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Emotions at the border: Increased punishment behaviour during fair interpersonal exchanges in Borderline Personality Disorder

Chiara De Panfilis^{1,3}, Graziana Schito¹, Irene Generali¹, Luigi Gozzi², Paolo Ossola¹, Carlo Marchesi¹, Alessandro Grecucci²

¹ Unit of Neuroscience, Department of Medicine and Surgery, University of Parma, Italy

² Clinical and Affective Neuroscience Lab, Department of Psychology and Cognitive Sciences, University of Trento, Italy

³ Personality Disorders Lab, Parma, Italy

Running head: Fairness and Borderline Personality Disorder

The study was approved by the City of Parma Ethical Authority (Study name: Affective regulation in Borderline Personality Disorder; Protocol# 2754, January 24th, 2014).

Author's Note: part of the results of this study have been presented at the XV Congress of the International Society for the Study of Personality Disorders (Heidelberg, September 26th, 2017) and at the III Brescia Workshop on Borderline Personality Disorder (Brescia, May 12th, 2017). They were also presented as a Poster at the European Workshop on Cognitive Neuropsychology (Brixen, January 2017), and that Poster was then posted on Research Gate.

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ABSTRACT

This study evaluated whether the impairment in cooperation that characterizes individuals with Borderline Personality Disorder (BPD) can be explained by the difficulty to use emotion regulation strategies and to accurately perceive the fairness of others' behaviour. Forty-one patients with BPD and forty-one sex and age matched healthy controls (HC) played the responder's role in a Modified Ultimatum Game during which they were asked to apply three different emotion regulation strategies: Look, Distancing and Reappraisal. Offer rejection rates were used as an index of punishment behaviour. After the experiment, participants also rated the degree of perceived equity of the offers after receiving fair and unfair offers. Reappraisal was effective in decreasing punishment behaviours for unfair offers in both the BPD and HC groups. By contrast, BPD patients displayed a different behaviour than HC when making decisions upon fair offers, independently from the regulation strategies adopted. In fact, they rejected higher rates of fair offers than HC. Further, BPD patients judged fair offers as less fair than HC. This indicates an altered judgment and decision making on fair interpersonal exchanges. In conclusion, BPD patients exhibit increased punishment behaviour during fair, "favourable" social exchanges, which they tend to perceive as less fair than controls. Thus, BPD patients may be biased toward under-estimating positive feedback from others.

General Scientific Summary

Individuals suffering with borderline personality disorder find it difficult to cooperate with others. This study indicates that such difficulty may be explained by their tendency to perceive and react to others' fair behaviour as if it was unfair. The results suggest a bias toward under-estimating positive interpersonal cues in borderline personality disorder.

Key words: Borderline Personality Disorder; interpersonal dysfunction; cooperation; fairness; emotion regulation; social expectations.

Borderline Personality Disorder (BPD) is characterized by persistent and severe impairment in social functioning (Gunderson et al., 2011). This pattern challenges research on BPD to clarify the mechanisms underlying such dysfunction, in order to detect potential foci of intervention and improve patients' functional outcomes. In this regard, interactive behavioural economic games represent powerful tools to help dissect and quantify specific aspects of social behaviour during interpersonal exchanges (Fineberg et al., 2017). Findings from such experiments typically suggest that healthy people are motivated to help those who are helping them, and to hurt those who are hurting them. Outcomes reflecting such motivations are called fairness equilibria and lead to inequity aversion (Rabin, 1993). In fact, while classic game theory would assume that players only care about their own payoffs and choose a strategy to maximize them, modern economic theories clarify that people care intrinsically about "fairness" – that is, both about the intention (i.e., kind or hostile) that is behind their co-player's action and about the equitability of the payoff distribution induced by the action. Specifically: "A) People are willing to sacrifice their own material well-being to help those who are being kind; B) People are willing to sacrifice their own material well-being to punish those who are being unkind; C) Both motivations (A) and (B) have a greater effect on behaviour as the material cost of sacrificing becomes smaller" (Rabin, 1993, p. 1282). In other words, in contrast to rational economic principles, individuals are motivated by other-regarding interests, i.e., they show social preferences for fairness, retaliation and finally forgiveness when the other person tries to "repair" his/her previous unfair behaviour, even at cost to their material self-interest. Of note, such reciprocal strategies that minimize inequity are thought to allow the evolution of interpersonal cooperation (Fehr & Schmidt, 1999). Limited but increasing research, though, suggests that BPD patients, as opposed to healthy controls, tend to behave as rational and self-interested agents: they do not derive utility from mutual cooperation and appear not to forgive a partner's unfairness; rather, they

seem to pursue a grim-trigger-strategy (i.e., once their partner defects, they will then defect for the remainder of the game) by punishing others even for small departures from cooperation (Jeung et al., 2016).

The Ultimatum Game

One useful way to study cooperation during interpersonal exchanges is the *Ultimatum Game* (UG), a socioeconomic game evaluating people's attitudes toward fair and unfair behaviours of others. In a classic UG, two players must split a given amount of money: a proposer suggests how the sum can be divided, and a responder decides to accept or reject the offer. If the responder accepts, each player keeps the money according to the proposal; if the responder rejects the offer, both receive nothing. From a rational perspective, the proposer should offer the smallest possible amount, and the responder should accept every offer regardless of the amount, in order to maximize their own gain. However, typically healthy proposers offer up to 25-50% of the money amount, and healthy responders reject offers equal or below 20%. The responders' tendency to reject unfair offers reflect their willingness to punish norm violators, i.e., those who offered "unfair" amounts, even though such punishment behaviour is costly for those who punish. Thus, the healthy players' behaviour reveals a social preference for inequity aversion and reciprocal fairness that sustains ongoing cooperation (Fehr & Schmidt, 1999; Polgàr et al., 2014).

With respect to BPD, the two studies that employed the UG (with participants playing the role of the responder) have confirmed altered cooperative behaviours in BPD, but reported either increased (Thielmann et al., 2014) or decreased (Polgàr et al., 2014) rejection rates of unfair offers, respectively indicating either an increased or decreased propensity to punish others for their unjust behaviour. Thus, those with BPD may have either an impaired ability to reactively cooperate by forgiving others when suffering exploitation by them (Thielmann

et al., 2014) or, conversely, a decreased tendency to punish norm violators that signals a preference for immediate rewards against long-term cooperation (Polgàr et al., 2014). Several methodological issues may explain these discrepant results, including sample characteristics (non-clinical in the Thielmann et al. study, versus clinical in the Polgàr et al. study), the manipulation of the facial expression of the proposer in the study by Polgàr and colleagues, or the use of two diverse variants of the UG by Thielmann and colleagues. These manipulations make it hard to interpret the reported results.

