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Mindful Acceptance, not Awareness, Associated with Lower Food Susceptibility

Natalie G. Keirns^a, Madison E. Stout^a, Caitlin E. Smith^b, Harley M. Layman^a, Ki L. Cole^c, Lucia Ciciolla^a, Misty A.W. Hawkins^a

^aDepartment of Psychology, Oklahoma State University, Stillwater, OK, USA

^bDepartment of Psychiatry, Yale School of Medicine, New Haven, CT, USA

^cDepartment of Research, Evaluation, Measurement, and Statistics, Oklahoma State University, Stillwater, OK, USA

Abstract

Purpose: Food susceptibility refers to an individual's thoughts, feelings, and motivations when highly palatable foods are available. Mindfulness, or the practice of paying attention, non-judgmentally, in the present moment, is a key element in acceptance-based programs, which have been shown to benefit those with high food susceptibility. This study examined the relationship between food susceptibility and 1) trait mindfulness and 2) mindfulness facets (i.e., awareness, acceptance) in daily life.

Methods: Participants were 108 adults with overweight/obesity (45.56±11.41 years old, 75.9% white, 72.2% female) enrolled in a weight loss trial ([ClinicalTrials.gov Identifier:NCT02786238](https://clinicaltrials.gov/ct2/show/study/NCT02786238)). Food susceptibility was measured with the Power of Food Scale (PFS). Mindfulness was assessed using the Philadelphia Mindfulness Scale (PHMS) and its two subscales: PHMS-Awareness and PHMS-Acceptance. Two regressions examined the associations of 1) total PHMS on PFS, and 2) simultaneous PHMS subscales on PFS. Covariates were age, sex, race, and education.

Results: Regression results revealed, after adjustment for covariates, that Total PHMS was significantly negatively associated with PFS scores ($\beta=-0.258, p=0.001$), but only one of the PHMS subscales, Acceptance, was significantly associated with PFS scores ($\beta=-0.328, p<0.001$). PHMS-Awareness was not related to PFS scores.

Conclusions: Greater levels of mindfulness were associated with lower food susceptibility in treatment-seeking adults with overweight/obesity. Mindful acceptance may be the driving factor in this relationship, suggesting that awareness alone is not sufficient for promoting healthier appetite

Address Correspondence to: Misty A.W. Hawkins, Ph.D., Department of Psychology, 116 Psychology Building, Oklahoma State University, Stillwater, OK, USA 74078. misty.hawkins@okstate.edu

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Consent to participate: Informed consent was obtained from all individual participants included in the study.

regulation. Interventions aimed to reduce food susceptibility and improve coping with cravings may benefit from an enhanced focus on teaching mindful-acceptance skills.

Level of Evidence: Level III, observational cohort study

Keywords

obesity; mindfulness; awareness; acceptance; food susceptibility; hedonic hunger

Introduction

Food susceptibility refers to the degree of one's appetite for highly palatable foods, specifically in an environment where such foods are readily available [1]. Otherwise known as appetitive responsiveness or hedonic hunger, food susceptibility captures the thoughts, feelings, and motivations an individual experiences in response to the availability of palatable foods, which often include foods high in fat and/or sugar [1-3]. High levels of food susceptibility are associated with problematic eating behaviors, such as emotional and/or disinhibited eating [1]. Further, individuals displaying higher levels of food susceptibility may be prone to experiencing greater levels of food cravings and have greater difficulty adhering to dietary recommendations for weight loss [4-6]. However, evidence suggests that these individuals experience greater weight loss success in alternative (i.e., acceptance-based) behavioral weight loss programs versus in the standard cognitive-behavioral approach (SBTs) [7]. Acceptance-based treatments (ABTs) are typically based in Acceptance and Commitment Therapy and focus on accepting negative cognitive and emotional states in order to engage in value-driven behavior; mindfulness is often a key component of these interventions [6].

Mindfulness can be simply described as paying attention, non-judgmentally, in the present moment [8]. This process requires two components: awareness (i.e., paying attention) and acceptance (i.e., non-judgmentally). Mindful awareness can be directed to either internal experiences (e.g., feelings of sadness) or the external environment (e.g., sounds of traffic), and often includes both. Mindful acceptance occurs when one can experience these internal or external stimuli without a desire to change, to avoid, or to pursue them [9]. Dispositional, or trait-like, mindfulness is associated with numerous benefits, such as decreased depression, rumination, and pain catastrophizing, and improved well-being and emotion processing and regulation [10, 11]. Additionally, mindfulness interventions show that practicing state mindfulness can have analogous benefits to health and increase trait levels of mindfulness [10, 12]. Given that mindfulness is a core component of the ABTs which may benefit those high in food susceptibility, the relationship between these constructs warrants exploration.

