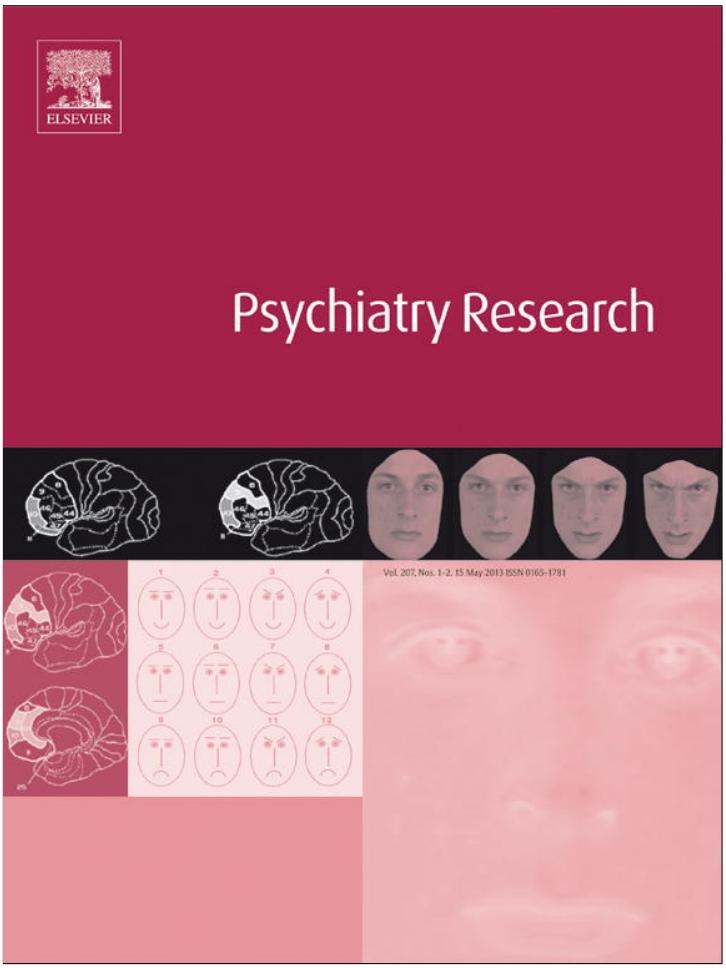

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# Influence of negative affect on choice behavior in individuals with binge eating pathology

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ABSTRACT

Research suggests that individuals with binge eating pathology (e.g., bulimia nervosa (BN) and binge eating disorders (BED)) have decision making impairments and particularly act impulsively in response to negative affect. The aim of this study was to examine the influence of negative affect on choice behavior in women with BN and BED. Ninety women (59 with BN or BED and 31 healthy controls) watched a sad or control film fragment and were subsequently asked to complete a choice behavior task (as measured by a variation of the Bechara Gambling Task (BGT)). Results showed that negative affect influenced choice behavior differently in healthy controls and in women with BN and BED after punishment (but not after reward). In the context of increased negative affect, punishment was associated with more disadvantageous choice behavior in both BN and BED women but not in healthy controls, while the effect was the exact opposite in both groups after a decrease in negative affect. Levels of sadness were not found to influence choice behavior after reward in either groups. These findings suggest that emotional states may have a direct impact on choice behavior of individuals with binge eating pathology and are not only related to pathological behavior itself.



## 1. Introduction

There is consistent evidence that negative affect is an antecedent of binge eating in both bulimia nervosa (BN) and binge eating disorders (BED) (Smyth et al., 2007; Hilbert and Tuschen-Caffier, 2007; Whiteside et al., 2007). It has been suggested that binging may serve as an attempt to reduce this affect (Smyth et al., 2007; Deaver et al., 2003). Furthermore, the instantaneous alleviation of negative feelings experienced after binging may be experienced as rewarding, and so can serve to reinforce this behavior (Smyth et al., 2007; Hilbert and Tuschen-Caffier, 2007; Hayaki, 2009).

Negative affect has previously been associated with an impulsive nature in individuals with eating disorders (Danner et al., 2012; Fischer et al., 2008). For example, a positive relation was found between bulimic behaviors and the tendency to act impulsively in response to negative affect (Fischer et al., 2003; Fischer et al., 2008). Impulsivity as well as sensitivity for reward and punishment are typical personality characteristics of individuals with both BN and BED (Fischer et al., 2003; Nasser et al., 2004; Schienle et al., 2009). Reward sensitivity is even thought to partly underlie the impulsive nature of these individuals and may play a role in the initiation of binge cravings and the desire to binge since tension often precedes the bingeing. As a result of this, the binge causes an immediate gratification (Brogan et al., 2010; Dawe and Loxton, 2004). The impulsive personality of these individuals, is not only expressed in pathological eating behavior, but also in other maladaptive behaviors associated with impulsivity such as substance abuse and impulse control problems (Hudson et al., 2007; Pearlstein, 2002).