Importantly, these studies did not manipulate participants' emotional reactions, which do affect behavioural outcomes in bargaining (Grecucci et al., 2012; Grecucci et al., 2013a; Grecucci et al., 2013c; Harlé & Sanfey, 2007; Jeung et al., 2016). In fact, others' unfair behaviour causes strong negative emotions in people (usually anger and moral disgust), which in turn triggers increased punishment behaviour toward defectors even when this is costly for the subject (Fehr & Gächter, 2002; Sanfey et al., 2003). Specifically, negative reactions arising from inequity and non-reciprocity in the UG may represent a mechanism by which inequity is avoided and serve precisely to foster mutual reciprocity and to encourage punishment of those seeking to take advantage of others (Sanfey, 2007). Consistently with the view that emotions play a major role in guiding the decisions in the UG, several psychiatric disorders (i.e., anxiety disorders, depression and schizotypal personality) are associated with altered emotional reactions and decision-making in the UG (Grecucci et al., 2013b; Pulcu et al., 2014; van't Wout & Sanfey, 2011). Finally, when healthy individuals are asked to regulate emotions elicited in the context of the UG by using cognitive strategies, decision behaviour is again affected: reappraising the proposer's intentions as less negative leads the responder to accept a greater number of unfair offers (Grecucci et al., 2013a; Grecucci et al., 2013c; Grecucci et al., 2013d; van't Wout et al., 2010). In addition, mindfulness training, which has been shown to enhance emotion regulation abilities

(Grecucci et al., 2015; Guendelman et al., 2017), increases the acceptance rates for unfair offers in the UG (Kirk et al., 2016). These mechanisms could be particularly important for BPD patients, who on the one hand find it difficult to self-regulate and exhibit negative affect and distress when facing negative social experiences (De Panfilis et al., 2016; Gunderson & Lyons-Ruth, 2008), and on the other hand may fail to efficiently employ emotion down-regulation strategies when processing social stimuli (Koenigsberg et al., 2009; Lang et al., 2012; Schulze et al., 2011), as well as exhibit various mentalizing difficulties (Sharp & Kalpakci, 2015).

Furthermore, how BPD patients evaluate the fairness of the offers received by the proposer during the UG has not been elucidated yet. Such investigation may clarify how BPD patients perceive fair and unfair interpersonal scenarios; in turn, this may inform about the norms that BPD patients use when perceiving and responding to social gesture (Sharp et al., 2012). A trust game experiment already allowed to demonstrate that individuals with BPD, as opposed to non-BPD controls, rely on atypical social norms: they do not have the social expectation that the others will cooperate with them. Rather, they regard others as untrustworthy and neurally react to their prosocial behaviour as it was unfair, thus failing to efficiently cooperate with them (King-Casas et al., 2008). Furthermore, BPD patients behave less cooperatively than controls after experiencing social acceptance (Liebke et al., 2018). This tendency of BPD patients to develop paranoia about their social partners, thus engaging in uncooperative behaviour, has been proposed as a key mechanism of interpersonal dysfunction in BPD (King-Casas & Chiu, 2012; Hula et al., 2018; Liebke et al., 2018).

Current Study

To our knowledge no study has yet evaluated whether the use of emotion regulation strategies can influence punishment behaviour (i.e., the extent to which the responder reject

the proposer's offers during the UG) among BPD patients, nor how BPD patients perceive fair and unfair socially interactive exchanges in the UG.

Thus, the aim of the present study is twofold.

Firstly, since difficulties in employing emotion regulation strategies may potentially explain the previous contrasting findings of BPD individuals in the UG (i.e., Thielmann et al., 2014; Polgàr et al., 2014), we employed a modified UG with three conditions: Look/Baseline, Distancing and Reappraisal. Prior research demonstrated that, among healthy individuals playing the responder's role in the UG, reappraisal is specifically effective in decreasing punishment behaviour after receiving *unfair* offers relative to both a baseline condition and a distancing condition (Grecucci et al., 2013a; Grecucci et al., 2013c; van't Wout et al., 2010). This is in keeping with the view that intentionality may play a role in people's attitudes about fairness: people determine the fairness of others according to their motives, not solely according to actions taken (Rabin, 1993). Therefore, the capacity to reappraise and mentalize the intentions of the other in a less negative way is likely to change one's reactions toward unfair interpersonal behaviors. Based on the reported association between difficulties in mentalizing and BPD (e.g., Sharp & Kalpakci, 2015), we hypothesized that this reappraisal-induced decrease in punishment behaviour after unfair offers, relative to a baseline and a distancing condition, will be diminished in BPD patients, as opposed to healthy controls. Thus, we expected that when both BPD patients and healthy subjects receive unfair offers by a proposer during the UG and are asked to reinterpret the proposer's intention as less negative, individuals with BPD will exhibit greater punishment behaviour toward the proposer (i.e., they will reject a greater rate of unfair offers) than controls. This would suggest that, among individuals with BPD, difficulties in successfully reappraising others' intentions may contribute to altered cooperation during challenging social exchanges.

Secondly, we evaluated BPD patients' perception of fair and unfair offers: we hypothesized that BPD patients, as compared to controls, will be inclined to judge the actual cooperative behaviour of their partners as unjust. Thus, we expected that BPD patients would rate the fair offers that they received during the UG as less equitable than healthy controls. This would confirm that individuals with BPD also show a distorted perception of social cues, which makes them underestimate their interaction partners' actual fair behaviour and limits their ability to cooperate with them (King-Casas & Chiu, 2012; Liebke et al., 2018).

In pursuing these goals, we also controlled for the potential confounding effect of general psychopathology and depression severity on task performance.

Method

Participants

This study involved 41 patients with BPD and 41 healthy controls (HC). All subjects were native Italian speakers and Caucasian, had a normal or corrected vision, and were 18-50 years old. BPD participants were recruited among outpatients receiving treatment at an Italian community-based Department of Mental Health, and were included in the study if the BPD diagnosis was confirmed with the Structured Clinical Interview for Axis II Disorders (SCID-II; First et al., 1997; Mazzi et al., 2003). HC were recruited through advertisements in the local community. Recruitment flyers informed that the study needed to enrol a non-clinical, healthy control group, who was free from past or current psychiatric disorders and had never sought psychiatric treatment or advice.

For the clinical group, exclusion criteria were a diagnosis of schizophrenia, other psychotic disorders, active bipolar disorder and substance dependence at the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID-I/P-RV) (First et al., 2002). For the

control group, exclusion criteria were a history of psychiatric disorders and endorsing more than 2 BPD symptoms at the SCID-II screening questionnaire.

Procedure

Baseline assessment. All subjects were asked to participate in an investigation on “affective regulation and borderline personality disorder” and gave written informed consent to the study.

For the clinical group, DSM-IV Axis I and Axis II disorders were evaluated by the SCID-I/P-RV and the SCID-II respectively. The Global Assessment of Functioning (GAF) scale was employed to assess patients' current level of psychosocial functioning. These assessments were carried out by two trained senior-level residents in psychiatry (G.S., I.G.).

As for the control group, a licensed psychologist trained and experienced in psychiatric diagnosing (L.G.) interviewed the participants at intake. The short interview included demographic questions as well as inquiry on previous mental health problems and psychiatric treatments (e.g., “Did you ever suffer, or were diagnosed with, any psychiatric or psychological disturbances? Did you ever seek a psychiatrist's or a psychologist's advice?”).

Participants were also assessed with the Symptom Checklist-90-revised (SCL-90-R; see description below) (Derogatis, 1994; Prunas et al., 2012), in order to further establish the non-clinical nature of the control group. Finally, control participants' BPD features were evaluated with the BPD-subscale of the SCID-II questionnaire. The BPD subscale consists of 14 questions, covering the nine DSM-IV BPD criteria, which ask ‘*Yes/No*’ statements with regard to the presence/absence of DSM-IV BPD symptoms. The number of BPD items endorsed forms the index of severity BPD features (in this sample: 0.24 ± 0.46 , range 0-2).

Using the SCID-II Interview as gold standard, the SCID-II questionnaire has demonstrated

good criterion validity (Germans *et al.*, 2010). The BPD subscale has good internal and construct validity and is correlated with ratings by friends ($r=.49$) (Piedmont *et al.*, 2003). In this sample, the internal consistency of the BPD subscale was also high ($\alpha=.84$).