The specific relationship between trait mindfulness and food susceptibility is unknown; however, substantial evidence suggests that mindfulness-based interventions within populations with overweight/obesity can be beneficial for both psychological and physical health [13]. Specifically, decreases in body mass index (BMI), depression, and anxiety, and improvements in eating behaviors and eating attitudes (i.e., thoughts/feelings related to eating) have been observed across numerous mindfulness-based interventions for overweight/obesity (e.g., acceptance-based weight loss programs) [13]. Though there is still

question as to the long-term effectiveness of mindfulness-based interventions for improving health behaviors and the degree of their benefit over traditional diet programs [14, 15], ABTs have displayed medium effect sizes for improving BMI and eating attitudes from pre- to post-treatment [13]. Recent work has also found that mindfulness-based approaches are efficacious in addressing problematic eating behaviors, such as eating based on external cues, and may be helpful for increasing adaptive eating strategies (i.e., intuitive eating) and coping with cravings [16, 17].

As individuals who are highly susceptible to the food environment may experience greater levels of food cravings [4, 5], studies examining the impact of mindfulness on food choices and craving responses are particularly relevant to understanding the mindfulness-food susceptibility relationship. One theoretical rationale posits that mindfulness can improve coping with cravings through the development of non-judgmental awareness of both problematic and more healthful eating patterns as well as the associated rewards and/or consequences of each [18]. The authors suggest that through this awareness *and* acceptance of the outcomes of eating behaviors, individuals will develop the ability to make flexible, intuitively-driven food choices, and be less susceptible to the hyper-palatable food environment [18]. Empirical studies have broadly supported this claim, specifically finding acceptance-based strategies to be successful in lowering food cravings and/or decreasing consumption of palatable foods as compared to control interventions [5, 19, 20]. Further, one recent study has recommended mindfulness as a potential treatment strategy for directly intervening on high levels of food susceptibility, rather than focusing on related constructs such as food cravings [3].

The above evidence lends itself to the following suppositions regarding food susceptibility and mindfulness in the context of interventions: 1) ABTs produce greater weight loss in individuals with high food susceptibility (vs. SBTs), 2) mindfulness interventions for individuals with overweight/obesity lead to improvements in health-related constructs (e.g., eating behaviors and attitudes), and 3) food cravings can be reduced through mindfulness interventions. In the above cases, the specific effects of these interventions on food susceptibility are unknown, and it is unclear whether increased mindfulness skills or decreased susceptibility to the food environment are the mechanisms of action. Foundational knowledge regarding baseline relationships between dispositional mindfulness and food susceptibility is also lacking, and differential relationships between mindful awareness and mindful acceptance with food susceptibility have not been investigated. The current study will address these gaps and add to the needed evidence base by meeting the following goals: a) determine whether food susceptibility is associated with general dispositional mindfulness in daily life, and b) observe differences between the facets of mindfulness (i.e., awareness, acceptance) in their associations with food susceptibility. We hypothesize that higher levels of mindfulness will be associated with lower food susceptibility. The investigation of differential relationships between the mindfulness facets and food susceptibility is exploratory, and no *a priori* hypotheses are made.

Method

Participants

Participants were a diverse sample of 156 adults with overweight/obesity ($M_{age}=44.95$; $SD = 11.1$) enrolled in the Cognitive and Self-Regulatory Mechanisms of Obesity Study (COSMOS) trial or the associated Pilot of Weight Reduction in Underserved Populations (POWER-UP) project and who had data from the baseline visit. COSMOS is a randomized controlled trial for acceptance based (ABT) versus standard (SBT) behavioral weight loss ([Clinical Trials.gov Identifier: NCT02786238](https://clinicaltrials.gov/ct2/show/study/NCT02786238)). POWER-UP is an additional open-trial arm testing the acceptability and feasibility of ABT for weight loss in a Native American population. Only data from the baseline visit of the COSMOS and POWER-UP trials were used for the present study. To meet inclusion criteria, participants had to be: between 25-65 years of age, English-speaking, have a baseline BMI ≥ 27.0 , and attend a study information session. POWER-UP participants additionally had to self-identify as Native American. Of note, participants with symptoms of a current or historic eating disorder or other serious psychological disorder, as determined by self-report completion of validated screening instruments [21], were excluded from the study. Detailed information regarding trial methodology, including all inclusion/exclusion criteria, are published elsewhere [21]. All participants gave informed consent prior to trial initiation and were compensated up to \$75 for their participation in the baseline visit.

