Is decision making really impaired in eating disorders?

Sébastien Guillaume, Caroline Ngo Ton Sang, Isabelle Jaussent, Isabelle Raingeard, Jacques Bringer, Fabrice Jollant, Philippe Courtet

Brief Report

Is decision-making really impaired in eating disorders?

Sébastien Guillaume[a,b,c], Caroline Ngo Ton Sang[b,c], Isabelle Jaussent[a,b], Isabelle Raingeard[d], Jacques Bringer[a,d], Fabrice Jollant[a,b,c], Philippe Courtet[a,b,c]

[a] Université Montpellier 1, Montpellier F-34006, France

[b]Inserm, U888, Montpellier F-34093, France

[c]Department of Psychological Medicine and Psychiatry, CHU Montpellier, F-34000, France

[d]Endocrinology Department, CHU Montpellier, F-34000, France

Corresponding author: Dr S. Guillaume, Hôpital Lapeyronie, Service de Psychologie Médicale et Psychiatrie, 371 avenue du Doyen G. Giraud, 34295 Montpellier Cedex 5, France.

Tel.: +33 467338289; Fax: +33 467338988. E-mail: guillaumesebastien@ymail.com

Word count: 2499

ABSTRACT

Objective: Decision-making has been reported to be reduced in eating disorders. However, studies are sparse and have been carried out in various selected populations. The current study was arranged to confirm previous observations and to assess the relationship between decision-making and dimensions relevant to eating disorders.

Method: Patients suffering from anorexia nervosa (n=49), bulimia nervosa (n=38), and healthy controls (n=83) were assessed using the Iowa Gambling Task (IGT). All patients were euthymic and free of psychotropic medication. Self-questionnaires (EDI-2 and EAT) were used to assess clinical dimensions relevant to eating disorders.

Results: No significant differences in IGT performance were observed between patients and healthy controls, or between restrictive and purging types of anorexia nervosa. No correlations were found between IGT performance and eating disorder questionnaires.

Conclusion: These results do not support reduced decision-making in patients with eating disorders, and suggest that previously reported alterations could be related to other clinical characteristics. This should stimulate new topic-related studies designed to reach a firm conclusion.

Keywords: anorexia nervosa, bulimia nervosa, Iowa Gambling Task, neuropsychology

INTRODUCTION

Eating disorders (EDs) are highly prevalent psychiatric disorders in young women (Treasure, Claudino, & Zucker, 2009). These disorders are often chronic and relapsing, and quite devastating when we refer to the recent data regarding high mortality rates (Crow, et al., 2009). The pathogenesis of EDs, are poorly understood. As a consequence, strong evidence to guide treatment is lacking. Neuropsychological assessment can contribute to a better understanding of cognitive functioning in patients and thus help to propose a more tailored therapeutic approach. Moreover, exploring cognitive function is particularly useful for understanding the pathophysiology (Keefe, 1995).

Several earlier studies have demonstrated various neuropsychological dysfunctions in patients with EDs [review in (Tchanturia, Campbell, Morris, & Treasure, 2005)]. Among them, decision-making (the capacity to make decisions about a course of action) has been studied. The interest in studying decision-making in EDs lies on 1) clinical consideration suggesting a behaviour of immediate reward despite the long-term consequences in anorexia (behaviour restriction and starvation are maintained despite the negative physical and psychosocial consequences) and in bulimia (immediate benefit of purging); 2) the neuro-anatomical consideration suggests that the key regions in decision-making are implicated in EDs (Kaye, Fudge, & Paulus, 2009); 3) lastly, the seroninergic systems possibly involved in EDs (Kaye, et al., 2009) seem to modulate decision-making (Rogers, et al., 2003). Lower decision-making capacity has been reported in anorexic (Cavedini, et al., 2004; Tchanturia, et al., 2007) as well as bulimic (Boeka & Lokken, 2006; Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007; Liao, et al., 2009) patients. It has been suggested that decision-making measured with the Iowa Gambling Task (IGT) could even constitute a prognostic marker of therapeutic response in anorexia (Cavedini, et al., 2006). However, few studies have been carried out in this area to date and only one (Liao, et al., 2009) compared a sample of bulimic and anorexic patients. In addition, most of these studies included patients with potential confounding factors such as a high level of depression or medication. Finally, some authors suggest that the validity of the current diagnostic categories for eating disorders would be insufficient (Fairburn &

Harrison, 2003). Thus an additional dimensional approach of ED would be useful. The results of earlier studies contrast in terms of a potential association between decision-making and dimension related to eating disorders (Cavedini, et al., 2004; Liao, et al., 2009; Tchanturia, et al., 2007).

