Published in final edited form as:

Appetite. 2014 February ; 73: 45–50. doi:10.1016/j.appet.2013.10.008.

Interrelationships among impulsive personality traits, food addiction, and Body Mass Index

Cara M. Murphy, Monika K. Stojek, and James MacKillop

Abstract

Objective—Impulsive personality traits have been robustly associated with alcohol and drug misuse, but have received little attention in the context of food addiction. The goal of the current study was to examine the interrelationships between impulsive personality traits, food addiction, and Body Mass Index (BMI), including indirect pathways of influence.

Method—Participants ($N = 233$) completed the Yale Food Addiction Scale (YFAS) to assess patterns of addictive consumption of food, the UPPS-P Impulsivity Scale to assess impulsive personality traits, and provided weight and height to generate BMI.

Results—Significant positive associations were found between facets of impulsivity, food addiction symptoms, and BMI. Impulsivity was found to be indirectly associated with BMI by way of associations with addictive consumption of food. In particular, an inclination toward behaving irrationally while experiencing negative mood states (Negative Urgency) and low levels of task persistence (lack of Perseverance) were significantly associated with food addiction directly and that relationship was responsible for their relationship to BMI.

Conclusions—Dispositional impulsivity, routinely associated with high-risk behaviors including addictive consumption of alcohol and drugs, may be an important risk factor when considering tendency to engage in addictive consumption of food. Monitoring food addiction symptoms early may help reduce the likelihood that compulsive food consumption patterns result in weight gain and obesity. Methodological considerations are discussed.

Keywords

obesity; food addiction; impulsivity

Introduction

Obesity is a major public health concern in the United States (Ogden & Carroll, 2010). More than a third of Americans are obese (i.e., have a Body Mass Index (BMI) of 30 or greater), and as the obesity rate continues to rise, the World Health Organization has labeled obesity as an “epidemic” (Ogden & Carroll, 2010; Yach, Stuckler, & Brownell, 2006). Obesity substantially increases the risk of morbidity from hypertension, type 2 diabetes, heart disease, stroke, and many types of cancer (National Heart & Blood Institute, 1998).

Resulting medical care costs of obesity in the US are estimated to be near \$147 billion (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Given such considerable costs to society, it is important to address the factors that contribute to obesity in the population.

Increased food intake has been cited as a sufficient explanation of the obesity epidemic in the US population (Swinburn, Sacks, & Ravussin, 2009). Recent research has discovered patterns of food intake that mimic those frequently found in the consumption of drugs of abuse, leading to theories that food may be addicting (Gearhardt, Corbin, & Brownell, 2009), akin to alcohol and other psychoactive drugs. A growing body of literature has found a number of parallels between excessive food consumption and addiction in studies of both animals and humans. In animal studies, rats with ready access to sugar, fat, and processed food, exhibited neural mechanisms similar to those found in addictions (Avena, Rada, & Hoebel, 2008; Johnson & Kenny, 2010; Rada, Avena, & Hoebel, 2005). In particular, after several weeks, rats fed with sucrose solution and lab chow on a schedule that induced bingeing (i.e., 12 h of access to food, 12 h of deprivation) exhibited behaviors similar to those found in addicted individuals, such as symptoms resembling tolerance, withdrawal, and craving (Avena et al., 2008). Relatedly, other animal research has detected compulsive-like consumption patterns of feeding in obese rats that is not disrupted by punishment (i.e., delivery of foot shock), thought to parallel the diagnostic criteria regarding continued use despite negative consequences (Johnson & Kenny, 2010). In humans, palatable food is associated with dopamine release in mesolimbic regions similarly found in response to the administration of many addictive substances (Volkow & Wise, 2005). Additionally, obesity has been linked to reduced dopamine D₂ receptors, also present in individuals with addictions, and subjective reward reported from eating palatable food is correlated with the resulting degree of dopamine release (Stice, Spoor, Bohon, & Small, 2008; Wang et al., 2001). In behavioral studies, presentation of palatable food in a laboratory setting elicits craving, and craving has been associated with increased consumption (Martin, O'Neil, Tollefson, Greenway, & White, 2008; Sobik, Hutchison, & Craighead, 2005), which parallels cue reactivity for alcohol and other drugs (e.g., MacKillop & Lisman, 2005; MacKillop et al., 2007).