Measures

Food Susceptibility.—Susceptibility to food cues was measured via the Power of Food Scale (PFS) [1]. The PFS is a 21-item self-report measure designed to assess the psychological impact of living in environments where food is abundant. Response options range from 1 (*Don't Agree at All*) to 5 (*Strongly Agree*). Scores are calculated as a sum of all items with higher scores indicating greater food susceptibility. The PFS is a well-validated measure demonstrated to have high internal consistency among normal weight adults and adults with overweight/obesity ($\alpha=.81-.91$). The PFS demonstrated good internal consistency in the present study ($\alpha=.948$).

Mindfulness.—The Philadelphia Mindfulness Scale (PHMS) is a 20-item, bidimensional measure of mindfulness comprised of two subscales: present-moment awareness (PHMS-Awareness) and acceptance (PHMS-Acceptance) [22]. PHMS-Awareness (10 items) involves continuous monitoring of current experiences and represents the behavioral component of mindfulness. PHMS-Acceptance (10 reverse-scored items) is defined as “experiencing events fully and without defense, as they are” [23]. Response options range from 1 (*Never*) to 5 (*Very Often*). Total and subscale scores are calculated as a sum of relevant items with higher scores indicating greater mindfulness (awareness, acceptance). The PHMS displayed good reliability in the present study for the total measure ($\alpha=.71$), as well as the awareness ($\alpha=.80$) and acceptance subscales ($\alpha=.83$), which is consistent with the validation sample: awareness ($\alpha=.75$) and acceptance subscales ($\alpha=.82$) [22].

Covariates.—Demographic variables, including participants' age (years), sex (0=male, 1=female), race (0=Black, Indigenous, & Persons of Color (BIPOC), 1=white), and

education (0=did not complete high school, 1=high school, 2=some college, 3=Associate's degree, 4=Bachelor's degree, 5=Master's degree, 6=professional degree, 7=Doctorate), were measured via the Weight and Lifestyle Inventory (WALI) [24]. The WALI is a self-report measure designed to collect information regarding weight and dieting history. We would like to acknowledge that including race as a dichotomously-coded covariate does not capture the true reasons (i.e., racism, discrimination) for potential differential outcomes across historically oppressed/marginalized racial groups in our sample. At the time of data collection, we did not include measures of everyday racism or discrimination, which we plan to do in future studies. Additionally, the decision to collapse all individuals identifying as BIPOC into one category was made due to inadequate representation in each of these groups, thus inhibiting more culturally appropriate and meaningful analyses.

Procedure

Participants enrolled in the COSMOS trial attended a baseline visit prior to the start of treatment, where data on food susceptibility and mindfulness were collected via self-report measures. Demographic data and baseline weight, using a Tanita body composition analyzer, were also collected during this assessment visit by a trained research assistant. All procedures were approved by the university's IRB.

Data Analyses.—Bivariate associations were run for each key study variable and demographic factors and two regression models were run. In the first, baseline mindfulness overall (PHMS-Total) was regressed on food susceptibility (PFS; Step 2), controlling for age, race, sex, and education (Step 1). In the second, the subscales of mindfulness (i.e., awareness and acceptance) and the same covariates were simultaneously regressed on PFS to examine whether each mindfulness skill had a unique relationship with food susceptibility (PFS). Given the simultaneous entry of the PHMS subscales into the same model, checks for multicollinearity were performed. Analyses were run using SPSS (Version 25.0, IBM Corp, 2017). Missing values were imputed using the multiple imputation missing values add-on for SPSS.

Results

Approximately half of participants were white (52.6%), and the majority were female (76.3%); participants were on average 45.0 (SD = 11.1) years old. All variables met the necessary assumptions for linear regression, including linearity, homoscedasticity, and normality. Additionally, multicollinearity was not a concern in the present dataset (tolerance values > 0.2 and TIF values < 10.0). Additional participant demographics are presented in Table 1. Thirty-seven participants had missing data on seven of the nine key study variables. Five datasets were imputed using multiple imputation, and the reported results are pooled values. Missing values analyses in SPSS revealed two patterns of missingness, suggesting that data were not missing completely at random, but missing at random. Values were estimated using multiple imputation.

Bivariate Associations

Correlation analyses were run to examine bivariate associations between key study variables and covariates (Table 2). PFS scores were significantly negatively correlated with PHMS-Total ($r=-0.24$) and PHMS-Acceptance ($r=-0.29$), suggesting that greater overall mindfulness and mindful acceptance exhibited small-to-moderate associations with lower food susceptibility. PHMS-Acceptance scores were significantly negatively correlated with PHMS-Awareness scores ($r=-0.26$) and participant sex ($r_{pb}=-0.24$), suggesting that greater awareness was associated with lower acceptance, and male participants tended to endorse greater awareness. All associations between study variables and covariates were in the small-to-moderate range.