The present study is aimed at confirming the hypotheses of lower decision-making skills in EDs amongst a large sample of patients free from comorbid mood disorders and medication and at exploring the link between some dimensions relevant to EDs and decision-making.

METHODS

Study population

Three groups of female participants were recruited: (1) patients suffering from anorexia nervosa (n=49); (2) patients with bulimia nervosa (n=38) according to DSM-IV criteria; and (3) healthy controls with no psychiatric history (n=83). Anorexic patients were further divided according to restrictive (n=37) and purging (n=13) subtypes.

Patients were recruited from outpatients and inpatients at Montpellier Academic Hospital. Healthy controls were recruited from announcements at the Montpellier Academic Hospital. The local ethics committee approved the study. Inclusion criteria comprised: subjects 18 to 60- years old , who were not depressed or receiving psychotropic medication when assessed, no lifetime history of psychiatric disorders in the case of the control subjects and a BMI between 18 and 25. Exclusion criteria included: weight loss secondary to somatic disease, any neurological disorder and previous use of the IGT (due to the learning effect).

Clinical assessment

All participants underwent a clinical examination carried out by experienced psychiatrists (SG, CNTS, FJ). Lifetime axis I psychiatric diagnoses were determined according to the DSMI-IV, using the French version of the lifetime Mini International Neuropsychiatric Interview (Sheehan, et al., 1998). Patients were normothymic at the time of evaluation, with a 21-item Hamilton Depression Rating Scale score (Hamilton, 1960) < 15 and no current diagnosis of a major depressive episode according to the MINI.

In addition, dimensions relevant to EDs were assessed using the Eating Disorder Inventory 2 (EDI-2) (Gardner, 1991) and the Eating Attitude Test (EAT-40) (Garner & Garfinkel, 1979). The EDI-2 is a six-point self-questionnaire assessing specific attitudes or behaviour concerning eating, weight and body shape, and personality traits such as perfectionism or body dissatisfaction. The EAT-40 is a six-point self-report indicating the symptoms of EDs.

Neuropsychological assessment

The pre-morbid intelligence quotient (IQ) was estimated using the French version of the National Adult Reading Test (NART) (Mackinnon, Ritchie, & Mulligan, 1999).

Decision-making was assessed using the computerised version of the IGT (Bechara, Tranel, & Damasio, 2000). An identical procedure was used for all participants. They all received the original instruction before carrying out the task (Bechara, et al., 2000). In this task, four decks of cards are presented on a computer screen. The participant has to choose a card from one of the decks. Each card results in a gain only or a gain and then a loss of money. The game continued for 100 cards, but the participants did not know this. The participants were also unaware of the fact that there were two beneficial decks, giving small gains, but even smaller losses (resulting in a net gain), and two disadvantageous decks, giving large gains, but even larger losses (resulting in a long-term net loss). The game is designed to create a feeling of uncertainty. The task emphasises the learning of reward and punishment combinations. Choices were classified as advantageous or disadvantageous. The IGT net score was calculated as the difference between the number of advantageous and disadvantageous choices. Therefore, higher scores indicate a better performance. At the end of the task, each participant was asked a list of questions in order to assess their conscious knowledge of the task (for list of questions see the following reference (Guillaume, et al., 2009).

Statistical analysis

The characteristics of the study population were described using median values and range for quantitative variables, and proportions for categorical variables. For continuous variables, the distributions were tested with the Shapiro-Wilk test and were skewed.

Chi square or Fisher tests were used to compare categorical variables. Comparison of quantitative variables between two groups was performed using the Mann-Whitney test and comparison of quantitative variables between more than two groups was performed using the Kruskall-Wallis test.

