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Influence of negative affect on decision making in women with restrictive and binge-purge type anorexia nervosa

Unna N. Danner [a,b,*], Lot Sternheim [a,b,c], Jojanneke M. Bijsterbosch [a,b], Alexandra E. Dingemans [d], Catharine Evers [c], Annemarie A. van Elburg [a,b,c]

[a] Altrecht Eating Disorders Rintveld, Altrecht Mental Health Institute, The Netherlands
[b] Utrecht Research Group Eating disorders, The Netherlands
[c] Department of Clinical and Health Psychology, Utrecht University, The Netherlands
[d] Center for Eating Disorders Ursula, Leiden, The Netherlands

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ABSTRACT

The present study aims to examine the influence of negative affect on decision making in women with anorexia nervosa (AN) compared to healthy control women and, secondly, to assess differences between the restrictive (ANR) and binge-purge (ANBP) subtypes. One hundred four women (32 with ANR, 32 with ANBP, and 40 healthy controls) participated. All women were asked to watch either a negative or a control film fragment, both followed by the Bechara Gambling Task (BGT). Before and after the fragments negative affect was measured. Additionally, relevant characteristics (e.g., overall depressive symptoms) were assessed. Differences in negative affect did not influence decision making performance. Independent of affective state, decision making was found to be impaired in women with ANBP (no learning effect on the BGT), but not in women with ANR. These findings highlight the importance of considering different AN subtypes when examining decision making processes. However, the role of negative affect on decision making remains uncertain. Since other affect related factors such as affect dysregulation may also play a role, future studies on decision making in AN should take the role of affect into account.

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1. Introduction

Individuals with anorexia nervosa (AN) are characterized by a below-normal weight, and are often even severely underweight. Low adherence to treatment and high drop out rates are common (Macdonald, et al., 2012; Schnicker, et al., 2013). Only half of the patients fully recovers from the disorder (Keel and Brown, 2010) and a substantial part remains chronically ill. AN has a serious negative effect on quality of life, impairing cognitive, interpersonal and societal functioning (Engel, et al., 2009; Bamford and Sly, 2010). It is therefore striking that individuals with AN are often reluctant to engage in treatment (in particular to gain weight). Their decisions seem to be based on the expected short-term consequences of their behavior despite of the longer-term outcome. Thus, on a more general level their decision making seems maladaptive with a strong focus on short-term goals that come at the cost of long-term goals (Cavedini et al., 2006). This is most evident in their eating behavior with avoiding food intake to lose weight or to reduce anxiety, while ignoring the long-term goal of eating food to gain weight and to recover from AN. Cavedini et al. (2006) tested the idea that anorectic psychopathology could be an expression of difficulties modulating reward and punishment in a longer-term perspective by using a neuropsychological measure of decision making, the Gambling Task (GT; Bechara et al., 1994) in a sample of individuals with AN.

The majority of studies on decision making in AN indeed point towards general decision making difficulties in individuals with AN compared to healthy controls, as they are inclined to make decisions based on the expected short-term consequences as examined with the GT (Bechara, et al., 1994), which varies the valence of the short-term and longer-term consequences of the choices (Cavedini et al., 2004; Tchanturia et al., 2007; Brogan, et al., 2010; Danner et al., 2012b; Fagundo et al., 2012; Galimberti et al., 2012; Lindner, et al., 2012; Tchanturia et al., 2012; Garrido and Subira, 2013).[1] The GT simulates

[1] A few studies did not find these decision making difficulties in AN (Bosanac et al., 2007; Jollant et al., 2007; Guillaume et al., 2010). The studies of Guillaume et al. (2010) and Jollant et al. (2007) that did not find decision making problems in AN, used exclusion criteria related to emotional problems, which may possibly account for their lack of findings: Guillaume et al. (2010) only included patients without comorbid depression and medication and Jollant et al. (2007) included AN patients who were normothymic (referring to a relative normal emotional state). The exclusion of these affect-related states may be responsible for the absence of observed decision making difficulties in AN, as the experience of negative affect and decision making performance in AN may importantly cohere, as will be argued in more detail below.

* Corresponding author at: Altrecht Eating Disorders Rintveld, Altrecht Mental Health Institute, Wenshoek 4, 3705 WE Zeist, The Netherlands.

