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Attentional biases towards food and body stimuli among individuals with disordered eating versus food allergies

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ABSTRACT

Background and objectives: Individuals with disordered eating display heightened attentional biases towards food- and body-related stimuli. However, it is unknown whether these attentional biases reflect maladaptive thinking/eating pathology. We investigated the differences between maladaptive and adaptive ways of thinking about food by assessing food- and body-related attentional biases among individuals with disordered eating, participants with peanut allergies (i.e., individuals who think frequently about food in an adaptive manner), and healthy controls. We also examined the extent to which negative mood and rumination exacerbated attentional biases among those in these groups.

Method: Three hundred and twenty-one individuals with disordered eating ($n = 139$), peanut allergies ($n = 60$), and healthy controls ($n = 122$) completed food- and body-based Stroop tasks prior to and following a cognitive rumination task designed to increase negative mood.

Results: Individuals with disordered eating and individuals with peanut allergies had significantly worse performance on the food and body Stroop tasks relative to healthy controls at baseline ($ps < .001$). However, there were no perceived differences in performance by group following rumination.

Limitations: The cognitive rumination task heightened negative mood for those in the disordered eating group but not for those in the peanut allergy or healthy control groups.

Conclusions: Findings suggest that frequent thoughts involving food are associated with attentional biases towards food and body stimuli. This appears to be the case regardless of whether these frequent thoughts are due to disordered eating or to fear of an allergic reaction.

1. Introduction

Eating disorders are serious mental illnesses that compromise emotional health and are associated with high rates of suicide and mortality (Franko et al., 2013; Rikani et al., 2013). Disordered eating is associated with greater levels of psychopathology, stress, and impairment even at the subthreshold level (Stice et al., 2013; Thomas et al., 2009). This highlights the need for a better understanding of mechanisms underlying disordered eating to inform potential targets for clinical prevention and intervention efforts.

One such mechanism is perseveration on food and the body, which is characteristic of eating disorders (American Psychiatric Association, 2013). In accordance with this, individuals with disordered eating display attentional biases—a cognitive pattern whereby individuals pay more subconscious attention than others to a given construct—towards food (Dobson & Dozois, 2004; Johansson et al., 2005; Pinhas et al., 2014; Ralph-Nearman et al., 2019; Werthmann et al., 2015) and body stimuli (Allen et al., 2018; Dobson & Dozois, 2004; Johansson et al., 2005; Ralph-Nearman et al., 2019) relative to healthy controls.

However, there is debate as to what may underly these attentional biases. Some research has highlighted that, under different circumstances, biased attention could reflect an approach motivation (i.e., will to engage with a stimulus), whereas in other cases, it could represent an avoidance motivation (i.e., will to cease engagement with a stimulus; Smeets et al., 2008; Werthmann et al., 2011, 2013, 2014). Other researchers have wondered whether these biases represent an inherently maladaptive relationship with food and the body or whether they may be confounded by frequent thoughts surrounding these constructs (Faunce, 2002).

Among individuals with disordered eating, attentional biases to food

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and body are associated with greater negative mood and higher frequency of eating disorder behaviors (Naumann et al., 2015; Smith et al., 2020; Svaldi et al., 2016). Disordered eating is associated with other maladaptive emotion regulation strategies, such as rumination (i.e., repetitive thinking about thoughts or events; Haynos et al., 2018; Haynos & Fruzzetti, 2011; Smith et al., 2018; Wang et al., 2017; Wang & Borders, 2018). Furthermore, rumination surrounding thin-ideal bodies is associated with increased negative affect, even among those without disordered eating (Dondzilo et al., 2018, 2020). Thus, it may follow that these behaviors, such as purposefully restricting food or overeating characterized by loss of control, function as an emotion regulation mechanism for negative affect. To our knowledge, no studies have thus far induced negative mood in individuals with disordered eating prior to an attentional bias task. However, studies have induced negative mood among participants with eating pathology to assess the effects on eating pathology behaviors. Findings have been mixed; some have found that individuals with eating pathology are more likely to engage in disordered eating behaviors, like binge eating, following this induction (Loxton et al., 2011; Yeomans & Coughlan, 2009), whereas others have found no association between emotional state and eating disorder behaviors (Wallis & Hetherington, 2009; Werthmann et al., 2014).

Yet, no studies to date have aimed to tease apart mood, emotion dysregulation, and attentional biases to food and body among individuals who think frequently about these constructs in a maladaptive versus adaptive manner. For individuals who think maladaptively about food and the body (e.g., those with disordered eating), these biases may be linked to negative affect and poor emotion regulation. However, this may not be the case for those who think frequently about food and/or the body in an adaptive manner.

