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The discrepancy between implicit and explicit attitudes in predicting disinhibited eating

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ABSTRACT

Disinhibited eating (i.e., the tendency to overeat, despite intentions not to do so, in the presence of palatable foods or other cues such as emotional stress) is strongly linked with obesity and appears to be associated with both implicit (automatic) and explicit (deliberative) food attitudes. Prior research suggests that a large discrepancy between implicit and explicit food attitudes may contribute to greater levels of disinhibited eating; however this theory has not been directly tested. The current study examined whether the discrepancy between implicit and explicit attitudes towards chocolate could predict both lab-based and self-reported disinhibited eating of chocolate. Results revealed that, whereas neither implicit nor explicit attitudes alone predicted disinhibited eating, absolute attitude discrepancy positively predicted chocolate consumption. Impulsivity moderated this effect, such that discrepancy was less predictive of disinhibited eating for those who exhibited lower levels of impulsivity. The results align with the meta-cognitive model to indicate that attitude discrepancy may be involved in overeating.

1. Introduction

Obesity has reached epidemic proportions in the United States, with 68% of the population now identified as overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). Becoming overweight or obese can lead to serious health concerns such as diabetes, heart disease, and stroke (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011). A growing line of research has determined that disinhibited eating is associated with long-term weight gain (Lowe, 1995; Moens & Braet, 2007; Stunkard & Messick, 1985). Disinhibited eating occurs when an individual is unable to control intake and overeats in response to internal (e.g., emotional stressors) or external (e.g., presence of palatable foods) cues despite his or her intentions not to do so (Keller, 2008).

1.1. Implicit and explicit attitudes

Prior research has indicated that attitudes about food, such as whether a certain food is viewed positively or negatively, can also strongly influence eating behavior, including disinhibited eating (Hofmann & Friese, 2008; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Hofmann, Rauch, & Gawronski, 2007). Attitudes can be grouped into two broad categories based on how each forms through different systems of reasoning: implicit attitudes and explicit attitudes (Gawronski & Strack, 2004; Olson & Fazio, 2006; Rydell & McConnell, 2006). Implicit attitudes tend to be automatic in nature, such that individuals are often not consciously aware of them and are hypothesized to form due to associative reasoning (Gawronski & Bodenhausen, 2007; Rydell & McConnell, 2006). Explicit attitudes are more deliberative in nature and are typically within conscious awareness; they are believed to form through logical processes (Gawronski & Bodenhausen, 2007; Rydell & McConnell, 2006). This grouping of attitudes is a hallmark of the dual-process model.

The dual-process model holds that both implicit and explicit attitudes regarding a target are evaluative (e.g., positive and/or negative), but are not necessarily concordant with one another (Petty, Brinol, & DeMarree, 2007). For example, someone could have a positive implicit attitude towards chocolate (driven by associations to its immediate hedonic properties) while simultaneously reporting, through *explicit* attitudes, a lesser liking towards chocolate (driven by associations to its unhealthy attributes). The meta-cognitive model extends the dual-process model by positing that individuals will have both negative and positive implicit and explicit attitudes towards one object, and they can tag each evaluative attitude as either true or false (Petty et al., 2007). When there is an inconsistency in these evaluative attitudes, and one judges both attitudes as true, the meta-cognitive model predicts that discrepancy will produce enhanced attention and information processing towards the attitudinal target (Brinol, Petty, & Wheeler,

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2006). Existing research on attitude discrepancy suggests that this affects decision-making more broadly (Petty et al., 2007). However, limited research comparing implicit and explicit attitudes has been conducted in the realm of eating behavior.

1.2. Attitude discrepancy and disinhibited eating

Friese, Hofmann, and Wanke (2008) have performed a series of studies revealing that implicit and explicit attitudes towards food often differ and that, under varying circumstances, one type of attitude tends to be more predictive of eating behavior than the other. Studies show that when individuals have high cognitive capacity, meaning when there is no distraction or other stimuli to attend to, explicit attitudes are more predictive of food choice (Friese et al., 2008). Conversely, when individuals have low cognitive capacity, implicit attitudes will predict food choice (Friese et al., 2008). Implicit attitudes also predict food choice when individuals are emotional (e.g., after watching an upsetting film) or when there is low inhibitory control (e.g., self-control resources have been depleted, high levels of impulsivity; Friese et al., 2008). Whereas prior research has identified the conditions under which implicit and explicit attitudes predict disinhibited eating, it did not examine whether the discrepancy between implicit and explicit attitudes predicts such behavior.