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real-life decision making under circumstances of uncertainty (i.e. not knowing what the exact outcome of a certain choice will be). Decision making behavior in this task is suggested to be complex and to rely on affective feedback from autonomic somatic changes (somatic marker hypothesis; Damasio, 1994). One of the hypothesis is that the affective feedback is experienced differently by individuals with AN resulting in poorer decision making ability. Direct evidence for this idea was reported by Tchanturia et al. (2007) who tested skin conductance response while participants with AN performed the task. Their results showed participants with AN to have significantly lower anticipatory SCR to all choices. In the GT, participants are asked to choose between four decks of cards and with every choice they win (=reward) or loose (=punishment) money. Gains and losses differ with each card and two of the decks have higher immediate gain but are disadvantageous in the longer-term. The idea is that participants with intact decision making ability forgo immediate gains for a longer-term successful outcome by learning to avoid these disadvantageous decks[1].

Decision making ability can be considered an important topic to investigate in AN, as assessing it may have prognostic value: a study of Cavedini et al. (2006) investigating the prognostic value of decision making abilities in AN showed that a better decision making profile (i.e., learned to make more advantageous choices during the GT) at the start of treatment was indicative of greater improvement in body mass index (BMI; an important marker of their nutritional state). Accordingly, the present paper aims to study decision making performance in women with AN, and will particularly focus on the role of negative affect.

Affect plays an important role in the decision making process (Damasio, 1994). Generally, negative affect comes at the cost of the more beneficial long-term goals and seems to trigger a focus on the short-term goals. For example, de Vries et al. (2008) found that participants in a negative affective state, as induced by a video excerpt, scored worse on a decision task (the GT) than participants in a positive state (see also Suhr and Tsanadis (2007)). Affect thus can be an important element influencing the decision making process.

The disadvantageous effect of negative affect in relation to decision making may play an extra prominent role in AN patients. Studies have shown disturbances in the affective system of AN patients (Wagner et al., 2007; O'Hara, et al., 2015). Furthermore, affective disorders such as depressive disorders, are the most frequent observed comorbid disorders in AN (e.g., Salbach-Andrae et al., 2008) and it is even suggested that emotional problems lie at the core of AN (Harrison, et al., 2009). In a large study among patients with different kind of psychiatric diagnoses including AN, it was found that impaired decision making was directly related to affective instability (Jollant et al., 2007) suggesting an influence of affective dysfunction on decision making. Additionally, several studies demonstrated that AN patients are inclined to regulate their emotions in dysfunctional ways (e.g. Danner et al., 2014, 2012a; Svaldi et al., 2012) resulting in the maintenance of negative affect. Whilst it thus seems likely that negative affect and decision making performance in AN are related, this has not yet been investigated.

Most studies on decision making in AN did not differentiate between AN subtypes, whilst this may be crucial. In other words, whilst the two subtypes share some eating disorders-related characteristics, such as restricted food intake and clinical perfectionism, they also show different and distinguishing characteristics. For example, binge-purge behaviors are specific to an ANBP diagnosis, whilst these are absent in ANR. Similarly, ANBP patients tend to display impulsivity, whilst ANR patients rarely do. Precisely these latter two concepts may be important in relation to the decision making process (Franken, et al., 2008). To illustrate, ANBP individuals have a more impulsive personality and report more behaviors that are regarded as impulsive behaviors such as stealing and substance abuse than ANR. ANBP patients also revealed less inhibitory control than ANR patients (Bruce, et al., 2003; Rosval et al., 2006). Furthermore, ANBP patients have been assessed as more sensitive to reward than ANR patients which may explain their tendency towards impulsive behaviors (Harrison, et al., 2010; Chan et al., 2014). The characteristic of ANBP patients being more impulsive than ANR patients seems important for decision making processes: Impulsive tendencies may cause reliance on short-term gains, while ignoring the longer-term consequences of the decision outcome in particularly ANBP patients. Studies that addressed the AN subtypes in relation to decision making ability, however, showed inconsistent findings. While Galimberti et al. (2012) found both subtypes to perform similarly poor on a decision making task, two other studies found different decision making patterns in the subtypes (Cavedini et al., 2004; Garrido and Subira, 2013). Both studies showed decision making impairments in all patients with AN, but contrary to what may be expected ANR patients performed worse than ANBP. The rationale for this remarkable difference is unclear, but the moderating impact of negative affect may provide an explanation. That is, perhaps ANBP patients are particularly likely to show decision making problems in emotionally negative situations.