Both groups completed the SCL-90-R, a 90-item self-report symptom scale designed to assess the psychological symptom status of both psychiatric and medical patients, as well as non-clinical individuals. The items are rated on a 5-point scale of distress (ranging from 0, 'not at all' to 4, 'extremely') and are selected to reflect 9 primary symptom dimensions (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism). The SCL-90-R also includes a global index of distress (General Severity Index, GSI), that is obtained by calculating the mean of all items scores. In this study, we focused on the GSI as a general measure of self-reported psychopathology, and on the Depression subscale of the SCL-90-R (DEP), since depression may influence social reward processing, and BPD patients often experience depressive symptoms. In this sample, the reliabilities of the GSI and the DEP were respectively $\alpha=.97$ and $\alpha=.89$.

Following the diagnostic screening, in a separate appointment all subjects participated, in the role of the responder, in a modified *Ultimatum Game* experiment (MUG) with three different experimental conditions: Look/Baseline, Reappraisal, and Distancing. This procedure was already employed and validated in prior studies (e.g., Grecucci *et al.*, 2013a, Grecucci *et al.*, 2013b; Grecucci *et al.*, 2013d; Grecucci *et al.*, 2015; van't Wout *et al.*, 2010). Before the game, participants were trained in the use of these emotion regulation strategies.

Training in the emotion regulation strategies. Participants were given the instructions of the MUG and told that they would have to use specific cognitive strategies upon the receipt of an offer. For the Look condition, they were to simply allow themselves to respond naturally. For the two emotion regulation strategies, subjects were provided with a written

protocol describing each of them. Following Gross (1998, 2014), a general Reappraisal definition was given as “reinterpreting the meaning of the situation in a less negative way”. A picture depicting a crying woman was presented. Participants were told that the way they interpret an event will affect the way they feel. For example, if they think that the woman is in great pain because she is mourning a loved one’s death they may feel upset, but if they think that the woman is merely tired or suffering from a headache they may feel less distressed by that event. After this example, participants were told to make an effort to reinterpret the event as less negative. To apply reappraisal to the MUG they were asked to try to build a less negative interpretation of the intentions behind the proposer’s behaviour. Some examples were given (“*he is not that stingy, probably does not have so much money to give me*”, “*this is the best he can do*” etc.). For the other strategy, Distancing, participants were told that how involved they feel in a situation will affect their perceived distress. A picture was presented depicting a bloody fight between police and terrorists, and they were told that if they feel themselves affected by this situation they probably will feel scared and worried, whereas if they think that that situation is far from their lives and not connected at all with them, they will feel quite neutral in relation to that event. Next, subjects were told how to apply this strategy to the context of MUG. Some examples were given, such as (“*this proposal won’t affect me*”, “*I don’t care*”). Importantly, Distancing was meant to be an avoidance-based, self-focused strategy, meaning that subject had to put themselves in a detached perspective, whereas Reappraisal was meant to be an other-focused strategy, which focuses on the intentions and behaviour of the proposer and not the economic offer itself (Grecucci et al., 2013a). Before beginning the first block of MUG, we verified that participants understood the respective emotion regulation instructions by asking each to verbalize what they would do when confronted with different offers. Furthermore, a practice session preceded every block of the MUG, after which subjects were asked to report any

difficulties they might have with the task and/or the correspondent emotion regulation strategy. The practice session was repeated until the participants felt to understand the task and apply the respective emotion regulation strategy. This training procedure was successfully validated in prior studies (i.e., Grecucci et al, 2013a; Grecucci et al., 2013c; Grecucci et al., 2013d; van't Wout, 2010; Gross, 1998). Such direct training by practicing the implementation of specific emotion regulation strategies has been found to significantly enhance adaptive emotional responses in both laboratory settings and daily interpersonal exchanges (Cohen & Ochsner, 2018).

Modified Ultimatum Game (MUG). Subjects played a computerized version of the MUG. They were told that the offers they were going to receive during the experiment were previously recorded from real life participants. Participants received offers from various proposers under the three diverse experimental conditions: Look/Baseline, Reappraisal, and Distancing. Each offer involved a €10 split; participants were informed they would be playing for real money and would be paid a percentage of their earnings in the game in cash afterwards. On each trial, after a fixation point lasting for 500 ms, participants saw instructions about which emotion regulation strategy was to apply for 2000 ms. They then saw a picture of their proposer partner and his/her offer for 8000 ms, and had to choose from two options, accept or reject. To avoid confounds facial expression of the partners was not manipulated, and balanced fair to unfair offers (5€:5€, 4€:6€, 3€:7€, 2€:8€, 1€:9€) were used as in the standard UG. These five different types of offers were repeated 4 times for a total of 20 offers presented in randomized order for each of the three experimental conditions presented in three blocks (Look, Reappraise, and Distance) (Figure 1). In the UG, the 5€:5€ and the 4€:6€ offers (i.e., the respondent is offered, respectively, 5€ out of 10€ or 4€ out of 10€) represent “fair” ones, and therefore are usually accepted, while offers equal or lower than 3€:7€ (i.e., the respondent is offered 3€ out of 10€ or less) are usually regarded as

unfair, and thus tend to be rejected. Offer rejection rates (ORR) represent an index of punishment behaviour (e.g., Polgàr et al, 2014; Fehr & Schmidt, 1999).

- *Figure 1 here* -

Post-MUG Assessment. After the game participants were asked to rate their judgment of the fairness conveyed by some prototypical offers, namely the 5€:5€ offer, the 3€:7€ offer, and the 1€:9€ offer, by rating them as totally unfair to totally fair on a 9-point Likert scale. The example item for the 5€:5€ offer is: “*How fair do you regard offer where the player split the money amount between the two of you by giving you 5€ and keeping 5€ for him/herself?*”; Subjects were fully debriefed after study completion. All of them reported having believed to respond to offers that were recorded from real participants prior to the experiment. In addition, as a further manipulation check, participants were asked to briefly write down what they did when asked to Reappraise and to Distance from the situation during the game, and their responses were consistent with the experimental manipulation. The Local Ethical Authority approved the study protocol.

Statistical Analyses

The two groups were compared in terms of sex, age, educational status, GSI and DEP using χ^2 test and *t*-test for independent samples. To examine the differences between patients and controls in terms of their decision-making, ORR (i.e., an index of punishment behaviour) were entered as the dependent variable in a repeated-measure mixed model ANOVA. Specifically, to evaluate whether BPD choices were affected by the cognitive strategies a 5X3X2 model was built, with Group (BPD vs. HC) as the between-subject factor, and Offer amount (€5, €4, €3, €2, €1) and Condition (Strategies: Look, Distancing, Reappraisal,) as the within-subject factors. Greenhouse-Geisser correction was performed when the assumption of sphericity was violated (Mauchly's test). Simple effects analyses with Bonferroni's correction for multiple comparisons were used to evaluate significant effects.

A multivariate ANOVA was used to evaluate between-group differences in the degree of perceived equity of the offers received (5€:5€, 3€:7€, and 1€:9€).

In order to control for the potential impact of general psychopathology (GSI) and depression (DEP) on MUG performance and perceived fairness of the offers received, DEP and GSI were entered as covariates in the repeated measure ANOVA (dependent variable: ORR) and in the multivariate ANOVA (dependent variable: perceived equity of the offers). We planned to enter in these models also socio-demographic variables that eventually differed between BPD and HC.