The parallels between food and drugs described have given rise to the concept of “food addiction” and, in an effort to examine this construct more systematically, the Yale Food Addiction Scale (YFAS) was created (Gearhardt et al., 2009). The goal for developing the YFAS was to create a psychometrically valid assessment tool to use in food addiction studies and to determine whether the construct of food addiction accounted for unique variability in eating-related problems unexplained by other forms of eating psychopathology. The YFAS has been used in studies of clinical samples, revealing that among weight loss surgery patients, more than 40% seeking bariatric surgery met the criteria for food addiction (Meule, Heckel, & Kübler, 2012) and individuals meeting YFAS food addiction criteria had poorer outcomes (Clark & Saules, 2013). While a smaller proportion, approximately 15%, of individuals presenting for weight loss treatment have been found to meet the YFAS criteria for food addiction (Eichen, Lent, Goldbacher, & Foster, 2013), these individuals may be especially prone to eating pathology and body shame which in turn may undermine treatment efforts (Burmeister, Hinman, Koball, Hoffman, & Carels, 2013).

One form of eating pathology, binge eating, has been demonstrated to have considerable overlap with food addiction. In particular, research has indicated that approximately half of individuals with Binge Eating Disorder (BED; Gearhardt, White, Masheb, & Grilo, 2013; Gearhardt et al., 2012) and compulsive-overeating (Bégin et al., 2012) met the criteria for food addiction. While there is an unmistakable connection between the two, the fact that many individuals who endorse binge eating do not meet the criteria for food addiction suggests that the two may reflect related but unique phenomena much in the same way that many, but not all, binge-drinkers may meet the criteria for an Alcohol Use Disorder. When considering binge eating behavior, the YFAS has demonstrated incremental validity, accounting for unique variability (Gearhardt et al., 2009), including accounting for unique variance beyond that accounted for by eating pathology and negative affect (Gearhardt et al., 2012). It is possible that the similarity between binge eating and food addiction may be related to similar dispositional traits underlying both phenomena. Thus, better understanding of the food addiction construct and its correlates may helpful to this end (see Fig. 1).

One possible correlate of food addiction is the personality trait of impulsivity. Recent research on overeating and food addiction has indicated that overweight individuals with BED who have co-occurring YFAS food addiction diagnoses were more impulsive than those who did not meet food addiction criteria (Davis, 2013). Conceptualizations of impulsivity have included acting without thinking, seeking out excitement, and inability to complete tasks (Evenden, 1999). A strong association between impulsivity and addictive behavior has been demonstrated in numerous studies (for reviews, see de Wit 2009; Dick et al. 2010; MacKillop et al. 2011). It is now widely recognized that impulsivity is not a singular trait and instead it is a multidimensional construct (Cyders & Coskunpinar, 2011; Dawe & Loxton, 2004). One measure of impulsivity, the UPPS Impulsive Behavior Scale, has been particularly predominant and has the potential to clarify the pathways to various behaviors associated with impulsivity (Smith et al., 2007; Whiteside & Lynam, 2001).

Based on the Five Factor Model of personality and developed using a number of previous measures of impulsivity, the UPPS includes distinct facets of impulsivity which have specific behavioral correlates and predictive utility (Smith et al., 2007; Whiteside & Lynam, 2001). Among the UPPS impulsivity facets are negative urgency, sensation seeking, and a lack of premeditation and perseverance. Perseverance refers to the ability to tolerate boredom and distraction. Premeditation involves the tendency to plan ahead and to think before acting. Sensation seeking is a tendency to seek out new and thrilling experiences. Negative urgency is the tendency to act rashly when experiencing negative emotions. Since its creation, the UPPS has been extended to include another facet of impulsivity, positive urgency or a tendency to act hastily when experiencing positive emotions (Cyders et al., 2007), thus becoming the UPPS-P Impulsive Behavior Scale.

The UPPS impulsivity traits, particularly negative urgency, have consistently been associated with problematic substance use (Fischer & Smith, 2008; Littlefield, Sher, & Wood, 2009; Whiteside & Lynam, 2003; Whiteside & Lynam, 2009; Zapolski, Cyders, & Smith, 2009). Negative urgency has also been reliably associated with pathological eating behavior, particularly bulimic symptoms (Fischer, Anderson, & Smith, 2004; Fischer, Settles, Collins, Gunn, & Smith, 2012; Fischer, Smith, & Anderson, 2003), as well as dieting and weight

fluctuations due to dietary restraint (Mobbs, Ghisletta, & Van der Linden, 2008). Finally, negative urgency has been identified as a common risk factor for both problematic eating and drinking (Dir, Karyadi, & Cyders, 2013; Fischer et al., 2004). While some research has begun to explore how these facets of impulsivity may be related to obesity, little is known regarding the possible contribution to food addiction. One recent study examining the UPPS impulsivity traits found that overweight and obese women had higher levels of negative urgency and lower levels of perseverance, which was positively associated with problematic eating (Mobbs, Crépin, Thiéry, Golay, & Van der Linden, 2010). Another study comparing obese women with BED, obese women without eating pathology, and women of normal weight, revealed that obese women with BED had significantly higher levels of negative urgency compared to obese women without BED and normal-weight controls (Manwaring, Green, Myerson, Strube, & Wilfley, 2011). Given the demonstrated links between negative urgency and addictive behavior, problematic eating, and obesity, one possible explanatory relationship is that negative urgency contributes to addictive eating which in turn leads to obesity. However, due to the relatively brief history of the food addiction construct, no studies have investigated this possibility.

