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Cognitive deficits and biases for food and body in bulimia: Investigation using an affective shifting task

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ABSTRACT

Objective: Studies suggest that attentional deficits and biases play a role in the development and maintenance of eating disorders. Many of these studies have methodological limitations and their results are difficult to interpret. In this study, we examine attentional deficits and biases in bulimia.

Method: 18 bulimic participants and 18 controls performed an adaptation of the go/no-go affective shifting task. That task allows the investigation of attention, inhibitory control and mental flexibility for stimuli related to the body and food.

Results: Bulimic participants tended to react faster than controls in the go/no-go affective task. They also had poorer discrimination ability than controls and showed inhibition problems, particularly when the targets were related to food. The magnitude of these effects ranged from moderate to large. No difference between groups was found concerning mental flexibility.

Discussion: These results suggest that bulimics present cognitive deficits and are more impulsive, especially with food-related stimuli. These cognitive deficits and biases may be at least partially responsible for the development and maintenance of bulimia.

1. Introduction

Recent studies suggest that attentional deficits and biases play a role in the development and maintenance of eating disorders (Lena, Fiocco, & Leyenaar, 2004). Attentional deficits refer to

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dysfunctions affecting basic attentional processes (e.g., inhibition, shifting, selective attention); these dysfunctions are unaffected by the content of the processed information. Attentional biases can be inferred when individuals preferentially attend to certain stimuli more than others, in this case, stimuli related to food and body shape (Dobson & Dozois, 2004).

In a recent meta-analysis, Dobson and Dozois (2004) identified 28 studies that examined attentional biases in eating disorders using the emotional Stroop task. In this task, the participant is asked to name the color of the ink of emotional words. When the processing time is slow, it indicates interference between the processes used to identify the word meaning and the processes used to name the ink color. In participants with bulimia, researchers have found that color naming is significantly slowed if the words are related to food and body shape or size (e.g., *fat, blubber*). The results yield a moderate effect size for the Food Stroop and Body/ Weight Stroop. In Dobson and Dozois's (2004) view, the fact that moderate effect sizes were also noted for the classic Stroop suggests that bulimic individuals may have a general deficit affecting color naming rather than a specific content problem. They also pointed out that the findings of existing studies of eating disorders are inconsistent, and consider that the discrepancies could be related to methodological limitations, such as not considering word length and imageability or using inappropriate control stimuli (e.g., words from different semantic categories or words pertaining to clothes). Some studies even employed heterogeneous word lists combining words pertaining to weight, shape, body parts and food, which represent different aspects of eating psychopathology, in single lists.

Moreover, results on the Stroop task are quite difficult to interpret. Two hypotheses have been proposed to explain the interference with color naming: eating-disorder-related stimuli may cause a greater degree of activation, hence a greater degree of interference, or the interference may be due to a difficulty inhibiting eating-disorder-related stimuli.

However, so far, to the best of our knowledge, only three studies have used other experimental tasks to measure attentional biases in bulimic individuals. Schotte, McNally, and Turner (1990) used a dichotic listening procedure. In this paradigm, participants hear two different messages, one in each ear, and are asked to attend to only one. The authors showed that bulimics detected a body-related word (e.g., *fat*) in the message they were not attending to more frequently than normal controls. Rieger et al. (1998) used a visual probe detection task. In this task, two words are displayed, one above the other, followed by a visual probe shown in the same location as one of the word stimuli. Participants are requested to signal their detection of the probe as quickly as possible. The authors found that bulimics tend to direct their attention away from "positive" shape words (e.g., *thin*) and towards "negative" shape words (e.g., *fat*). Recently, Shafran, Lee, Cooper, Palmer, and Fairburn (2007) used a pictorial version of the dot-probe task.

Very few studies have explored the existence of attentional deficits affecting capacities such as inhibition or shifting. However, there is evidence that bulimics suffer from attentional and executive impairments. According to Ferraro, Wonderlich, and Jocic's (1997) study, bulimic participants were