Results

Sample characteristics

BPD patients did not differ from HC in terms of age (37.93 ± 11.61 vs. 36.07 ± 13.50 y.o., $t_{80} = .67$, $p = .51$) nor gender distribution (% females: 82.9% vs 70.7%, $\chi^2 = 1.71$, $p = .19$), but reported a lower educational level than HC (years of education: 11.71 ± 2.97 vs. 14.27 ± 2.29 , $t_{80} = 4.37$, $p < .001$). Therefore, we also controlled for educational level in subsequent analyses. As expected, patients reported greater general psychopathology and depressive symptoms than HC (GSI: $.93 \pm .53$ vs. $.66 \pm .52$, $t_{80} = 2.28$, $p = .02$; DEP: $1.29 \pm .82$ vs. $.78 \pm .62$, $t_{80} = 3.18$, $p = .002$). HC mean scores on the GSI corresponded to a T-score ≤ 57 , which is far lower than the 63 T-score cut-off signalling the risk of being a clinical case (Derogatis, 1994). This further confirms the non-clinical nature of the control group. For the clinical group, current DSM-IV Axis I and II comorbidity rates are depicted in Table 1; the mean GAF score was 57.56 ± 9.94 .

- Table 1 here -

Offers rejection rates during the MUG

Table 2 shows ORR in BPD patients and HC as a function of offer amount and experimental condition.

General effects of the experimental manipulation. Main effects of offer amount and experimental condition are reported in Table 2; however, these effects were qualified as a significant Offer X Strategy interaction ($F_{6,6513.8}=5.6, p<.001, \eta_p^2=.07$). In keeping with prior research that applied emotion regulation strategies to the UG, the effect of the emotion regulation strategies (and specifically Reappraisal) on ORR varied as a function of the offer amount received. Overall Reappraisal had no effect during totally fair social exchanges during the MUG (i.e., receiving an offer of 5€ out of 10€), but decreased the responders' punishment behaviour for all the offers that were less fair than the 4€:6€ one relative to the Baseline/Look condition, and for all the offers that were less fair than the 5€:5€ relative to the Distancing condition. Specifically, compared to the Look condition Reappraisal was associated with decreased ORR for unfair offer amounts of 1-2-3€ (1€: $p=.001$; 2€: $p<.001$; 3€: $p<.001$), but not for the fair offers of 4€ and 5€ (respectively, $p=.58$ and $p=1$). Compared to the Distancing condition, Reappraisal was associated with lower ORR for the 1-2-3-4€ offer amounts, but not for the fairest 5€ offer amount (1 to 3€: $p<.001$; 4€: $p=.003$; 5€: $p=.22$). Collaterally, post hoc analysis revealed no differences between the Distancing and Look conditions at any offer amount (p between .11 and 1).

Effect of BPD status. Results did not support the study hypothesis that BPD patients would reject more unfair offers than HC because of underlying difficulties in the cognitive control of emotions. In fact, the Group X Strategy X Offer interaction was not significant ($F_{6,6513.8}=1.7, p=.11, \eta_p^2=.02$): this indicates that the two groups did not differ in their degree of punishment behaviours after receiving unfair offers as a function of any type of emotion regulation strategy employed. Thus, individuals with BPD rejected similar rates of unfair offers than HC in the Reappraisal condition. This suggests that Reappraisal was equally effective across groups in reducing punishment behaviour when participants deal with unjust social exchanges.

Unexpectedly, however, while BPD was associated with greater punishment behaviour than HC (main effect of Group; Table 2), this pattern depended on the amount of offer received (Group X Offer interaction: $F_{2,6,202,9}=2.74, p=.05, \eta_p^2=.03$): for the BPD group, the fairer the offer received, the higher the probability to punish the proposer by rejecting his/her offer. Specifically, as compared to HC, BPD patients rejected a greater number of fair offers (5€: $F_{1,78}=6.78, \eta_p^2=.08, p=.01$; 4€: $F_{1,78}=10.27, \eta_p^2=.12, p=.002$) and of 3€ offers ($F_{1,78}=4.30, \eta_p^2=.05, p=.04$); however, they did not reject offer amounts that were lower than the 3€ one to a greater extent than HC (2€: $F_{1,78}=.34, \eta_p^2=.004, p=.56$; 1€: $F_{1,78}=0.6, \eta_p^2=.001, p=.81$) (Figure 2). Thus, contrarily to HC BPD patients find it difficult to diminish their punishment behaviour after receiving fair offer amounts, but they reacted similarly than HC during the most inequitable social exchanges in the UG.

- Table 2 and Figure 2 here -

Effect of comorbid psychiatric symptoms. When GSI, DEP and years of education were entered as covariates in the repeated measure ANOVA, none of them was found to be related with ORR (GSI: $F_{1,75}=.005, \eta_p^2=.000, p=.95$; DEP: $F_{1,75}=.12, \eta_p^2=.002, p=.73$; years of education: $F_{1,75}=.37, \eta_p^2=.005, p=.55$). Furthermore, the above reported Offer X Strategy and Group X Offer interactions were confirmed. Specifically, overall Reappraisal diminished rejection rates for the unfair offers amounts of 1-2-3€ as compared to both the Look and the Distancing condition (1€: $F_{2,74}=14.57, \eta_p^2=.28, p<.001$; 2€: $F_{2,74}=25.45, \eta_p^2=.41, p<.001$; 3€: $F_{2,74}=17.42, \eta_p^2=.32, p<.001$). Reappraisal also diminished rejection rates for the fair offer amounts of 4€ as compared the Distancing condition only ($F_{2,74}=14.57, \eta_p^2=.14, p=.005$). However, Reappraisal was not associated with lower ORR than the Look and Distancing conditions for the fairest 5€ offer amount ($F_{2,74}=2.45, \eta_p^2=.06, p=.09$). Finally, even after covarying for GSI, DEP and level of education, BPD patients rejected a greater number of fair offers (5€: $F_{1,75}=3.01, \eta_p^2=.04, p=.05$; 4€: $F_{1,75}=9.71, \eta_p^2=.11, p=.003$) and of 3€ offers

($F_{1,75}=5.80$, $\eta_p^2=.07$, $p=.02$) than HC; however, they did not reject offer amounts that were lower than the 3€ one to a greater extent than HC (2€: $F_{1,75}=1.29$, $\eta_p^2=.02$, $p=.26$; 1€: $F_{1,75}=0.3$, $\eta_p^2=.000$, $p=.87$).

Post-MUG Assessment

Perceived equity of the offers. While the two groups did not differ with regard to how much equitable they perceived the 1€ and 3€ offers, BPD patients rated less fair than HC the very fair offer of 5€ (Table 3). This indicates a bias, among individuals with BPD, toward un-noticing actual fairness in interpersonal exchanges, confirming the hypothesis of reduced perception of others' cooperative behaviour. This result was confirmed even after controlling for GSI, DEP and years of education (effect of Group: $F_{3,75}=4.42$, $\eta_p^2=.15$, $p=.006$); in addition, none of those covariates significantly affected the level of perceived equity of the offers (GSI: $F_{3,75}=1.23$, $\eta_p^2=.05$, $p=.29$; DEP: $F_{3,75}=1.23$, $\eta_p^2=.07$, $p=.12$; years of education: $F_{3,75}=0.51$, $\eta_p^2=.02$, $p=.68$).

-Table 3 here-

Discussion

To our knowledge, this study was the first to evaluate whether the extent to which BPD patients engage in retaliatory/punishment behaviours during interactive interpersonal exchanges may be explained by their difficulty to apply emotion regulation strategies and/or by altered perception to their partners' actual behaviour. Two main findings emerged.