Toward this end, the goal of the current study was to examine the interrelationships between the impulsivity, food addiction, and BMI. We hypothesized that individuals who were more impulsive would be more likely to endorse food addiction criteria. Similarly, we hypothesized those who endorsed symptoms of addictive eating would be more likely to have higher BMI. Specifically, we predicted that an indirect relationship would be present between impulsivity and BMI as a function of symptoms of food addiction.

Method

Participants

Participants were students at the University of Georgia ($N = 233$; 77% female), who received research credit or extra credit for participating in the research study. Descriptive statistics are provided in Table 1. Although the sample was predominantly female, the percentage of participants that met the criteria for food addiction did not differ by gender, $\chi^2(1, N = 233) = 0.01, p = .93$.

Procedures

All study procedures were reviewed and approved by the Institutional Review Board. Participants attended group sessions during which they completed informed consent and paper and pencil format questionnaires. The demographics assessment included height and weight, which was used to calculate BMI using the standard formula: $[(\text{weight (lb)})/(\text{height (in)}^2)] \times 703$.

Measures

UPPS-P Impulsive Behavior Scale (UPPS-P; Cyders et al., 2007; Whiteside & Lynam, 2001)—The UPPS-P is a 59-item measure which assesses five domains of impulsivity. The scales are (1) lack of Perseverance (i.e., tendency to give up on a task); (2) lack of Premeditation (i.e., tendency to act with limited forethought); (3) Sensation Seeking

(i.e., preference for exciting and stimulating experiences), (4) Negative Urgency, and (5) Positive Urgency (i.e., proneness to react to negative and positive emotional states, respectively). Each item is rated from 1 (*agree strongly*) to 4 (*disagree strongly*) with higher overall scores indicating greater impulsivity. The subscales of the UPPS-P were found to be highly reliable in this sample ($\alpha = .82-.95$).

Yale Food Addiction Scale (YFAS; Gearhardt et al., 2009)—The YFAS is a 25-item measure which assesses addictive eating behavior such as reduced involvement in social, occupational and recreational pursuits due to addictive eating (e.g., there have been times when I avoided professional or social situations because I was not able to consume certain foods there) and food tolerance (e.g., over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure). Responses are used to calculate a symptom count of food addiction symptoms ranging from zero to seven. A diagnosis of food addiction can be made if an individual endorses three or more symptoms and indicates clinically significant impairment. The YFAS was demonstrated to have high internal consistency in this sample ($\alpha = .89$).

Data analysis

Zero-order correlations (Pearson's r) were examined between impulsivity, as measured by the five UPPS-P impulsivity indices, food addiction symptoms, as measured by the YFAS, and BMI. To clarify the interrelationships among variables in relation to overweight and obesity, two strategies were employed. First, regression analyses were used to account for overlapping variance between facets of impulsivity when predicting food addiction symptoms and BMI. In instances in which facets of impulsivity were found to predict eating and weight variables, tests of indirect effects were used to clarify the relationships.

Indirect effects analyses examined whether the relationship between given facets of impulsivity and BMI were partially attributable to symptoms of food addiction. This was done using a bootstrapped, nonparametric approach designed to test whether one variable is significantly affecting another by way of a third (Preacher & Hayes, 2004). This method is based on the null hypothesis of no difference between the total effect of one variable on a second variable (e.g., the effect of impulsivity on BMI) and the effect of one variable on a second variable after controlling for a third (e.g., the effect of impulsivity on BMI after controlling for food addiction symptoms). If the difference between the two effects does not appear to be inconsequential (i.e., near zero), it can be concluded that some indirect effect is occurring. Bootstrap estimates of the indirect effects were calculated using sampling with replacement of a large number of samples (5000) from the dataset of the original sample size with 95% confidence intervals derived accordingly. If zero is not in the 95% confidence interval, using this method, it can be concluded that the indirect effect is significantly different from zero. All analyses were conducted using SPSS 18.0 with a Type I error rate (α) set at $p = .05$.

Results

Zero-order correlations between impulsivity, BMI, and YFAS food addiction symptoms are provided in Table 2. The various facets of impulsivity as measured by the UPPS-P were all

significantly interrelated, with the exception of the Sensation Seeking scale which only significantly correlated with Positive Urgency and Premeditation. Magnitudes of associations ranged from small to very large. Aside from the Sensation Seeking scale, significant positive associations were found between all facets of impulsivity and number of food addiction symptoms endorsed. Body Mass Index (BMI) was positively associated with food addiction symptoms. There was also an association between BMI and lack of Premeditation.