Given that disinhibited eating involves a discrepancy between intent and behavior, it is possible that attitude discrepancies towards food drive disinhibited eating. The meta-cognitive model would suggest that such an attitude discrepancy would lead to enhanced attention to the food object, making it more likely that one will overeat even when globally attempting to restrain from eating a particular food (Coelho, Polivy, Herman, & Pliner, 2009; Federoff, Polivy, & Herman, 2003).

1.3. Impulsivity as potential moderator

If attitude discrepancy predicts disinhibited eating, it would be helpful to determine what other factors might impact this relationship. One variable that might moderate the relationship between attitude discrepancy and disinhibited eating is impulsivity (Hofmann & Friese, 2008; Hofmann et al., 2007; Lattimore, Fisher, & Malinowski, 2011). Previous research has shown that individuals who are more impulsive are more likely to act on automatic attitudes, and specifically that impulsivity heightens the effects of implicit food attitudes on overeating (Hofmann & Friese, 2008; Hofmann et al., 2007; Yeomans, Leitch, & Mobini, 2008). Attitude *discrepancy* is also theorized to influence behavior through automatic cognitive processes and can cause enhanced attention towards an attitude object (Brinol et al., 2006; Petty et al., 2007). This increased attention likely enhances temptation to eat, which will pose a greater inhibitory challenge. Thus, we hypothesize that those with higher levels of impulsivity will be more affected by attitude discrepancy.

1.4. Current study

Whereas previous studies have investigated the role of implicit and explicit attitudes in overeating (e.g., Czyzewska & Graham, 2008; Friese et al., 2008; Hoefling & Strack, 2008; Stroebe, Henk, Schut, & Kruglanski, 2007), no study to date has directly investigated the role of attitude discrepancy in disinhibited eating. In the current study we measured disinhibited eating of chocolate by means of both self-report and a behavioral measure of consumption. The primary aim of the current study was to determine if attitude discrepancy would predict disinhibited eating. We additionally hypothesized that both implicit and explicit attitudes would each be related to consumption, based on prior work documenting their ability to predict eating behavior in a variety of situations (Craeynest et al., 2005; Czyzewska & Graham, 2008; Friese et al., 2008; Roefs & Jansen, 2002). A secondary aim was to examine the effects of a potential moderator, impulsivity. Based on previous literature, we expect impulsivity, as measured by a laboratory task, to moderate the relationship between implicit attitudes and disinhibited eating. However, we hypothesized that the moderation effect of impulsivity on attitude discrepancy would predict disinhibited eating over and above any other effects, such that attitude discrepancy would more predictive of disinhibited eating among those who are more impulsive.

2. Material and methods

2.1. Participants

Participants were 95 healthy weight or overweight (mean body mass index = 23.55 kg/m^2, range = 17.59–38.22 kg/m^2, *SD* = 3.88 kg/m^2), female undergraduate students enrolled in psychology courses from a private university in Philadelphia, Pennsylvania. College women were selected due their known tendency towards higher restraint levels, which was borne out in the current sample (Eating Inventory restraint subscale mean = 53.95, *SD* = 19.17). Participants were between the ages of 18 and 31 years (M_{age} = 19.87, *SD* = 2.16), and the samples were 67.4% Caucasian (n = 64), 26.3% Asian (n = 25), 3.2% African American (n = 3), 2.1% Latino (n = 2), and 5.3% other ethnicity (n = 5). Recruitment was conducted from August 2011 through December 2011 through fliers as well as in-class announcements. The study was also posted on a secure online database that distributes extra credit in psychology courses in exchange for research participation.