Being sensitive to reward as well as impulsivity has been associated with decision making in the general population (Franken and Muris, 2005). According to Franken and colleagues (2008) impairments in adaptive choice behavior may be related to impulsive personality characteristics. In their study, highly impulsive participants displayed deficits in decision making performance in comparison to participants low in impulsivity. They further showed that high impulsivity was related to weaknesses

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in learning of reward and punishment associations, which in turn resulted in a decreased ability to alter choice behavior. This indicates that having an impulsive personality makes it more difficult to ignore the immediate reward and learn from punishment in order to make different choices based on long-term positive outcomes.

Furthermore, negative affect, in the form of affective liability as well as direct experience of negative affect, has been linked to disadvantageous decision making (Jollant et al., 2007; de Vries et al., 2008). In fact, a recent study has shown that the tendency to act impulsively in response to negative affect is related to all kinds of problematic behaviors and in specific to disadvantageous decision making (Billieux et al., 2010).

Seeing the impulsive nature of individuals who display binge eating behaviors and their generally high levels of negative affect, it logically follows that these individuals are likely to show impaired decision making ability. Indeed, recent research has demonstrated impaired decision making in individuals with binge eating pathology, both in BN and in BED (Boeka and Lokken, 2006; Brand et al., 2007; Davis et al., 2010; Danner et al., 2011). As expected, choice behavior of these individuals typically appears to be based on short-term rewards, thereby ignoring long-term consequences (Danner et al., 2011; Liao et al., 2009). However, as yet it remains unclear in what way the direct experience of negative affect influences choice behavior in women with BN and BED.

The current study set out to examine how negative affect influences choice behavior in women with binge eating pathology, and to compare such outcomes with the behavior of healthy control women with normal weight. Two separate groups were studied, namely women with BN and with BED, since it has been suggested that purging behavior may be even more related to impulsivity than binge eating behavior (Hoffman et al., 2012) and purging behavior is only seen in individuals with BN and not with BED. Additionally, we decided to include healthy weight, and not to include obese women without eating pathology as a comparison group for BED participants because this group is known to experience decision making problems comparable to individuals with eating disorders (Davis et al., 2010; Danner et al., 2011) and are also characterized by impulsivity and reward sensitivity (Guerrieri et al., 2008; Franken and Muris, 2005).

To test choice behavior in the context of punishment and reward, we used an adapted version of BGT (Bechara Gambling Task; Bechara et al., 1994; Mueller, 2009), in which participants received either a reward (winning money) or a punishment (loss of money) after each choice. Unlike the BGT, reward and punishment are never given simultaneously thereby allowing us to fully explore choice behavior in response to reward vs. punishment.

In sum, this study aims to test the following hypotheses. First, women with binge eating pathology (both BN and BED) display poorer decision making than control women. Second, this effect is amplified after the experience of negative affect. Finally, we aimed to explore similarities and difference in women with BN and BED.

## 2. Methods

### 2.1. Participants and design

Ninety-five women participated in the study: 30 women with a diagnosis of BN or EDNOS with a BN indication and 31 women with a diagnosis of EDNOS subtype BED. These women were recruited from two specialized clinics for eating disorders and from individual therapists in The Netherlands, and they were all in treatment for their eating disorder. Their diagnoses were determined according to DSM-IV criteria as ascertained by eating disorder experts (all medical doctors). Thirty-four healthy controls, women without eating disorders diagnoses, were recruited at Utrecht University and within the community. Prior to participation, they were screened by telephone using the Mini International Neuropsychiatric Interview (MINI), an abbreviated psychiatric structured interview (see also van Vliet and de Beurs, 2007) to preclude any psychiatric disorder (anxiety disorder, substance abuse) and in particular all eating disorders. In addition, Eating Disorders Diagnostic Scale diagnosis scores (see Section 2.2.3) were calculated after their participation to exclude healthy controls who showed sub- or full-threshold eating disorders.