Number of food addiction symptoms endorsed was regressed on the four facets of impulsivity that had significant zero-order associations (i.e., Negative Urgency, Positive Urgency, lack of Premeditation, and lack of Perseverance). When entered simultaneously into a regression model, both Negative Urgency and lack of Perseverance remained significant predictors of food addiction symptoms (Table 3). Although initial significant associations were found between Positive Urgency and Premeditation, given the absence of unique associations with food addiction symptoms, these variables were not used when testing indirect effects.

Using the bootstrapping approach proposed by Preacher & Hayes (2004), analyses of indirect effects were conducted to clarify further the relationship between impulsivity, food addiction, and BMI. Although Perseverance and Negative Urgency were not associated with BMI directly, the test of indirect effects concluded that there were significant indirect effects. The 95% confidence intervals of the indirect effect of Perseverance on BMI via food addiction were 0.10 and 1.12. Similarly, the 95% confidence intervals of the indirect effect of Negative Urgency on BMI by way of food addiction were 0.03 and 0.98. As zero fell outside the 95% confidence intervals of both bootstrapped distributions, it can be concluded that the indirect effects are present.

Discussion

The goal of the current study was to examine the interrelationships between impulsivity-related traits, food addiction symptoms, and BMI. As predicted, similar to other addictive behaviors, impulsivity was associated with addictive consumption of food. In particular, individuals who reported acting more rashly when experience strong levels of positive (Positive Urgency) and negative (Negative Urgency) emotions, endorsed more symptoms of addictive eating. Similarly, individuals who reported more food addiction symptoms indicated that they often did things without thinking (lack of Premeditation) and that they had difficulty following through with boring and/or challenging tasks (lack of Perseverance). Unlike the previous four UPPS subscales, Sensation Seeking was unrelated to number of food addiction symptoms endorsed and BMI. Thus, there may be some aspect of enjoying and seeking out exciting/thrilling/frightening experiences that may be incompatible with or a buffer to developing symptoms of food addiction. Importantly, there was a small but statistically significant positive association between addictive eating and BMI, with higher BMI individuals reporting higher levels of addictive eating such as tolerance, or needing to eat more to experience the positive or negative reinforcing effects of food.

When exploring the possible ways impulsivity may indirectly contribute to an individual being overweight or obese, two specific facets of impulsivity appeared to be key contributors to BMI via food addiction symptoms. First, Negative Urgency significantly predicted food addiction symptoms, and was indirectly associated with having a higher BMI. Thus, individuals with a tendency to act rashly when feeling upset or angry may be more likely to engage in addictive eating to alleviate negative mood states. They may include consuming certain foods to prevent feelings of anxiety, dysphoria, and/or physical symptoms resembling a food withdrawal syndrome and lead to weight gain. In addition, there was an indirect association between lack of Perseverance and BMI, as a function of food addiction symptoms. Here, individuals who reported that they give up easily and tend not to finish tasks, may find it more challenging to persist in efforts to change or regulate addictive eating behaviors, subsequently resulting in a higher BMI. Research investigating the relationships between overeating using the Barratt Impulsiveness Scale has also suggested that only certain facets of impulsivity are related to number of food addiction symptoms endorsed (Meule, 2013). In particular, attentional impulsivity (i.e., racing thoughts rather than thinking steadily, trouble concentrating and paying attention) was correlated with food addiction symptoms; the authors suggest this may be related to a greater likelihood of palatable food cues attracting one's attention. Thus, across measures, certain facets of impulsivity appear more germane when considering food addiction than others and better understanding these mechanisms may be key when considering possible intervention.

These findings contribute to the literature on food addiction and obesity in a number of ways. First, results of meta-analytic review have suggested that overweight/obese youth tend to be more impulsive (Thamotharan, Lange, Zale, Huffhines, & Fields, 2013). Thus, high levels of impulsivity early in life may predispose individuals to develop features of a food addiction much in the same way that impulsivity has been linked to several high risk behaviors such as substance use. Indeed, previous research has demonstrated that obese women display higher levels of Negative Urgency and Lack of Perseverance than their normal-weight counterparts (Mobbs et al., 2010). Individuals with food addiction likely represent a specific subgroup of obese individuals who are more impulsive and emotionally reactive (Davis 2013; Davis et al., 2011). Indeed, although addictive eating patterns do not always equate to obesity, the rates for meeting the criteria for food addiction is two to three times greater in obese individuals (Avena, Gearhardt, Gold, Wang, & Potenza, 2012). The present study found support for certain facets of impulsivity contributing to the development of addictive eating behavior which indirectly contributed to increased BMI. It is worth noting, however, that many factors aside from personality (e.g., appetite, environment, energy expenditure) contribute to body weight and personality should be considered alongside these other important influences (Ziauddeen, Farooqi, & Fletcher, 2012).