Primary Outcomes

A linear regression was conducted to examine the relationship between mindfulness and food susceptibility adjusting for age, sex, race, and education. Results revealed that total PHMS scores accounted for 5.5% of the variance in PFS scores. Further, PHMS scores were negatively associated with PFS scores ($\beta=-0.237$, $p=.020$), such that – independent of covariates – higher levels of mindfulness were uniquely related to lower food susceptibility.

We then conducted the same analyses using the mindfulness subscales (PHMS-Awareness and PHMS-Acceptance) as simultaneous predictors (Table 3). PHMS subscales uniquely explained 8.9% of the variance in PFS. PHMS-Acceptance scores were significantly related to PFS scores ($\beta=-0.321$, $p<.001$), whereas PHMS-Awareness scores were not ($\beta=-0.085$, $p=.322$). This pattern suggests that higher levels of mindful acceptance are related to less susceptibility to food, while levels of mindful awareness were not significantly associated with levels of food susceptibility.

Discussion

The goals of this study were to investigate whether food susceptibility is associated with general dispositional mindfulness in daily life and to investigate differences between the facets of mindful awareness and mindful acceptance in their associations with food susceptibility. We hypothesized that higher levels of general mindfulness would be associated with less susceptibility to food, and this hypothesis was supported. In a diverse sample of adults with overweight/obesity, individuals with higher levels of mindfulness displayed less susceptibility to palatable foods, as measured by the Power of Food Scale. Further, levels of mindful acceptance appear to contribute to this relationship. Having a greater level of mindful acceptance was associated with less susceptibility to food, whereas no relationship between mindful awareness and food susceptibility was observed.

These results are generally consistent with previous literature. Although other studies have not directly examined relationships between trait mindfulness and food susceptibility, the success of mindfulness or acceptance-based behavioral weight loss interventions supports a relationship between the practice of mindfulness and more controlled appetite for palatable foods [13]. Further, studies of acceptance-based interventions for food cravings have found that these strategies can improve one's ability to tolerate cravings and make food

choices based on factors other than appetite for palatable food [5, 19, 20]. Results of the current study further suggest that the negative relationship between mindfulness and food susceptibility is driven by individuals' levels of mindful acceptance and that awareness may not be associated with eating patterns. One related study found that a standard attention exercise (i.e., food-cue exposure) actually led to increased hunger and food consumption as compared to a "mindful attention" induction which included an emphasis on non-judgment [25]. It may be that awareness – or attention – in the presence of negative judgement or self-criticism functions differently than awareness accompanied by acceptance. The role of attention is clearly still important as a first step toward acceptance, and literature suggests that awareness factors, such as attention to food cues, are in fact important in determining food choices, especially in certain subgroups.

Specifically, studies have found interventions primarily focused on increasing awareness of internal hunger/satiety signals and/or modifying attention to food cues in the environment to be successful in decreasing food susceptibility [26-28]. These studies were conducted in clinical populations with binge eating disorder (BED), which makes it difficult to compare their results with the current sample of BWL treatment-seeking adults with overweight/obesity but no comorbid eating pathology (specific inclusion/exclusion criteria for the current sample previously reported) [21]. Thus, increasing awareness alone may have positive outcomes in certain populations or contexts in which eating may be characterized by rapid and uncontrolled consumption, as in the case of bingeing or loss of control eating [29]. In these instances, mindful attention may serve as a buffer against fast, impulsive food intake. However, there are also certain theoretical risks to focusing on awareness in isolation of acceptance. Becoming cognizant of uncontrolled eating without explicit interventions to avoid judgment (i.e., acceptance) of this behavior could lead to increased shame or other negative emotions or cognitions [30]. Such symptoms could contribute to cognitions and behaviors associated with eating or mood pathology, such as body dissatisfaction, food preoccupation, and feelings of guilt or self-loathing [31, 32].

Other reasons for inconsistencies across studies could be methodological differences between attention/awareness intervention studies and the current study's self-report measure of mindful awareness. The specific measure of mindfulness used in the current study was the Philadelphia Mindfulness Scale [22]. Certain characteristics of this scale are important to consider when interpreting the present findings. The PHMS is made up of two subscales: Awareness (10 items) and Acceptance (10 items), with higher scores on each subscale representing greater levels of that construct. Of note, the items on the Awareness scale are all positively worded (e.g., "I am aware of what thoughts are passing through my mind"), while the items on the Acceptance scale are all negatively worded (e.g., "I try to distract myself when I feel unpleasant emotions"). Some researchers have raised concern with the use of mixed item wordings, especially when the use of positively- and negatively-worded items is unbalanced, as this may lead to response biases and method effects, or error [33, 34]. In fact, there is some factor analysis evidence suggesting that positively and negatively worded items tend to cluster together into what appear to be subscales capturing different constructs but may simply be groupings due to the wording of the items [35].

