RESEARCH ARTICLE

Reward Dependence and Harm Avoidance among Patients with Binge-Purge Type Eating Disorders

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Abstract

Introduction: The Cloninger's Psychobiological Model of Temperament and Character includes temperamental dimensions such as reward dependence (RD) and harm avoidance (HA). Studies of RD differentiate between sensitivity to reward (SR) *versus* to punishment (SP). We investigated the interrelationship between HA and RD in acutely ill patients with binge/purge (B/P) type eating disorders (EDs) and following symptomatic stabilization.
Methods: Fifty patients with B/P EDs were assessed at admission to inpatient treatment, 36 of whom were reassessed at discharge. Thirty-six controls were similarly assessed. Participants completed Tridimensional Personality Questionnaire (TPQ), Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ), and took the Gambling Task.
Results: Patients with B/P EDs had higher TPQ-RD and lower TPQ-HA accompanied by lower SPSRQ-SR and SPSRQ-SP. SPSRQ-SP correlated positively and negatively with TPQ-HA and TPQ-RD, respectively.
Conclusions: Combination of lower TPQ-HA, lower SPSRQ-SP, and greater risk-taking inclination may maintain disordered eating in patients with B/P EDs.

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Keywords

binge-purge eating disorders; harm avoidance; reward dependence; personality dimensions; gambling task

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Introduction

Eating disorders (EDs) are common among adolescent and young-adult women (Vohs, Bardone, Joiner, Abramson, & Heatherton, 1999). These disorders are characterized by maladaptive eating behaviours, distorted body image, and undue influence of weight/shape on self-evaluation, leading to a host of compensating behaviours to prevent weight gain (American Psychiatric Association, 2013). These behaviours may put both well-being and prospects of thriving at risk. Hence, it is worthwhile to gain a better understanding of the role of patients' personality traits in mediating their ED-related condition (Amianto, Abbate-Daga, Morando, Sobrero, & Fassino, 2011).

Cloninger's Psychobiological Model of Temperament and Character is one of the most notable theories focusing on the relationship between personality and psychopathology. The model proposes a linkage between personality dimensions and impairment in different neuronal substrates. Personality is described as a complex dynamic system relying on four temperamental dimensions, each mediated by a specific neurotransmitter system: (i) reward dependence (RD), mediated by dopamine, is characterized by the tendency to react to rewarding stimuli, especially those involving social acceptability (Zohar, 2007), in order to preserve behaviours that enhance reward and/or avoid punishment; (ii) harm avoidance (HA), mediated by serotonin, is characterized by the tendency to react to stimuli and signals that are internalized as arousing anxiety and disgust; (iii) novelty seeking (NS), mediated by norepinephrine, is characterized by the tendency to react emotionally to new stimuli, as well as by impulsive decision-making and extrovert behaviours; and (iv) persistence (P), which lacks a specific mediating neurotransmitter and is defined as a willingness to invest and persist despite frustrations, combined with a linkage and attraction to issues that interest the individual (Cloninger, 1987; Elovainio *et al.*, 2004). Importantly, each dimension is regarded as genetically homogeneous and independent (Cloninger, Svrakic, & Przybeck, 1993).

The association between the personality types in Cloninger's model and EDs is complex. Studies focusing on RD differentiate between sensitivity to positive reward (SR) and sensitivity to negative reward/punishment (SP). According to the reinforcement sensitivity theory, both SR and SP are considered as representing

stable personality characteristics, potentially associated with distinct neuronal substrates (McNaughton & Gray, 2000). Claes *et al.* (2006) and Jappe *et al.* (2011) have demonstrated higher SP in patients with anorexia nervosa (AN) and bulimia nervosa (BN) compared to healthy controls. Nonetheless, the subpopulation diagnosed with binge-purge type AN (AN-BP) is characterized by reduced SP (Claes *et al.*, 2006). From a different perspective, patients with BN and AN-BP share similarly high NS in contrast to patients with restrictive type AN (AN-R) (Klump *et al.*, 2004). Last, patients with EDs, whether of the restrictive or the binge/purge (B/P) type, exhibit higher levels of HA in comparison to controls (Fassino *et al.*, 2002; Peterson *et al.*, 2010), suggesting that patients with EDs may be more averse to danger and adventure.

