

Is testosterone the key to sex differences in human behaviour?

Cordelia Fine: A common assumption, which I refer to as the 'Testosterone Rex' view, is that testosterone is a proximal tool of distal evolutionary processes, acting via the brain (prenatally, then from pubescence) to shape sex differences in behaviour that would have been differentially reproductively advantageous for men versus women in our ancestral past. Joe, as you put it in your book *Testosterone: Sex, Power and the Will to Win*, 'for [male] reproduction to be successful, testosterone has to act on many parts of the male to make him fit for the competitive world of male sexuality'. So, for example, males' greater testosterone exposure predisposes them to be more risk-taking and competitive than females – an idea sometimes called on to help explain gender gaps in risky and competitive occupations, a category which happens to include most high-status and well-remunerated roles.

So what exactly does testosterone do? Testosterone acts directly on the brain, but the circulating level of testosterone in the blood is just one part of a highly complex, multifaceted system. What's more, different species appear to tweak those system dials in different ways, enabling cross-species differences in relations between hormones and behaviour.

What do we need to try to explain when it comes to humans? One important feature of sex differences in behaviour is that these are much smaller than sex differences in testosterone exposure (a lot of overlap between female and male populations, and very little, respectively). This casts serious doubt on the assumption that more testosterone means more masculinity, and that men must inevitably be more masculine because they have higher absolute levels of testosterone on average.

Also, in humans, masculinity includes a suite of behaviours that don't necessarily come as a package deal. For example, although we think of risk-taking as a quintessential masculine personality trait (hence the expression, 'grow some balls'), people are idiosyncratic when it comes to which domains of risk appeal: the physical risk-taker isn't necessarily a financial risk-taker, for instance. So what kind of risk-taker do we expect a high-testosterone person to be? This 'mosaicism' makes it unrealistic to expect consistent relations between testosterone levels and masculine behaviour: an expectation borne out by the empirical research.

Patterns of sex differences are also highly variable across context, culture and time-period. Joe, your explanation of this is that it reflects cultural differences in success in channelling or overcoming testosterone's powerful effects. However, given a conception of testosterone as helping animals to modulate behaviour to the physical, social and, in our own case, cultural environment – gender constructions can even modulate testosterone reactivity – this seems to get things back-to-front. Finally, the 'Testosterone Rex' view overlooks indirect effects of testosterone on behaviour. Testosterone masculinises the body, from the basics of genitals to secondary sexual characteristics, and this masculine phenotype can influence a male's behaviour and his interactions with others. These indirect effects of sex on behaviour are of increasing interest. Social dynamics can be part of a 'developmental system' that is reliably inherited along with the genes, and can play a key, constructive role in the development of evolved, adaptive behaviours. In humans, we call this gender socialisation.

Joe Herbert: Our basic biology is no different from other primates (or even mammals). There is no doubt that there are marked sex differences in behaviour in these species, and that these are powerfully (but not exclusively) influenced by testosterone. But there will be individual variations in the exact effects that testosterone has, depending on genetic and environmental factors. These differences are one result of testosterone acting on the limbic parts of the brain. What is different in humans is the ability to modify basic biology in ways that are much more complex, and culturally variable, than in other species. This is a function of the huge human cerebral cortex, which devises a variety of laws, customs and cultures

completely unknown in the animal world. Your mistake is to deny the existence of the basic sex-related patterns because they are modified historically and culturally: but this is an outstanding function of the human brain. Think of the way we use food – far beyond its basic function: or clothes. Do not deny (or be ashamed of) your biological heritage!

In your book (*Testosterone Rex*) you seem desperate to eliminate or minimise sex differences in the brain or in behaviour. Most males are stronger than most women: but some women (Olympic athletes, for example) are stronger than many men: and men's strength differs. This doesn't eliminate the sex difference. We can measure strength, so we can assign a value to each individual. Your problem is that we can't do this to behaviour – what is a 'small' difference? Most sex differences in the brain refer to the size of various regions: a wholly uninformative guide as to whether these are relevant or important for behaviour, though more recent accounts of biochemical or epigenetic differences, for example from Michael Baum, may prove to be more interesting (if they apply to humans). So your statement about the relation between testosterone (T) levels and behaviour is uninterpretable from both viewpoints: levels of T don't tell you very much either (you need to include genetic variation in the androgen receptor, time of exposure, etc., etc.), and most men have more T than they need.

Masculinity is a package of behaviours, orchestrated largely by testosterone. However, the content of the package will vary considerably between individuals. Why do you have a problem with that? Variation is the basic stuff of biology: and 'small' differences are the stuff of evolution. Don't discount them. Social and environmental events can vastly moderate the masculine profile: that's a prominent and distinguishing feature of the human brain. It's what makes a human being and our history. Sex differences are a major and welcome contribution to individuality. They are not the only one, nor should they be used as a basis for discrimination, any more than other biological variations (e.g. skin colour). It's odd to see a self-declared feminist trying to abolish femininity!