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deficient on the Wisconsin Card Sort task, in which they are required to sort a number of cards by a rule that changes periodically. Moreover, they were faster and made more errors than controls on the WAIS-R Symbol- Digit Modalities Test, where they had to transcribe symbols paired with the numbers 1 through 9 as quickly as possible; the test comprises 100 digits in a random order. Bulimics also performed worse than controls on the Trail Making Test A and B (TMT-A and TMT-B) and the Talland Letter Cancellation Test—Revised (Jones, Duncan, Brouwers, & Mirsky, 1991; Tchanturia et al., 2004). In the latter task, the participant is asked to mark out a target letter in an array of letters. Some of the letters used are capitalized, and some are separated by double spaces. The task requirements include three variations: crossing out capital letters, crossing out the letters immediately before and after a double space, and performing both tasks at once. In addition, bulimic participants take longer to adopt new strategies in the set-shifting portion of the TMT (TMT-B). As a reminder, in the TMT-A, the participant's task is to quickly draw lines on a page connecting 25 consecutive numbers in an ascending sequence. In Part B, the lines must alternate between numbers and letters in an ascending sequence. Although these various findings are interesting, they are based on studies that use *multidetermined* tasks, which limits the detection of subtle differences in these patients. For example, the TMT requires different neuropsychological functions such as cognitive flexibility, attention, inhibition and working memory; therefore, patients may be impaired on this task for different reasons. This is a major limitation if we want *to isolate* the processes that might affect eating- disordered patients and refine the assessment of their cognitive deficits in order to better understand the psychological processes related to bulimia. Furthermore, some studies did not use a control group (Lauer, Gorzewski, Gerlinghoff, Backmund, & Zihl, 1999).

Considering all these methodological and theoretical limitations, we conducted a study to re-examine attentional biases and deficits. For this purpose, we used an adaptation of the go/no-go affective shifting task (Murphy et al., 1999). Murphy et al. (1999) successfully used this task to characterize deficits and biases *separately* in depression and mania. In this go/no-go task, words denoting "forbidden" foods, "negative" shapes or neutral objects are presented one by one in the center of a screen. Half of the words are targets and half are distracters. Participants must respond to targets by pressing the space bar as quickly as possible but must withhold responses to distracters. The aim was to test bulimic persons' ability to discriminate between food/body-related and neutral words. Sometimes, the food/body-related words were the targets for the "go" response, with the neutral words as distracters, and sometimes the reverse was true. Several shifts in target type occurred during the task. Due to its structure (see Methods section for more details), the affective shifting task allows one to examine the various components *separately*, which is less feasible with other tasks. More specifically, this task allows for the examination of different levels of inhibitory control: (1) general ability to inhibit behavioral responses and focus attention; (2) individuals' ability to inhibit and reverse stimulus–reward associations; and (3) individuals' ability to inhibit eating-disorder-congruent attentional biases (Murphy et al., 1999).

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2. Methods

2.1. Participants

The study was carried out with patients attending the Eating Disorder Center at the Clinique des Vallées in Annemasse, France, who conformed to the following inclusion criteria: (1) a DSM-IV (American Psychiatric Association, 1994) diagnosis of bulimia nervosa, as confirmed by an interview; and (2) no history of neurological or other severe medical diseases, alcoholism, or drug abuse/dependence. All patients admitted during both recruiting periods were included in the study. Thirty-six participants were recruited: 18 bulimic patients and 18 normal controls. Six patients were experiencing a current major depressive episode, one had generalized anxiety disorder, three obsessive—compulsive disorder, one posttraumatic stress disorder and one social phobia. Three participants, one of whom met standard criteria for being a statistical outlier on the modified shifting task because her discrimination and decision bias scores were more than 3 standard deviations away from the mean, one who was too underweight (BMI= 15.73) and one male, were excluded from the bulimic group and replaced. In the end, there were 18 women in the bulimic group and 18 women in the control group. The bulimic patients' mean age was 25.11 years (SD= 3.88). Sixteen belonged to the purging subtype, with binge episodes always followed by self-induced vomiting, and two belonged to the nonpurging subtype, in which binge episodes were followed by fasting or excessive exercising.

Table 1 *- Means (SDs) on questionnaires for bulimic patients and controls with t-test comparison*

	Patients (*n* = 18)	Controls (*n* = 18)	*t*-value
Age	25.11 (3.88)	24.28 (3.36)	0.69
Education, years	16.17 (3.40)	16.17 (2.85)	0.00
BMI	20.38 (2.61)	21.02 (1.64)	− 0.88
Height	1.65 (0.07)	1.65 (0.05)	− 0.37
Weight	54.82 (9.11)	57.53 (6.28)	− 1.03
DT EDI-2	12.89 (4.73)	0.94 (1.47)	10.24∗
BN EDI-2	7.94 (4.47)	0.22 (0.55)	7.28∗
BD EDI-2	18.83 (7.01)	7.44 (6.36)	5.11∗
MAC-24	85.56 (16.01)	54.00 (10.03)	7.09∗
BDI-2	25.06 (11.41)	5.11 (3.74)	7.04∗
STAI Y-A	49.67 (9.26)	32.28 (9.37)	5.60∗
STAI Y-B	60.33 (8.97)	36.78 (10.63)	7.18∗

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Note. Education = number of years; BMI = Body Mass Index; DT = Drive for Thinness subscale of the Eating Disorder Inventory-2 score (EDI-2); BN = Bulimia subscale of the EDI-2; BD = Body Dissatisfaction subscale of the EDI-2; MAC-24 = Mizes Anorectic Cognition Questionnaire; BDI-2 = Beck Depression Inventory; STAI Y-A/ B= State and Trait Anxiety questionnaires, respectively. Degrees of freedom for the t-test= 34.