The aim of the present study was to carry out an in-depth investigation of the interrelationship between HA and RD in patients with B/P type EDs in the acute phase of their illness and following symptomatic stabilization. Despite the weight differences between BN and AN-BP populations, we decided to combine them in this study. Both disorders share similar impairments in impulse control and affect regulation compared to patients with AN-R, and both exhibit oscillations between over- and under-control that are fundamental characteristics of their pathophysiology (Butler & Montgomery, 2005; Casper, Hedeker, & McClough, 1992). Along the same line of reasoning, Claes *et al.* (2006) suggested that EDs may lie along a spectrum of disorders with varying degrees of obsessive–compulsive and impulsive traits. Specifically, AN-R is thought to belong to the obsessive pole of the spectrum, whereas AN-/BP and BN belong to the impulsive pole.

In our study, we focused on the dimensions of HA and RD as defined in Cloninger's model and further divided the RD dimension into SR and SP. In order to assess the impact of patients' personality dimensions on relevant behavioural aspects before and after stabilization of weight and disordered eating, we administered a decision-making task involving risk management by combining reward *versus* punishment feedback. In this way, we sought to expand Cloninger's model by examining its neuropsychological expressions in patients with EDs and to assess the effect of stabilization of weight and disordered eating on personality dimensions and cognitive functions.

Our hypotheses were:

1. HA and RD will be higher in patients with B/P type EDs compared to controls.
2. Sensitivity to reward and to punishment will be higher among patients with B/P type EDs compared to controls.
3. HA and RD will be correlated with sensitivity to punishment and reward.
4. Among patients with stabilized weight and eating, the levels of HA and RD will not change in comparison to baseline. By contrast, an improvement between the two study points will emerge for the experimental risk-taking behaviours assessed in this study.
5. Higher scores on the personality dimensions of HA and RD will be associated with increased experimental risk-taking behaviours in both the acute and the stabilized phases of the illness in the research but not the control participants.

Materials and methods

Participants

This prospective longitudinal study included 50 inpatients with B/P subtype EDs (11 with AN-B/P, 18 with BN, and 21 with eating disorders not otherwise specified (EDNOS) B/P type), as diagnosed with the *DSM-IV* (American Psychiatric Association, 1994). Inclusion criteria were as follows: (i) female gender; (ii) age between 15 and 25 years; (iii) good understanding of the Hebrew language; and (iv) consent by patients and their parent/legal guardian (in the case of minors under the age of 18) to participate in the study. Exclusion criteria were lifetime or current schizophrenic spectrum disorder, bipolar disorder, substance use disorder, organic brain disorder, mental retardation, and any medical illness potentially affecting appetite or weight (e.g., diabetes mellitus or thyroid disorders).

The patients were hospitalized in either the adolescent or the adult ED inpatient departments of the Sheba Medical Center in central Israel. Complete medical and neurological evaluations were administered on admission. Routine laboratory examinations, including electrolytes, liver, kidney, and thyroid functions, complete blood count, urinalysis, and levels of iron, ferritin, transferrin, folic acid, and vitamin B-12, were collected at baseline (within the first week of hospitalization), monthly thereafter, and additionally whenever required. An electrocardiogram was performed on admission and discharge and at other periods as required. Patients' weight (weekly) and height (monthly for adolescents, on admission only for adults) were assessed using standardized procedures (Tanner, 1994). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared (Bray & Atkinson, 1992). Thirty-four patients were assessed again at discharge after having stabilized their weight and their disordered eating. To qualify for discharge from either inpatient department, patients diagnosed with BN and EDNOS-B/P type EDs were required to abstain from B/P behaviours for two weeks according to their self-recordings on daily food monitoring sheets. In addition, patients diagnosed with AN-B/P were required to have reached their target weight and to maintain it for two weeks. Reasons for not completing the study were either premature discharge from inpatient treatment or refusal to participate in the second study assessment. Nonetheless, a comparison of the patients who did and did not participate in the second assessment yielded no significant differences on any of the demographic, clinical, or psychometric variables assessed at baseline (results not shown).

Thirty-six healthy control participants were matched with the patients for age, gender, education level, and IQ, and were assessed at two evaluation points, at time intervals similar to those of the research group. Adolescent control participants were recruited from the families of Sheba Medical Center staff members. Adult control participants were recruited *via* advertisements distributed in several universities in Israel. Inclusion criteria for control participants were as follows: (i) absence of lifetime or current psychiatric disorders, medical disorders, or chronic use of medications; (ii) no stigmata indicative of an ED; and (iii) regular menses since menarche. The weight of the adolescent controls had to be greater than 85% of ideal body

weight according to the sex-specific growth charts from the Center for Disease Control and Prevention (CDC) in 2000 (www.cdc.gov/growthcharts), found to be adequate also for Israeli youngsters (Goldstein, Haelyon, Krolik, & Sack, 2001). The weight of the adult controls had to be over 85% of ideal body weight since puberty according to the Metropolitan Life Insurance Company revised charts (1983). Weight and height of control participants were obtained by self-report.

