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## Set-shifting abilities, mood and loss of control over eating in binge eating disorder: An experimental study

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### ABSTRACT

Executive functions play an important role in problem-solving and self-control. Set-shifting is an aspect of executive functioning and represents cognitive flexibility. The inability to control eating in Binge Eating Disorder (BED) may imply deficits in set-shifting which could be exacerbated by negative mood and depressive symptoms. The aim of the study was to test whether there is a causal relationship between set-shifting ability, changes in mood and loss of control over eating in BED. Seventy-five participants diagnosed with BED were randomly assigned to a negative or neutral mood induction. Set-shifting abilities, depressive symptoms, current mood and loss of control over eating were assessed. Having depressive symptoms and poorer set-shifting abilities resulted in a more negative mood after a negative mood induction, whereas this was not observed in the neutral mood induction. Post-hoc analyses revealed that individuals with poorer set-shifting abilities and more changes in negative mood, experienced more feelings of loss of control over eating than individuals whose set-shifting abilities were better and whose mood did not change. The results suggest that both depressive symptoms and deficits in set-shifting abilities may decrease an individual's ability to handle negative affect and increase loss of control over eating in individuals with BED.

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### 1. Introduction

Binge eating disorder (BED) has recently been added as a distinct eating disorder category to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013). Binge eating disorder involves the consumption of objectively large amounts of food within a limited period of time with an associated loss of control over eating, but without inappropriate compensatory behaviors (i.e., self-induced vomiting, misuse of laxatives or diuretics, excessive exercising). Binge eating is characterized by eating much more rapidly than usual, eating until feeling uncomfortably full and eating large amounts of food without being physically hungry. Individuals with BED usually go through their binge eating episodes alone because they feel embarrassed. Afterwards they often feel disgusted with themselves, depressed and guilty. Individuals with BED do not enjoy eating during a binge; in fact, they display marked distress regarding binge eating (Dingemans et al., 2002).

Forty-six to 61% of individuals with BED have a lifetime diagnosis of mood disorders (Hudson et al., 2007; Javaras et al., 2008; Grilo et al., 2009). Several cross-sectional, experimental and therapy outcome studies suggested an association between depressive symptoms (trait), acute negative mood (state), and binge eating behavior (Antony et al., 1994; Telch & Agras, 1996; Grilo et al., 2001; Peterson et al., 2005; Masheb & Grilo, 2008; Dingemans et al., 2009a, 2009b). These studies indicated that higher levels of depression are related to more severe binge eating. Also, ecological momentary assessment studies have demonstrated that binge eating in BED is preceded by the experience of negative emotions (Hilbert and Tuschen-Caffier, 2007; Stein et al., 2007; Goldschmidt et al., 2012; Munsch et al., 2012). In two experimental studies of our research group (Dingemans et al., 2009a, 2009b), we found that patients with BED with depressive symptoms were less able to cope with negative moods than BED patients with no depressive symptoms and were therefore more likely to engage in ineffective coping strategies such as binge eating. More specifically, individuals with BED with depressive symptoms who experienced more severe negative mood changes consumed more calories during a bogus taste task than those who were less affected by a negative movie clip.

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The pervasiveness of the link between depressive symptoms, negative emotions and binge eating suggests that the question is not whether but how negative mood leads to binge eating (Tice et al., 2001). The escape from self-awareness model suggests that binge eating is used as a means to escape from negative mood and to help alleviate emotional stress (Heatherton and Baumeister, 1991). According to this model, binge eating episodes can be seen as the result of an individual's effort to draw attention away from emotional distress by narrowing the focus from an aversive self-perception towards the immediate environment (food). Indeed, negative emotions have found to be associated with (Svaldi et al., 2014a) and preceded by (Agras and Telch, 1998; Goldschmidt et al., 2012) failures in the behavioral control over eating. It has been suggested that loss of control may be the most salient aspect of binge eating (Agras & Telch, 1998; Wolfe et al., 2009; Goldschmidt et al., 2012). A negative mood may lower an individual's threshold for losing control over eating with binge eating as a result. Individuals with BED frequently lose control over eating especially in the context of negative mood because they fail to regulate their negative mood in a more healthy way. In other words, affect-evoking situations may interact with individuals' emotion regulation strategies (Dingemans et al., 2009a; Svaldi et al., 2014b; Kittel et al., 2015;).