There are as yet no studies that have investigated differences in decision making between subtypes in relation to negative affect. However, based on the finding that affect-driven impulsiveness (i.e., the tendency to act rashly when experiencing negative affect; Whiteside and Lynam, 2001) is typically associated with bulimic-related behaviors (Fischer, et al., 2003; Claes, et al., 2005), behaviors prototypically displayed in ANBP patients, it can be assumed that negative affect may increase the tendency to make more impulsive decisions in ANBP (and not ANR) patients, thus resulting in more decisions based on the short-term instead of long-term outcomes.

1.1. Present study

The present study aims to firstly examine the influence of negative affect on decision making in women with AN compared to healthy controls and secondly to test differences between the ANR and ANBP subtypes. Negative affect will be triggered by means of a negative affect induction. Each participant within each group (ANR, ANBP and healthy participants) will be randomly assigned to either a negative affect condition or a neutral condition.

First, we expect both patient groups to display poorer decision making compared to the control group, in line with previous findings (Cavedini et al., 2004; Tchanturia et al., 2007; Danner et al., 2012b). More importantly, we expect an increase in negative affect to worsen decision making performance (Raghunathan and Pham, 1999), particularly for ANBP patients. Decision making of these patients will be stronger impaired when their negative affect intensifies, conform their affect-driven impulsiveness tendency (Fischer et al., 2003; Claes et al., 2005). Decision making will be examined using the GT (Bechara et al., 1994).

2. Methods

2.1. Participants

All 104 participants in this study were female and at least 18 years of age: 32 women with a diagnosis of AN restrictive subtype or EDNOS clinically referred to as ANR (24 women with ANR and 8 women with EDNOS-ANR), and 32 women with a diagnosis of AN binge-purge subtype or EDNOS clinically referred to as ANBP (23 women with ANBP and 9 women with EDNOS-ANBP) and 40 healthy control women. Only patients without a history of

crossover in eating disorders (sub)diagnosis and without current use of antidepressant medication were included in the study. These women were recruited from two specialized clinics for eating disorders and from private practices 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 (psychologists and psychiatrists) according to the DSM-IV criteria (American Psychiatric Association, 2000) using questions of two standardized semi-structured interviews: the Eating Disorder Examination (Fairburn and Cooper, 1993) and/or the Longitudinal Interval Follow-up Evaluation (Keller et al., 1987; Krämer, 1996) and confirmed by either the Eating Disorders Examination (Cooper and Fairburn, 1987) or the Eating Disorders Examination Questionnaire (Aardoom, et al., 2012). Patients with EDNOS clinically referred to as AN had an eating disorder of clinical severity and met all but one criteria of AN according to the DSM-IV criteria (Fairburn and Harrison, 2003). Reasons for not meeting one criteria were use of contraceptives, still menstruating, a BMI slightly above 18.5 kg/m^2, or a mild distortion of body image. Importantly, all patients would be diagnosed with AN according to the DSM-5 criteria.

Forty healthy controls 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 (such as affective disorders) and in particular all eating disorders. In addition, to exclude healthy control women who showed sub- or full threshold eating disorders or reported experience of loss of control over eating, Eating Disorders Diagnostic Scale diagnosis scores (EDDS; see Section 2.2.3) were calculated after their participation.

In total, eight participants were excluded from the analyses: six healthy control women (because of subthreshold eating disorder diagnoses or reporting experience of loss of control over eating on the EDDS), one patient with ANR (no data were stored due to technical problems) and one patient with ANBP (after participation she revealed having experienced crossover between ANR and ANBP) resulting in the inclusion of 96 women (ANR=31, ANBP=31, control=34) in the analyses.

Ethical approval for this study was obtained from the Medical Ethical Committee (METC) of the University Medical Center Utrecht (protocol number NL33536.041.10) and the Institutional Review Board (CWO; protocol number 2010-25/oz1023).

2.2. Procedure, measures and materials

All participants followed the same study procedure: starting with filling in several questionnaires to assess clinical and personality traits (e.g. Barrett Impulsiveness Scale; Patton, et al., 1995, Sensitivity for Punishment and Sensitivity for Reward Questionnaire; Torrubia, et al., 2001) including level of depression (as measured by the Beck Depression Inventory-short form (BDI-SF; Beck, et al., 1996; Furlanetto, et al., 2005). This was followed by watching a film fragment (sad or neutral mood induction) and an assessment of negative affect before and after the film fragment." Subsequently, participants performed the BGT, filled in an eating pathology questionnaire (EDDS), and provided demographic information. The type of film fragment (sad vs. neutral) watched by the participants was randomly determined within each group between participants.

