Effects of testosterone administration on individuals‘ processing of social threat information

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Introduction

- Testosterone is one of the major sex steroids and plays a large role in human sexual behavior and reproduction.
- An angry facial expression is a threatening signal that may cause the recipient to fight or escape, according to the dominant relationship between the sender and the recipient (dominant/submissive).
- More and more studies have found that testosterone can affect individuals' processing related to threatening emotions. However, there are many inconsistencies in the results of these studies, and little is known about its cognitive neural mechanisms.
- The present research aims to combine testosterone administration and measurements, behavioral experiment and neuroimaing techniques to investigate the cognitive and neural mechanisms by which testosterone influences the processing of threat stimuli.
- The study combines the drift diffusion model to investigate the influence of testosterone on the threat stimulus on the rate of information accumulation (drift rate), the deviation of the starting point or the height of the boundary. At the same time, combined with signal detection theory to test whether testosterone affects the subject’s sensitivity to angry faces is an evaluation criterion.

Method

- A total of 120 healthy male participants (testosterone: n = 60; placebo: n = 60) were recruited in this study, using 2 (experimental groups: testosterone group, placebo group) × 2 (mixed types: anger-neutral, fear-neutral) × 7 (morph level: 20%, 30%, 40%, 50%, 60%, 70%, 80%) mixed experimental design.
- At 3h post-administration, participants performed the modified fuzzy face recognition task (Brennan & Baskin-Sommers; shown in Figure 1). They need to judge the emotion that appears in the center of the screen, and choose one of the two options that they think is more consistent.

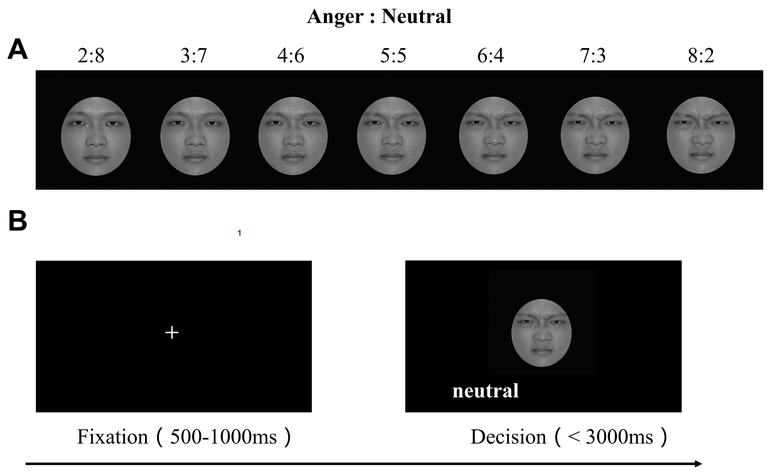

Figure 1(A): Schematic diagram of stimulus morph level*. We used emotional pictures that morph anger, fear, and neutral faces to generate two types of mixed emotions, namely: anger-neutral and fear-neutral. Each of these blending types will contain 7 morph levels, with an increment of 10%.*

Figure 1(B): Experimental procedure

Result

- We used mixed-effects logistic regression to fit the regression of the ratio of selecting a certain emotion to the ratio of mixed emotion faces (morph level), the experimental group and its interaction conditions.
- We further used signal detection analysis on angry-neutral mixed emotion faces to test the discrimination *d’* and the judgment standard *β*.
- For reaction time data, combined with decision data (anger vs. neutral), this study used different time DDM (Maier et al., 2020) to fit the rate of evidence accumulation of angry and neutral emotional faces with different morph levels in the decision-making process.

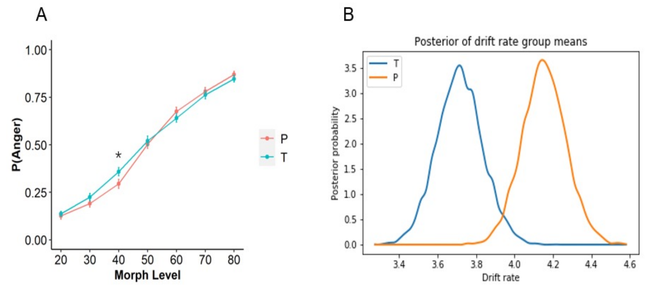

Figure 2(A): *According to the logistic regression model, in the anger-neutral mixed type, the overall recognition rate of angry expressions in the testosterone group was significantly higher than that in the placebo group ($p < 0.05$), and there was a significant interaction between the group and the level of deformation ($p < 0.05$), but this result was not found in the fear-neutral mixed emotions.*

Figure 2(B): *Testosterone reduced the drift rate of angry face processing, which means that testosterone reduces the subjects’ effective processing of threatening emotional faces.*

Summary

- By identifying emotional faces with different mixed levels, exogenous testosterone reduces the rate of information accumulation when processing anger, which shows that testosterone reduces the subjects’ effective processing of threatening emotions.

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