Tools

a. Diagnosis

The Structured Clinical Interview for *DSM-IV* Axis I Disorders-Patient Edition (SCID-I/P Version 2.0) (First, Spitzer, Gibbon, & Williams, 1995) was used to establish ED diagnosis among the inpatients and lack of ED diagnosis among controls. Diagnoses of eating disorder not otherwise specified (EDNOS B/P type) was established if patients met all but one of the *DSM-IV* (APA, 1994) criteria for full-blown AN-B/P or BN. The SCID-I/P Version 2.0 was also used to assess the presence of other lifetime *DSM-IV* Axis I psychiatric morbidities among the inpatients, and their absence in the control group.

b. *Demographic and clinical variables*

Data on the inpatients' age, education level, BMI on admission and discharge, duration of illness before hospitalization, and duration of inpatient treatment were collected by means of a structured interview and from the patients' medical records.

Intelligence test

The Raven's matrices test (Irwing & Lynn, 2005) was used to test intelligence because it is relatively easy to administer, does not involve verbal behaviour that could confound performance, and is considered to be relatively culture free.

c. *Personality assessment*

1. *The Tridimensional Personality Questionnaire (TPQ;* Cloninger, 1987*)*

This questionnaire includes 100 yes/no questions. It is based on the personality dimension theory (Cloninger, 1987), which evaluates four personality temperamental dimensions—NS, HA, RD, and P. A higher score in each of the four TPQ dimensions (sum of 'yes' answers on every scale) reflects a greater tendency toward that dimension.

Previous studies (Benjamin *et al.*, 1996; Ebstein *et al.*, 1996) have verified the validity and reliability of the Hebrew version of the TPQ. The internal reliability of the four scales in the present study was high in both the first (Cronbach α for NS, RD, HA, and P were 0.61, 0.88, 0.71, and 0.59, respectively) and second (Cronbach α for NS, RD, HA, and P were 0.56, 0.85, 0.74, and 0.47, respectively) evaluations. To the best of our knowledge, the current study is the first to use the TPQ among Israeli patients with EDs.

Sensitivity to punishment and sensitivity to reward questionnaire (SPSRQ; Torrubia, Avila, Molto & Caserasd, 2001)

This questionnaire is composed of 48 yes/no questions, divided equally between questions evaluating the individual's SP (sum of unpaired questions) *versus* SR (sum of paired questions). Higher scores (sum of 'yes' answers on each of the two scales) indicate higher sensitivity to the examined parameter. Alpha and test–retest reliabilities have been found to reach acceptable levels for both SD and SR scales (Torrubia, Avila, Molto, & Caserasd, 2001). Three professional translators independently translated the SPSRQ into Hebrew for the present research, and all three approved the final version after parallel comparison of the three drafts. In the current study, the internal consistencies of both scales were high in the first (Cronbach α for SR and SP were 0.73 and 0.84, respectively) and the second (0.75 and 0.86, respectively) stages. The examined parameters were SR and SP scores.

d. *Emotional characteristics*

1. *Beck Depression Inventory (BDI-Beck, Beck, Steer, & Carbin,* 1988*)*

This self-report scale includes 21 items assessing various dimensions of depression. General scores of 0–9, 10–18, 19–29, and 30 and above indicate no depression, mild depression, moderate depression, and severe depression, respectively. The BDI has been previously used in patients diagnosed with EDs (Pollice, Kaye, Greeno, & Weltzin, 1997), including in Israeli samples (Stein *et al.*, 2005). The internal reliability of the BDI in the present study was high in both the first and the second stages (Cronbach α of 0.94 and 0.93, respectively).

