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Hormones and Behavior 46 (2004) 592–599

Hormones and Behavior

www.elsevier.com/locate/yhbeh

Effects of affiliation and power motivation arousal on salivary progesterone and testosterone

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Received 6 January 2004; revised 27 April 2004; accepted 13 July 2004
Available online 11 September 2004

Abstract

Following up on earlier research suggesting a link between implicit affiliation motivation and progesterone (P) and implicit power motivation and testosterone [T; Schultheiss, O.C., Dargel, A., Rohde, W., 2003. Implicit motives and gonadal steroid hormones: Effects of menstrual cycle phase, oral contraceptive use, and relationship status. Horm. Behav. 43, 293–301.], we tested whether arousal of affiliation motivation increases P levels and whether arousal of power motivation increases T levels. Sixty subjects were randomly assigned to watch 30 min of either *Bridges of Madison County* (affiliation arousal) or *The Godfather II* (power arousal), or a documentary about the Amazon (control condition). Levels of P and T were assessed in saliva samples taken before (T1), immediately after (T2), and 45 min after the movie (T3). The efficacy of experimental conditions to differentially arouse motives was verified by assessment of changes in affiliation and power motive imagery expressed in imaginative stories written before and after the movie. After the movie, salivary P levels (T2 and T3) in the affiliation-arousal group were significantly higher than in the control group and marginally higher than in the power-arousal group. Subjects' postmovie T responses (T3) depended on premovie T levels: in men, higher premovie T levels predicted a greater likelihood of postmovie T increases in the Power Arousal condition but not in the other conditions, whereas in women, higher premovie T levels tended to be associated with postmovie T decreases in the Power Arousal condition but not in the other conditions. These findings suggest that aroused affiliation motivation has a specific stimulatory effect on P, whereas aroused power motivation has a specific stimulatory effect on T in men, but not in women, with high baseline T levels.

Keywords: Testosterone; Progesterone; Movies; Motivational arousal; Implicit motives; Sex differences; Power motive; Affiliation motive

Introduction

There is considerable evidence that, beyond their immediate physiological effects on reproductive and metabolic functions, gonadal steroid hormones are involved in motivational processes related to dominance, sex drive, and attachment (e.g., Carter, 2002; Monaghan and Glickman, 1992; Young and Insel, 2002). A large body of research documents a relationship between testosterone (T) and dominance, although the specifics of this relationship vary by species, gender, and context (e.g., Albert et al., 1992; Bernstein et al., 1983; Mazur and Booth, 1998; Wingfield et al., 1990). In primates and other mammals, the T-dominance relationship is often reciprocal, with successful assertion of dominance resulting in a transient T peak and high T levels in turn increasing individuals' likelihood to respond aggressively to a dominance challenge (Kemper, 1990; Mazur, 1985).

In human males, a dispositional need for dominance, called the implicit power motive, has been shown to be associated with T release. The implicit power motive is a nonconscious concern for having impact on others or the world at large and is assessed by coding imaginative stories that individuals write about picture cues (a procedure called Picture Story Exercise or PSE) for power-related themes

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doi:10.1016/j.yhbeh.2004.07.005

(Smith, 1992; Winter, 1973). High implicit power motivation is associated with elevated basal T levels and predicts transient T increases in response to both anticipated dominance challenges and a victory in an actual dominance contest (Schultheiss and Rohde, 2002; Schultheiss et al., 1999, 2003).

Comparatively less is known about the role of progesterone (P) in motivational processes in humans and primates. Some research suggests that, like in other mammals, declining P levels, in combination with elevated estradiol levels, increase maternal motivation at the end of a pregnancy and enhance the mother's attachment to the newborn (cf. Fleming et al., 1997; Pryce et al., 1993). Outside of pregnancy, elevated P during the luteal phase of the menstrual cycle has been associated with decreased sexual motivation, which may be due in part to P's antiandrogenic effects (Carter, 2002). The antiandrogenic properties of P have also been exploited to decrease libido in sex offenders through the administration of progestins (Cooper, 1986).

