



## Not so fast: The impact of impulsivity on weight loss varies by treatment type



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### ABSTRACT

Behavioral weight loss (BWL) treatments result in suboptimal weight losses for many individuals. Impulsivity appears to be a maintenance factor of obesity, yet few studies have examined impulsivity as a predictor of outcomes from BWL. We examined specific facets of impulsivity (inhibitory control and delay discounting) as moderators of outcome in BWL. Overweight adults ( $n = 190$ ) were randomized to standard behavioral treatment (SBT) or acceptance-based behavioral treatment (ABT). We hypothesized that impulsivity would be inversely associated with weight loss, and that the association between impulsivity and outcome would be attenuated in the ABT condition. Poorer general inhibitory control predicted lower percent weight lost at 12 months across conditions at the trend level ( $b = -0.003$ ,  $p = 0.06$ ). The negative impact of low inhibitory control on weight loss was attenuated by assignment to ABT versus SBT ( $b = 0.004$ ,  $p = 0.03$ ). Treatment condition, at trend level, also moderated the impact of delay discounting ( $b = -0.011$ ,  $p = .098$ ) and food-specific inhibitory control ( $b = 0.003$ ,  $p = 0.06$ ) on percent weight loss such that those with greater impulsivity benefitted most from ABT. Results reveal a potential pattern that impulsivity reduces benefit derived from SBT but not ABT. Further research on the moderating effect of impulsivity is necessary to inform the development of targeted treatments for clinically meaningful subtypes of patients.

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### 1. Introduction

Obesity (i.e., body mass index of greater than 30 kg/m<sup>2</sup>) represents a major public health problem (Yang & Colditz, 2015). While behavioral weight loss treatments robustly produce clinically significant weight losses averaging 5–8% at the end of a 12-month intervention (Butryn, Webb, & Wadden, 2011), participants generally lose substantially less weight than desired (Foster, Wadden, Vogt, & Brewer, 1997), and remain at increased risk for obesity-related medical issues, such as heart disease and cancer (Wilson, D'Agostino, Sullivan, Parise, & Kannel, 2002). Moreover, even within 'successful' interventions, substantial proportions of participants do not achieve clinically significant weight loss (i.e., >5% of initial weight) (Butryn et al., 2011). Identification of individual factors that may contribute to suboptimal outcomes from behavioral weight loss interventions is thus warranted to provide

direction for treatment development.

A large body of literature implicates impulsivity, i.e., the tendency to engage in behavior with little regard for future consequences, as a potential risk and maintenance factor for obesity (Davis, Levitan, Muglia, Bewell, & Kennedy, 2004; Schag, Schönleber, Teufel, Zipfel, & Giel, 2013; Thamocharan, Lange, Zale, Huffhines, & Fields, 2013). In particular, inhibitory control (i.e., the ability to withhold a prepotent response) and delay discounting (i.e., the tendency to choose smaller, shorter-term rewards, over long-term rewards) have been identified as two domains of impulsivity that may be particularly important in the maintenance of obesity-related behaviors and potentially, differential response to behavioral treatment (Ames et al., 2014; Fields, Sabet, & Reynolds, 2013; Houben, 2011; Jasinska et al., 2012). Specifically, successful inhibitory control may allow an individual to withhold an already-initiated "automatic" response to approach-salient stimuli, such as palatable food. An individual with greater delay discounting would place a higher value on the short-term pleasure of consuming appetizing yet unhealthy food, compared to the longer-term benefit of weight loss. Thus, both of these constructs

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appear to be especially relevant to success in behavioral weight loss interventions, which requires continued adherence to specific dietary recommendations.

Cross-sectional research has robustly demonstrated that obese individuals evidence greater delay discounting than healthy weight controls (Davis, Pate, Curtis, & Reid, 2010; Weller, Cook, Avsar, & Cox, 2008), although some studies show differential effects depending on the type of stimuli (e.g., food versus money) used in the delay discounting task (Lawyer, Boomhower, & Rasmussen, 2015; Rasmussen, Lawyer, & Reilly, 2010). A body of research also shows that obese individuals display poorer inhibitory control than healthy weight controls as measured by go/no-go and stop-signal tasks (Batterink, Yokum, & Stice, 2010; Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006). Individuals with obesity appear to also show even more pronounced deficits in inhibiting responses to food-specific stimuli, i.e., when the inhibitory control task asks participants to withhold responses to images of palatable food (e.g., pizza, ice cream) rather than neutral (e.g., hammers, staplers) stimuli (Houben, Nederkoorn, & Jansen, 2014). Furthermore, a prospective study showed that greater impulsivity predicted naturalistic weight gain over a one-year period in a sample of women (Nederkoorn, Houben, Hofmann, Roefs, & Jansen, 2010). These cross-sectional and prospective findings strongly suggest that impulsivity should be examined as a predictor of outcome from behavioral weight loss treatments.

