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Testosterone's Negative Relationship With Empathic Accuracy and Perceived Leadership Ability

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Abstract

Two studies examine the relationship between naturally occurring levels of circulating testosterone and empathic accuracy. In Study 1, the authors find that higher endogenous levels of testosterone are negatively related to the accuracy with which people infer the thoughts and feelings of others. In Study 2, the authors use 360 data collected in the field to show that individuals with higher levels of endogenous testosterone are evaluated by their real-world professional colleagues as functioning with lower levels of empathic accuracy. Furthermore, the authors report evidence that this negative relationship between testosterone and perceived empathic accuracy has downstream consequences for perceptions of one's leadership skills and abilities.

Keywords

nonverbal behavior, person perception, psychophysiology, social cognition, interpersonal processes

> If you just learn a single trick, Scout, you'll get along a lot better with all kinds of folks. You never really understand a person until you consider things from his point of view . . . Until you climb inside of his skin and walk around in it.
>
> Atticus Finch, To Kill a Mockingbird

The essence of Atticus Finch's message to Scout is the same message extolled by Gandhi, the Dalai Lama, and Jesus Christ; empathy—that is, the ability to feel what another person is feeling—is the basis of social harmony. Empathy improves marital relations (Davis & Oathout, 1987; Noller & Feeney, 1994), increases altruism (Toi & Batson, 1982), decreases the stigmatization of out-groups (Galinsky & Moskowitz, 2000), and even attenuates one of the most robust effects in social psychology, the fundamental attribution error (Regan & Totten, 1975). Beyond simply *feeling* for others, the ability to *accurately* infer others' emotions and mental states—empathic accuracy—predicts leadership effectiveness (Rubin, Munz, & Bommer, 2005), happier marriages (Noller & Feeney, 1994), social adjustment in children (Nowicki & Duke, 1992) and adults (Gleason, Jensen-Campbell, & Ickes, 2009), and lower cardiovascular activation during social interactions (Levenson & Ruef, 1992).[1] Here, it seems science and religion converge—accurately understanding the thoughts and feelings of those around us confers social, personal, and even organizational benefits.

Given that empathy is a seeming panacea, a reliable remedy to a variety of social ills, it is not surprising that experimental philosophers, developmental scientists, neuroscientists, and social and personality psychologists have been collectively puzzling over empathy— what it is, what it predicts, and what are its cultural bases—for a half-century now. Only recently has science begun exploring the role of biological systems in the onset, maintenance, and processes that underlie empathy. One mechanism, which may be a foundational contributor, is the sex hormone testosterone.

For example, some research shows that exposure to higher levels of testosterone in the uterus (measured via amniocentesis) predicts impoverished interpersonal competencies across the life span; including limited eye contact at age 1 (Lutchmaya, Baron-Cohen, & Raggatt, 2002a), underdeveloped vocabulary at age 2 (Lutchmaya, Baron-Cohen, & Raggatt, 2002b), and difficulties referencing mental and emotional states at age 3 (Chapman et al., 2006). Similarly, exogenous administration of testosterone has been shown to impair sensitivity to threatening facial expressions (van Honk & Schutter, 2007) and reduce facial mimicry (Hermans, Putman, & van Honk, 2006), both of which are thought to be pillars of empathic processes. Most recently, testosterone administration was found to impair performance on a paper-and-pencil task (The Reading the Mind in the Eyes Test [RMET]; Baron-Cohen, Wheelwright, Hill,

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Raste, & Plumb, 2001) in which intentions are judged from pictures of eyes (van Honk et al., 2011).

Taken together, these studies indicate that testosterone has a negative relationship with a variety of empathic processes and suggest the possibility that higher levels of naturally occurring testosterone may predict deficits in naturally unfolding empathic accuracy—however, no research has directly tested this question. The most direct existing test of testosterone's relationship with empathic accuracy is demonstrated by impaired performance on the RMET, following exogenous administration of testosterone in females. However, higher scores on the RMET do not demonstrate a more accurate appraisal of the targets' *actual* thoughts and feelings, but rather reflect responses that are consistent with target emotions selected by judges and independent raters during the test's development (Baron-Cohen, Joliffe, Mortimore, & Robertson, 1997).

