Approach and inhibition responses to external food cues among average-weight women who binge eat and weight-matched controls

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ABSTRACT

Despite laboratory evidence linking impulsivity to binge-eating (BE) among people with obesity, it is unclear whether such inhibitory control deficits extend to average-weight persons who binge eat or influence actual calories consumed when such opportunities present. Towards clarifying these issues, women with higher (n = 31) and lower (n = 31) BE levels engaged in a visual Go/No-Go task comprising images of high-calorie foods, low-calorie foods, and household objects, after which they completed a self-report battery in an environment conducive to snacking. Analyses indicated these groups did not differ in task-based false alarm rates (i.e., responding when response inhibition was required) but the higher BE group reported more trait-based impulsivity, was faster and more accurate in responding to "Go" trials involving high-calorie food images, and was more likely to eat at least one snack during post-task questionnaire completion. Within the entire sample, faster "Go" trial reaction times and higher false alarm rates across image types predicted higher post-task calorie intake levels while BE status and trait impulsivity did not. In sum, average weight women who binge eat were more responsive to high calorie food cues but showed no evidence of behavioral inhibitory control deficits compared to weight-matched controls.

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1. Introduction

Despite evidence from laboratory paradigms linking inhibitory control problems to binge-eating (BE) in overweight or obese groups, it is unclear whether these deficits extend to average-weight persons with BE or whether responses on such tasks predict actual snacking behavior when such opportunities present to these groups. Towards clarifying these issues, we assessed inhibitory control responses associated with a visual Go/No-Go task and their associations with later food consumption among average weight women with higher versus lower levels of BE.

Binge eating (BE) refers to the consumption of large amounts of food within discrete intervals and is often accompanied by a perceived loss of control. BE is common among people on diets to lose or maintain weight (Coker, von Lojewski, Luscombe, &

Abraham, 2015; Crowther, Armey, Luce, Dalton, & Leahey, 2008). Up to 40% of college-age women experience BE symptoms (Saules et al., 2009). BE is a hallmark of disordered eating and frequent, persistent symptoms increase risk for Binge Eating Disorder (BED) or Bulimia Nervosa (BN), depending on compensatory responses to such episodes (American Psychiatric Association, 2013). Indeed, one-third of people who experience subthreshold BED symptoms may eventually develop clinical BED (Stice, Marti, & Rohde, 2013). Depression, interpersonal problems, and reduced quality of life are potential correlates and consequences of excessive BE (Ambwani, Roche, Minnick, & Pincus, 2015; Donofry, Roecklein, Rohan, Wildes, & Kamarck, 2014; Galanti, Gluck, & Geliebter, 2007; Hay, 2003; Rosenbaum & White, 2015).

Both theory and research have underscored the potential impact of impulsivity on risk for BE (Davis et al., 2008; Meule & Platte, 2015; Schag, Teufel, et al., 2013). For example, recent dual-process models of self-control posit that both (1) increased appetitive drives for desired stimuli (e.g., food cues) and (2) deficits in self-regulatory processes such as inhibitory control contribute to self-regulation problems, including BE (Hofmann, Adriaanse, Vohs, & Baumeister, 2014; Hofmann, Friese, & Strack, 2009).

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Preliminary research has supported increased appetitive drive for food-specific stimuli in overweight or obese BE groups compared to weight-matched controls (Schag, Teufel, et al., 2013; Schmitz, Naumann, Biehl, & Svaldi, 2015; Schmitz, Naumann, Trentowska, & Svaldi, 2014). However, evidence for inhibitory control deficits related to BE has been mixed. With respect to self-report measures of impulsivity, some studies have found higher scores in BE groups than controls (Schag, Teufel, et al., 2013; Svaldi, Naumann, Trentowska, & Schmitz, 2014; Wu et al., 2013), while others have found no such deficits in BE samples (Hege et al., 2015; Schienle, Schäfer, Hermann, & Vaitl, 2009).

Laboratory research has also found variable support for inhibitory control deficits in BE groups compared to non-BE controls. For example, using a Go/No-Go paradigm, Mobbs, Iglesias, Golay, and Van der Linden (2011) presented "forbidden" food (e.g., cookie), "negative" body shape (e.g., cellulite), and neutral object (e.g., bolt) words in rapid succession to obese BED patients and weight-matched controls. Participants were instructed to respond to "Go" stimuli by pressing the space bar as quickly as possible but to withhold responses to "No-Go" stimuli. Compared to controls, the BED group had significantly more omission errors (i.e., not pressing the appropriate key when "Go" words were presented) reflecting attention problems and false alarms (i.e., pressing the key when "No-Go" words were displayed and response inhibition was required) indicative of impaired inhibitory control (Ames et al., 2014) during food and body word presentations. Mobbs et al. concluded this pattern highlighted disturbance-specific inhibitory control problems.