One group of people who think frequently about food for adaptive reasons are those with peanut allergies. Individuals with food allergies must avoid foods containing their allergen and pay careful attention in any situation where food may be present (Herbert & Dahlquist, 2008). This may be especially true for individuals whose allergies result in anaphylactic reactions, which is often the case for those with peanut allergies (Bock et al., 2001). Previous research has established that food is a salient cue for these individuals (Shanahan et al., 2015), though to our knowledge, no studies to date have investigated whether individuals with food allergies demonstrate attentional biases to food- or body-related stimuli. In this way, individuals with peanut allergies make a particularly useful comparison group when examining attentional biases to food-related words. Investigation of attentional biases to food and body stimuli in individuals with peanut allergies may shed light on the relationship between attentional biases and emotion regulation in groups with maladaptive versus adaptive thoughts related to food.

The current study aimed to disentangle the association between attentional biases and content of thoughts about food/bodies. In addition, we aimed to examine the roles of negative mood and cognitive rumination in food- and body-related attentional biases. To test these questions, we recruited a group of individuals with disordered eating, a group with peanut allergies, and a group of healthy controls and assessed performance on food- and body-based Stroop tasks. We hypothesized that individuals with disordered eating and individuals with peanut allergies would demonstrate heightened attentional biases (i.e., slower reaction times) on food-related Stroop words relative to healthy controls. This is because both groups devote attention towards food cues, whether due to eating pathology or health concerns. For body-related Stroop words, we predicted that individuals with disordered eating would display heightened attentional biases relative to those with peanut allergies and healthy controls. We hypothesized that a cognitive rumination task would exacerbate attentional biases towards food-and body-related stimuli on a second Stroop task for individuals with disordered eating but not for those with peanut allergies or healthy controls. All hypotheses were specified before data was collected.

2. Materials and methods

2.1. Participants

Participants included 321 individuals (*M*age = 35.4, *SD* = 11.19). This sample size was determined using a power analysis accounting for adequate power (0.80) to detect medium effects ($f^2 = 0.20$) at alpha <.05, given six groups (disordered eating: rumination/distraction, peanut allergies: rumination/distraction, healthy controls: rumination/distraction). Inclusion criteria for all groups included female gender, English fluency, and 18+ years of age. We included only female participants because most individuals with disordered eating are female (Brown et al., 2020; Hudson et al., 2007) and the food and body stimuli used in this study had only been validated among women (Mahamedi & Heatherton, 1993). Given that men and women endorse different body image ideals (Forrest et al., 2019; Lavender, Brown, & Murray, 2017; Nagata et al., 2019), the specific stimuli used in this study may not have generalized as well to men. Individuals in the disordered eating group scored above a cut-off of 2.3 on the Eating Disorders Examination Questionnaire (EDE-Q; Mond et al., 2004) and did not endorse peanut allergies. Individuals in the peanut allergies group endorsed a peanut allergy and were required to score below a 1.7 on the EDE-Q. These scores were selected based on previous research on community norms for the EDE-Q (Fairburn & Beglin, 1994). Individuals in the healthy control group did not endorse peanut allergies and were required to score below 1.7 on the EDE-Q.

Between all three groups, 1,493 individuals were screened for this study. We excluded 519 individuals for reporting a non-female gender and 192 for reporting a non-peanut allergy. Of individuals who identified as female and had a peanut allergy, we excluded 220 for having EDE-Q scores above the clinical cut-off. Of individuals without allergies, we excluded 21 for having EDE-Q scores in between the clinical cut-off and community norms. Of those who qualified and completed the survey, 166 individuals were removed due to incomplete data or due to failing attention checks (described in more detail in the Data Analysis section).

2.2. Measures

2.2.1. Attentional bias

Attentional bias was measured using a modified Stroop task. This task measures how quickly participants can identify the color of words presented on a computer screen. Longer response times indicate greater interference from the semantic content of the word, indicating attentional bias towards the word itself. The Stroop task itself cannot parse approach and avoidance motivations that may underly attention bias, for which others like the dot-probe task, especially when used in tandem with eye-tracking, may be better equipped (Smeets et al., 2008; Werthmann et al., 2014). However, the emotional Stroop task has demonstrated feasibility of online dissemination, allowing for collection of large sample sizes (Johansson et al., 2008). Given concerns about reliability of the dot-probe task (Chapman et al., 2019), and the difficulty of conducting eye-tracking methods online, we chose to use a Stroop task.

Based on previous research using a modified Stroop task to assess biases in clinical populations (Cha et al, 2010, 2018; Stewart et al., 2016) and research demonstrating that the valence of words may affect responses (Redgrave et al., 2008), we used a blocked design for the Stroop task, with each block containing one word from six groups: 1) food words, 2) body words, 3) peanut words, 4) positive words, 5) negative words, and 6) neutral words. We created eight blocks, with each block containing one of each category of word. Blocks were presented to participants in a random order, and words within each block were also randomized. Split-half reliability was high for both food ($r = 0.86$) and body ($r = 0.84$) Stroop words.

The positive, negative, and neutral words were taken from the

Affective Norms for English words (Bradley & Lang, 1999) and were included to control for any possibility that the valence of particular words may have explained certain patterns of results. Peanut-related words were included to examine whether individuals with peanut allergies experience biases towards food-related words in general or towards only words related to their allergy specifically. A list of all words used is provided in the supplementary materials.