Firstly, relative to a baseline condition Reappraisal was equally effective in decreasing punishment behaviour after receiving unfair offers (1 to 3€) during the UG in both the HC and BPD groups. This finding indicates that, at least in the experimental conditions of the present study, BPD patients may be as capable as healthy individuals to apply cognitive control strategies during uncertain social exchanges to regulate emotions when asked to. The

fact that reappraisal reduced retaliatory behaviour in the present sample confirms that mentalizing the intentions of others as less negative influences social decision-making (Grecucci et al., 2013a, Grecucci et al., 2013c; Grecucci et al., 2015); by considering the motives of the others and not solely their actions in determining their fairness, individuals tend to punish less the actual unfair behaviour of others (Rabin, 1993; Sanfey, 2007; van't Wout et al., 2010). As compared to Distancing, an emotion regulation strategy by which individuals detach from the situation and take the distance from the interaction partner's behaviour, Reappraisal was associated with reduced punishment behaviour even following the fair offer of 4€. A potential explanation of this result could be that Distancing reduced participants' positive emotions toward the proposer during the game to a greater extent than negative emotions, similarly to what already found among non-clinical samples (Grecucci et al., 2013d), thus resulting in greater punishment behaviour relative to Reappraisal even during equitable social interactions.

Secondly, BPD patients punished their interaction partner more often when receiving fair offers and perceived their partner's fair offers as less fair as compared with controls. This finding suggests that BPD individuals exhibit a distorted perception of the fairness of others' behaviours and subsequent altered behavioural reactions. Notably, this did not apply to unfair offers: in this study BPD patients did not over-react to unfair social exchanges: they engaged in punishment behaviours after receiving unfair offers at a similar rate than controls and regarded them as unfair as controls.

Taken together, the current results suggest that the social risk preferences of BPD patients in uncertain social exchanges indicate a tendency to under-estimate the "justice" conveyed by their partner's behaviour: conversely, they are as accurate as non-BPD controls in recognizing others' unjust behaviour.

These findings are consistent with increasing evidence that individuals with BPD might exhibit a specific bias toward under-estimating positive feed-back from others. For instance, BPD patients are biased to under-notice trust in others, and their “skeptical” and untrustworthy attitude toward others is associated with their stress-related paranoia, interpersonal problems, and identity disturbance (Fertuck et al., 2013; Unoka et al., 2009). They also exhibit a negative evaluation bias for positive, self-referential social information (Winter et al., 2015), feel excluded even when objectively included or even overincluded by others (Staebler et al., 2011; De Panfilis et al., 2015; Weinbrecht et al., 2018), and respond with less positive emotions than controls to others’ warm and friendly behaviour (Sadikaj et al., 2010). The present data add to this line of research that in BPD angry retaliation can be triggered even by objectively fair interpersonal interactions, thereby explaining the clinical observation that, sadly, BPD patients find it difficult to benefit from mutually rewarding social exchanges.

Finally, results support the view that BPD patients have different social expectations than unaffected individuals. In fact, they punished their partner’s fair behaviour as if this was violating their social norms. Individuals with BPD might have overvalued ideas about justice, which lead them to be over-sensitive to being victimized by others; in turn, this heightened victim-sensitivity makes them react aggressively in the attempt to defend their needs (Cousineau & Young, 1997; Lis et al., 2017). Victim-sensitive individuals exhibit a specific cognitive dissonance between an internal need to live in a perfectly trustworthy world, which translates into a strong motivation to avoid being exploited, and a stable expectation that others are not trustworthy, which ultimately makes them anticipate malevolence from others (Gollwitzer et al., 2013; 2015). Interestingly, in this study BPD patients punished their partners when they behaved in a fair fashion toward them; that is, “as if” their partners were malevolent and unjust. From victim-sensitive individuals’ point of view, experiencing a

“normally fair” interpersonal exchange during the UG might not perfectly match BPD patients’ strong desire to live in a perfect world in which all the other people can be trusted. Rather, BPD patients seem to keep relying on an attributional bias toward hostile interpretations of others’ intentions. Consistent with object-relations theory (Kernberg, 1984; Yeomans et al., 2015), this response pattern may indicate that actual fair behaviour of others does not sufficiently fulfil the patient’s unconscious idealized need of finding a perfectly “just” treatment from others. The attempt to protect such an idealized split-off internal representations of the self as perfectly cared for, and of the others as perfectly just, leads the BPD individual to project one’s own negative affect into the others, whom are therefore perceived as malevolent and unfair regardless their actual behaviour. In other words, individuals with BPD under-notice actual fair behaviour of their interaction partners, and react to it as if they were treated unfairly, as this would mean relinquishing their unconscious hope of a “perfect” relationship (Yeomans et al., 2015; Clarkin & De Panfilis, 2013). Recent evidence confirmed that BPD patients show less expectations of being socially accepted than controls and cannot adjust these expectations in response to actual positive feedback. Most strikingly, after experiencing actual social acceptance they behave less cooperatively in a modified trust game (Liebke et al, 2018).

A major implication of this and other behavioural economic studies on BPD is that individuals with BPD or high BPD features seem heterogeneous in terms of their social decision making. For instance, previous UG studies reported higher or lower rejection rates for unfair offers in BPDs than controls (Thielmann et al., 2014; Polgàr et al., 2014), while the present study did not detect any between-group difference regarding subjects’ response to unfair offers, although the different experimental manipulations across studies make it difficult to compare the results. In addition, our finding that BPD participants seemed to under-notice others’ fair behaviour is inconsistent with previous reports that BPD patients do

not differ from controls in judging the fairness of cooperative behaviour of a co-player during other behavioural economic tasks (Franzen et al., 2011; Wischniewski & Brune, 2013). Other variables than the sole BPD diagnosis could shape borderline patients' cooperative or uncooperative behaviour. In this study, we tested the hypothesis that the use (or lack thereof) of emotion regulation strategies could play a role in this respect, but found no support for this. Given the usefulness of economic experiments in advancing our understanding of interpersonal behaviour in BPD (Fineberg et al., 2017; Sharp et al., 2012), the contrasting findings gathered so far clearly encourage further research in this area.

While this study was the first to apply an emotion-regulation manipulation to a socially interactive scenario like the UG in BPD, future studies should compare BPD patients with clinical control groups on the MUG in order to evaluate whether the response pattern we found is specific to BPD. Importantly though, we were able to exclude that the results were driven by the potentially confounding effect of comorbid general psychopathology and depression. Polgàr and colleagues (2014) similarly found that the severity of comorbid psychopathology did not affect BPD patients' performance during the UG. Furthermore, all BPD participants were receiving some kind of psycho-pharmacotherapy, therefore we could not control for the potential confounding effect of medications on task performance. A previous study found that psychotropic medications did not affect BPD patients' offer rejection rates during the UG (Polgàr et al., 2014); further research is needed to determine whether this applies to the MUG as well.

In conclusion, the results of this study support the view that BPD patients' interactions with others rely on perturbed perceptions of others' just behaviours. Individuals with BPD react to actually fair social exchanges as if they were unfair, suggesting a bias toward underestimating actual positive feed-back from others. Unfortunately, such atypical social norms might result in a vicious circle by which BPD patients, who see the others as untrustworthy,

actually do behave themselves in an untrustworthy and retaliatory fashion toward them; tragically, this ultimately makes it difficult for both BPD patients and their interaction partners to benefit from “positive”, cooperative social exchanges. Thus, individuals with BPD may benefit from interventions (e.g., Yeomans et al., 2015) that systematically address their polarized and distorted self-other representations.

