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FlashReport

Decision making and testosterone: When the ends justify the means

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ABSTRACT

Behavioral endocrinology research suggests that testosterone may play a role in moral decision making. Studies involving human and nonhuman animals indicate that high basal testosterone is associated with decreased aversion to risk and an increased threshold for conflict, fear, stress, and threat. We tested the role of testosterone in moral decision making. We predicted and found that individuals high in testosterone are more likely to make utilitarian decisions—specifically when doing so involves acts of aggression and social cost.

Introduction

For centuries philosophers have debated how people *should* approach moral decisions, yet psychologists are only just beginning to get traction on the question of how they *do* approach them. Recent advances in our understanding of both the psychological (Haidt, 2001; Wheatley & Haidt, 2005) and neural processes underlying moral decision making (Greene, 2007; Greene, Sommerville, Nystrom, Darley, & Cohen, 2001) converge to suggest that affect and intuition guide morality judgments as much as deliberate reasoning and explicit principles (e.g., rules prescribed by religion). The present study seeks to extend our understanding of when and how normative values guide decisions by considering the role of testosterone in morality judgments. Behavioral endocrinology research suggests that testosterone is associated with diminished sensitivity to the affective signals which facilitate pursuit of empathic behaviors and choices (Damasio, Tranel, & Damasio, 1991; van Honk, Peper, & Schutter, 2005; van Honk et al., 2004). High-testosterone individuals may therefore be prone to approach moral decisions in a less affective manner—as if they were math problems, judging the moral quality of an option entirely on the utility of the outcome. We predict that when a potential action, which would secure a high-utility outcome, violates a strong moral norm—violently assaulting an innocent person, for example—the emotional aversion low-testosterone individuals feel toward this act overshadows their desire to maximize the outcome for the greatest number of people. In contrast, we predict that high-testosterone individuals will exhibit intransigent utilitarianism, even when the pursuit of an outcome is affective, aggressive, or violates entrenched moral norms.

Several behavioral endocrinology findings are consistent with the possibility that testosterone is associated with a diminished sensitivity to the affective signals which change the manner in which affective decisions and behaviors unfold. Research involving both human and nonhuman animals indicates that high basal testosterone is associated with weakened startle responses (Hermans, Putman, Baas, Koppeschaar, & van Honk, 2006) and lower stress reactivity (Dabbs, Alford, & Fielden, 1998; Hermans et al., 2007), impaired recognition of others' facial expressions of fear and anger (van Honk & Schutter, 2007), attenuations in empathic emotive mimicry (Hermans, Putman, & van Honk, 2006), and decreased aversion to risk (Booth, Johnson, & Granger, 1999). When making decisions in gambling tasks, women injected with testosterone switch from favoring safe bets to pursuing high-risk options with large-yielding but extremely improbable outcomes (van Honk et al., 2004). High testosterone is associated with enhanced performance in making high-stakes decisions. Coates and Herbert (2008) found that during periods of extreme market volatility, male traders highest in testosterone on a particular day earned the largest profits, presumably because they pursued high-reward outcomes at the risk of their reputation, bonus, and job.

Results of recent neuroscience research suggest that consistent (and sometimes rigid) utilitarianism is associated with lesions to the ventromedial prefrontal cortex (vmPFC), a cortical region previously implicated in moral decision making (e.g., Greene et al., 2001; Moll & de Oliveira-Souza, 2007). Patients with vmPFC lesions are significantly more likely than both healthy controls and

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patients with lesions elsewhere to pursue outcomes that maximize aggregate welfare despite significant social and emotional consequences (Koenigs et al., 2007). For example, individuals with vmPFC lesions were twice as likely to advocate suffocating their baby to prevent its crying from revealing the whereabouts of a group of villagers to enemy troops instructed to kill them, for example, than control participants. Explanations for these results center on the vmPFC's role in encoding and signaling the emotional value of decisions and behaviors. Consistent with this framework, individuals with vmPFC lesions are significantly less likely to experience guilt over norm violations (Krajbich, Adolphs, Tranel, Denburg, & Camerer, 2009), regret over their actions (Camille et al., 2004), or embarrassment after violating moral strictures (Beer, Heerey, Keltner, Scabini, & Knight, 2003). Indeed, the psychological profile of vmPFC patients resembles that of high-testosterone individuals. In addition to exhibiting diminished emotional responsivity, vmPFC patients have poorly regulated anger and frustration (Anderson, Barrash, Bechara, & Tranel, 2006; Koenigs & Tranel, 2007), despite preserved intelligence and knowledge of social and moral norms (Saver & Damasio, 1991). Of central importance to the current investigation is recent evidence that testosterone suppresses vmPFC activity during social decision making tasks (Mehta and Beer, 2009). This raises the possibility that testosterone down-regulates the vmPFC's sensitivity to important somatic (Damasio, 1996) and social signals (e.g., an angry glare by a significant other; van Honk & Schutter, 2007).