While this study is the first to demonstrate an indirect association between impulsive personality traits and BMI, its contributions must be considered within the context of the study's strengths and limitations. First, this sample was not a clinical sample and endorsed relatively few symptoms of food addiction. Related, the mean BMI of this sample fell within the normal-weight range. These two considerations likely contributed, in part, to the small effect size observed in the positive association between BMI and YFAS symptoms. Replicating and extending these findings in samples with larger proportions of overweight or

obese individuals may be beneficial. Additionally, this study did not assess bingeing, a behavior that has shown demonstrable overlap with food addiction in numerous studies. Future work in this area should explore the extent to which bingeing is related to the impulsivity, food addiction, and BMI constellation. Other sample limitations were the lopsided race and sex ratios, with greater representations of participants of European ancestry and who were female. Replicating these findings in diverse groups and with a more gender-balanced sample would be beneficial. Despite these limitations, this study elucidates possible deleterious consequences of ignoring or minimizing addictive eating behaviors. Specifically, just as impulsive individuals may put themselves at greater-risk for various negative health outcomes by engaging in traditional addictive behaviors (e.g., smoking cigarettes, using illegal drugs), impulsive individuals may, similarly, jeopardize their health via a pathological relationship to food by way of addictive eating behaviors.

A final consideration is the use of cross-sectional data in this study. Because of this, it is not possible to show that dispositional impulsivity precedes food addiction symptoms temporally, nor can we conclude that symptoms of addictive eating have a causal influence contributing to increases in BMI. Future research exploring these relationships using data collected longitudinally will be important to demonstrate that the higher levels of impulsivity seen at even a young age may increase the likelihood of addictive eating just as it is a risk factor for misusing alcohol and other addictive substances. More generally, the concept of food addiction still remains a fairly new construct and further study is needed. This includes experimental research to demonstrate the potential impact of impulsivity on addictive food consumption. Similarly, better understanding of addiction liability of various foods and related craving and impulsive consumption patterns may be beneficial. Finally, future work may seek to differentiate the way in which various forms of impulsivity may be manifest in addictive consumption of food versus addictive consumption of alcohol and other substances.

Acknowledgments

We are grateful to the Research Assistants of the Experimental and Clinical Psychology Laboratory who assisted in conducting this research.

This study was partially supported by NIH grant K23 AA016936 (JM).

References

- Avena NM, Gearhardt AN, Gold MS, Wang G, Potenza MN. Tossing the baby out with the bathwater after a brief rinse? The potential downside of dismissing food addiction based on limited data. *Nature Reviews Neuroscience*. 2012; 13(7):514. doi:10.1038/nrn3212-c1.
- Avena NM, Rada P, Hoebel BG. Evidence for sugar addiction: behavioral and neurochemical effects of intermittent, excessive sugar intake. *Neuroscience & Biobehavioral Reviews*. 2008; 32(1):20–39. doi:10.1016/j.neubiorev.2007.04.019. [PubMed: 17617461]
- Bégin C, St-Louis MÉ, Turmel S, Tousignant B, Marion LP, Ferland F, Gagnon-Girouard MP. Does food addiction distinguish a specific subgroup of overweight/obese overeating women?. *Health*. 2012; 4(12A):1492–1499. doi:10.4236/health.2012.412A214.
- Burmeister JM, Hinman N, Koball A, Hoffmann DA, Carels RA. Food addiction in adults seeking weight loss treatment. Implications for psychosocial health and weight loss. *Appetite*. 2013; 60:103–110. doi:10.1016/j.appet.2012.09.013. [PubMed: 23017467]

