Short communication

Unfairness sensitivity and social decision-making in individuals with alcohol dependence: A preliminary study

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A R T I C L E   I N F O

Article history:
Received 26 May 2013
Received in revised form 13 August 2013
Accepted 14 August 2013
Available online 26 August 2013

Keywords:
Alcohol
Ultimatum
Unfairness
Decision-making
Altruism

A B S T R A C T

Background: Altruistic punishment is an evolutionary-based mechanism aimed at maximizing the probability of reciprocity in cooperative exchanges, through the deterrence of non-cooperators. In economic games, humans will often punish others for non-cooperation, even if this punishment is costly to the self. For instance, in the Ultimatum Game paradigm, people refuse offers considered as unfair even though they are disadvantaged financially by doing so. Here, we hypothesize that, due to an impulsive decision making style, individuals with alcoholism will display an heightened unfairness sensitivity that leads them to reject advantageous offers more frequently on the Ultimatum Game.

Methods: Thirty recently detoxified alcohol-dependent individuals and 30 matched healthy control participants performed the Ultimatum Game task, in which participants had to respond to take-it-or-leave-it offers ranging from fair to unfair and made by a fictive proposer.

Results: Alcohol-dependent participants decided to reject unfair offers more frequently during the Ultimatum Game, as compared to controls.

Conclusions: In situations of social frustration or irritation, such as unfair Ultimatum Game offers, alcohol-dependent individuals may have more difficulty than controls regulating their emotional impulses, and respond aggressively or retributively (i.e., by rejecting the unfair offer).

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1. Introduction

Addicted people are often impaired in their ability to make self-advantageous decisions in situations that require the exercise of the reflective self-regulation system in order to overcome the impulsive emotional automatic response (for a review, see Noël et al., 2013). However, the influence of interactions in social contexts on decision making in substance abusers is not very well known (Rilling et al., 2008).

Emotions induced by interpersonal interactions may bias decisions differently than those in nonsocial contexts do (Rilling et al., 2008). Indeed, in social contexts, decisions are based upon strategic choices that must be tailored and updated to the particular mental state of another human being. For example, in a nonsocial context, if a person is offered the choice of gaining a reward versus gaining nothing, the usual decision is to choose the reward. However, in the context of particular social interactions, evolutionary psychology has shown that non-cooperators will be punished in order to enhance reciprocity in cooperation transactions, even at personal costs to the punisher (Fehr and Fischbacher, 2003; Trivers, 1971) and that punishing non-cooperators activates reward systems in the brain (de Quervain et al., 2004). The effects of social interaction on decision-making have been investigated via behaviors in economic games. In the Ultimatum Game, two players (a proposer and a responder) have to divide a sum of money in a single trial. If the responder accepts the offer made by the proposer, the deal is validated. On the other hand, if the responder rejects the offer, neither player gets anything. The only way to maximize profits is for the responder to always accept offers. However, whereas apes may behave rationally as if there were no sense of fairness (Jensen et al., 2007; but see Proctor et al., 2013 for whom humans and chimpanzees show similar preference regarding reward division), children and adult humans refuse offers financially advantageous but considered as unfair (e.g., Guth et al., 1982).

Thus, in the Ultimatum Game, participants have to respond to unfair take-it-or-leave-it offers that can trigger frustration. In this context, Ultimatum Game related decisions may involve a competition between impulsive emotional processing (e.g., anger and frustration) and higher-level controlled or deliberative processing that bias decision-making in opposite ways (Rilling et al., 2008).
More specifically, receiving an unfair offer during the Ultimatum Game is associated with negative emotions (evidenced through brain activation within the anterior insular cortex and through higher skin conductance activity for unfair offers; Sanfey et al., 2003; van’t Wout et al., 2006) and these negative emotions predict the rejections of unfair offers. Unfair offers during the Ultimatum Game are also associated with activation in brain areas involved in affective (ventrolateral prefronal cortex; Shamay-Tsoory et al., 2012) and cognitive (dorsolateral prefronal cortex; Sanfey et al., 2003) regulation of emotions. Hence, during the Ultimatum Game, subjects are more likely to accept unfair offers when the balance between emotion and reflection processes in decision-making is biased toward the latter (Rilling et al., 2008). In other words, high rates of rejection of unfair monetary offers during the Ultimatum Game may reflect poor regulation of triggered emotional frustration (Moil and de Oliveira-Souza, 2007).