While the effects of P on sexual motivation seem to suggest that high P levels decrease the desire for intimate contact with others, Schultheiss et al. (2003) have recently reported significant covariations between P and the implicit affiliation motive, which is defined as a nonconscious need to have close, friendly relationships with others and can, like the power motive, be assessed by coding PSE stories for motivational content (Koestner and McClelland, 1992). Schultheiss et al. (2003) found that the use of oral contraceptives, which contain progestins, is associated with higher levels of affiliation motivation in women. In women who do not use oral contraceptives, higher salivary P levels tended to be associated with higher affiliation motivation throughout the menstrual cycle. In contrast, men's salivary P levels showed a strong, inverse relationship with implicit affiliation motivation. Due to the cross-sectional nature of the data Schultheiss et al. (2003) reported, the causal direction of these effects remains unknown.

In the present research, our primary goal was to establish whether implicit affiliation motivation has a causal effect on P release. To test this hypothesis, we used an approach that has been successfully employed in previous studies (e.g., McClelland and Kirshnit, 1988) and presented participants with movie excerpts to induce aroused motivational states. Specifically, we presented excerpts from a movie with strong affiliative content (*Bridges of Madison County*) to one group of participants and compared changes in their salivary P levels from before to after the movie with those obtained in a control group of participants who had watched a motivationally neutral movie (a documentary about the Amazon).

Moreover, to demonstrate that the effect of watching *Bridges of Madison County* on P levels is specific to the affiliative content of the movie and does not generalize to other movies with social cues unrelated to affiliation, we had a third group of participants watch a movie with strong power- and dominance-related themes, but lacking affiliative cues (*The Godfather II*). While we did not expect P release in this third group to differ markedly from that of participants in the control group, we predicted that, due to the power motive-arousing content of *The Godfather II*, participants in this condition would register an increase in salivary T levels not observed in participants in the other two conditions. To verify the effectiveness of our motive arousal manipulation by independent (i.e., nonhormonal) means, we administered a short PSE both before and after the movie to assess changes in participants' implicit power and affiliation motivation.

Method

Participants

Sixty individuals (39 women) with an average age of 19.78 ± 0.17 years participated in sessions scheduled between 10 AM and 5 PM on weekdays in late winter and early spring. Ten women reported to currently use birth-control pills. On average, women were on day 18 ± 2.08 of their menstrual cycle, calculated as the difference between the date women identified as the onset of their last menstruation and the testing date. Participants were enrolled as undergraduate students at the University of Michigan, Ann Arbor. Psychology majors were not admitted.

Design

Arousal condition (neutral, affiliation arousal, power arousal) was varied between subjects, with random assignment of 20 participants to each condition. Hormone assessment (premovie: T1; postmovie: T2, T3) represented a within-subjects factor. For our manipulation check measure, which was administered both pre- and postmovie to assess changes in power and affiliation motivation, we examined whether temporal proximity of the postmovie assessment to the arousing movie influenced the degree of measured motivational arousal; hence half of the participants received the postmovie motive assessment 5 min after the movie and the rest received it 20 min postmovie, which constituted the factor Sequence. Dependent variables were participants' postmovie changes in P and T, controlled for premovie baseline levels in these hormones, and changes in power and affiliation motive scores from before to after the movie.

Procedure

Participants were scheduled and tested in groups up to four. After participants had given their informed consent, they provided a first saliva sample (T1, at 0 h 0 min). Then, their premovie motive levels were assessed with a PSE. Next, participants watched an excerpt from the movie that defined the Arousal condition they were assigned to. After

the movie, they collected a second saliva sample (T2, at 1 h 0 min), and then worked on a postmovie PSE and an attentional orienting task (not reported below), with the ordering of these tasks determined by the factor Sequence. Participants then completed another task unrelated to the results reported below and finally collected a third saliva sample (T3, at 1 h 45 min) while working on a biographical and background data questionnaire. They were debriefed and paid US$15.

Arousal condition

Each movie clip was about 30 min long and represented a contiguous portion of the original movie. Movie excerpts were presented on a 32-in. color TV. Participants watched the movies in a semidark room from a distance of 2 to 3 m.

