brains and the Truth about Autism*. London: Allen Lane.
- Baron-Cohen S, Knickmeyer RC and Belmonte MK (2005) Sex differences in the brain: Implications for explaining autism. *Science* 310: 819–823.
- Birke L (2011) Telling the rat what to do: Laboratory animals, science, and gender. In: Fisher JA (ed.) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press, pp. 91–107.
- Bleier R (1979) Social and political bias in science: An examination of animal studies and their generalizations to human behavior and evolution. In: Hubbard R and Lowe M (eds) *Genes and Gender II: Pitfalls in Research on Sex and Gender*. New York: Gordian Press, pp. 49–69.
- Bluhm R, Jacobson AJ and Maibom HL (eds) (2012) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan.
- Brizendine LA (2006) *The Female Brain*. London: Bantam.
- Dussauge I and Kaiser AJ (eds) (2012a) Neuroscience and Sex/Gender (special issue). *Neuroethics* 5(3): 211–324.
- Dussauge I and Kaiser A (2012b) Re-queering the brain. In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 121–144.
- Einstein G (2012) Situated neuroscience: Exploring biologies of diversity. In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 145–174.
- Fausto-Sterling A (2000) *Sexing the Body: Gender Politics and the Construction of Sexuality*. New York: Basic Books.
- Fine C. (2010) *Delusions of Gender: The Real Science behind Sex Differences*. New York: W.W. Norton.
- Fisher JA (ed.) (2011) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press.
- Geschwind N and Behan P (1982) Left-handedness: Association with immune disease, migraine, and developmental learning disorder. *Proceedings of the National Academy of Sciences of the United States of America* 79(16): 5097–5100.

- Grossi G and Fine C (2012) The role of fetal testosterone in the development of the 'essential difference' between the sexes: Some essential issues. In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 73–104.
- Hoffman G (2012) What, if anything, can neurosciences tell us about gender differences? In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 30–55.
- Hubbard R and Lowe M (eds) (1979) *Genes and Gender II: Pitfalls in Research on Sex and Gender*. New York: Gordian Press.
- Jordan-Young RM (2011) *Brain Storm: The Flaws in the Science of Sex Differences*. Cambridge, MA: Harvard University Press.
- Kaiser A, Haller S, Schmitz S and Nitsch C (2009) On sex/gender related similarities and differences in fMRI language research. *Brain Research Reviews* 61(2): 49–59.
- Karafyllis NC and Ulshöfer G (eds) (2008) *Sexualized Brains: Scientific Modeling of Emotional Intelligence from a Cultural Perspective*. Cambridge, MA: MIT Press.
- Kraus C (2012) Linking neuroscience, medicine, gender and society through controversy and conflict analysis: A 'dissensus framework' for feminist/queer brain science studies. In: Bluhm R, Jacobson AJ and Maibom H (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 193–215.
- Lowe R and Hubbard M (1979) Sociobiology and biosociology: Can science prove the biological basis of sex differences in behavior? In: Hubbard R and Lowe M (eds) *Genes and Gender II: Pitfalls in Research on Sex and Gender*. New York: Gordian Press, pp. 91–111.
- Maibom HL (2012) In a different voice? In: Bluhm R, Jacobson AJ and Maibom H (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 56–72.
- Meynell L (2012) The politics of pictured reality: Locating the object from nowhere in fMRI. In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 11–29.
- Morland I (2011) Intersex treatment and the promise of trauma. In: Fisher J (ed.) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press, pp. 147–163.
- Rogers LJ (2011) Sex differences are not hardwired. In: Fisher J (ed.) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press, pp. 27–42.
- Roy D (2012) Cosmopolitics and the brain: The co-becoming of practices in feminism and neuroscience. In: Bluhm R, Jacobson AJ and Maibom HL (eds) *Neurofeminism: Issues at the Intersection of Feminist Theory and Cognitive Science*. New York: Palgrave Macmillan, pp. 175–192.
- Schmitz S (2006) Frauen- und Männerhirne. Mythos oder Wirklichkeit? In: Ebeling S and Schmitz S (eds) *Geschlechterforschung und Naturwissenschaften. Einführung in ein komplexes Wechselspiel*. Wiesbaden: VS Verlag, pp. 211–234.
- Spanier BB and Horowitz JD (2011) Looking for difference? Methodology is in the eye of the beholder. In: Fisher J (ed.) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press, pp. 43–66.
- Star SL (1979) Sex differences and the dichotomization of the brain: Methods, limits and problems in research on consciousness. In: Hubbard R and Lowe M (eds) *Genes and Gender II: Pitfalls in Research on Sex and Gender*. New York: Gordian Press, pp. 113–130.

Willey A and Giordano S (2011) 'Why do voles fall in love?' Sexual dimorphism in monogamy gene research. In: Fisher J (ed.) *Gender and the Science of Difference: Cultural Politics of Contemporary Science and Medicine*. New Brunswick, NJ: Rutgers University Press, pp. 108–125.

Young RM and Balaban E (2006) Psychoneuroendocrinology. *Nature* 443: 634.

Author biography

Svenja Matusall is a sociologist interested in the transforming notions of social in contemporary (social) neurosciences and endocrinology. She is currently working at *MINDLab* and at the Interacting Minds Centre at Aarhus University, Denmark.