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Hormonal response to competition among male coalitions

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Abstract

Previous research has shown that testosterone (T) and cortisol (C) are released in response to a wide variety of social stimuli including dyadic (one on one) competitive events, but humans also compete as groups. Here we report results from a pilot study of hormonal responses to competition between male coalitions. Salivary T and C levels were assessed in adult males from a rural Caribbean village who competed at dominoes, as two-man teams, against (a) familiar men from their own village (within coalition), and (b) strangers from another village (between coalitions). Analyses indicate that both T and C levels were higher and responses more pronounced for between-village competition than for within-village competition, but we could not compare responses to victory and defeat in the between-village case, since our subjects happened to win both such contests. Further studies of endocrine responses in the context of coalitional competition are warranted. © 2002 Elsevier Science Inc. All rights reserved.

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1. Introduction

Humans respond to physical (wrestling, judo, basketball) and mental (chess, computer games) challenges with complex endocrine responses. In men, testosterone (T) and cortisol (C) levels typically rise in anticipation of competition, and winners subsequently have higher

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T levels than losers (Dabbs & Dabbs, 2000; Elias, 1981; Mazur & Lamb, 1980). Most studies have focused on dyadic (one on one) interactions, but people often compete as groups, and there are a number of reasons for thinking that intergroup competition has played a crucial role in human social evolution (Alexander, 1989, 1990; Chagnon, 1992; Humphrey, 1976; Wrangham, 1999).

In some nonhuman primates, males sometimes cooperate in dominance interactions. In male baboons, T and C levels are highly sensitive to social stimuli, particularly situations dealing with dominance competition, and successful males have higher T levels than those who lose rank (Sapolsky, 1991, 1992), similar to findings in studies of human competition (Elias, 1981; Mazur & Lamb, 1980). However, there are important differences between human and baboon coalitions. For baboons, “forming a cooperative coalition with another male can be very helpful in a fight; however, when the fight actually occurs, the male often fails to aid his coalitional partner, or even defects to the opposing side” (Sapolsky, 1991, p. 282). Coalitional behavior among humans tends to be more permanent, reliable, and deadly (e.g., Chagnon, 1992).

The emergence of extensive coalitions in humans generates complex arenas of social competition both within and between groups, which may involve different competitive and cooperative mechanisms, including endocrine mechanisms (Geary & Flinn, 2002; Taylor et al., 2000). However, research on hormonal responses to competition in humans has not yet incorporated the social context of male coalitions. To begin to address these issues, we studied hormonal responses surrounding domino contests within Bwa Mawego, a rural Caribbean village, and then against a neighboring village. Domino is a popular game in the Caribbean, typically played between two teams of two men. Each player receives seven tiles and the team with the first man to play all of his tiles wins. In Bwa Mawego, domino is an integral part of life, accompanying most social gatherings. Domino sets are present in most homes, and villagers often play long into the night at tables in shops and bars. Matches can become hotly contested affairs, particularly if wagering is involved. By all accounts, domino matches elicit strong psychological responses in this study population and serve as meaningful proxies of coalition-based competition.

The research was designed to test the hypothesis that competition between coalitions (villages) stimulates greater hormone (T and C) response than competition within villages.

2. Methods

Bwa Mawego is a rural village on the east coast of Dominica (see Flinn, Quinlan, Decker, Turner, & England, 1996). It is an ideal setting for investigating male coalitions because villagers are life-long acquaintances, and are immersed in kin networks and reciprocity-based friendships like the social conditions that have presumably characterized human evolution. Participants were recruited from a pool of Bwa Mawego men whose social networks were known on the basis of key informant interviews and participant observation. We chose men based on the perceived closeness of their relationships and confidence that they had histories of friendly cooperation with one another. Eight men, including two half-brothers and two first

cousins, between the ages of 19 and 36 were selected. All were in good health and were experienced domino players.

Matches were held on two separate days, and began at about noon in order to control for expected circadian hormone patterns. Winners of all matches received small cash prizes. On the first day, all eight men competed in two simultaneous matches at a local shop/bar within the village. About 10 onlookers observed the matches, which both lasted a little over 20 min (ending within moments of one another), were competitive throughout, and ended decisively. A heated argument occurred between the two cousins, who self-assembled on opposing teams, over a scoring discrepancy towards the end of their match.

Two days later, four of the eight men (the two cousins as well as one man from each of the teams in the other match) accompanied J.D.W. to compete against residents of another village, a 90-min walk from Bwa Mawego. Unfortunately, duplicate sets of playing materials (table, chairs, dominoes) could not be produced in this village, which forced the matches to be held consecutively and introduced some methodological problems (see Results). Both matches were again competitive, and lasted about 25 min. Both Bwa Mawego teams were victorious, with the cousins winning the first match as a team. Towards the end of the second match, a heated argument occurred between a Bwa Mawego man and one of the men from the other village.

Salivary samples were collected from the Bwa Mawego men immediately before the start of a match, and at 15 and 45 min after its end (t_2 and t_3 , respectively). A further baseline sample was also collected 30 min before the within-village matches and 90 min before the start of the between-village matches. Finally, one additional sample was taken the morning before leaving for the distant village to check for hormone increase resulting from physical exertion (see, e.g., Kuoppasalmi, Naveri, Rehunen, Harkonen, & Adlercreutz, 1976).

Salivary samples were collected using standard procedures, preserved with sodium azide, and frozen within 4 h of collection. Assays were performed at University of Michigan Hospitals. For collection procedures, laboratory protocol, and quality of results, see Flinn (1999).

