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Sex differences in testosterone reactivity during marital conflict

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ABSTRACT

When attempting to resolve relationship problems, individuals in close relationships sometimes challenge their partners with statements that oppose their partners' point of view. Such oppositional behaviors may undermine those partners' relational value and threaten their status within the relationship. We examined whether perceptions of opposition from a partner during a series of problem-solving interactions were associated with reactivity in testosterone levels and whether those associations were different for men and women. Fifty newlywed couples discussed four marital problems. Each member of the couple reported how much oppositional behavior they perceived from their partner during the discussions. Pre- and post-discussion saliva samples were assayed for testosterone. For men, but not for women, perceptions of oppositional behavior were associated with heightened testosterone reactivity, and this result replicated across three different measures of testosterone reactivity. Findings were specific to men's *perceptions* of oppositional behavior, and held controlling for objective measures of oppositional behavior coded from videos of the conversations. Results highlight the benefits of considering pair-bonded relationships as a novel context for investigating associations involving hormones and behavior. Findings also raise the possibility that sex differentiated hormonal reactions to opposition partly explain why conflict among heterosexual partners can be so divisive.

Imagine Rob and Molly, two people in a romantic relationship who live together and lead busy lives. One day, they find themselves in a disagreement about child-rearing. When Rob expresses his views on a number of topics (grades, chores, religion), he perceives that Molly opposes some of his opinions. Rob perceives Molly's statements as a challenge and feels a threat to his status and relationship value. The current research addresses the question: What physiological responses in Rob might be evoked by this sense of threat?

There is reason to believe Rob may experience testosterone reactivity (i.e., relatively positive changes in testosterone). Testosterone is a hormone often associated with competition and aggression outside the context of a close relationship (Archer, 2006; Carré and McCormick, 2008; Carré et al., 2011; Mazur and Booth, 1998; Mehta and Josephs, 2006). Specifically, several theoretical perspectives imply that testosterone reactivity serves adaptive functions in the context of social challenge or threat (Archer, 2006; van Anders et al., 2011; Wingfield et al., 1990) by preparing the individual for possible aggression or competition (Carré et al., 2011). Traditional perspectives, such as the challenge hypothesis (Wingfield et al., 1990), and related research (for meta-analyses see Archer, 2006; Geniole et al., 2017) have emphasized the role of testosterone reactivity during competition. Much of the evidence to support the link between challenge and testosterone reactivity in humans thus has been from research focused on physiological responses in the context of sports competitions (e.g., Edwards et al., 2006; Mazur and Lamb, 1980; Neave and Wolfson, 2003) or in instances in which individuals are partnered with strangers in lab experiments (e.g., Carré et al., 2010; Gladue et al., 1989; Henry et al., 2017; Maner et al., 2008). This literature has for the most part stopped short of examining situations in which individuals may feel challenged by their close relationship partners.

Yet, people also face important challenges in their romantic relationships. As illustrated in the scenario about Rob and Molly, when discussing important areas of disagreement people may use oppositional behaviors, such as blaming their partners, rejecting their point of view, and demanding that they behave differently (Overall and McNulty, 2017). Although such behaviors are not inherently detrimental to the relationship, and can even be functional in the context of severe problems (McNulty and Russell, 2010), perceiving that one's partner is behaving in an oppositional manner may nevertheless be associated with feeling challenged or threatened. Conflict can also lead people to feel uncertain about whether their partners value and accept them (Murray et al., 2006), and such feelings of threat and uncertainty become especially pronounced when partners try to exert their influence through oppositional behaviors (Overall et al., 2009; Overall and

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McNulty, 2017). Indeed, oppositional behavior can be perceived as fundamentally threatening to one's relational value and status in the relationship (see Lemay et al., 2012; Overall et al., 2016; Reis et al., 2004). Perceptions of a partner's oppositional behavior, thus, may be associated with reactivity in levels of testosterone.

