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Testing the reinforcement sensitivity theory in borderline personality disorder compared with major depression and healthy controls

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ABSTRACT

Links between the reinforcement sensitivity theory (RST) proposed by Gray and several mental disorders have been established in a number of studies. However, specifically in the field of personality disorders, there is a lack of evidence regarding clinical samples. The aim of the present study was to test the RST in subjects with borderline personality disorder (BPD, $n = 100$), compared to subjects with major depression disorder (MDD, $n = 45$) and healthy controls (HCs, $n = 100$). Behavioral approach system (BAS) and behavioral inhibition system (BIS) were assessed using the sensitivity to punishment and sensitivity to reward questionnaire; in addition all participants completed the beck depression inventory. Individuals with BPD showed higher scores on BIS and BAS compared with both control groups. An interaction between BIS and BAS was not observed, suggesting that the joint subsystems hypothesis (JSH) is not applicable in the case of BPD. A logistic regression analysis indicated that scores in sensitivity to punishment and sensitivity to reward were able to predict almost an 80% of BPD cases. Findings suggest that BIS and BAS reactivity is related to BPD main psychopathology.

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1. Introduction

In the original formulation the reinforcement sensitivity theory (o-RST) proposed by Gray (1987) suggests the existence of two major motivational systems: the behavioral inhibition system (BIS) and the behavioral approach system (BAS). The BIS is sensitive to signs of punishment and unconditioned fear stimuli. BIS activation has been related with neuroticism personality trait and a tendency to experience negative affect. To the contrary, BAS organized behavior in response to appetitive stimuli related with signs of unconditioned reward and non-punishment. BAS activity has been related with the impulsivity trait of personality and a tendency to experience positive affect (Bijttebier, Beck, Claes, & Vandereycken, 2009).

The o-RST has undergone a major reformulation over the past years (Gray & McNaughton, 2000). In the revised version (r-RST), BAS is conceptualized in most aspects as in the o-RST; BIS is related to resolving conflicts, especially the approach–avoidance type but not to reactions to punishment as in the original model; finally, a third construct named Fight-Flight-Freeze System (FFFS), that in many aspects is similar to the original BIS, is responsible for reactivity to all types of punishment. The o-RST adopted a separable subsystems hypothesis (SSH) assuming that BIS and BAS were separable subsystems that operate independently of one another. In contrast to this assumption, Corr (2001) presented the joint subsystems hypothesis (JSH), which postulates that BIS and BAS could have interdependent or joint effects. Whereas the JSH is expected to be valid under certain human experimental conditions, it is believed that the SSH is more suitable in extreme personality groups or in cases where sensitivity to punishment and sensitivity to reward are both high (Bijttebier et al., 2009; Corr, 2001, 2004).

BIS and BAS activity, as defined in the o-RST, have been studied in relation to a broad range of Axis I disorders, showing that extreme levels of BIS and BAS activation are related with several disorders (e.g., depression, anxiety or drug abuse; Bijttebier et al.,

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2009). Recently, RST study has expanded to personality disorders (Caseras, Torrubia, & Farré, 2001). Borderline personality disorder (BPD) is a severe psychiatric condition that is very prevalent in clinical populations (Leichsenring, Leibing, Kruse, New, & Leweke, 2011). Current theories of BPD agree to consider that emotional dysregulation and impulsivity are two major features of the disorder (Crowell, Beauchaine, & Linehan, 2009; Gunderson, 2010). Recently, the DSM-5 incorporates an alternative model for personality disorders (DSM-5, section III; APA, American Psychiatric Association, 2013), based on maladaptive personality traits. According to this new proposal (American Psychiatric Association, 2013), BPD is characterized by pathological personality traits in the negative affectivity (NA), disinhibition and antagonism domains. The NA domain – the pathological pole of neuroticism-include among others, emotional lability, anxiousness and depressivity. While, impulsivity and risk taking are part of the disinhibition domain – the pathological pole of conscientiousness – (Miller, Morse, Nolf, Stepp, & Pilkonis, 2012; Skodol, 2012). In studies regarding non-clinical samples, BIS activation has been related with NA, whereas BAS activation has been related with the impulsivity trait (Smits & Boeck, 2006; Taylor, Reeves, James, & Bobadilla, 2006; Zelenski & Larsen, 1999).

Considering the previous literature, it can be expected that BPD subjects were characterized by a high activation of both BIS and BAS, as they were postulated in the original model. However, empirical testing of the RST framework in large BPD samples is still needed. To further clarify this matter, the present study has the following aims: (1) to investigate BIS and BAS sensitivities as defined in the o-RST in BPD subjects by contrasting 3 groups: individuals with BPD, individuals with major depressive disorder (MDD), and healthy controls (HCs), (2) to investigate the joint subsystems hypothesis (JSH) in regard to the three groups (BPD, MDD and HC), and (3) to clarify if o-RST framework could be useful for discriminating between BPD and MDD subjects.

