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RESPONSE STYLE AND VULNERABILITY TO ANGER-INDUCED EATING IN OBESE ADULTS

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Abstract

Emotional eating appears to contribute to weight gain, but the characteristics that make one vulnerable to emotional eating remain unclear. The present study examined whether two negative affect response styles, rumination and distraction, influenced palatable food intake following an anger mood induction in normal weight and obese adults. We hypothesized that higher rumination and lower distraction would be associated with greater vulnerability to anger-induced eating, particularly among obese individuals. Sixty-one participants (74% female, mean age = 34.6) underwent neutral and anger mood inductions in counterbalanced order. Directly following each mood induction, participants were provided with 2,400 kcals of highly palatable snack foods in the context of a laboratory taste test. Results revealed that distraction influenced energy intake following the mood induction for obese but not normal weight individuals. Obese participants who reported greater use of distraction strategies consumed fewer calories than those reporting less use of distraction strategies. These findings were independent of subjective hunger levels, individual differences in mood responses and trait anger, and other factors. Rumination did not account for changes in energy intake among obese or normal weight participants. Among obese individuals, the tendency to utilize fewer negative affect distraction strategies appears to be associated with vulnerability to eating in response to anger. Future research should determine whether coping skills training can reduce emotional eating tendencies.

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Contributors

BMA conducted statistical analyses and wrote the first draft of the manuscript. MCW edited the manuscript. KLS and JO collected and prepared study data and edited the manuscript. SLP designed and obtained funding for the study and edited the manuscript. All authors contributed to and have approved the final manuscript.

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Conflict of Interest

The first author (BMA) has consulted for Merck. All other authors declare that they have no conflicts of interest.

Research Highlights

- Distraction response style predicts decreased anger-induced eating among the obese
- Distraction was not linked to anger-induced eating among normal weight subjects
- Rumination was not associated with vulnerability to anger-induced eating

Keywords

Obesity; Emotional eating; Anger; Distraction; Rumination

1. Introduction

The prevalence of obesity has increased dramatically during the past 25 years as the environment has become increasingly obesogenic (Ogden et al., 2006; Ogden, Carroll, & Flegal, 2008). The identification of individual difference factors associated with overeating and risk for obesity is essential to the development of prevention and treatment approaches (Davis, 2009). Emotional eating, defined as food intake triggered by negative emotional states, is associated with weight gain over the lifespan (Hays & Roberts, 2008). Prior studies have shown that emotional experiences can influence eating behavior in the laboratory (Greeno & Wing, 1994; Torres & Nowson, 2007) and in naturalistic settings (O'Connor, Jones, Conner, McMillan, & Ferguson, 2008), but these effects may vary substantially according to the type and intensity of the emotional experience (Macht, 1999; O'Connor et al., 2008). Anger, an emotion state with negative valence, high arousal, and specific cognitive and behavioral tendencies (Cox & Harrison, 2008), has been linked to increased motivation to eat among men (Macht, 1999) and women (Macht & Simons, 2000) and is frequently reported as a trigger of eating on self-report measures (Arnow, Kenardy, & Agras, 1995). However, to our knowledge, no published studies have examined the effects of anger on objectively measured food intake, and the individual difference factors that confer vulnerability to anger-induced eating are unknown.

Several functional associations between emotions and eating have been proposed (Macht, 2008), including the use of palatable food to regulate negative affect (Macht, 2008; Spring et al., 2008; Wallis & Hetherington, 2004). It has been hypothesized that emotional eating may depend on whether more adaptive response strategies are available to an individual (Spoon, Bekker, Van Strien, & van Heck, 2007), with those lacking effective strategies for responding to emotional distress being most vulnerable to emotional eating. The notion that emotional eating may be viewed as a strategy employed to compensate for maladaptive response strategies is consistent with “escape theory” and affect regulatory explanations of emotional eating (Wallis & Hetherington, 2004). In support of this notion, greater reported use of maladaptive or ineffective coping strategies is associated with emotional eating and binge eating among both healthy adults and binge eaters (Evers, Stok, & de Ridder, 2010; Spoon et al., 2007; Whiteside et al., 2007).