2.2.1. Negative affect manipulation

To induce negative affect, 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 (Zonnevylle-Bender, 2002; Dingemans, et al., 2009; Danner et al., 2013). In the control condition, a neutral 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 affective state (Schaefer, et al., 2006; Evers and Ridder, 2008).

To examine the influence of the affect manipulation, negative affect was measured by assessing the degree of sadness at the start of the study 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 7-point Likert scales ranging from 0 "not at all" to 6 "very strongly".

2.2.2. Gambling task

The gambling task was programmed in e-prime version 1.2 and based on the Bechara Gambling task (BGT) which is an electronic version of the GT (Bechara et al., 1994; van den Bos, et al., 2006; Mueller, 2009). The BGT procedure used in this study is comparable to other versions of the BGT (van den Bos et al., 2006; Mueller, 2009). The purpose of the BGT is to test participants' ability to resist immediate gains in favor of a longer-term positive outcome (Bechara and Damasio, 2005; Tchanturia et al., 2007; Danner, et al., 2011). The task is suggested to capture the inability of individuals to make adaptive decisions when presented with complex choices (Tchanturia et al., 2007). This is done by examining how often participants choose cards from more favorable and less favorable decks. Participants have to learn which decks are the more favorable ones during the task by relying on their "gut feeling" rather than learning the rules since the task is rather complex and the rules underlying the decks are not easily figured out. When decision making ability is intact, participants learn to avoid the less favorable decks during the task by choosing more often cards from the favorable decks. The instructions participants get is to win as much money as possible starting with €0 of (virtual) money by choosing one card at a time from one of four decks (A, B, C, D). Two of the decks have higher immediate gains (€100) but also higher or more frequent losses resulting in a net loss per 10 choices of €250, these are the less favorable decks (A and B). The other two decks of cards have smaller immediate gains (€50), but also lower or less frequent losses resulting in a net win per 10 choices of €250, these are the more favorable decks (C and D). Immediately after every choice, participants learned how much money they won and if they also lost money. In order to determine decision making performance, the number of cards chosen from each of the decks was counted. Performance on the gambling task was examined with the total score (the total number of advantageous choices (decks C and D), minus the number of disadvantageous choices (decks A and B)), and with the learning effect by dividing the 100 card choices in five blocks of 20 trials (Bechara et al., 1994). Subsequently, the net score for each of the five blocks was calculated as the difference in choices between the advantageous and disadvantageous decks [(C+D)−(A+B)]. The learning effect is determined by testing if performance improves over time (between the consecutive blocks).

2.2.3. Descriptive instruments

The following relevant clinical and personality characteristics were measured at the start of the study: *Impulsivity* with the Barratt Impulsiveness Scale (BIS; Patton et al., 1995; Cronbach's $\alpha=0.79$). In this study the subscale 'attention impulsivity' of the BIS was used as a measure of affect-driven impulsiveness (see Fischer, et al. (2008); Cronbach's $\alpha=0.76$). The BIS consists of 30 items and the subscale attention impulsivity of 5 items, with each answer scored on a scale with values from 1 (almost never) to 4

Table 1
The mean and SD of demographic information (e.g. age), clinical characteristics (e.g. eating pathology) and personality characteristics (impulsivity) per group (ANR, ANBP, Control).

	ANR		ANBP		Control				
	Mean	SD	**Mean**	SD	**Mean**	SD	*F*	*p*	η_p^2
Age	**23.19**	6.60	**27.23**	9.34	**24.44**	5.83	2.44	0.093	
Years of education[b]	**14.37**	2.74	**15.61**	2.90	**16.18**	2.15	4.01	0.022	0.08
Completed education	**5.32**	1.72	**5.61**	1.17	**5.91**	1.14	1.52	0.23	
BMI[c]	**17.33**	1.74	**17.06**	1.91	**21.67**	2.64	47.40	< 0.001	0.50
Eating pathology[d]	**28.68**	9.82	**45.94**	17.47	**7.26**	5.77	86.43	< 0.001	0.65
Age of onset[*]	**17.71**	4.76	**17.32**	4.36	**n.a.**	n.a.	0.11	0.74	
Illness duration[*]	**5.65**	4.90	**10.03**	9.88	**n.a.**	n.a.	4.90	0.031	0.08
Depression[c]	**16.87**	8.07	**18.19**	6.79	**1.62**	2.19	74.37	< 0.001	0.62
Sensitivity for reward	**10.65**	4.22	**11.03**	4.56	**9.03**	3.90	2.08	0.13	
Sensitivity for[c] punishment	**17.00**	4.89	**16.39**	5.51	**6.50**	4.91	43.85	< 0.001	0.49
Impulsivity[e]	**1.86**	0.25	**2.10**	0.33	**1.85**	0.27	7.90	0.001	0.15
Affect driven[d] impulsivity	**2.25**	0.60	**2.55**	0.63	**1.80**	0.40	15.40	< 0.001	0.2