If perceptions of opposition from a partner are associated with testosterone reactivity, there is some reason to expect sex differences in this association. Traditional perspectives have focused on testosterone reactivity in men, and evidence suggests that social threat leads to testosterone reactivity in men more than women (Archer, 2006; Carré et al., 2013; Gladue et al., 1989; Kivlighan et al., 2005; Mazur and Booth, 1998). Such findings are consistent with theories emphasizing greater levels of intrasexual competition among men than among women (Ainsworth and Maner, 2012; Wilson and Daly, 1985), and the role testosterone plays in that competition (Archer, 2006; Trivers, 1972). Nevertheless, as noted, such perspectives have not been applied to contexts in which threat is experienced in close relationships. Further, recent perspectives such as the Steroid/Peptide Theory of Social Bonds (S/P theory) suggest that testosterone reactivity can extend to threats perceived by both men and women involved in a pair-bonded relationship (van Anders et al., 2011) by specifically positing that testosterone reactivity can prepare both men and women to respond to perceived threats to their status in the relationship. Indeed, men and women tend to engage in oppositional behavior with the same frequency (e.g., Hellmuth and Mcnulty, 2008; McNulty and Russell, 2010). Thus, although there are reasons to think the link between perceptions of oppositional behavior and testosterone reactivity is greater among men than women, there are also reasons to question whether there are sex differences in the link between perceived opposition and testosterone reactivity in close relationships.

Although other recent studies have examined the role of testosterone in romantic relationships (e.g., Kaiser and Powers, 2006; Roney and Gettler, 2015; van Anders et al., 2011; Wardecker et al., 2015), we are aware of only one study that has examined testosterone reactivity in the context of conversations in romantic couples (Peters et al., 2016), and that study did not examine conflict discussions. Peters et al. (2016) examined the association between testosterone reactivity and the self-regulation of emotions. Those authors asked both members of a couple to watch an emotionally evocative film clip and then randomly assigned one member of the couple to suppress or express emotions during a discussion with the partner. Both men and women who were asked to regulate their emotional responses experienced greater decreases in testosterone than people who expressed their emotions naturally, suggesting that testosterone plays a role in emotion regulation for both sexes. However, the authors did find a sex difference in the extent to which this association was moderated by the partner's level of authoritativeness; a particularly pronounced drop was observed in female but not male participants with authoritative partners. In our research, we examined whether testosterone is also reactive to perceptions of oppositional behavior from one's partner. We predicted that people's perceptions of their partners' oppositional behaviors would be positively associated with their own testosterone reactivity. We also tested for possible sex differences in this association.

1. The current research

We examined a sample of married couples engaged in a series of problem-solving discussions and assessed the association between each individual's testosterone levels and their perceptions of their partners' oppositional behavior. We predicted that people's perceptions of oppositional behavior from their partner would be associated with heightened testosterone reactivity. Moreover, we predicted that this effect would emerge even when controlling for objective features of the partners' oppositional behavior. Indeed, both the S/P Theory and the Integrated Specificity Model of Stress (Kemeny, 2003) posit that people's *perceptions* of the environment are responsible for initiating the cascade of physiological reactions displayed in response to environmental stimuli (e.g., Goldey and van Anders, 2011).

We examined whether testosterone reactivity would be associated with perceived opposition independent of other aspects of the discussions, such as observable opposition by the partners and individuals' perceptions of problem severity, as well as whether testosterone reactivity would be independently associated with these variables. Perceptions of problem severity may indicate that the discussion is about an important topic and disagreeing with one's partner on this topic is not a pleasant experience. However, perceptions that a problem is severe do not imply that an individual is being challenged or threatened by their partner's behavior. These additional analyses, thus, allowed us to examine the specificity of our hypothesized effect.

2. Method

2.1. Participants

Participants were 102 members of 51 newlywed couples participating in an ongoing longitudinal study of 120 couples (for additional information about the total sample, see Hicks et al., 2016, Study 1)[1]; given funding constraints, we assayed the hormonal data available from only the first 51 couples with usable data. Testosterone was reliably assessed for 97 of those 102 participants (47 women) (M_{age} = 31.43, SD_{age} = 8.16; 81% White/Caucasian). All couples in this subset were heterosexual. Due to a camera malfunction, video data were not available for one couple, leaving a final sample of 50 couples.