Nolen-Hoeksema and colleagues have described two general classes of responses to distressing situations, each of which may confer vulnerability to anger-induced eating. Rumination is a maladaptive strategy that refers to repetitive thinking about the source and consequences of negative affect (Nolen-Hoeksema, 1991; Smith & Alloy, 2009). Rumination is linked to increased experience of negative affect and is thought to contribute to risk for depression (Mor & Winquist, 2002; Thomsen, 2006). In contrast, distraction is the adaptive strategy of turning attention away from the source or experience of negative affect (Nolen-Hoeksema, 1991). For example, one might exercise, listen to music, or engage in a hobby to divert attention away from negative affect. The effectiveness of distraction in regulating emotions was supported in a recent meta-analysis (Augustine & Hemenover, 2009).

Studies have demonstrated that response styles modify the intensity of an angry mood, with rumination associated with increased, and distraction with decreased experience of anger during laboratory mood induction protocols (Rusting & Nolen-Hoeksema, 1998).

Distraction and rumination may directly influence vulnerability to emotional eating following anger by either tempering, in the case of distraction, or heightening, in the case of rumination, one's response to an emotionally provocative situation. In one prior study, higher rumination was associated with greater desire to eat following stressful events in naturalistic settings (Kubiak, Vögele, Siering, Schiel, & Weber, 2008).

The present study extended prior research linking anger to the subjective motivation to eat by testing the impact of anger on objectively measured palatable food intake among normal weight and obese adults. We also examined whether distraction and rumination response styles are associated with vulnerability to anger-induced eating. Given prior research suggesting that associations between affective traits and emotional eating are specific to overweight or obese individuals (Jansen et al., 2008), we hypothesized that obese individuals with lower self-reported use of distraction and higher reported rumination would demonstrate an increase in palatable food intake following an anger mood induction, whereas the associations between response styles and anger-induced eating would be attenuated or absent among normal weight individuals.

2. Methods

2.1 Participants

Healthy men and women with a BMI in the normal weight (BMI: 18.5-25) or class I/class II obese (BMI: 30-40) range were recruited through printed advertisements for a study of “memory and food preferences” posted in the community and on a medical center campus. Eligibility criteria were assessed through an initial telephone interview and a subsequent laboratory screening visit. Participants were excluded if they endorsed any of the following: (1) any uncontrolled health condition (e.g., recent myocardial infarction, uncontrolled hypertension, diabetes); (2) DSM-IV criteria for a psychotic disorder, substance abuse or dependence, bipolar disorder, anorexia nervosa, or bulimia nervosa; (3) use of medications known to affect appetite or mood or to suppress menstruation; (4) active suicidal ideation or behavior; (5) illiteracy; (6) pregnancy, intention to become pregnant, lactation, or history of severe premenstrual distress; (7) smoking >3 cigarettes/day or daily use of any nicotine product; (8) use of appetite suppressants; (9) history of obesity surgery; (10) food allergy or sensitivity. Additionally, participants were excluded if they failed to respond to a test negative mood induction (described below) during the laboratory screening visit. The Institutional Review Boards of University of Illinois-Chicago and University of Massachusetts Medical School Human approved study procedures.

2.2 Procedure

2.2.1 Screening visit—Written consent was obtained upon arrival to the laboratory. BMI [weight (kg)/height²(m)] was derived from measurements taken in light clothing on a balance beam scale to ensure that participants were in an eligible BMI category (i.e., 18.5-25, 30-40). The Structured Clinical Interview for DSM-IV, nonpatient version (SCID-NP; Spitzer, Williams, Gibbon, & First, 1992) was administered to rule out the presence of exclusionary Axis I disorders.

Participants who remained eligible following the SCID-NP completed a test mood induction to ensure that they could be induced into a negative mood. To reduce demand characteristics, the mood inductions were described as methods to help the researchers determine whether memories of everyday experiences affect enjoyment of food. Based on Litt et al. (Litt, Cooney, Kadden, & Gaupp, 1990), participants were asked to describe a number of emotionally positive, negative, and neutral events in the past year, including situations that currently made them very angry. For the neutral mood induction, participants

