



## The sweet life: The effect of mindful chocolate consumption on mood



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### ABSTRACT

Chocolate consumption is anecdotally associated with an increase in happiness, but little experimental work has examined this effect. We combined a food type manipulation (chocolate vs. crackers) with a mindfulness manipulation (mindful consumption vs. non-mindful consumption) and examined the impact on positive mood. Participants ( $N = 258$ ) were randomly assigned to eat a small portion (75 calories) of chocolate or a control food (crackers) in a mindful or non-mindful way. Participants who were instructed to mindfully eat chocolate had a greater increase in positive mood compared to participants who were instructed to eat chocolate non-mindfully or crackers either mindfully or non-mindfully. Additional analyses revealed that self-reported liking of the food partially mediated this effect. Chocolate appears to increase positive mood, but particularly when it is eaten mindfully.

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People in the U.S. are estimated to consume candy once every 2–3 days on average (Hornick, Duyff, Murphy, & Shumow, 2014). Consumption is higher in other areas of the world (Forbes, 2015). Chocolate and other candies are treats and indulgent foods that typically have added sugars, which people are told to avoid in large quantities (O'Neil, Fulgoni, & Kicklas, 2011). Yet, candy consumption in moderation does not appear to be related to adverse physical health issues (Duyff et al., 2010; O'Neil et al., 2011).

People's consumption of candy like chocolate is likely due to many reasons. Chocolate is reported to be one of the most craved foods (Pelchat, 1997; Weingarten & Elston, 1991) likely because of its good taste, the pleasant physiological effects of the ingredients, the association with childhood experiences, and its consumption in pleasurable situations (Molinari & Callus, 2012; Parker, Parker, & Brotchie, 2006). An interesting related reason may be because of its effect on mood. Although there seems to be an anecdotal belief that chocolate or candy consumption increases happiness, only a small amount of experimental research appears to exist. We do note that there is work on mood and the consumption of the individual ingredients in chocolate (Scholey & Owen, 2013), but little work has examined chocolate consumption and mood using chocolate in a form that people consume as a treat (e.g., a candy bar). One of the earliest studies was conducted by Weisenberg,

Gerby, and Mikulincer (1993) who found that, compared to participants in a control condition who did not eat anything, participants who ate chocolate after working on an unsolvable task reported less anxiety on a one-item measure that used a visual analog response (0–100). Macht and Dettmer (2006) conducted a more direct study. These researchers found that participants reported a more positive mood using a one-item bi-polar scale (0 = extremely bad mood to 10 = extremely good mood) 5, 30, 60, and 90 min after eating a chocolate bar (50 grams) versus an apple or nothing. To our knowledge, the study by Macht and Dettmer (2006) is the only experimental study that has examined chocolate and positive mood. Other work has shown that eating chocolate seems to reduce a negative mood after it is induced via a manipulation. For example, eating chocolate versus drinking water decreased participants' self-reported negative mood assessed using a one-item 25-point scale (1 = very bad mood to 25 = very good mood) after it was induced via a sad movie (Macht & Mueller, 2007; see Scholey & Owen, 2013, for a review of related work).

Eating in general is associated with emotions and moods. For example, people in a more positive mood tend to choose more nutritious foods while people in a more negative mood tend to choose more indulgent or less healthy foods (Canetti, Bachar, & Berry, 2002; Gardner, Wansink, Kim, & Park, 2014; Macht, 2008). Eating can be used to regulate or reduce negative emotions like anxiety and may partially explain some instances of disordered eating (Canetti et al., 2002; Christensen, 1993).

The limited literature discussed above suggests that moderate candy consumption might be beneficial for short-term mood states

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and therefore the exploration of ways to enhance its impact is useful. Yet, experimental research on candy consumption and mood is scarce. One potential reason for this lack of published research could be because some studies have not found significant effects and therefore have not been published (e.g., a file drawer problem). Candy may have an effect on mood, but only in certain situations that have not yet been identified. We believe there could be unidentified moderators or variables that make candy consumption more versus less likely to affect mood. Mindfulness might be one variable that could moderate the connection between candy consumption and positive mood. Mindfulness is characterized by a receptive and non-evaluative awareness of present experiences (Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007; Goodman, Quaglia, & Brown, 2015). Mindfulness is rooted in Buddhist philosophy and it has become a widely examined topic in multiple disciplines (Brown et al., 2007; Hölzel et al., 2011). People high in mindfulness tend to focus more on the present environment and they experience situations less defensively and allow positive and negative thoughts and feelings to occur with less judgement.

Mindfulness is apparent at state and trait levels (Brown & Ryan, 2003; Brown et al., 2007). In state terms, people can be encouraged to be more or less mindful in the moment. That is, in momentary terms, people can be more or less likely to be receptive and non-evaluative of their present experiences. Several studies reveal that state mindfulness can be briefly manipulated in a laboratory setting in a variety of ways (e.g., Heppner et al., 2008; Hopthrow, Hooper, Mahmood, Meier, & Weger, in press; Jordan, Wang, Donatoni, & Meier, 2014; Ostafin & Kassman, 2012; Weger, Hooper, Meier, & Hopthrow, 2012). A common technique, which influenced the current study, involves the mindful consumption of raisins (Heppner et al., 2008; Kabat-Zinn, 1990). This manipulation encourages people to eat a raisin either mindfully or normally. In the mindful condition, participants are asked to slow down and pay attention to the color, texture, and smell of a raisin. When eating it, they are asked to chew slowly and notice the sensations produced by the raisin and so on. State mindfulness scales (e.g., “I was curious about each of the thoughts and feelings I was having”) can be used to assess the effect of manipulations like this one (Lau et al., 2006). Recent work has even shown that state mindfulness can be induced over the internet using computer-mediated manipulations (Mahmood, Hopthrow, & Randsley de Moura, 2016).

