

## **It isn't the Hormones**

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One of the oldest explanations of the creation of the sexes, the story of Genesis in the Bible, gets it spectacularly wrong. Eve is not fashioned out of Adam's rib. Adam is made out of Eve. The basic state of human development is female.

In every human cell there are 46 chromosomes. Forty-four are identical pairs, but two are different. These two chromosomes regulate sexual development.

Females normally have two X-shaped sex chromosomes, males have an X and a Y. Without a Y the embryo develops as a female. To be a male, however, not only demands a Y but that one of the genes on its Y turns on a switch to direct the formation of the testes.

Most people are not particularly interested in the Y chromosome when it comes to explaining how men tick. Instead they focus on testosterone, the hormone produced by the male testis that results from the actions of the genes on the Y. There are respected scientists and political commentators, virtually all men, who endow this hormone with awesome powers.

Testosterone, they insist, underpins patriarchal societies, explains the predominance of men in governments and boardrooms, impels American youths to machinegun schoolchildren, fuels the sexual use and abuse of women and children. Testosterone is the reason men fly to the moon, climb Mount Everest, paint the Sistine chapel and peddle pornography. Testosterone, quite simply, precludes the possibility of a social system whose authority structure is not dominated by males.

But what is the evidence that testosterone holds the key to male aggression and violence? The hormone does explain why men are physically larger, stronger, faster and leaner on average than women, why they grow facial hair, have deeper voices and narrower hips.

What about those differences between the sexes that the sociobiologists insist are a consequence of the different ways in which the male and female brains are wired? Most studies of sexual brain differentiation have been undertaken on laboratory animals. When fragments from brain centres in newborn male rats are transplanted into the brains of female rats, male copulatory behaviour occurs in these females in adulthood. It has also been shown that exposing the developing brains of female mice and female rhesus monkeys to high levels of male sex hormones makes the females more aggressive.

Such research has led biologists to overreach themselves in explaining human sex differences as the result of sex hormones acting on the developing brain. The conventional wisdom is that boys play with soldiers and guns, girls with dolls and prams, boys engage in rough-and-tumble play, girls in more ordered and organised games involving domestic and child-bearing fantasies.

So what happens if, for some reason, females during their embryonic development or their early childhood are exposed to testosterone?

Nature herself provides an opportunity to study the biological and behavioural effects of the male hormones. There is a condition termed congenital adrenal hyperplasia (CAH) in which the production of abnormally large amounts of male hormones (androgens) can occur in females because of a genetic defect. Women with the defect are chromosomally female but suffer a masculinisation of the genitalia at birth. If untreated, they manifest a masculine physical appearance.

Several early studies appeared to show that CAH girls tended to be more tomboyish in childhood than unrelated control girls. They tended to be more physically active, to engage in more rough-and-tumble play. In a much-quoted study by Sheri Berenbaum and Melissa Hines, the CAH girls preferred to play with more stereotypically masculine toys.

Much has been made of this work but it is full of shortcomings. First, the sample of affected girls is small. Second, there is the fact, rarely referred to by the researchers, that girls who suffer from congenital adrenal hyperplasia are, for the most part, anatomically and psychologically seriously affected. For the first few years of their lives, and certainly until they have plastic surgery, they have a penis-like clitoris and a scrotum. There is, too, the question of the parents' attitudes to and expectations of their CAH daughters. It is perfectly possible that the girls manifesting the so-called masculine behaviour were those most seriously anatomically affected and most likely to think of themselves as boys.

On the other hand what happens if you remove circulating testosterone? Such research as has been done has focused only on the effects on aggressive and sexual behaviour. Studies have been undertaken of sex offenders who have been given chemical agents capable of suppressing testosterone.

A number of studies suggest that such chemicals can reduce the number and intensity of sexual fantasies and episodes of deviant behaviour. Associated claims of reduced reoffending and violence have been made, but these rates have not been compared with rates for similar men not so treated.

What we do know is that the great majority of men who sexually abuse and molest women and children do not manifest any consistent, reliable and significant abnormalities in testosterone secretion or levels. Something else is at work.

What about the link between testosterone and aggression? Males have more testosterone in their circulation than females and men are more aggressive. Women do produce testosterone and men do produce oestrogen. The normal woman produces about 200 micrograms of testosterone and 120 micrograms of oestrogen each day, a ratio of about 1.6 to 1. The normal male produces about the same amount of oestrogen daily (100 micrograms) but a

comparatively huge amount of testosterone - 5,100 micrograms per day - giving a testosterone/oestrogen ratio of 51 to 1.

Deprived of testosterone, men appear to lose the desire for sex. But the relationship between testosterone and the penis is very complex. Spontaneous erections, such as those that occur in the night, are highly dependent on the level of circulating testosterone. They occur less or not at all when testosterone levels are low, and it has been shown that they occur more frequently when testosterone is injected. In contrast, erections in response to erotic visual stimulus seem to be independent of circulating testosterone. The relationship between testosterone and aggression is even more complicated.

With the development of easier and more reliable methods of measuring testosterone, extraordinary claims from research studies have demonstrated varying degrees of imagination. High levels of testosterone have been reported in violent criminals; in aggressive hockey players; in army veterans with significant histories of marital disruption; in those suffering from drug and alcohol abuse, antisocial behaviour, and difficulties with the law.