2.2. Procedures

Both members of each couple attended a laboratory session within three months of their wedding. During this session, couples completed a variety of tasks beyond the scope of the current analyses[2] and engaged in four eight-minute discussions of marital problems (two chosen by each spouse), each of which was separated by approximately 5–10 min. At the end of each conversation, participants answered questions about their perceptions of their partners' behavior during the discussion. Before beginning the first discussion and approximately 8 min after the last discussion, participants provided saliva samples via passive drool.

2.3. Measures

2.3.1. Testosterone

Samples were frozen at −20 °C immediately after each session. Before samples were assayed, they were thawed, centrifuged for 15 min at 3000 RPM, and the supernatant was refrozen in aliquots. Testosterone was assessed using commercially available enzyme-linked immunosorbent assay (ELISA) kits (Salimetrics, State College, PA). Samples were run in duplicate. The inter-assay coefficient of variability was 10.65 and the intra-assay coefficient of variability was 3.19.

Researchers have operationalized testosterone reactivity in three ways (see Carré et al., 2013): absolute testosterone change (e.g., Peters et al., 2016), percent change in testosterone (e.g., Carré and Putnam, 2010), and the residuals from regressing post-manipulation testosterone onto baseline levels (e.g., Welker et al., 2017). To ensure effects were not specific to one operationalization, we provide results for all three approaches. Similar patterns emerged using all three

[1] Although data from this sample have been described in several other published reports, none have involved data on either testosterone or variables related to these discussions (e.g., behaviors or perceptions of behaviors).

[2] Given broader study goals, participants were photographed, had their hands scanned, and completed several implicit tasks in individual rooms prior to engaging in the discussions that are investigated in this paper. Couples did not engage in any interpersonal tasks before the start of the discussions.

operationalizations. We standardized testosterone reactivity (for gram change and percent change) by creating Z-scores for men and women separately. We obtained the residualized testosterone reactivity values by regressing post-discussion testosterone onto pre-discussion testosterone separately for men and women and saving those residuals. We included within-sex mean-centered baseline testosterone as a covariate.

As expected, a paired-samples *t*-test revealed that baseline testosterone was higher in men ($M = 94.91$, $SD = 37.40$) than women ($M = 40.16$, $SD = 17.46$), $t(46) = 9.13$, $p < .001$, *Cohen's* $d = 2.69$. However, another paired-samples t-test revealed no difference between men ($M = -4.63$, $SD = 19.09$) and women ($M = -5.14$, $SD = 10.29$) in absolute levels of testosterone change, $t(45) = 0.15$, *ns*, $d = 0.04$. Overall, testosterone change ($M = -4.55$, $SD = 15.52$, range: -45.41 to 39.30) was significantly lower than zero, $t(96) = -2.88$, $p = .005$, $d = 0.59$, although testosterone change was positive for 30 (31%) of the participants. Average decreases in testosterone during laboratory sessions are consistent with prior research (e.g., Carré et al., 2009; Miller and Maner, 2010) and can be explained by the presence of diurnal testosterone cycles. Testosterone levels decline over the course of the day and, on average, approximately 1 h passed between the baseline and post-discussion saliva samples. Thus, testosterone reactivity in the current research is operationalized as degree of positive change in testosterone over time, relative to other same-sex members of the sample.

Given that couples attended lab sessions at different times of the day, we assessed and controlled time of day (operationalized as a linear increase from 7 am) in our primary analyses. Indeed, testosterone reactivity was correlated with time of day for both percent change ($r = -0.24$, $p = .019$) and residualized change ($r = -0.23$, $p = .026$), such that reactivity was greater in the mornings. The association involving gram change was also negative but did not reach significance ($r = -0.12$, $p = .167$).

2.3.2. Oppositional behavior

Conversations were recorded and coded by 1 of 7 independent raters using a version of the verbal tactics coding scheme (VTCS; Sillars, 1982). Each individual's speaking turn was coded for 3 direct oppositional behaviors (blaming, rejecting, making demands of the partner) and 5 indirect oppositional behaviors (sarcasm, hostile joking, hostile questioning, mind-reading, denying responsibility). A second coder overlapped on 18% of the conversations (ICC = 0.68). Analyses focused on the proportion of individuals' total speaking turns that received oppositional codes (see McNulty and Russell, 2010). As is typical, the proportion of oppositional behavior ranged from 0.00 to 0.47 ($M = 0.10$, $SD = 0.10$) and was somewhat positively skewed, although the skew statistic was not above the traditional cutoff point (*skew* = 1.58, $SE = 0.24$). Notably, only 6 individuals (all from different couples) exhibited no oppositional behavior in any of their conversations.