Trait mindfulness is a personality variable and it generally refers to the tendency to have more versus less experiences of state mindfulness. People high versus low in trait mindfulness tend to engage in more mindful thought, attention, and behavior on a daily basis (Goodman et al., 2015). Trait mindfulness has been measured with a variety of personality scales that tap different aspects of attention, thought, and behavior (e.g., “I find myself listening to someone with one ear, doing something else at the same time”; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Brown & Ryan, 2003).

Mindfulness has been specifically examined in relation to food consumption in multiple ways. Research indicates that mindfulness as a state or trait is related to healthier food choices (Jordan et al., 2014), reduced caloric intake (Beshara, Hutchinson, & Wilson, 2013; Timmerman & Brown, 2012), and a reduced susceptibility to hunger cues. For example, Marchiori and Papies (2014) found that a mindfulness manipulation did not reduce the portion size effect (i.e., consuming more calories when given a larger versus smaller portion of food), but self-reported hunger was not related to calories consumed in a mindfulness condition but it was in a non-mindfulness condition (hungry people consumed more calories; also see Papies, Pronk, Keesman, & Barsalou, 2015). When applied to eating behavior, mindfulness practices are centered on focusing attention to the present eating situation and enhancing

the sensations experienced by eating. Participants are encouraged to attend to different aspects of food such as its color, texture, smell, etc. Such experiences are meant to enhance the pleasure of eating as well as to decrease hunger sensations even when people consume small portions (Kristeller, 2015; Kristeller & Wolever, 2010; Timmerman & Brown, 2012). Mindful eating strategies also focus on food choices, but the goal is not to eliminate less healthy foods from one's diet, but to encourage moderate consumption. Such techniques may enhance the positive mood people receive from eating candy like chocolate and we therefore examined this idea in the current study.

## 1. The current study

The study by Macht and Dettmer (2006) appears to be the only published study that experimentally examined chocolate consumption and positive mood. In the current study, the effect of mindful chocolate consumption on mood was examined. Participants were randomly assigned to eat a small portion of chocolate or a control food (crackers) in a mindful or non-mindful way. Positive and negative mood were measured before and after consumption and a measure of food liking was also collected. It was hypothesized that participants assigned to a mindful chocolate consumption condition versus a non-mindful chocolate consumption or mindful and non-mindful cracker consumption conditions would experience enhanced positive mood. We believed one potential reason or mediator could be related to the liking of the chocolate. Negative mood or negative affect is typically at the lower end of a given measurement scale (e.g., 1.50 on a 5-point scale) unless it is induced via a manipulation. We therefore did not expect the manipulation to affect it given its low resting value (Watson, Clark, & Tellegen, 1988).

## 2. Method

### 2.1. Participants

Data was collected from 273 Gettysburg College participants, but analyses were performed on 258 participants (167 females; 90 males; 1 reported neither male nor female) with a mean age of 19.12 ( $SD = 2.31$ ) years. The majority of the sample was Caucasian (212 or 82%). Fifteen participants were removed from the sample for various reasons. Five participants had suspicions about the true purpose of the study in that they mentioned the study was about attention to eating and mood. Many participants thought the study was assessing an aspect of mood, which is reasonable considering the numerous mood items, but these five participants specifically mentioned a mindful-like component. Four participants were removed because they did not spend any time eating their food after the audio instructions were finished. Data from three participants were lost due to a computer crashing and the remaining three participants were removed because they did not eat all of their food or they ate prior to the study within the two-hour timeframe. The number of participants in each condition was as follows: Mindful/Chocolate  $N = 59$ , Mindful/Cracker  $N = 64$ , Non-Mindful/Chocolate  $N = 68$ , and Non-Mindful/Cracker  $N = 67$ .

### 2.2. Procedure and materials

The study was approved by the Gettysburg College IRB. Participants were randomly assigned to one of four conditions in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs. Crackers) design. Participants ate either 5 pieces of Blommers Appalachian Gold Milk Chocolate Discs (approximately 14 grams) or 5 Carr's Plain Table Water crackers

(approximately 17 grams). Participants were told that the study was being conducted to examine taste, perception, and personality processes. In each condition, the food eaten contained approximately 75 calories and the chocolate amount eaten was equivalent to approximately 1/3 of a standard sized chocolate bar. Participants were asked to listen to and follow a mindful or non-mindful 4.5-minute audio recording. In the mindful condition, participants were given various instructions to eat the food slowly, purposely, and mindfully. For example, they were told to hold a chocolate/cracker in their hand and gaze at the color and appearance and to think about the farmers who produced the ingredients needed to create the food. When putting the food in their mouth, they were told to focus on the sensations created by the food. These instructions were adapted from other state mindfulness manipulations (Hopthorn et al., in press; Kabat-Zinn, 1990; Weger et al., 2012). In the control condition, participants were told to eat one chocolate/cracker and then to wait for more instructions. The time before the second piece was eaten was kept constant across conditions. Therefore, participants in all conditions ate the remaining pieces about 4.5 min after the audio instructions began. The Appendix shows the entire transcripts of the audio instructions.