Testosterone causes aggression: that is how this research is reported in the media. Alongside such an interpretation goes the hand-wringing conclusion that attempts to tame and civilise males are doomed by the rampant imperialism of testosterone.

The reality is much more complicated. What these studies really show is a correlation between levels of aggression and levels of testosterone. There is more than one explanation for such a correlation. Yes, indeed, raised levels of testosterone might cause aggression. But, likewise, increased levels of aggressive behaviour might cause higher levels of testosterone.

Is there any evidence that aggressive behaviour or the anticipation of conflict and competition might result in higher testosterone levels? A review by Allan Mazur at Syracuse University and Alan Booth of Penn State documents a sizeable body of research which supports such a relationship. For example, it has been shown that testosterone levels rise in athletes shortly before their matches, as if in anticipation.

This rise may enable the individual to take risks and improve co-ordination, cognitive performance and concentration. It has also been found that for one or two hours after a match, testosterone levels of winners are high relative to those of losers.

Other studies of non-physical contests show similar findings. Testosterone levels rise before chess matches and are higher in winners than in losers afterwards. Even being a passive spectator can produce variations. After the World Cup final in 1994 (in which Brazil defeated Italy after a penalty shoot-out), testosterone levels increased significantly in Brazilian fans who had watched the match on television and decreased in Italian fans.

Even more significant research, illustrating the complexity of the role of testosterone in aggressive behaviour, concerns men confronted with a symbolic challenge or insult.

Southerners in America are more likely to take offence at insults and to consider violence an appropriate response. A highly imaginative experiment was conducted in which an experimenter insulted a college student by bumping into him in a narrow hallway and swearing at him. American northerners tended to ignore the incident. Southerners did not take it so lightly. The testosterone levels of the southerners surged after the insult, whereas those of the northerners did not.

Contrast the clarity of the false statement, that testosterone is the cause of aggression, with the complexity of the true statement: that testosterone and aggressive behaviour are linked in a circular relationship in which aggressive behaviour can result in elevated levels of testosterone and substantial increases in testosterone can lead to increased aggressive behaviour. And then there is the problem of what we mean by aggression. For Mazur and Booth, an individual will be said to act aggressively if his apparent intent is to inflict physical injury on a member of his species. They distinguish aggression from dominance.

What is meant by dominance? Mazur and Booth define it as action intended to enhance status. At the heart of dominance is the desire to change the views or actions of others and the willingness to engage in behaviour to bring about such a change. Usually humans express dominance without recourse to aggression. Why men dominate with intent to harm is due to more than just the levels of their testosterone. What about other influences of testosterone on men and masculine behaviour? There was much excitement in the mass media when two American researchers produced findings that suggested men with high levels of testosterone were less likely to marry and more likely to divorce. In their study, men who divorced had elevated testosterone levels before and after divorce. The testosterone levels of men who married during the decade of the study fell as they made the transition from bachelor to married man.

Much speculation was triggered by this report. The social biologists, enthusiastic supporters of the "men will be promiscuous rogues because of their testosterone" theory, seized on the link. But there are other, less simplistic possibilities.

Stress can result in high testosterone levels. It has been suggested that for men marital status is less stressful than being single. Single men are more likely than their married counterparts to encounter confrontation and difficulty. This is exactly the sort of situation in which testosterone might be expected to rise. Divorce would likewise be expected to be accompanied by persistently high testosterone levels.

Another possible explanation is that sexual activity could affect testosterone levels in men - it does in mice - which could explain higher levels in single and divorced men. Laboratory male mice, exposed to new females, with or without physical contact, manifest a rise in testosterone. Following ejaculation, testosterone levels decrease. It is possible, therefore, that the low testosterone levels found in stable, married men are a consequence of a regular sex life.

There are some technical objections to simplistic assumptions, too. Testosterone measurements are still far from perfect. The certainty with which some commentators assert testosterone's ability to bring about this or that behaviour are not justified when a close look is taken at the research on which such claims are founded.

Given the widespread popular assumption about the importance of testosterone, it is somewhat surprising to discover how few and how flimsy are the research findings in support of the theory that increased circulating testosterone increases aggression and dominance in males. Nor is the research adequate on other hormones that are known to influence human behaviour, mood, aggression and dominance, hormones such as serotonin and adrenaline.

Testosterone dominates research and public discussion. The reason is simple. Serotonin and noradrenaline are not sex-linked to the extent that testosterone is. Testosterone has become synonymous with maleness, and analysing its effects titillatingly holds out the promise of providing a hormonal justification for male/female difference, for the inevitability of patriarchy and the incorrigibility of human aggression. By concentrating on testosterone, the quintessential male hormone, those who most loudly trumpet its alleged causal role in aggression and dominance do so in support of an ideological position.

The belief that men are incorrigibly and intrinsically violent is widespread. But male aggression and violence are both highly susceptible to factors that are non-biological (ie, cultural, social and psychological). There is a convincing body of evidence supporting a reciprocal relationship between testosterone and behaviour, and in particular dominant behaviour, in which each affects the other. Testosterone is not necessarily the prime culprit and cause.

The message is that men can tame their aggression, can harness and direct their tendency to dominate and can still be men. They are not puppets and products of their hormones.

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