Participants were excluded if they were on antidepressant medication. Three healthy control women (reporting binge episodes on the EDDS) and two BED women (on antidepressant medication) were excluded, resulting in the inclusion of 90 women in the analyses.

The study had a factorial design with two factors: emotion condition (negative vs. control) and group (BN, BED, healthy control). Demographic information of the participants was assessed with a self-report questionnaire asking their age, weight and height (to calculate Body Mass Index (BMI) in kg/m$^2$), as well as the highest level of education completed (participants were asked to report their highest completed level of education on a scale from one, primary school, to seven, university degree). Demographic information was compared between the groups. BED women were older than BN and control women, while BN and control women did not differ in age (BN $M=25.37$, S.D.$=3.16$, BED $M=38.48$, S.D.$=10.68$, and control women $M=30.19$, S.D.$=14.50$); moreover, as expected a similar effect was found for BMI: BED women had a higher BMI ($M=37.46$ kg/m$^2$, S.D.$=5.10$) than BN women ($M=23.44$ kg/m$^2$, S.D.$=3.29$) and control women ($M=21.83$ kg/m$^2$, S.D.$=2.30$), while the latter two groups did not differ. BED women completed on average a lower level of education ($M=4.93$, S.D.$=1.51$) than control women ($M=6.00$, S.D.$=0.97$), and BN women did not differ from either group ($M=5.47$, S.D.$=1.36$).

### 2.2. Measures and materials

The study consisted of an emotion induction, choice task and several questionnaires to assess relevant clinical and personality traits.

#### 2.2.1. Emotion induction

To evoke negative emotions, a film fragment (2:51 min) was used from the movie "The Champ". This film fragment is known to elicit sadness (Gross and Levenson, 1997) and has been proven successful in inducing sadness in eating disordered individuals (Dingemans et al., 2009; Zonnevylle-Bender, 2002). In the control condition, a control film fragment was used as a control stimulus comparable in duration (3:32 min). The fragment concerned a weather report that has previously been rated as affectively neutral and as not changing the current emotional state (Evers and de Ridder, 2008; Schaefer et al., 2006).

To examine the effect of the emotion induction on the actual experience of sadness, sadness experience was measured prior to and after the film fragment following a procedure outlined by Gross and Levenson (1997). This procedure requires participants to rate the extent to which they are experiencing sadness at that moment, by using seven-point Likert scales ranging from zero "not at all" to six "very strongly".

Analyses were conducted with the difference scores in sadness before and after the film fragments. It was necessary to calculate the difference scores in sadness due to two reasons. First, the groups differed in overall level of sadness (see Section 3.2) particularly with the BN and BED groups higher on sadness both at baseline and after the emotion induction compared to healthy controls. Second, we were interested in testing whether an increase in negative affect influences choice behavior. Difference scores were calculated by subtracting sadness on *T*0 from sadness on *T*1.

#### 2.2.2. Choice task

The choice task was based on the Bechara Gambling task (BGT) which is an electronic version of the Iowa Gambling Task that is available for free (Bechara et al., 1994; Mueller, 2009; van den Bos et al., 2006). In this task, participants had to choose cards from different decks and with every choice, participants won or lost money. Differing from the BGT (where on the punishment trials participants won and lost money simultaneously with the net result of losing money) participants either won ***or*** lost money so that decision behavior in response to reward and punishment can be systematically examined. The magnitude of the losses was kept similar to the magnitude of the losses in the BGT. In order to determine decision making ability the number of cards chosen from each of the decks were counted.

Participants were instructed to win as much money as possible by choosing cards from the different decks as the money participants could win or lose differs in each deck. Starting with a €0 of (virtual) money, participants were told to chose one card at a time from one of four decks (A, B, C, D) until a stop sign appeared on the screen. Immediately after every choice (100 in total), participants learned whether they had won money (i.e. reward) or whether they had lost money (i.e. punishment). The rewards of decks A and B were larger (100) than the rewards of decks C and D (50). Punishments varied in each deck and were unpredictable for the participants. Punishment from decks A and C was frequent, but rather low in magnitude, while punishment was less frequent but high in magnitude in decks B and D. In the long run, decks A and B were the disadvantageous decks (net loss −7500 and −3500 respectively in case all 100 cards are chosen from the same deck), and decks C and D were the advantageous decks (net win 225 and 2300 respectively in case all 100 cards are chosen from the

same deck). Participants were informed that some decks were more beneficial and were warned to keep away from the unfavorable decks.