We used G Power (<http://www.ats.ucla.edu/stat/gpower/>) to help determine an appropriate sample size. In order to detect a medium effect size, we needed at least 128 participants to reach 80% power. We collected data across two semesters to achieve a sample size well above 128. Data was collected on weekdays between the hours of 2 p.m. and 6 p.m. Participants were recruited through an email to a college community digest and were paid \$15 for their participation or they were recruited through the psychology department's subject pool, which allows students to complete research studies or a research paper for credit in their Introduction to Psychology course. Participants were asked to refrain from eating or drinking anything besides water for at least two hours before the study. At the end of the study, a suspicion check was performed. Participants were asked to "tell us about your impression of the studies as well as what you think was the purpose of the studies."

Participants completed a number of questionnaires before and after food consumption. In order to comprehensively measure both positive and negative mood, participants completed four commonly used positive mood measures and two commonly used negative mood measures before and after food consumption:

### 2.2.1. One-item visual analog question

The first measure was a one-item mood question that used a visual analog response that had "sad" at the left end and "happy" at the right end. This type of question was used in past research on chocolate and mood that was discussed earlier (e.g., Macht & Dettmer, 2006). Participants were asked to choose a point on a line (using the mouse cursor) that indicated how they felt right now. The line measured 1000 pixels on the computer screen and therefore had a range of 0–1000 (before  $M = 612.09$ ;  $SD = 220.22$ ; after  $M = 687.94$ ;  $SD = 195.92$ ; test-retest reliability in this sample:  $r = 0.63$ ,  $p < 0.001$ ).

### 2.2.2. Positive affect and joviality

The second and third measures were the positive affect and joviality scales from the PANAS-X (Watson & Clark, 1994), a measure that is used frequently in research on mood. The positive affect scale has ten items (e.g., active & alert) and the joviality scale has eight items (e.g., happy & joyful) that are completed on a 1 (very slightly or not at all) to 5 (extremely) scale. Participants were asked to rate their feelings right now and the items for each scale were averaged to create before and after scores (positive affect - before  $\alpha = 0.87$ ;  $M = 3.03$ ;  $SD = 0.71$ ; after  $\alpha = 0.91$ ;  $M = 3.07$ ;  $SD = 0.80$ ;

test-retest reliability in this sample:  $r = 0.79$ ,  $p < 0.001$ ; joviality - before  $\alpha = 0.93$ ;  $M = 2.86$ ;  $SD = 0.89$ ; after  $\alpha = 0.91$ ;  $M = 3.08$ ;  $SD = 0.95$ ; test-retest reliability in this sample:  $r = 0.74$ ,  $p < 0.001$ ).

### 2.2.3. Satisfaction with life

The fourth measure was the five-item Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). This five-item scale (e.g., "In most ways my life is close to my ideal") assesses satisfaction with life in a retrospective manner and it is used frequently to assess happiness or subjective well-being. The instructions were modified so that participants responded to each item by focusing on how they felt in regards to each question *right now* using a 1 (strongly disagree) to 7 (strongly agree) scale. The items were averaged to create before and after scores (before  $\alpha = 0.84$ ;  $M = 4.67$ ;  $SD = 1.29$ ; after  $\alpha = 0.88$ ;  $M = 4.78$ ;  $SD = 1.32$ ; test-retest reliability in this sample:  $r = 0.89$ ,  $p < 0.001$ ).

### 2.2.4. Negative affect and sadness

The negative affect and sadness scales from the PANAS-X (Watson & Clark, 1994) were completed by participants. The negative affect scale has ten items (e.g., scared & hostile) and the sadness scale has five items (e.g., sad & blue) that are completed on a 1 (very slightly or not at all) to 5 (extremely) scale. Participants were asked to rate their feelings right now and the items for each scale were averaged to create before and after scores (negative affect - before  $\alpha = 0.82$ ;  $M = 1.57$ ;  $SD = 0.54$ ; after  $\alpha = 0.84$ ;  $M = 1.40$ ;  $SD = 0.49$ ; test-retest reliability in this sample:  $r = 0.83$ ,  $p < 0.001$ ; sadness - before  $\alpha = 0.87$ ;  $M = 1.73$ ;  $SD = 0.81$ ; after  $\alpha = 0.87$ ;  $M = 1.53$ ;  $SD = 0.70$ ; test-retest reliability in this sample:  $r = 0.81$ ,  $p < 0.001$ ).