2.3.3. Perceived opposition

We operationalized perceptions of threat to one's relational value by assessing individuals' perceptions that their partners had exhibited oppositional behavior during each conversation. Specifically, both members of the couple answered the following three questions after each discussion (1 = Not at all, 7 = Very much): "How much did your partner blame you for the problem?", "How much did your partner reject you because of the problem?", and "How much did your partner demand that you change your behaviors, thoughts, and/or goals in order to resolve the problem?" As noted, targets of these behaviors tend to feel that their relational value and status has been threatened (Lemay et al., 2012; Overall et al., 2016; Reis et al., 2004). We averaged the three items for each of the four conversations (α ranged from 0.72 to 0.76).

2.3.4. Perceptions of problem severity

We also examined individuals' perceptions of another undesirable aspect of the conversations that is likely unassociated with one's relational value and status – perceptions of problem severity. After each discussion, both members of the couple answered the following question (1 = Not at all, 7 = Very much): "How severe is the problem you just discussed?"

2.3.5. Statistical method

Data from couples offer unique challenges to statistical estimation because the two members of the couple share experiences with each other that they do not share with other members of the sample, thereby violating assumptions of non-independence. These current data structure offer an additional challenge to independence because each member of the couple reported on perceived opposition on multiple occasions. Given these occasions were exactly the same for each member of the couple, statistical scholars recommend estimating a two level model in which conversations were crossed for individuals who are nested within couples (see Bolger and Laurenceau, 2013). This model pools estimates across husbands and wives while simultaneously accounting for their non-independence by estimating separate but correlated random intercepts. Specifically, each individual's four reports of perceived opposition (or problem severity) were regressed onto sex (effects coded: husbands = "−1", wives = "1"), conversation order (centered), baseline testosterone (within-sex centered), and testosterone reactivity (as described in the Measures section). We estimated each model three times, once for each of the three operationalizations of testosterone reactivity using the mixed procedure in SPSS. We examined sex differences in these associations by estimating Sex x Testosterone Reactivity interactions. For all critical effects, we report effect size *r*, which is comparable to a correlation coefficient, by taking the square root of the value obtained by dividing the squared *t* value by the value obtained by adding the squared *t* value and the *df* (see Rosenthal and Rosnow, 1991).

3. Results

We first examined whether testosterone reactivity was associated with perceptions of opposition from one's partner and whether these associations were different for husbands and wives. Results are reported in Table 1 (Model 1). Across the three operationalizations of testosterone reactivity we found the same pattern, such that there was a significant association between testosterone reactivity and perceptions of opposition from the partner during the problem-solving discussions among husbands but not wives. The interaction between Sex and Testosterone reactivity was significant in the analysis involving the gram change operationalization and trended toward significance in the analysis involving the percent change operationalization. The interaction was not significant in the analysis involving the residualized change.[3]

In supplemental analyses, we examined whether perceptions of opposition from one's partner were associated with testosterone reactivity when we controlled for partner's actual oppositional behavior. The association between perceptions of opposition and testosterone reactivity continued to emerge for all three operationalizations (see Table 1, Model 2). In similar models that estimated the association between testosterone reactivity and other dependent measures, individuals' testosterone reactivity was not associated with partners' behavior (all *p*'s > 0.789) nor with perceptions of problem severity (all *p*'s > 0.241). Correlations between all key variables are reported in Table 2; perceptions of opposition, partner's behavior, and perceptions

[3] Some have raised concerns about within-sex standardizing of testosterone reactivity when examining associations in data collected from couples (Edelstein et al., 2014; Kenny et al., 2006). In ancillary analyses, we standardized testosterone reactivity across sex and obtained the same pattern of results.

Table 1
Associations between Individuals Perceptions of Opposition from their Partner and their Testosterone Reactivity.

