Does testosterone affect emotional perception after social approach-avoidance?

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Introduction

Testosterone may promote approach-related behaviors by modulating sensitivity to social threat (for a review see 1). In humans, testosterone increases amygdala activation to angry facial expressions (2-4), specifically when threat approach is required (5). As both increased and decreased threat detection after testosterone administration have been reported (6-9), we aim to contribute to the discussion by sharing additional results, i.e., perception ratings, from our previously published findings (5). Here, a single dose of 0.5 mg of testosterone increased amygdala activation during threat approach, and decreased it during threat avoidance. After the MRI session, about 5 hours post-administration, participants rated their emotional perception of the faces to which they had made approach and avoidance actions in the social approach-avoidance task.

Materials and Methods

Out of the 54 female participants performing the social approach-avoidance task (5), 53 subsequently rated the stimuli (n = 26 testosterone; n = 27 placebo). In the course of the original study, written informed consent was obtained from all participants, with the protocol being approved by the CMO Nijmegen-Arnhem in accordance with the Declaration of Helsinki.

The rating was conducted after the MRI session, outside the MR scanner on a PC, about 5 minutes after the last saliva sample was obtained, i.e., 5 hours post-administration, when testosterone levels were still elevated (compare Table 1 in (5)).

Participants rated the affective expression of all stimuli used in the social approach-avoidance task (36 angry, 36 happy faces). In randomized order, stimuli were presented in the center of the screen until a response was given. Participants were instructed to base their rating on a bipolar scale with 1 = “very angry” and 7 = “very happy” as verbal endpoints (and 4 = “neutral”). Presentation of stimuli and acquisition of responses were controlled by Presentation software version 13.

Mean ratings were calculated for each emotion (angry, happy). Normal distribution was verified via Kolmogorov-Smirnov tests before the rating data were subjected to a repeated measures ANOVA, with the within-subject factor Emotion (angry, happy) and the between-subjects factor Substance (testosterone, placebo). As in the RT analyses of the social approach-avoidance task (5), the standardized testosterone and cortisol levels from the first saliva measurement were included in the ANOVA as covariates. Within-subject effects with Greenhouse Geisser correction are reported.

In addition, we tested whether the rating of angry faces was related to amygdala activation. As amygdala activation significantly differed between approach and avoidance after testosterone administration (5), this difference score (approach angry – avoid angry) was correlated (Pearson’s correlation coefficient) with the mean rating for angry faces per Substance group. For all analyses, the α -level was set at $P < 0.05$. Statistical testing was performed with the Statistical Package for the Social Sciences (IBM SPSS 25).

Results

There was a main effect of Emotion ($F_{1,49} = 2266.64$, $P < 0.001$, partial $\eta^2 = 0.98$), due to higher ratings for happy ($M = 5.89$; $SD = 0.35$) than for angry faces ($M = 2.23$, $SD = 0.35$).

The Emotion x Substance interaction showed a trend toward significance ($F_{1,49} = 3.0$, $P = 0.089$, partial $\eta^2 = 0.06$), but all other effects, i.e., of Substance or involving the covariates were not (nearly) significant (all F s < 0.8 , P s > 0.38).

Decomposing the Emotion x Substance interaction revealed a marginally significant Substance effect for angry faces ($F_{1,49} = 3.46$, $P = 0.069$, partial $\eta^2 = 0.07$), but not for happy faces ($F_{1,49} = 0.90$, $P = 0.35$, partial $\eta^2 = 0.02$). As the means in Table 1 indicate, participants in the testosterone group tended to rate the angry faces as more angry than participants in the placebo group.

Ratings for angry faces were not correlated with amygdala activation ($r = -0.13$, $P = 0.53$ for placebo; $r = -0.17$, $P = 0.40$ for testosterone, respectively).

Table1. Means (SD) of the stimulus rating (scale from 1 to 7). *P*-values indicate differences between substance groups.

	Placebo (n = 26)	Testosterone (n = 27)	<i>P</i> -value
Angry faces	2.31 (0.30)	2.14 (0.39)	0.069
Happy faces	5.84 (0.39)	5.93 (0.29)	0.35

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