2. State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970)

This self-report scale examines anxiety level at the time of evaluation (STAI-State or STAI-S), as well as the general tendency to exhibit anxiety (STAI-Trait or STAT-T). Each dimension includes 20 items. For the STAI-S, scores of 20–40, 41–50, and above 50 indicate mild, moderate, and severe situational anxiety, respectively. On the STAI-T, scores of 20–40, 41–52, and above 52 indicate mild, moderate, and severe trait anxiety, respectively. The STAI has been previously used in patients diagnosed with EDs (Pollice, Kaye, Greeno, & Weltzin, 1997), including in Israeli samples (Rothschild *et al.*, 2008). In the present study, the internal consistency of both scales was high in the first (Cronbach α for STAI-$T = 0.93$, for STAI-S = 0.95) and second (Cronbach α for STAI-$T = 0.94$, for STAI-S = 0.95) stages.

e. *Behavioural and decision-making assessment*

1. *Gambling task* (Bechara, Damasio, Damasio, & Anderson, 1994)

The objective of the gambling task (GT) is to evaluate the participant's dependence on positive and negative rewards. The

paradigm has been originally developed to investigate ventromedial insults. Its advantage lies in its ability to mimic real-world situations, as it simultaneously encompasses lack of certainty, reward and punishment.

Participants were instructed to choose one card from four decks of cards 100 times, with the aim of earning as many rewards as possible. A 'financial' reward was associated with each card picked up, along with occasional losses. Each card deck had a specific pattern, so that over the long term, decks C and D were advantageous whereas decks A and B were disadvantageous. Advantageous decks gave participants small rewards with small losses, so that sustained choosing eventually resulted in financial reward. In contrast, the disadvantageous decks included high rewards with very high losses, so that consistent long-term selection of these decks resulted in financial losses. The working hypothesis in this task's design is that repeatedly choosing 100 times will enable participants to understand the pattern of each deck, leading to optimal deck selection toward the end of the task. The main characteristics of the GT are lack of certainty regarding reward or punishment, immediate feedback after every card pick-up, and the combination of motivation and learning over time.

f. *Interaction between personality dimensions and decision-making*

To assess the interaction between personality dimensions and behavioural characteristics, we established an additional criterion for classifying participants: the difference in GT score between admission and discharge. This score represents the participants' selection of non-advantageous decks at discharge (T2) *versus* admission (T1). A positive difference score indicates improvement of performance at T2 compared to T1 by reducing non-advantageous selection, while a negative difference score indicates no reduction in non-advantageous selection from T1 to T2. Thereafter, we computed the interaction between the difference scores and personality dimensions for both the research and the control groups.

Procedure

The study was approved by the Helsinki Institutional Committee of the Sheba Medical Center. All patients and their parents/legal guardians (in the case of minors under age 18) agreed to participate by signing a written informed consent form after receiving an explanation about the study aims and procedure.

The study was conducted in two stages: during the acute phase of illness in the first period of hospitalization (T1) and toward discharge when the patients were weight-restored and no longer exhibited ED-related symptoms (T2). Controls went through similar stages at time intervals correlated with the patients' intervals. The research staff members were blind to the participants' group-allocation and hospitalization timing (T1 *vs.* T2).

Experienced adult and child and adolescent psychiatrists interviewed the patients on admission using the SCID-I/P Version 2.0. The department teams confirmed the diagnoses at clinical meetings. Psychology students studying for their master's degree and trained by one of the authors (D.S.) similarly interviewed the control participants using the SCID-I/P Version 2.0.

The computerized assessments took place individually in a quiet room an hour after breakfast, to reduce the influence of food consumption on the results of the study. Each session lasted approximately 2 h. All participants performed the computerized task on the same laptop computer with Processor/CPU Intel Core2, 2GB memory, and Windows 7 software. The self-rating questionnaires were administered in random order. The self-rating questionnaires and computerized test were administered twice to all participants by a different team of psychology students studying for their master's degree.

Statistical analysis

Data were analysed using SPSS software. Demographic, clinical, and psychometric parameters, including age, education, Raven's test score, and duration of illness and of inpatient treatment, were initially analysed using descriptive statistics. A series of unidirectional variability analyses were conducted, with study group as the independent parameter and the aforementioned parameters as the dependent parameters.

The next step was evaluation of the study's hypotheses. Three assessments were conducted for each task using a series of mixed variability analyses, in which the independent inter-participant parameter was study group while the independent intra-participant parameter was assessment timing. First, we evaluated whether the study groups differed from each other according to the TPQ-RD and TPQ-HA, irrespective of the time of evaluation (main effect of study group). Second, we assessed the potential differences in these personality dimensions between the two assessments, irrespective of the participant's group of reference (main effect of evaluation time). Third, we examined the interaction between study group and evaluation time for the TPQ-RD and TPQ-HA. Computation involved a series of mixed variability analyses in which the independent inter-participant parameter was study group while the independent intra-participant parameter was assessment timing. Dependent parameters were specifically defined for each tool.