were asked to recall engaging in a routine household task (e.g., washing dishes) that did not evoke a negative emotion. Participants rated each memory's vividness and ability to provoke various emotions on 10-point Likert scales ranging from 1= "not at all" to 10="very much." Among those rated 5 or more on both 'angry' and 'vividness', the memory with the highest 'angry' rating was selected as imagery for the mood induction. Participants were then asked to recall and re-experience the most intense anger memory provided (specific instructions described below). Mood ratings were collected on a 10-point Likert scale from 1= "not at all" to 10="extremely" prior to and immediately following the test mood induction. Of 116 individuals who completed the mood induction during the screening visit, 49 did not demonstrate an increase of at least 4 points in anger ratings following the anger induction and were deemed ineligible due to nonresponsiveness. These participants did not differ from enrolled participants on BMI ($F_{(1,108)}=.16$, $p=.69$) or sex (43% vs 26% male; $\chi^2_{(1,n=110)}=3.36$, $p=.07$). Six additional participants lost interest in participating after the screening visit and did not complete any of the experimental sessions. The final sample was composed of 61 normal weight ($n=37$) and obese ($n=24$) men and women who completed all study sessions.

At the conclusion of the screening visit, participants rated the palatability of 38 snack foods representing a variety of tastes, textures, and macronutrient composition on a 0-10 scale, where 0 was 'do not enjoy this food at all' and 10 was 'enjoy this food extremely.' Examples of study foods include peanut butter cups, potato chips, chocolate chip cookies, brownies, and ice cream. Participants were informed of brand names when possible and were not asked to attempt to rate foods they were not familiar with. Six foods that received a palatability rating higher than 6 out of 10 during the screening visit were offered to participants during study sessions.

2.2.2 Experimental sessions—Participants completed 2 experimental sessions occurring 1 to 6 days apart. Sessions involved either the neutral or anger mood induction. Participants also completed a session with an anxious mood induction as part of a separate study. The order of the three sessions was counterbalanced. A brief dietary recall interview was administered at the beginning of each session, and participants who had not complied with instructions to fast for 2 hours prior to experimental sessions were rescheduled ($n=1$). Participants completed baseline mood and hunger ratings following the dietary recall. The experimenter then introduced the mood induction task, again under the false pretense that the study examined how memories of everyday situations affect preferences for various foods. Participants were told that the specific memory selected for the mood induction was chosen at random. The participant was read the brief description of the memory they provided during their screening visit, and were then given the following instructions (Rusting & Nolen-Hoeksema, 1998; Wright & Mischel, 1982).

"During the next 7 minutes, try to re-experience the memory you've retrieved as vividly as you can. Picture the event happening to you all over again. Picture in your "mind's eye" the surroundings as clearly as possible. See the people or objects; hear the sounds; experience the events happening to you. Think the thoughts you actually had in that situation. Feel the same feelings you felt in that situation. Let yourself react as if you were actually there right now. Don't be afraid to really get into it, because we can bring you back to feeling as you did when you began the session."

Participants provided mood and hunger ratings immediately following the mood inductions. Then, participants were immediately presented with 400-kcal portions of 6 foods (total 2400 kcal) that they previously rated as highly palatable during the screening session. Participants were instructed to sample each food and to eat as much or as little as they like. They were told that all leftover food will be discarded after the session and they do not have the option

of taking any home. Participants were left alone to eat for 20 minutes. At the end of 20 minutes, participants provided mood and palatability ratings. A positive mood induction was then performed if mood had not yet recovered to baseline levels ($n=10$).

2.3 Measures

2.3.1 Axis 1 disorders—Axis 1 exclusion criteria was assessed by the structured interview modules for mood disorders, substance use disorders, anxiety disorders, and eating disorders of the Structured Clinical Interview for DSM-IV, Nonpatient Version (SCID-NP; (Spitzer et al., 1992)). Satisfactory reliability data for these diagnoses have been reported, and the SCID-NP compares favorably with other diagnostic assessment methods (Williams, Gibbon, First, & Spitzer, 1992).

2.3.2 Anger—The Profile of Mood States (POMS; (McNair, Lorr, & Droppleman, 1992)) was administered to evaluate anger response to the mood induction, and to ensure that participants had adequately recovered from the mood induction prior to leaving the laboratory. Participants are asked to rate the extent to which they are experiencing affective states at the time of assessment from “0-not at all” to “4-extremely.” The POMS includes 65 items corresponding to both positive and negative affective states. The anger subscale, which was used for this study, contains 12 items. Anger reactivity was calculated as the change in anger ratings from baseline to immediately following the anger mood induction.