To evaluate the learning process of IGT, we used a sign rank test (S) comparing the first and second score (related scores). Spearman's correlations were used for the correlations studies. A correction for multiple comparisons (Bonferroni method) of each instrument was applied. For all comparisons, significance was set at $p \leq 0.05$. Statistical analyses were performed using SAS software, version 9.1 (SAS Institute, Cary, NC, USA).

RESULTS

Demographic and clinical variable (Table 1)

Healthy controls were significantly older than anorexic and bulimic patients. Controls had a higher median NART score than anorexic patients, whereas bulimic patients did not differ significantly from the two other groups.

As expected, anorexic patients had a lower median body mass index (BMI) than the bulimic patients and healthy controls. Anorexic and bulimic patients did not differ in terms of psychiatric comorbidities. In-patients were more anorectic at the time of the assessment. As shown in Table 1, anorectic and/or bulimic patients differed from the healthy controls for most of the dimensional assessments.

Between-group performance on decision-making

The two patient groups did not differ significantly from healthy controls in IGT performance for the total net score or for each intermediate score (Table 2). Moreover, there were no differences between the groups in terms of the knowledge of task contingency. In all the groups there was a significant task-related learning effect as highlighted by the improvement in the score during the task ($p<0.0001$ for controls, $p<0.03$ for anorectic subjects, $p<0.005$ for bulimic subjects)

Association with clinical variables

As was expected, eating disorder measures were inter-correlated. Indeed, positive correlations were found between all the subscores of EDI and the total score of EAT ($r>0.4$ and $p<0.001$ for all the correlations).

There was no correlation between the NART score and the total IGT score in the whole sample ($r=0.07$; $p=0.40$) or in the healthy control ($r=0.15$; $p=0.22$), anorectic ($r=-0.06$; $p=0.67$) or bulimic ($r=0.07$; $p=0.67$) sample.

The current BMI was not correlated with the total IGT score in the whole sample ($r=0.008$; $p= 0.9231$), or in the healthy control ($r= 0.037$; $p= 0.83$), anorectic ($r=0.055$; $p=0.7$) or bulimic ($r=0.12$; $p= 0.45$) sample.

Age of onset was not correlated with the total IGT score in the anorectic ($r=-0.13$; $p=0.38$) or bulimic ($r=0.034$; $p=0.4$) sample.

Duration of disease was not correlated with the total IGT score in the anorectic (r=0.156; p=0.34) or bulimic (r=0.056; p= 0.77) sample.

In the anorexic sample, the lowest BMI was not correlated with the total IGT score (r= -0.13; p=0.51).

In the whole sample, the net IGT score was not correlated with the EAT total score (r=0.015; p=0,89), or with any of the EDI subscales (p> 0,26 for all subscores).

DISCUSSION

This study failed to confirm the previous findings of decision-making alterations, measured with the IGT, in a large population of patients with EDs (Boeka & Lokken, 2006; Cavedini, et al., 2004; Cavedini, et al., 2006; Liao, et al., 2009; Tchanturia, et al., 2007). Moreover, no significant correlation was found between any dimension relevant to EDs and decision-making.

When compared to previous studies, the controls in our population performed in a more or less similar fashion to those in previous studies (Cavedini, et al., 2004; Cavedini, et al., 2006; Liao, et al., 2009; Tchanturia, et al., 2007). In contrast, both the anorexic and bulimic patients performed better than those previously described (Cavedini, et al., 2004; Cavedini, et al., 2006; Liao, et al., 2009; Tchanturia, et al., 2007). Thus, the discordant results between studies do not seem to be related to differences in the performance of controls, but may be explained by differences in patient characteristics. Firstly, medication could have an impact on cognitive performance. The serotonin system is involved in decision-making (Jollant, et al., 2007; Rogers, et al., 2003), and it can be hypothesised that serotonergic drugs (SSRI) may influence these cognitive performances. Only one previous study enrolled patients free of medication (Cavedini, et al., 2004), and information regarding medication status is lacking in two studies (Boeka & Lokken, 2006; Cavedini, et al., 2006). In the study carried out by Tchanturia, et al. (2007), 44% of patients were taking SSRI but the authors did not find any differences between medicated and non-medicated patients. Another explanation could be related to the level of depression. It was decided not to include patients with depression in the present study. The impact of depression on decision-making is unclear as some authors have found that depressive symptoms can affect decision-making performance (Murphy, et al., 2001), whereas others argue that decision-making is not influenced by current depressive episodes (Oldershaw, et al., 2009). Importantly, Tchanturia, et al. (2007) found a significant negative association between depression scores and IGT performance. In other previous studies, the depression level was either not assessed (Cavedini, et al., 2004; Cavedini, et al., 2006), or the mean depression level (assessed by the Beck Depression Inventory) was higher than the usual cut-off values (Boeka & Lokken,

