Published in final edited form as:

Appetite. 2014 June ; 77: 124–132. doi:10.1016/j.appet.2014.03.003.

Implicit affective associations predict snack choice for those with low, but not high levels of eating disorder symptomatology

Erin M. Ellis, MS¹, Marc T. Kiviniemi, PhD¹, and Catherine Cook-Cottone, PhD²

¹Department of Community Health and Health Behavior, University at Buffalo, SUNY, Kimball Tower, 3435 Main St., Buffalo, NY 14214

²Department of Counseling, School, and Educational Psychology, University at Buffalo, SUNY, 424 Baldy Hall, Buffalo, NY 14260

Abstract

OBJECTIVE—The central purpose of the current study was to examine whether eating disorder symptomatology moderates the extent to which implicitly and explicitly measured affective associations with fruits, or the feelings and emotions individuals associate with them, predict food choice.

METHOD—Participants (N=107) completed both implicit and explicit measures of affective associations with fruits, a self-report of eating disorder symptomatology, and their cognitive beliefs about fruits. In a subsequent snack selection task, they selected either a granola bar or fruit as a measure of their food choice behavior.

RESULTS—Logistic regression analyses revealed that eating disorder symptomatology moderated the relation of implicit affective associations on behavior, $OR=0.27$, $p=.024$, 95% CI (0.085, 0.84). A test of the simple effects indicated that implicit affective associations predicted snack choice at or below mean symptomatology levels [$OR=2.073$, $p=.02$, 95% CI (1.12, 3.84)], but not at high levels [$OR=0.56$, $p=.28$, 95% CI (0.18, 1.74)]. The effects of explicit measures on eating behavior were not moderated by eating disorder symptomatology ($ps>.05$).

CONCLUSION—These findings advance our understanding of both the relation of implicit affective associations on behavior, as well as the ways in which eating disorder symptomatology may impact the decision-making process, thereby perpetuating disorder-related eating behavior. These findings have implications for both health decision-making theory and practice, as well as for the study and treatment of eating disorders.

Keywords

affect and emotion; implicit attitudes; decision making

© 2014 Elsevier Ltd. All rights reserved.

Corresponding Author: Erin M. Ellis, 329 Kimball Tower, 3435 Main St., Buffalo, NY 14214, erinwals@buffalo.edu; Phone: 1-716-829-5702.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Eating disorders (EDs) are complex behavioral disorders characterized by disordered self-regulation specific to food, eating behaviors, and the body. Cognitions associated with EDs include obsession with food, body dissatisfaction, idealization of the thin ideal, and a lack of integration of somatic cues during food-based decision making (Southgate, Tchanturia, & Treasure, 2005). Efficient neurological integration among regions of the brain, which is essential for self-regulation and adaptive decision making, may also be compromised, resulting in reduced cognitive control of behavior, particularly under demanding situations (Southgate et al., 2005). These cognitive impairments manifest as behaviors that reflect a disconnect between the physiological needs of the body and behavior, such as food restriction and/or compulsive eating, and for some, compensatory behaviors (e.g., purging, compulsive exercise; Cook-Cottone & Smith, 2012). Together, the cognitions and behaviors associated with EDs may signify changes to the decision-making process surrounding food choices, particularly the extent to which factors, such as feelings and beliefs about food, influence behavioral outcomes (Brand et al., 2007; Cavedini et al., 2004).

Diagnostically, individuals with EDs engage in deleterious decision making regarding food by overly restricting food intake or taking in extreme amounts of food when bingeing (Cook-Cottone & Smith, 2012). Such decision-making deficits are often assessed using gambling tasks that require participants to learn from their mistakes and forgo immediate gratification in order to avoid longer-term negative consequences (Southgate et al., 2005). Although evidence is mixed (Guillaume et al., 2010; Lindner, Fichter, & Quadflieg, 2012), participants with EDs often display poorer outcomes compared to healthy controls, suggestive of deficits in global decision making and executive functioning (Boeka & Lokken, 2006; Danner et al., 2012). Further, preliminary evidence suggests that individuals with EDs may process food and illness-related cues (e.g., body image) differently, and fMRI studies reveal abnormal brain activation in cortical and subcortical regions of the brain associated with affective processing and planning of behavior (García-García et al., 2013; Southgate et al., 2005). These neurological differences may also impact the decision-making process.

Despite the clear relevance to ED research and treatment, few experimental studies have examined whether and how these changes in cognitive functioning influence the inputs and decisional *processes* underlying dietary behavior and food choice specifically. While the differences in the behavioral outcomes of decisions about eating behavior are clear (i.e., which specific foods are eaten and how much is consumed), a deeper examination of the decision-making processes themselves is warranted. The current study sought to address this gap in the literature by examining the extent to which ED symptomatology moderates the decision-making processes surrounding food choice, and the extent to which such differences are consistent with the broader ED literature.

Health decision-making models and theories tend to explain food choices as resulting from the interplay of a series of social-cognitive factors. While variations in specific constructs exist between the theories (Glanz, Rimer, & Lewis, 2008; Weinstein, 1993), each incorporates an evaluative component that captures the attitudes, beliefs, or feelings an individual holds about the behavioral choice. For instance, the behavioral affective associations model posits that affective associations, or the feelings and emotions

individuals associate with a given behavior, are proximally related to engagement in the behavior (Kiviniemi & Bevins, 2007; Kiviniemi, Voss-Humke, & Seifert, 2007). In the realm of eating behavior, for example, positive affective associations about foods help to explain the appeal of comfort foods (Wansink, Cheney, & Chan, 2003), and also predict consumption of more nutritious food items, such as fruits and vegetables (Kiviniemi & Duangdao, 2009; Walsh & Kiviniemi, in press).