ANR = anorexia nervosa restricting subtype, ANBP = anorexia nervosa binge-purge subtype, BMI = body mass index.
[a] Patient groups differ, but not from control group.
[*] Only tested between AN groups.
[b] ANR group differs (marginally) from other groups.
[c] Both patient groups differ from control group.
[d] All groups differ (marginally).
[e] ANBP group differs from other groups.

(almost always) and higher scores indicating stronger impulsiveness. *Sensitivity for reward and punishment* was measured with the Sensitivity for Punishment and Sensitivity for Reward Questionnaires (SPSRQ; Torrubia et al., 2001; Cronbach's $\alpha = 0.93$ for punishment sensitivity and Cronbach's $\alpha = 0.77$ for reward sensitivity) that consists of 48 items (yes/no). Higher scores suggest more sensitivity. Level of *depressive symptoms* was assessed with Beck Depression Inventory-short form (BDI-SF; Beck et al., 1996; Furlanetto et al., 2005; Cronbach's $\alpha = 0.95$) that contains 13 questions, each answer scored on a scale value of 0–3 with higher scores indicating more severe symptoms. To measure *overall level of eating pathology*, the Dutch version of Eating Disorders Diagnostic Scale (EDDS; Stice, Telch, and Rizvi, 2000; Krabbenborg et al., 2012; Cronbach's $\alpha = 0.86$) was used. The EDDS is a brief measure to DSM-IV eating disorders diagnoses and these scores were used to determine sub- and full threshold eating disorders in the control group. The EDDS contains 22 items that generates a continuous eating disorder symptom composite to reflect the overall level of eating pathology, with higher scores pointing towards more severe eating pathology. 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 number of years education and highest level of education completed (participants were asked to report their highest completed level of education on a scale from 1, primary school, to 7, university degree).

2.3. Statistical analyses

All statistical analyses were conducted using SPSS version 20.0 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. A repeated measures ANOVA was done to test the effect of the manipulation: differences in negative affect at the start of the study and after the affect induction between conditions and groups.

Subsequently, to examine the influence of negative affective state on decision making, 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 learning effect (scores on block 1–5) on the BGT, while controlling for number of years education (see Section 3).

Finally, to explore relations between decision making performance (BGT total score), and clinical and personality characteristics within the clinical groups, Pearson correlations were calculated separately for each group.

3. Results

3.1. Demographic, clinical and personality characteristics

Information regarding demographic, clinical and personality characteristics are presented per group (ANR, ANBP, control) in Table 1. Noticeable is that ANR women completed fewer years of education, scored lower on eating pathology, and were less impulsive, particularly in an affective context (i.e., affect-driven impulsive), than women with ANBP. Women with ANR were just as impulsive as control women, except when in an affective context in which they scored in between control and ANBP women. No group differences were found regarding highest completed level of education and sensitivity for reward.

3.2. Negative affect induction

A 2 (condition: affect vs. neutral)*3 (group: ANR, ANBP, control)*2 (time: before and after the film fragment) ANOVA was performed with negative affect as dependent variable, see also Table 2. The main effect of condition was significant, $F(1, 90) = 4.71$, $p = 0.033$, $\eta_p^2 = 0.050$, indicating that more negative affect was reported in the affect condition ($M = 3.79$, $SD = 0.23$) than in the control condition ($M = 3.11$, $SD = 0.22$). This main effect was qualified by a significant interaction effect of condition × time, $F(1, 90) = 29.39$, $p < 0.001$, $\eta_p^2 = 0.25$, confirming that all participants (so independent of group) reported more negative affect after than before the negative film fragment, $p = 0.002$, and less negative affect after than before the neutral film fragment, $p < 0.001$. Prior to the film fragments, sadness scores were similar in all conditions, $p = 0.53$. Additionally, the main effect of group was significant, $F(1, 90) = 25.11$, $p < 0.001$, $\eta_p^2 = 0.36$, showing patients to report more negative affect than control participants (pairwise comparisons: ANR

Table 2
The mean (and SD) negative affect score prior to and after the film fragments per group (ANR, ANBP, control) per condition (neutral, negative affect).