2006; Liao, et al., 2009; Tchanturia, et al., 2007). The affective symptomatology could therefore have impaired the patient's performance in the IGT, and could explain why our patients performed better than those in previous studies. It is questionable whether depressive symptoms, which are very common among ED patients, are a factor in impaired decision-making rather than of the eating disorder *per se*.

Beyond the scope of this study, the question of the effect of starvation on decision-making skills also arises. In their study, Liao et al. (2009) found that the net IGT score improves with weight gain. On the other hand, we found no correlation between the net IGT score and BMI, and Cavedini et al (2006) suggested that, "The decision-making impairment seems to be stable over time and does not appear to depend on physical and clinical modifications". It is nevertheless possible that confounding factors, other than BMI, have played a role in this link, but a specific study assessing the effect of starvation on decision-making would be useful.

No correlation was found between any dimension of EAT and EDI and decision-making skills. Contrasting results were obtained in earlier studies. Two studies (Cavedini, et al., 2006; Liao, et al., 2009) suggest than obsessive-compulsive symptoms are behind the IGT findings whereas another study failed to detect such a link (Cavedini, et al., 2004). One study (Boeka & Lokken, 2006) on bulimia suggests a link between decision-making and weight and eating concerns /restricting behaviour whereas three studies failed to find such a correlation (Brand, et al., 2007; Liao, et al., 2009; Tchanturia, et al., 2007). Thus, contradictory results are obtained once again, but tend to suggest that decision-making is not associated with many of the main ED symptoms.

Our study has several limitations. Firstly, we have not assessed the potential implications of other executive functions (such as attention or working memory), which may vary in conjunction with IGT performance. Similarly we have not assessed the impact of obsessive-compulsive symptoms, which are very common in EDs and are associated with decision-making impairment on IGT (Lawrence, et al., 2006). Moreover, in order to assess the dimensional characteristics of EDs, it would have been relevant to include a sample of patients with non-otherwise specified EDs, who represent the largest group of

patients in clinical practice (Fairburn & Harrison, 2003). Lastly, decision-making was assessed solely with the IGT and it would be interesting to add other decision-making tasks such as the Game of Dice Task previously used to detect impairment in bulimia (Brand, et al., 2007).

We did not find any difference in terms of the conscious knowledge of the mechanism of IGT. A previous study by Tchanturia et al (2007) found an impairment of emotional signal guiding decision-making, at least in anorexia. Good performance on the IGT may be obtained by a conscious explicit knowledge of task contingency or by the presence of an emotional signal (somatic markers) (Guillaume, et al., 2009). It can be hypothesised than ED patients make up for their lowest emotional signal by demonstrating a sound ability to understand the tasks. This would be consistent with data suggesting deficits in emotional skills among EDs (Friederich, et al., 2006; Harrison, Sullivan, Tchanturia, & Treasure, 2009; Pollatos, Herbert, Schandry, & Gramann, 2008; Uher, et al., 2004) and data suggesting learning capacity integrity in EDs (Duchesne, et al., 2004). In order to confirm this hypothesis, a study assessing both explicit knowledge and the emotional system in EDs would be interesting.