Affective associations and other attitudinal constructs, such as cognitive beliefs, are thought to exist at both an explicit and implicit level. Explicit attitudes reflect higher order cognitive processing; individuals consciously deliberate and are aware of their thoughts and feelings. Because they are consciously accessible, explicit attitudes can be measured using self-report questionnaires. Attitudinal constructs also exist at an implicit level that is less accessible to conscious awareness and influences decisions through more heuristic-based, automatic, and spontaneous processes (Gawronski & Bodenhausen, 2006). Increasing evidence suggests that food choices are often made quickly with little conscious deliberation (Cohen & Babey, 2012; Harris, Bargh, & Brownell, 2009; Hollands, Prestwich, & Marteau, 2011; Papies, Barsalou, & Custers, 2012; Sheeran, Gollwitzer, & Bargh, 2013), suggesting that implicit attitudes may have a strong influence on the decision-making processes surrounding eating behaviors. Because they are inaccessible to conscious awareness, implicit attitudes are assessed indirectly based on performance on experimental paradigms (Gawronski & Payne, 2010).

While implicit and explicit attitudes are often correlated, studies suggest that both are capable of developing, changing, and influencing behavior independently of each other (Gawronski & Bodenhausen, 2006; Wilson, Lindsey, & Schooler, 2000). In the realm of food choice, a consistent and predictable relation between implicit and explicit attitudes and behavior remains inconclusive (Ayres et al., 2012; Conner et al., 2007; Hofmann et al., 2005). For instance, some studies have found relations between implicit – but not explicit – attitudes and spontaneous snack selections (Hollands et al., 2011; Perugini, 2005), while others found no such relation (Ayres et al., 2012; Karpinski & Hilton, 2001; Spruyt et al., 2007).

These inconsistencies may be explained in part by dispositional or situational factors that moderate the relative influence of implicit compared to explicit attitudes during food choice decision-making (Conner et al., 2007). For instance, experimental studies have demonstrated that temporary reductions in cognitive capacity and self-regulation resources as a result of emotion suppression, alcohol use, or time constraints, increase the effect of implicit attitudes on behavior (Frieze, Hofmann, & Wänke, 2008; Hofmann & Frieze, 2008; Hofmann, Rauch, & Gawronski, 2007).

Conversely, the excessive inhibitory control and self-regulation that is symptomatic of EDs may have the opposite effect and reduce the relation between implicit attitudes and behavior (Frieze & Hofmann, 2009; Hofmann, Frieze, & Roefs, 2009). Instead, factors unrelated to food preferences may guide eating behavior by intervening in the decision-making process and overriding the factors that would otherwise predict eating behavior. Specifically, individuals with EDs manifest a rigid over-control of food intake that may be compensatory

for their difficulty inhibiting thoughts related to food and body shape and weight (García-García et al., 2013). In this way, effortful processing reflects a purposeful and functionally corrective disconnection between both somatic experiences and automatically activated feelings about foods and subsequent eating behavior. Consequently, the implicitly measured affective associations that would otherwise predict food choice are no longer driving behavior. Given this conceptualization of EDs, the current study sought to examine the extent to which the effects on behavior of implicit and explicit affective associations are moderated by the level of ED symptomatology.

Study Overview

While a theoretical justification exists for a diminished effect of implicit influences, including implicit affective associations, on the decision-making processes surrounding food choice among ED patients, health decision-making research often includes ED diagnosis as an exclusionary criterion and restricts participation to “healthy” individuals. Therefore, the central purpose of the current study was to examine whether ED symptomatology moderates the extent to which implicitly and explicitly measured affective associations and cognitive beliefs predict food choice.

Data collection occurred at two time points. Participants completed a baseline survey over the telephone that assessed their current levels of fruit consumption. In a subsequent laboratory session, participants completed both implicit and explicit measures of their affective associations about fruits. They also self-reported their cognitive beliefs about fruits and ED symptomatology, and completed a snack selection task as a measure of their food choice behavior.¹

Based on the evidence reviewed above, we hypothesized that ED symptomatology would moderate the effects of implicit affective associations on snack selection, such that implicit measures would be less predictive of behavior for participants with higher levels of disordered eating. Given that explicit affective associations exist within one’s conscious awareness and control, their effect on behavior may be cognitively overridden regardless of ED symptomatology. Therefore, we hypothesized that their effect on food choice would not be moderated by ED symptomatology.

Methods

Participants

Participants (N=107) took part in the study in exchange for a cash payment. Participants were 55% women, 77.6% were university students and had a mean age of 27 years (SD=11.9 years). Racial/ethnic backgrounds were diverse, with 44% self-identifying as Asian/Pacific Islander, 13% as black, 39% as white, and 5.6% self-identifying as more than one racial/ethnic group. Using the recommended cut-off score of 20 on the EAT-26, 13% (n=14) presented with clinically significant levels of eating disorder symptomatology.

¹This study was a subcomponent of a larger study that examined the effect of an implicit priming paradigm, which was completed during the lab interview, on thoughts and feelings about fruit and snack choice behavior. The priming manipulation did not influence any results reported here and is therefore not discussed further.

Participants were recruited by means of advertising flyers that were distributed throughout the campus community. Given the purpose of the study, the flyer and distribution techniques specifically targeted individuals with EDs. The elevated prevalence of ED symptomatology in the current study is partially reflective of this recruitment process. The university's Institutional Review Board approved the data collection protocol prior to data collection and all participants completed an informed consent process.

Procedure

Baseline interview—Participants completed a baseline telephone survey in which they reported their fruit and vegetable consumption over the past month (see *Measures*).

Laboratory task—Participants completed a series of measures including: the Affect Misattribution Procedure (AMP) to assess their implicit affective associations about fruits, self-report measures of cognitive beliefs and affective associations about fruits, a measure of ED symptomatology, and a behavioral choice task in which they selected either a granola bar or fruit as a snack (see *Measures*).

Measures

Implicit affective associations—The Affect Misattribution Procedure (AMP) is an implicit measure affective evaluations of attitude objects that is based on the premise that people make misattributions about their affective reactions to stimuli (Payne et al., 2005; Payne et al., 2010). It asks people to make judgments about the pleasantness of ambiguous and neutral images when they immediately follow an image of the attitude object of interest. Because of the misattributions people make about their affective reactions to objects, the affective responses generated by the attitude object will be misattributed to the neutral image, thus making their ratings of the neutral image actually reflective of the feelings they associate with the object of interest (Payne et al., 2005). Therefore, the AMP served as an assessment of implicitly-held affective associations.