- Clark SM, Saules KK. Validation of the Yale Food Addiction Scale among a weight-loss surgery population. *Eating Behaviors*. 2013; 14(2):216–219. doi:10.1016/j.eatbeh.2013.01.002. [PubMed: 23557824]
- Cyders MA, Coskunpinar A. Measurement of constructs using self-report and behavioral lab tasks: Is there overlap in nomothetic span and construct representation for impulsivity? *Clinical Psychology Review*. 2011; 31(6):965–982. doi:10.1016/j.cpr.2011.06.001. [PubMed: 21733491]
- Cyders MA, Smith GT, Spillane NS, Fischer S, Annus AM, Peterson C. Integration of impulsivity and positive mood to predict risky behavior: development and validation of a measure of positive urgency. *Psychological Assessment*. 2007; 19(1):107–118. doi:10.1037/1040-3590.19.1.107. [PubMed: 17371126]
- Davis C. Compulsive overeating as an addictive behavior: overlap between food addiction and Binge Eating Disorder. *Current Obesity Reports*. 2013; 2:171–178. doi:10.1007/s13679-013-0049-8.
- Davis C, Curtis C, Levitan RD, Carter JC, Kaplan AS, Kennedy JL. Evidence that 'food addiction' is a valid phenotype of obesity. *Appetite*. 2011; 57(3):711–717. doi:10.1016/j.appet.2011.08.017. [PubMed: 21907742]
- de Wit H. Impulsivity as a determinant and consequence of drug use: a review of underlying processes. *Addiction Biology*. 2009; 14:22–31. doi:10.1111/j.1369-1600.2008.00129.x. [PubMed: 18855805]
- Dawe S, Loxton NJ. The role of impulsivity in the development of substance use and eating disorders. *Neuroscience & Biobehavioral Reviews*. 2004; 28(3):343–351. doi:10.1016/j.neubiorev.2004.03.007. [PubMed: 15225976]
- de Wit H. Impulsivity as a determinant and consequence of drug use. A review of underlying processes. *Addiction Biology*. 2009; 14:22–31. doi:10.1111/j.1369-1600.2008.00129. [PubMed: 18855805]
- Dick DM, Smith G, Olausson P, Mitchell SH, Leeman RF, O'Malley SS, Sher K. Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology*. 2010; 15(2):217–226. doi:10.1111/j.1369-1600.2009.00190.x. [PubMed: 20148781]
- Dir AL, Karyadi K, Cyders MA. The uniqueness of negative urgency as a common risk factor for self-harm behaviors, alcohol consumption, and eating problems. *Addictive Behaviors*. 2013; 38:2158–2162. doi:10.1016/j.addbeh.2013.01.025. [PubMed: 23454879]
- Eichen DM, Lent MR, Goldbacher E, Foster GD. Exploration of "food addiction" in overweight and obese treatment-seeking adults. *Appetite*. 2013; 67:22–24. doi:10.1016/j.appet.2013.03.008. [PubMed: 23535004]
- Evenden JL. Varieties of impulsivity. *Psychopharmacology (Berl)*. 1999; 146(4):348–361. doi:10.1007/PL00005481. [PubMed: 10550486]
- Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: Payer- and service-specific estimates. *Health Affairs*. 2009; 28(5):w822–w831. doi:10.1377/hlthaff.28.5.w822. [PubMed: 19635784]
- Fischer S, Anderson KG, Smith GT. Coping with distress by eating or drinking: role of trait urgency and expectancies. *Psychology of Addictive Behaviors*. 2004; 18(3):269–274. doi:10.1037/0893-164X.18.3.269. [PubMed: 15482082]
- Fischer S, Settles R, Collins B, Gunn R, Smith GT. The role of negative urgency and expectancies in problem drinking and disordered eating: Testing a model of comorbidity in pathological and at-risk samples. *Psychology of Addictive Behaviors*. 2012; 26(1):112–123. doi:10.1037/a0023460. [PubMed: 21604832]
- Fischer S, Smith GT. Binge eating, problem drinking, and pathological gambling: Linking behavior to shared traits and social learning. *Personality and Individual Differences*. 2008; 44(4):789–800. doi:10.1016/j.paid.2007.10.008.
- Fischer S, Smith GT, Anderson KG. Clarifying the role of impulsivity in bulimia nervosa. *International Journal of Eating Disorders*. 2003; 33(4):406–411. doi:10.1002/eat.10165.
- Gearhardt AN, Corbin WR, Brownell KD. Preliminary validation of the Yale Food Addiction Scale. *Appetite*. 2009; 52(2):430–436. doi:10.1016/j.appet.2008.12.003. [PubMed: 19121351]
- Gearhardt AN, White MA, Masheb RM, Grilo CM. An examination of food addiction in a racially diverse sample of obese patients with binge eating disorder in primary care settings.

