# Better Battles over Sex and Gender

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In her review of my book, *Testosterone Rex,* Brown concludes by advocating an understanding of the action of steroid hormones on brain and behaviour as complex and dynamic, a source of developmental flexibility, and as best viewed in a developmental, rather than snap-shot, perspective [1]. Brown also calls for an end to the swinging of the pendulum between 'nature' and 'nurture', gesturing to an emergency exit in the form of an extended view of evolutionary theory. Since I provide evidence and arguments for each of these points in my book [2, and see also 3], I am in heated agreement with Brown. But curiously, we seem to disagree that we agree. Exploring why may be instructive for increasing productive scientific exchange in this politically charged domain.

Brown's primary criticism of my book is that I pay insufficient attention to animal studies of the effects of early testosterone on brain and behaviour. A useful context for considering this criticism is a recent framework developed by Joel & McCarthy [4]. They argue that sex effects on the brain and behaviour can be classified by asking four questions: is the difference stable or transient; does it depend on context (e.g., housing, stress, other environmental conditions); is it truly dimorphic in form or continuous; and is it the product of a direct effect of genetic or hormonal sex on the brain, or an *indirect* effect, in which biological sex contributes to physical attributes that differ between the sexes (such as size,

muscles, smell, genitals) that then impact behaviour and the individuals' interactions with others. As they note, much research in this area is not designed to reveal answers to these questions.

My book clearly acknowledges direct effects of testosterone on brain and behaviour; the traditional focus of consideration. It includes brief summaries of contemporary understanding of early sexual differentiation of the brain (which includes hormonal action) and testosterone's myriad direct neuronal effects. It notes that testosterone can both "restructure neural pathways" in "more lasting effects that take place at critical junctures in life – such as prenatally" (p. 135), and also have more transient direct effects.

However, as Joel & McCarthy's framework makes plain, identification of a sex effect on the brain or behaviour is only a first step. My book therefore focuses on research that has taken further ones, and in doing so has provided evidence of kinds of sex effects that have historically received less theoretical and empirical attention. One example is context-dependent sex effects on the brain in which, for example, the presence or absence of stress can eliminate or reverse a sex effect in the brain [see 5]. Moreover, I discuss prescient work on the role of early testosterone exposure that, unusually, took the developmental perspective that Brown advocates and in doing so identified an example of an *indirect* route by which biological sex can also get its developmental 'work' done: mothers. Male pups have higher levels of testosterone (a component of hormonal sex) in their urine, which elicits higher intensity licking by mothers. Remarkably, this

difference in maternal care contributes to sexual differentiation of brain and behaviour, generation after generation [6, 7].

Clearly, the answers to Joel & McCarthy's framework's four questions will vary depending on the sex effect under consideration, and also likely the species. My book, which is largely focused on the notion of evolved, testosterone-mediated sex differences in risk-taking and competition, cashes out the implications for humans of the relatively recent incorporation of context-dependent, and especially indirect sex effects, into models of sexual differentiation of brain and behaviour. It is unclear to me how or whether the studies Brown was disappointed not to see discussed – which identify sex differences in endpoints, but do not probe questions such as developmental route (direct or indirect) or context-dependence – would have impacted any of my arguments.

Turning now from the science, Brown writes that my use "of the abbreviation 'T', rather than the word 'testosterone', in the short section that refers to the physiological effects of this hormone on neural functioning … suggests that [I am] genuinely conflicted about how to incorporate this experimental evidence into [my] world view."

Certainly, it is diverting to learn what conclusions others infer about your psyche from your scientific writing, even at the level of a liberally used abbreviation. But there is an opportunity cost: personal speculation adds nothing to scientific debate. As an admirer of her work, I would much rather Brown had used column inches to explicitly identify and discuss points of disagreement, counter-evidence

or points of tension. *Ad hominem* remarks also license others to dismiss the book and its arguments altogether. Who would read a book by an author supposedly so irrational that she cannot put the word "testosterone" and "brain" together in the same sentence? That seems unfortunate, given that Brown seems to think that my book has a useful contribution to make in exposing the flaws in common empirical and theoretical assumptions. There are currently signs of a new openness in neuroscience to critiques, constructive recommendations and debate regarding sex effects in the brain [8]. In these interactions, which "should be nurtured and normalised", there is no useful role for conjecture about the feelings or motives thought to lie behind the actual scientific arguments.

**References:**

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