The last analysis focused on the correlations between the different dimensions, using Pearson's correlations matrices. Specifically, regarding the GT parameter analysis, we added a covariant test for anxiety and depression to exclude possible emotional bias.

Results

Demographic and clinical variables and response to treatment

No between-group differences were found for age, years of education, and the time duration between the beginning and end of the study (Table 1). Significant differences in depression and anxiety were found between patients with B/P type EDs and controls (Figure 1). The study group scored significantly higher than the control group on both depression and anxiety at T1 (upon admission), followed by a significant improvement in both parameters among the research participants at T2 (at discharge). Body mass index was found to be significantly lower in patients with BP type EDs at T1 compared to controls ($p < 0.01$), followed by improvement from admission to discharge among research participants ($p < 0.05$; BMI: 19 ± 3.2 and $21 \pm 2\,kg/m^2$ among research and control participants, respectively, at T1 compared to 20.9 ± 2 and $21.1 \pm 1.8\,kg/m^2$, respectively, at T2).

Table 1 Between-group differences in demographic and clinical variables

	B/P*		Control			
	Mean	SD	Mean	SD	$T_{(2,68)}$	p
Age	18.42	2.96	18.76	2.94	.53	NS†
Education (years)	11.06	1.39	11.14	1.50	.25	NS
Duration of hospitalization‡ (months)	3.13	1.47	3.59	.79	1.63	NS

*B/P: binge/purge spectrum eating disorders.
†NS: not significant.
‡Duration of hospitalization describes the interval between admission and discharge and a matched duration between the two study points for the control group.

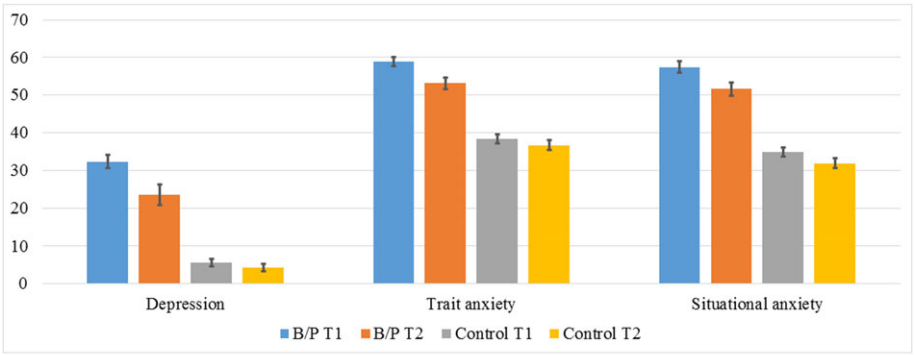

Figure 1. Emotional characteristics at baseline (T1) and second (T2) assessment points. [Colour figure can be viewed at wileyonlinelibrary.com]

Personality dimensions

a. *TPQ harm avoidance and reward dependence*

A significant difference was found between the research and control participants for both TPQ-RD and TPQ-HA (Figure 2). Specifically, the B/P cohort had significantly lower HA scores ($p < 0.05$) and higher TPQ-RD scores ($p < 0.01$). While RD decreased significantly from T1 to T2 ($p < 0.05$) without significant between-group differences, no significant difference was found in HA levels between T1 and T2 for either research or control participants.

b. *Sensitivity to reward (SR) versus sensitivity to punishment (SP)*

Two significant between-group differences were found for the SPSRQ. First, patients with B/P type EDs had significantly lower SPSRQ-SR scores compared to controls ($p < 0.05$). Second, for both groups, SPSRQ-SR was significantly lower at T1 compared to T2 ($p < 0.01$, Figure 3).

For the SPSRQ-SP dimension, we found that B/P type EDs patients scored significantly lower on SP than control participants ($p < 0.001$). Additionally, for both groups, the SPSRQ-SP score was significantly lower at T1 compared to T2 ($p < 0.05$, Figure 3).