Alcohol-dependent individuals are often impaired when automatic emotional, cognitive and motor responses are to be suppressed (for reviews, see Noël et al., 2010, 2013). Thus, we hypothesized that, as compared with a group of healthy control participants, alcohol-dependent participants would exhibit an abnormally high rate of rejection of unfair monetary offers during the Ultimatum Game.

2. Methods

2.1. Participants and recruitment

All subjects were adults. Demographics for the two groups are presented in Table 1. Forty alcoholic dependent participants were recruited for this study from the Alcohol Detoxification Unit of the Brugmann University Hospital (Brussels). They were tested in their third week of alcohol detoxification. They all received complete medical, neurological and psychiatric examinations at the time of the selection. Alcohol-dependent participants were all diagnosed with alcohol dependence according to DSM-IV-TR (APA, 1994) criteria and confirmed by the Alcohol Use Disorders Identification Test (Saunders et al., 1993). We excluded any subjects who reported a lack of comprehension of French language, or who had evidence of schizophrenia and other psychotic disorders, bipolar disorders, polysubstance-related disorders, pathological gambling and overt cognitive dysfunction.

Forty control participants, similar for sex, age, and educational level, were recruited by word of mouth from healthy community members; they were not paid for their participation. Exclusion criteria were a present Axis I psychiatric diagnosis; substance-use disorder during the year before enrollment in the study; or consumption of more than 4 standard alcoholic drinks per day for longer than one month.

2.2. Current clinical status

Current clinical status of depression and anxiety levels were rated with the Beck Depression Inventory (Beck et al., 1961) and the Spielberger State-Trait Anxiety Inventory (Spielberger, 1983). The Positive and Negative Affect Schedule (Watson et al., 1988) was also administered in order to control for the influence of positive or negative mood state on acceptance rates during the Ultimatum Game task (e.g., Harlé and Sanfey, 2007).

2.3. The Ultimatum Game

The version of the Ultimatum Game used here was adapted from the protocol described by Crockett et al. (2008). Participants played as responders in a series of 54 single round trials of the Ultimatum Game via computer interface. Before the game started, participants were given detailed verbal explanations, and confirmed verbally that they understood the game. No real monetary amount was awarded to the participants. The participants saw a photograph of the proposer for 1500 ms. Then, they saw the amount of the stake for 1500 ms. Next, they saw the amount proposed by the partner for 3000 ms. During this time, while the offer was on the screen, they indicated whether they accepted or reject the offer by pressing one of two buttons (labeled ‘accept’ or ‘reject’) on a button box. Intertial interval was 500 ms. Photographs of 54 faces (27 male, 27 female, Caucasian, with a neutral expression) were randomly matched with the offers. There were 18 fair offers (proposition of 40, 45 or 50% of the stake to the responder), 18 medium-fair offers (proposition of 27, 30 or 33% of the stake to the responder) and 18 unfair offers (proposition of 17, 20 or 22% of the stake to the responder). During each session, the order of the offers was randomized. Dependent measures were the proportion of offers accepted at each level of fairness.

2.4. Procedures

All participants provided informed consent. The study was fully approved by the Ethics Committee of the Brugmann University Hospital. For the alcohol-dependent group, medical histories were obtained by interview by a board-certified psychiatrist. All participants were asked to complete current clinical status and affective states measures before the Ultimatum Game.