	Neutral film			Negative film		
	Prior to film fragment	After film fragment	N	Prior to film fragment	After film fragment	N
ANR	**4.56** (2.07)	**3.19** (2.11)	16	**4.20** (2.01)	**5.00** (2.00)	15
ANBP	**4.75** (1.69)	**3.50** (1.90)	16	**4.27** (2.34)	**4.33** (2.02)	15
Control	**1.59** (1.06)	**1.06** (0.24)	17	**1.76** (0.90)	**3.18** (1.59)	17

Note. ANR=anorexia nervosa restricting subtype, ANBP=anorexia nervosa binge-purge subtype.

and ANBP group differed from the control group, both *p's* < 0.001, but not from one another, $p=0.95$). This main effect was qualified by a significant interaction effect of time × group, $F(2, 90)=3.46$, $p=0.036$, $\eta_p^2=0.071$, revealing ANBP patients to report less negative affect after than before watching the film fragments, $p=0.047$. Further examination of this effect showed that ANBP patients reported only less negative affect after the neutral fragment, $p=0.003$; not after the negative fragment, $p=0.88$. All other effects were not significant, *ps* > 0.38.

To conclude, negative affect was successfully induced in the negative condition compared to the neutral condition across groups, with negative affect being reduced in the neutral condition across groups. Within the group of ANBP patients, however, negative affect did not increase in the negative condition. Nevertheless, as these patients still revealed more negative affect in the negative condition compared to the neutral condition, the induction was considered partly successful in the ANBP group.

3.3. Decision making – Bechara Gambling Task (BGT)

The next step was to examine the influence of negative affect (negative affect difference scores before and after the affect manipulation) on decision making performance as measured with the learning effect on the BGT (100 choices divided in five blocks to examine if decision making performance became better over time) between groups, while controlling for number of years education, see also Fig. 1. Since sphericity could not be assumed, Huynh-Feldt outcomes were used.

No effects of affect difference scores on decision making performance were found, all *F's* < 1 and *p's* > 0.44. The results did show a main learning effect, $F(4, 348)=3.28$, $p=0.014$, $\eta_p^2=0.04$, which was qualified by an interaction effect with group, $F(8, 348)=2.12$, $p=0.038$, $\eta_p^2=0.05$. Pairwise comparisons showed ANR and control participants learning to choose more advantageously (or to avoid the disadvantageous decks) during the task, resp. $p=0.003$ and $p=0.028$, but not for ANBP patients, $p=0.15$.

3.4. Correlations

Since the results showed no effect of negative affect difference scores on decision making performance, participants in both conditions were combined to calculate correlations. Correlation analyses between decision making performance (BGT total score; see also Table 3) and clinical and personality characteristics revealed that *ANBP* patients with a lower BMI performed worse on the BGT. No significant correlations were found between decision making scores and characteristics in the control group.

4. Discussion

The purpose of this study was to investigate the influence of negative affect on decision making in women with ANR and ANBP by measuring decision making performance following a negative affect induction and comparing the findings with those of control women. To measure decision making performance, we used the BGT (Bechara et al., 1994) which simulates real-life decision making under circumstances of uncertainty (i.e., not knowing what the exact outcome of a certain choice will be).

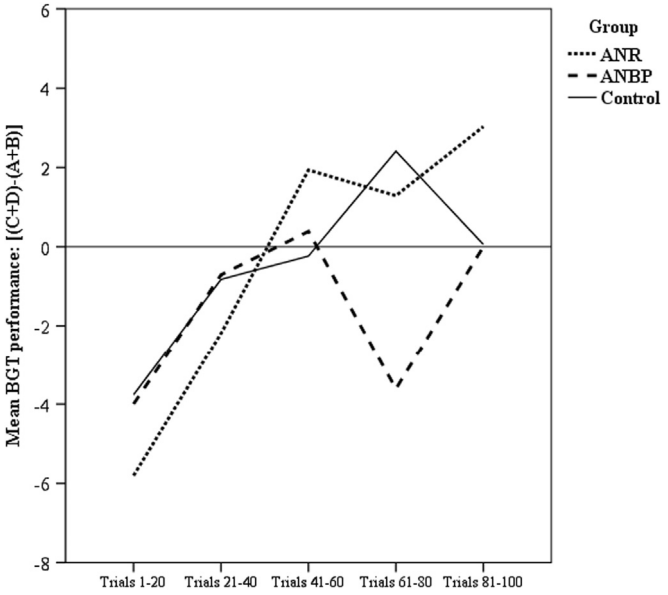

Fig. 1. Decision making performance on the BGT as the mean number of cards chosen from the advantageous decks (C+D) minus the mean number of cards chosen from the disadvantageous decks (A+B) per block of 20 trials per group: ANR, ANBP and control women.