Other studies using the PHMS have also consistently found that the Awareness scale is not related to a variety of constructs (e.g., global life satisfaction) that are associated with the Acceptance scale [22, 36]. This pattern of mindful acceptance being more commonly related to other constructs of interest could very well be due to valid theoretical relationships and differential functioning between the two components of mindfulness. However, it is important to consider the possibility that method effects due to item wordings have affected these results. Future studies utilizing revised PHMS subscales with balanced item wordings and matched-item pairs are necessary in order to rule out possible method effects and confirm the theoretical relationships between mindful awareness, mindful acceptance, and other constructs of interest [33, 37].

If food susceptibility is in fact related to mindful acceptance but not mindful awareness, this pattern would have both theoretical and clinical implications. Theoretically, the results suggest that acceptance, or non-judgment, is the driving factor in the relationship between mindfulness and food susceptibility. As alluded to above, simply being aware of our internal experiences or external environments – without acceptance of these factors – is not enough to contribute to lesser susceptibility to highly palatable foods. Therefore, interventions for coping with cravings or resisting palatable foods would need to include an emphasis on not judging oneself for having said cravings or desires for delicious foods. In fact, some research would suggest that an awareness-only approach may increase risk for experiencing negative emotions such as shame, which can be counter-productive for health behaviors [30, 38].

The current findings warrant future research in this area. Firstly, future acceptance- or mindfulness-based dismantling studies are needed to confirm whether the acceptance aspect of mindfulness is the essential mechanism by which ABTs exert positive health outcomes compared to awareness alone. Such information could be useful for enhancing or streamlining interventions to their most potent or essential change agents. However, such dismantling studies should confirm the construct validity of the PHMS so that the measure can be revised, updated, or replaced if needed to best measure mindfulness as a mechanism. Additionally, future studies should consider other variables that may confound, explain, or change the relationship between mindfulness and food susceptibility. For example, when post-hoc adjusting for depression in the current analyses, the overall pattern of results was unchanged (i.e., mindful acceptance, but not awareness, was related to lesser food susceptibility); however, depression uniquely explained an additional 4.8% of variance in food susceptibility. Therefore, larger and/or longitudinal studies should *a priori* consider affective factors, such as depression, and how they may mediate or moderate the relationship between mindful acceptance and food susceptibility.

Further, additional research should investigate differences between people high in awareness or acceptance versus both. Interestingly, a negative correlation between the Awareness and Acceptance subscales was observed in the current data. This may be surprising, as one would likely assume that the two subscales would increase or decrease together in individuals higher and lower in mindfulness, respectively. This negative relationship could be due to the subscales' abilities to function as separate constructs, characteristics of the current sample of individuals with overweight/obesity enrolled in a weight loss study, or psychometric characteristics of the PHMS. Further research is needed to better

understand and measure the constructs of mindful awareness and mindful acceptance and their relationships with susceptibility to palatable foods, but the present data suggest that acceptance may be the more healthful aspect of mindfulness when it comes to eating patterns.

In discussing the theoretical, clinical, and research implications of this study, some additional limitations must be noted. First, this project utilized cross-sectional, self-reported data. The cross-sectional nature of this study inhibits causal conclusions regarding relationships between food susceptibility and mindfulness. This study assumed that levels of mindfulness – especially mindful acceptance – predict levels of susceptibility to palatable foods. However, reverse causality is possible, such that individuals with less food susceptibility may find it easier to engage in mindful acceptance, or unobserved confounding factors could explain the observed relationship between these two variables. Additionally, self-report measures have inherent weaknesses due to their subjective nature. Some individuals may have had difficulty accurately reporting susceptibility to palatable foods or their tendency to be mindful of internal/external experiences. Lastly, though these data were collected in a relatively diverse sample, participants were mostly middle-aged, treatment-seeking adults with overweight/obesity; thus, findings may not generalize to a non-treatment-seeking sample, a sample without overweight/obesity, or individuals with differing demographic profiles (e.g., younger people, older people). It may be particularly interesting to conduct similar studies in populations at high risk for eating pathology or negative body image, such as adolescent or emerging adult women, or to examine these relationships across the lifespan to see if development impacts the nature or magnitude of the findings [39, 40].