2.3.3 Distraction and Rumination—Distraction and rumination were assessed at the end of the screening visit with a 32-item Response Styles Checklist (RSC) developed by Nolen-Hoeksema and colleagues (Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Participants rated the frequency with which they typically experience or engage in 16 distracting and 16 ruminative thoughts and behaviors when they “feel down, sad, or depressed.” Responses were provided on a 4-point scale ranging from “almost never” to “almost always”. The statistical clustering of RSC items into distraction and rumination strategies was previously confirmed (Nolen-Hoeksema et al., 1993) and both scales had adequate internal consistency in the current study (Distraction, $\alpha=.73$; Rumination, $\alpha=.80$). Although this measure refers to responses to depressed mood, distraction and rumination have a similar impact on angry mood (Rusting & Nolen-Hoeksema, 1998), and response styles are relatively consistent across situations and emotion states (Mikolajczak, Nelis, Hansenne, & Quoidbach, 2008; Ptacek, Pierce, & Thompson, 2006).

2.3.4 Hunger—Hunger was assessed at baseline and following the test meal in both conditions via a 0-10 rating of hunger, with 0 as ‘not hungry at all’ and 10 as ‘extremely hungry.’

2.3.5 Palatability—On each study day, palatability of each food item was measured on a 0-10 scale, with 0 being ‘do not enjoy this food at all’ and 10 being ‘I enjoy this food extremely.’

2.3.6 Food Intake—Calorie intake was the primary dependent variable in this study. Six foods were served to the participant in 400 kcal portions. Each 400 kcal portion was weighed (in grams) before consumption. The food remaining after the experimental session was weighed again, and the difference between the pre-session food weight and post-session weight was calculated and then converted from grams to kilocalories using nutrition information from the food packages.

2.4 Data Analysis

Our primary analyses tested whether 1) induced anger was associated with changes in energy intake, 2) individual differences in distraction and rumination were associated with vulnerability to anger-induced eating, and 3) if these associations differed among obese and normal weight participants. In all analyses, we used repeated measures general linear models (GLM; SPSS 17.0) to characterize the pattern of within-subjects change in energy intake during the neutral and anger conditions. Distraction and rumination were entered as continuous predictors in separate models, along with their interaction terms with BMI group, in order to examine their independent effects on energy intake. Age, sex, and mood induction sequence were entered as control variables in all models, and Huynh-Feldt corrections for sphericity violations were applied. Eta-squared (η^2), representing the percentage of total variance in the pattern of within-subjects change in energy intake accounted for by a predictor variable, is reported as a measure of effect size. Data from one normal weight subject was excluded from analyses predicting within-subjects change in snack intake due to an outlying value for change in snack intake (increase of 1,251 kcals; >4 SDs above the mean). The significance and direction of the effects reported below were not affected by the removal of this case.

3. Results

3.1 Preliminary analyses

Sample characteristics are shown in Table 1. T-tests were performed to compare BMI groups on several measures. Four subjects (3 normal weight, 1 obese) had some missing data due to incomplete questionnaire items. The obese group comprised a larger percentage of females ($\chi^2_{(1,N=61)}=3.86$, $p<.05$). BMI groups did not differ on trait anger ($p=.37$), distraction ($p=.77$), or rumination ($p=.24$).

As a manipulation check, we examined the degree to which the anger induction elicited a change in anger ratings on the POMS anger scale. Anger ratings significantly increased from baseline to post-induction ($M=1.9$, $SD=4.4$ vs. $M=17.6$, $SD=11.2$, respectively; $t_{(60)}=-11.32$, $p<.001$). The magnitude of change in subjective anger, reflected in anger reactivity change scores, was similar for normal weight and obese participants ($M=15.3$, $SD=9.6$ vs. $M=16.3$, $SD=12.6$, respectively; $p=.73$). Distraction ($r=.22$, $p=.10$) and rumination ($r=.11$, $p=.59$) were not significantly correlated with anger reactivity.

Hunger ratings from the neutral mood and anger conditions were equivalent at baseline as well as post-meal, and did not differ by BMI group (see Table 1). Hunger ratings significantly declined from baseline to post-meal in both the neutral ($M=6.39$, $SD=2.09$ vs. $M=1.64$, $SD=1.07$, $t_{(60)}=16.46$, $p<.001$) and anger ($M=6.44$, $SD=1.90$ vs. $M=1.90$, $SD=1.36$, $t_{(60)}=18.64$, $p<.001$) conditions. The correlations between baseline hunger ratings and snack intake in each condition were relatively modest (neutral condition: $r_{(61)}=.25$, $p=.05$; anger condition: $r_{(61)}=.29$, $p=.02$). BMI groups did not differ in energy intake (Table 1) in the neutral ($F_{(1,59)}=.02$, $p=.90$, $\eta^2=.00$) and anger mood conditions ($F_{(1,59)}=.13$, $p=.72$, $\eta^2=.00$).