In conclusion, the results of the current study suggest normal decision-making abilities in euthymic and non-medicated patients with EDs. Further studies on this subject are required in order to reach a conclusion. *More broadly, neuropsychological studies constitute an interesting field of investigation for understanding psychiatric disorders. Additional studies investigating executive functions in EDs are needed in order to obtain a greater understanding of the pathophysiology of EDs and thus help in improving therapeutics.*

ACKNOWLEDGEMENT

We would like to thank Dr J. Sultan for her help in patient recruitment. The authors are also grateful to the anonymous reviewers for their suggestions on earlier versions of this manuscript.

FUNDING SOURCE

This study received financial support from CHU Montpellier (AOI UF 7880). Dr Ngo Ton Sang received a grant from the Federation Hospitalière de France.

REFERENCES

Bechara, A., Tranel, D., & Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain, 123 (Pt 11)*, 2189-2202.

Boeka, A. G., & Lokken, K. L. (2006). The Iowa gambling task as a measure of decision making in women with bulimia nervosa. *J Int Neuropsychol Soc, 12*(5), 741-745.

Brand, M., Franke-Sievert, C., Jacoby, G. E., Markowitsch, H. J., & Tuschen-Caffier, B. (2007). Neuropsychological correlates of decision making in patients with bulimia nervosa. *Neuropsychology, 21*(6), 742-750.

Cavedini, P., Bassi, T., Ubbiali, A., Casolari, A., Giordani, S., Zorzi, C., et al. (2004). Neuropsychological investigation of decision-making in anorexia nervosa. *Psychiatry Res, 127*(3), 259-266.

Cavedini, P., Zorzi, C., Bassi, T., Gorini, A., Baraldi, C., Ubbiali, A., et al. (2006). Decision-making functioning as a predictor of treatment outcome in anorexia nervosa. *Psychiatry Res, 145*(2-3), 179-187.

Crow, S. J., Peterson, C. B., Swanson, S. A., Raymond, N. C., Specker, S., Eckert, E. D., et al. (2009). Increased mortality in bulimia nervosa and other eating disorders. *Am J Psychiatry, 166*(12), 1342-1346.

Duchesne, M., Mattos, P., Fontenelle, L. F., Veiga, H., Rizo, L., & Appolinario, J. C. (2004). [Neuropsychology of eating disorders: a systematic review of the literature]. *Rev Bras Psiquiatr, 26*(2), 107-117.

Fairburn, C. G., & Harrison, P. J. (2003). Eating disorders. *Lancet, 361*(9355), 407-416.

Friederich, H. C., Kumari, V., Uher, R., Riga, M., Schmidt, U., Campbell, I. C., et al. (2006). Differential motivational responses to food and pleasurable cues in anorexia and bulimia nervosa: a startle reflex paradigm. *Psychol Med, 36*(9), 1327-1335.

Gardner, L. (1991). *EDI-2: Professional Manual*: Odessa.

Garner, D. M., & Garfinkel, P. E. (1979). The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychol Med, 9*(2), 273-279.

Guillaume, S., Jollant, F., Jaussent, I., Lawrence, N., Malafosse, A., & Courtet, P. (2009). Somatic markers and explicit knowledge are both involved in decision-making. *Neuropsychologia*.

Hamilton, M. (1960). A rating scale for depression. *J Neurol Neurosurg Psychiatry, 23*, 56-62.

Harrison, A., Sullivan, S., Tchanturia, K., & Treasure, J. (2009). Emotion recognition and regulation in anorexia nervosa. *Clin Psychol Psychother*.

Jollant, F., Buresi, C., Guillaume, S., Jaussent, I., Bellivier, F., Leboyer, M., et al. (2007). The influence of four serotonin-related genes on decision-making in suicide attempters. *Am J Med Genet B Neuropsychiatr Genet, 144B*(5), 615-624.

Kaye, W. H., Fudge, J. L., & Paulus, M. (2009). New insights into symptoms and neurocircuit function of anorexia nervosa. *Nat Rev Neurosci, 10*(8), 573-584.

Keefe, R. S. (1995). The contribution of neuropsychology to psychiatry. *Am J Psychiatry, 152*(1), 6-15.