Of critical importance is that none of the "easier to administer" task-based measures of nonverbal sensitivity/empathic accuracy/accuracy in thin slice judgments (e.g., the RMET mentioned previously but also other measures such as the Diagnostic Analysis of Nonverbal Accuracy and the Profile of Nonverbal Sensitivity) actually correlate with or predict real-world empathic accuracy (Zaki & Ochsner, 2009, 2011). Thus, if science is to move forward in its efforts to understand the antecedents and consequences of empathic accuracy, and what role if any is played by circulating testosterone, we need to move to more direct measures of the construct itself. One goal of the present research was therefore to present the first test of testosterone's relationship with empathic accuracy in a real social interaction.

A further goal of the current research was to expand the literature by testing the effect of *naturally occurring* circulating testosterone. Previous research has focused primarily on the developmental consequences of prenatal testosterone exposure for empathic processes, and not the effects of circulating testosterone. The one study to move beyond these developmental effects manipulated testosterone levels via exogenous administration (van Honk et al., 2011). However, exogenous administration of testosterone is differently absorbed and metabolized by the body, leading to different physiological outcomes and side effects that naturally occurring testosterone does not have (e.g., Emmelot-Vonk et al., 2008). Thus, the dissociation between exogenously administered, and endogenously existing testosterone is significant—the consequences associated with the former do not provide parallel evidence for the latter. Although useful for drawing causal inferences, exogenous administration of testosterone provides little information about the longer term consequences of naturally higher levels of testosterone. For instance, people with naturally high levels of testosterone may find ways to compensate for impaired empathic processes. Alternatively, impediments may compound across time, as foundational processes are not mastered. The existing literature provides no test of whether differences in basal levels of testosterone have any bearing on empathic concern, processes, or accuracy.

Finally, no research has tested the possible downstream consequences of testosterone's negative relationship with empathic accuracy. Specifically, as empathic accuracy has been positively linked to interpersonal leadership effectiveness (Rubin et al., 2005), a critical question concerns the possibility that the hypothesized negative relationship between testosterone and empathic accuracy may have negative consequences for interpersonal leadership skills and abilities. This possibility was particularly intriguing, given testosterone's positive relationship with implicit power motivations (Stanton & Schultheiss, 2009), and the pursuit and possession of dominance and status (Mazur & Booth, 1998).

To address these questions, the current research drew data from both the lab and the field. In the lab, we specifically targeted empathic accuracy by randomly assigning participants to dyads in which they socially interacted while attempting to discern each other's mental states. Following the interaction, we measured the accuracy with which they were able to identify their counterpart's thoughts and feelings as they unfolded during the interaction. In the field, we collected reports from participants' colleagues, supervisors, and subordinates. With these data, we examined whether higher levels of naturally occurring testosterone are related to whether one is perceived to be less attuned to others' thoughts and feelings, as well as to perceptions of one's organizationally critical leadership skills and abilities.

The current research makes a number of unique contributions to both the empathic accuracy and the behavioral endocrinology literature. It is the first to directly test the relationship between naturally occurring testosterone levels and naturally unfolding empathic accuracy. This test is critical to understanding whether testosterone in one's every day life is related to empathic functioning in actual social interactions. In two studies, we examine whether higher basal levels of testosterone were associated with actual empathic accuracy in social interactions (Study 1), and lower ratings of participants' ability to infer others' thoughts and feelings by their real-world colleagues (Study 2). Finally, in Study 2, we also provide preliminary evidence for the downstream consequences of testosterone's negative relationship with empathic accuracy—diminished perceptions of one's interpersonal leadership skills and abilities.