3.2 Primary analyses

3.2.1 Main effect of anger—Analyses showed no overall effect of condition (neutral vs. anger mood induction) on energy intake in the overall sample ($F_{(1,52)}=1.59$, $p=.21$, $\eta^2=.02$; Table 2). Including BMI group in the model as a control variable had no impact on the effect of condition. In a separate repeated measures GLM model, BMI groups were found not to differ in the within-subjects change in energy intake across conditions ($F_{(1,59)}=.30$, $p=.59$, $\eta^2=.00$), indicating that vulnerability to anger-induced eating did not differ between obese and normal weight individuals. Though *mean* change in energy intake between conditions

was trivial ($M=-4.1$ kcals), there was substantial *variability* in the effect of condition on energy intake ($SD=294.2$ kcals, median absolute change= ± 117.9 kcals; see Table 1 for energy intake data in each session). Subsequent analyses tested whether distraction and rumination, and their interaction with BMI group, accounted for this variability in the within-subjects change in energy intake.

3.2.2 Distraction—A model was formed predicting the pattern of within-subjects change in energy intake from distraction, BMI group, the BMI group X distraction interaction term, and age, sex, and mood induction sequence as control variables. Results revealed a significant BMI X distraction interaction on food intake ($F_{(1,46)}=4.77$, $p=.03$, $\eta^2=.07$; Table 2, Figure 1) such that higher distraction score was associated with less intake following anger induction among obese participants ($F_{(1,14)}=6.12$, $p=.03$, $\eta^2=.14$), but no association was found among normal weight participants. The BMI X distraction interaction term ($F_{(1,44)}=4.29$, $p=.04$, $\eta^2=.07$) and the simple effect of distraction within the obese group ($F_{(1,12)}=4.56$, $p=.05$, $\eta^2=.11$) remained significant when baseline hunger ratings and trait anger were added simultaneously to the model.

3.2.3 Rumination—A second repeated measures GLM was used to determine if rumination interacted with BMI status to predict energy intake following the anger mood induction. The model included rumination, BMI group, the BMI group X rumination interaction term as predictors, with age, sex, and mood induction sequence as control variables. None of the predictor variables were significant in this model (Table 2), or in a subsequent model that included baseline hunger ratings and trait anger as additional control variables.

4. Discussion

The present study sought to extend previous research by testing the effect of experimentally-induced anger on objectively measured intake of highly palatable snacks. Given that emotion states have varied effects on eating behavior across individuals (Greeno & Wing, 1994; Jansen et al., 2008; Rutters, Nieuwenhuizen, Lemmens, Born, & Westerstorp-Plantenga, 2009a), we also tested whether stable individual differences in response styles previously linked to the experience of anger confer vulnerability to anger-induced changes in energy intake among obese individuals. While induced anger did not impact energy intake in the overall sample, distraction response style was associated with anger-induced change in snack consumption among obese participants. Specifically, obese participants who reported less frequent use of distraction strategies demonstrated increased energy intake in response to anger relative to a neutral mood, whereas obese participants who reported greater use of distraction strategies did not. The effect was not accounted for by trait anger, gender, sex, or age. Contrary to hypotheses, rumination did not account for changes in snack intake following the anger induction in either normal weight or obese participants.

Findings provide support for the notion that the availability of adaptive strategies for responding to negative emotions, such as healthy distraction (Nolen-Hoeksema, 1991), might reduce one's reliance on eating as a coping mechanism (Evers et al., 2010; Spoor et al., 2007; Whiteside et al., 2007). Obese individuals with few distraction response strategies might rely heavily on food for distraction or as a way to regulate negative affect, especially when food is easily accessible during the experience of negative affect. Increasing the use of distraction response strategies during periods of anger among obese individuals may be helpful in reducing emotional eating. Dialectical behavior therapy, which emphasizes the acquisition of emotion regulation strategies, has been shown somewhat effective as a treatment for binge eating disorder (Telch, Agras, & Linehan, 2001; Wiser & Telch, 1999), and further research is warranted to determine its efficacy for reducing emotional eating

among non-bingeing obese individuals. Behavioral activation treatment (Hopko, Lejuez, Ruggiero, & Eifert, 2003; Lejuez, Hopko, Acierno, Daughters & Pagoto, 2001) may also be beneficial for reducing emotional eating given its aim of improving mood by replacing negative affect-producing behaviors with healthier responses. This process is highly congruent with the nature of distracting responses, which involve “purposeful turning of one's attention away from one's symptoms... to pleasant or neutral activities (Nolen-Hoeksema, 1991, p.570).” Future research should test whether treatments such as behavioral activation, dialectical behavior therapy, or others can reduce emotional eating by promoting the use of distraction response strategies.