	Gram change in testosterone						Percent change in testosterone						Residualized change in testosterone					
	b	*SE*	*t*	*df*	*p*	*r*	*b*	*SE*	*t*	*df*	*p*	*r*	*b*	*SE*	*t*	*df*	*p*	*r*
Model 1																		
Intercept	2.49	0.11	21.76	45.68	< 0.001		2.48	0.12	21.50	45.23	< 0.001		2.48	0.12	21.46	45.36	< 0.001	
Sex	0.01	0.07	0.09	44.05	0.929	0.01	0.01	0.07	0.14	43.81	0.890	0.02	0.01	0.07	0.20	43.33	0.840	0.03
Conv. order	−0.11	0.05	−2.21	138.94	0.029	0.18	−0.11	0.05	−2.21	138.93	0.028	0.18	−0.11	0.05	−2.22	138.83	0.028	0.19
Base T.	0.01	0.004	2.98	59.49	0.004	0.36	0.01	0.003	2.55	59.53	0.013	0.31	0.005	0.003	1.63	55.89	0.108	0.21
Severity	0.22	0.04	6.09	269.35	< 0.001	0.35	0.22	0.04	6.03	268.93	< 0.001	0.35	0.22	0.04	6.07	268.49	< 0.001	0.35
Time	0.05	0.04	1.55	50.15	0.128	0.21	0.06	0.04	1.61	51.78	0.114	0.22	0.05	0.04	1.51	49.81	0.137	0.21
T. change	0.26	0.04	2.82	73.71	0.006	0.31	0.23	0.09	2.46	70.68	0.016	0.28	0.02	0.01	2.33	58.71	0.023	0.29
Sex × T. change	−0.20	0.09	−2.30	78.23	0.024	0.25	−0.17	0.09	−1.91	77.33	0.060	0.21	−0.004	0.01	−0.57	56.77	0.566	0.08
Simple slopes																		
Husbands	0.46	0.13	3.59	50.90	0.001	0.45	0.39	0.13	3.06	51.68	0.004	0.39	0.02	0.01	3.18	47.24	0.003	0.42
Wives	0.07	0.13	0.52	47.54	0.603	0.08	0.06	0.12	0.47	43.66	0.638	0.07	0.01	0.01	1.00	42.53	0.319	0.15
Model 2																		
Intercept	2.48	0.10	25.09	43.94	< 0.001		2.48	0.10	24.97	43.32	< 0.001		2.48	0.10	24.88	43.32	< 0.001	
Sex	0.01	0.07	0.16	43.88	0.873	0.02	0.01	0.07	0.21	43.80	0.839	0.03	0.02	0.07	0.28	43.10	0.781	0.04
Conv. order	−0.10	0.05	−2.24	137.63	0.027	0.19	−0.10	0.05	−2.24	137.65	0.027	0.19	−0.10	0.05	−2.24	137.47	0.026	0.19
Base T.	0.01	0.003	2.71	59.70	0.009	0.33	0.01	0.003	2.26	59.92	0.027	0.28	0.003	0.003	1.19	56.27	0.239	0.16
Severity	0.19	0.03	5.65	272.06	< 0.001	0.32	0.19	0.03	5.61	270.96	< 0.001	0.32	0.20	0.03	5.63	271.70	< 0.001	0.32
Time	0.04	0.03	1.35	49.07	0.183	0.19	0.05	0.03	1.45	50.55	0.154	0.20	0.04	0.03	1.32	48.51	0.193	0.19
Partner behavior	2.76	0.41	6.80	311.14	< 0.001	0.36	2.80	0.41	6.91	312.11	< 0.001	0.36	2.79	0.41	6.88	311.62	< 0.001	0.36
T. change	0.28	0.09	3.09	78.89	0.003	0.33	0.24	0.09	2.73	76.05	0.008	0.30	0.02	0.01	2.55	60.81	0.013	0.31
Sex × T. change	−0.16	0.08	−1.90	83.56	0.061	0.20	−0.16	0.08	−1.87	82.02	0.065	0.20	−0.003	0.01	−0.40	58.81	0.693	0.05
Simple slopes																		
Husbands	0.44	0.12	3.60	50.02	0.001	0.45	0.39	0.12	3.34	50.74	0.002	0.42	0.02	0.01	3.36	46.56	0.002	0.44
Wives	0.12	0.12	0.98	48.05	0.331	0.14	0.08	0.12	0.69	44.94	0.497	0.10	0.01	0.01	1.22	43.65	0.230	0.18

Table 2
Correlations between key variables.