The current study was the first to directly investigate relationships between mindfulness and food susceptibility, specifically exploring differential relationships between mindful awareness and mindful acceptance. Higher levels of trait mindfulness were associated with lower levels of food susceptibility, and this relationship was driven by mindful acceptance. If replicated, these findings have implications for the design of interventions focusing on decreasing susceptibility to highly palatable foods and coping with cravings. Future research should continue to deepen the understanding of relationships between mindful awareness, mindful acceptance, and susceptibility to palatable foods.

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References

1. Lowe MR, et al. , The Power of Food Scale. A new measure of the psychological influence of the food environment. *Appetite*, 2009. 53(1): p. 114–118. 10.1016/j.appet.2009.05.016 [PubMed: 19500623]
2. Lowe MR and Butryn ML, Hedonic hunger: a new dimension of appetite? *Physiology & behavior*, 2007. 91(4): p. 432–439. 10.1016/j.physbeh.2007.04.006 [PubMed: 17531274]

3. Howard LM, et al. , Examining the ecological validity of the Power of Food Scale. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 2020: p. 1–5. 10.1007/s40519-020-00871-1
4. Rejeski WJ, et al. , Power of food moderates food craving, perceived control, and brain networks following a short-term post-absorptive state in older adults. *Appetite*, 2012. 58(3): p. 806–813. 10.1016/j.appet.2012.01.025 [PubMed: 22329987]
5. Forman EM, et al. , A comparison of acceptance-and control-based strategies for coping with food cravings: An analog study. *Behaviour research and therapy*, 2007. 45(10): p. 2372–2386. 10.1016/j.brat.2007.04.004 [PubMed: 17544361]
6. Forman EM and Butryn ML, A new look at the science of weight control: how acceptance and commitment strategies can address the challenge of self-regulation. *Appetite*, 2015. 84: p. 171–180. 10.1016/j.appet.2014.10.004 [PubMed: 25445199]
7. Forman E, Butryn M, and Juarascio A, Comparison of Acceptance-Based Versus Standard Behavioral Treatment for Obesity in Adults. *JCOM*, 2013. 20(11).
8. Kabat-Zinn J, Mindfulness. *Mindfulness*, 2015. 6(6): p. 1481–1483. 10.1007/s12671-015-0456-x
9. Lacaïlle J, et al. , The effects of three mindfulness skills on chocolate cravings. *Appetite*, 2014. 76: p. 101–112. 10.1016/j.appet.2014.01.072 [PubMed: 24503333]
10. Tomlinson ER, et al. , Dispositional mindfulness and psychological health: a systematic review. *Mindfulness*, 2018. 9(1): p. 23–43. 10.1007/s12671-017-0762-6 [PubMed: 29387263]
11. Lundwall C, et al. , Self-Regulation Mechanisms Explain How Dispositional Mindfulness Promotes Well-Being. *Journal of Positive School Psychology*, 2019. 3(2): p. 153–164.
12. Hofmann SG, et al. , The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of consulting and clinical psychology*, 2010. 78(2): p. 169. 10.1037/a0018555 [PubMed: 20350028]
13. Rogers JM, et al. , Mindfulness-based interventions for adults who are overweight or obese: a meta-analysis of physical and psychological health outcomes. *Obesity reviews*, 2017. 18(1): p. 51–67. 10.1111/obr.12461 [PubMed: 27862826]
14. Ruffault A, et al. , The effects of mindfulness training on weight-loss and health-related behaviours in adults with overweight and obesity: A systematic review and meta-analysis. *Obesity research & clinical practice*, 2017. 11(5): p. 90–111. 10.1016/j.orcp.2016.09.002 [PubMed: 27658995]
15. Fuentes Artiles R, et al. , Mindful eating and common diet programs lower body weight similarly: Systematic review and meta-analysis. *Obesity reviews*, 2019. 20(11): p. 1619–1627. 10.1111/obr.12918 [PubMed: 31368631]
16. Warren JM, Smith N, and Ashwell M, A structured literature review on the role of mindfulness, mindful eating and intuitive eating in changing eating behaviours: effectiveness and associated potential mechanisms. *Nutrition research reviews*, 2017. 30(2): p. 272–283. 10.1017/S0954422417000154 [PubMed: 28718396]
17. Lattimore P, Mindfulness-based emotional eating awareness training: taking the emotional out of eating. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, 2020. 25(3): p. 649–657. 10.1007/s40519-019-00667-y
18. Brewer JA, et al. , Can mindfulness address maladaptive eating behaviors? Why traditional diet plans fail and how new mechanistic insights may lead to novel interventions. *Frontiers in psychology*, 2018. 9: p. 1418. 10.3389/fpsyg.2018.01418 [PubMed: 30250438]
19. Forman EM, et al. , Comparison of acceptance-based and standard cognitive-based coping strategies for craving sweets in overweight and obese women. *Eating behaviors*, 2013. 14(1): p. 64–68. 10.1016/j.eatbeh.2012.10.016 [PubMed: 23265404]
20. Alberts HJ, et al. , Coping with food cravings. Investigating the potential of a mindfulness-based intervention. *Appetite*, 2010. 55(1): p. 160–163. 10.1016/j.appet.2010.05.044 [PubMed: 20493913]
21. Hawkins MA, et al. , Cognitive and Self-regulatory Mechanisms of Obesity Study (COSMOS): Study protocol for a randomized controlled weight loss trial examining change in biomarkers, cognition, and self-regulation across two behavioral treatments. *Contemporary clinical trials*, 2018. 66: p. 20–27. 10.1016/j.cct.2017.12.010 [PubMed: 29274893]