In related work, overweight/obese participants with BE and weight-matched controls completed a stop-signal task (SST) with task blocks featuring food-specific images, positive non-food images, and neutral images (Manasse et al., 2016). The task required participants initiate "Go" responses to these image types but inhibit this response on approximately 50% of trials that involved a stop signal (a 5 ms discrete auditory tone). The BE group had comparatively longer stop signal reaction times (SSRTs), reflecting poorer inhibitory control of initiated responses across stimulus types. However, in one other SST study, Wu et al. (2013) found no SSRT differences between overweight/obese BED patients and weight-matched controls. In contrast to other work, however, stimuli were limited to geometric shapes and included neither food nor body image stimuli.

Together, these findings suggest that BE samples are more likely to show inhibitory control deficits though evidence has been mixed regarding the specificity of these deficits to salient cues (i.e., those related to food and body concerns). In a general review of the literature on obesity and BED, Schag, Schönleber et al. (2013) and Schag, Teufel et al. (2013) concluded that BED samples show more impulsivity related to food stimuli than non-food stimuli compared to controls.

Notwithstanding evidence that BE groups have inhibitory control deficits on certain laboratory tasks compared to non-BE controls, the associated literature has several limitations. First, related studies have focused on obese or overweight groups with BE. Although risk for BE corresponds to having a higher body mass index (BMI) (Ames et al., 2014; Nicdao, Hong, & Takeuchi, 2007), several studies have reported BE is also frequent in non-obese groups (Chen & Jackson, 2008; Kelly, Bulik, & Mazzeo, 2013; Saules et al., 2009). For example, Saules et al. (2009) found rates of BE were nearly identical for non-overweight (43.2%) and overweight (42.6%) U.S.-based respondents with weight concerns but noted researchers have neglected the former group. Furthermore, within samples from non-Western countries where much of the world's population is concentrated, majorities who engage in BE can have BMIs within the average range and are neither overweight nor obese (Kiriike et al., 1988; Nakai, Nin, & Noma, 2014; Tong et al., 2011). Given such data, further consideration of average weight groups would provide a more complete account of links between BE and inhibitory control deficits.

A second limitation of laboratory studies on BE has been the failure to evaluate effects of high-versus low-calorie food cues on impulse control problems of BE groups. In light of evidence highlighting binge-eater preferences for sweet and/or high fat foods (Drewnowski, 1997), there is utility in evaluating how exposure to high-versus low calorie food cues influences behavior reward responsiveness and inhibitory control in BE groups versus controls.

A third limitation of research based on visual food Go/No-Go task paradigms has been the failure to assess whether task performance indices predict salient "real-world" behaviors such as post-task calorie intake levels of BE and/or control group samples. In past research, higher scores on associated self-report measures including the Barratt Impulsiveness Scale (Galanti et al., 2007) and impulsive responding on the SST (Guerrieri et al., 2007; Nederkoorn, Guerrieri, Havermans, Roefs, & Jansen, 2009) correlated with more calories consumed in average weight samples. Related work has linked impulsivity and errors on food-based Go/No-Go trials to increased snack intake within restrained eating samples (Meule, Lukito, Vögele, & Kübler, 2011; Price, Lee, & Higgs, 2016). Given such evidence and links between dietary restraint and binge eating risk, paradigm extensions to binge-eating groups appear to be warranted.

To elaborate, considering how performance on food-related visual Go/No-Go tasks is related to real-world behaviors salient to BE provides opportunities to evaluate the ecological validity of task indices including "Go" trial RTs, false alarm rates, and omission errors. Explicitly examining how well Go/No-Go task response indices predict conceptually-relevant behaviors (e.g., calorie consumption from snacking) compared to alternative measures (e.g., self-reported inhibition problems) would be useful in evaluating the extent to which laboratory task performance is related to everyday responding of BEs in the presence of food.

To address each issue outlined above, a food-related Go/No-Go task with high- and low-calorie food images as well as neutral, non-food images was introduced to test the impact of appetitive food cues on approach responding and inhibitory control within average weight young women with BE and weight-matched controls without BE problems. Based on predictions from dual-process models (Hofmann et al., 2009, 2014) and select past evidence from obese BE groups (Mobbs et al., 2011; Schag et al., 2013), we expected that BE women would display stronger approach tendencies towards high calorie food images based on having faster "Go" trial RTs which have been conceptualized as automatic approach biases associated with incentive salience (Meule, Lutz, Vögele, & Kübler, 2012) in addition to making fewer omission errors and reporting stronger liking of this image category compared to controls. Furthermore, relative to controls, we hypothesized BE women would show more inhibitory control deficits, as reflected in higher levels of self-reported impulsivity and higher task-based false alarm rates, particularly in response to high-calorie food images. Finally, we explored the extent to which BE levels, questionnaire-based impulsivity, and responses on each Go/No-Go task index were associated with post-task calories consumed from snacking within the entire sample and each subsample.

2. Materials and methods

2.1. Participants

The sample included 31 undergraduate women with BE tendencies and 31 age-matched undergraduate women who showed