- Comprehensive Psychiatry. 2013; 54(5):500–505. doi:10.1016/j.comppsy.2012.12.009. [PubMed: 23332551]
- Gearhardt AN, White MA, Masheb RM, Morgan PT, Crosby RD, Grilo CM. An examination of the food addiction construct in obese patients with binge eating disorder. *International Journal of Eating Disorders*. 2012; 45(5):657–663. doi:10.1002/eat.20957. [PubMed: 22684991]
- Johnson PM, Kenny PJ. Dopamine D2 receptors in addiction-like reward dysfunction and compulsive eating in obese rats. *Nature Neuroscience*. 2010; 13(5):635–641. doi:10.1038/nn.2519. [PubMed: 20348917]
- Littlefield AK, Sher KJ, Wood PK. Is “maturing out” of problematic alcohol involvement related to personality change? *Journal of Abnormal Psychology*. 2009; 118(2):360–374. doi: 10.1037/a0015125. [PubMed: 19413410]
- MacKillop J, Amlung MT, Few LR, Ray LA, Sweet LH, Munafò MR. Delayed reward discounting and addictive behavior: a meta-analysis. *Psychopharmacology*. 2011; 216(3):305–321. doi:10.1007/s00213-011-2229-0. [PubMed: 21373791]
- MacKillop J, Lisman SA. Reactivity to alcohol cues: Isolating the role of perceived availability. *Experimental and Clinical Psychopharmacology*. 2005; 13(3):229–237. doi: 10.1037/1064-1297.13.3.229. [PubMed: 16173886]
- MacKillop J, Menges DP, McGeary JE, Lisman SA. Influences of craving and DRD4 VNTR genotype on the relative value of alcohol. *Behavioral and Brain Functions*. 2007; 3(1) doi: 10.1186/17449081-3-11.
- Manwaring JL, Green L, Myerson J, Strube MJ, Wilfley DE. Discounting of various types of rewards by women with and without binge eating disorder: Evidence for general rather than specific differences. *Psychological Record*. 2011; 61(4):561–582. [PubMed: 24039301]
- Martin CK, O'Neil PM, Tollefson G, Greenway FL, White MA. The association between food cravings and consumption of specific foods in a laboratory taste test. *Appetite*. 2008; 51(2):324–326. doi: 10.1016/j.appet.2008.03.002. [PubMed: 18417253]
- Meule A. Impulsivity and overeating: a closer look at the subscales of the Barratt Impulsiveness Scale. *Frontiers in Psychology*. 2013; 4 doi:10.3389/fpsyg.2013.00177.
- Meule A, Heckel D, Kübler A. Factor structure and item analysis of the Yale Food Addiction Scale in obese candidates for bariatric surgery. *European Eating Disorders Review*. 2012; 20(5):419–422. doi:10.1002/erv.2189. [PubMed: 22761046]
- Mobbs O, Crépin C, Thiéry C, Golay A, Van der Linden M. Obesity and the four facets of impulsivity. *Patient Education and Counseling*. 2010; 79(3):372–377. doi:10.1016/j.pec.2010.03.003. [PubMed: 20399590]
- Mobbs O, Ghisletta P, Van der Linden M. Clarifying the role of impulsivity in dietary restraint: A structural equation modeling approach. *Personality and Individual Differences*. 2008; 45(7):602–606. doi:10.1016/j.paid.2008.06.021.
- National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. National Institute of Health; 1998.
- Ogden C, Carroll M. Prevalence of overweight, obesity, and extreme obesity among adults: United States, trends 1960–1962 through 2007–2008. *NCHS Health and Stats*. 2010
- Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers*. 2004; 36(4):717–731. doi: 10.3758/BF03206553.
- Rada P, Avena NM, Hoebel BG. Daily bingeing on sugar repeatedly releases dopamine in the accumbens shell. *Neuroscience*. 2005; 134(3):737–744. doi:10.1016/j.neuroscience.2005.04.043. [PubMed: 15987666]
- Smith GT, Fischer S, Cyders MA, Annus AM, Spillane NS, McCarthy DM. On the validity and utility of discriminating among impulsivity-like traits. *Assessment*. 2007; 14(2):155–170. doi: 10.1177/1073191106295527. [PubMed: 17504888]
- Sobik L, Hutchison K, Craighead L. Cue-elicited craving for food: A fresh approach to the study of binge eating. *Appetite*. 2005; 44(3):253–261. doi:10.1016/j.appet.2004.12.001. [PubMed: 15876472]