After the second set of mood measures, participants completed the additional measures described below:

### 2.2.5. Toronto mindfulness scale

This state-mindfulness (Lau et al., 2006) scale has 13-items (e.g., "I approached each experience by trying to accept it, no matter whether it was pleasant or unpleasant") that are completed using a 1 (not at all) to 5 (very much) scale. Participants were asked to complete the scale in reference to their food consumption. This questionnaire was used to determine if participants in the mindfulness conditions reported eating their food more mindfully than participants in the non-mindful conditions (a manipulation check). The 13 items were averaged to create a state-mindfulness score ( $\alpha = 0.86$ ;  $M = 3.07$ ;  $SD = 0.70$ ).

### 2.2.6. Food liking

In order to assess liking of the food as a potential mediator, participants next completed a three-item measure of food liking that we created ("I liked the food I ate", "I experienced pleasure from eating the food", & "I experienced satisfaction from eating the food") using a 1 (strongly disagree) to 7 (strongly agree) scale. The three items were averaged to form a food-liking score ( $\alpha = 0.93$ ;  $M = 5.29$ ;  $SD = 1.49$ ). Finally, as a compliance check, participants were asked how long in hours it has been since they last ate or drank anything besides water ( $M = 3.64$ ;  $SD = 2.32$ ).

## 3. Results

Several between-subjects ANOVAs were run on the variables

<sup>1</sup> Participants also completed additional measures that were not part of the current hypotheses. These measures were pro-social feelings, the big five personality traits, frequency of candy consumption, perceived stress, the eating disorder inventory, trait mindfulness, weight, and height.

**Table 1**  
Means and standard deviations for hours since last eaten, state mindfulness, and food liking by study condition.

	Control/Chocolate	Control/Cracker	Mindful/Chocolate	Mindful/Cracker
Hours since last eaten	3.62 (2.54)	3.60 (1.71)	3.73 (3.00)	3.61 (1.96)
State mindfulness	2.99 (0.77)	2.90 (0.76)	3.17 (0.65)	3.24 (0.54)
Food liking	5.60 (1.48)	4.58 (1.46)	5.86 (1.47)	5.18 (1.26)

collected as shown below:

### 3.1. Hours since last eaten

The number of hour since participants' last eating occasion was assessed in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs. Crackers) ANOVA. No differences were found between conditions (no main effects or interactions),  $F_s < 1$  (see Table 1 for the means by condition).

### 3.2. State mindfulness

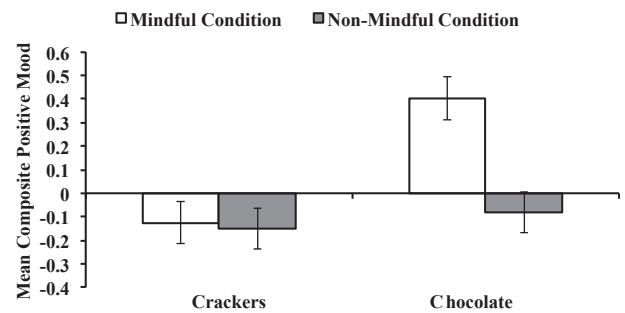
State mindfulness scores were analysed in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs. Crackers) ANOVA (see Table 1 for the means by condition). The main effect of Mindfulness condition was significant,  $F(1, 254) = 8.91, p = 0.003$ , partial eta squared = 0.03. Participants in the Mindful conditions reported experiencing more mindfulness while eating ( $M = 3.20; SD = 0.59$ ) than participants in the Non-mindful conditions ( $M = 2.95; SD = 0.76$ ). The main effect of Food condition and the interaction between Mindfulness condition and Food condition were not significant,  $F_s < 1$ . This result supports the validity of the mindfulness manipulation.

### 3.3. Food liking

Food liking was examined in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs. Crackers) ANOVA (see Table 1 for the means by condition). The main effect of Mindfulness condition was significant,  $F(1, 254) = 5.80, p = 0.017$ , partial eta squared = 0.02. Participants in the Mindful conditions liked their food more ( $M = 5.51; SD = 1.40$ ) than participants in the Non-mindful conditions ( $M = 5.10; SD = 1.55$ ). The main effect of Food condition was also significant,  $F(1, 254) = 22.73, p < 0.001$ , partial eta squared = 0.08. Participants in the Chocolate conditions liked their food more ( $M = 5.72; SD = 1.48$ ) than participants in the Cracker conditions ( $M = 4.88; SD = 1.39$ ). The interaction between Mindfulness condition and Food condition was not significant,  $F_s < 1$ .

### 3.4. Positive mood

The main hypotheses related to positive mood. Participants completed multiple positive mood measures before and after consumption. A difference score was created for each mood measure by subtracting the pre-food score from the post-food score. Positive scores mean that positive mood increased after food consumption compared to before food consumption and negative scores mean the reverse. Because the mood measures used different numeric scales, the difference scores were standardized (Z-scored) and a mean of the four scores (visual analog question, positive affect, joviality, and current satisfaction with life) served as a composite positive mood score ( $\alpha = 0.72; M = 0.00; SD = 0.74$ ). Composite positive mood was assessed in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs.



**Fig. 1.** Composite positive mood difference scores (post food score – pre food score) for the interaction between mindfulness condition and food condition (error bars represent the standard errors).