As previously mentioned, for every choice, it was determined whether the choice followed a reward or punishment. Subsequently, the number of choices after reward and the number of choices after punishment were counted for the disadvantageous decks (A and B) and for the advantageous decks (C and D). Choice behavior was examined by setting out the number of choices from disadvantageous decks against the number of choices from the advantageous decks following reward and following punishment.

#### 2.2.3. Descriptive instruments

The following clinical and personality characteristics are all considered relevant factors for emotion experience and choice behavior in individuals with binge-related disorders. We measured *impulsivity* with the Barratt Impulsiveness Scale (BIS; Patton et al., 1995) and included the subscale attentional impulsivity of the BIS as a measure of *urgency*, which refers to emotion driven impulsiveness (see Fischer et al., 2008). The BIS consists of 30 items, with each answer scored on a scale with values from one (almost never) to four (almost always). *Sensitivity for reward and punishment* was measured with the SPSRQ (Sensitivity for Punishment and Sensitivity for Reward Questionnaires; Torrubia et al., 2001) that consists of 48 yes/no items. Severity of depressive symptoms was assessed with BDI-II (BDI-II; Beck et al., 1996) that contains 21 questions, each answer scored on a scale value of zero to three with higher scores indicating more severe symptoms.

In addition, we used the Dutch version of EDDS (Eating Disorders Diagnostic Scale; Krabbenborg et al., 2012; Stice et al., 2000) to measure *overall level of eating pathology*. The EDDS contains 22 items that generates a continuous eating disorder symptom composite that reflects the participant's overall level of eating pathology and assesses *DSM-IV* symptoms for all three eating disorders. The EDDS is therefore a brief measure to diagnose AN, BN and BED, and these scores were used to determine sub- and full-threshold eating disorders in the control group. Cronbach's alpha for all questionnaires was acceptable (higher than 0.70).

### 2.3. Procedure

BN and BED women were first informed about the study by their therapist and those who were interested received an information letter and an informed consent form that required their signatures. Healthy control women were recruited through flyers in the community and were screened by telephone with the MINI to ensure that they did not suffer from current or lifetime psychiatric disorders. For suitable participants an appointment for the assessment was made. Participants were placed behind a computer in a quiet room. The order of testing was as follows: assessment of personality characteristics (BIS, SPSRQ), level of depression (BDI), baseline measure of sadness experience, emotion induction, second measure of sadness experience, choice task, and finally assessment of eating disorders symptoms (EDDS). Finally, participants were debriefed about the study.

### 2.4. Statistical analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS) version 16.0 for Windows. Analyses of Variance (ANOVA) were used to compare demographics, clinical and personality characteristics (e.g., age, overall level eating pathology, impulsivity) between the groups. Repeated measure ANOVAs were performed to check baseline differences (prior to emotion induction) in sadness experience and to test the effect of the manipulation (sadness experience prior and after the emotion induction).

Normality of the data was assessed in each group separately for sadness difference scores and choice behavior on each of the decks. Choice behavior was normally distributed, but sadness difference scores in at least one group were not normally distributed. We therefore transformed sadness difference scores using square root transformations, in which a constant of 10 was added to the sadness difference scores to generate only positive scores in order to proceed with the square root transformation for this variable (Tabachnik and Fidell, 2001).

Subsequently, to examine choice behavior, we conducted regression analyses with the General Linear Model using repeated measures (Tabachnik and Fidell, 2001) with group and sadness difference scores as predictors for the number of cards selected from the four decks, while controlling for BMI, level of education and age. We conducted two regression analyses in which we tested choices after win trials and choices after loss trials. Finally, to explore relations between overall level of eating pathology, general impulsivity, emotion driven impulsiveness (urgency), reward sensitivity, punishment sensitivity and depression level while controlling for BMI, level of education and age, partial correlations were calculated.

## 3. Results

### 3.1. Personality and clinical characteristics

As expected, in comparison to control women (see the mean and S.D. per group per characteristic at the bottom of Table 1), BN and BED women had much higher overall levels of eating pathology and BN women had a somewhat higher level of eating pathology than BED women. Both BN and BED women were in general more impulsive than control women, while in particular BN women reported to be more inclined to act impulsively in response to negative affect in comparison to BED and control women, while the latter two groups did not differ. Sensitivity for punishment was higher in BN and BED groups than in control women, while there was no group difference in sensitivity for reward. BN women had a higher depression level than BED women, and both groups reported higher depression levels than the control group.