Lawrence, N. S., Wooderson, S., Mataix-Cols, D., David, R., Speckens, A., & Phillips, M. L. (2006). Decision making and set shifting impairments are associated with distinct symptom dimensions in obsessive-compulsive disorder. *Neuropsychology, 20*(4), 409-419.

Liao, P. C., Uher, R., Lawrence, N., Treasure, J., Schmidt, U., Campbell, I. C., et al. (2009). An examination of decision making in bulimia nervosa. *J Clin Exp Neuropsychol, 31*(4), 455-461.

Mackinnon, A., Ritchie, K., & Mulligan, R. (1999). The measurement properties of a French language adaptation of the National Adult Reading Test. *International Journal of Methods in Psychiatric Research, 8*(1), 27-38.

Murphy, F. C., Rubinsztein, J. S., Michael, A., Rogers, R. D., Robbins, T. W., Paykel, E. S., et al. (2001). Decision-making cognition in mania and depression. *Psychol Med, 31*(4), 679-693.

Oldershaw, A., Grima, E., Jollant, F., Richards, C., Simic, M., Taylor, L., et al. (2009). Decision making and problem solving in adolescents who deliberately self-harm. *Psychol Med, 39*(1), 95-104.

Pollatos, O., Herbert, B. M., Schandry, R., & Gramann, K. (2008). Impaired central processing of emotional faces in anorexia nervosa. *Psychosom Med, 70*(6), 701-708.

Rogers, R. D., Tunbridge, E. M., Bhagwagar, Z., Drevets, W. C., Sahakian, B. J., & Carter, C. S. (2003). Tryptophan depletion alters the decision-making of healthy volunteers through altered processing of reward cues. *Neuropsychopharmacology, 28*(1), 153-162.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., et al. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *J Clin Psychiatry, 59 Suppl 20*, 22-33;quiz 34-57.

Tchanturia, K., Campbell, I. C., Morris, R., & Treasure, J. (2005). Neuropsychological studies in anorexia nervosa. *Int J Eat Disord, 37 Suppl*, S72-76; discussion S87-79.

Tchanturia, K., Liao, P. C., Uher, R., Lawrence, N., Treasure, J., & Campbell, I. C. (2007). An investigation of decision making in anorexia nervosa using the Iowa Gambling Task and skin conductance measurements. *J Int Neuropsychol Soc, 13*(4), 635-641.

Treasure, J., Claudino, A. M., & Zucker, N. (2009). Eating disorders. *Lancet*.

Uher, R., Murphy, T., Brammer, M. J., Dalgleish, T., Phillips, M. L., Ng, V. W., et al. (2004). Medial prefrontal cortex activity associated with symptom provocation in eating disorders. *Am J Psychiatry, 161*(7), 1238-1246.