We hypothesized that intransigent utilitarians in a moral decision making context, those who prioritized the outcome regardless of the potentially aversive process through which the outcome was reached, would have higher basal testosterone than other types of decision makers. The "trolley problem" in moral philosophy (Thomson, 1976) includes a pair of decision making dilemmas—(a) the "switch" and (b) the "footbridge"—suited to test this possibility. In the switch version, people generally advocate choosing to flip a switch that will divert a trolley to a track where only one person is stuck if their action prevents the trolley from killing five people stuck on the original track. When posed a nearly identical dilemma in the footbridge version—sacrificing one life in exchange for five—the majority of people cease being utilitarian: They are unwilling to endure the emotional, physiological and social consequences of endorsing the pushing a man off a footbridge to block a trolley from killing five people stuck on the track, even though from a utilitarian decision making standpoint, the two scenarios are equivalent.

Methods

Participants and procedure

One hundred seventeen graduate students at Columbia University (32 female, mean age = 28 years old) participated for course credit. Because basal salivary testosterone measured in the afternoon is stable across weeks (Sellers, Mehl, & Josephs, 2007), the mean time for saliva sampling was 2:27 pm; *SD* = 2 h 55 min. Standard salivary hormone-collection procedures were used based on Schultheiss and Stanton (2009) and full details about the sampling and assaying methods used in the current report can be found in the online supporting material.

Three weeks after providing saliva samples, participants responded to both the switch and the footbridge dilemmas (in that order) through an online porthole available only to the participants. Participants responded with "yes" versus "no" after making judgments about the switch and the footbridge dilemmas. The switch dilemma stated: "A trolley is running out of control down a track. In its path are five people who have been tied to the track. Fortunately, you can flip a switch, which will lead the trolley down a different track to safety. Unfortunately, there is a single person tied to that alternative track. Do you flip the switch?" The footbridge dilemma stated: "As before, a trolley is hurtling down a track towards five people. You are on a bridge under which it will pass, and you can stop it by dropping a heavy weight in front of it. As it happens, there is a very heavy man next to you – your only way to stop the trolley is to push him over the bridge and onto the track, killing him to save five. Do you push the man?"

Results

Trolley-problem finding

Consistent with previous research, the majority of participants responded in a utilitarian manner to the switch dilemma: 105 of the 117 participants said yes, they would flip the switch sacrificing one life to save five, $\chi^2(1, N = 117) = 79.92$, $p < .001$. The expected reverse effect was found for the footbridge version of the trolley dilemma: The majority of participants, 78 of them, abandoned the utilitarian approach, indicating they would not push the man to save five others, $\chi^2(1, N = 117) = 13.00$, $p < .001$. The pattern of responses from the switch dilemma was significantly different from the pattern of responses from the footbridge dilemma, $\chi^2(1, N = 117) = 6.78$, $p < .01$; effect size $r = .24$.

Testosterone and decision making

Responses to the trolley problem yielded three types of decision makers: (1) intransigent utilitarians, who were always willing to endorse trading one life to save five ($n = 39$); (2) fair-weather utilitarians, who gave a utilitarian response to the switch dilemma but defected from this approach in the footbridge dilemma ($n = 66$); and (3) avoiders, who refrained from getting involved in either case ($n = 12$). As would be expected, no participant expressed willingness to push the man but not flip a switch to save lives.

As predicted, intransigent utilitarians choosing a practical solution to the problem, regardless of the cost, were significantly higher in testosterone than fair-weather utilitarians, those willing to endorse flipping the switch but unwilling to endorse pushing the man. A planned contrast showed the intransigent utilitarians ($M = 106.42$; $SD = 47.76$) were statistically significantly higher in basal testosterone than the fair-weather utilitarians ($M = 77.39$; $SD = 38.97$), $t(114) = 2.0$, $p < .05$; effect size $r = .18$. Mean testosterone level for the avoiders was the lowest ($M = 71.56$); however, no other comparisons were significantly different. Fig. 1 illustrates the overall effect.