Study 1

The goal of Study 1 was to examine the degree to which participants' estimations of their counterpart's thoughts and feelings corresponded with their counterpart's *actual* thoughts and feelings (i.e., real-time, naturally unfolding empathic accuracy).

Forty Masters of Business Administration (MBA) students were randomly assigned to dyads (28 males). Dyads spent 30 min engaged in a role-play exercise designed to motivate attention to and accurate inference of one's partner's thoughts and feelings. The role-play was intended to address concerns that any observed relationship between testosterone and empathic accuracy might be due to either a *lack of regard* for others' mental states or alternatively a *diminished capacity* to read others' mental states. In the cut-and-thrust of real-world social exchanges, attention to others' thoughts and feelings is not a given; rather one must overcome one's own egocentric focus to even consider the possibility of other's mental states. Thus, we explicitly directed and implicitly motivated participants to attend to their counterpart's thoughts and feelings during the interaction.

The role-play involved the potential sale of a fictional consumer foods company to a larger international company seeking to expand its operations (Bontempo & Iyengar, 2008). Participants were randomly assigned to the role of either President and majority stockholder of the company under consideration or Vice President of Business Development for the potential purchasing company. Participants received confidential role information and were instructed to attempt to reach an agreement on the sale and obtain the best possible terms for themselves and those they represented. Participants were instructed that the multi-issue, integrative nature of the negotiation meant that in order to reach an efficient resolution, they would need to attend closely to their partner's verbal and nonverbal cues. Thus, in addition to the provided instructions, the task itself was designed to implicitly motivate attention to one's partner's thoughts and feelings. Participants were given 30 min to discuss the deal face to face.

Following the exercise participants used a series of 5-point scales anchored by (1) *not at all* and (5) *extremely* to report on how *excited*, *powerful*, *nervous*, *dominant*, *in charge*, *anxious*, and *happy* they felt during the interaction. They then used these same scales to report on how they thought their partner was feeling during the prior interaction. Every participant estimated both their partner's thoughts and feelings, and reported on their own thoughts and feelings. Following the general approach taken by Ickes (1997), we calculated an index of empathic accuracy using profile correlations (Carney, Colvin, & Hall, 2007; Hall, Bernieri, & Carney, 2005). Profile correlations were calculated such that for every judge-target pair, participant's vector of estimations of how they thought their partner was feeling was correlated with their partner's vector of reports of how they were actually feeling (across items). In this way, higher scores on the resulting Pearson's correlation coefficient ($M = .50$, $SD = .37$) indicated a more accurate understanding of one's partner's actual thoughts and feelings as they unfolded in real time during the social interaction across the seven rated items. We applied the Fisher's z transformation to these 40 profile correlation coefficients, resulting in an approximately symmetrical distribution suitable for parametric statistical testing. These 40 z transformed coefficients were used as the primary dependent variable, nested within dyads in a hierarchical linear model.