Eligibility requirements for the study were consuming chocolate at least once a month and being a female student. Exclusion criteria were chocolate-related allergies, diabetes, pregnancy, and a history of and/or current eating disorder. Upon completion of the study, participants received extra credit in a psychology course.

2.2. Measures

2.2.1. Implicit attitudes about chocolate

Implicit attitudes were measured by performance on an Implicit Associations Test (IAT; Greenwald, McGhee, & Schwartz, 1998). IATs require participants to respond quickly to images presented on a computer screen so that the association between two ideas may be assessed. Due to the nature of the assessment (that participants must respond quickly), there is no time for complex deliberation. The test is therefore thought to tap uncensored, immediate associations between ideas. The measure yielded from IATs is a *D* score. The *D* score is based on the notion that participants take longer to respond to associations inconsistent with beliefs (e.g., pairing "negative" pictures with chocolate, on the assumption that chocolate is a positively valenced stimulus) and shorter to respond to associations consistent with beliefs (e.g., pairing "positive" pictures with chocolate). Thus, a *D* score is the ratio between mean reaction times (reaction times consistent with beliefs subtracted from reaction times inconsistent with beliefs) and pooled standard deviations. A positive *D* score implies that one has a positive implicit attitude towards chocolate, and a negative *D* score implies that one has a negative implicit attitude towards chocolate. In the current study, we used the single-category IAT (Karpinski & Steinman, 2006). Previous research using the IAT has demonstrated that the test can effectively measure implicit attitudes in various settings (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Greenwald et al., 1998). Variations of this measure have also been used successfully in weight attitude research and implicit food preference research, which suggest that it may also be a useful tool to measure implicit relations towards food (Craeynest et al., 2005; McKenna, 2010).

During the instruction phase of the IAT, participants were told that their task was to use the computer keyboard to sort images, which appeared in the center of the screen, into one of three categories: "good," "bad," and "chocolate". Participants were told that the words

"good" and "bad" would be presented on opposite (left versus right) corners of the screen. They were also told that "chocolate" would also be presented on either the left or right, and would switch depending on the block ("chocolate" was presented on the left for half of the trials and on the right for the remaining half). It was explained that the participants' task would be to press the "e" key (on the left) if the image matched a category on the left side of the screen, and the "i" key (on the right) if the image matched a category on the right side of the screen. They were also instructed to react quickly and accurately as the assessment would not record responses that were too slow. In each of the five trials, stimuli that were either "good" (i.e., babies, puppies, kittens, and flowers), "bad" (i.e., snakes, spiders, insects) or "chocolate" (images of pure chocolate and various chocolate food items) were presented in the center of the screen for 2000 ms, preceded by an inter-stimulus white box for 500 ms.

The IAT created for this study primarily measured response latency (i.e., the amount of time from the presentation of the stimulus until a response was selected), and was administered using E-Prime™ software (Psychology Software Tools, Inc., Pittsburgh, PA; Schneider, Eschman, & Zuccolotto, 2002). The assessment recorded response time as well as the difference in time between trials that were consistent with positive or negative attitudes (i.e., chocolate and "good" categories using the same key, pairing "good" with chocolate) and trials that were inconsistent with positive or negative attitudes (i.e., chocolate and "bad" categories using the same key, pairing "bad" with chocolate). The task began with 20 practice trials, and then proceeded with 4 blocks of 60 trials each; thus the task consisted of 5 blocks total. Participants were randomly allocated to four distinct presentation orders, thereby ensuring that there would be no between- or within-participants order effects. IAT scores were calculated according the procedure outlined by Greenwald, Nosek, and Banaji (2003).

One participant was dropped from analyses because more than 10% of her IAT trials were under 300 ms, the accepted threshold for data validity (Greenwald et al., 2003). Prior to the main study analyses, IAT scores were examined by order of blocks, and found to differ, $F(3,91) = 3.87$, $p = .01$. Specifically, IAT scores were lowest when trials consistent with beliefs (i.e., chocolate is good) were presented first and when pairing was on the right side. Thus, all subsequent analyses controlled for IAT presentation order.