In the current study, the association between distraction and emotional eating was observed among obese, but not normal weight individuals. Given that obesity does not appear to be directly associated with proneness to emotional eating, both in this study and others (Appelhans, Pagoto, Peters, & Spring, 2010; Torres & Nowson, 2007), it is unclear why distraction (or other affective traits) would correlate with emotional eating only among obese individuals. The differential association between distraction and emotional eating among normal weight and obese participants was not driven by group differences in distraction or reactivity to the mood induction. It may be that individuals who are predisposed to emotional eating due to limited use of distraction have become obese over time, or that other unmeasured factors differentially impact emotional eating in normal weight and obese participants. The nature of this cross-sectional study limits our ability to differentiate between these two possibilities.

It is also unclear why rumination, a maladaptive response style that prolongs the experience of anger (Rusting & Nolen-Hoeksema, 1998), was unrelated to anger-induced eating in our sample. It is possible that the availability of adaptive responses such as distraction buffers the potential impact of maladaptive response styles on emotional eating. Alternatively, whereas distraction responses might affect eating behavior more rapidly, our experimental protocol may not have provided enough time for ruminative processes (e.g., focusing on negative affect, social withdrawal) to influence eating behavior. Given that we assessed stable individual differences in response style and did not manipulate or measure the actual use of specific strategies during the study, we are unable to evaluate this possibility.

The current findings highlight the value of understanding emotional eating within a “stress and coping” framework. The most widely studied vulnerability factor in emotional eating is dietary restraint. Self-report measures of “dietary restraint” at least partially explain individual differences in emotional eating, particularly among women (Greeno & Wing, 1994; Torres & Nowson, 2007; Wardle, Steptoe, Oliver, & Lipsey, 2000; Zellner et al., 2006). However, the exact nature of the construct reflected in measures of dietary restraint is quite unclear, and recent evidence suggests that dietary restraint measures do not correspond to attempted dietary restriction or a state of reduced energy balance (Stice, Cooper, Schoeller, Tappe, & Lowe, 2007; Stice, Sysko, Roberto, & Allison, 2009) and more likely reflect an endogenous vulnerability to weight gain (Lowe & Kral, 2006; Rutters, Nieuwenhuizen, Lemmens, Born, & Westerterp-Plantenga, 2009b). Maladaptive responses (e.g., avoidance, emotion suppression) are associated with increased emotional eating among those reporting high levels of dietary restraint (Evers et al., 2010; Lee, Greening, & Stoppelbein, 2007), suggesting that response style may be an important factor for understanding emotional eating even when considering other known vulnerability factors.

The present study had several noteworthy strengths and limitations. Unlike many prior laboratory eating studies that exposed all participants to a standardized set of foods, participants in the current study were presented with equicaloric portions of their most preferred foods. This approach would be expected to reduce extraneous variance in food

intake associated with taste preferences and increase the external validity of our study. Other strengths include the application of relatively stringent eligibility criteria to eliminate eating disorders and other pathology, and the use of a validated mood-induction protocol. A limitation of the study is that the sample included a relatively small proportion of men, and we excluded overweight (BMI 25.0-29.9) and severely obese (BMI >40) individuals and individuals who were unable to be induced into a negative mood during screening. Therefore, the generalization of our findings to these excluded populations is limited. A second limitation is that the measure of distraction and rumination response style used in this study has been most frequently used in context of depressed mood and has not been specifically validated for measuring responses to anger. Though rumination and distraction have been found to similarly impact the experience of anger and depressed mood (Rusting & Nolen-Hoeksema, 1998), a validated anger-specific measure would have been preferred. Finally, while participants were not aware that the *amount* of food consumed was being measured, the knowledge that food preference was a focus of the study may have affected food intake. Given that food intake was quite high in this study (approximately 1,000 kcals on average in both conditions), and that the presence of an observer would be expected to decrease food intake (Herman, Roth, & Polivy, 2003), it is unlikely that food intake was meaningfully affected by the description of the study provided to participants.