Saliva Sampling, Assays, and Testosterone Analysis

Saliva samples were collected between 12:30 p.m. and 4:30 p.m. to control for diurnal variation in testosterone levels (Granger, Schwartz, Booth, & Arentz, 1999). As is typical and appropriate, participants did not eat, drink, or brush their teeth for at least 1 hr before providing saliva samples. Participants rinsed their mouths with water and chewed a piece of sugar-free Trident Original Flavor gum for 3 min in order to stimulate salivation. Participants drooled approximately 1.5 mL of saliva through a straw into a sterile polypropylene microtubule and spit out their gum. Saliva samples were immediately brought to a freezer in an adjacent lab room to avoid hormone degradation and to precipitate mucins. Within 2 days, frozen samples were packed in dry ice and shipped for analysis to Salimetrics in State College, Pennsylvania. At Salimetrics, samples were assayed in duplicate for salivary testosterone, using a highly sensitive enzyme immunoassay (Cat. No. 1-2402, Salimetrics LLC). The test, which used 25 μl of saliva per determination, has a lower limit of sensitivity of 1.0 pg/mL, a standard curve range from 6.1 pg/mL to 600 pg/mL, and an average intra-assay coefficient of variation (CV) of 4.66%. Salimetrics reports an overall lab interassay CV of 8.25%. Method accuracy determined by spike recovery averaged 104.4%, and linearity determined by serial dilution averaged 99.9%. As is typical, the raw *M*s and *SD*s for each sex were statistically different from each other. As is expected with appropriately taken and assayed samples (Schultheiss & Stanton, 2009), men had much higher testosterone levels ($M = 99.93$, $SD = 38.46$) than women ($M = 43.95$, $SD = 17.15$), $F(1, 38) = 23.17$, $p < .001$; effect size $r = .65$. As indicated, each sample was assayed twice, and the mean testosterone level across the two tests was used in all analyses. Sex (coded as 1 and -1) was entered as a covariate in all reported analyses. Testosterone was mean-centered prior to the creation of the testosterone-by-sex interaction term (Jaccard & Turrisi, 2003).

Results

To control for dependency issues within dyads, we used hierarchical linear modeling (HLM) to test for the relationship between testosterone and empathic accuracy. HLM models this dyadic dependency by nesting each individual (i) within a dyad (j). Our sample for this analysis included 40 individuals nested within 20 dyads. Our dependent variable was each participant's Fisher's Z transformed profile correlation score, calculated as described above. Testosterone was mean centered, and sex was controlled for in the HLM model presented below.

$$\text{Empathic Accuracyij} = \beta 0j + \beta 1j * (\text{Testosterone}) + \beta 2j * (\text{Sex}) + \beta 3j * (\text{Testosterone by Sex}) + rij.$$

The main effect of testosterone on empathic accuracy was significant, $B_1 = -.003$, $t(18) = -2.09$, $p = .05$. Neither the main effect of sex, $B_2 = .06$, $t(18) = .74$, $p = .47$, nor the interaction between sex and testosterone, $B_3 = .002$, $t(17) = .38$, $p = .71$, emerged as significant predictors of empathic accuracy in this model.

These results demonstrate that regardless of sex, the higher one's naturally occurring, freely circulating testosterone levels, the worse one's ability to detect the thoughts and feelings of one's partner in a social interaction. It is noteworthy to point out that testosterone's negative relationship with empathic accuracy persisted despite the explicit instructions given prior to the interaction—which provided motivation and directions for participants to attend to their partner's thoughts and feelings.

Table 1. Correlation Table for Perspective Taking Items.

Item	*M*	*SD*	1	2	3	4
1. . . . misjudges people's personality and character (*r*)	5.91	.46				
2. . . . is good at sensing what other people are thinking and feeling	4.93	.47	.35			
3. . . . fails to realize the impact of what he or she says and do on others (*r*)	5.71	.60	.75	.31		
4. . . . is good at assessing other people's strengths and weaknesses	5.22	.31	.32	.46	.27	
5. . . . is able to empathize and understand someone else's perspective	5.28	.52	.38	.67	.43	.42

Items with a (*r*) were reverse coded before conducting the correlations.

Study 2

While Study 1 demonstrated that testosterone is negatively related to empathic accuracy in a naturalistic social interaction, we wanted to test whether this effect would generalize to real social skills in the real world. Thus, our goals in Study 2 were twofold: (1) To test whether higher levels of testosterone would be negatively related to colleagues' and peers' reports of participants' perspective-taking and empathic accuracy tendencies and (2) To examine the potentially negative downstream consequences of testosterone's relationship with empathic accuracy. Specifically, we tested the possible indirect relationship between testosterone and perceived leadership ability through the mediating variable of empathic accuracy.