For the current study, the attitude objects were images of fruits and the ambiguous target items were Chinese pictographs.² Following five practice trials, participants viewed fruit images on the computer screen for 125 milliseconds, immediately followed by a 100-millisecond display of a Chinese pictograph. Participants were instructed to rate the pictograph as more or less pleasant compared to the average pictograph, and to avoid letting the attitude object influence their rating. A pattern mask consisting of black and white “noise” appeared on the screen until participants responded (Payne et al., 2005). In addition to images of fruits, participants also completed trials in which the attitude objects were neutral filler items. Ratings on these trials provided baseline ratings of pleasantness. Participants' AMP score was calculated as the difference between the proportion of pleasant ratings on the fruit trials and neutral trials, with higher scores indicating more pleasant ratings of fruits.

²In order to ensure that the Chinese pictographs were indeed neutral and ambiguous, we asked participants whether they were fluent in Chinese during their baseline phone interview, and examined whether familiarity with the pictographs influenced AMP scores by running analyses with and without Chinese participants (n=14). No significant differences emerged.

Explicit affective associations and cognitive beliefs

Specific food affective associations: Participants rated how much they enjoyed each of 15 food items. Responses were made on an 8-point scale ranging from (1) “not at all” to (8) “extremely.” Embedded within these food items were the three snack options: apples, bananas, and granola bars, in order to assess participants’ affective associations with the snack options.

Global affective associations: Participants’ affective associations about fruits were assessed with a 14-item scale modified from Crites et al.’s (1994) multiresponse checklist measures. Participants were given the prompt “When I think about eating fruits, I feel ____” followed by 7 positive words (e.g. joy, calm, delighted) and 7 negative words (e.g. angry, sorrow, bored). Each item was rated on a 9-point scale from (0) “not at all” to (8) “extremely.” Mean scores were calculated for participants’ positive ($\alpha=.87$) and negative ($\alpha=.85$) affective associations with fruits.

Explicit cognitive beliefs: Participants’ perceived benefits and barriers to eating fruits were assessed using a decisional balance scale (Ling & Horwath, 2001). This previously validated 22-item measure includes 13 questions that assessed the benefits of eating more fruits ($\alpha=.81$) and 9 items that assessed the barriers to eating more fruits ($\alpha=.70$). Participants indicated the extent to which items were important in their decision whether or not to eat fruits (e.g., “*Eating more fruits would help me look better.*”) on a 5-point scale (1= not very important; 5=extremely important). Participants’ perceived benefits and barriers to eating fruits were calculated based on their mean scores.

Disordered Eating—The Eating Attitudes Test-26 (EAT) is a 26-item standardized measure of symptoms and characteristics of eating disorders (Garner et al., 1982). For most questions, participants indicated the extent to which items were true for them (e.g. “*I find myself preoccupied with food.*”) using a 6-point scale from (1) “never” to (6) “always”. Overall scores were calculated using a standardized system of summing responses ($\alpha=.83$; Garner et al., 1982).

Mean scores for three standard subscales were also calculated: 1) *Dieting*: 13 items assessed the frequency of pathological dieting ($\alpha=.73$), 2) *Preoccupation*: 6 items assessed preoccupation and frequency of binge eating and purging behaviors ($\alpha=.73$), and 3) *Oral Control*: 7 items assessed cognitive restraint or control over eating ($\alpha=.64$). Using the recommended cut-off score of 20 (Garner et al., 1982), a dichotomous item that represented whether participants met the criteria for a clinically significant ED was also created.

Eating behavior

Baseline fruit consumption: During the baseline interview, participants reported their consumption of 10 different categories of fruits and vegetables (e.g. lettuce salad, 100% juice, fruits) over the past 30 days using the National Cancer Institute’s (NCI) Quick Food Scan. For each food category, participants indicated the number of times they had eaten the food in the past month using 10 response categories that ranged from “never” to “5 or more times per day.” They also indicated the quantity or number of servings they consumed each

time they ate the food item. Responses were used to calculate the number of servings of fruits and vegetables that each participant consumed per day based on an NCI algorithm (National Cancer Institute, 2007).

Snack selection task: The snack selection task provided a measure of fruit consumption behavior. Participants selected from a box of apples, bananas, and a variety of granola bar flavors. These snack options were selected to be roughly calorically equivalent (approximately 100 kilocalories), to be easily transportable by the participant, and to reduce the chance that a strong distaste for one particular snack option would disproportionately guide participants' snack choice. Using random assignment, half of participants selected their snack halfway through the experiment, and half selected one after completing all other measures. Timing of the task did not influence results. In each case, the experimenter uncovered a previously hidden box of snacks and presented it to participants. There were 4 of each snack option in the box: granola bars, apples, and bananas. The experimenter offered each participant a snack from the box using the standardized prompt, "As a small token of appreciation for your effort and participation, we have some snacks here. Go ahead and pick one." After the participant selected the snack, the experimenter went to an adjoining room and immediately recorded the snack selection. Seventeen (16%) participants chose not to select a snack and were excluded from the snack selection analyses. Snack selection was dichotomized as a fruit or non-fruit selection, and served as the behavioral outcome variable.

Other measures

Current hunger: Participants indicated the extent to which they currently felt *satiated* and *hungry* using a 5-point scale from (1) "not at all" to (5) "extremely".

Social Desirability Scale: The Marlowe-Crowne Social Desirability Scale assessed participants' tendency to provide socially desirable responses (Crowne & Marlowe, 1960). It consisted of 33 "True" (1) or "False" (0) items. Items were reverse coded where appropriate and a mean score was computed such that higher scores represented greater tendency to respond in a socially desirable manner.

Data analysis strategy

All analyses were conducted in SPSS version 20. We used linear regression models to test for relations between ED symptomatology, cognitive beliefs, and affective associations about fruits. We used logistic regression models to examine the effects of ED symptomatology, cognitive beliefs, and affective associations on eating behavior. We then tested whether ED symptomatology moderated the relation between affective associations measures (both implicit and explicit) and the behavioral outcomes by computing interaction terms using standardized variables and including them in the regression equations (Aiken & West, 1991). For significant interaction terms, we examined the simple effects by calculating the relation of implicit and explicit measures on behavior at one standard deviation above and below the mean on each ED scale.