⁎p b.01.

The healthy comparison participants were recruited among university students and volunteers. They had no history of eating disorders and were not being treated with medication that might potentially influence cognition (e.g., benzodiazepines, antidopaminergics, antihistamines). We selected comparison participants of normal weight who were as similar as possible to the clinical participants regarding age and education. Their mean age was 24.28 years (SD= 3.36). All participants were native speakers of French and had normal or corrected vision (criteria for inclusion).

Body Mass Index (BMI: Weight/Height^2 [kg/m^2]) was calculated from the participants' self-reported height and weight. For the patients, the accuracy of these measures was checked in their medical files. The patients' mean BMI of 20.38 (SD= 2.61; range= 17.50–28.37) was in the normal range, as was the comparison group's mean BMI of 21.01 (SD= 1.64; range= 18.42–24.46). All controls were of normal weight. However, even though the average BMI for the clinical group was within the normal range (BMI= 18.5–25), 3 individuals were underweight, 14 were of normal weight and 2 were overweight. *T*-tests revealed no significant differences between bulimics and controls in terms of age, years of education and BMI (Table 1).

2.2. PROCEDURE

Participants were naive to the study hypotheses, and their participation was voluntary. They were asked to complete the shifting task on an Armada 1500c Compaq laptop with a 12-inch screen running E-Prime presentation software (Psychology Software Tools, Inc.). Each participant was recorded individually. General task instructions were given orally first, then participants were given more detailed instructions on screen. They were not informed explicitly that the instructions would change. It was mentioned that a tone would sound for each false alarm. The same examiner administered first the shifting task and then the self- rating scales. The scales were introduced in random order, except for the STAI, which was completed immediately after the individuals had finished the shifting task.

2.3. MEASURES

2.3.1. Questionnaires

Patients' psychopathological state was evaluated with the following instruments: (1) the Drive for Thinness, Bulimia and Body Dissatisfaction subscales of the Eating Disorder Inventory-2 (EDI-2; Garner, 1991, French version by Archinard, Rouget, Painot, & Liengme, 2002) and the Mizes Anorectic

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Cognition Questionnaire (MAC-24; Mizes & Klesges, 1989, French version by Volery, Carrard, Rouget, Archinard, & Golay, 2006) to assess eating disorder; (2) the Beck Depression Inventory-2 (BDI-2; Beck, Steer, & Brown, 1996, French version by the Editions du Centre de Psychologie Appliquée, 1998) to investigate depression; and (3) the State and Trait Anxiety tests (respectively STAI Y-A and STAI Y-B; Spielberger, Gorsuch, & Lushene, 1983, French version by Editions du Centre de Psychologie Appliquée, 1993) to evaluate concomitant anxiety symptoms. *T*-tests revealed significant differences between bulimics and controls in terms of scores on self-rating scales (Table 1). On the EDI-2 questionnaire, bulimics had higher scores on the Drive for Thinness subscale ($t(34)= 10.24$, $p <.01$), the Bulimia subscale ($t(34)= 7.28$, $p <.01$), and the Body Dissatisfaction subscale ($t(34)= 5.11$, p b.01). They also had more eating disorder dysfunctional cognitions, as indicated by their higher score on the MAC-24 ($t(34)= 7.09$, $p <.01$). Finally, bulimics rated themselves as more depressed on the BDI ($t(34)= 7.04$, $p <.01$), and more anxious on the STAI Y-A ($t(34)= 5.60$, $p <.01$), and on the STAI Y-B ($t(34)= 7.18$, $p <.01$)

2.3.2. Affective shifting task

To measure shifting and inhibition, participants completed the modified affective shifting task, which was developed by Murphy et al. (1999). This task was modeled on the "set-shifting" paradigm of Dias, Robbins, and Roberts (1996). In this go/no-go task, words are rapidly presented one by one in the center of a 12-inch screen. Words are shown in 8-mm black letters. Participants must respond to targets by pressing the space bar with their dominant hand as quickly as possible but must withhold responses to distracters. Words are presented for 300 ms, with an interstimulus interval of 900 ms. This presentation time involves controlled processing of the stimuli (Mialet, 1999). A 500-ms/450-Hz tone sounds for each false alarm, but not for omissions. False alarms constitute responses to distracter stimuli while omissions are failure to respond to target stimuli.