### 3.2. Emotion induction

We tested if the groups had similar sadness scores at baseline (before the emotion induction) and whether negative emotion induction was successful and induced the same change in sadness in all groups. There was a main effect of group in terms of sadness scores, $F(2, 84)=7.49$, $p=0.001$, $\eta_p^2=0.16$, showing that sadness

**Table 1**
Partial correlations within the women displaying *binge eating behavior* (*bulimia nervosa and binge eating disorder*) between overall level of eating pathology (EDDS), impulsivity (BIS total), urgency (BIS attitudinal), reward and punishment sensitivity (SPSRQ), and depression (BDI) controlling for BMI, highest level of finished education and age as well as the mean (and S.D.) scores per group (bulimia nervosa vs. binge eating disorder vs. control women).

| | EDDS symptoms | BIS total | BIS attitudinal | SPSRQ reward | SPSRQ punishment | BDI |
|---|---|---|---|---|---|---|
| EDDS symptoms | | 0.42* | 0.29** | 0.20 | 0.14 | 0.25 |
| BIS total | 0.43* | | 0.65* | 0.34** | 0.16 | 0.42* |
| BIS attitudinal | 0.29** | 0.65* | | 0.20 | 0.22 | 0.25 |
| SPSRQ reward | 0.20** | 0.34** | 0.20 | | −0.07 | 0.14 |
| SPSRQ punishment | 0.14 | 0.16 | 0.22 | −0.07 | | 0.58* |
| BDI | 0.25 | 0.42* | 0.25 | 0.14 | 0.58* | |
| | Mean* (S.D.) | Mean* (S.D.) | Mean* (S.D.) | Mean (S.D.) | Mean* (S.D.) | Mean* (S.D.) |
| Bulimia nervosa $N=30$ | 47.57[a,b] (16.95) | 2.29[a] (0.39) | 2.43[a,b] (0.61) | 11.70 (4.39) | 13.00[a] (6.00) | 13.07[a,b] (7.20) |
| Binge eating disorder $N=29$ | 31.93[a,c] (9.85) | 2.20[a] (0.25) | 2.11[c] (1.85) | 9.86 (3.30) | 11.72[a] (6.52) | 9.35[a,c] (5.62) |
| Healthy controls $N=31$ | 9.10 [b,c] (6.54) | 1.94[b,c] (0.24) | 1.85[c] (0.51) | 10.03 (3.40) | 5.94[b,c] (3.59) | 1.39[b,c] (2.06) |

EDDS=Eating Disorder Diagnostic Scale, BIS=Barratt Impulsivity Test, SPSRQ=Sensitivity for Punishment and Reward Questionnaire, and BDI=Beck Depression Inventory.

* $p<0.001$.
** $p<0.05$.
[a] Different from control group.
[b] Different from the binge eating disorder group.
[c] Different from the bulimia group.

**Table 2**
Mean (and S.D.) of sadness score prior to (*T0*) and after (*T1*) the film fragments per group (bulimia nervosa, binge eating disorder and control group) in both conditions (negative and control emotion).

| Groups | Negative emotion | | | | Control emotion | | | |
|---|---|---|---|---|---|---|---|---|
| | *T0* | | *T1* | | *T0* | | *T1* | |
| | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| Bulimia nervosa, $N=30$ | 4.20 | 1.82 | 5.20 | 1.97 | 5.20 | 2.54 | 3.73 | 2.71 |
| Binge eating disorder, $N=29$ | 4.40 | 2.50 | 4.80 | 2.08 | 3.64 | 1.82 | 2.14 | 1.51 |
| Control, $N=31$ | 1.94 | 1.69 | 3.38 | 1.67 | 2.73 | 1.58 | 2.40 | 1.55 |

scores were overall (at both time points, baseline and after the emotion induction) higher in the BN and the BED group than in the control group, resp. $p<0.001$ and $p=0.015$. The BN and BED group did not differ from each other, $p=0.21$, see also Table 2 (at both baseline and after induction). There was also a main effect of condition, $F(1, 84)=5.11$, $p=0.026$, $\eta_p^2=0.06$, indicating that overall, the sadness scores were higher in the negative emotion condition than in the control emotion condition. More importantly, the results showed an interaction between time and emotion condition, $F(1, 84)=19.34$, $p<0.001$, $\eta_p^2=0.19$, and no other effects—$F$'s $<2.85$ and all $p$'s $>0.064$, indicated that in all groups sadness increased after the negative film fragment ($p=0.001$, difference score $T0-T1=-0.95$) and decreased after the control film fragment ($p=0.007$, difference score $T0-T1=0.77$) to the same extent.