2.2.2. Explicit attitudes about chocolate

Explicit attitudes were measured using a Visual Analogue Scale of food images. This measure has been used successfully in attitude research (e.g., Stockwell, Walkder, & Eshleman, 2010). The survey consisted of the same seven chocolate images used in the IAT. For each picture, participants rated, on a scale of 0 to 100, how much they liked eating that item (i.e., the level of enjoyment they would receive from eating it). The participants were told to view the images as long as it took to provide an accurate rating. Ratings were recorded and averaged so that each participant had an average explicit attitude towards chocolate score.

2.2.3. Attitude discrepancy

Attitude discrepancy was calculated using the same scoring procedure utilized by a number of previous studies of discrepancy (e.g., Brinol et al., 2006; Petty et al., 2007). An index of implicit–explicit discrepancy was formed as the absolute value of the difference between calculated z-scores (computed using the total sample mean and standard deviation) of implicit and explicit attitudes towards chocolate. When examining attitude discrepancy, it was found that a total of 49 participants had positive discrepancies (i.e., standardized implicit scores were larger than explicit) and 44 participants had negative discrepancies (i.e., standardized explicit scores were larger than implicit). A common criticism of absolute differences scores is that they cannot be properly interpreted due to their "directionless" nature (Edwards, 1994). To address this criticism, the direction of the discrepancy (e.g., positive or negative) was used as a covariate in our analyses (Edwards, 1991, 1994).

2.2.4. Disinhibited eating

2.2.4.1. Self-report. The Disinhibition Scale (Overduin & Jansen, 1996) was used to assess self-reported disinhibited eating. The Disinhibition Scale requires participants to rate how often particular statements apply to them (e.g., When I am dieting, I can't control myself and start eating 'forbidden foods'). This measure was used successfully in past research to measure the effects on implicit and explicit attitudes towards food (Czyzewska & Graham, 2008). The Disinhibition Scale has been shown to be psychometrically sound (Overduin & Jansen, 1996).

2.2.4.2. Behavioral assessment. As a behavioral measure of disinhibited eating, participants were asked to complete a mock taste test of chocolate chips. According to several studies, chocolate is a highly craved food, especially in the college population (Hill & Weaver, 1991; Rodin, Mancuso, Granger, & Nelbach, 1991; Rozin, Levine, & Stoess, 1991; Weingarten & Elston, 1991). To ensure similar hunger levels, participants were asked not to eat 2 h before the assessment, but to have a meal before the 2-hour restriction period. Participants were given four separate bowls of assorted chocolate chips (dark chocolate, milk chocolate, white chocolate, and butterscotch chocolate) and a taste rating form that inquired about overall appeal, taste, and smell. Participants were instructed to "Please taste the following foods and fill out the survey in front of you. I'd like you to taste each item at least once so that you can make an accurate rating on your survey. However, I am going to leave you alone for a little while to do this so please take your time and consider your ratings very carefully as you make them. Please don't use your cell phone or do anything else during this time. Feel free to eat as much as you want in order to make your ratings, remember we have to throw this food away after your leave." The researcher then left the participants alone for 15 min. Once the form was collected and the testing session had ended, the researcher weighed each bowl to assess how much the participant ate. The taste rating forms were used to assess participant affinity for the chocolate being tasted. Participants were asked, "How often do you feel guilty/disappointed when consuming chocolate?" A majority (56.8%) of participants reported feeling guilt after eating chocolate. This coupled with the moderate–high restraint scores of our sample allows us to infer that eating that occurred during the mock taste test was disinhibited. This method has been successfully used in similar studies involving disinhibited eating (Jansen et al., 2008).

2.2.5. Restrained eating

The cognitive restraint subscale of the Eating Inventory (EI; formerly, Three-Factor Eating Questionnaire; Karlsson, Persson, Sjostom, & Sullivan, 2000) was used to measure restrained eating. High scores indicate susceptibility towards restrictive food intake. The EI requires participants to rate how well a particular statement applies to them (e.g., I don't eat some foods because they make me fat). The EI has shown good internal consistency ($\alpha = 0.83$; Karlsson et al., 2000). Furthermore, the cognitive restraint subscale has strong discriminant validity with low correlations ($r < 0.30$) with the other EI scales (Karlsson et al., 2000).

