



## Research report

## Decision-making impairments in women with binge eating disorder

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## ABSTRACT

Even though eating is frequently driven by overindulgence and reward rather than by energy balance, few studies so far have analyzed decision-making processes and disturbances in feedback processing in women with binge eating disorder (BED). In an experimental study, 17 women with BED (DSM-IV) and 18 overweight healthy controls (HC) were compared in the game of dice task (GDT). This task assesses decision-making under risk with explicit rules for gains and losses. Additionally, differences in dispositional activation of the behavior inhibition and behavior approach system as well as cognitive flexibility were measured. Main results revealed that women with BED make risky decisions significantly more often than HC. Moreover, they show impaired capacities to advantageously utilize feedback processing. Even though these deficits were not related to disease-specific variables, they may be important for the daily decision-making behavior of women with BED, thus being relevant as a maintenance factor for the disorder.

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## Introduction

Uncontrolled eating in the form of binge attacks is the core feature of women suffering from binge eating disorder (BED). Several studies indicate that the consequences of binge eating include overweight and obesity, medical (Bulik, Sullivan, & Kendler, 2002; Johnson, Spitzer, & Williams, 2001) and psychological sequelae (Hudson, Hiripi, Pope, & Kessler, 2007) and an increased mortality risk (Fichter, Quadflieg, & Hedlund, 2008). Research so far has mostly focused on the role of negative emotions (Arnold, Kenardy, & Agras, 1995; Hilbert & Tuschen-Caffier, 2007; Stein et al., 2007; Svaldi, Caffier, & Tuschen-Caffier, in press; Telch & Agras, 1996) and over evaluation of weight and shape (Grilo, Hrabosky, et al., 2008; Masheb & Grilo, 2008; Mond, Hay, Rodgers, & Owen, 2007; Svaldi, Caffier, Blechert, & Tuschen-Caffier, 2009) in the onset and maintenance of binge attacks in BED. Comparably, neuropsychological paradigms have been neglected or have mainly focused on subclinical eating disorders, anorexia nervosa (AN), bulimia nervosa (BN) and obesity.

Given the high availability of palatable food, gluttonous eating may not only be a response to powerful physiological drives. Specifically, on several occasions, resisting omnipresent temptations may require skills such as behavior inhibition, attention shift and delay of gratification. Such skills are supposed to be

associated with prefrontal cortex regions and distinct subcortical structures (so-called fronto-striatal loops) that mediate executive functions (Lie, Specht, Marshall, & Fink, 2006; Markela-Lerenc et al., 2004; Masterman & Cummings, 1997; Petrides & Pandya, 2002; Robbins, 1996). For example, Nederkoorn, Van Eijs, and Jansen (2004) used the stop signal task (Logan, Schachar, & Tannock, 1997) to test behavior inhibition in restrained eaters. In the stop signal task, participants have to respond as fast as possible in a choice reaction time task, unless a stop signal is presented. In this case, participants have to inhibit their response. Nederkoorn et al. (2004) found restrained eaters to be significantly worse in the inhibition of non-food-related motor responses. Similarly, obese women (Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006) and obese children (Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006) are affected by less adequate response inhibition, although null results for AN and BN have been reported as well (e.g., Claes, Nederkoorn, Vander-eucken, Guerrieri, & Vertommen, 2006).

In neuropsychological research, another task to evaluate intentional motor inhibition is the Go/No-Go task (Nigg, 2000). In this task, participants are required to press a key whenever a target stimulus is presented. At the same time, they have to refrain from pressing the key whenever a non-target stimulus is presented. Rosval et al. (2006) found women with BN and women with AN binge/purging type to display significantly more errors than women with AN restricting type and healthy controls. Mobbs, Van der Linden, d'Acremont, and Perroud (2008) assessed inhibitory control in women with BN and healthy controls by

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use of an adapted Go/No-Go task which included stimuli related to the body and food. Again, participants with BN expressed inhibition problems, especially on food-related targets.