360 Multi-Rater Data

Seventy-four MBA students (52 males) were evaluated by at least eight individuals: four or more student peers, and four or more professional colleagues with whom they had previously worked (i.e., 360 data). Observer evaluations reflect repeated exposure to an individual's actual behavior and when averaged across raters, they form a reliable and accurate sketch of the target (Norman & Goldberg, 1966). For each participant, we harvested multisource ($M = 9.24$, $SD = 2.61$) feedback on (1) their capacity to infer the mental and emotional states of others (intraclass correlation [ICC] = 0.68) and (2) their capacity for interpersonal leadership (ICC = 0.51).

Empathic Accuracy

Defining empathic accuracy more broadly as the ability and tendency to accurately infer others' thoughts and feelings, participants were evaluated on a 5-item measure ($\alpha = .78$) in which colleagues of each participant responded on a 7-point scale to statements about participants' empathic ability (e.g., . . . is able to empathize and understand someone else's perspective). A list of the scale items along with descriptive statistics and intercorrelations can be seen in Table 1. All scale items were anchored by (1) *very untrue of this person* and (7) *very true of this person*.

Leadership Skills and Abilities

To measure perceptions of leadership ability, we used a 9-item measure ($\alpha = .77$) that asked participants' colleagues to respond on a 7-point scale to statements about interpersonal leadership skills and abilities (e.g. . . .is able to build effective working relationships with others who have different opinions). Scale items, descriptive statistics, and intercorrelations can be seen in Table 2. All scale items were anchored by (1) *very untrue of this person* and (7) *very true of this person*.

Saliva Sampling, Assays, and Testosterone Analysis

Sampling and assay procedures mirrored those described for Study 1. The mean intra-assay CV was 4.66% $SD = 5.50$. Testosterone was in the normal range for men $M = 91.18$, $SD = 35.57$, and women $M = 41.05$, $SD = 21.16$, $F(1, 72) = 37.83$, $p < .001$, $r = .65$. Once again, sex was coded as 1 and −1 and entered as a covariate in all analyses. Testosterone was again mean centered prior to the creation of the testosterone-by-sex interaction term.

Results

Consistent with predictions and Study 1, regressing peer-reported empathic accuracy on testosterone and sex-revealed testosterone to be negatively related to peer-reported empathic accuracy, $B = -.32$, $t(71) = -2.24$, $p = .03$. Neither the main effect for sex $t(71) = 0.50$, $p = .62$ nor the interaction between sex and testosterone $t(70) = 0.38$, $p = .70$ were significant. In other words, higher levels of naturally occurring testosterone predicted being perceived by one's real-world peers and professional colleagues as functioning with lower levels of empathic accuracy.

To test for the relationship between testosterone and leadership, we regressed peer-reported leadership skills and abilities on testosterone, while controlling for sex, $B = -.26$, $t(71) = -1.82$, $p = .07$.[1] Once again, neither the main effect for sex, $B = .06$, $t(71) = 0.40$, $p = .69$ nor the interaction between sex and testosterone $B = -.09$, $t(70) = -0.50$, $p = .62$ were significant.

Next, we tested the indirect relationship between testosterone and interpersonal leadership through empathic accuracy (see Figure 1). Following Hayes (2009), we used a bootstrapping procedure (Preacher & Hayes, 2004) with 10,000 resamples, entering mean-centered testosterone as the independent variable, empathic accuracy as the mediating variable, sex as a covariate, and peer-reported interpersonal leadership ability as the dependent variable. Results indicated that empathic accuracy significantly mediated the negative relationship