References

- Clarkin, J.F., & De Panfilis, C. (2013). Developing conceptualization of Borderline Personality Disorder. *The Journal of Nervous and Mental Disease, 201*, 88-93.
- Cohen, N., & Ochsner, K.N. (2018). From surviving to thriving in the face of threats: the emerging science of emotion regulation training. *Current Opinion in Behavioral Sciences, 24*, 143-155.
- Cousineau, P., & Young, J.E. (1997). Treatment of borderline personality disorder with the schema-focused approach. *Sante Mentale au Quebec, 22*, 87-105.
- De Panfilis, C., Meehan, K.B., Cain, N.M., & Clarkin, J.F. (2016). Effortful Control, Rejection Sensitivity, and Borderline Personality Disorders Features in Adulthood. *Journal of Personality Disorders, 30*, 595-612.
- De Panfilis, C., Riva, P., Preti, E., Cabrino, C., & Marchesi C. (2015). When social inclusion is not enough: Implicit expectations of extreme inclusion in Borderline Personality Disorder. *Personality Disorders: Theory, Research and Treatment, 6*, 301-9.
- Derogatis, L.R. (1994). *Symptom Checklist-90-R: Administration, scoring, and procedures manual* (3rd ed.). Minneapolis, MN: National Computer Systems.
- Fehr, E., & Schmidt, K.M. (1999). A theory of fairness, competition, and cooperation. *Quarterly Journal of Economics, 114*, 817-868.
- Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature, 415*, 137-140.
- Fertuck, E.A., Grinband, J., & Stanley, B. (2013). Facial trust appraisal negatively biased in borderline personality disorder. *Psychiatry Research, 207*, 195-202.
- Fineberg, S.K., Stahl, D.S., & Corlett PR (2017). Computational psychiatry in borderline personality disorder. *Current Behavioral Neuroscience Reports, 4*, 31-40.

- First, M.B., Spitzer, R.L., Gibbon, M., & Williams, J.B.W. (1997). *Structured Clinical Interview for DSM-IV Personality Disorders, (SCID-II)*. Washington, DC: American Psychiatric Press Inc.
- First, M.B., Spitzer, R.L., Gibbon, M., & Williams, J.B.W. (2002). *Structured Clinical Interview for DSM-IV-TR Axis-I Disorders, Research version, Patient Edition (SCID-I/P-RV)*. New York: Biometrics Research Department, New York State Psychiatric Institute, November 2002 Revision; Web Site <http://www.scid4.org> (Italian translation by Perrone R).
- Franzen, N., Hagenhoff, M., Baer, N., Schmidt, A., Mier, D., Sammer, G., Gallhofer, B., Kirsch, P., & Lis, S. (2011). Superior theory of mind in borderline personality disorder: an analysis of interaction behavior in a virtual trust game. *Psychiatry Research, 187*, 224-233.
- Germans, S., Van Heck, G.L., Masthoff, E.D., Trompenaars, F.J., & Hodiament, P.P. (2010). Diagnostic efficiency among psychiatric outpatients of a self-report version of a subset of screen items of the Structured Clinical Interview for DSM-IV-TR Personality Disorders (SCID-II). *Psychological Assessment, 22*, 945.
- Gollwitzer, M., Rothmund, T., & Sussenbach, P. (2013). The Sensitivity to Mean Intentions (SeMI) model: basic assumptions, recent findings, and potential avenues for future research. *Social and Personality Psychology Compass, 7*, 415-426.
- Gollwitzer, M., Sussenbach, P., & Hannuschke, M. (2015). Victimization experiences and the stabilization of victim sensitivity. *Frontiers in Psychology, 6*, 439.
- Greccucci, A., De Pisapia, N., Venuti, P., Palladino, M.P., & Job, R. (2015). Baseline and strategic mindful regulation: behavioral and physiological investigation. *Plos One 10(1)*, e0116541.

Grecucci, A., Giorgetta, C., Bonini, N., & Sanfey, A. (2013a). Reappraising social emotions: the role of inferior frontal gyrus, temporo-parietal junction and insula in interpersonal regulation. *Frontiers in Human Neuroscience*, 7, 523.

Grecucci, A., Giorgetta, C., Brambilla, P., Zanon, S., Perini, L., Balestrieri, M., Bonini, N., & Sanfey, A. (2013b). Anxious Ultimatums. How Anxiety Affects Socio-economic Decisions. *Cognition & Emotion*, 27, 230-44.

Grecucci, A., Giorgetta, C., van Wout, M., Bonini, N., Sanfey, A. (2013c). Reappraising the Ultimatum: an fMRI study of emotion regulation and decision-making. *Cerebral Cortex*, 23, 399-410

Grecucci, A., Giorgetta, C., Bonini, N., & Sanfey, A.G. (2013d). Living emotions, avoiding emotions: behavioral investigation of the regulation of socially driven emotions. *Frontiers in Psychology*, 3, 61.

Guendelman, S., Medeiros, S., Rampes, H. (2017). Mindfulness and Emotion Regulation: Insights from Neurobiological, Psychological, and Clinical Studies. *Frontiers in Psychology*, 8, PMC5337506.

Gross, J.J. (1998). The emerging field of emotion regulation: an integrative review. *Review of General Psychology*, 2, 271-299.

Gross, J.J. (2014). *Handbook of emotion regulation* (2nd ed.). New York, NY: Guilford Press.

Gunderson, J.G., & Lyons-Ruth, K. (2008). BPD's interpersonal hypersensitivity phenotype: a gene-environment-developmental model. *Journal of Personality Disorders*, 22, 22-41.

Gunderson, J.G., Stout, R.L., McGlashan, T.H., Shea, M.T., Morey, L.C., Grilo, C.M., Zanarini, M.C., Yen, S., Markowitz, J.C., Sanislow, C., Ansell, E., Pinto, A., & Skodol, A.E. (2011). Ten-year course of borderline personality disorder:

- psychopathology and function from the Collaborative Longitudinal Personality Disorders Study. *Archives of General Psychiatry*, 68, 827-837.
- Harle, K.M., & Sanfey, A.G. (2007). Incidental sadness biases social economic decisions in the Ultimatum Game. *Emotion*, 7, 876-881.
- Hula, A., Vilares, I., Dayan, P., & Montague, P.R. (2018). A model of risk and mental state shifts during social interaction. *PLoS Computational Biology*, 14(2): e1005935.
- Jeung, H., Schwieren, C., & Herpertz, S.C. (2016). Rationality and self-interest as economic-exchange strategy in borderline personality disorder: Game theory, social preferences, and interpersonal behaviour. *Neuroscience and Biobehavioral Reviews*, 71, 849-864.
- Kernberg, O.F. (1984). *Severe personality disorders*. New Haven: Yale University Press.
- King-Casas, B., & Chiu, P.H. (2012). Understanding interpersonal function in psychiatric illness through multiplayer economic games. *Biological Psychiatry*, 72, 119-125.
- King-Casas, B., Sharp, C., Bream, L.L., Lohrenz, T., Fonagy, P., & Montague, P.R. (2008). The rupture and repair cooperation in borderline personality disorder. *Science*, 321, 806-810.
- Kirk, U., Xiaosi, G., Sharp, C., Hula, A., Fonagy, P., & Montague, P.R. (2018). Mindfulness training increases cooperative decision making in economic exchanges: Evidence from fMRI. *Neuroimage*, 138, 274-283.
- Koenigsberg, H.W., Fan, J., Ochsner, K.N., Liu, X., Guise, K.G., Pizzarello, S., Dorantes, C., Guerreri, S., Tecuta, L., Goodman, M., New, A., & Siever, L.J. (2009). Neural correlates of the use of psychological distancing to regulate responses to negative social cues: a study of patients with borderline personality disorder. *Biological Psychiatry*, 66, 854-863.