The Bridges of Madison County (director: Clint Eastwood) was chosen to arouse affiliation motivation in participants. The excerpt shown depicts how a farmer's wife, after her family departs for an exhibition, makes the acquaintance of a photographer who stops at her farm to ask for directions. The two feel attracted to each other; the farmer's wife invites the photographer for lunch, and they spend time together in the outdoors. Although the excerpt does not reveal whether the two protagonists actually become lovers, it is rich with cues related to affiliation and intimacy, while featuring no cues related to power and dominance.

The Godfather, Part II (director: Francis Ford Coppola) was chosen to arouse viewers' power motivation. The excerpt presented the story of Don Corleone's rise from a store owner in early 20th century New York who is being blackmailed by the neighborhood Mafia boss to the position of a "godfather" who takes charge of his community and solves a squabble between a landlord and a tenant by exerting subtle pressure on the landlord. The excerpt also shows how Corleone traps and kills the neighborhood's previous "godfather." The excerpt is rich with power and dominance cues but features virtually no cues related to friendship and affiliation.

Amazon: Land of the Flooded Forest (a National Geographic documentary written and produced by Barbara Jampel) was chosen as a control movie which, although interesting and engaging to watch, did not contain cues related to power or affiliation. The excerpt presents the fauna and flora in and around the Amazon as well as some of the daily activities (e.g., fishing) of the people who live at the river.

Manipulation check

To assess whether motive Arousal conditions actually induced the intended motivational states, we presented two different PSEs before and after the movie. PSE set A consisted of the cues *captain talking to a passenger*, *trapeze artists*, and *couple sitting opposite a woman*; PSE set B consisted of the cues *women in laboratory*, *nightclub scene*, and *girlfriends in café with male approaching* (the last picture in each set has been used by Schultheiss et al., 2003; all other pictures were taken from McClelland, 1975, and Smith, 1992). Within each set, pictures were presented in random order. Set order (AB, BA) was balanced across participants in each cell resulting from the crossed factors Arousal condition and Sequence. All stories were coded for power and affiliation motive imagery according to Winter (1994) *Manual for Scoring Motive Imagery in Running Text* by a trained scorer who had previously attained over 85% agreement with training materials prescored by experts and which are contained in the *Manual*. The scorer was blind with regard to participants' gender and experimental condition. On set A, participants wrote 312 $\pm$ 8 words, containing 2.85 $\pm$ 0.22 power and 2.30 $\pm$ 0.22 affiliation images summed across all three stories. On set B, participants wrote 314 $\pm$ 7 words, containing 1.92 $\pm$ 0.19 power and 4.33 $\pm$ 0.31 affiliation images. Within each set, motive scores were adjusted for protocol length by regression. To remove between-set variance from the motive scores, we converted motive score residuals to z scores within each set separately for each assessment (before movie, after movie).

Hormone assays

Sample collection and processing

At each sampling point, participants used a fresh sugar-free chewing gum to collect 7 ml of saliva in a sterile polypropylene vial (Dabbs, 1991). Vials were closed and frozen immediately at the end of each session. Samples were freed from mucopolysaccharides and other residuals by three freeze–thaw cycles with subsequent centrifugation. One participant failed to provide any saliva samples, and another participant supplied too little sample at T1 for hormone assaying; hence, $N = 58$ for all analyses involving hormone levels. All hormone assays were conducted using solid-phase Coat-A-Count ^{125}I radioimmunoassays for T (TKTT) and P (TKPG) provided by Diagnostic Products Corporation (Los Angeles), and all samples were measured in duplicate for 2 min in a gamma counter after vortexing, incubation, and decanting. Unknown sample concentrations were estimated from the standard curve using log–logit curve fitting. Interassay reliability was evaluated by including samples from male and female in-house saliva pools in each assay; intraassay reliability was determined in participants' samples, and recovery was assessed with Bio-Rad Lyphochek (Hercules, CA) calibrators, appropriately diluted for expected low and high levels of each hormone in saliva. According to validation data supplied by the manufacturer, none of the assays cross-reacts with estrogens and gestagens contained in oral contraceptives.

Testosterone assay

For determination of salivary T, we conducted two assays according to the protocol described in Campbell et al.