Two covariates, hunger and social desirability, were included in the study design and designated as covariates on *a priori* theoretical grounds (Jaccard et al., 2006). Given that the

behavioral outcome measure involved snack selection, hunger was included because of the role that visceral states such as hunger can play in decision making. Because reports of diet and of beliefs about foods can be influenced by social desirability, social desirability was included to control for this effect. In addition, we conducted preliminary analyses (described below) to identify unrelated demographic variables that might account for variance in outcomes. Covariates related to the outcome at $p < .10$ were included to reduce error variance. We conducted all analyses both with and without these covariates included (Jaccard et al., 2006). The covariate inclusion did not change any patterns of results. Results reported below include identified covariates.

Results

Preliminary analyses

We examined the effect of participant demographic characteristics on the primary attitudinal and behavioral outcomes of interest. Demographic characteristics with a relation to behavior at the $p < .10$ level were retained as covariates in applicable models. Characteristics tested were: gender, race/ethnicity, and baseline fruit and vegetable consumption. Race/ethnicity was marginally associated with snack selection; white participants (relative to non-white participants) had a lower odds of selecting a fruit in the snack selection task [OR=0.45, $p = .10$, 95% CI (0.17, 1.17)]. Race/ethnicity was therefore included as a covariate in models that examined snack selection.

Based on the analysis plan logic described above, current hunger and social desirability were also included as covariates of theoretical interest (see *Analysis Strategy*). Hunger was associated with lower odds of selecting a fruit as one's snack [OR=0.71, $p = .044$, 95% CI (0.50, 0.99)], and was unrelated to attitudinal constructs ($ps > .30$). Social desirability was negatively associated with perceived barriers [$\beta = -0.31$, $p = .001$, 95% CI (-0.50, -0.12)], and negative affective associations [$\beta = -0.31$, $p = .001$, 95% CI (-0.51, -0.13)], and was positively associated with positive affective associations [$\beta = 0.22$, $p = .023$, 95% CI (0.032, 0.42)], and AMP scores [$\beta = 0.17$, $p = .084$, 95% CI (-0.023, 0.37)]. It was not associated with the odds of selecting a fruit [OR=0.91, $p = .94$, 95% CI (0.068, 12.15)].

Relation of ED Symptomatology, Affective Associations, and Cognitive Beliefs

We also examined the relations between affective associations, cognitive beliefs, and ED symptomatology (see Table 1). As can be seen in the table, there were associations between components of ED symptomatology and explicit negative affective associations, perceived benefits, and perceived barriers. There were no relations between symptomatology and explicit positive affective associations or AMP scores.

In addition, we tested for significant differences in snack choice, affective associations (implicit and explicit), and cognitive beliefs between ED cases and non-cases using the EAT-26's clinical cut-off. Compared to those below the cut-off, participants above the clinical cut-off reported significantly more barriers ($F(1,101) = 16.62$, $p < .001$) as well as benefits of fruit consumption ($F(1,101) = 4.96$, $p = .028$). No other significant differences emerged.

Implicit affective associations

As expected, implicitly measured affective associations were marginally associated with the odds of selecting a fruit. Controlling for hunger, race/ethnicity, and social desirability, higher standardized AMP scores were associated with a greater odds of selecting a fruit as one's snack, $OR=1.65$, $p=.058$, 95% CI (0.98, 2.79).

Explicit affective associations and cognitive beliefs

As depicted in Table 2, controlling for hunger, social desirability, and race/ethnicity, explicit measures of affective associations were unrelated to snack selection. Cognitive beliefs were associated with snack selection, but in the reverse direction, with greater perceived benefits being associated with a lower odds of selecting a fruit [$OR=0.53$, $p=.017$, 95% CI (0.31, 0.89)], and greater perceived barriers being associated with a greater odds of selecting a fruit [$OR=1.90$, $p=.044$, 95% CI (1.02, 3.55)].

Eating disorder symptomatology

There was no significant relation between the EAT-26 and the odds of declining to take a snack in the snack selection task, $OR=0.96$, $p=.13$, 95% CI (0.91, 1.01). The *Oral Control* subscale was the only scale that was significantly associated with snack selection, such that greater attempts to control food intake were associated with lower odds of selecting a fruit over the granola bar alternative, $OR=0.30$, $p=.05$, 95% CI (0.09, 1.00).

Moderating effects of ED symptomatology

To test whether eating disorder symptomatology moderated the relations between affective and cognitive constructs and snack selection behavior, we standardized each predictor and included an interaction term as the final step in each regression model.

Implicit affective associations—A series of significant interaction terms suggest that the relation between AMP scores and snack selection was moderated by ED symptomatology. The overall EAT-26 moderated the relation between AMP scores and snack selection, $OR=0.27$, $p=.024$, 95% CI (0.085, 0.84). Further, all three of the EAT subscales also moderated the AMP-behavior relation, with each producing a significant or marginally significant interaction term (*dieting*: $OR=0.47$, $p=.064$, 95% CI [0.21, 1.05]; *preoccupation*: $OR=0.22$, $p=.028$, 95% CI [0.058, 0.85]; *control*: $OR=0.22$, $p=.072$, 95% CI [0.22, 1.07]).

Tests of the simple effects at one standard deviation above and below mean EAT scores revealed that the AMP significantly predicted snack selection for those at or below the mean score of 10.6 on the EAT (see Table 3). At mean levels of ED symptomatology, higher AMP scores (indicating more positive ratings of fruits) were associated with a greater odds of selecting a fruit as one's snack, $OR=2.073$, $p=.02$, 95% CI (1.12, 3.84). The AMP-behavior relation was even stronger at one standard deviation below mean symptomatology levels, $OR=7.74$, $p=.005$, 95% CI (1.85, 32.49). When EAT scores were one standard deviation above the mean (overall EAT-26 score = 19.6), the AMP did not predict snack selection ($ps>.10$; see Figure 1).