Table 2. Correlation Table for Interpersonal Leadership Items

Item	*M*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1 . . . . is able to build effective working relationships with others who have different opinions	5.86	.43								
2 . . . . fails to direct meetings in his/her favor (*r*)	5.50	.54	.31**							
3 . . . . is not effective at giving helpful and constructive feedback to others (*r*)	5.72	.55	.36**	.30*						
4. When working in a team . . . . makes sure everyone is kept informed and in the loop	5.84	.52	.40**	.29*	.33**					
5 . . . . is able to sacrifice his/her interests for the good of the team	5.56	.79	.36**	.13	.08	.68				
6 . . . . is flexible and tries to accommodate others' needs	5.92	.52	.56**	−.004	.24	.42**	.49**			
7. After listening to others . . . . builds on what he/she has heard, incorporating it into the conversation	5.67	.41	.57**	.37**	.31**	.38**	.11	.40**		
8 . . . . fails to consider the viewpoints of other parties involved in a conflict (*r*)	5.96	.50	.61**	.20	.36**	.24*	.32**	.61**	.55**	
9 . . . . makes effective use of other people's advice in making decisions	5.80	.61	.64**	.23*	.32**	.45**	.06	.42	.66**	.57**

Items with a (*r*) were reverse coded before conducting the correlations.

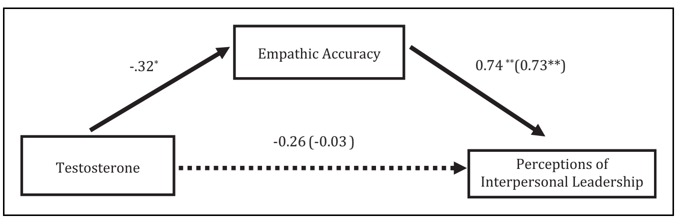

Figure 1. Mediation of the effect of testosterone on interpersonal leadership via empathic accuracy.[2] Numbers represent standardized regression coefficients; numbers in parentheses represent simultaneous regression coefficients. *p < .05. **p < .01.

between testosterone and interpersonal leadership (indirect effect = −.002, *SE* = .0009, 99% bias-corrected confidence interval did not include zero: −.0053, −.0002). These results suggest that via testosterone's negative relationship with empathic accuracy, higher levels of testosterone exert a negative indirect effect on perceptions of one's leadership skills and abilities.

Additional Analyses

To establish whether any reverse causal effects were present, an additional multiple regression analysis was conducted. This time interpersonal leadership was entered as the mediating variable, sex was entered as a covariate, and empathic accuracy was entered as the dependent variable. This alternative model was not supported by the data (indirect effect = −.003, *SE* = .0019, 99% confidence interval, −.0100, .0003).

Given the frequently reported sex difference in empathy (e.g., Baron-Cohen & Wheelwright, 2004; Hall, 1984), the absence of a main effect for sex here is unexpected. However, Hall (1984) also shows that the average effect size is $r = .20$ with a normal distribution around this average value. In other words, sex effects—despite their average robustness—do not always appear in this kind of research. Although this result is not central to the present research, one possibility is that differences in expectations for empathic accuracy, for men versus women, may lead observers to adjust for sex when making their evaluations.

General Discussion

Across two studies, we provide the first evidence that for both men and women, higher levels of naturally occurring circulating testosterone have a negative relationship with the ability to infer others' thoughts and emotions. In Study 1, we showed that even following explicit directions to attend closely to a social partner's mental and emotional states, higher endogenous levels of testosterone negatively related to one's ability to accurately read a partner's thoughts and feelings. In Study 2, we showed that this relationship emerges in the context of one's day-to-day social exchanges, is sufficiently robust to be observable by one's peers and coworkers, and has downstream consequences for the perception of one's interpersonal leadership skills and abilities. These results extend a growing body of literature that has begun to explore the role of prenatal testosterone in empathy (Baron-Cohen, 2003; Hermans et al., 2006; van Honk et al., 2011; van Honk & Schutter, 2007). Our findings suggest that within both the home and the workplace, the many interpersonal competencies that rely on the ability to accurately see the world from another person's point of view may also be negatively related to higher levels of naturally occurring testosterone.