3. Results

3.1. Current clinical status

Independent samples t-tests revealed that alcohol-dependent participants had higher scores of depression, state and trait anxiety and negative affectivity prior to testing. These results are shown in Table 1. However, we found no correlation (Spearman rank, N = 80) between performance on the Ultimatum Game and the measure of current clinical status. There was also no relationship between performance on the Ultimatum Game in the alcohol-dependent group and duration of consumption or mean consumption per day.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>AD</th>
<th>Controls</th>
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<tbody>
<tr>
<td>n (years)</td>
<td>40</td>
<td>40</td>
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<tr>
<td>Age (years)</td>
<td>46.47 (11.72)</td>
<td>43.70 (11.01)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>27/1</td>
<td>27/17</td>
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<tr>
<td>Education</td>
<td>15/12/13</td>
<td>14/13/13</td>
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<tr>
<td>Duration</td>
<td>18.80 (11.47)</td>
<td>–</td>
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<tr>
<td>of alcohol</td>
<td>17.15 (8.93)</td>
<td>0.70 (1.34) ***</td>
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<tr>
<td>abuse (years)</td>
<td>3.05 (3.95)</td>
<td>–</td>
</tr>
<tr>
<td>Mean alcohol</td>
<td>18.56 (16.47)</td>
<td>6.75 (8.88) ***</td>
</tr>
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<td>use (standard</td>
<td>30.30 (6.44)</td>
<td>3.52 (4.21) ***</td>
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<td>drinks/day)</td>
<td>12.82 (7.97)</td>
<td>3.35 (3.93) ***</td>
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<tr>
<td>Number of</td>
<td>42.92 (13.37)</td>
<td>32.20 (10.97) ***</td>
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<td>prior hospitalizations</td>
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<td>for alcohol</td>
<td>48.18 (11.68)</td>
<td>35.20 (10.81) ***</td>
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<td>detoxification</td>
<td>32.47 (8.71)</td>
<td>32.32 (6.49)</td>
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<td>AUDIT</td>
<td>22.47 (10.37)</td>
<td>13.13 (3.89) ***</td>
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<td>Positive</td>
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<td>Affect subscale</td>
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<td>Affect Schedule</td>
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<td>(PANAS+)</td>
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| (labeled ‘accept’ or ‘reject’) on a button box. Intertial interval was 500 ms. Photographs of 54 faces (27 male, 27 female, Caucasian, with a neutral expression) were randomly matched with the offers. There were 18 fair offers (proposition of 40, 45 or 50% of the stake to the responder), 18 medium-fair offers (proposition of 27, 30 or 33% of the stake to the responder) and 18 unfair offers (proposition of 17, 20 or 22% of the stake to the responder). During each session, the order of the offers was randomized. Dependent measures were the proportion of offers accepted at each level of fairness.

Note: Values shown are the mean and standard deviation on each measure. Level of education was coded as follows: level 1 = completion of the first 3 years of secondary school or equivalent; level 2 = completion of secondary school or equivalent; and level 3 = post-secondary school training. AUDIT = Alcohol Use Disorders Identification Test, BDI = Beck Depression Inventory, STAI S = State subscale of the State-Trait Anxiety Inventory, STAI T = Trait subscale of the State-Trait Anxiety Inventory, PANAS+ = Positive Affect subscale of the Positive and Negative Affect Schedule, PANAS− = Negative Affect subscale of the Positive and Negative Affect Schedule.

*** p < 0.001.

**t-Test p < 0.0001.**
3.2. Ultimatum Game performances

The mean proportion of acceptance at each level of type of offers (fair, medium-fair, and unfair) was not normally distributed. Therefore, non-parametric statistical test were performed to analyze the Ultimatum Game performances. A Friedman test was performed separately in each group in order to examine the effect of the type of offers (fair vs. medium-fair vs. unfair) on the proportion of acceptance. These analyses showed that there were significant differences, in each group, between the fair, and the medium-fair offers ($p < 0.0001$), between the fair and the unfair offers ($p < 0.0001$) and between the medium-fair and the unfair offers ($p < 0.0001$) (see Fig. 1).

Mann–Whitney $U$ tests were then performed to examine between-groups differences on the proportion of acceptance according to the type of offers. There was a significant difference between alcohol-dependent (average rank = 35.21) and controls (average rank = 45.73) for the unfair offer (Mann–Whitney $U$ statistic = 591.00; $Z = -2.047$, $p = .041$), indicating that alcohol-dependent (median = 0.12) decided to reject unfair offers more frequently than controls (median = 0.29). There was no significant difference between alcohol-dependent and controls for the medium-fair (Mann–Whitney $U$ statistic = 615.00; $Z = -1.784$, $p = .074$) and the fair offers (Mann–Whitney $U$ statistic = 670.50; $Z = -1.25$, $p = .211$). In addition, in order to estimate the interaction between group and type of offers, Mann–Whitney $U$ tests were performed with scores computing the difference of acceptance rate between each type of offers (i.e., unfair minus fair; unfair minus medium-fair; medium-fair minus fair). These analyses did not reach any significant results, all $p > 0.05$.