The task comprises two parts: one that investigates attention and executive functions in connection with food-related information, and one that investigates attention and executive functions in connection with body-related information. Each part consists of 16 test blocks of 16 stimuli each: eight food words and eight object words. In each test block, either food (F) or object words (O) are specified as targets, with targets for the 16 blocks presented in the following order: FFOOFFOOFFOOFFOO. Because of this arrangement, eight test blocks are "shift" blocks, where participants must begin responding to stimuli that were distracters and cease responding to stimuli that were targets in the previous block (FFOOFFOOFFOOFFOO), and eight test blocks are "non- shift" blocks, where participants must continue responding to stimuli that were targets and withholding responses to stimuli that were distracters in the previous block (FFOOFFOOFFOOFFOO). In part 2, food words are replaced by body-related words. This task requires participants to shift their attention from one word category to the other. Half of the participants started with part 1, followed by part 2 and half started with part 2, followed by part 1.

The words are presented in a fixed-randomized format with the constraint that no three words from the same category appeared consecutively. Each word appears twice, once each in the shift

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and non-shift conditions, yielding 128 trials. Prior to the experimental trials, participants were given two practice blocks with words unrelated to the experimental word categories (flower and furniture words).

The test blocks comprise 128 stimuli of three types: 32 food words, 32 body words, and 64 object words, which are used as controls. The words used were selected from an original list of 300 food, object and body words because they were consistently rated on a 9-point Likert scale, by 20 unrestrained eaters (tested with the Restraint Scale, Polivy, Herman, & Warsh, 1978, French version by Lluch, 1995) who were blind to the purpose of the study, as being neutral (control words), forbidden (food words) or negative (shape words connoting a large physique or emotionally charged body parts, Jansen, Nederkoorn, & Mulkens, 2005). They also rated the words in terms of imageability. Research emphasizes that the foods that trigger binges are those which the patients view as prohibited (Rodin, Mancuso, Granger, & Nelbach, 1991). The food, body, and object words do not differ in terms of word length (number of characters per word) ($F(2, 125) = 1.10$, $p = 0.34$); frequency ($F(2, 125) = 1.16$, $p = 0.32$), as determined using the Lexique database (New, Pallier, Ferrand, & Matos, 2001); or imageability ($F(2, 125) = 2.13$, $p = 0.12$). The words presented to participants were French words. Examples of the three word categories are given in the Appendix with their English translations.

2.4. STATISTICAL ANALYSES

Measures of interest were response times (RT) to targets, false alarms (responses to distracter stimuli), and omissions (failure to respond to target stimuli). RTs of less than 100 ms, reflecting anticipation, were excluded from our analyses. These measures allow for examination of different levels of inhibitory control: (1) by examining overall performance irrespective of target valence and shift condition, general ability to inhibit behavioral responses and focus attention can be assessed; (2) by comparing overall performance on shift relative to non-shift blocks, individuals' ability to inhibit and reverse stimulus–reward associations can be determined; and (3) by contrasting performance measures for food/body-related targets, the presence of eating-disorder- congruent attentional biases can be evaluated (Murphy et al., 1999).

False alarms alone cannot be interpreted as an indication of an inhibition problem. We therefore performed a signal detection analysis to distinguish discrimination (d') from decision bias (C) (Snodgrass & Corwin, 1988). A d' value of 0 or less indicates that participants were either unable to discriminate targets from distracters or were not performing the task as instructed. A high d' indicates good discrimination ability (i.e., more hits and fewer false alarms). A high C indicates a decreased tendency to respond to any stimulus (conservative attitude with fewer hits and fewer false alarms). Thus, a low C was considered as a sign of problematic inhibition. Because decision bias (C) takes both hits and false alarms into account, it is a better indicator of problematic inhibition than false alarms alone. The bulimic patient excluded from the analysis had an extremely low discrimination score, suggesting that she had not understood the task instructions.

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Mean response times, *d'*, and *C* were analyzed with repeated-measures ANOVAs for independent groups with Group as between-subject factor (control versus bulimic), and Part of the task (food versus body part), Target type (interest versus neutral) and Shift condition (shift versus non-shift) as within-subject factors.