These findings showed that the emotion induction was overall successful and that this effect was similar in all three groups. Since no group differences were found in the degree to which sadness changed as a result of the emotion induction but sadness scores in general were higher in both the BN and BED group in comparison to the control group, we used sadness difference scores in our analyses to test the influence of negative affect on choice behavior after reward and punishment.

### 3.3. Choice behavior

We first tested whether the groups differed in the *number of choices* in which they won vs. lost money during the choice task. All participants had more win trials ($M=73.89$, S.D.$=4.51$) than loss trials ($M=25.11$, S.D.$=4.51$), $F(1, 87)=2619.12$, $p<0.001$, $\eta_p^2=0.97$, and there was no difference between the groups, $F(2, 87)=0.79$, $p=0.46$.

Next, we tested the effect of sadness experience on choice behavior *after reward* between the groups. No main effects of group, sadness experience or choice of decks and no interaction effects were found, all $F$'s $<1.88$ and $p$'s $>0.16$.

Finally, we examined the effect of sadness experience on choice behavior between the groups *after punishment*. We did not find a main effect of group, sadness experience or choice of deck and no interaction effects of sadness experience with choice of deck or with group, all $F$'s $<1.67$, all $p$'s $>0.20$. There was a significant interaction effect of group $\times$ choice of deck, $F(2, 81)=4.90$, $p=0.01$, $\eta_p^2=0.11$. All groups chose (slightly) more cards from the disadvantageous decks; BN: $p<0.002$, BED: $p=0.06$, control: $p<0.001$. Most importantly, we found a three-way interaction between sadness experience $\times$ group $\times$ choice of deck, $F(2, 81)=5.37$, $p=0.006$, $\eta_p^2=0.12$.

To interpret the three-way interaction, we conducted simple comparisons in which we compared group $\times$ deck outcomes for two distinct levels of sadness experience (an increase vs. decrease in sadness), see also Fig. 1. The mean sadness difference score was $-0.12$ (and S.D.$=2.04$) and approximated to zero. Scores one standard deviation above the mean and one standard deviation below the mean were estimated in order to identify the levels of sadness experience to use in the comparisons (Tabachnik and Fidell, 2001). Finally, we compared two levels of sadness: more sadness (1S.D. above the mean) and less sadness (1S.D. below the