Crackers) ANOVA. The main effect of Mindfulness condition was significant,  $F(1, 254) = 8.42, p = 0.004$ , partial eta squared = 0.03, which revealed that participants in the Mindful conditions had a higher positive mood after food consumption compared to before food consumption ( $M = 0.13; SD = 0.83$ ) than participants in the Non-mindful conditions ( $M = -0.12; SD = 0.62$ ). The main effect of Food condition was also significant,  $F(1, 254) = 11.52, p = 0.001$ , partial eta squared = 0.04, which revealed that participants in the Chocolate conditions had a higher positive mood after food consumption compared to before food consumption ( $M = 0.14; SD = 0.74$ ) than participants in the Cracker conditions ( $M = -0.14; SD = 0.71$ ). Most importantly and supporting the hypothesis, the interaction between Mindfulness condition and Food condition was significant,  $F(1, 254) = 6.80, p = 0.01$ , partial eta squared = 0.03. As shown in Fig. 1, participants in the Mindful/Chocolate condition had a greater increase in positive mood compared to participants in the other conditions. Three planned contrasts confirmed that the Mindful/Chocolate group had a significantly higher composite positive mood score than the Mindful/Cracker group,  $F(1, 254) = 17.21, p < 0.001$ , the Non-mindful/Cracker group,  $F(1, 254) = 19.34, p < 0.001$ , and the Non-mindful/Chocolate group,  $F(1, 254) = 14.92, p < 0.001$ . The Mindful/Cracker group, the Non-mindful/Cracker group, and the Non-mindful/Chocolate group did not significantly differ from each other in terms of composite positive mood (all  $F_s < 1$ )<sup>2</sup>.

### 3.5. Negative mood

Participants completed two negative mood measures before and

<sup>2</sup> The four positive mood measures were averaged because they each tapped positive mood in a slightly different but related manner and they assessed aspects of subjective well-being. Two (Mindfulness condition: Mindful vs. Non-mindful) by two (Food condition: Chocolate vs. Crackers) ANOVAs were performed on the difference scores for each measure individually. In each case, the pattern of means were nearly identical to Fig. 1, and the interactions between Mindfulness condition and Food condition were significant for positive affect ( $p < 0.005$ ) and joviality ( $p < 0.012$ ) and marginally significant for satisfaction with life ( $p = 0.11$ ). This interaction was not significant for the visual analog scale ( $p = 0.50$ ) even though the means reflected the pattern observed in Fig. 1.

after the food consumption. A difference score was created for each mood measure by subtracting the pre-food measure from the post-food measure. Positive scores mean that negative mood increased after food consumption compared to before food consumption and negative scores mean the reverse. These differences scores (negative affect and sadness) were standardized (Z-scored) and averaged to create a composite negative mood score ( $\alpha = 0.62$ ;  $M = 0.00$ ;  $SD = 0.85$ ). Composite negative mood was examined in a 2 (Mindfulness condition: Mindful vs. Non-mindful) by 2 (Food condition: Chocolate vs. Crackers) ANOVA. The main effect of Mindfulness condition was significant,  $F(1, 254) = 4.08$ ,  $p = 0.044$ , partial eta squared = 0.02, which revealed that participants in the Mindful conditions had a lower negative mood score after food consumption compared to before food consumption ( $M = -0.11$ ;  $SD = 0.92$ ) than participants in the Non-mindful conditions ( $M = 0.10$ ;  $SD = 0.78$ ). The main effect of Food condition was not significant,  $F < 1$ . The interaction between Mindfulness condition and Food condition was not significant,  $F(1, 254) = 2.78$ ,  $p = 0.097$ , partial eta squared = 0.01. The means for the four conditions are shown Fig. 2.

### 3.6. Mediation analyses

Participants in the Mindful/Chocolate condition had a higher positive mood than participants in the other three conditions. One potential reason is because of food liking. It could be that participants who were instructed to eat the chocolate in a mindful manner liked it more and had a greater increase in positive mood as a result. In order to examine this idea, a mediation analysis was run to determine if food liking partially mediated the link between mindful chocolate eating and positive mood. Participants in the Mindful/Chocolate group were compared to everyone else given that composite positive mood was similar in the mindful/cracker, control/cracker, and control/chocolate conditions.

A mediation analysis was conducted using Hayes' (2013) PROCESS macro and its bootstrapping procedures (10,000 samples) for SPSS. Mindful chocolate eating (1) versus the other conditions (-1) was related to average food-liking scores (the proposed mediator),  $t = 3.38$ ,  $p < 0.001$ , Beta = 0.21, as well as composite positive mood (the outcome variable),  $t = 5.01$ ,  $p < 0.001$ , Beta = 0.30. Additionally, food liking was related to composite positive mood,  $t = 6.30$ ,  $p < 0.001$ , Beta = 0.37. To determine whether there was significant mediation, PROCESS computed a 95% bias-corrected confidence interval (BCCI) for the mediated or indirect pathway from Mindful/Chocolate versus other conditions to food liking to composite positive mood. The standardized indirect effect of this pathway was 0.06 (95% Confidence Interval: 0.03 to 0.11). Because the confidence interval excluded 0, it can be concluded that food

liking was a significant mediator between the Mindful/Chocolate condition versus the other conditions and composite positive mood.