(1999) but included a 24-h preincubation at room temperature before adding tracer. Interassay CV was 6.05% for female saliva (19 pg/ml) and 11.97% for male saliva (95 pg/ml), intraassay CV was 9.48%, and analytical sensitivity ($B_0 - 3\ SD$) was 1.39 pg/ml. For diluted Lyphochek control samples, analytical recovery was 117.95% (low female range: 8 pg/ml), 89.11% (high female range: 18 pg/ml), 108.54% (low male range: 90 pg/ml), and 100.57% (high male range: 152 pg/ml).

Progesterone assay

To determine salivary P, we conducted two assays according to the protocol described in Schultheiss et al. (2003). Interassay CV was 1.54% for luteal-phase female saliva (165 pg/ml) and 12.76% for male saliva (27 pg/ml), intraassay CV was 11.73%, and analytical sensitivity ($B_0 - 3\ SD$) was 3.12 pg/ml. For diluted Lyphochek control samples, analytical recovery was 112.48% (low male and follicular female range: 9 pg/ml), 119.40% (medium male and follicular female range: 20 pg/ml), and 95.93% (high female range: 123 pg/ml).

Statistical procedures

All analyses were conducted with SYSTAT 10 and involved regression and correlation analysis, repeated-measures ANOVA, and ANCOVA. Descriptive statistics are given as mean ± SEM. An α level of 0.05 (two-tailed) was employed in all analyses.

Results

Manipulation check

A significant Motive × Time × Condition × Sequence on Motive Imagery interaction, $F(2, 54) = 3.06$, $P = 0.05$, was due to the fact that participants' motive levels showed signs of changing differentially in response to the arousal manipulation (as indicated by a Motive × Time × Condition interaction) when the second PSE was presented immediately after the movie, $F(2, 27) = 3.33$, $P = 0.05$, but not if it was presented with a delay. Follow-up analyses in the former group revealed a Time × Condition trend for power motive scores, $F(2, 27) = 2.90$, $P < 0.10$, but no significant changes for affiliation motive scores. However, when we restricted our analyses to a comparison of the power- and affiliation-arousal groups, the Time × Condition interaction was fully significant for power motive scores, $F(1, 18) = 5.21$, $P < 0.05$, and marginally significant for affiliation motive scores, $F(1, 18) = 2.57$, $P < 0.10$. As Fig. 1 shows, affiliation arousal participants registered an increase in affiliation motivation with a corresponding decrease in power motivation, whereas power-arousal participants registered an increase in power motivation and a corresponding decrease in affiliation motivation, with the neutral group falling in between with essentially no change in motive imagery. The reciprocal changes in affiliation and power motivation in the two arousal groups are consistent with the observation that, on the PSE, high levels of imagery for one motive are typically associated with a reduced amount of imagery for the other motive (cf. Schultheiss and Brunstein, 2001). We conclude from these findings that, as intended, *Bridges of Madison County* triggered an increase in affiliation motivation, *The Godfather II* elicited an increase in power motivation, and the Amazon documentary left participants' motivational state unchanged. The motivational changes observed in the Power and Affiliation Arousal conditions were transient and had dissipated 20 min after the movie.

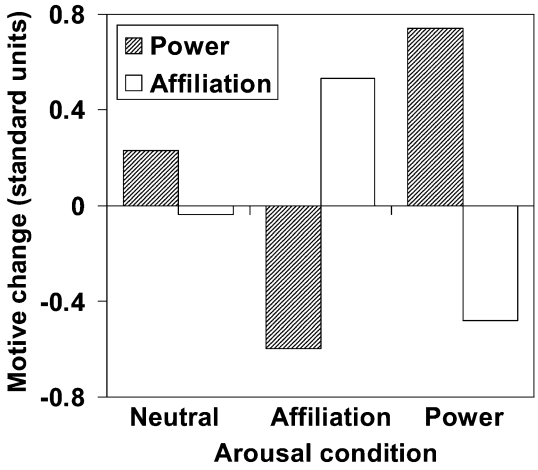

Fig. 1. Effect of arousal condition on changes in power and affiliation motive imagery (postmovie minus premovie z scores) assessed 5 min after the movie ($n = 10$ in each condition).