- Stice E, Spoor S, Bohon C, Small D. Relation between obesity and blunted striatal response to food is moderated by TaqIA A1 allele. *Science*. 2008; 322(5900):449–452. doi:10.1126/science.1161550. [PubMed: 18927395]
- Swinburn B, Sacks G, Ravussin E. Increased food energy supply is more than sufficient to explain the US epidemic of obesity. *American Journal of Clinical Nutrition*. 2009; 90(6):1453–1456. doi: 10.3945/ajcn.2009.28595. [PubMed: 19828708]
- Thamotharan S, Lange K, Zale EL, Huffhines L, Fields S. The role of impulsivity in pediatric obesity and weight status: A meta-analytic review. *Clinical Psychology Review*. 2013; 33(2):253–262. doi: 10.1016/j.cpr.2012.12.001. [PubMed: 23313762]
- Volkow N, Wise R. How can drug addiction help us understand obesity? *Nature Neuroscience*. 2005; 8(5):555–560. doi:10.1038/nn1452. [PubMed: 15856062]
- Wang G, Volkow ND, Logan J, Pappas NR, Wong CT, Zhu W, Fowler JS. Brain dopamine and obesity. *Lancet*. 2001; 357(9253):354–357. doi:10.1016/S0140-6736(00)03643-6. [PubMed: 11210998]
- Whiteside S, Lynam D. The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*. 2001; 30(4):669–689. doi:10.1016/s0191-8869(00)00064-7.
- Whiteside SP, Lynam DR. Understanding the role of impulsivity and externalizing psychopathology in alcohol abuse: Applications of the UPPS Impulsive Behavior Scale. *Experimental and Clinical Psychopharmacology*. 2003; 11(3):210–217. doi:10.1037/1064-1297.11.3.210. [PubMed: 12940500]
- Whiteside SP, R. Lynam D. Understanding the role of impulsivity and externalizing psychopathology in alcohol abuse: Application of the UPPS Impulsive Behavior Scale. *Personality Disorders: Theory, Research, and Treatment*. 2009; S(1):69–79. doi:10.1037/1949-2715.s.1.69.
- Yach D, Stuckler D, Brownell KD. Epidemiologic and economic consequences of the global epidemics of obesity and diabetes. *Nature Medicine*. 2006; 12(1):62–66. doi:10.1038/nm0106-62.
- Zapolski TCB, Cyders MA, Smith GT. Positive urgency predicts illegal drug use and risky sexual behavior. *Psychology of Addictive Behaviors*. 2009; 23(2):348. doi:10.1037/a0014684. [PubMed: 19586152]
- Ziauddeen H, Farooqi IS, Fletcher PC. Obesity and the brain: how convincing is the addiction model?. *Nature Reviews Neuroscience*. 2012; 13(4):279–286. doi:10.1038/nrn3212.

Fig 1.

The indirect association between impulsivity and BMI by way addictive food consumption.

Note: Panel A depicts negative urgency scale of the UPPS Impulsive Behavior Scale; Panel B depicts perseverance scale of UPPS Impulsive Behavior Scale; Food addiction = Number of YFAS food addiction symptoms endorsed; BMI = Body Mass Index. Regression coefficients for the indirect relationships between impulsivity and BMI controlling for food addiction in parentheses. * $p < .01$.

Table 1Participant characteristics ($N = 233$)

	%/M (SD); range
Gender	77% Female 23% Mmale
Race	84% White 8% Black 4% Asian <1% Pacific Islander 1% Mixed race 2% Another race
Age	19.65 (2.15); 18-32 years
Body Mass Index	22.78 (4.00); 16.09-47.82
Weight status	5% Underweight (BMI < 18.5) 73% Normal weight (BMI 18.5 - 24.9) 16% Overweight (BMI 25.0 - 29.9) 5% Obese (BMI ≥ 30)
YFAS symptoms	1.80 (1.39); 0-7 symptoms
YFAS diagnosis	24% met criteria 76% did not criteria
UPPS Negative urgency	2.12 (.51)
UPPS Positive urgency	1.84 (.53)
UPPS Perseverance	1.96 (.42)
UPPS Premeditation	1.97 (.46)
UPPS Sensation Seeking	2.79 (.58)

Note. YFAS = Yale Food Addiction Scale; Weight status slightly different from 100% due to rounding; UPPS = UPPS Impulsive Behavior Scale mean item score by scale.

Table 2

Zero-order correlations between food addiction, weight, and impulsivity variables

	NU	PU	PS	PM	SS	FA
PU	.71 **					
PS	.55 **	.44 **				
PM	.39 **	.41 **	.44 **			
SS	.12	.25 **	-.09	.26 **		
FA	.31 **	.20 **	.29 **	.19 **	.02	
BMI	.04	.04	-.02	.14 *	-.01	.18 **

Note. PU = UPPS-P Positive Urgency; NU = UPPS-P Negative Urgency; PM = UPPS-P lack of Premeditation; PS = UPPS-P lack of Perseverance; SS = UPPS-P Sensation Seeking; BMI = Body Mass Index; FA = Food Addiction as measured by the Yale Food Addiction Scale (YFAS).

*
 $p < .05$

**
 $p < .01$.

Table 3

Multiple regression of the impulsivity scales in relation to food addiction symptoms

	B	SE B	β	p
Negative Urgency	.69	.26	.25	<.01
(Lack of) Premeditation	.15	.22	.05	.49
(Lack of) Perseverance	.52	.26	.16	<.05
Positive Urgency	-.18	.24	-.07	.45