Thus far, research examining impulsivity as a predictor of treatment outcome across eating and weight disorders is sparse. One behavioral weight loss trial demonstrated relatively poorer weight loss within highly impulsive, compared to less impulsive, obese children (Nederkoorn, Jansen, Mulken, & Jansen, 2007), and a behavioral treatment for bulimia nervosa resulted in better treatment completion rates for less impulsive participants (Agras et al., 2000). More broadly, examinations of behavioral treatments for substance use have revealed impulsivity is associated with higher attrition, poorer compliance, and lower abstinence rates (Krishnan-Sarin et al., 2007; Patkar et al., 2004; Stanger et al., 2012). While these results suggest that impulsivity could represent a transdiagnostic predictor of treatment outcome, this variable has yet to be examined as a predictor of outcome from an adult behavioral weight loss intervention. Theoretically, impulsivity could be expected to weaken response to standard treatments through several mechanisms, including difficulty adhering to prescribed behavior changes (e.g., low calorie diets and physical activity) and poor in-the-moment decision making, resulting in dietary lapses. However, obese individuals with high impulsivity may especially benefit from behavioral treatments that address behavioral difficulties (e.g., lapsing from a diet) resulting from deficits in inhibitory control and impulsive decision-making.

“Acceptance-based” behavioral treatments (ABTs), which focus on decreasing avoidance and increasing tolerance of negative emotional and physical experiences, appear to result in increased weight loss among overweight and obese individuals (Forman et al., 2016) compared to gold standard behavioral treatments (SBTs; e.g., treatments such as those used in Look AHEAD that focus on behavioral changes to facilitate weight loss, such as self-monitoring of calorie intake, prescriptions for a balanced-deficit diet and physical activity, and stimulus control) (D. P. P. R. Group, 2002; L. A. R. Group, 2006). The benefit of ABT may be in its focus on clarification and awareness of one’s long-term goals and values (e.g., to be an active and involved grandparent), tolerance of less pleasurable states (e.g., resisting an urge to eat), and slowing down decision-making processes to bring behaviors in line with these values (Forman & Butryn, 2015; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). These strategies could be of particular benefit to individuals with a greater tendency to make decisions based on

short-term comfort, and/or who have difficulties with inhibiting automatic responses. In fact, one study showed that an acceptance-based workshop decreased monetary discounting in obese adults (Morrison, Madden, Odum, Friedel, & Twohig, 2014), and another study showed that mindful eating (a tenant of many acceptance-based eating interventions) decreased food-specific discounting (Hendrickson & Rasmussen, 2013). However, despite this preliminary evidence, no studies to our knowledge have examined the impact of impulsivity on behavioral treatment outcomes in adults with obesity, and none have examined its effects within ABT-based interventions.

The current study aims to examine the potential moderating role of impulsivity (specifically, delay discounting, general inhibitory control, and food-specific inhibitory control) in behavioral weight loss treatment outcomes. To this end, we administered behavioral measures of impulsivity at baseline in a randomized controlled trial comparing ABT to SBT for overweight and obese adults. We hypothesized that impulsivity would negatively predict weight loss outcomes across treatment conditions at post-treatment (12 months), but that this relationship would be attenuated in the ABT condition (i.e., that poorer weight loss outcomes associated with greater baseline impulsivity would be less pronounced in the ABT versus SBT condition).

## 2. Methods

### 2.1. Participants

Participants ( $n = 190$ ) had a body mass index [BMI] between 27 and 50 kg/m<sup>2</sup> and were between 18 and 70 years of age. Participants were excluded if any of the following applied: had a medical or psychiatric condition which limited their ability to comply with the behavioral recommendations of the program or posed a risk to the participant during weight loss; began a course of or changed the dosage of medication within the previous three months that could cause significant change in weight; had lost more than 5% of their weight in the past 6 months.

### 2.2. Procedure

The current study was conducted as part of the Mind Your Health II randomized controlled trial; see Forman et al., 2016 for a complete description of recruitment methods and treatment procedures. Recruitment for the current study was completed in four waves of 38–45 participants. Potential participants were recruited through referrals from local primary care physicians and advertisements in newspapers and radio stations. Participants were randomly assigned to standard behavioral treatment (SBT;  $n = 90$ ) or acceptance-based behavioral treatment (ABT;  $n = 100$ ). Participants in both treatments attended 25 treatment sessions in 75-min, small (10–14 participants), closed-group sessions. Treatments were manualized and groups were held weekly for the first 16 sessions, biweekly for the next 5 sessions, monthly for the next 2 sessions, and bi-monthly for the final 2 sessions. Session structure consisted of brief individual check-ins, skill presentation, and a skill building exercise. Interventionists were doctoral-level clinicians with previous experience delivering behavioral weight loss treatment, accompanied by a trainee co-leader. Drexel University’s Institutional Research Board approved the study.

#### 2.2.1. Treatment

Behavioral components of both treatments (i.e., self-monitoring of caloric intake, daily caloric and physical activity prescriptions, and stimulus control) were similar to those used in Look AHEAD and the Diabetes Prevention Program protocols (Look Ahead

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