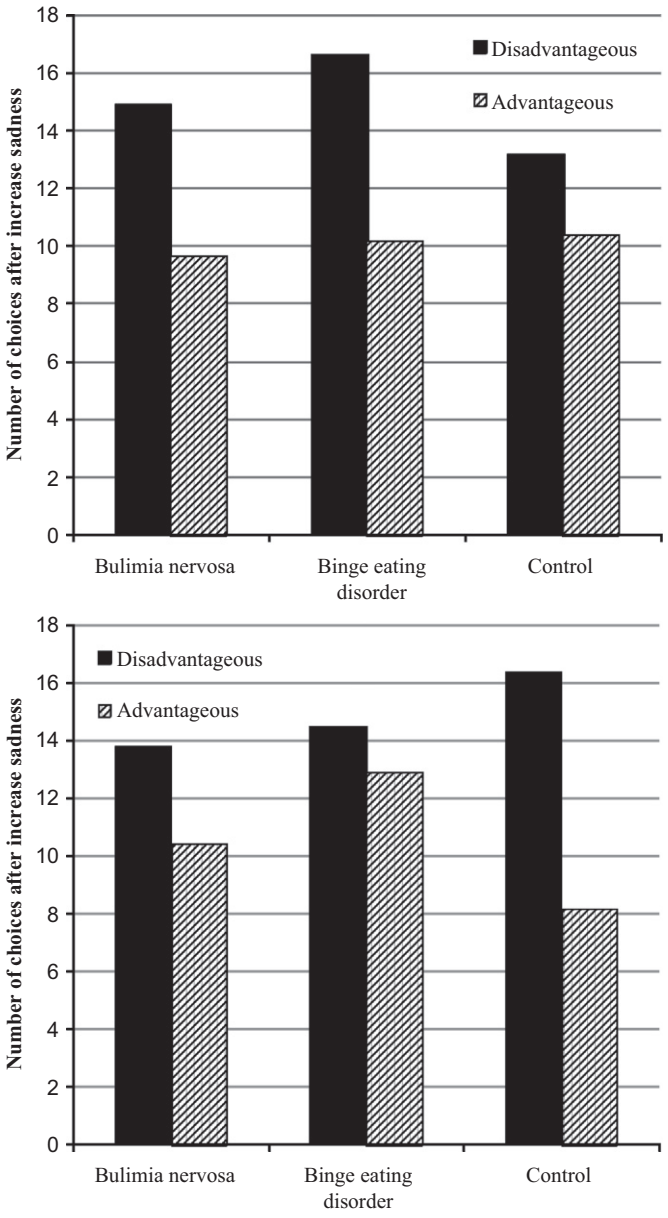


**Fig. 1.** (a) The mean number of cards chosen after ***punishment*** from the disadvantageous and the advantageous decks per group: bulimia nervosa, binge eating disorder and control women when sadness ***increased***. (b) The mean number of cards chosen after ***punishment*** from the disadvantageous and the advantageous decks per group: bulimia nervosa, binge eating disorder and control women when sadness ***decreased***.

mean) comparable to the effect of sadness prior and after the film fragments. The analysis showed that after an *increase* in sadness, both BN and BED women chose more often from the disadvantageous decks than from the advantageous decks, resp. $F(1, 81)=10.37$, $p=0.002$, $\eta_p^2=0.11$ and $F(1, 81)=6.39$, $p=0.013$, $\eta_p^2=0.07$, while control women did not differ in their choice for disadvantageous over advantageous decks, $F(1, 81)=2.44$, $p=0.12$. After a *decrease* in sadness, the effect was reversed: control women chose more often from the disadvantageous decks than from the advantageous decks, $F(1, 81)=18.64$, $p<0.001$, $\eta_p^2=0.19$, while this effect was less pronounced in BN and even absent in BED women, resp. $F(1, 81)=3.61$, $p=0.06$, $\eta_p^2=0.04$ and resp. $F(1, 81)=0.43$, $p=0.51$. In sum, negative affect did not influence choice behavior after reward (winning money) and there were no differences between BN, BED and control women in this context. However, after punishment (loss of money), an increase in sadness caused only BN and BED women to choose more disadvantageously, while a decrease in sadness caused only control women to choose more disadvantageously.

### 3.4. Correlations

We explored correlations between clinical and personality characteristics in BN and BED women together, see Table 1. Results showed that binge eating women with more clinical symptoms (EDDS symptom composite) were more impulsive in general and in response to negative affect. In addition, impulsivity was positively related to reward sensitivity and level of depression, while sensitivity for punishment was positively related to level of depression.

## 4. Discussion

The aim of our study was to examine choice behavior in women with binge eating pathology after reward and punishment in the context of negative affect and test possible differences in BN and BED women. Reward (winning money) did not result in differences in choice behavior between groups nor was negative affect an influence on choice behavior after reward. However, differences in choice behavior did emerge after punishment (loss of money). We found that negative affect influenced choice behavior after punishment differently in control women than in women displaying binge eating behavior, both BN and BED. While BN and BED women typically chose more disadvantageously after *increased* negative affect, control women typically chose more disadvantageously after *decreased* negative affect. Indeed, literature confirms that individuals with binge eating pathology are more likely to act impulsively in response to negative affect (Fischer et al., 2003; Fischer and Smith, 2008) and this tendency seems to be related to all sorts of problematic behaviors (Billieux et al., 2010), that exclusively pertain to problematic eating behavior per se. Billeux et al. (2010) have discussed about how these individuals seem to forget the long-term consequences of their choices when in a negative affective state, and consequently act impulsively thereby resulting in maladaptive impulsive behavior.

Binge eating women in this study reported a higher sensitivity for punishment and were more inclined to show impulsiveness, and in particular BN women reported more impulsivity in the context of negative affect. So why then did they refrain from changing their choice behavior after punishment (loss of money) when they experienced an increase in negative affect? Although individuals with binge eating pathology are more sensitive for the experience of punishment (Harrison et al., 2010; Loxton and Dawe, 2007), evidence suggests that this sensitivity does not determine their actions. Research have shown that individuals with a disposition to engage in impulsive action when experiencing negative affect are characterized by lower inhibitory capacities (Billieux et al., 2010) and it has been argued that negative affect may prevent more analytical deliberative processes that are necessary to consider the future costs of the choices. Similarly, Marsh et al. (2009) have found that individuals with BN seemed more prone in detecting error, but showed limited attempts to correct errors, and this finding have led the researchers to suggest that such behavior is a likely reflection of their impulsive personality. It thus seems that individuals with binge eating pathology may not be able to resist short-term gains even when long-term negative consequences are likely to result from it.