Looking specifically at the testosterone levels of the individuals who endorsed pushing versus not pushing the man in the

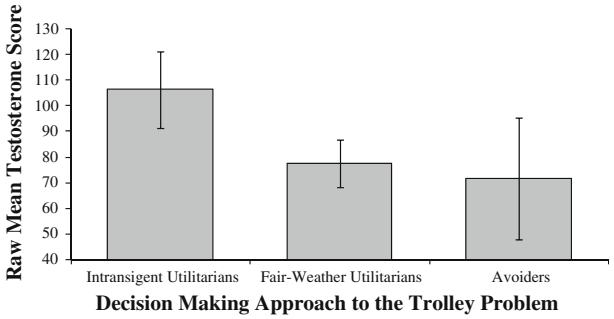

Fig. 1. Relation between decision making approach to the trolley problem and testosterone (error bars are 95% CI). Intransigent utilitarians are highest on testosterone.

footbridge dilemma, those willing to push (M = 107.91; SD = 47.47) were significantly higher on basal testosterone than those unwilling to push the man (M = 76.70; SD = 39.78), $t(112) = 2.08$, $p < .05$; effect size $r = .19$. There was no relation between response to the switch dilemma and testosterone ($p > .60$) as almost everyone agrees to endorse flipping the switch.

The main result was examined for gender effects. The planned contrast analyses was conducted separately on females and males and showed the same pattern. For females, intransigent utilitarians were slightly higher (but not significantly so) on testosterone (M = 66.86; SD = 21.37) than fair-weather utilitarians (M = 42.24; SD = 24.10), $t(29) = 1.69$, $p < .11$; effect size $r = .30$. For males, intransigent utilitarians were slightly higher (but not significantly so) on testosterone (M = 109.72; SD = 48.01) than fair-weather utilitarians (M = 94.96; SD = 32.61), $t(82) = 1.61$, $p < .11$; effect size $r = .18$. Interestingly, the magnitude of the effect was stronger for women than men in this sample.

Discussion

Consistent with our hypothesis, intransigent utilitarians had significantly higher basal testosterone levels than those who no longer endorsed utilitarian outcomes when achieved through action which violated a strong moral norm. In other words, high-testosterone individuals appear willing to endorse a tough and costly decision, provided it promotes the greater good. Although we have no direct measure of the mechanism by which testosterone affects moral decision making, we argue that the intransigent utilitarianism of high-testosterone individuals reflects diminished sensitivity to the affect-eliciting properties of the footbridge dilemma. The current findings and previous evidence of diminished emotional responsivity together suggest that individuals high in testosterone are able—and perhaps likely—to approach decision making in a manner that is divorced from negative affect and disproportionately focused on outcome. This theorizing is entirely consistent with emerging work in social neuroscience in which testosterone has been shown to blunt negative social emotions. Utilitarian decision making is associated with reduced activity and lesions in the vmPFC (e.g., Koenigs et al., 2007). Research also shows that both vmPFC lesions and testosterone are associated with impairments in empathic behavior. Individuals with vmPFC lesions do not experience negative social emotions such as guilt, embarrassment, and anxiety in a manner consistent with non-lesion populations (for a review see van den Bos and Güroglu (2009), and exogenous administration of testosterone decreases empathic behavior toward others (Hermans, Putman, & van Honk, 2006). And finally, Mehta and Beer (2009) show that higher testosterone suppresses vmPFC activity during social decision making. We argue that testosterone increases utilitarian decision making, at least in part, by reducing activity in vmPFC.

We do, however, recognize that an alternative mechanism could account for our observed result. It makes sense to think that individuals high in basal testosterone are simply more aggressive and thus willing to endorse pushing the man off the footbridge. There is some evidence of a link between androgen hormones, such as vasopressin, and aggression in nonhuman animals such as male golden hamsters (Delville, Mansour, & Ferris, 1996). However, there is almost no evidence for the link between androgen hormones (e.g., testosterone) and aggression in humans (for a review, see Simpson (2001). Thus, while we recognize that it seems intuitive that testosterone causes aggression in humans which would account for our effect; because there is no evidence of such a link in humans we do not believe it is a viable alternative.

It is also important to note that the dynamics of the endocrine system are incredibly complex. The current study explored the relationship between basal testosterone, which can be thought of as a "trait-like" level of the hormone, and utilitarianism. While we measured basal testosterone, it is a hormone which can fluctuates with internal and external changes. It is also worth highlighting that testosterone and its metabolites and precursors bind with various receptor sites, such as those for cortisol, resulting in interactions between testosterone and other hormones (e.g., Mehta, Jones, & Josephs, 2008). The measurement of testosterone and what it means is a complex issue. Our theorizing about the manner in which testosterone shapes moral decision making should be considered within a much larger and more complex set of physiological, neuroendocrine and neurological systems.

The implication of these results extends beyond ethics and moral reasoning and illuminates how high-testosterone individuals reason and behave generally. A heightened focus on outcomes and disregard for the cost of pursuit may help explain why individuals high in testosterone have more success on Wall Street and in other contexts (Coates & Herbert, 2008) where success requires insensitivity to some of the more immediate consequences of one's actions. At minimum, the result presented here certainly points to the need for more research on how testosterone and other biological systems influence decision making.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jesp.2010.02.003.

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