Mean hormone concentrations

As Table 1 shows, T levels changed differently in men and women [for the Time × Gender effect, $F(2, 112) = 7.75$, $P < 0.001$]. On average, men's T levels declined during the experimental session [$F(1, 19) = 4.01$, $P = 0.05$, for the linear effect; a quadratic effect reached only trend level, $P < 0.10$], whereas women did not show any significant T changes. While the majority of women had salivary P levels between 10 and 50 pg/ml and thus closely resembled women in the follicular phase and women on oral contraceptives in the Schultheiss et al. (2003) study, five women (none of them on oral contraceptives; all of them were between days 18 and 32 of their menstrual cycles) had P levels that fell between 70 and 230 pg/ml at T1 and thus were in the luteal-phase range of salivary P (cf. Schultheiss et al., 2003). Their P levels at all three assessments greatly skewed subjects' P distributions, and we therefore subjected all three P measures to a log transformation to lessen the influence of these extreme values on subsequent analyses. Participant gender had no significant effect on the log-transformed P levels. Only the main effect of Time was

Table 1
Mean (± SEM) salivary hormone concentrations in pg/ml at T1 (premovie), T2 (immediately postmovie), and T3 (45 min postmovie)

Gender	N	Testosterone			Progesterone		
		T1	T2	T3	T1	T2	T3
Women	38	20 (2)	18 (2)	17 (1)	38 (6)	30 (4)	31 (5)
Men	20	82 (6)	94 (6)	92 (8)	25 (1)	22 (2)	21 (1)

significant, $F(2, 112) = 14.92$, $P < 0.00001$, and displayed a quadratic trend, $F(1, 56) = 8.38$, $P = 0.005$, which reflected the fact that P decreased strongly from T1 to T2 and leveled off thereafter.

Arousal effects on progesterone changes

We subjected participants' postmovie log-transformed P levels (T2 and T3) to a repeated-measures ANCOVA with premovie log-transformed P as a covariate and Arousal condition as between-subjects factor. The main effect of Arousal condition was significant, $F(2, 54) = 4.80$, $P < 0.05$, but not the Arousal condition × Time interaction. We also tested whether participant gender moderated the effect of Arousal condition on P and whether birth-control pill use or menstrual-cycle stage moderated the effect of arousal on P among women, but without significant results. Removing five women with P levels greater 70 pg/ml at T1 from the analyses left the main effect of Arousal condition intact, $P < 0.01$. For subsequent analyses, we averaged log-transformed P at T2 and T3 into a single postmovie P variable. When we tested for significant between-condition differences in this variable by comparing the affiliation-arousal group with the no-arousal group or with the power-arousal group, we found that the affiliation group differed significantly from the no-arousal group, $F(1, 36) = 7.93$, $P < 0.01$, marginally from the power-arousal group, $F(1, 35) = 2.95$, $P < 0.10$, and significantly from the combined no-arousal and power-arousal groups, $F(1, 55) = 7.71$, $P < 0.01$. As shown in Fig. 2, participants in the affiliation-arousal group were the only ones to have elevated log-transformed P levels after the movie. To express these differential changes in salivary P in a more meaningful metric, we partialed untransformed P at T1 from untransformed P levels averaged across T2 and T3 and found residualized changes from premovie to postmovie levels to be -2.90 ± 0.93 pg/ml in the control group, 3.91 ± 3.14 pg/ml in the affiliation-arousal group, and -0.85 ± 1.25 pg/ml in the power-arousal group.