The experience of punishment is likely to increase negative affect in individuals who are more sensitive to punishment, which requires additional effective regulatory control such as inhibitory processes. However, binge eating pathology has been related to inhibitory difficulties (Rosval et al., 2006; Nederkoorn et al., 2006). Neurobiological findings provide additional evidence for impaired ability to regulate behavior (Marsh et al., 2009). The prefrontal cortex (PFC), for example, has been associated with disinhibited behavior (Dawe and Loxton, 2004) and decreased PFC activation was directly related to binge eating pathology in BN and BED (Karhunen et al., 2000; Uher et al., 2004) as well as to more impulsive behavior in BN (Marsh et al., 2009). In addition, while the orbitofrontal cortex (OFC) is important in decision making and emotional experience that is associated with reward and punishment (Bechara et al., 2000; Li et al., 2010; Rolls and Grabenhorst, 2008), and abnormalities in the OFC have been linked to binge eating pathology (Uher et al., 2004). For example, there are increased medial OFC volumes, as well as altered medial OFC processes, in BN and BED individuals (Schienle et al., 2009; Schafer et al., 2010).

Interestingly, the BN and the BED group in this study did not differ from control women in self-reported reward sensitivity. Scores on reward sensitivity were perhaps non-significant, but still somewhat higher in BN than in control women. Interestingly, the S.D. was much larger in the BN group than in the control group, which is suggestive of larger individual differences. However, BED women scored similarly as control women and their S.D.s were also comparable. Previous work on sensitivity to reward in relationship to binge eating pathology shows slightly inconsistent findings (see also Harrison et al., 2010) and future studies may want to focus on discrepancies between self-reported and neurobiological issues of reward sensitivity.

There are some implications of current findings for treatment of binge eating pathology. Previous studies show that impaired decision making is predictive of pathological behavior, for example, of poor treatment outcome in AN (Cavedini et al., 2006) and of binge drinking in adolescents who also showed a strong tendency to act impulsively in response to negative affect (Xiao et al., 2009). Since performance on decision making tasks can be predictive of treatment outcome, it may be valuable to include decision making competence at the start of treatment as individuals displaying impairments may be trained to learn more adaptive strategies (Davis et al., 2010). Indeed, studies have shown that executive functions can be modified through training with extensive practice that includes one or more executive functioning tasks during which the difficulty of the task systematically increases (see also Olesen et al., 2004; Wiers et al., 2010). When these individuals are additionally troubled by emotional problems and other impulsive type behaviors, more emphasis may be placed on the acquirement of adaptive emotion regulation skills (Fischer and Smith, 2008), not only in relationship to disturbed eating behavior, but also to other maladaptive behaviors.

An interesting finding was that women with and without binge eating pathology did not only respond differently after an increase in sadness, but more interestingly was after a decrease in sadness control women chose more disadvantageously than BN and BED women. This is an intriguing topic for further investigation.

There are some limitations worthy of mentioning. First, in the present study, all groups differed in level of depression. It is possible that depression level was of influence on the results. Since previous studies have found no relationship between level of depression and decision making performance in BN and in BED groups (Liao et al., 2009; Svaldi et al., 2010; Boeka and Lokken, 2006), we did not control for depression level. Furthermore, the purpose of this study was to examine the influence of negative affect on choice behavior and since the control condition resulted in a reduction of sadness, choice behavior after an increase in negative affect was compared to a condition in which negative affect decreased instead of not changed (same as negative affect at baseline). Future studies may want to ensure that prior to the start of the study the control condition does not evoke any changes in negative affect. Moreover, since the task was an adaption of the BGT, the measure of choice behavior used in the present study has not yet been validated. It would be worthwhile to examine in prospective studies how negative affect influences different types of decision making (e.g. under risky vs. uncertain conditions) using validated tasks. Finally, BMI's were based on self-report data which, whilst this is a method often employed in eating disorders research, future research would benefit from actual measurements.

In conclusion, individuals with binge eating pathology display a number of different impulsive behaviors including pathological behaviors (e.g. binge eating, substance abuse). They are particularly inclined to behave in an impulsive fashion when confronted with a negative affective state. Although they may be able to recognize punishment, the present findings suggest that this does not result in more advantageous choice behavior to anticipate long-term negative consequences. Emotional states may have a direct impact on the impulsive nature of binge eaters and seems not only related to pathological behavior itself.

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