- Lang, S., Kotchoubey, B., Frick, C., Spitzer, C., Grabe, H.J., & Barnow, S. (2012). Cognitive reappraisal in trauma-exposed women with Borderline Personality Disorder. *Neuroimage*, *59*, 1727-1734.
- Liebke, L., Koppe, G., Bungert, M., Thome, J., Hauschild, S., Defiebre, N., Izurieta Hidalgo, N.A., Schmal, C., Bohus, M., & Lis, S. (2018). *Journal of Abnormal Psychology*, E-pub ahead of print.
- Lis, S., Schaedler, A., Liebke, L., Hauschild, S., Thome, J., Schmal, C., Stahberg, D., Kleindienst, N., & Bohus, M. (2017). Borderline personality disorder and sensitivity to injustice. *Journal of Personality Disorders*, *32*, 192-206..
- Mazzi, F., Morosini, P., De Girolamo, G., & Guaraldi, G.P. (2003). *SCID-II - Structured Clinical Interview for DSM-IV Axis II Personality Disorders, Italian Version*. Firenze: Organizzazioni Speciali.
- Piedmont, R.L., Sherman, M.F., Sherman, N.C., & Williams, J.E.G. (2003). A first look at the Structured Clinical Interview for DSM-IV Personality Disorders Screening Questionnaire: More than just a screener. *Measurement & Evaluation in Counseling & Development*, *36*, 150-160.
- Polgàr, P., Fogdt, D., Unoka, Z., Siràly, E., & Csukly, G. (2014). Altered social decision making in borderline personality disorder: an ultimatum game study. *Journal of Personality Disorders*, *28*, 841-852.
- Prunas, A., Sarno, I., Preti, E., Madeddu, F., Perugini, M. (2012). Psychometric properties of the Italian version of the SCL-90-R: A study on a large community sample. *European Psychiatry*, *27*, 591-597.

- Pulcu, E., Trotter, P., Thomas, E., McFarquhar, M., Juhasz, G., Sahakian, B., et al. (2014). Temporal discounting in major depressive disorder. *Psychological Medicine, 44*, 1825–1834.
- Rabin, M. (1993). Incorporating fairness into game theory and economics. *The American Economic Review, 83*, 1281-1302.
- Sadikaj, G., Russel, J.J., Moskowitz, D.S., & Paris, J. (2010). Affect dysregulation in individuals with borderline personality disorder: persistence and interpersonal triggers. *Journal of Personality Assessment, 92*, 490-500.
- Sanfey, A.G. (2007). Social Decision-Making: Insights from game theory and neuroscience. *Science, 318*, 598-602.
- Schulze, L., Domes, G., Kruger, A., Berger, C., Fleischer, M., Prehn, K., Schmahl, C., Grossmann, A., Hauenstein, K., & Herpertz, S.C. (2011). Neural correlates of cognitive reappraisal in Borderline Patients with Affective Instability. *Biological Psychiatry, 69*, 564-573.
- Sharp, C., & Kalpackci, A. (2015). Mentalization in borderline personality disorder: from bench to bedside. *Personality Disorders: Theory, Research and Treatment, 6*, 347-355.
- Sharp, C., Monterosso, J., & Montague, R. (2012). Neuroeconomics: a bridge for translational research. *Biological Psychiatry, 72*, 87-92.
- Staebler, K., Renneberg, B., Stopsack, M., Fiedler, P., Weiler, M., & Roepke S (2011). Facial emotional expression in reaction to social exclusion in borderline personality disorder. *Psychological Medicine, 41*, 1929-38.

- Thielmann, I., Hilbig, B.E., & Niedtfeld, I. (2014). Willing to give but not to forgive: borderline personality features and cooperative behavior. *Journal of Personality Disorders, 28*, 778-795.
- Unoka, Z., Seres, I., Aspàn, N., Bòdi, N., & Kéri, S. (2009). Trust game reveals restricted interpersonal transactions in patients with borderline personality disorder. *Journal of Personality Disorders, 23*, 399-409.
- van 't Wout, M., & Sanfey, A.G. (2011). Interactive decision-making in people with schizotypal traits: a game theory approach. *Psychiatry Research, 185*, 92-6.
- van 't Wout, M., Chang, L.J., & Sanfey, A.G. (2010). The influence of emotion regulation on social interactive exchanges. *Emotion, 10*, 815–821, 2010.
- Weinbrecht, A., Niedeggen M., Roepke, S., & Renneberg, B. (2018). Feeling excluded no matter what? Bias in the processing of social participation in borderline personality disorder. *Neuroimage: Clinical, 19*, 343-350.
- Winter, D., Herbert, C., Koplín, K., Schmal, C., Bohus, M., & Lis, S. (2015). Negative evaluation bias for positive self-referential information in borderline personality disorder. *PLoS ONE, 10*, e0117083.
- Wischniewski, J., & Brune, M. (2013). How do people with borderline personality disorder respond to norm violations? Impact of personality factors on economic decision-making. *Journal of Personality Disorders, 27*, 531-546.
- Yeomans, F.E., Clarkin, J.F., & Kernberg, O.F. (2015). *Transference-Focused Psychotherapy for Borderline Personality Disorder. A clinical guide*. Washington, DC: American Psychiatric Publishing.

Table 1. Comorbidity rates in the BPD sample (n=41).

Type of Comorbid Disorder	<i>n</i>	%
<i>DSM-IV Axis I disorders</i>		
Mood Disorder	6	14.6
Eating Disorder	4	9.8
Adjustment Disorder	14	34.1
Substance Abuse Disorder	11	26.8
Gender Identity Disorder	1	2.4
<i>DSM-IV Axis II disorders</i>		
Paranoid PD	2	4.9
Histrionic PD	2	4.9
Narcissistic PD	2	4.9
Antisocial PD	2	4.9
Dependent PD	1	2.4
Obsessive-Compulsive PD	3	7.3
Passive-Aggressive PD	5	12.2
Depressive PD	3	7.3

Table 2. Offer rejection rates (%) in the Modified Ultimatum Game for BPD patients and controls, as a function of offer amount and emotion regulation strategy.

<i>Offer amount/ Condition</i>	BPD		HC		Main effects	Interactions
	Mean	SD	Mean	SD		
<i>Look</i>						
1€	75.0	38.7	73.7	34.9	Offer $F_{2,6,2029}=128.6, p<.001, \eta_p^2=.62$	StrategyXOffer $F_{6,6,5138}=5.6, p<.001, \eta_p^2=.07$
2€	73.8	37.5	69.9	39.4		
3€	60.9	40.7	42.1	39.8		
4€	31.1	34.8	9.6	19.6		
5€	9.76	20.	5.77	13.4		
<i>Distancing</i>						
1€	76.8	33.3	85.3	32.3	Strategy $F_{1,8,1384}=28.8, p<.001, \eta_p^2=.27$	GroupXOffer $F_{2,6,2029}=2.74, p=.05, \eta_p^2=.03$
2€	76.8	33.3	78.9	36.5		
3€	57.3	42.3	54.5	44.0		
4€	37.2	39.6	19.2	33.2		
5€	20.7	33.5	7.69	21.6		
<i>Reappraisal</i>						
1€	59.8	41.8	57.7	42.6	Group $F_{1,78}=3.8, p=.05, \eta_p^2=.05$	GroupXStrategy $F_{1,8,1384}=.98, p=.37, \eta_p^2=.01$
2€	53.1	40.8	42.9	42.3		
3€	42.7	39.6	19.2	29.5		
4€	21.9	32.7	8.97	21.1		
5€	12.8	24.5	3.21	10.2		

Figure 1. Example of the Timeline of events in the Modified Ultimatum Game.