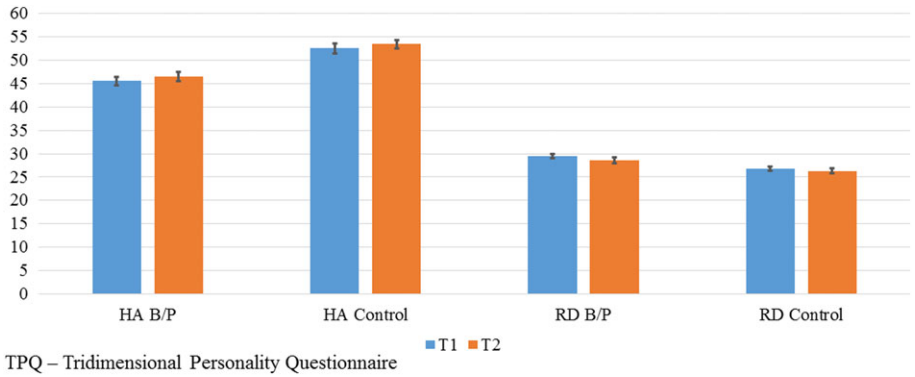

Figure 2. TPQ harm avoidance (HA) and reward dependence (RD). [Colour figure can be viewed at wileyonlinelibrary.com]

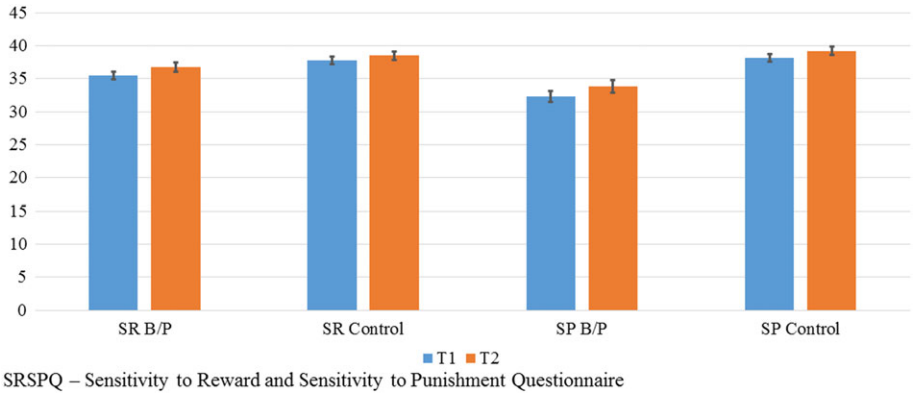

Figure 3. SRSPQ-sensitivity to reward (SR) and sensitivity to punishment (SP) scores at baseline (T1) and second (T2) assessment points. [Colour figure can be viewed at wileyonlinelibrary.com]

c. *Correlations among the personality dimensions*

While significant correlations were found between SRSPQ-SP and both TPQ-RD and TPQ-HA, SRSPQ-SR did not correlate with any TPQ parameter. SRSPQ-SP correlated negatively with TPQ-RD and correlated positively with TPQ-HA at both assessment points (Supporting Information Table 1).

Behavioural and decision-making assessment according to the gambling task (GT)

While patients with B/P type EDs demonstrated similar performance on the GT at both time points, healthy control participants showed improved performance at T2 compared to T1, as reflected by significantly reduced non-advantageous card selection accompanied by significantly increased advantageous card selection ($p = 0.05$), representing a possible learning curve (Figure 4). No between-group differences were found for GT at both assessment points. Covariance analysis for emotional parameters demonstrated that severity of depression ($p = .57$), situational anxiety ($p = .69$), and trait anxiety ($p = .36$) did not moderate the between-group differences on GT performance at either admission or discharge.

Interaction between personality dimensions and decision-making

We established a 'difference score' criterion representing non-advantageous card deck selections at T1 and T2. A 'positive difference score' was defined in the case of improvement in GT performance resulting from a reduction in non-advantageous selection. In the case of a 'negative difference score,' there was no reduction in non-advantageous card selection at T2 compared to T1.

A three-way analysis revealed an interaction between 'difference score' and TPQ-HA [$F(1, 65) = 4.44$, $p = 0.04$, $\eta^2 = 0.064$]. This interaction was more robust in the research group [$F(1, 31) = 5.31$, $p = 0.028$, $\eta^2 = 0.146$]. Specifically, patients with a positive difference score exhibited significantly higher TPQ-HA scores (Supporting Information Figure 1). On the contrary, no significant interaction was found between 'difference score' and TPQ-HA in the healthy controls [$F(1, 30) = 0.47$, $p = 0.5$, $\eta^2 = 0.015$].