2.2.6. Impulsivity

Impulsivity was measured using an adapted version of the Go/No Go Association Task (GNAT; Nosek & Banaji, 2001) in which pictures of chocolate items and pictures of neutral household stimuli were administered via E-Prime™. Chocolate stimuli were chosen to make the procedure as relevant to actual food consumption as possible. The task required participants to monitor a series of stimuli presented in the center of a computer screen and respond as quickly and accurately as possible by pressing the space bar to neutral household stimuli (go cues),

Table 1
Study means and standard deviation.

	M	*SD*
Eating Inventory—restraint subscale	53.95	19.62
Attitude discrepancy score	1.21	0.87
GNAT—impulsivity score	7.51	4.19
IAT—implicit attitudes	0.25	0.31
VAS—explicit attitudes	69.39	19.38
Mock Taste Test—chocolate consumed (g)	31.67	19.17
DIS—self-reported disinhibited eating	21.73	7.87

while withholding responses to chocolate stimuli (no-go cues). The images were presented one after another for 500 ms with an inter-stimulus plus sign that persisted anywhere from 1042 ms to 2418 ms, at random. The GNAT consisted of one practice block consisting of 28 trials, of which 7 were no go cues and 21 were go cues. There was one test block consisting of 196 trials, of which 49 (25%) were go cues and 147 (75%) were no-go cues. For the purposes of this study, impulsivity towards chocolate stimuli was measured by commission errors (i.e., an error in which a participant responded when required not to respond).

2.2.7. Body mass index

Participants were weighed in light clothing using a medical-grade scale that measures body weight to the nearest tenth of a pound. Height was measured to the nearest tenth of an inch. Body mass index (BMI, kg/m^2) was calculated for each participant.

2.3. Procedure

Prior to testing, participants were randomized to an IAT presentation order. Participants completed the IAT first followed by the explicit measure of chocolate images. Then, depending on randomization, participants completed a mock taste test followed by a questionnaire packet with impulsivity task or vice versa. All assessment procedures took place in a small testing room. Before leaving, participants were debriefed as to the true intent of the mock taste test. Extra credit points in a psychology course were awarded for participation in the study.

3. Results

3.1. Descriptive statistics of the sample

Twenty-seven percent of participants reported that they consumed chocolate two-three times per week, and another 17% reported daily consumption. On a scale of 1 (never guilty) to 5 (always guilty), participants reported an average of 2.55 ($SD = 0.79$) level of guilt when consuming chocolate. Thus, participants typically felt somewhat guilty upon consumption. On the mock taste test, participants consumed on average 31.67 g of chocolate ($SD = 19.17$).

Participants scored a mean of 0.25 ($SD = 0.30$) on the IAT, indicating that, on average, participants possessed positive implicit attitudes about chocolate. On the explicit measure participants reported a high explicit affinity for chocolate, scoring an average of 69.39 ($SD = 19.38$) on a scale of 1 to 100. The mean discrepancy score calculation (absolute value) was 1.21 ($SD = 0.87$). See Table 1 for descriptive statistics and Table 2 for correlations of key study variables.

3.2. Implicit and explicit attitudes predicting disinhibited eating

A bivariate correlation revealed that implicit attitudes about chocolate were not associated with behavioral disinhibition, $r = -.08$, $p = .50$, or with self-reported disinhibition, $r = -.003$ $p = .81$. There was likewise no relationship between explicit attitudes about chocolate and disinhibited eating (behavioral disinhibition, $r = -.06$, $p = .65$; self-reported, $r = -.02$, $p = .89$).

3.3. Attitude discrepancy predicting disinhibited eating

Hierarchical linear regressions were used to investigate the relationship between attitude discrepancies (given in absolute terms) and disinhibited eating (both self-report and behavioral measures). Regressions controlled for direction of discrepancy (measured dichotomously as positive or negative), BMI, and the effects of implicit and explicit attitudes. Consistent with hypotheses, attitude discrepancy significantly and positively predicted behaviorally-measured disinhibited eating over and above the effects of implicit and explicit attitudes ($\beta = 0.44$, $F(3,67) = 3.17$, $p < .01$). However, the relationship with self-reported disinhibited eating was small and not statistically significant ($\beta = 0.13$, $F(3,68) = 0.45$, $p = .34$).