4.1. Decision making in AN

Decision making performance was not influenced by negative affect, suggesting no influence of negative affect on decision making in women with AN in general or in control women. An important finding was the difference in decision making performance between women with ANR and with ANBP. Both healthy control women and women with ANR displayed adaptive decision making patterns as shown by an increased performance over time (i.e., they adapted their decision making according to the feedback provided), while decision making performance of women with ANBP was impaired (no improvement over time).

This difference in decision making performance between ANR and ANBP patients is interesting. Whilst two studies reported

Table 3
Correlations for the AN restrictive (ANR), AN binge-purge (ANBP) and control groups of decision making performance (BGT total score), with clinical and personality characteristics (BMI, eating pathology (EDDS), impulsiveness (BIS), affect-driven impulsiveness (BISaff), reward sensitivity (SR), punishment sensitivity (SP), and depression (BDI)).

ANR (n=31)	BMI	EDDS	BIS	BISaff	BDI	SR	SP
BGT	0.33	−0.06	−0.25	−0.04	−0.002	0.05	−0.04
ANBP (n=31)							
BGT	**0.36***	−0.12	−0.17	−0.09	−0.24	−0.13	−0.14
Control (n=34)							
BGT	−0.11	−0.22	0.10	−0.01	−0.16	−0.04	−0.1

AN=anorexia nervosa, BGT=Bechara Gambling Task; BMI=body mass index; EDDS=Eating Disorders Diagnostic Scale; BIS=Barrett Impulsiveness Scale; BDI=Beck Depression Inventory.

* $p \leq 0.05$.

worse decision making in ANR patients on the BGT (Cavedini et al., 2004; Garrido and Subira, 2013), our study found decision making to be impaired in women with ANBP rather than ANR. Although speculative, the reasons for these different outcomes across studies may be driven by methodological differences, such as seeing a film fragment prior to the decision making task, controlling for cross-over between AN diagnoses, and exclusion of patients on antidepressant medication. Differences in study population may also be important. For example, women with ANBP in our study had a more severe illness as measured with the EDDS and a longer illness duration compared to women with ANR. Although no correlations were found with decision making performance, these clinical characteristics may contribute to differences in decision making outcomes in people with AN across studies.

Results of this study are in line with decision making findings in other psychiatric populations revealing impulsive behaviors, such as individuals with borderline personality disorder or attention-deficit/hyperactivity disorder (for example, substance abuse or binge drinking) (Haaland and Landrø, 2007; Malloy-Diniz, et al., 2007; Johnson et al., 2008). Impulsivity and decision making processes are closely related considering that impulsive people are inclined to make decisions based on the short term gains without considering longer term consequences. Therefore several studies have focused on individuals displaying binge eating pathology (e.g., Boeka and Lokken, 2006; Brand, et al., 2007; Danner et al., 2013) as many of their behaviors contain impulsive elements, which is illustrated by a focus on obtaining immediate gratification in spite of long-term negative outcomes, such as negative feelings and biological disturbances (Dawe and Loxton, 2004; Smyth et al., 2007). Individuals with ANBP are thought to share relevant personality features such as (affect-driven) impulsiveness with individuals with binge-related disorders (Peat, et al., 2009; Danner et al., 2012a, 2012b). Garrido and Subira (2013) indeed found that impulsivity was related to impaired decision making performance in ANBP patients, but not in ANR patients. In light of ANBP patients generally having a more impulsive personality than ANR patients, our finding that typically ANBP patients showed impaired decision making, is not surprising.

Another important finding between the AN subtypes was the result of the negative affect induction. Whilst ANR patients reported more negative affect after the induction, ANBP patients did not do so. Apparently, women with different types of AN responded differently to the negative film fragment. This finding was not related to women with ANBP experiencing more negative affect prior to the negative affect induction than women with ANR (i.e., a ceiling effect), as both clinical groups reported similar levels of negative affect ($p=0.82$) and also depressive feelings ($p=0.60$). If women with ANBP indeed respond differently to affective triggers than women with ANR, this has important consequences. For example, it illustrates the necessity to differentiate between the AN subtypes, particularly in affect-related studies.