The acceptance or rejection of a hypothesis based on *p* value alone has been shown to be problematic, because *p* values do not distinguish effect from sample size (Cohen, 1994; Schmidt, 1996). We followed the recommendation of the Task Force on Statistical Inference (Wilkinson & Task Force on Statistical Inference, 1999) and the American Psychological Association (2001) and calculated effect sizes within 95% Confidence Intervals (CI). The magnitude of the ANOVA effects was measured with a correlation ($r_{\text{effect size}}$) following the method developed by Rosnow and Rosenthal (2003). An $r_{\text{effect size}}$>.10 is generally considered as a small effect, N.30 as a moderate effect and N.50 as a large effect (Cohen, 1988). An $r_{\text{effect size}}$ >.10 corresponds to a negligible effect. All analyses were computed with *R* (R Development Core Team, 2006).

3. Results

3.1. Shifting task

3.1.1. Response time

Using Response Time (RT) as the dependent measure, the four-way ANOVA (Group× Part× Target× Shift) revealed a moderate to large effect of Part of task, with all participants reacting faster in the part of the task related to food than in the part related to the body ($F(1, 34)=10.50$, $p<.01$, $r_{\text{effect size}}=.49$, CI (.19, .70)). The ANOVA also revealed a large effect of Target type, with all participants being quicker to detect food- and body-related targets than neutral targets ($F(1, 34)=126.90$, $p<.001$, $r_{\text{effect size}}=.89$, CI=(.79, .94)). A marginally significant effect of Group was also found and the effect was moderate ($F(1, 34)=3.37$, $p=.075$, $r_{\text{effect size}}=.30$, CI= (−.03, .57)), with bulimic participants being quicker in the modified shifting task than controls. The Group× Target interaction was also significant and this effect was moderate ($F(1, 34)=4.89$, $p=.03$, $r_{\text{effect size}}=.36$, CI=(.03, .61)). No other effects were significant (see Table 2 and Fig. 1.a.).

3.1.2. Discrimination (d')

When considering discrimination (*d'*), the ANOVA revealed an effect of Group. Comparison of means revealed that bulimic participants had a poorer discrimination ability (lower *d'*) than controls in all parts of the task ($F(1, 34)=6.53$, $p=.02$). This effect was moderate ($r_{\text{effect size}}=.40$, CI (.08, .65)). The ANOVA revealed a large effect of Part of task, with discrimination being better (higher d') in the part of the task related to food than in the part related to the body ($F(1, 34)=15.53$, $p<.001$, $r_{\text{effect size}}=.56$, CI (.29, .75)). In addition, the ANOVA revealed a large effect of Target type, with discrimination for food-and body-related targets being better (higher *d'*) than discrimination for neutral targets ($F(1, 34)=47.02$, $p<.001$, $r_{\text{effect size}}=.76$, CI=(.58, .87)). Moreover, the ANOVA revealed a moderate effect of

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Shift condition, with discrimination being better (higher *d'*) in the non-shift condition ($F(1, 34)=4.62$, $p=.04$, $r_{effect\ size}=.34$, CI (.01, .60)). No other effects were significant (see Table 2 and Fig. 1.b.).

3.1.3. Decision bias (C)

The ANOVA on Cs revealed a moderate effect of Group ($F(1, 34)= 4.19$, $p=.048$, $r_{effect\ size}=.33$, $CI=(.01, .60)$). The interaction between Group and Part was also significant and corresponded to a moderate effect ($F(1, 34)= 4.09$, $p=.05$, $r_{effect\ size}=.32$, CI (−.01, .59)). The inhibition problem (lower C) of bulimic participants was more pronounced in the food part (see Table 2 and Fig. 1.c.). No other effect was significant.

4. Discussion

In this study, we simultaneously examined attentional deficits and biases towards body-and food-related words in bulimia by means of a modified affective shifting task. The strength of our study is that it eliminates some of the methodological limitations affecting previous studies. First, we divided the food and body shape stimuli into two separate lists. Second, we improved the word lists by matching them for normative word frequency, word length, number of syllables and word imageability. Third, we constructed a homogeneous control word list (objects). Finally, we used a control group.

The results indicated that participants in both groups tended to respond faster to stimuli of interest, in this case words related to food and the body, than to neutral stimuli. Their discrimination was also better for stimuli of interest than for neutral stimuli. These target type effects were large and suggest that stimuli related to food and the body capture attention and are processed more efficiently. This may be due to the fact that food and body information are very familiar and have a particular significance and therefore a special status in memory.