## 4. Discussion

The current study appears to be the first to examine mindful chocolate consumption and its impact on mood. Participants who were instructed to eat chocolate mindfully had a greater increase in positive mood compared to participants who were instructed to eat chocolate non-mindfully or the same caloric amount of crackers either mindfully or non-mindfully. Further analyses revealed that food liking partially mediated this effect. In sum, it appears that chocolate consumption increases positive mood, but such effects are heightened when it is eaten mindfully.

### 4.1. Potential mechanisms

Food liking appeared to be a mediator between mindful chocolate consumption and positive mood. Such results are in line with mindful eating paradigms, which aim to affect the pleasure people experience from eating food in general (Kristeller, 2015; Timmerman & Brown, 2012). Yet, other potential mechanisms are possible. Although mindful eating paradigms focus on food in general (Kristeller, 2015; Timmerman & Brown, 2012), it was telling that mindful cracker consumption did not appear to have an impact on positive mood in the current study. Participants who ate crackers mindfully did not report higher positive moods than participants who ate crackers non-mindfully. Such results suggest that while mindful eating may impact other non-mood variables such as satiation and food choice, the positive mood impact of mindful food consumption might be most apparent with foods that are associated with pleasure or reward. Heppner, Spears, Irvin Vidrine, and Wetter (2015) contend that mindfulness training has been shown to increase the positive mood that results from engaging in pleasurable experiences. They contend that being in a mindful state could enhance responses to positive experiences (a broad savoring) in general with chocolate consumption being one example. It might be the case that other pleasurable foods unrelated to candy (e.g., potato chips, pizza, etc.) could significantly boost positive mood when eaten mindfully even if liking is unaffected.

### 4.2. Other potential moderators

A surprisingly small amount of experimental literature has examined chocolate (or other candy) consumption and its effect on positive mood (for a review, see Scholey & Owen, 2013). The results of the current study suggest that chocolate consumption does affect mood especially when considering situational mindfulness. We found that state mindfulness is one moderator, but future work should examine other potential moderators. For example, people who engage in more versus less mindful eating (e.g., Framson et al., 2009) might be impacted differently. It could be that people who engage in mindful eating on a routine basis are more impacted by chocolate consumption in terms of positive mood potentially because they would savor it more. Other potential moderators could include personality variables that bring out differences in attention to rewards (e.g., neuroticism or extraversion).

### 4.3. Implications for candy consumption

It is noteworthy that the portion size consumed in the current

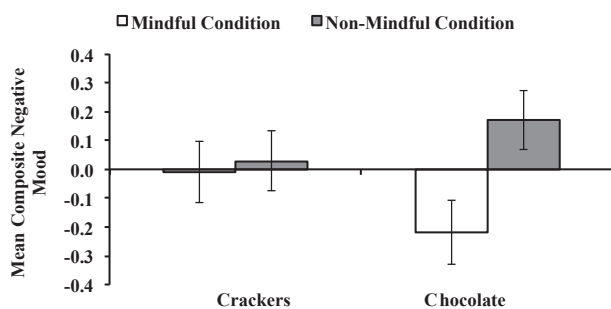


Fig. 2. Composite negative mood difference scores (post food score – pre food score) for the interaction between mindfulness condition and food condition (error bars represent the standard errors).

study was small. The 14 grams of chocolate participants consumed contained only 75 calories and was equivalent to approximately 1/3 of a standard sized chocolate bar. Yet, this amount resulted in an increased positive mood when participants were instructed to eat it mindfully. Although speculative, such results may suggest that the positive effect of eating chocolate in terms of mood may occur with small portions when eaten mindfully. It could be the case that eating 150 calories of chocolate does not enhance mood any more than eating 75 calories of chocolate. This possibility is particularly intriguing given the frequent recommendations to reduce consumption of added sugars. A mindful eating program (MB-EAT) for binge eating disorder (Kristeller, 2015; Kristeller & Wolever, 2010) offers some guidance with this idea. One focus of this program is to encourage people to better regulate consumption amounts by encouraging people to more strongly focus on satiety and emotional states, which may cause people to eat less without affecting mood. Future work will be needed to examine this portion size prediction in terms of chocolate and mood. Given the frequency of obesity in the U.S. and elsewhere (Flegal, Carroll, Ogden, & Curtin, 2010; World Health Organization, 2016), mindful eating could be a useful intervention.

#### 4.4. Limitations

The current project has at least a couple of limitations. One, the project involves one study and given the current focus on replication, one-study projects should be considered tentatively. Yet, we note that our project involved a more than adequate sample size to reach 80% statistical power and therefore such concerns are tempered. Two, our control condition did not involve an

attention-grabbing task and therefore it could be the case that paying attention to anything while eating chocolate could enhance positive mood regardless of whether mindfulness is in play. Although this limitation is a possibility, we note that several studies have used a variety of control conditions when manipulating mindfulness in a laboratory setting and have found the predicted effects when using control conditions with (Hopthrow et al., in press; Ostafin & Kassman, 2012; Mahmood et al., 2016) or without (Hopthrow et al., in press; Weger et al., 2012) an attention-grabbing task. Future work should include attention-grabbing control conditions to overcome this potential limitation.