4.1 Conclusions

That distraction response style was associated with food intake following anger in obese (but not normal weight) participants is consistent with the notion that adaptive responses to emotional distress reduce one's vulnerability to emotional eating. Future studies should pursue the physiological mechanisms underlying this effect, and examine the potential benefits of coping skills training to reduce emotional eating.

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Figure 1.

Associations between distraction and change in energy intake among normal weight and obese participants. Positive values reflect an increase in energy intake from the neutral mood condition to the anger condition. Analyses were conducted using repeated measures general linear models; the change in energy intake score was computed for graphical purposes only.

Table 1

Sample characteristics.

	Total (N=61)	Normal weight (n=37)	Obese (n=24)
	<i>M (SD)</i>		
Age (y) *	34.6 (11.4)	31.8 (10.6)	39.0 (11.4)
Height (m)	1.7 (.1)	1.7 (.1)	1.7 (.1)
Weight (lbs) *	77.8 (20.2)	65.5 (11.9)	96.8 (14.8)
Body mass index *	27.6 (6.6)	22.8 (1.7)	34.9 (4.0)
Distraction (n=58)	37.8 (6.0)	37.7 (5.8)	38.1 (6.4)
Rumination (n=57)	30.6 (6.9)	31.5 (7.2)	29.3 (6.3)
Trait anger (n=59)	27.6 (6.5)	26.9 (6.5)	28.5 (6.5)
Anger reactivity [†]	15.7 (10.8)	15.3 (9.6)	16.3 (12.6)
Food intake (kcal)			
Neutral condition	1000.2 (363.8)	995.7 (410.8)	1007.3 (284.7)
Anger condition	996.1 (317.5)	1008.1 (342.1)	977.6 (281.4)
Hunger			
Neutral condition, baseline	6.4 (2.1)	6.2 (2.3)	6.8 (1.8)
Neutral condition, post-meal	1.6 (1.1)	1.8 (1.1)	1.5 (1.1)
Anger condition, baseline	6.4 (1.9)	6.3 (2.1)	6.7 (1.6)
Anger condition, post-meal	1.9 (1.4)	1.9 (1.3)	1.9 (1.5)
	<i>n (%)</i>		
Sex *			
Female	45	24	21
Male	16	13	3
Ethnicity			
Caucasian	50 (82.0)	29 (78.4)	21 (87.5)
African-American	6 (9.8)	4 (10.8)	2 (8.3)
Asian, Pacific Islander	4 (6.6)	3 (8.1)	1 (4.2)
Multi-ethnic	1 (1.6)	1 (2.7)	0 (0.0)

* Significant BMI group differences at $p < .05$.[†] Positive values reflect an increase in anger ratings from baseline to post-induction.

Table 2

Results of primary analyses predicting within-subjects change in energy intake.

	<i>F</i>	<i>df</i>	<i>P</i>	η^2
Model 1: Main effect of anger induction				
Condition	1.59	1,52	.21	.02
Age $\times$ Condition	2.62	1,52	.11	.04
Sex $\times$ Condition	.68	1,52	.41	.01
Mood induction sequence $\times$ Condition	1.49	5,52	.21	.12
Model 2: Distraction				
Condition	1.51	1,46	.23	.02
Age $\times$ Condition	3.26	1,46	.08	.05
Sex $\times$ Condition	.53	1,46	.47	.01
Mood induction sequence $\times$ Condition	1.49	5,46	.21	.11
Distraction $\times$ Condition	.19	1,46	.67	.00
BMI group $\times$ Condition	5.03	1,46	.03	.07
Distraction $\times$ BMI group $\times$ Condition	4.77	1,46	.03	.07
Model 3: Rumination				
Condition	1.18	1,45	.28	.02
Age $\times$ Condition	2.90	1,45	.10	.05
Sex $\times$ Condition	.33	1,45	.57	.01
Mood induction sequence $\times$ Condition	1.16	5,45	.35	.10
Rumination $\times$ Condition	.01	1,45	.93	.00
BMI group $\times$ Condition	.74	1,45	.40	.01
Rumination $\times$ BMI group $\times$ Condition	.61	1,45	.44	.01