Table 2 **-** Means (and SDs) for hit response time (RT), decision bias (C) and discrimination (d') by group

	Patients (n = 18)	Controls (n = 18)	Group differences F (1,34)
Hit RT			
Total	540.03 (63.36)	568.91 (63.40)	$p=.075$
Body part	556.04 (68.14)	574.42 (58.33)	n.s. (post hoc test)
Food part	524.03 (54.06)	563.40 (68.06)	n.s. (post hoc test)
Decision bias			
Total	− 0.171 (0.29)	− 0.066 (0.24)	$p=.048$
Body part	− 0.135 (0.36)	− 0.095 (0.25)	n.s. (post hoc test)

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Food part	− 0.208 (0.26)	− 0.037 (0.23)	*p* b.001 (post hoc test)
Discrimination			
Total	2.68 (0.81)	3.01 (0.66)	*p* =.015
Body part	2.52 (0.82)	2.85 (0.66)	n.s. (post hoc test)
Food part	2.84 (0.77)	3.16 (0.63)	n.s. (post hoc test)

In addition, the data indicate significant group differences. Bulimics showed poorer discrimination in the whole task; they also had more problems with inhibition, especially in the food part of the task. In addition, they tended to be faster than controls in the whole task. The magnitude of these effects ranged from moderate to large. The poorer discrimination of bulimic patients might reflect a general impairment in attentional function, as their efficiency is reduced for all types of stimuli. They also appear to have more inhibition problems, as is shown by the lower decision bias and their overall tendency to react faster. Interestingly, they have more inhibition problems for food words, as shown by their more pronounced decision bias in the food part of the task. These results (decreased discrimination abilities, lower decision bias and faster response) suggest that bulimic patients have a general impairment of the attentional function (reflecting deficits) and a specific impairment of the attentional function in relation to food (reflecting bias). This pattern of results may reflect attentional deficits and biases.

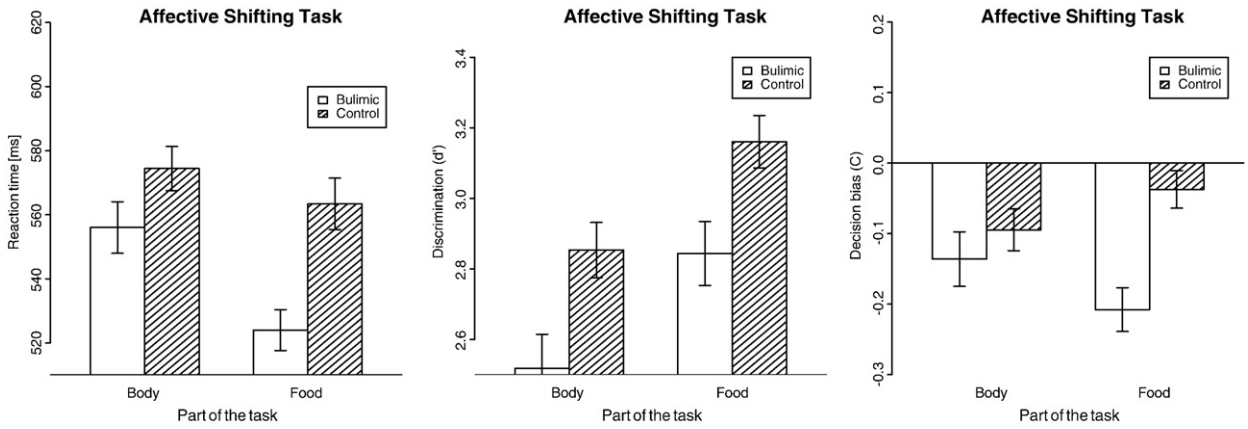

Fig. 1. a) Mean response time (RT) and standard error (SE) for bulimic and control participants on the modified affective shifting task. b) Mean discrimination (d') and standard error (SE) for bulimic and control participants on the modified affective shifting task. A higher d' corresponds to better performance. c) Mean decision bias (C) and standard error (SE) for bulimic and control participants on the modified affective shifting task. A higher C corresponds to more inhibition.