#### 5. Conclusion

The current study revealed that the consumption of chocolate (vs. crackers) enhanced positive mood, but particularly when it was eaten mindfully. This finding suggests that mindfulness may enhance pre-existing rewarding experiences such as chocolate consumption. Future work should examine additional mechanisms, moderators, and the implications of this effect in relation to the consumption amounts of candy. It could be that a small versus large portion of candy might similarly increase positive mood when both are eaten in a mindful manner.

#### Note

The authors thank the National Confectioners Association for supporting this research.

#### Appendix. Transcript of audio recordings

Mindful conditions (participants received the chocolate or cracker audio).

Time	Instructions
0:00	First, take a chocolate/cracker and hold it in the palm of your hand. Focusing on it, imagine that you have never seen an object like this before in your life.
0:23	Take time to really see it, gaze at the chocolate/cracker with care and full attention. Let your eyes explore every part of it, examining the highlights where the light shines, the darker hollows, and any asymmetries or unique features.
1:03	Turn the chocolate/cracker over between your fingers, exploring its texture. Maybe even with your eyes closed, if that enhances your sense of touch. As you do this, think about the farmers who helped grow the ingredients for the chocolate/cracker. Think about the workers who created the chocolate/cracker, and the people who deliver this chocolate/cracker to different locations around the world.
1:40	Now, holding the chocolate/cracker beneath your nose, with each breath, drink in any smell, aroma, or fragrance that may arise, noticing as you do this, anything interesting that may be happening in your mouth or stomach.
2:00	Slowly bring the chocolate/cracker to your lips, noticing how your hand and arm know exactly how and where to position it. Gently place the chocolate/cracker in your mouth, without chewing. Spend a few moments exploring the sensation of having it in your mouth, exploring it with your tongue.
2:43	When you are ready, prepare to chew the chocolate/cracker, noticing how and where it needs to be for chewing. Then, very consciously, take one or two bites into it, and notice what happens in the aftermath. Experience any waves of taste and flavor that form as you continue chewing. Saver the experience.
3:15	Without swallowing yet, notice the bare sensations of flavor and texture in the mouth, and how these may change over time, moment by moment, as well as any changes in the chocolate itself.
3:36	When you feel ready to swallow the chocolate/cracker, see if you can first detect the intention to swallow so that even this is experienced consciously. Finally, see if you can feel what is left of the chocolate moving down into your stomach and sense how the body as a whole is feeling.
4:18	Please eat the remaining chocolates/crackers using this same practice for each one. Slow down and focus on what it looks like, what it feels like on your lips, what it feels like rolling around in your mouth, what it tastes like when you take small bites of it, what it tastes and feels like chewing it slowly and thoroughly and finally swallowing it. When you finish eating all of the chocolates/crackers in this manner, press the spacebar.

Control conditions (participants received the chocolate or cracker audio).

Time	Instructions
0:00	Please take one chocolate/cracker, and eat it. After you have eaten the chocolate/cracker, wait a few minutes for more instructions before continuing.
4:35	Now, eat the remaining chocolates/crackers. When you finish eating all of the chocolates/crackers, press the spacebar.