A critical direction for future research involves an investigation into the proximal mechanisms by which testosterone may be impeding empathic accuracy. Research emerging from within social neuroscience provides a handful of clues that suggest a possible path of investigation. Although the neural architecture that supports empathy is comprised of a comprehensive network of brain structures (Decety, 2011; Mitchell, 2009; Zaki

& Ochsner, in press), one important region is the ventromedial prefrontal cortex (vmPFC; Seitz, Nickel, & Azari, 2006). Along with a diminished capacity to understand others' mental states (Stone, Baron-Cohen, & Knight, 1998), patients with lesions to the region are excessively egocentric in their perspective taking (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999). Important to our own hypothesizing is the recent finding that testosterone reduces activity in the medial orbitofrontal cortex (Mehta & Beer, 2011). Taken together, these findings support recent theorizing that testosterone's negative influence on empathy may be mediated by attenuation of activity within the vmPFC (Carney & Mason, 2010).

Future research might also seek to further explore the distinction between empathic regard and empathic accuracy. Study 1 sought to address this distinction by explicitly instructing participants to attend to one another's mental states and highlighting that accurate inference of their partner's thoughts and feelings would provide a competitive advantage in the negotiation exercise. Thus, we tentatively interpret the negative relationship between testosterone and empathic accuracy in Study 2 as suggestive of diminished capacity rather than simply regard. However, we concede the possibility that participants may not have found our instructions, or the task itself particularly motivating. Future research might seek to overcome this by attaching financial incentives to better negotiation outcomes and/or using a sample of experienced negotiators who are familiar with the importance of accurate person perception within a negotiation context. Further, we acknowledge that regard can ultimately feed into capacity, and that across time concern for other people's thoughts and feelings may lead to the development of skills that help one more accurately infer such mental states. The effect observed here might therefore be the consequence of an underdeveloped capacity, as opposed to a capacity limitation. Future research can seek to disentangle these possibilities by employing a longitudinal design and examining the relationship between testosterone and empathic accuracy across development.

The present finding that testosterone exerts a negative indirect effect on perceptions of leadership skills and abilities provides an important pathway for future research. For instance, future research might seek to determine whether the relationship is limited to how one is viewed by others or extends to more quantitative leadership outcomes. There are many different ways to lead and although testosterone's indirect relationship with the interpersonal skills and abilities measured here may make a "transformational" approach to leadership a difficult fit (Rubin et al., 2005), there are other approaches and leadership styles in which high-testosterone individuals may excel, and where empathic accuracy may be more a burden than a blessing.

Indeed, the negative relationship between testosterone and empathic accuracy invites a consideration of why such an association exists, as well as when and for whom empathic accuracy is an aid versus an impediment. Although there is much to be gained from the cooperative approach to social interactions that empathy stimulates, empathy is not without its disadvantages. Within negotiation contexts empathy can act as an impediment to personal outcomes (Galinsky, Maddux, Gilin, & White, 2008). Within mixed-motive games empathy motivates cooperation, even to the point of knowingly permitting oneself to be exploited by an opponent (Batson & Ahmad, 2001). And in zero-sum contexts, empathy can work to one's detriment, as any concessions made in the interests of one's opponent are made at a cost to oneself. Surges in testosterone that occur in preparation for competition may then be adaptive, attenuating empathic concerns for one's opponents that might otherwise undermine the benefits of a more cutthroat approach. Taken together, these findings suggest that in competitive contexts—such as those from which our MBA sample was drawn, and to which high-testosterone individuals are attracted (Dabbs & Dabbs, 2000)—the negative relationship between testosterone and empathic accuracy reported here may in fact help rather than hinder the pursuit of one's social goals. Future research might therefore seek to tease apart the conditions under which the negative relationship between testosterone and empathic accuracy is beneficial or detrimental to social outcomes.

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Notes

1. Higher cardiovascular activation is linked to high arousal and negative emotion (Kamarck et al., 1998).
2. As explained in Hayes (2009), the marginal direct relationship between testosterone and leadership skills and abilities does not rule against testing for an indirect pathway through a mediating variable.

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