Against the background of the widespread accessibility of high caloric, tasty food, healthy nutrition is, to a large degree, dependent on conscious decisions with regard to food choices, quantity and frequency of meals. A task recognized to detect decision-making impairments is the Iowa Gambling Task (IGT) which requires subjects to choose from various alternatives (card decks) without having any information about the outcome (gains or losses). Patients with AN (Cavedini et al., 2004), patients with BN (Boeka & Lokken, 2006) as well as obese individuals (Davis, Levitan, Muglia, Bewell, & Kennedy, 2004) expressed disadvantageous decision-making patterns in this task. However, the transfer of these results to actual eating behavior is problematic. While the IGT simulates situations in which the outcome of a decision is unpredictable – at least before the contingencies have been understood on the basis of feedback following previous trials – in everyday life, individuals with eating disorders most often know explicitly the deleterious long-term consequences of their disturbed eating behavior. A laboratory task that simulates decision-making with explicit rules for gains and losses and obvious probabilities is the game of dice task (GDT; Brand, Fujiwara, et al., 2005). In the GDT, individuals are required to decide between various alternatives explicitly related to a specific amount of gain or loss. Thereby, the alternatives have obvious winning probabilities. Several studies have demonstrated the GDT's sensitivity to differentiate between healthy controls and patients with a variety of clinical syndromes such as pathological gambling (Brand, Kalbe, et al., 2005), Korsakoff's syndrome (Brand, Fujiwara, et al., 2005), Parkinson's disease (Brand, Labudda, et al., 2004; Euteneuer et al., 2009), Alzheimer's disease (Delazer, Sinz, Zamarian, & Benke, 2007) and selective amygdala damage (Brand, Grabenhorst, Starcke, Vandekerckhove, & Markowitsch, 2007). There is further evidence that poor decision-making in the GDT is linked to impaired capacities to advantageously utilize feedback processing and to deficits in executive function (Brand, 2008; Brand, Labudda, & Markowitsch, 2006; Brand, Roth-Bauer, Driessen, & Markowitsch, 2008; Brand, Laier, Pawlikowski, & Markowitsch, 2009; Brand, Pawlikowski, et al., 2009; Clark et al., 2008; Euteneuer et al., 2009; Labudda et al., 2008). In eating disorders, to our knowledge, only one study so far has tested decision-making processes if rules for reinforcement and punishment are explicitly clear and the outcome is defined by probabilities. Brand, Franke-Sievert, Jacoby, Markowitsch, and Tuschen-Caffier (2007) compared women with BN to a group of healthy controls in the GDT. Results revealed that, under explicit rules, patients with BN chose disadvantageous alternatives significantly more frequently than controls. Moreover, decision-making impairments were significantly related to deficits in executive functions. Several other studies indicate that women with BN have impairments in executive functions, such as attention and memory deficits (see Duchesne et al., 2004 for a review). These deficits are supposed to be linked to alterations of the serotonin system (Kaye et al., 2005) which, in turn, is thought to affect functions of the (medial) prefrontal cortex. This brain region is also involved in decision-making processes, as yielded by several studies on patients with selective damage to the ventromedial part of the prefrontal cortex (Bechara, Damasio, Tranel, & Anderson, 1998; Bechara, Tranel, & Damasio, 2000; Manes et al., 2002).

Contrary to the case with BN, to our knowledge, no neuropsychological studies have been conducted in BED. One study conducted by Woolley et al. (2007) allows us to draw some comparisons to individuals affected by BED. To identify the brain regions associated with binge eating, the authors compared 32 patients with neurodegenerative disease and 18 healthy control

subjects in a free-feeding task using MR voxel-based morphometry (VBM). From the clinical group, those patients who binged in the task had all been previously diagnosed with frontotemporal dementia. Results using VBM revealed that binge eating patients had significantly greater atrophy in the right ventral insula, striatum and orbitofrontal cortex. Hence, in BED, functions of the prefrontal cortex may play an important role in the maintenance of binge attacks.

Overall, compared to BN and AN, little research has been conducted on cognitive biases and executive functions in BED. However, in line with a transdiagnostic approach to eating disorders (Fairburn, Cooper, & Shafran, 2003), some assumptions for BED may be drawn from BN. Similarly to patients with BN, women with BED are often well aware of the deleterious consequences of ongoing binge attacks and often feel ashamed about them. Especially in periods preceding a binge attack, the ability to make advantageous decisions may be important. Clinical observations suggest that women affected by BED frequently “know” that the binge is coming and nevertheless decide to go to the supermarket to buy junk food. Or, they say that they “know” that not talking about their anger will lead to a binge attack but they still choose to say nothing. Similarly, they often know that chaotic eating patterns may trigger binge attacks but they still make attempts at restricting caloric intake at times (Masheb & Grilo, 2000; Raymond, Neumeier, Warren, Lee, & Peterson, 2003; Rossiter, Agras, Telch, & Bruce, 1992; Yanovski & Sebring, 1994). This is especially important, as persistent caloric restraint predicts relapse following treatment for BED (Safer, Lively, Telch, & Agras, 2002). Thus, even though other factors such as negative emotions may be the immediate trigger for the occurrence of a binge attack, decision-making processes may be of relevance in handling preceding events. We were therefore interested in analyzing decision-making processes in this group of patients.

In line with the research just mentioned, the following hypotheses were made: first, compared to healthy controls, women with BED were expected to select disadvantageous choices significantly more often. Second, women with BED were expected to show impaired capacities to advantageously utilize feedback processing compared to healthy controls. As a multidimensional construct (Guerrieri, Nederkoorn, & Jansen, 2008), impulsivity is conceptualized as a tendency to think, plan and control insufficiently (Solanto et al., 2001), which – in the case of BED – may result in the maladaptive response of bingeing. Furthermore, impulsivity has been linked with risk-taking behavior (Lejuez et al., 2002; Leland & Paulus, 2005; Nicholson, Soane, Fenton-O'Creedy, & Willman, 2005). Therefore, our third hypothesis was that, compared to healthy controls, women with BED were expected to be characterized by an under-activation of the behavioral inhibition system and a higher activation of the behavior approach system concerning fun seeking and reward responsiveness (Gray, 1991, 1994), as measured by the BIS/BAS scale (Carver & White, 1994). Fourth, because of the correlations found between executive dysfunction and disadvantageous decision-making, we expected women with BED to score significantly worse in a task measuring cognitive flexibility. Fifth, we expected a significant positive correlation between disadvantageous decision-making and severity of eating pathology in women with BED.

## Participants and methods

### Participants

Seventeen women with BED and 18 healthy controls (HC) participated in the study. Inclusion criterion for the BED group was the presence of a DSM-IV-TR diagnosis (APA, 2000) of BED. Exclusion criteria were the presence of substance abuse or

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