Discussion

Personality dimensions have a major impact on the development of EDs. The aim of the current study was to assess the personality

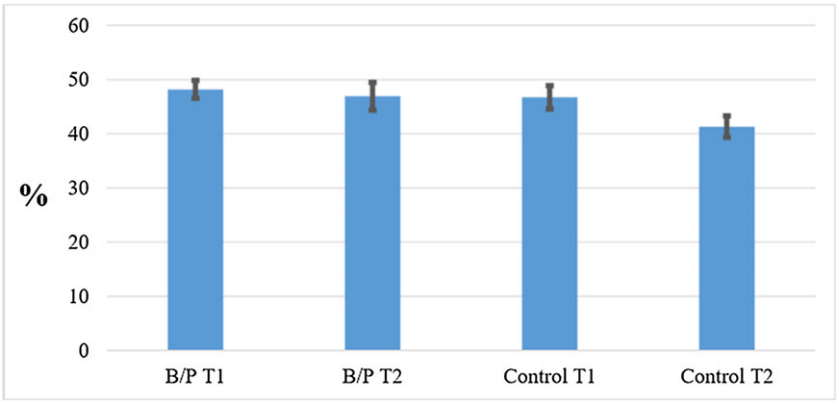

Figure 4. Means and standard deviation of disadvantageous cards selection among patients with binge/purge (B/P) type eating disorders and controls in the gambling task (GT) at baseline (T1) and second (T2) assessment points. [Colour figure can be viewed at wileyonlinelibrary.com]

dimensions TPQ-RD and TPQ-HA among patients with B/P type EDs, both during the acute phase of their illness upon admission to specialized inpatient ED departments, and following weight restoration and symptomatic stabilization at discharge. We also sought to explore the relations between these traits and the participants' decision-making abilities as exemplified in an experimental risk-taking behavioural task.

On our main evaluation tool, the TPQ, both patients and controls exhibited no change in TPQ-RD or in TPQ-HA scores from admission to discharge, in keeping with our fourth hypothesis. This may suggest that a period of several months is not sufficient to exert any change in long-lasting biologically dependent personality characteristics (Van den Akker, Dekovic, Asscher, & Prinzie, 2014). In contrast, patients exhibited significant improvement in the emotional dimensions of depression and anxiety from admission to discharge.

Contrary to the first hypotheses, our results indicate that patients with B/P type EDs show lower TPQ-HA scores compared to healthy controls. These findings contradict previous studies reporting higher TPQ-HA scores in patients with both AN and BN (Brewerton, Hand, & Bishop, 1993; Klump *et al.*, 2000; Peterson *et al.*, 2010). One possible explanation for this discrepancy is that some of our patients were adolescents, i.e., younger than the adult patients assessed in most previous studies. Perhaps, a definite period of time needs to elapse before individuals develop aversion to change and risk-taking (Barbot, Hunter, Grigorenko, & Luthar, 2013; Van den Akker *et al.*, 2014). In contrast, the results confirmed our first hypothesis regarding the occurrence of higher TPQ-RD in patients with B/P type EDs. They further corroborated the findings of previous studies emphasizing dysfunctional reward mechanisms among patients with EDs (Schulte, Grilo, & Gearhardt, 2016), as well as increased activation in neural regions associated with reward appraisal in response to food stimuli (Weygandt, Schaefer, Schienle, & Haynes, 2012).

RD sub-dimensions related to sensitivity to reward and punishment were evaluated using a self-report questionnaire, the SPSRQ, and an empirical task—the GT—assessing participants' tendency to choose advantageous *versus* non-advantageous decks of cards. In contrast to our second hypothesis, patients with B/P type EDs demonstrated reduced SP, which significantly correlated with their lower TPQ-HA scores, as suggested in hypothesis three. In other words, the tendency to react to stimuli and signals internalized as arousing anxiety and greater avoidance of change correlated with greater SP. Moreover, patients with B/P type EDs may disregard the changes associated with their ED-related health deterioration because they are less sensitive to negative consequences (punishments) than healthy controls. Whereas a previous study showed a dissociation between positive and negative rewards in patients with AN and BN (Cardi, Di Matteo, Corfield, & Treasure, 2013), our findings suggest that in patients with B/P type EDs, a higher SR goes along with a simultaneous lower SP. These findings may place the emphasis on low weight as a positive reward for young patients and a major motivation for continuing with their ED behaviour, rather than their being discouraged by the negative consequences of their illness (Lose, Davies, Renwick, Kenyon, Treasure, & Schmidt, 2014).