Explicit affective associations and cognitive beliefs—Of the 16 interaction terms created to test whether ED symptomatology moderated the effects of explicit measures on snack selection, the interaction between baseline positive affective associations and the *preoccupation* subscale of the EAT was the only one that reached marginal statistical significance, $OR=0.010$, $p=.056$, 95% CI (0.0001, 1.13). A test of the simple effects revealed that positive affective associations were negatively associated with the odds of selecting a fruit when EAT scores were one SD above the mean ($OR=0.049$, $p=.053$, 95% CI [0.00, 1.04]), but were not associated with snack selection at or below the mean ($OR=2.74$, $p>.10$, 95% CI [0.79, 9.68]). These findings suggest that ED symptomatology did not consistently moderate the effect of explicit measures of cognitive and affective constructs on snack selection, and in the one instance that it did, there was an inverse relation between affective associations and food choice at higher levels of ED symptomatology.

Discussion

As hypothesized, the effects on eating behavior of explicitly measured affective associations and cognitive beliefs did not differ as a function of ED symptoms. However, ED symptomatology did moderate the effect of implicit affective associations on behavior, such that affective associations were significant predictors of snack choice at low, but not high levels of symptomatology. By examining the moderating effect of self-reported ED symptomatology on the relation between implicit affective associations and behavior, the current study advances our understanding of both the implicit attitude-behavior relation, as well as the ways in which ED symptomatology may impact the decision-making process, thereby perpetuating disorder-related eating behavior.

Implicit and explicit affective associations

Within the realm of dietary behavior, the current findings are consistent with prior evidence of an association between implicit, but not explicit attitudes about various healthy and unhealthy foods and future consumption of them (Hollands et al., 2011; Perugini, 2005; Sheeran et al., 2013). Given prior inconsistencies in the strength of the relation between implicit measures and spontaneous eating behavior, the current study also sought to identify one individual-level factor, ED symptomatology, that may moderate the strength of the relation (Ayres et al., 2012; Karpinski & Hilton, 2001; Spruyt et al., 2007). To the extent that ED symptomatology involves exceptionally elevated efforts to control one's eating behavior and thoughts about food, one possible explanation for the current findings is that this elevated self-control reduces the strength of the effect of implicit affective associations on behavior (Frieze & Hofmann, 2009). Such an explanation is consistent with evidence that implicit attitudes tend to be predictive of behavior among individuals with low dispositional or experimentally depleted self-control, but not for those with high self-control (Frieze & Hofmann, 2009; Hofmann et al., 2007; Sheeran et al., 2013).

Effects of disordered eating on decision-making

The current findings are also consistent with neurological models of EDs that illustrate a disconnect from the physiological self as individuals present with effortful compensatory

processing that functions to control impulses and thoughts related to food, weight, and body shape (Cook-Cottone & Smith, 2012; García-García et al., 2013). Those who struggle with EDs no longer eat or behave in service to the body. With great effort and purpose, cognitions and actions are aligned with an externally constructed conceptualization of how to eat and what to look like (Cook-Cottone, 2006). This disconnection from the body and its needs seems to come at a cost: a reduced ability to engage in effective decision making that translates one's attitudinal likes and dislikes into behavioral choices regarding food and health.

In the current study, participants with and without clinically significant levels of ED symptomatology (as determined by the recommended EAT-26 cut-off score) did not significantly differ in their implicitly measured affective associations about fruits. However, the strength of the relation between these implicit measures and snack choice did differ. In addition, hunger did not moderate the effect of implicit affective associations on snack selection, suggesting that ED symptomatology influenced the decision-making process independently of its potential influence on participants' feelings of hunger.

One possible explanation for these findings suggests that as ED symptomatology increased, the "normal" decision-making process, in which implicit affective associations predict behavior, became interrupted by effortful processing of disorder-related cognitions, such as attempts to control food intake. While prior studies have assessed differences in implicitly measured preferences for healthy and unhealthy food items as a function of body mass index and ED status (Czyzewska & Graham, 2008), this was the first study, to our knowledge, that examined differences in the decision-making process itself as a function of ED symptomatology.

Given the tendency for prior studies to assess preferences of foods that are discernibly different in their caloric content and healthiness (e.g. chocolate cake vs. salad; Czyzewska & Graham, 2008), the current study's utilization of two calorically equivalent snack options may have also impacted the extent to which ED symptoms alter the decision-making process. For instance, individuals with Binge Eating Disorder (BED) tend to have more difficulty with decision-making when consequences of choices are less obvious and perhaps more complex (Danner et al., 2012). The ambiguity caused by the caloric equivalence of the snack options may have created a more complex decision-making scenario and multiple opportunities for a disconnect between implicit affective associations and behavior to occur.

Not unrelated to our premise that the effortful processing of ED-related cognitions interrupts the relation of implicit attitudes to behavior, factors that are characteristic of, but not contingent on, ED symptomatology may also be underlying our findings. For instance, it has been suggested that implicit measures may reflect societal portrayals of the attitudinal objects, which are salient in one's mind, regardless of whether they are personally endorsed (e.g., Devine, 1989; Karpinski & Hilton, 2001; Olson & Fazio, 2004). Therefore, it is possible that AMP scores partially reflected participants' perceptions of societally-endorsed portrayals of fruits. To the extent that those with EDs do not follow socially normative eating behavior, their implicitly measured attitudes may be less correlated with their eating behavior.

Similarly, elevations in self-control are characteristic of, but not unique to EDs. To the extent that self-control accounts for the attenuation in the effect of implicit drives on behavior, the current findings likely generalize beyond the ED population, which is, in fact, quite consistent with the implicit measures literature. However, regardless of the specific facet(s) of ED symptomatology driving our findings, the implications for our understanding and treatment of EDs remains highly relevant.

Treatment implications

Research suggests that although ED diagnoses are relatively rare, many individuals manifest subclinical levels of ED behaviors that affect their relationship with their bodies and food (Masuda, Hill, & Tone, 2012). For instance, a cut-off score of 20 on the EAT-26 is traditionally used when screening EDs in a clinical setting, but a much lower cut-off of 11 has been recommended for detecting subclinical symptoms in a non-psychiatric setting (Orbitello et al., 2006). While these individuals may not meet the diagnostic criteria for an ED, they may still benefit from nutritional intervention (Orbitello et al., 2006). Further, the current study suggests that some of the cognitive impairments associated with EDs may exist below a clinical cut-off, which is consistent with prior literature on decision-making among individuals with varying severities of binge eating disorders (Danner et al., 2012). Given the breadth of these issues and the risks associated with full clinical manifestation of EDs, a better understanding of variations in the decision-making process across the continuum of those with healthy to disordered eating is important. Further, such research may provide much-needed insight into the etiological pathway to disorder.