Arousal effects on testosterone changes

We subjected participants' T levels to the same ANCOVA described above for P, but without significant results. However, we found a strong interaction between premovie T, participant gender, Arousal condition and Time (T2 vs. T3), $F(2, 46) = 7.92$, $P = 0.001$, which was based on a highly significant Arousal condition × Gender × Testosterone (T1) on Testosterone (T3) interaction effect, $F(2, 46) = 9.79$, $P < 0.0005$, which did not emerge for T at T2. For T at T3, the Arousal condition × Testosterone (T1) interaction was significant both for men, $F(2, 14) = 7.69$, $P < 0.01$, and for women, $F(2, 32) = 4.38$, $P < 0.05$. Among women, it was not significantly moderated by birth-control pill use or menstrual cycle stage. To illustrate the interaction effect for T at T3, we calculated T changes by regressing T (T1) from T (T3) separately for each gender and plotted participants' residual change scores against their baseline T levels (cf. Fig. 3). In men, higher baseline T levels were not significantly associated with T changes at T3 in the control condition, but significantly predicted T decreases in the Affiliation Arousal condition [$r(5) = -0.91$, $P < 0.05$] and T increases in the Power Arousal condition [$r(7) = 0.77$, $P < 0.05$]. Men's regression slope in the Power Arousal condition significantly differed from the slope of the combined control and affiliation-arousal groups, $t(16) = 3.73$, $P < 0.005$. In women, higher baseline T levels were not a significant predictor of T changes at T3 in the control group or the affiliation-arousal group, but significantly predicted T decreases in the power-arousal group [$r(12) = -0.57$, $P = 0.05$; $r = -0.52$, $P < 0.10$ after square-root transformation of T at T1 to lessen the influence of an outlier with basal $T > 50$ pg/ml]. Women's regression slope in the Power Arousal condition significantly differed from the slope of the combined control and affiliation-arousal groups, $t(34) = -3.44$, $P < 0.005$.

Discussion

As predicted, we found that participants whose affiliation motive had been aroused (as verified by a transient increase in affiliation motive imagery on the PSE) showed postmovie

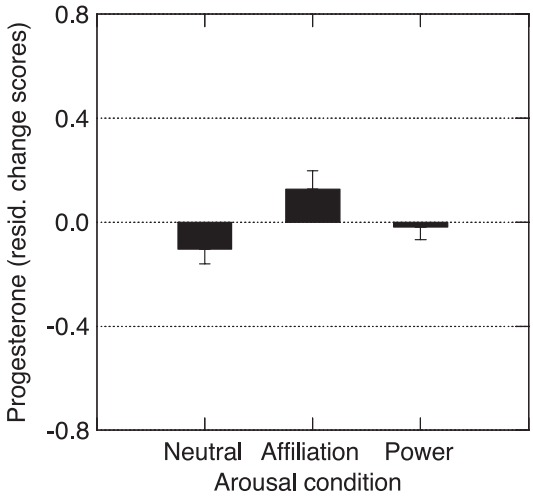

Fig. 2. Effect of arousal condition on postmovie salivary progesterone (averaged postmovie log-transformed P, residualized by regression for log-transformed P at T1). Neutral condition: $n = 20$; Affiliation condition: $n = 19$; Power condition: $n = 19$.