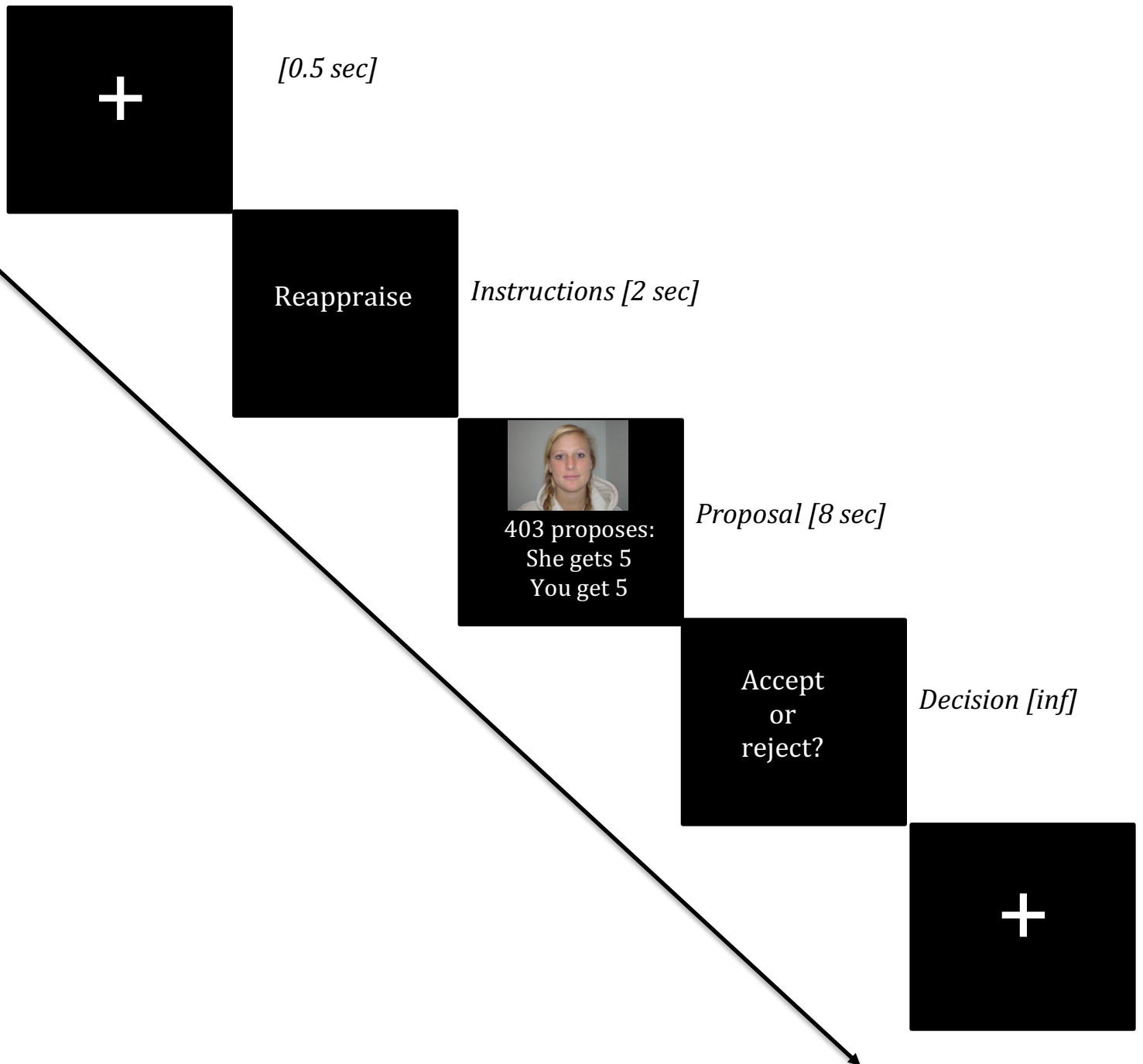
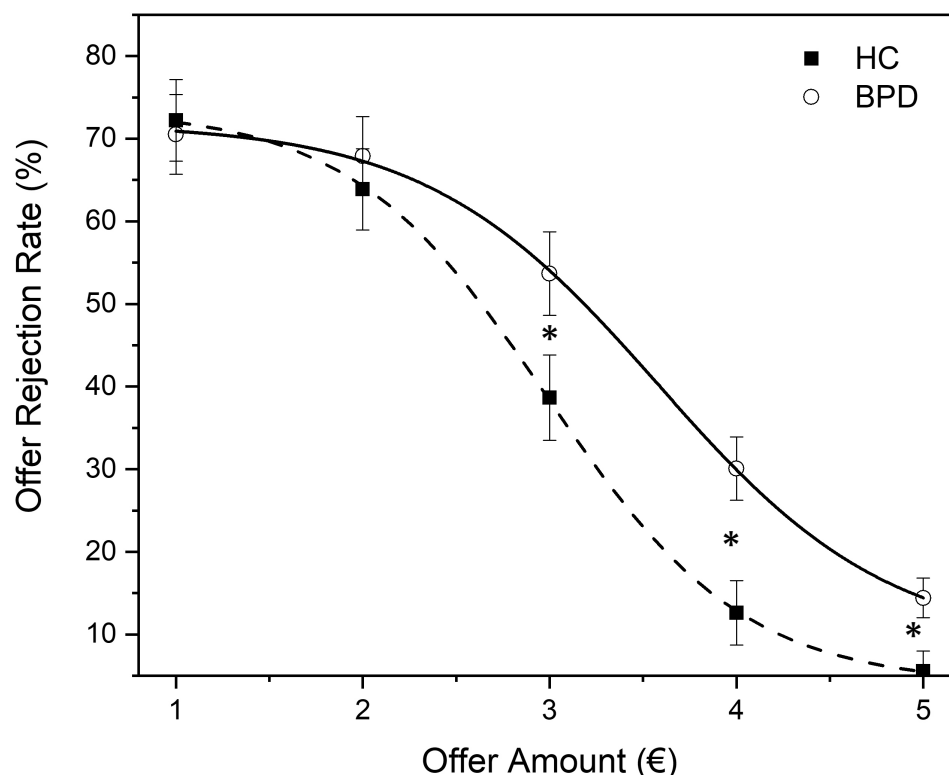


Figure 2. Offer rejection rate in BPD patients and healthy controls as a function of the received offer amount.



*: $p < .05$; BPD rejected a greater number of offers than controls after receiving offer amounts of 3€, 4€ and 5€; see text for details.

Note: We evaluated the curves of offer rejection rates in the study sample using Boltzmann's non-linear fit with Levenberg-Marquard algorithm [$y = a_2 + (a_1 - a_2) / (1 + \exp((x - x_0) / dx))$], where $x_0 = F50$ (i.e., offer amount corresponding to a 50% rejection rate), and $dx = \text{slope}$.

Data confirmed a non-linear fit of offer rejection rates in both BPD and HC (BPD: $R^2 = 0.9998$; HC: $R^2 = 0.9999$).

BPD patients rejected offers at greater offers amounts than HC:

BPD: 50% of rejection rates at offer amount = 3.58 ± 0.04 (x_0); HC = 50% at offer amount = 2.99 ± 0.05 (x_0).

Moreover, the groups differed in slopes too (BPD: $dx = 0.62 \pm 0.05$; HC: $dx = .53 \pm 0.02$), with the HC slope being steeper than the BPD one. This indicates that among HC offer rejection rates decreased faster than among BPD as the offer amounts increased. In other words, BPD patients find it difficult to "adjust" their punishment behaviour to increasingly fair offer amounts.

Table 3. Level of perceived fairness of the offers after the MUG in BPD patients and healthy controls as a function of offer amount.

	BPD		HC		ANOVA	Comparisons
	Mean	SD	Mean	SD		
<i>Perceived fairness of the offers</i>						
1€	1.56	1.1	1.39	1.4	$F_{1,81}=.37, p=.55$	BPD=HC
3€	3.22	1.4	3.10	1.3	$F_{1,81}=.16, p=.69$	BPD=HC
5€	6.68	1.7	8.07	1.7	$F_{1,81}=13.4, p<.001$	BPD<HC