3.4. Moderation analyses

Impulsivity and its interactions with main independent variables (i.e., implicit attitudes, explicit attitudes, and attitude discrepancy) were added to the regressions. There was no statistically significant moderation effect of impulsivity on implicit attitudes. There was a significant moderation effect of impulsivity and explicit attitudes on self-reported disinhibited eating ($\beta = 0.37$, $F(9,68) = 1.98$, $p = .007$). Evidence for a moderation effect of impulsivity, over and above all other effects, was obtained for the relationship between attitude discrepancy and self-reported disinhibition ($\beta = 0.42$, $F(9,68) = 1.98$, $p = .002$), and for objectively-measured behavioral disinhibition ($\beta = 0.28$, $F(9, 67) = 2.30$, $p = .03$; see Figs. 1 and 2). A strong, positive association was observed between attitude discrepancy and disinhibited eating, but only for those exhibited greater levels of impulsivity.

Post hoc analyses were used to test the relationship between attitude discrepancy and disinhibited eating among high and low impulsives (utilizing a median split; $Mdn = 7$). Results confirmed the moderation effect, showing non-significant results for those with lower impulsivity. For those with higher impulsivity, attitude discrepancy was a significant predictor of behavioral disinhibited eating ($\beta = 0.52$, $F(5, 37) = 2.84$, $p = .001$), however not for self-reported disinhibited eating.

4. Discussion

This study represents the first investigation of the extent to which implicit–explicit attitude discrepancy is associated with disinhibited eating. Results support our hypotheses that the discrepancy between

Table 2
Study correlation matrix.

	Restraint	Self-reported DIS	Chocolate consumed	Impulsivity	Implicit attitudes	Explicit attitudes	Attitude discrepancy
Restraint	–	−0.43**	−0.20	−0.04	0.16	−0.01	0.01
Self-reported DIS	–	–	0.06	0.06	−0.03	−0.02	0.08
Chocolate consumed	–	–	–	0.01	−0.08	−0.06	0.38**
Impulsivity	–	–	–	–	0.00	0.01	0.12
Implicit attitudes	–	–	–	–	–	−0.08	−0.09
Explicit attitudes	–	–	–	–	–	–	−0.08

** $p < .01$.

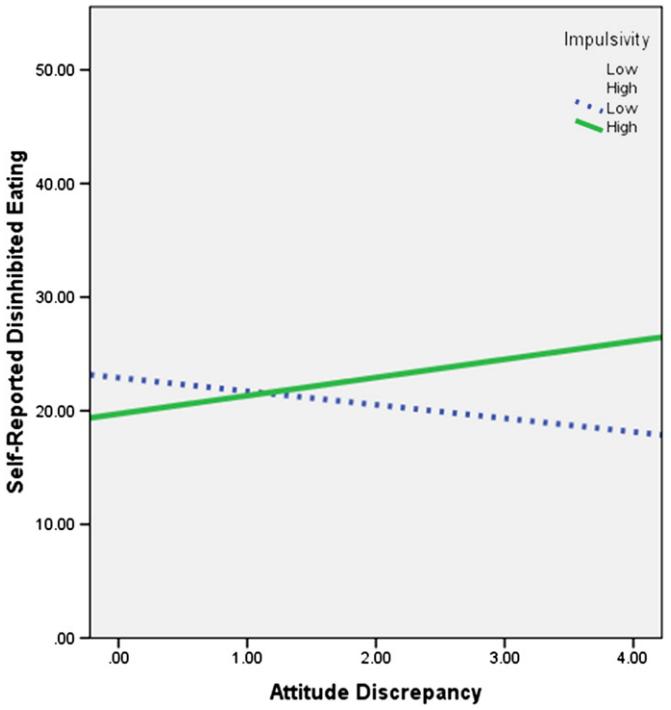

Fig. 1. Impulsivity moderates the relationship between attitude discrepancy and self-reported disinhibited eating.

implicit and explicit attitudes would positively predict objectively-measured disinhibited eating. Surprisingly, while discrepancy was a powerful predictor of eating, neither implicit nor explicit attitudes independently predicted objectively-measured chocolate consumption. Self-reported disinhibited eating was unassociated with implicit and explicit attitudes, as well as attitude discrepancy. This finding was likely due to the broad, rather than in-the-moment nature of the disinhibited eating subscale and self-report error.