22. Cardaciotto L, et al. , The assessment of present-moment awareness and acceptance: The Philadelphia Mindfulness Scale. *Assessment*, 2008. 15(2): p. 204–223. 10.1177/1073191107311467 [PubMed: 18187399]
23. Hayes SC, Content, context, and the types of psychological acceptance. *Acceptance and change: Content and context in psychotherapy*, 1994: p. 13–32.
24. Wadden TA and Foster GD, Weight and lifestyle inventory (WALI). *Obesity*, 2006. 14(S3): p. 99S–118S. 10.1038/oby.2006.289 [PubMed: 16648601]
25. Fisher N, Lattimore P, and Malinowski P, Attention with a mindful attitude attenuates subjective appetitive reactions and food intake following food-cue exposure. *Appetite*, 2016. 99: p. 10–16. 10.1016/j.appet.2015.12.009 [PubMed: 26702601]
26. Kristeller J, Wolever RQ, and Sheets V, Mindfulness-based eating awareness training (MB-EAT) for binge eating: A randomized clinical trial. *Mindfulness*, 2014. 5(3): p. 282–297. 10.1007/s12671-012-0179-1
27. Boutelle KN, et al. , An open trial targeting food cue reactivity and satiety sensitivity in overweight and obese binge eaters. *Cognitive and behavioral practice*, 2017. 24(3): p. 363–373. 10.1016/j.cbpra.2016.08.003 [PubMed: 29269997]
28. Boutelle KN, et al. , An open trial evaluating an attention bias modification program for overweight adults who binge eat. *Journal of behavior therapy and experimental psychiatry*, 2016. 52: p. 138–146. 10.1016/j.jbtep.2016.04.005 [PubMed: 27116704]
29. Goldschmidt AB, Are loss of control while eating and overeating valid constructs? A critical review of the literature. *Obesity Reviews*, 2017. 18(4): p. 412–449. 10.1111/obr.12491 [PubMed: 28165655]
30. Arndt J and Goldenberg JL, From self-awareness to shame-proneness: Evidence of causal sequence among women. *Self and Identity*, 2004. 3(1): p. 27–37. 10.1080/13576500342000022
31. Kim S, Thibodeau R, and Jorgensen RS, Shame, guilt, and depressive symptoms: a meta-analytic review. *Psychological bulletin*, 2011. 137(1): p. 68. 10.1037/a0021466 [PubMed: 21219057]
32. Blythin SP, et al. , Experiences of shame and guilt in anorexia and bulimia nervosa: A systematic review. *Psychology and Psychotherapy: Theory, Research and Practice*, 2020. 93(1): p. 134–159. 10.1111/papt.12198
33. Matlock KL, Turner RC, and Gitchel WD, A study of reverse-worded matched item pairs using the generalized partial credit and nominal response models. *Educational and psychological measurement*, 2018. 78(1): p. 103–127. 10.1177/0013164416670211 [PubMed: 29795949]
34. Baumgartner H and Steenkamp J-BE, Response styles in marketing research: A cross-national investigation. *Journal of marketing research*, 2001. 38(2): p. 143–156. 10.1509/jmkr.38.2.143.18840
35. Greenberger E, et al. , Item-wording and the dimensionality of the Rosenberg Self-Esteem Scale: Do they matter? *Personality and individual differences*, 2003. 35(6): p. 1241–1254. 10.1016/S0191-8869(02)00331-8
36. Klein R, et al. , The Toronto and Philadelphia Mindfulness Scales: Associations with satisfaction with life and health-related symptoms. *International Journal of Psychology and Psychological Therapy*, 2015. 15(3): p. 133–142.
37. Cole KL, Turner RC, and Gitchel WD, A study of polytomous IRT methods and item wording directionality effects on perceived stress items. *Personality and Individual Differences*, 2019. 147: p. 63–72. 10.1016/j.paid.2019.03.046
38. Conradt M, et al. , Who copes well? Obesity-related coping and its associations with shame, guilt, and weight loss. *Journal of Clinical Psychology*, 2008. 64(10): p. 1129–1144. 10.1002/jclp.20501 [PubMed: 18729137]
39. Neumark-Sztainer D, I'm, like, SO fat!: helping your teen make healthy choices about eating and exercise in a weight-obsessed world. 2005: Guilford Press.
40. Hoek HW and Van Hoeken D, Review of the prevalence and incidence of eating disorders. *International Journal of eating disorders*, 2003. 34(4): p. 383–396. 10.1002/eat.10222