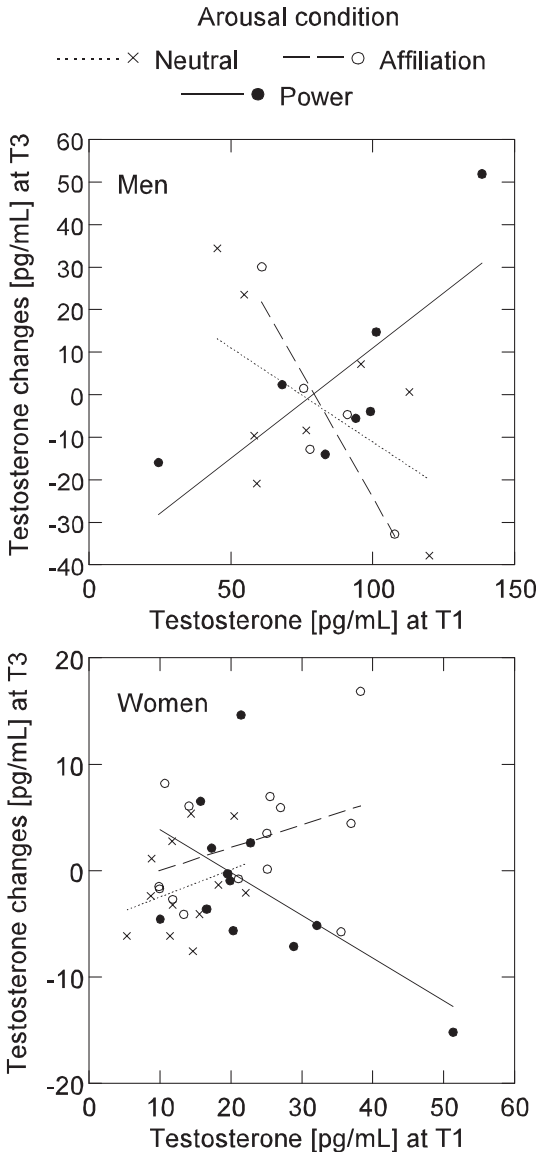

Fig. 3. Effect of arousal condition, participant gender, and baseline salivary testosterone levels (T1) on salivary testosterone changes 45 min after the movie (T3, residualized change scores). For men, *n*s are 8, 5, and 7 in the neutral, Affiliation, and Power condition, respectively. For women, *n*s are 12, 14, and 12 in the neutral, Affiliation, and Power condition, respectively.

salivary P levels that, after adjustment for premovie P levels, were higher than those of participants who had watched a motivationally neutral movie and that also tended to be higher than those of participants whose power motive had been aroused. This finding corroborates the observation of Schultheiss et al. (2003) that salivary P levels are associated with implicit affiliation motivation and suggests that aroused affiliation motivation has a causal effect on increased P release. Our findings differ from those of Schultheiss et al.'s (2003) in that we did not obtain any evidence that affiliation motive arousal affects P release in different ways for women and men. While it is difficult to interpret this apparent discrepancy of findings without further research, we would like to point out that a negative correlation between P and affiliation motivation (as reported for men by Schultheiss et al., 2003) does not necessarily rule out a positive causal effect of aroused affiliation motivation on P release.

In contrast to Schultheiss et al. (2003) who failed to find a correlation between affiliation motivation and P in women on oral contraceptives, we found that affiliation motive arousal increases salivary P in women, regardless of oral contraceptive use. This may suggest that the P increases observed in women who used such contraceptives either had a nonovarian source (e.g., the adrenals) or were driven by the stimulatory effects on the ovaries of a hormone outside of the hypothalamic–pituitary–gonadal (HPG) axis. For instance, it is conceivable that P increases induced by affiliation arousal may reflect a surge in oxytocin, a hormone that has a central role in attachment and affiliation (Insel, 1992; Uvnäs-Moberg, 1998) and that stimulates the release of P from the gonads independently of effects of luteinizing hormone in vitro (cf. Adashi et al., 1984; Miyamoto and Schams, 1991). Such an explanation would also be consistent with our observation that menstrual cycle stage, which in women not using oral contraceptives is closely associated with HPG axis effects on P release, did not moderate the stimulatory effect of affiliation arousal on P. Clearly, further research is needed to explore the precise mechanisms that mediate the effect of affiliation arousal on P release. Nevertheless, together with the results of Schultheiss et al. (2003), our present findings provide strong evidence for a causal effect of affiliation motivation on P release in both women and men and thus point to an important role of P beyond reproductive function in females and inhibition of androgen release in males.

We also found that power motivation arousal had an effect on T release 45 min after the movie, although the effect emerged only if premovie T levels were taken into consideration and it differed between women and men. In comparison to men and women with low baseline T relative to their gender, who did not display any pronounced T changes after watching a power-arousing movie, high-T men showed a tendency to increase in postmovie T levels, whereas high-T women showed a postmovie T decrease. These findings differed from participants' T changes in the neutral and Affiliation Arousal conditions: Overall, women and men in these conditions tended to maintain their premovie T levels, with the exception of high-T men in the Affiliation Arousal condition, whose postmovie T levels dropped. This latter finding, although based on a small number of cases, is consistent with reports of men showing decreased T levels when they are engaged in close, romantic relationships (e.g., Burnham et al., 2003). We did not find an effect of Arousal condition (or Arousal condition in combination with premovie T levels) on T assessed immediately after the movie, which is consistent with earlier research indicating that power arousal effects on T changes may not be observable immediately after the arousing event, but only with some delay (cf. Gladue et al., 1989; Schultheiss and Rohde, 2002).