2. Methods

2.1. Participants and procedure

A total of 245 subjects were recruited: 100 diagnosed with BPD, 45 diagnosed with MDD and 100 HCs. HCs were recruited directly by the authors through appeals at the hospital and university, while clinical participants were outpatients recruited during a 1 year period at two Departments of Psychiatry in Spanish Hospitals. Inclusion criteria for HCs were as follows: (a) no current or past psychiatric diagnosis; (b) absence of history of psychotropic medication; (c) absence of depressive symptoms according to BDI scores (BDI >13) and (d) absence of BPD diagnosis according to a screening instrument for subjects with BPD.

Diagnosis of both clinical groups was assessed by means of structured interviews. Exclusion criteria for MDD and BPD groups consisted of: presence of psychotic disorder, current substance dependence or eating disorders according to DSM-IV-TR criteria, or severe physical conditions. Patients were allowed to be under pharmacological treatment.

The study was approved by the Clinical Research Ethics Committee of the Hospital de la Santa Creu i Sant Pau and followed the principles outlined in the Declaration of Helsinki. Participants did not receive any remuneration and an informed consent to participate in the study was acquired.

2.2. Measures

The Structured Clinical Interview for DSM-IV-TR Axis I and II (SCID-I and SCID-II) were used to make BPD and MDD diagnosis.

In addition, BPD was confirmed by the Revised Diagnostic Interview for Borderlines (*DIB-R*; Barrachina et al., 2004). To dismiss BPD criteria in HCs and MDD samples, the *McLean Screening Instrument for Borderline Personality Disorder* (*MSI-BPD*; Zanarini et al., 2003) was used. The original version reports adequate psychometric properties (Zanarini et al., 2003). In our study, internal consistency as measured by Cronbach's alpha was .89. Depressive symptoms were assessed by the *beck depression inventory* (BDI-II; Sanz, García-Vera, Espinosa, Fortún, & Vázquez, 2005). To examine BIS and BAS activation we used the *Sensitivity to Punishment and Sensitivity to Reward Questionnaire* (SPSRQ; Torrubia, Ávila, Moltó, & Caseras, 2001), which consists of 48 yes/no items and it is divided into two independent scales. The sensitivity to punishment scale (SP) evaluates individual differences regarding BIS activity. The sensitivity to reward scale (SR) measures individual differences regarding BAS activity. The original version of the SPSRQ has shown good psychometric properties regarding internal consistency and test–retest reliability and both scales have been related with other BIS and BAS scales (Caseras, Ávila, & Torrubia, 2003; Torrubia et al., 2001).

2.3. Statistical analysis

To compare sociodemographic variables and clinical data among groups Chi square and ANOVA Tests were performed. Differences between groups were tested by means of ANOVAs using post hoc tests (Bonferroni). In the venue of significant differences among groups in other variables, ANCOVAs were to be carried out instead, together with comparisons between groups by means of pairwise ANCOVA.

To test the effect of SR and SP and their interaction on BDI scores, 3 regression analyses were conducted (one for each group: BPD, MDD and HCs). BDI scores were entered as dependent variable and SP and SR scores (mean-centred) were entered as factors in the first step. A two way cross product (SP × SR (mean-centred)) was entered as factor in the second step.

A backward stepwise logistic regression analysis was performed in order to explore the ability of SP, SR and BDI scores to predict whether participants belonged to the BPD group. Data analysis was performed using SPSS version 18.0 for Windows with level of significance at $p < .05$.

3. Results

No significant differences were found for sex distribution [percentage of women: BPD (94.0%), MDD (93.3%) and HCs (93%)]. Statistical differences were found for age [$F(2, 238) = 35.33$, $p < .001$; BPD, 33.6 (9.7), MDD 44.9 (12.3), HC 29.8 (9.3)] and level of education ($\chi^2(2) = 16.15$, $p < .001$; percentage of high school/university studies: BPD, 83%, MDD, 73.5%, HC, 98.6%). Sample size for BDI comprised only 222 participants (BDP $n = 100$, MDD $n = 45$, HCs $n = 77$), due to incomplete data of the HCs sample. Scores on BDI differed significantly among groups [$F(2, 219) = 148.996$, $p < .001$), BPD 29.2 (13.4), MDD 23.4 (10.2), HC, 2.9 (2.3)].

Separate ANCOVAs were conducted for each scale (SR and SP) as dependent variables, groups (BPD, MDD and HCs) as between-subjects factor, controlling for the effect of age and BDI. As the main effect of group was significant for SP [$F(2, 214) = 10.61$, $p < .0001$] pairwise comparisons were performed. BPD participants showed significant higher scores than MDD [$F(1, 142) = 8.01$, $p < .005$] and HCs [$F(1, 174) = 16.57$, $p < .0001$]. Analysis with SR showed a group main effect [$F(2, 214) = 15.43$, $p = .000001$]; pairwise comparisons showed that BPD participants displayed significantly higher scores than both MDD [$F(1, 142) = 26.41$, $p = .000001$] and HC [$F(1, 174) = 23.08$, $p = .00003$]. Difference between MDD and