Although the findings of this study should be considered preliminary and are in need of replication, their consistency with other studies that also implicate an overriding of the attitude-behavior relation by ED-related cognitions can cautiously inform treatment. In the clinical setting, it is not unusual for those who are struggling with ED behavior to present with positive explicit attitudes about foods, as well as intentions to act on them, and still have difficulty aligning food choice behavior with their cognitions. The current study suggests that this disconnect between attitudinal preferences and food choice may result in an overriding of implicitly measured affective associations' influence on behavior as well. Therapeutic focus should include work to align physiological experiences, thoughts and impulses related to food, and food choices. Helping patients explore, accept, and appropriately address potential implicit drives and attitudes and physiological sensations can help to align internal and external experiences, forming a more coherent neurological and behavioral experience of self.

Limitations

There are, of course, limitations to the study, which should be acknowledged and considered in interpretation of our results. By only providing two snack options, the food choice task was highly constrained and simpler than most real-world decisions surrounding eating behavior. However, in the experimental environment, it allowed for the control of extraneous influences, such as differences in caloric content and transportability of the snack options, thereby increasing our confidence that participants' selections reflected their affective associations with the foods.

Further, we assessed snack selection rather than actual consumption. While it seems reasonable to infer that participants selected a food with the intention of consuming it (especially given that a subset of participants elected not to select a snack), and that they would not select a snack that directly conflicted with their relative preferences for the two options, this could not be guaranteed.

While the EAT-26 is one of the most commonly used self-report ED instruments (Mintz & O'Halloran, 2000), it does not reliably differentiate between types of EDs, such as anorexia nervosa and bulimia nervosa, nor subtypes within each category (e.g., restrictive, binge, and binge and compensate patterns of behavior). Therefore, we are limited in the conclusions that we can draw about the moderating effect of symptomatology that is unique to these different disorder subtypes within the ED spectrum.

An additional area for future research involves the unexpected marginally significant association between social desirability and the AMP. One possible explanation is that social desirability bias does in fact influence people's implicit attitudes, but to a lesser degree than explicit measures. For instance, to the extent that implicit measures are influenced by salient societal portrayals of the attitudinal object, it is possible that social desirability bias was associated with greater awareness of positive portrayals of fruits in society, thus resulting in more positive implicit ratings of them.

Another finding that has been demonstrated elsewhere (Perugini, 2005; Walsh & Kiviniemi, in press), but warrants further research is the non-significant relation of explicitly measured constructs on snack choice. One possible explanation is that positive beliefs about fruits are associated with a perception that one is eating a sufficient amount of them, thus reducing the motivation to consume an additional piece of fruit during the experiment. Lending preliminary support for this hypothesis, the relation between perceived benefits and snack choice in the current study was negatively associated with the odds of selecting a fruit when baseline consumption was above the mean, but not when it was below it.

Finally, our sample was not representative of the general public in terms of race/ethnicity, nor ED symptomatology (given our intentional oversampling of those with ED symptoms), so caution should be taken when generalizing our findings. However, there are no theoretical or empirical reasons to believe that the relation between implicitly and explicitly measured affective associations and behavior differs by race or ethnicity.

Conclusion

Impulse control is often conceptualized as necessary for healthy eating; failure to control one's impulses is synonymous with giving in to hedonic temptation and can result in overeating and obesity. However, the current study suggests that impulse control may be equally maladaptive at the other extreme. Through compensatory and effortful control of food intake, the effect on behavior of automatically activated affective associations is interrupted, potentially contributing to ED-related behaviors.

Given the increasing focus on dual process models and the role of implicit attitudes in health decision-making, the current study's findings provide preliminary evidence that ED

symptomatology moderates the effect implicit affective associations on eating behavior. Such findings are consistent with both the ED literature as well as the literature on the relation between implicit measures and behavior. By contributing to our understanding of disorder-related differences in the decision-making process surrounding food choice, these findings have implications for both health decision-making research as well as for the study and treatment of EDs.

References

- Aiken, LS.; West, SG. Multiple regression: Testing and interpreting interactions. Thousand Oaks, CA US: Sage Publications, Inc; 1991.
- Ayres K, Conner MT, Prestwich A, Smith P. Do implicit measures of attitudes incrementally predict snacking behaviour over explicit affect-related measures? *Appetite*. 2012; 58:835–841. [PubMed: 22326883]
- Boeka AG, Lokken KL. The Iowa gambling task as a measure of decision making in women with bulimia nervosa. *Journal of the International Neuropsychological Society*. 2006; 12:741–745. [PubMed: 16961954]
- Brand M, Franke-Sievert C, Jacoby GE, Markowitsch HJ, Tuschen-Caffier B. Neuropsychological correlates of decision making in patients with bulimia nervosa. *Neuropsychology*. 2007; 21:742–750. [PubMed: 17983288]
- Cavedini P, Bassi T, Ubbiali A, Casolari A, Giordani S, Zorzi C, et al. Neuropsychological investigation of decision-making in anorexia nervosa. *Psychiatry Research*. 2004; 127:259–266. [PubMed: 15296825]
- Cohen DA, Babey SH. Contextual influences on eating behaviours: heuristic processing and dietary choices. *Obesity Reviews*. 2012; 13:766–779. [PubMed: 22551473]
- Conner MT, Perugini M, O’Gorman R, Ayres K, Prestwich A. Relations between implicit and explicit measures of attitudes and measures of behavior: Evidence of moderation by individual difference variables. *Personality and Social Psychology Bulletin*. 2007; 33:1727. [PubMed: 18000106]
- Cook-Cottone CP. The attuned representation model for the primary prevention of eating disorders: An overview for school psychologists. *Psychology in the Schools*. 2006; 43:223–230.
- Cook-Cottone, CP.; Smith, A. Eating Disorders. In: Noggle, CA.; Dean, RS., editors. *The Neuropsychology of Psychopathology*. New York, NY: Springer Publishing; 2012. p. 441-458.
- Crites SL, Fabrigar LR, Petty RE. Measuring the affective and cognitive properties of attitudes: Conceptual and methodological issues. *Personality and Social Psychology Bulletin*. 1994; 20:619–634.
- Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*. 1960; 24:349–354. [PubMed: 13813058]
- Czyzewska M, Graham R. Implicit and explicit attitudes to high- and low-calorie food in females with different BMI status. *Eating Behaviors*. 2008; 9:303–312. [PubMed: 18549989]
- Danner UN, Ouwehand C, van Haastert NL, Hornsvelt H, de Ridder DTD. Decision-making impairments in women with binge eating disorder in comparison with obese and normal weight women. *European Eating Disorders Review*. 2012; 20:e56–e62. [PubMed: 21308871]
- Devine PG. Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology*. 1989; 56:5.
- Friese M, Hofmann W. Control me or I will control you: Impulses, trait self-control, and the guidance of behavior. *Journal of Research in Personality*. 2009; 43:795–805.
- Friese M, Hofmann W, Wänke M. When impulses take over: Moderated predictive validity of explicit and implicit attitude measures in predicting food choice and consumption behaviour. *British Journal of Social Psychology*. 2008; 47:397–419. [PubMed: 17880753]
- García-García I, Narberhaus A, Marqués-Iturria I, Garolera M, R doi A, Segura B, et al. Neural Responses to Visual Food Cues: Insights from Functional Magnetic Resonance Imaging. *European Eating Disorders Review*. 2013; 21:89–98. [PubMed: 23348964]