CF: The conclusion that I am trying 'to abolish femininity' is a very strange one to draw from a book that examines what advances in scientific understanding mean for the familiar 'Testosterone Rex' view of human sex differences in behaviour, particularly risk-taking and competition. On our shared 'basic biology' with other mammals, evolutionary biology is observing the fitness consequences of dominance and competition for female mammals, while scientific models are moving towards the incorporation of indirect effects of sex via sex-linked environments, and sex-by-environment interactions. On 'the stuff of evolution', the extended modern synthesis recognises multiple forms of inheritance for evolved traits. We agree that there are many sources of intra-sex variation in gendered behaviour, but empirical data repeatedly challenge the view that the gendered traits I focus on in my book are 'largely orchestrated by testosterone'.

It's legitimate to ask what all this means for our understanding of the development of sex differences in behaviour. Yet scattered through your reply – 'desperate', 'minimise', 'deny', 'ashamed', 'have a problem', 'abolish' – is an implication with a long history in this scientific terrain. Namely, that political beliefs are interfering with an objective reading of the science. The irony here is that it has not been feminist values that have misled and biased the science, but stereotypical assumptions about the sexes. In debates about frameworks, assumptions, data and interpretation, colourful speculations about critics' supposed inner turmoil are a distraction.

JH: Let's agree that men have dominated and repressed women throughout history. It's not a new problem: Anne Finch (Lady Winchelsea) wrote a poem about it in 1661. But sex differences are not always caused by repression and inequality. When survival depended on hunting or agriculture, this was the males' social role, whereas raising children and home-making was necessarily dependent largely on women. Defending the group against enemies was also a male function, in this case, mostly younger males (it's important to distinguish age as an important factor in the social roles of males). Time and technology can change that. In my youth, female bus drivers were almost unknown. Why? Two reasons: a social one – the job was not thought to be suitable for women – and technology: buses were very hard to drive. Altered social views on gender roles have blurred artificial boundaries about job discrimination, and the invention of power steering has made buses easier to drive: so now we see female drivers all over the place.

So there are two ways to deal with gender-related repression, and they are not mutually exclusive. Either deny that there are any sex differences in ability, motivation or behaviour, or make sure that such differences, which exist but vary between individuals as well as between sexes, are not the basis for unequal access to assets, opportunities or decision-making. You prefer the former: whilst I agree that many sex differences have been politically or socially contrived (though on a biological basis), denying they exist is neither accurate nor an optimal way of dealing with gender-based inequality.

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The biology and history of testosterone shows it has only one function: to facilitate reproduction. It's been so successful that mammals, reptiles, fish and birds all use it. The reason for its success is that it has powerful influences on a range of body functions: sperm, penis, muscles, aggression, competitiveness, sexual motivation, etc. All these are necessary for successful reproduction by males. If this is what you mean by a stereotype, then that's what it is. But it's important to be clear that testosterone is not masculinity (I say this several times in my book), though it's an essential component. Age, upbringing, experience and the social milieu of the time all have important roles, and they all interact. Human history shows that we can alter elements of social functions that may have derived from sex differences that were useful, or accepted, in other times using political and legal mechanisms as well as technology. This doesn't need us to deny those sex-differences exist: just that they are not a reason for inequality. You continue to confuse the two concepts. If you deny (implausibly) that there are genuine sex differences in any behaviour, then you have abolished the concept of both masculinity and femininity: the words have no longer any meaning except to describe the genitalia.

CF: There are several points on which I think we agree. But let me first sweep out of the way two distracting red herrings.

First, you are simply mistaken when you insist that I confuse legal and moral understandings of equality with similarity. To the contrary, I find it very concerning when ethical values of equality, respect and tolerance seem to be held hostage to particular scientific views (for example, of 'naturalness' or being 'born that way'). As with my previous book, *Delusions of Gender*, my concern is with the quality of the scientific methods, assumptions and interpretations used to support conclusions that the sexes are inherently suited, or drawn, to different kinds of roles in our society. Scientific conclusions in this area can of course have political implications, but you confuse scientific arguments with political ones.

Second, it is neither correct nor helpful to claim that I 'deny that there are any sex differences in ability, motivation or behaviour'. My book repeatedly references studies of sex differences, including meta-analyses of sex differences in risk-taking, sexuality, aggression, interests, cognition, communication, and social and personality variables, as well as the National Survey of Sexual Attitudes & Lifestyles and substantive reviews of sex differences in values and financial risk-taking. That the size and pattern of these differences is consistent with the combined and continuous action of many small causal influences is certainly counter to the idea of sex differences being powerfully caused by testosterone, but it is not a denial of the differences themselves.