Executive functions play an important role in mediating self-control, self-regulation and decision-making. Executive functions are intrinsic to the ability to respond to novel situations in an adaptive manner and they form the basis of many cognitive, emotional and social skills (Lezak et al., 2011). Set-shifting is an aspect of executive functioning and concerns the ability to move back and forth between multiple tasks, operations or mental sets; it represents cognitive flexibility. Set-shifting may contribute to rigid mental acts and behaviors that are central to the phenomenology of several mental disorders, particularly obsessive-compulsive disorder and eating disorders but also attention deficit hyperactivity disorder and substance dependence (Robbins et al., 2012). Regarding BED, it has been hypothesized that the inability to control eating in BED may imply deficits in executive functioning (Galioto et al., 2012; Manasse et al., 2014). That is, poorer set-shifting might narrow the number of strategies individuals are capable of using when they have to deal with stress or negative emotions. Indeed, a major finding of a recent meta-analysis (Wu et al., 2014) was that anorexia nervosa, bulimia nervosa, BED and obesity were associated with diminished set-shifting abilities. The number of studies which investigated set-shifting in BED specifically is however limited. A more recent systematic review by Kittel et al. (2015) included more studies than Wu et al. (2014), showing mixed results. Two studies found set-shifting deficits in patients with BED, when compared to matched controls without BED (Duchesne et al., 2010; Svaldi et al., 2010), whereas three other studies found no differences in set-shifting abilities between patients with and without BED (Galioto et al., 2012; Kelly et al., 2013; Manasse et al., 2014). These mixed results may be partly explained by the differences in characteristics of participants in the five studies such as age and BMI and by the different tests that were used to assess set-shifting.

However, the presence of a negative mood might hamper set-shifting, as studies have shown depression to negatively affect executive functioning and decrease initiation and problem solving and impede cognitive flexibility (McClintock et al., 2010; Roberts et al., 2010). In the context of negative mood individuals with poorer set-shifting abilities might have more difficulties regulating their negative mood in a healthy way than individuals with better set-shifting abilities. It can be speculated that as a result of the narrowing of the focus to the immediate environment (food) during a negative mood state (Heatherton and Baumeister, 1991) individuals with BED have difficulties shifting to healthy coping

behavior. This might be due to an impairment in the ability to shift attention and behavior from one set to another.

The aim of this experimental study was to test whether there is a causal relationship between set-shifting ability and changes in mood and/or loss of control over eating. Participants diagnosed with BED were randomly assigned to a negative or neutral mood induction. Set-shifting abilities, depressive symptoms, current mood and loss of control over eating were assessed. Our research questions were threefold:

1. Do set-shifting abilities predict changes in mood during an acute mood induction?
2. Is this association affected by the overall level of depressive symptoms?
3. Do set-shifting abilities and changes in mood have an effect on feelings of loss of control over eating?

We hypothesized that individuals with poorer set-shifting abilities are more affected by a negative mood induction and therefore experience more changes in negative mood. We further hypothesized that individuals with moderate to severe depressive symptoms and poorer set-shifting abilities experience more increases in negative mood and loss of control over eating than individuals with no to mild symptoms of depression and better set-shifting abilities. No effects were to be expected in the neutral mood condition. Finally, we hypothesized that set-shifting abilities and changes in negative mood are associated with feelings of loss of control over eating. More specifically, individuals who experience more negative mood and who have more deficits in set-shifting will have more feelings of loss of control over eating.

## 2. Materials and methods

### 2.1. Participants

Eligible participants were non-pregnant females with a primary diagnosis of BED according to DSM-5 criteria (American Psychiatric Association, 2013). To be included in the study, a participant had to report an average of one binge eating episode a week over the previous 3 months. If participants were on medication, they could participate in the study if their response to and doses of the medication was stable (at least 2 months). Exclusion criteria were current or past self-induced vomiting, misuse of laxatives, diuretics, diet pills or other weight controlling medications, fasting, or excessive exercise within the last 3 months. Participants were recruited from three clinics specialized in treating eating disorders at the beginning of treatment as well as through advertisements in local newspapers and on Internet websites.

### 2.2. Measures

#### 2.2.1. Beck depression inventory-II (BDI-II)

The Dutch version of the BDI-II (Beck et al., 1988; Van der Does, 2002) contains 21 items, each with four self-evaluative statements rated according to severity (scored from 0 to 3). The BDI-II measures the severity of depressive symptoms. The total score is the sum of the 21 item scores and may range from 0 to 63. The following guidelines are suggested as BDI cut-off scores: no or mild depressive symptoms 0–19; moderate to severe depressive symptoms 20–63. The internal consistency of the Dutch version of the BDI-II was high for a psychiatric outpatient group and a healthy control group. Test-retest reliability in these same groups was high. In this study Cronbach's alpha was 0.90.

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