Influences of Testosterone, Aggression and Anger on Ultimatum Game Behavior

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Introduction

The Ultimatum Game

The Ultimatum Game is an economic game where one person is given a sum to divide between themselves and a second person. The second player then chooses whether to accept or reject the division. If the second player accepts, they get the portion offered, but if they reject, neither player gets anything. If players act solely to maximize their dollar amount offered is a sizable sum.2

What motivates this rejection? Some argue that low offers violate the second player’s sense of “fairness.” Rejection behavior does vary in cultures with different norms of fairness, but not always in a way that the fairness hypothesis predicts.3 Others suggest that rejection behavior has a strong emotional component, and can be better predicted by personality variables such as anger, aggression, dominance and impulsiveness.4 A study by Prifitera and Margarine found a strong correlation between feelings of anger and the decision to reject low offers (r = 0.51, p = 0.002), but a weak, non-significant effect of feelings of unfairness (r = 0.10).5

Testosterone and Aggression

Anger and aggression can be observed indirectly through physiological measures, in addition to questionnaires and experimental manipulations. The androgen hormone testosterone has been linked to aggression, especially provided aggression, by a number of studies.6 If one considers an “unfair” low Ultimatum offer to be a form of aggression, one can view rejection of low offers as a form of provoked aggression. There have been few studies measuring testosterone as it relates to Ultimatum Game behavior, although one such study did find that digit ratio, an indicator of prenatal testosterone levels, was correlated with rejection.7

Methods

Testosterone: Saliva Samples

Subjects were run between 6 p.m. and 10 p.m. at night in order to minimize diurnal variation in circulating testosterone concentrations. Testosterone concentrations were measured by assaying the saliva samples in anti-testosterone antibody-coated wells. The assay was done twice, several hours apart, in order to assess the validity of the measures. Testosterone levels in the two assays were highly correlated (r = 0.776, p = 0.001) but significant differences remained (two-sided test: t = 1.95, p = 0.05), possibly due to degradation of the samples after thawing.

Testosterone: Digit Ratio

Subjects’ hands were scanned onto a computer, and three different raters took measurements of the length of fingers, which are indicators of prenatal testosterone levels. Two different saliva testosterone variables were calculated: baseline testosterone level, taken from the first sample collected, and change in testosterone, calculated by subtracting the testosterone concentration in the first sample from the concentration in the second.

Testosterone and Aggression

Subjects generally followed one of two strategies. One group (n = 9) accepted virtually all offers, with rejection percentages never reaching higher than 5%. The majority of subjects (n = 22) tended to reject all offers of 1 dollar, and accept all offers of 5 dollars, with rates of acceptance for offers of 25 and 35 varying. Only three subjects failed to utilize one of these strategies.

Results

Rejections and reaction times were analyzed for the four different types of offers.

<table>
<thead>
<tr>
<th>Offers</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>Five</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction Rate</td>
<td>66%</td>
<td>42%</td>
<td>2%</td>
<td></td>
</tr>
</tbody>
</table>

Subjects who rated high on the BPA subscale of the BPA assessed themselves as more aggressive, more anxious, and more hostile. Higher scores indicate greater aggression.

Testosterone

We calculated the change in testosterone as concentration of the first sample subtracted from the second sample, giving us an average increase of (0.049 pg/dL), a change which was not significant (two-tailed t-test: t = 2.03, p = 0.154).

Aggression and Behavior

- BPA has four subscales: physical aggression, verbal aggression, anger and hostility. High scores indicate greater aggression.
- Mean BPA Score: 69.4 (n = 37, SD = 19.9)
- Subscale scores correlated significantly with total score and with each other (p < 0.001).
- No correlations between BPA and rejection for all subjects together, but with subjects who accepted all offers excluded, high scores on the anger subscale of the BPA were positively associated with rejection of offers of two (r = 0.437, p = 0.043) and three (r = 0.489, p = 0.021, see Figure 2).

Discussion

The decision to pursue a no rejection strategy does not appear related to either testosterone levels or self-reported aggressive traits. However, if a subject chooses to reject increasingly low offers, their rates of rejection may be linked to how prone they are to anger. Because these questionnaires were administered after the subjects made their rejections, it is possible that the low offers increased subjects’ self-perceived anger at that moment, rather than being due to trait angry tendencies. Either way, this result suggests that anger and not just a general sense of fairness helps motivate rejections in the Ultimatum Game, although it may not influence the decision to reject.

Testosterone levels were correlated with scores on the BPA, suggesting that both the saliva sampling and digit ratio were at least somewhat valid measures. However, there was no relationship found between testosterone levels and rejection behavior. This could be due to the experimental design, which may have minimized a sense of being challenged either through task performance, or rejection of trials. It may also mean that testosterone does not play a role in rejection behavior. There was a correlation between digit ratio and average offer which, since it was made after the rejection trials, becomes less a pure first offer player and more of a response to offers, making the results difficult to interpret. However, taken at face value, this result suggests that organizational testosterone levels, not dynamic levels, have more influence on this type of behavior.

This study suggests a number of avenues for exploration. Replicating the study while simplifying the design might allow us to tell if our negative or confusing results are due to design choices or to real, underlying phenomenon (or lack thereof). It can be shown that trait anger, testosterone, and Ultimatum Game behavior truly are linked, it would be interesting to explore how anger, dominance, and testosterone influence and are influenced by other decisions to punish in every day life.

References


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