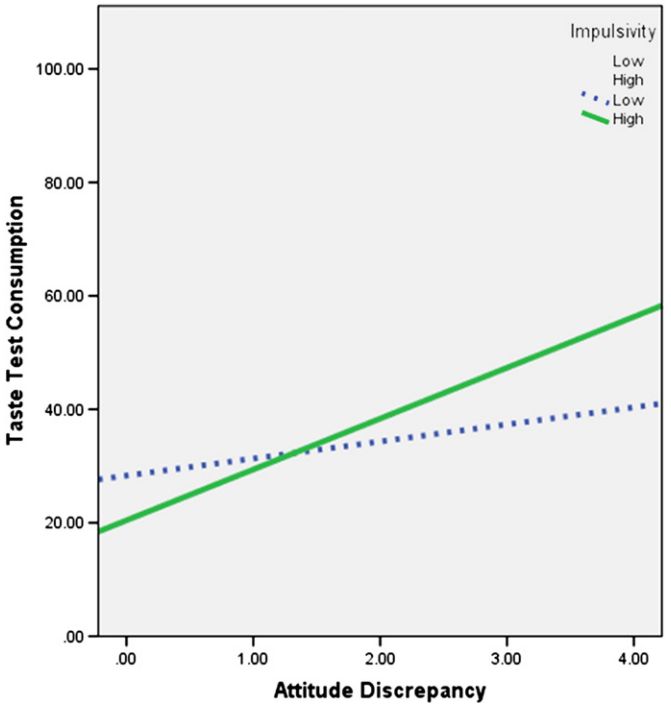

Fig. 2. Impulsivity moderates the relationship between attitude discrepancy and taste test consumption.

Evidence suggests that implicit attitudes are more likely to be associated with disinhibited eating when self-regulation resources are low, e.g., under conditions of emotion suppression, alcohol consumption, or habitualness. However, the present results revealed that neither implicit nor explicit attitudes alone predicted disinhibited eating. When examining the moderating effect of impulsivity on implicit and explicit attitudes, it was surprising that there was no effect of impulsivity on implicit attitudes to predict eating behavior. Furthermore, there was evidence for a moderating effect of impulsivity on explicit attitudes to predict self-reported disinhibited eating only. This finding is not typically found in previous literature. Disinhibited eating is a complex behavior that is typically governed by a variety of internal and external experiences, and such mixed results could indicate that neither type of attitude alone is a reliable predictor of disinhibited eating. Given that both attitudes tend to predict eating behavior in different circumstances, it may be more prudent to study disinhibited eating in the context of both implicit and explicit attitudes.

The finding that the discrepancy between implicit and explicit attitudes predicts disinhibited eating can be explained by the meta-cognitive model, which posits that discrepancy intensifies focus on the attitude object (i.e., the chocolate in this case) and all information relevant to the discrepancy (Petty et al., 2007). It is notable that attitude discrepancy predicted disinhibited eating regardless of the direction of discrepancy. Given previous research with implicit attitudes, it is intuitive that a discrepancy between positive implicit associations and more negative explicit liking would produce disinhibited eating. However, a negative discrepancy (in which explicit liking was more positive and implicit associations were negative) also predicted to disinhibited eating in this study. Prior research has shown that it is not uncommon for overweight individuals to have negative implicit associations towards appetitive foods that they find appealing (Czyzewska & Graham, 2008). Similarly, as disinhibited eaters, some individuals likely exhibited negative implicit attitudes towards chocolate due to its association with weight gain or being unhealthy. However, the commonality between both positive and negative attitude discrepancies, according to the meta-cognitive model is that they both created intensified focus on the chocolate. This likely enhanced the temptation of chocolate, thereby increasing the likelihood of a disinhibited eating episode.