In addition to the personality dimensions, the present study evaluated the participants' tendency toward risk-taking decisions and behaviours. In keeping with the fifth hypothesis, our results demonstrate a clear association between the temperamental personality dimensions of the TPQ and risk-taking tendencies in patients with B/P type EDs. Specifically, those patients with reduced non-advantageous card selection at symptomatic stabilization (represented by a positive difference score) had significantly higher TPQ-HA scores, in comparison to patients whose risk-taking tendencies were not affected by symptomatic change. In other words, high TPQ-HA, reflecting greater anxiety and rejection of change, was associated with reduced selection of risky card decks, resulting in improved performance at symptomatic stabilization. The associations found between greater TPQ-HA and greater SP, as well as between greater TPQ-HA and lower risk-taking tendencies on the GT, may protect B/P type ED patients against their often elevated impulsive tendencies (Cassin & von Ranson, 2005). During the GT, the non-advantageous card decks were characterized by higher rewards but even higher losses compared to the advantageous card decks. Therefore, choosing these card decks reflected a preference for short-term rewards despite long-term losses. During repetitive exposure to GT at T2, healthy controls demonstrated a significantly lower tendency to choose non-advantageous card decks compared to patients with BP type EDs. Similar to previous studies (Cavedini *et al.*, 2004), our findings highlight the inability of patients with B/P type EDs to adjust their poor decision-making, despite symptomatic improvement.

In summary, two separate tools identified reduced HA among the patient group: the TPQ-HA and choosing non-advantageous card decks in the GT. These findings have important implications. First, the maladaptive eating behaviour of patients with B/P type EDs may derive from their overall low HA. In other words, the negative consequences of their ED on their health do not prevent them from continuing with their ED-related behaviours. Second, the RD sub-dimensions provide a better understanding of the potential role of dysfunctional reward systems in patients with B/P type EDs in interfering with overall outcome. Our findings suggest that patients' low HA may be associated with low SP rather than with elevated SR. In other words, patients with B/P type EDs may not pay attention to the deleterious effects of their disordered eating on their health, not because they overestimate the positive reward of the ED (e.g., weight loss), but rather because they are not sensitive to the potentially negative effects of their illness. Moreover, these findings may have clinical implications, as treatment should target the patients' low HA and SP. In other words, treatment should aim to increase patients' awareness of the negative implications of their illness and of the risks implicated in its continuation. In addition, as the TPQ is a well-accepted tool in the assessment of personality, it should be noted that according to our findings, in patients with B/P type EDs the RD dimension relates mainly to SP rather than to SR.

Limitations and advantages

In considering the current findings, one should bear in mind the limitations of this prospective longitudinal study. First, not all

inpatients took part in the second evaluation at discharge. Nevertheless, we found no differences for any of the variables assessed on admission when comparing patients who did and did not participate in the second assessment. Second, we did not evaluate the potential influence of comorbid *DSM-IV* (APA 1994) Axis I psychiatric disorders on our findings. However, we did check for the potential impact of depression and anxiety on the results using self-rating questionnaires. Third, two weeks of abstinence from bingeing and/or purging behaviours before discharge may be too short a period to qualify for stabilization of these behaviours. Similarly, two weeks of normal BMI may not be sufficient to achieve nutritional rehabilitation. Yet, in practice, most of our B/P type ED patients have shown a considerable reduction in B/P behaviours, and most of the patients with AN-B/P achieve a near target BMI before the last two weeks of inpatient treatment. Finally, as the study included only inpatients, our findings cannot be generalized to populations with less severe EDs treated in ambulatory settings.

Despite these limitations, the study also has several important advantages. This longitudinal hypothesis-generated research study used well-established questionnaires and empirical tools for comprehensive assessment of HA and RD and their association with important behavioural correlates among patients with EDs during the acute stage of their illness and following symptomatic stabilization.

Conclusion

Comprehensive assessment of the personality dimensions of HA and RD using both the TPQ and empirical tools shows that patients with B/P type EDs exhibit an association between reduced SP and reduced HA. We speculate that this association may cause these patients to ignore the likely deleterious effects of their illness. From a neuropsychological perspective, the current research demonstrates a clear distinction between SR *versus* SP. In addition, it demonstrates a significant association between RD (mainly SP) and HA. It also raises the possibility that assessing RD using the TPQ seems to mark decreased SP rather than increased reward sensitivity. Third, the reinforcement sensitivity theory describes two separate motivational systems focusing on SR *versus* SP. Our findings add to this distinction by showing different influences of SP and SR in patients with B/P type EDs. Future research should focus on a larger cohort of ambulatory patients with both restrictive and B/P type EDs from the early stage of the illness to recovery to assess the association between the personality dimensions evaluated in this study and overall outcome.

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