Table 1: A comparison of demographic and clinical variables between the groups

	Anorexia Nervosa	Bulimia Nervosa	Healthy Control	p-value	post hoc
Median [Min-Max] (n)	49	38	83		
Age, years	23.3 [18.0;46.1]	23 [18.0;36.0]	28 [18.7;60.0]	<0.0001	HC> AN, BN
Age of onset, years	17.3 [12-26] (46)	17 [6-24.9] (33)		0.27	
Disease duration, years	3 [1-14] (39)	5 [0.5-21] (29)		0.0137	
Educational level, years	14 [11.0;18.0]	14.5 [9.0;18.0]	15 [9.0;18.0]	0.0099	HC> AN
NART	23 [15;30]	25 [15;33]	26 [15;31]	<0.0001	HC > AN
BMI	15.4 [12.1;17.3]	21.3 [16.8;33.1]	20.2 [18.0;24.2]	<0.0001	HC, BN >AN
HAMD	2 [0;9]	2 [0;11]	0 [0;2]	<0.0001	HC> AN, BN
EAT total score	48 [10-92]	40 [13-83]	8 [2-42]	<0.0001	AN, BN >HC
EDI- Drive for Thinness	9 [0-21]	13 [3-19]	0 [0-16]	<0.0001	BN > AN > HC
EDI - Bulimia	0 [0-17]	11 [1-20]	0 [0-3]	<0.0001	BN > AN, HC
EDI- Body Dissatisfaction	10 [4-27]	18 [1-27]	4 [0-25]	<0.0001	AN, BN>HC
EDI- Ineffectiveness	8.5 [0-20]	9.5 [1-20]	1 [0-11]	<0.0001	AN, BN > HC
EDI- Perfectionism	7 [0-17]	5 [0-13]	1 [0-16]	0.0044	AN, BN >HC
EDI- Interpersonal Distrust	5 [1-13]	6 [0-16]	1 [0-10]	<0.0001	AN, BN >HC
EDI – Interoceptive Awareness	9 [1-22]	8 [3-19]	0 [0-4]	<0.0001	AN, BN >HC
EDI- Maturity Fears	5 [0-16]	6 [0-17]	0 [0-12]	<0.0001	AN, BN >HC
EDI - Asceticism	5 [0-16]	7.5 [0-14]	3 [0-6]	<0.0001	AN, BN >HC
EDI- Impulse Regulation	3 [0-19]	3 [0-22]	0 [0-4]	<0.0001	AN, BN >HC
EDI- Social Insecurity	7 [1-20]	6 [0-14]	0 [0-9]	<0.0001	AN, BN >HC
n (%)					
Current hospitalisation	19 (38.8)	2 (5.4)	-	0.0004	
Diagnosis (lifetime)					
No mood disorders	23 (46.9)	15 (39.5)	-	0.66	
Depressive disorder	22 (44.9)	18 (47.4)	-		
Bipolar disorders	4 (8.2)	5 (13.1)	-		
Anxiety disorders					
None	18 (36.8)	17 (44.7)		0,26	
Any (except OCD)	23 (46.9)	19 (50)			
OCD	8 (16.3)	2 (5.3)			
Substance misuse	2 (4.1)	3 (7.9)	-	0,65	

AN=anorexia nervosa; BN=bulimia nervosa; HC=Healthy control; NART=national adult reading test; BMI=bone modelling unit, HAMD=Hamilton depressive rating scale, EAT=Eating attitude test; EDI= eating disorders inventory, OCD= obsessive compulsive disorders; NS= non significant

Table 2: Iowa Gambling Task scores between the three groups

	Anorexia Nervosa				Bulimia Nervosa N=38	Healthy Control N=83	
	Whole Anorexic N=49	Anorexia restrictive N=37	Anorexia Purging N=12	p-value☆			p-value⌗
Total Net Score Median [min-max]	8 [-46-62]	8 [-42-62]	7 [-46-54]	0.89	4 [-64-96]	2 [-40-64]	0.98
1-20 net score Median [min-max]	-2 [-12-20]	-2 [-12-20]	-4 [-8-20]	0.41	-4 [-20-16]	-4 [-20-20]	0.37
21-40 net score Median [min-max]	0 [-12-20]	0 [-12-12]	4 [-6-20]	0.13	0 [-12-20]	0 [-18-20]	0.80
41-60 net score Median [min-max]	0 [-20-20]	-2 [-12-18]	4 [-20-20]	0.52	1 [-18-20]	2 [-12-20]	0.35
61-80 net score Median [min-max]	2 [-20-20]	2 [-16-20]	1 [-20-20]	0.43	3 [-20-20]	2 [-20-20]	0.87
81-100 net score Median [min-max]	4 [-16-20]	4 [-12-20]	2 [-16-20]	0.77	0 [-16-20]	4 [-20-20]	0.94
Knowledge of the task n (%)							
None	22 (45.8)	18 (50.0)	4 (33.3)	NA	17 (44.8)	29 (34.9)	0.49
Intermediate	7 (14.6)	4 (11.1)	3 (25.0)		7 (18.4)	22 (26.5)	
Full	19 (39.6)	14 (38.9)	5 (41.7)		14 (36.8)	32 (38.6)	

NA: Chi2 Not Applicable ☆Comparison IGT Score between anorexia restrictive and anorexia purging ⌗ Comparison of IGT Scores between anorexia nervosa subjects, bulimia nervosa subjects and healthy controls