3. Results

Results of all individual hormone assays are presented in Table 1.

The C levels generally tended to increase from the first assay 30 or 90 min before the match ($X=0.40\pm0.18$ $\mu\text{g}/\text{dl}$) to the second assay immediately before the match ($X=0.60\pm0.39$). Combining the data for within-village and between-village matches, this increase was significant (t_{11} $df=1.87$, one-tailed, $P<.05$), but it was mainly due to an increase of 0.38 $\mu\text{g}/\text{dl}$ before between-village matches (t_3 $df=2.03$, one-tailed, $P=.07$); the increase before within-village matches was smaller (0.12 $\mu\text{g}/\text{dl}$; t_7 $df=0.89$, one-tailed, $P=.20$). The T levels exhibited a similar pattern, increasing more before between-village contests (from 13.1 to 22.4 ng/dl) than before within-village contests (from 16.6 to 17.0 ng/dl), but these changes were not significant.

The T levels did not exhibit significant changes during the actual matches, nor was there any clear effect of victory or defeat. In within-village matches, T levels decreased between the

Table 1

Individual salivary C (in $\mu\text{g}/\text{dl}$) and T (in ng/dl) levels of eight Bwa Mawego domino players before and after team matches

	30 or 90 min prior to match		Immediately prior to match		15 min postmatch		30 postmatch	
	C	T	C	T	C	T	C	T
<i>Within-village contests</i>								
Winners								
Player 1	0.23	16.1	0.41	18.9	0.78	16.6	0.54	15.1
Player 3	0.50	14.0	0.31	10.1	0.25	8.8	0.23	9.8
Player 5	0.60	17.0	0.42	16.9	0.41	13.4	0.36	15.6
Player 7	0.64	25.5	0.66	23.0	0.50	42.8	0.44	30.4
Losers								
Player 2	0.24	9.0	0.44	10.2	1.03	9.0	0.56	11.7
Player 4	0.28	21.1	0.32	18.9	0.18	10.3	0.39	31.1
Player 6	0.24	12.2	0.15	13.1	0.33	11.2	0.31	10.3
Player 8	0.59	17.8	1.55	25.0	0.64	23.4	0.34	15.3
<i>Between-village contests</i>								
Player 1	0.27	17.2	0.38	17.4	1.16	24.0	0.65	21.2
Player 2	0.67	9.2	0.72	12.2	1.72	19.9	1.09	12.7
Player 3	0.29	13.5	0.80	19.1	0.63	14.5	0.38	12.3
Player 4	0.22	12.3	1.06	40.7	1.48	21.0	1.25	19.0

The first sample (data in Column 1) was collected 30 min before the match in within-village contests, and 90 min before in between-village contests. (Between-village contest data are not divided into “winners” and “losers” because the study participants won both matches.)

immediate prematch and immediate postmatch assays in all four losers, but also in three of the four winners; only Player 7 exhibited an increase. Of those whose T levels fell during the match, two of four losers but none of the three winners exhibited a rebound in the final assay to a level higher than in the immediate prematch assay. There was, however, a difference in response to within-village versus between-village competition: all four men who participated in both exhibited higher T levels immediately after the between-village contest ($X = 19.9 \text{ ng}/\text{dl}$) than they had immediately after the within-village contest ($X = 11.2 \text{ ng}/\text{dl}$; $t_3 \text{ df} = 6.80$, one-tailed, $P < .01$).

This type of study design usually calls for repeated-measures ANOVA. However, because the between-coalition matches were held in succession due to a lack of materials, Players 3 and 4 witnessed the victory of their fellow villagers, Players 1 and 2, before playing themselves, creating the possibility of vicarious effects and other confounds (Bernhardt, Dabbs, Fielden, & Lutter, 1998; Kanaley, Weltman, Pieper, Weltman, & Hartman, 2001; Kemper, 1990). This may be relevant to Players 3 and 4's relatively large C and T increases prior to their own between-village contest (see Table 1). Player 4 was also the man who engaged in an argument, and it is noteworthy that Players 1 and 2, the cousins who argued during the within-village match, also showed relatively large hormone level changes during that contest.

4. Discussion

Competition between- and within-coalitions appears to stimulate different endocrine responses in this sample. The lower levels of C and T during within-village matches, compared to between-coalition matches, suggest that activation of endocrine mechanisms might be contingent upon the context of competition. T levels do not appear to rise in response to moderate competition within coalitions, which is noteworthy because it contravenes the standard model of T and competition—prior studies have not considered coalitional effects.

If we accept that T levels are correlated with dominance behaviors, coalition formation may necessitate inhibiting overt dominance strivings that could otherwise weaken a coalition. In small-scale societies, efforts to dominate other group members are often penalized by various leveling mechanisms, of which murder is the most extreme (Boehm, 1999). Thus, expressing dominant behaviors or becoming overly aroused (indexed by T and C levels, respectively) during within-group competition may be a liability for males who would then be subjected to leveling measures by other coalition members. Conversely, when competition occurs between distinct groups or coalitions, the opposite response seems advantageous.

The present study is of course only suggestive. Effects of winning and losing in the within-versus between-coalition contexts could not be compared, and various confounds are possible. A larger sample size and more refined coalition measures are needed. Competing on familiar ground or traveling to an unfamiliar venue could be investigated and/or controlled in future studies, and effects of having limited information about a competitor might be separable from the effects of competing against outgroups per se. But despite these limitations, the results of this pilot study suggest that the topic warrants further investigation.

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