The inhibition problem displayed by bulimic participants in the modified shifting task, an index of impulsivity, may play a role in initiating and maintaining bulimia. It may be involved in the bulimic patients' inability to prevent themselves from overeating. When this happens under conditions of negative affect, it is often called “emotional eating,” in other words, overeating in response to negative emotions (anxiety, sadness, loneliness, fatigue and anger) (Masheb & Grilo, 2006). Interestingly, Lyke and Spinella (2004) found that a person's sense of loss of control over eating was related to both the attentional and motor impulsivity subscales of the Barratt Impulsivity Scale—version 11 (BIS-11) (Patton, Stanford, & Barratt, 1995). These attentional difficulties, which were also revealed in the modified shifting task, are probably related to difficulties in controlling thoughts of food or thoughts concerning body shape and weight. In fact, it seems that high-impulsive individuals report more thoughts related to eating disorders (eating, weight and shape concerns) than do low-impulsive individuals (Guerrieri, Nederkoorn, & Jansen, 2007). This phenomenon may lead to overeating because thoughts of food increase the desire to eat (Johnston, Bulik, & Anstiss, 1999).

Finally, two limitations on our study should be noted. First, our word category was limited to negatively valenced body image words. The absence of positively valenced stimuli (e.g., words connoting a thin physique) limits our understanding of body image information processing in bulimia. Second, we did not control for the duration of the disorder and for the possible effect of differences between the groups in terms of hunger levels. Future studies should also include words reflecting a thin physique and “permitted” foods and employ other specific tests of attention to investigate in more detail the maladaptive cognitive processes implicated in bulimia. It would also be interesting to explore impulsivity by using other cognitive tasks specifically designed to explore the processes underlying impulsivity (see Bechara & Van der Linden, 2005, for suggestions).

Appendix. Some sample lists of words

Food words

Biscuit	Cookie	Bonbon	Candy
Cacahuètes	Peanuts	Chocolat	Chocolate
Croissant	Croissant	Fromage	Cheese
Glace	Ice cream	Mayonnaise	Mayonnaise
Pizza	Pizza	Sandwich	Sandwich

Body words

Bourrelet	Roll of fat	Cellulite	Cellulite
Cuisse	Thigh	Fesse	Buttock
Hanche	Hip	Jambe	Leg
Joue	Cheek	Menton	Chin
Molle	Calf	Poitrine	Chest

Object words

Boulon	Bolt	Boussole	Compass
Calculatrice	Calculator	Clé	Key
Ciseau	Scissors	Compass	Compasses
Crayon	Pencil	Disquette	Diskette
Jeton	Token	Parapluie	Umbrella
Pinceau	Brush	Punaise	thumbtack

References

American Psychiatric Association (1994). Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: Author. American Psychological Association (2001). Publication manual, (5th ed.) Washington, DC: Author.

Archinard, M., Rouget, P., Painot, D., & Liengme, C. (2002). Traduction française du "Eating disorder inventory 2 - EDI-2". In M. Bouvard & J. Cottraux (Eds.), Protocoles et échelles d'évaluation en psychiatrie et en psychologie (pp. 265–273). Paris: Masson.

Bechara, A., & Van der Linden, M. (2005). Decision-making and impulse control after frontal lobe

injuries. Current Opinion in Neurology, 18, 734−739. Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Beck depression inventory II manual. San Antonio, TX: The Psychological Corporation.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Hillsdale, NJ: Erlbaum. Cohen, J. (1994). The earth is round (p b .05). American Psychologist, 49, 997−1003.

Dias, R., Robbins, T. W., & Roberts, A. C. (1996). Dissociation in prefrontal cortex of affective and attentional shifts. Nature, 380, 69−72.

Dobson, K. S., & Dozois, D. J. A. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. Clinical Psychology Review, 23, 1001−1022.

Editions du Centre de Psychologie Appliquée (1993). Manuel de l'Inventaire d'anxiété état-trait. Forme Y. Paris: Editions du Centre de Psychologie Appliquée (ECPA). Editions du Centre de Psychologie Appliquée (1998). Inventaire de dépression de Beck, BDI-II. Paris: Editions du Centre de Psychologie Appliquée (ECPA).

Ferraro, F. R., Wonderlich, S., & Jocic, Z. (1997). Performance variability as a new theoretical mechanism regarding eating disorders and cognitive processing. Journal of Clinical Psychology, 53, 117−121.

Garner, D. M. (1991). EDI 2: Eating disorder inventory 2. Professional manual. Odessa, FL: Psychological Assessment Resources.

Guerrieri, R., Nederkoorn, C., & Jansen, A. (2007). How impulsiveness and variety influence food intake in a sample of healthy women. Appetite, 48, 119−122.

Jansen, A., Nederkoorn, C., & Mulkens, S. (2005). Selective visual attention for ugly and beautiful body parts in eating disorders. Behaviour Research and Therapy, 43, 183−196.