These results also add to basic attitude discrepancy research outlined by Petty et al. (2007) by demonstrating that attitude discrepancy can predict eating behavior. However, we did not measure attention or information processing to confirm the mechanisms posited by the meta-cognitive model, which could be an area of future investigation. Along a similar vein, it is possible that attitude discrepancy generates a source of stress that depletes cognitive resources, which leads to overeating (Muraven & Baumeister, 2000). Future studies also may benefit from examining how discrepancies in attitudes towards unhealthy foods can be reduced, thereby potentially lessening consumption of these foods. Conceivably, reducing discrepancy around unhealthy foods could be accomplished by lessening positive implicit attitudes (e.g., through associative priming or evaluative conditioning; Baeyens, Elen, Crombez, & Van den Bergh, 1992; Rydell & McConnell, 2006) and even (counter-intuitively) by lowering the intensity of negative explicit attitudes (e.g. decreasing "forbidden foods" designation and rigidity, e.g. Schlam & Wilson, 2007).

The strong positive relationship between attitude discrepancy and disinhibited eating appeared to be present only among those at higher levels of impulsivity, a finding that aligns with previous research on the moderating role of impulsivity in processes leading to appetitive behavior (Hofmann & Friese, 2008; Hofmann et al., 2007; Yeomans et al., 2008). These results bolster the notion that the increased temptation for chocolate, created by the attitude discrepancy, was a challenge for individuals who were more impulsive. Results raise the possibility that reductions in impulsivity (e.g., through computerized inhibitory control trainings; Houben, 2011) might attenuate

unconscious attention towards food and therefore reduce the likelihood of eating in presence of unhealthy food.

The current study has several limitations. The sample was entirely female, thus reducing generalizability. Also, attitude discrepancy was calculated using standardized implicit and explicit attitude scores. This calculation, though supported by previous research (Petty et al., 2007) means that an individual's attitude scores were relative to the scores of the group as a whole rather than an absolute positive or negative. In addition, our measure of disinhibited eating and our use of the term "disinhibited" assume that participants would like to eat chocolate, but attempted to refrain from doing so. While participants' age, gender, and high guilt levels support this notion, we had no way to confirm that lab-based chocolate consumption was disinhibited in all cases. As a check, we examined our results in our medium-high restraint subsample only and the pattern of results was equivalent. Lastly, the cross-sectional design precludes conclusions about causation. A controlled intervention trial utilizing methods to manipulate attitude valence would provide a stronger test of causal effects of attitudes with respect to disinhibited eating.

A strength of the present investigation is that it considered the relative importance of both implicitly- and explicitly-measured food attitudes, as well as the discrepancy between these attitudes, in the context of a single study. Moreover, we utilized both self-report and behavioral measures of the targeted constructs. This study is also the first investigation of the role of attitude discrepancy in eating behavior and adds to literature regarding attitudes and eating behavior.

5. Conclusion

In sum, we found that the discrepancy between implicit and explicit attitudes, but neither alone, predicted disinhibited eating. The effect of attitude discrepancy was moderated by impulsivity. Although the results of the current study are preliminary, they raise intriguing possibilities for continued research in the fields of attitudes and eating behaviors.

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Contributors

The first author, Stephanie Goldstein, assisted in developing the study protocol along with Drs. Evan Forman, James Herbert, and Nachshon Meiran. Stephanie also collected and organized data, conducted statistical analyses, and was involved in drafting each section of the manuscript. The second author, Dr. Evan Forman (the PI of the above-mentioned grant), assisted in developing the study protocol, overseeing and editing the manuscript at several periods of its development, and consulting on statistical analyses. Dr. Nachshon Meiran assisted with the development of study protocol as well as study measures and manuscript editing. Dr. James Herbert assisted with the development of study protocol and editing the manuscript at several stages. Dr. Adrienne Juarascio assisted with conducting statistical analyses and in drafting the manuscript. Dr. Meghan Butryn assisted with study procedures and editing the manuscript.

Conflict of interest

All authors declare that they have no conflict of interest.

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