- Garner DM, Olmsted MP, Bohr Y, Garfinkel PE. The Eating Attitudes Test: psychometric features and clinical correlates. *Psychological Medicine*. 1982; 12:871–878. [PubMed: 6961471]
- Gawronski B, Bodenhausen GV. Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*. 2006; 132:692–731. [PubMed: 16910748]
- Gawronski, B.; Payne, BK. *Handbook of implicit social cognition: Measurement, theory, and applications*. New York: Guilford Press; 2010.
- Glanz, K.; Rimer, BK.; Lewis, FM. *Health Behavior and Health Education: Theory, Research and Practice*. 4. San Francisco, CA: Jossey-Bass; 2008.
- Guillaume S, Sang CNT, Jaussent I, Raingeard I, Bringer J, Jollant F, et al. Is decision making really impaired in eating disorders? *Neuropsychology*. 2010; 24:808–812. [PubMed: 20853958]
- Harris JL, Bargh JA, Brownell KD. Priming effects of television food advertising on eating behavior. *Health Psychology*. 2009; 28:404–413. [PubMed: 19594263]
- Hofmann W, Friese M. Impulses got the better of me: Alcohol moderates the influence of implicit attitudes toward food cues on eating behavior. *Journal of Abnormal Psychology*. 2008; 117:420–427. [PubMed: 18489218]
- Hofmann W, Friese M, Roefs A. Three ways to resist temptation: The independent contributions of executive attention, inhibitory control, and affect regulation to the impulse control of eating behavior. *Journal of Experimental Social Psychology*. 2009; 45:431–435.
- Hofmann W, Gawronski B, Gschwendner T, Le H, Schmitt M. A meta-analysis on the correlation between the Implicit Association Test and explicit self-report measures. *Personality and Social Psychology Bulletin*. 2005; 31:1369–1385. [PubMed: 16143669]
- Hofmann W, Rauch W, Gawronski B. And deplete us not into temptation: Automatic attitudes, dietary restraint, and self-regulatory resources as determinants of eating behavior. *Journal of Experimental Social Psychology*. 2007; 43:497–504.
- Hollands GJ, Prestwich A, Marteau TM. Using aversive images to enhance healthy food choices and implicit attitudes: An experimental test of evaluative conditioning. *Health Psychology*. 2011; 30:195. [PubMed: 21401253]
- Jaccard J, Guilamo-Ramos V, Johansson M, Bouris A. Multiple Regression Analyses in Clinical Child and Adolescent Psychology. *Journal of Clinical Child & Adolescent Psychology*. 2006; 35:456–479. [PubMed: 16836483]
- Karpinski A, Hilton JL. Attitudes and the Implicit Association Test. *Journal of Personality and social Psychology*. 2001; 81:774–788. [PubMed: 11708556]
- Kiviniemi, MT.; Bevins, R. Affect-behavior associations in motivated behavioral choice: Potential transdisciplinary links. In: Zelig, PR., editor. *Issues in the Psychology of Motivation*. Hauppauge, NY: Nova; 2007. p. 65-80.
- Kiviniemi MT, Duangdao KM. Affective associations mediate the influence of cost-benefit beliefs on fruit and vegetable consumption. *Appetite*. 2009; 52:771–775. [PubMed: 19501779]
- Kiviniemi MT, Voss-Humke AM, Seifert AL. How Do I Feel About the Behavior? The Interplay of Affective Associations With Behaviors and Cognitive Beliefs as Influences on Physical Activity Behavior. *Health Psychology*. 2007; 26:152–158. [PubMed: 17385966]
- Lindner SE, Fichter MM, Quadflieg N. Decision-making and planning in full recovery of anorexia nervosa. *International Journal of Eating Disorders*. 2012; 45:866–875. [PubMed: 22552824]
- Ling AM, Horwath C. Perceived benefits and barriers of increased fruit and vegetable consumption: validation of a decisional balance scale. *Journal of Nutrition Education*. 2001; 33:257–265. [PubMed: 12031176]
- Masuda A, Hill M, Tone E. The Role of Mindfulness and Disordered Eating Cognitions in Psychological Distress among College Females with Elevated Disordered Eating. *Mindfulness*. 2012; 3:132–138.
- Mintz LB, O'Halloran MS. The Eating Attitudes Test: Validation With DSM-IV Eating Disorder Criteria. *Journal of Personality Assessment*. 2000; 74:489–503. [PubMed: 10900574]
- National Cancer Institute. *Fruit & Vegetable Screeners: Scoring the All-Day Screener*. 2007 Retrieved August 3, 2007.