And now to more interesting and relevant issues. I agree that physical differences between the sexes can give rise to sex-segregation of roles that technological and other advances can then make less relevant. In fact, in my book I refer to the work of Alice Eagly and Wendy Wood, who point to men's greater average upper body strength, and pregnancy and breastfeeding by women, as an important organising principle for understanding cross-cultural regularities in the division of labour. I would be interested to know your views though on strongly sex-segregated occupations like engineering, financial trading, surgery, childcare and nursing. Perhaps you could clarify what you mean by saying that sex differences 'are not a reason for inequality'. Do you mean that sex differences are: 'not a reason to discriminate'; or 'not a reason for men and women to continue to be unequally represented in traditionally masculine and feminine occupations'?

I also agree that many interacting factors contribute to variation in gendered traits. Where we differ is in my attention to the constructive role of the reliably inherited 'developmental system' in the development of evolved, adaptive behaviours: meaning that when a critical feature of the environment changes, the evolved behaviour develops differently, or not at all. Earlier in our exchange, you referred to powerfully testosterone-driven 'basic sex-related patterns' that are then modified by culture. Could you explain what that basic sex-related pattern is, and in what conditions it would be expressed in an unmodified state?

JH: You ask: Under what conditions would sex-related behaviour be expressed in an unmodified state? There is no such state. Thomas Hobbes was a very great philosopher, but had he known a little more about animal society, he would never have postulated a 'state of nature' in which there was no governance of testosterone-related behaviour. Testosterone is the fundamental driver of sexuality in male fish, birds, reptiles and all mammals. It's a great evolutionary success, because it underlies so much of what is needed for male reproduction. But – as I point out in my book – no animal species allows unbridled testosterone-related behaviour. So your question has no answer except: 'It doesn't happen!' What does happen in humans is a great variety of mechanisms and forms of regulation: these have varied across time and place in a manner unknown in other species. (E.O. Wilson makes the point that variability is the outstanding feature of human behaviour.)

There is no 'Testosterone Rex stereotype'. You seem to think that the presence of a Y chromosome, and the surge of testosterone that the male brain experiences in early life, does nothing. It does a lot; but this is variable between different males, and modifiable to an enormous extent by subsequent experiential or social factors. You do confuse similarity with equality: your book has a monotonic theme: sex-differences in behaviour either don't exist, are too small to be significant, or are the result of social determinism. There is no need to try to eliminate sex-differences in behaviour, however caused, to promote gender equality, just as, in a decent society, a plumber (or his/her children) has equal opportunity and status with an astrophysicist. This is implicit in your question about sex-segregated occupations. I have no idea how much social pressures ensure that most engineers are male, and most nurses are female (though the increasing number of the minor sex in each suggests there must be some). Do I think we would reach Eldorado when there are 50 per cent males/females in each? Not at all. I would be perfectly happy with a highly skewed distribution if I could be sure that any female who wanted to be an engineer was encouraged to be one, and ditto for males and nurses. You will know about Simon Baron-Cohen's work on 'systemising' and 'empathising' traits in males and females, which may reflect differences in preferences and choices of career, etc. If these traits are, at least partly, the result of the presence or lack of testosterone (which is very likely, given all the evidence), then this isn't a reason for inequality, but it is (one) reason for dissimilarity. Take a hard look at any other mammalian species. You will see marked sex differences in behaviour (testosterone dependent), and marked variation between species in how those differences are expressed (though there are some consistent features). Either humans have, in some mysterious way, jettisoned their mammalian heritage or, much more plausibly, they have developed ways, still evolving, of modifying or even eliminating these sex differences according to the social norms and requirements of the time. This isn't 'Testosterone Rex': it's 'Testosterone Cogitans'.

CF: There are many methodological and empirical problems with Baron-Cohen's account (see *Delusions of Gender* and Jordan-Young's *Brain Storm*). The supposedly strongest evidence comes from girls with congenital adrenal hyperplasia (exposed to very high levels of prenatal androgens), who have fewer female-typical toy preferences. But these girls are also impervious to the usual strong influence of gender modelling and labels on toy preferences. So does testosterone create a male brain evolved to be especially interested in toy cars (but not also 'systemising'-y Lego planes or jigsaw puzzles)? Or, in line with the notion of indirect effects of sex, could something else be going on?

Whether it's claims about the role of testosterone in sex differences in interests, risk-taking or competition, scientific discourse should allow questions to be asked about methods, data and interpretations without accusations of confusing equality with similarity, trying to abolish femininity, or any other such absurdities. You recommend a 'hard look' at other mammals. In non-human primates, testosterone's influence on behaviour is one of many interacting factors, replaceable, overrideable, experientially modulated. In rats, greater testosterone in the males' urine evokes more intensive maternal licking, which contributes to effective mounting and intromission via sexual differentiation of the brain. An indirect, dynamic effect of sex (via maternal behaviour) is already at work in this essential evolved behaviour. You can be sure that natural selection won't have overlooked our rich, inherited gendered cultures in the development of our overlapping, contingent, mosaic masculinities and femininities. Rebadging Testosterone Rex as 'Testosterone Cogitans' persists in an outdated view of evolution and development, and gives testosterone a star billing it doesn't deserve.