	1	2	3	4	5	6	7
1. Baseline testosterone	0.01	−0.49***	−0.38***	0.00	−0.06	0.04	−0.12
2. Gram testosterone change	−0.42**	−0.17	0.93***	0.87***	0.03	0.36*	0.13
3. Percent testosterone change	−0.22	0.89***	−0.11	0.85***	−0.04	0.32*	0.04
4. Residualized testosterone change	0.00	0.91***	0.88***	0.02	−0.03	0.34*	0.07
5. Perceived severity	0.02	0.05	0.15	0.06	0.41**	0.54***	0.18
6. Perceived opposition	0.29†	0.06	0.10	0.20	0.45**	0.59***	0.49***
7. Partner actual opposition	0.48**	−0.20	−0.04	0.01	0.31*	0.50***	0.34*

Note. Coefficients above the diagonal represent correlations among husbands. Coefficients below the diagonal represent correlations among wives. Correlations between husbands' and wives' measures are on the diagonal.

*** $p < .001$.

** $p < .01$.

* $p < .05$.

† $p < .051$.

of severity are averaged across the discussions.

4. Discussion

Using observational, self-report, and neuroendocrinological data obtained from married couples discussing real problems, we demonstrated that perceptions of oppositional behavior from romantic partners were associated with men's, but not women's, testosterone reactivity. Husbands who perceived greater (compared with less) opposition during the conversations displayed greater testosterone reactivity. Furthermore, the associations between testosterone reactivity and perceptions of opposition emerged in models that accounted for perceptions of problem severity and objective codes of partners' oppositional behavior. These results are thus consistent with the Integrated Specificity Model of Stress (Kemeny, 2003) in demonstrating that such physiological responses hinge on *perceptions* of one's spouse's behavior as oppositional.

The current work extends previous theories of the link between testosterone and social interaction by joining a growing body of literature demonstrating that perceived challenge, even within a committed relationship, is linked to testosterone reactivity in men (Archer, 2006; Carré et al., 2011). Although a wealth of research has demonstrated that men experience testosterone reactivity in competitive settings, both during real sporting events and laboratory situations (see Archer, 2006 for a meta-analysis), no previous studies have (to our knowledge) assessed testosterone reactivity in response to conflict within close romantic relationships. In this novel context, our findings suggest that perceived challenges from one's partner provoke testosterone reactivity in men. This is consistent with the hypothesis that oppositional behavior from one's partner can undermine one's feelings of relational value and status.

One limitation of our study is the relatively small sample size, which may have undermined our power to observe consistent sex differences; the interaction was significant for gram change in testosterone, trending for percent change in testosterone, and not significant for residualized change in testosterone. However, the fact that the sex

difference was sometimes significant combined with the fact that the association between testosterone reactivity and perceived opposition was always significant for husbands, and never significant for wives, lends considerable credence to the possibility that testosterone reactivity is indeed differentially associated with perceived opposition for men and women.

The fact that women did not appear to experience the same levels of testosterone reactivity in response to perceived opposition is consistent with existing theory and evidence that men and women sometimes experience different physiological responses to stressors. The Tend-and-Befriend Theory, for example, posits that, among women, stressors may result in the release of oxytocin, which may facilitate an affiliative response (Taylor, 2006; Taylor et al., 2000). Future research may benefit from examining other hormones (e.g., progesterone) and neuropeptides (e.g., oxytocin) that may be released among women in these contexts and whether these responses facilitate particular behavioral strategies aimed at solving relationship problems.

Taken together, the current findings suggest that pair-bonded relationships may be a useful context in which to test novel predictions regarding neuroendocrine processes. As noted, Peters et al. (2016) demonstrated that testosterone plays a role in emotional regulation and tuning during discussions with a romantic partner. Together these studies highlight the benefits of integrating into research on testosterone reactivity the behaviors of two people involved in meaningful interdependent relationships. However, these two studies differ in a substantial way: whereas we found an association between relatively *positive* changes in testosterone and perceptions of opposition for men, Peters and colleagues found an association between relative *decreases* in testosterone and emotional regulation for both men and women, but also that this decrease was moderated by partner authoritativeness among women. These findings are consistent with perspectives suggesting different motivations associated with positive versus negative changes in testosterone. For example, the S/P Theory of Social Bonds posits that whereas higher levels of testosterone are associated with competitive motivations relevant to the preservation of one's status and resources, lower levels of testosterone are associated with more nurturant motivations relevant to pair-bond closeness and comforting of one's partner (van Anders et al., 2011). Thus, the different patterns of testosterone reactivity in men and women may fit with potentially different motivations men and women have in relationships more broadly (e.g., Buss and Schmitt, 1993).