- Olson MA, Fazio RH. Reducing the influence of extrapersonal associations on the Implicit Association Test: personalizing the IAT. *Journal of Personality and Social Psychology*. 2004; 86:653. [PubMed: 15161392]
- Orbitello B, Ciano R, Corsaro M, Rocco PL, Taboga C, Tonutti L, et al. The EAT-26 as screening instrument for clinical nutrition unit attenders. *International Journal Of Obesity* (2005). 2006; 30:977–981. [PubMed: 16432540]
- Papies EK, Barsalou LW, Custers R. Mindful Attention Prevents Mindless Impulses. *Social Psychological and Personality Science*. 2012; 3:291–299.
- Payne BK, Cheng CM, Govorun O, Stewart BD. An inkblot for attitudes: Affect misattribution as implicit measurement. *Journal of Personality and Social Psychology*. 2005; 89:277–293. [PubMed: 16248714]
- Payne BK, Hall DL, Cameron CD, Bishara AJ. A Process Model of Affect Misattribution. *Personality and Social Psychology Bulletin*. 2010; 36:1397–1408. [PubMed: 20837777]
- Perugini M. Predictive models of implicit and explicit attitudes. *British Journal of Social Psychology*. 2005; 44:29–45. [PubMed: 15901390]
- Sheeran P, Gollwitzer PM, Bargh JA. Nonconscious processes and health. *Health Psychology*. 2013; 32:460–473. [PubMed: 22888816]
- Southgate L, Tchanturia K, Treasure J. Building a model of the aetiology of eating disorders by translating experimental neuroscience into clinical practice. *Journal of Mental Health*. 2005; 14:553–566.
- Spruyt A, Hermans D, De Houwer J, Vandekerckhove J, Eelen P. On the predictive validity of indirect attitude measures: Prediction of consumer choice behavior on the basis of affective priming in the picture–picture naming task. *Journal of Experimental Social Psychology*. 2007; 43:599–610.
- Walsh EM, Kiviniemi MT. Changing how I feel about the food: Experimentally manipulated affective associations with fruits change fruit choice behaviors. *Journal Of Behavioral Medicine*. :1–10. in press.
- Wansink B, Cheney MM, Chan N. Exploring comfort food preferences across age and gender. *Physiology & Behavior*. 2003; 79:739–747. [PubMed: 12954417]
- Weinstein ND. Testing four competing theories of health-protective behavior. *Health Psychology*. 1993; 12:324–333. [PubMed: 8404807]
- Wilson TD, Lindsey S, Schooler TY. A model of dual attitudes. *Psychological Review*. 2000; 107:101–126. [PubMed: 10687404]

a.)

b.)

c.)

d.)

Figure 1.

Simple effects illustrating the relation between implicit affective associations (AMP) and snack selection at one SD above and below mean ED symptomatology levels (EAT).

Table 1

Means, standard deviations, Pearson correlations (two-tailed), and reliability coefficients.

	Mean (SD)	2	3	4	5	6	7	8	9	10
<u>Implicit affective associations</u>										
AMP (1)	.10 (.21)	.23*	-.16	.27**	.058	.047	.087	.016	-.034	.015
<u>Explicit affective associations and cognitive beliefs</u>										
Positive AAs (2)	6.37 (1.54)	(.87)	-.35**	.37**	.04	.027	.012	-.08	.133	.36**
Negative AAs (3)	1.90 (1.15)		(.85)	-.11	.29**	.22*	.27**	.18	-.001	-.12
Perceived benefits (4)	3.58 (0.67)			(.81)	.24*	.26**	.30**	.09	.15	.15
Perceived barriers (5)	1.98 (0.63)				(.70)	.40**	.45**	.37**	.08	-.027
<u>ED symptomatology</u>										
EAT-26 (6)	10.55 (9.10)					(.83)	.91**	.78**	.70**	.019
Dieting (7)	0.53 (0.43)						(.73)	.58**	.41**	-.029
Bulimia & food preoccupation (8)	0.22 (0.42)							(.73)	.45**	.027
Oral control (9)	0.33 (0.41)								(.64)	.092
<u>Past eating behavior</u>										
30-Day Food Recall (10)	2.72 (1.40)									

* p<.05;

** p<.01

Table 2
Cognitive and affective predictors of snack selection controlling for hunger, race/ethnicity, and social desirability.

	OR	95% CI
<u>Implicit affective associations</u>		
AMP (standardized)	1.65	(0.98, 2.79)
<u>Explicit affective associations</u>		
Positive affective associations	0.84	(0.62, 1.14)
Negative affective associations	0.89	(0.61, 1.32)
<u>Explicit cognitive beliefs</u>		
Perceived benefits	0.53 *	(0.31, 0.89)
Perceived barriers	1.90 *	(1.02, 3.55)
<u>ED symptomatology</u>		
Overall EAT-26 score	0.96	(0.91, 1.01)
Dieting subscale	0.55	(0.18, 1.70)
Bulimia & food preoccupation subscale	1.42	(0.31, 6.67)
Oral control subscale	0.30 *	(0.09, 1.00)

* $p < .05$

Table 3

Eating disorder symptomatology as moderator of relation between implicit affective associations and the odds of selecting a fruit as one's snack

	ED symptoms x implicit affective associations	Simple effects of implicit affective associations		
		1 SD below mean	At mean ED symptom level	1 SD above mean
Overall EAT-26	0.24* (0.085, 0.84)	7.74** (1.85, 32.49)	2.073* (1.12, 3.84)	0.56 (0.18, 1.74)
Dieting	0.47 [†] (0.21, 1.05)	3.33* (1.29, 8.57)	2.48* (1.22, 5.07)	0.79 (0.29, 2.19)
Bulimia & food preoccupation	0.22* (0.06, 0.85)	5.16** (1.49, 17.90)	1.14 (0.57, 2.32)	0.25 (0.044, 1.45)
Oral control	0.49 [†] (0.22, 1.07)	5.30* (1.35, 20.80)	1.62 (0.89, 2.94)	1.16 (0.60, 2.26)

OR (95% CI);

[†]
p<.10

*
p<.05

**
p<.01