Although our findings for the effects of power motive arousal on male T are based on a small subsample, they are compatible with a voluminous literature documenting an increased concern for dominance and social status in males who have high T levels either by natural endowment or through experimental hormone manipulations (Mazur and Booth, 1998; Monaghan and Glickman, 1992). This T-induced drive for dominance is situation-dependent; that is, it will only become manifest in endocrine or behavioral responses if cues are present in a situation that predicts, for instance, an opportunity to increase one's status and dominate others (cf. Sapolsky, 1987). Such cues were present in *The Godfather II*, which depicts a mafioso's rise to power, but not in the movies presented in the other two conditions. Thus, high-T men's concern for dominance and power was aroused after watching *The Godfather II* and manifested itself in increased postmovie T levels.

Although it could be argued that the dominance cues presented in the movie do not have any tangible real-life consequences for the viewers and therefore should not affect viewers' hormone levels, effects of vicarious dominance and aggression on T have also been reported by other researchers. For instance, soccer fans have increased T levels after they have watched their team win a match and decreased T levels after they have watched their team lose (Bernhardt et al., 1998), and fish respond with increased T levels to watching other fish fight (Oliveira et al., 2001). Finally, Steele (1973; cited in McClelland, 1987) has shown that individuals who are exposed to recordings of power-arousing speeches show not only an increase in implicit power motivation (as we observed in our Power Arousal condition), but also a concomitant increase in epinephrine and norepinephrine, whose stimulatory effect on T release from the Leydig cells may explain the increased T levels we found in men who had watched *The Godfather II* (cf. Gerra et al., 1996; Sapolsky, 1986).

The fact that we failed to obtain a similar stimulatory effect of dominance cues on high-T women's postmovie T levels may be taken to indicate that T does not play the same role for dominance or power motivation in women as it does in men, as suggested by Mazur and Booth's (1998) review of the literature on dominance and T in humans. However, recent research that has placed greater emphasis than earlier studies on experimental manipulations of T levels and on rigorous assessment of behavioral indicators of dominance in women provides mounting evidence for a critical role of T in female dominance motivation. For instance, van Honk et al. (2001) reported that women's cardiac response to threat faces, but not to neutral or friendly faces, was increased after T administration, and research by Josephs et al., (2003) shows that high-T women's math performance is more sensitive to status cues than low-T women's. Thus, high T levels in women may indeed reflect a strong concern with dominance, as they do in men, but it is possible that the Power Arousal condition of our study did not arouse this concern in women in the same way as it did in men. Note that the portions of *The Godfather II* we presented to participants showed an exclusively intermale struggle for dominance; women appeared in very few scenes and were never shown as competing for dominance. Therefore, the scenes from *The Godfather II* that we selected for the Power Arousal condition may not have been arousing (but possibly aversive) for high-T women, despite the fact that male and female participants alike showed a relative increase in power motivation after watching this movie. We speculate that movies showing women struggling for dominance (e.g., *Elizabeth*, *Working Girl*) may be more suitable for eliciting a T surge in high-T women, but this assumption awaits empirical verification.

To conclude, the present study presents evidence that affiliation motive arousal has a specific, stimulatory effect on salivary P levels which is independent of a person's gender and, in women, is not moderated by the use of oral contraceptives or menstrual cycle stage. Our data also show that power motive arousal has a specific effect on salivary T levels but that this effect depends on a person's baseline T levels (the higher, the stronger the response) and gender (high-T men respond with a T increase, high-T women tend to show a decline in T 45 min after motive arousal). Finally, our study also suggests that movies have the capacity to alter one's endocrine milieu temporarily and that this effect can be exploited for research purposes. Movies provide the investigator with the option to present complex social cues to participants that are difficult to stage with other methods of laboratory research, be it because the convincing enactment of such cues requires the skills of professional actors or because such cues could not be presented in any other way for ethical reasons, as in the case of the violence and aggression often inherent in dominance struggles.

Acknowledgments

The present research was supported by a Horace H. Rackham School of Graduate Studies Faculty Research Grant. We would like to thank Sara Naheedy for her help with data collection and Kathrin Riebel for processing the saliva samples.

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