Despite the finding that negative affect did not influence decision making performance in the present study, it is still important to consider affect in future studies on decision making in AN. The role of negative affect, such as depressive feelings, are much debated in the literature on decision making in AN making the present findings relevant (Jollant et al., 2007; Guillaume et al., 2010; Tchanturia et al., 2012). For example, Guillaume et al. (2010) argued that lack of decision making impairments in their study might have been caused by excluding patients with a comorbid depression, since it may have impaired performance on the task as was found by other researchers. Examination of the study populations in other studies showed many studies to have an oversampling of women with ANR (e.g., Guillaume et al., 2010; Danner et al., 2012b), which was also true in the study of Tchanturia et al. (2007) who reported a negative correlation between decision making performance and depressive symptoms. Guillaume et al. (2010) discussed the possibility that serotonergic drugs (SSRI) or depressive symptoms may influence decision making performance. According to Tchanturia et al. (2007), decision making difficulties in AN may also be a consequence of insensitivity to and/or a failure to generate emotional responses via feedback from autonomic somatic changes (also referred to as somatic markers; Damasio, 1996) that can be caused by a depressive state.

Jollant et al. (2007) found a relationship between decision making and affective lability and argued that affective dysregulation may have a major influence on decision making abilities. A first study indeed revealed a direct influence of affect regulation on BGT performance in a non-clinical sample (Heilman et al., 2010). The authors argue that decision making performance is influenced by negative affect because it causes physiological noise hindering the adaptive influence of the somatic markers, and adaptive affect regulation reduces the impact of negative affect. Seo and Barrett (2007) qualified this idea by showing that negative affect does not necessarily undermine decision making, but does so in individuals who are less able to understand and differentiate between their current negative feelings. Considering that individuals with AN are inclined to regulate affect in a dysfunctional manner (Danner et al., 2014; Svaldi et al., 2012) and are less able to understand their negative affective state (e.g., Zonnevylle-Bender et al., 2004; Bydlowski et al., 2005), future studies on decision making in AN may want to take different aspects related to affective functioning (e.g. difficulties regulating affect) of these patients into account and test possible differences between the AN subtypes.

4.2. Limitation and future directions

Across groups, the induction of negative affect was successful and in comparison to control women, AN patients reported more negative affect. Women with ANBP displayed a different pattern however and future studies aiming to examine the influence of negative affect may require a more thorough testing of the affect induction since it clearly matters what type of AN patients will take part in the study. Although the affect induction has been found to induce negative affect in different studies using non-clinical and psychiatric populations (Gross and Levenson, 1997; Macht and Mueller, 2007; Potvin, et al., 2007) and even in our previous study in women with BN and binge eating disorder (Dingemans et al., 2009; Danner et al., 2013), it may not have been strong enough to increase negative affect levels in a meaningful way in women with AN and particularly in women with the ANBP subtype. Another limitation noteworthy of mentioning, which is also related to the negative affect induction, is that one may argue that it is not possible to draw any conclusion regarding the influence of negative affect on decision making for ANBP patients since they did not report an increase in negative affect as a result of the induction. Although negative affect was *on average* not increased in the group of women with ANBP, we used negative affect difference scores (after the induction versus prior to the induction) to test the influence of negative affect. In addition, an interesting avenue for future studies may be to examine alternative emotions than sadness (e.g., anger) and the role of relevant traits, such as negative urgency, on the influence of negative affect on decision making, as some studies reported a direct influence of such traits on decision making performance (e.g., Jollant et al., 2007; Franken et al., 2008). Another interesting finding that needs to be explored in future studies is the relation between decision making performance and BMI in the ANBP group (and in the ANR group albeit non-significant). Previous studies did not find this relationship, but this may be related to the inclusion of more women with ANR than with ANBP (e.g., Tchanturia et al., 2007). It is furthermore

important to be aware that the sample size in this study was small and the patient population may not be entirely representative of individuals with AN due to exclusion of participants on anti-depressive medication and considering their long illness duration. Both factors hold especially true for the ANBP patients.

To conclude, individuals with AN often experience difficulties to incorporate future outcomes when making decisions. Although ANR patients showed adaptive decision making in this study, ANBP patients seemed to base their decisions more on the short-term outcomes of their choices. Findings in the present study indicate no direct influence of increased negative affect on decision making, although this should be interpreted with some caution. It is important to gain more insight in the decision making process of individuals with AN and the role of different aspects of affective functioning. The findings in this study add to our understanding of decision making performance in AN and underlines the importance to differentiate between AN subtypes.

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