Johnston, L., Bulik, C. M., & Anstiss, V. (1999). Suppressing thoughts about chocolate. International Journal of Eating Disorders, 26, 21−27.

Jones, B. P., Duncan, C. C., Brouwers, P., & Mirsky, A. F. (1991). Cognition in eating disorders. Journal of Clinical Experimental Neuropsychology, 13, 711−728.

Lauer, C. J., Gorzewski, B., Gerlinghoff, M., Backmund, H., & Zihl, J. (1999). Neuropsychological assessments before and after treatment in patients with anorexia nervosa and bulimia nervosa. Journal of Psychiatric Research, 33, 129−138.

Lena, S. M., Fiocco, A. J., & Leyenaar, J. K. (2004). The role of cognitive deficits in the development of eating disorders. Neuropsychology Review, 14, 99−113.

Lluch, A. (1995). Identification des conduites alimentaires par approches nutritionnelles et psychométriques. Unpublished doctoral dissertation, Université Henri Poincaré Nancy 1, France.

Lyke, J. A., & Spinella, M. (2004). Associations among aspects of impulsivity and eating factors in a nonclinical sample. International Journal of Eating Disorders, 36, 229−233.

Masheb, R. M., & Grilo, C. M. (2006). Emotional overeating and its associations with eating disorder psychopathology among overweight patients with binge eating disorder. International Journal of Eating Disorders, 39, 141−146.

Mialet, J. -P. (1999). L'attention. Paris: Presses Universitaire de France.

Mizes, J. S., & Klesges, R. C. (1989). Validity, reliability and factor structure of the anorectic cognitions questionnaire. Addictive Behaviors, 14, 589−594.

Murphy, F. C., Sahakian, B. J., Rubinsztein, J. S., Michael, A., Rogers, R. D., Robbins, T. W., et al. (1999). Emotional bias and inhibitory control processes in mania and depression. Psychological Medicine, 29, 1307–1321.

New, B., Pallier, C., Ferrand, L., & Matos, R. (2001). Une base de données lexicales du français contemporain sur Internet: Lexique™. L'Année psychologique, 101, 447–462.

Patton, J. H., Stanford, M.S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. Journal of Clinical Psychology, 51, 768–774. Polivy, J., Herman, C. P., & Warsh, S. (1978). Internal and external components of emotionality in restrained and unrestrained eaters. Journal of Abnormal Psychology, 87, 497–504.

R Development Core Team (2006). R: A language and environment for statistical computing (Version 2.3.0) [Computer software].Vienna: R Foundation for Statistical Computing. Retrieved from http://www.r-project.org/.

Rieger, E., Schotte, D. E., Touyz, S. W., Beumont, P. J., Griffiths, R., & Russel, J. (1998). Attentional biases in eating disorders: A visual probe detection procedure. International Journal of Eating Disorder, 23, 199–205.

Rodin, J., Mancuso, J., Granger, J., & Nelbach, E. (1991). Food cravings in relation to body mass index, restraint and estradiol levels: A repeated measures study in healthy women. Appetite, 17, 177–185.

Rosnow, R. L., & Rosenthal, R. (2003). Effect sizes for experimenting psychologists. Canadian Journal of Experimental Psychology, 57, 221–237.

Schmidt, F. (1996). Statistical significance testing and cumulative knowledge in psychology: Implications for training of researchers. Psychological Methods, 1, 115–129.

Schotte, D. E., McNally, R. J., & Turner, M. L. (1990). A dichotic listening analysis of body weight concern in bulimia nervosa. International Journal of Eating Disorders, 9, 109–113.

Shafran, R., Lee, M., Cooper, Z., Palmer, R. L., & Fairburn, C. G. (2007). Attentional bias in eating disorders. International Journal of Eating Disorders, 40, 369–380.

Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. Journal of Experimental Psychology, 117, 34–50.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. (1983). The state-trait Anxiety Inventory (STAI) test manual. Palo Alto, CA: Consulting Psychologists Press.

Tchanturia, K., Anderluh, M. B., Morris, R. G., Rabe-Hesketh, S., Collier, D. A., Sanchez, P., et al. (2004). Cognitive flexibility in anorexia nervosa and bulimia nervosa. Journal of the International Neuropsychological Society, 10, 513–520.

Volery, M., Carrard, I., Rouget, P., Archinard, M., & Golay, A. (2006). Cognitive distortions in obese patients with or without eating disorders. Eating and Weight Disorders, 11, 123–126.

Wilkinson, L., & Task Force on Statistical Inference (1999). Statistical methods in psychology journals: Guidelines and explanations. American Psychologist, 54, 594–604.