The current work also provides a valuable springboard for assessing whether testosterone is associated with other important processes in relationships. For example, testosterone reactivity might undermine relationship stability, especially as higher (vs. lower) levels of testosterone have been linked to decreased satisfaction and commitment in men and women (Edelstein et al., 2014; van Anders et al., 2011). Moreover, the association between perceived opposition and testosterone reactivity may be moderated by differences in relationship length and stability. Although we could not examine such moderating factors because our sample consisted of newlywed couples all assessed within three months of marriage, these are important variables to examine in future research. Additionally, the link between testosterone and increased sexual desire (Archer, 2006; van Anders et al., 2011) suggests that experiencing increased testosterone in response to a partner's oppositional behavior may explain the increased likelihood of sexual behavior following arguments (Hatfield et al., 2012). Future research may benefit from examining this possibility directly, as well as the extent to which testosterone reactivity is uniquely associated with other romantic relationship processes. Indeed, it is not yet clear whether any associations of testosterone reactivity with relationship processes are unique from associations with processes that occur outside of relationships (e.g., competition).

These findings also provide insight into and suggest novel directions for relationship science. As one example, the link between testosterone reactivity and aggressive responding (Archer, 2006; Carré et al., 2011) suggests men's testosterone reactivity in response to their partner's oppositional behavior may lead to more aggressive responses (see Overall et al., 2016), and may correspond to a detrimental pattern of communication in relationships—negative reciprocity (Gottman, 2014). Unfortunately, the fact that we assessed testosterone reactivity over the course of the four discussions, with the second assessment occurring after the final discussion, made it impossible to assess which discussion(s), in particular, evoked the most reactivity. Consequently, we were unable to assess the link between partners' testosterone reactivity and one's own aggressive responses. Future research may benefit from assessing this link directly, particularly to the extent that it considers the possible interactive role of other neuroendocrinological processes. Both the S/P Theory and the dual hormone hypothesis (Mehta and Josephs, 2010; Mehta and Prasad, 2015) suggest the link between testosterone and aggression is likely to be moderated by other neuroendocrine processes. According to S/P Theory, whether testosterone reactivity is associated with increased aggression, for example, may depend on the presence of neuropeptides that promote bonding, such as oxytocin and vasopressin. According to the dual-hormone hypothesis, increases in cortisol levels may attenuate the association between increased testosterone and reciprocal oppositional behaviors.

Regardless of the specific mechanism underlying any link between testosterone reactivity and negative reciprocity, the fact that men (but not women) experience testosterone reactivity in response to opposition highlights one potential explanation for the divisiveness of conflict in heterosexual relationships. It is possible that men more than women adopt an adversarial and perhaps even aggressive stance in response to perceived opposition from a close relationship partner. Such a pattern could, in turn, drive the two partners' perspectives further apart—she may not understand why he is getting so angry and he may resent her for questioning his anger. Future research may benefit from examining other hormonal processes that may have similar implications, perhaps hormonal reactions that occur in women but not men, as well as ways to buffer spouses from the escalated misunderstandings that may ensue.

5. Conclusion

Conflict poses a challenge to both members of a pair-bonded relationship. Consider again the conflict between Rob and Molly, who have different goals and opinions regarding child-rearing. When voiced, those differences can be perceived as highly oppositional and can undermine a person's sense of status and value within the relationship. The current research highlights one important response to such perceptions – testosterone reactivity in men. The pattern that testosterone reactivity was observed in men but not women offers potential insight into misunderstandings and even escalations of conflict that sometimes occur in relationship discussions. More broadly, findings highlight the utility of investigating neuroendocrinological processes in the context of close romantic relationships.

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