4. Discussion

In the present study, we have observed that alcohol-dependent individuals exhibited higher rejection rates of unfair offers during the Ultimatum Game. These results suggest that the social interactive context influences alcohol-dependent individuals’ decisions more than healthy controls individuals: in situations of frustration or irritation (i.e., unfair offers), alcohol-dependent display more difficulties regulating their impulses than healthy control individuals, and they respond aggressively or retributionally (i.e., reject the offer).

Notably, social decision-making has also been investigated in alcohol dependence via ‘moral dilemmas,’ in which there is a conflict between what is good for the majority (utilitarian judgment) and emotional factors (Greene et al., 2001). For instance, individuals have to accept or reject the sacrifice one person’s life to save the lives of others. A utilitarian choice maximizes aggregate welfare (total number of life saved), whereas emotional aversion, generated by dislike of the idea of inflicting direct harm on another person, leads to the rejection of actions that produce such harms. Interestingly, alcohol-dependent are more prone to choose the rational option (i.e., utilitarian moral judgment) when faced with emotionally salient moral personal dilemmas (Khemiri et al., 2012; but see Kornreich et al., 2013a). This finding is in apparent contrast with our results, in which we observed diminished rational choice in alcohol-dependent participants. This same pattern has, however, been previously reported in ventromedial prefrontal cortex damaged patients. Those patients show abnormally high rates of utilitarian judgments in moral dilemmas (Koenigs et al., 2007) and low rates of rational choices during the Ultimatum Game (Koenigs and Tranel, 2007).

These seemingly contradictory findings highlight two distinct aspects of emotion regulation impairment (Moll and de Oliveira-Sousa, 2007). Specifically, in the moral judgment task, participants respond to hypothetical actions and outcomes that elicit social emotions triggered by a concern for others. By contrast, in the Ultimatum Game, participants respond to unfair take-it-or-leave-it offers that trigger frustration in themselves. In other words, the Ultimatum Game involves self-interest, whereas the moral judgment task focuses on the interest of others (Moll and de Oliveira-Sousa, 2007). One direction for future study would be to examine self- and externally centered social decision-making in alcohol dependence within the same study design. Future studies should also examine whether contextual factors may modulate the emotional rejection response during the Ultimatum Game. For instance, as alcohol-dependent are impaired in emotional facial expression recognition (e.g., Kornreich et al., 2013b), the emotional facial expression of the proposer might have interesting effects on the rejection rate of unfair offers in alcohol-dependent during the Ultimatum Game.

The present research was not designed to obtain a direct measure of emotional processes underlying participants’ responses during the Ultimatum Game. Hence, our conclusions about the specific role of emotion in Ultimatum Game responding are tentative (e.g., Rilling et al., 2008). Collection of direct, systematic measurements of emotional responses would be an important next step in this line of work. Additional studies are also needed to examine the clinical impact of lower impulse regulation when facing unfairness in alcohol dependence. For instance, feelings of unfairness triggered by social interactions may contribute to alcohol consumption and relapses in alcoholics, as a means to regulate their negative emotions.

This study represents a first step toward the examination of social decision-making in alcohol dependence. Alcohol-dependent participants exhibited a lower rate of rational choice during an Ultimatum Game. This result suggests that alcohol dependence may be associated with less ability to regulate the emotional responses needed to make advantageous decisions for the self. Therefore, hypersensitivity to unfairness in alcohol dependence might be a future treatment target for cognitive therapy techniques.

Role of funding source

Funding for this study was provided by the Laboratory of Medical Psychology and Addictology, CHU-Brugmann, Université Libre de Bruxelles, Belgium.

Contributors

Damien Brevers, Xavier Noél, David Dabiri and Charles Kornreich designed the study and wrote the protocol. David Dabiri
included subjects and collected data. Damien Brevers and Charles Kornreich undertook the statistical analyses. Damien Brevers and Charles Kornreich managed the literature searches and summaries of previous related work. Damien Brevers, Xavier Noël and Charles Kornreich wrote the manuscript. Elsa Ermer and Paul V. Van Breven reviewed several times the manuscript and suggested modifications. All authors have approved the final manuscript.

Conflict of interest
No conflict declared.

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