What is already known on this subject?

Mindfulness interventions promote mental and physical health in individuals with overweight/obesity. These interventions tend to improve persons' abilities to cope with cravings for palatable foods.

What your study adds?

This study establishes an association between trait-level mindfulness and decreased susceptibility to palatable foods, and identifies acceptance as the key mindfulness component in this relationship. Interventions for coping with cravings or resisting palatable foods should include an emphasis on not judging oneself for having said cravings or desires for delicious foods.

Table 1.Participant Demographics (Max $N=156$)

	Mean (SD), n (%)
Age (years)	44.95 (11.1)
Sex	119 (76.3%) female
Race-Ethnicity	82 (52.6%) White, non-Hispanic 39 (25.0%) American Indian/Native American 19 (12.2%) More than one race 5 (3.2%) Black/African American 5 (3.2%) Other 4 (2.6%) Missing 2 (1.3%) Asian
Education	2 (1.9%) Less than High School Diploma 18 (11.5%) High School Diploma 27 (17.3%) Some College 14 (9.0%) Associate's Degree 42 (26.9%) Bachelor's Degree 50 (32.1%) Graduate Degree 3 (1.9%) Missing
Body Mass Index (kg/m ²)	36.00 (5.5)
Body Fat Percentage (%)	42.35 (7.1)
PHMS-Total (20-100)	65.78 (7.6)
PHMS-Awareness (10-50)	35.75 (5.7)
PHMS-Acceptance (10-50)	30.20 (6.5)
PFS-Total (21-105)	56.72 (18.6)

Note: Continuous variables are observed mean (standard deviation). Categorical variables are observed frequencies (%). PHMS = Philadelphia Mindfulness Scale; PFS = Power of Food Scale.

Table 2.Bivariate Associations between Key Study Variables ($N=156$)

	1	2	3	4	5	6
1. Food Susceptibility (PFS)	-					
2. Mindfulness (PHMS-Total)	-0.24**	-				
3. Awareness (PHMS-Aware)	-0.01	0.62*	-			
4. Acceptance (PHMS-Accept)	-0.29**	0.61**	-0.26**	-		
5. Age	-0.10	0.05	-0.03	0.09	-	
6. Sex [†]	0.10	-0.11	0.10	-0.24*	-0.13	-
7. Race [‡]	-0.10	-0.06	0.08	-0.16	-0.18*	0.05

Note. PHMS = Philadelphia Mindfulness Scale; PFS = Power of Food Scale.

*
= $p < 0.05$

**
= $p < 0.01$

[†]
0=male, 1=female

[‡]
0=Black, Indigenous, Person of Color, 1=white

Table 3.

Baseline Regressions Between Mindfulness (PHMS) and Food Susceptibility (PFS)

	Model 1: Total PMHS (n = 108)		Model 2: PMHS Subscales (n = 108)	
	<i>R</i> ²	<i>R</i> ²	<i>R</i> ²	<i>R</i> ²
Step 1	0.033	--	0.033	--
Step 2	0.088	0.055	0.122	0.089
Step 2	<i>β</i>	<i>p</i>	<i>β</i>	<i>p</i>
Age	-0.102	0.203	-0.096	0.226
Sex [†]	0.071	0.383	0.029	0.725
Race [‡]	-0.126	0.140	-0.159	0.061
Education	0.015	0.858	-0.008	0.928
PHMS-Total ^a	-0.237	0.020	-	-
PHMS Awareness ^b	-	-	-0.085	0.322
PHMS Acceptance ^b	-	-	-0.321	<0.001

Note: Bolded values significant at $p < 0.05$; PFS=Power of Food Scale; PHMS = Philadelphia Mindfulness Scale

[†]0=male, 1=female

[‡]0= Black, Indigenous, Person of Color, 1=white

^aModel 1, regression of PHMS-Total on PFS

^bModel 2, regression of PHMS-Awareness and PHMS-Acceptance on PFS.