## References

- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*, 27–45.
- Beshara, M., Hutchinson, A. D., & Wilson, C. (2013). Does mindfulness matter? Everyday mindfulness, mindful eating and self-reported serving size of energy dense foods among a sample of South Australian adults. *Appetite*, *67*, 25–29.
- Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological wellbeing. *Journal of Personality and Social Psychology*, *84*, 822–848.
- Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*, 211–237.
- Canetti, L., Bachar, E., & Berry, E. M. (2002). Food and emotion. *Behavioural Processes*, *60*, 157–160.
- Christensen, L. (1993). Effects of eating behavior on mood: A review of the literature. *International Journal of Eating Disorders*, *14*, 171–183.
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*, 71–75.
- Duyff, R. L., Birch, L. L., Byrd-Bredbenner, C., Johnson, S. L., Mattes, R. D., & Murphy, M. M. (2010). Candy consumption patterns, effects on health, and behavioral strategies to promote moderation: Summary of a roundtable discussion. *Advances in Nutrition*, *6*, 139s–146s.
- Flegal, K. M., Carroll, M. D., Ogden, C. L., & Curtin, L. R. (2010). Prevalence and trends in obesity among U.S. adults, 1999–2008. *Journal of the American Medical Association*, *303*, 235–241.
- Forbes. (2015). *The world's biggest chocolate consumers*. Retrieved from <http://www.forbes.com/sites/niallmccarthy/2015/07/22/the-worlds-biggest-chocolate-consumers-infographic/#48a2178e12b8>.
- Framson, C., Kristal, A. R., Schenk, J., Littman, A. J., Zeliadt, S., & Benitez, D. (2009). Development and validation of the mindful eating questionnaire. *Journal of the American Dietetic Association*, *109*, 1439–1444.
- Gardner, M. P., Wansink, B., Kim, J., & Park, S. (2014). Better moods for better eating?: How mood influences food choice. *Journal of Consumer Psychology*, *24*, 320–335.
- Goodman, R. J., Quaglia, J. T., & Brown, K. W. (2015). Burning issues in dispositional mindfulness research. In B. D. Ostafin, M. D. Robinson, & B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 67–80). New York: Springer.
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: Guilford Press.
- Heppner, W. L., Kernis, M. H., Lakey, C. E., Campbell, W. K., Goldman, B. M., Davis, P. J., et al. (2008). Mindfulness as a means of reducing aggressive behaviour: Dispositional and situational evidence. *Aggressive Behavior*, *34*, 486–496.
- Heppner, W. L., Spears, C. A., Irvin Vidrine, J., & Wetter, D. W. (2015). Mindfulness and emotion regulation. In B. D. Ostafin, M. D. Robinson, & B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 107–120). New York: Springer.
- Hölzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., et al. (2011). Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Research: Neuroimaging*, *191*, 36–43.
- Hopthrow, T., Hooper, N., Mahmood, L., Meier, B. P., & Weger, U. W., (in press). Mindfulness reduces the correspondence bias. *Quarterly Journal of Experimental Psychology*.
- Hornick, B., Duyff, R. L., Murphy, M. M., & Shumow, L. (2014). Proposing a definition of candy in moderation for health and well-being. *Food and Nutrition*, *49*, 87–94.
- Jordan, C. H., Wang, W., Donatoni, L., & Meier, B. P. (2014). Mindful eating: Trait and state mindfulness predict healthier eating behavior. *Personality and Individual Differences*, *68*, 107–111.
- Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. New York: Dell Publishing.
- Kristeller, J. L. (2015). Mindfulness, eating disorders, and food intake regulation. In B. D. Ostafin, M. D. Robinson, & B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 199–215). New York: Springer.
- Kristeller, J. L., & Wolever, R. Q. (2010). Mindfulness-based eating awareness training for treating binge eating disorder: The conceptual foundation. *Eating Disorders*, *19*, 49–61.
- Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., et al. (2006). The Toronto mindfulness scale: Development and validation. *Journal of Clinical Psychology*, *62*, 1445–1467.
- Macht, M. (2008). How emotions affect eating: A five-way model. *Appetite*, *50*, 1–11.
- Macht, M., & Dettmer, D. (2006). Everyday mood and emotions after eating a chocolate bar or an apple. *Appetite*, *46*, 332–336.
- Macht, M., & Mueller, J. (2007). Immediate effects of chocolate on experimentally induced mood states. *Appetite*, *49*, 667–674.
- Mahmood, L., Hopthrow, T., & Randsley de Moura, G. (2016). A moment of mindfulness: Computer-mediated mindfulness practice increases state mindfulness. *PLoS ONE*, *11*, e0153923. <http://dx.doi.org/10.1371/journal.pone.0153923>.
- Marchiori, D., & Papies, E. K. (2014). A brief mindfulness intervention reduces unhealthy eating when hungry, but not the portion size effect. *Appetite*, *75*, 40–45.
- Molinari, E., & Callus, E. (2012). Psychological drivers of chocolate consumption. In A. Conti, R. Paoletti, A. Poli, & F. Visioli (Eds.), *Chocolate and health* (pp. 137–153). Milan: Springer.
- Ostafin, B. D., & Kassman, K. T. (2012). Stepping out of history: Mindfulness improves insight problem solving. *Consciousness and Cognition*, *21*, 1031–1036.
- O'Neil, C. E., Fulgoni, V. L., & Kicklas, T. A. (2011). Candy consumption was not associated with body weight measures, risk factors for cardiovascular disease, or metabolic syndrome in US adults: NHANES 1999–2004. *Nutrition Research*, *31*, 122–130.
- Papies, E. K., Pronk, T. M., Keesman, M., & Barsalou, L. W. (2015). The benefits of simply observing: Mindful attention modulates the link between motivation and behavior. *Journal of Personality and Social Psychology*, *108*, 148–170.
- Parker, G., Parker, I., & Brotchie, H. (2006). Mood state effects of chocolate. *Journal of Affective Disorders*, *92*, 149–159.
- Pelchat, M. L. (1997). Food cravings in young and elderly adults. *Appetite*, *28*, 103.
- Scholey, A., & Owen, L. (2013). Effects of chocolate on cognitive function and mood: A systematic review. *Nutrition Reviews*, *71*, 665–681.
- Timmerman, G. M., & Brown, A. (2012). The effect of a mindful restaurant eating intervention on weight management in women. *Journal of Nutrition Education and Behavior*, *44*, 22–28.
- Watson, D., Clark, L. A., & Tellegen, A. (1988). *Journal of Personality and Social Psychology*, *54*, 1063–1070.
- Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the positive and negative affect schedule-expanded form*. Ames: The University of Iowa.
- Weger, U. W., Hooper, N., Meier, B. P., & Hopthrow, T. (2012). Mindful maths: Reducing the impact of stereotype threat through a mindfulness exercise. *Consciousness and Cognition*, *21*, 471–475.
- Weingarten, H. P., & Elston, D. (1991). Food cravings in a college population. *Appetite*, *17*, 167–175.
- Weisenberg, M., Gerby, Y., & Mikulincer, M. (1993). Aerobic exercise and chocolate as means for reducing learned helplessness. *Cognitive Therapy and Research*, *17*, 579–592.
- World Health Organization. (2016). *Data and statistics. The challenge of obesity - Quick statistics*. Retrieved from <http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity/data-and-statistics>.