2.2.2. Mood ratings

To assess state ratings of mood, we used two Likert scale mood ratings from 1 (not at all) to 7 (very much) asking participants "How positive do you feel?" and "How negative do you feel?" The order in which these two questions were presented was counterbalanced across participants.

2.2.3. Eating disorders examination-questionnaire (Fairburn & Beglin, 1994)

The Eating Disorders Examination Questionnaire (EDE-Q) is a 28-item questionnaire that assesses eating pathology over the past 28 days. Higher scores indicate greater levels of eating pathology. The Eating Disorders Examination Questionnaire has been shown to have high reliability and validity (Berg et al., 2012). In the current study, Cronbach's α was 0.96.

2.2.4. Ruminative responses scale (Nolen-Hoeksema & Morrow, 1991)

The Ruminative Responses Scale is a 22-item questionnaire that assesses depressive rumination, with higher scores indicating greater levels of rumination. The Ruminative Responses Scale has been shown to have high internal consistency and validity, in that participants who report high scores tend to ruminate more frequently in everyday life (Nolen-Hoeksema & Morrow, 1991). In the current study, Cronbach's α was 0.96.

2.2.5. Emotion regulation questionnaire (Gross & John, 2003)

The Emotion Regulation Questionnaire is a 10-item questionnaire that includes two factors, with the first measuring reappraisal (e.g., "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm") and the second factor measuring suppression (e.g., "I keep my emotions to myself"). Higher scores on these factors indicate higher levels of reappraisal and suppression, respectively. Both factors have been shown to have high levels of validity and reliability (Gross & John, 2003). In the current study, Cronbach's α were 0.90 and 0.85 for the suppression and reappraisal subscales, respectively.

2.2.6. Beck depression Inventory-II (Beck, Steer, & Brown, 1996)

The Beck Depression Inventory-II is a 21-item questionnaire that is designed to identify symptoms and attitudes associated with depression. Higher scores indicate higher levels of depression. The Beck Depression Inventory-II has been shown to have high levels of validity and reliability (Beck et al., 1996). In the current study, Cronbach's α was 0.96.

2.3. Procedure

This study was approved by the Institutional Review Board. Participants were recruited using Amazon Mechanical Turk (MTurk). Following informed consent, participants completed mood ratings, the Time 1 Stroop task, and a second mood rating. Next, participants underwent a negative mood induction identical to that used by Fox et al. (2018, 2019) during which they wrote about a time they had failed. Participants wrote for 5 min and then completed a third mood rating.

They were then randomly assigned to either a rumination ($n = 163$) or distraction (n = 158) condition. In the rumination condition, participants continued writing about the same failure memory for another 3 min. Participants in the distraction condition heard a list of neutral words from the Affective Norms for English words (Bradley & Lang, 1999) and were asked to write down the words they heard, alternating between writing in capital or lowercase letters (see Fox et al., 2017). Participants then completed a fourth mood rating. Finally, participants completed the Time 2 Stroop task, followed by a final mood rating and a battery of questionnaires.

2.4. Data Analysis

All analyses were conducted in R (R Core Team, 2018) and were pre-specified based on the study hypotheses. Data were cleaned to ensure that all individuals included completed necessary components of the study and were dedicating adequate attention to the study. Participants were excluded if they failed to complete either Stroop task or any of the surveys, the negative mood induction, rumination, or distraction tasks. Participants were also excluded if they did not follow directions for any of the tasks (i.e., did not write about a negative memory and/or did not correctly transcribe words in the distraction task). In line with previous research on Stroop and other reaction time tasks (Munafò et al., 2003; Ratcliff, 1993), we excluded participants whose reaction times were faster or slower than two standard deviations from the mean for each word type. The number and percent of each group of participants included for each word type is listed in Table 1. Finally, in order to ensure participants were paying adequate attention during the study, we added timers to every page of the survey component of the study. This method was chosen as an alternative to traditional attention check questions, which are not reliable among professional survey respondents, like MTurk workers (Thomas & Clifford, 2017). Based on prior research, we holistically chose time cutoffs based on the lengths of surveys included (Kugler et al., 2010). If participants spent less than 30 seconds or more than seven minutes on a given questionnaire, they were excluded.

First, we used analyses of variance (ANOVAs) to explore differences in sample characteristics at baseline. As a partial manipulation check for the rumination versus distraction tasks, we also used 3 (mood rating: 1, 2, 3, 4, 5) x 3 (group: disordered eating, peanut allergies, healthy control) x 2 (condition: rumination, distraction) ANOVAs to test for changes in positive and negative mood throughout the study.

To test our primary hypothesis that individuals with disordered eating and peanut allergies would display elevated attentional bias to food-related words (compared to healthy controls) and that individuals with disordered eating would display elevated attentional bias to body-related words (compared to those with peanut allergies and healthy controls), we conducted two ANOVAs to compare Time 1 Stroop performance across groups. We additionally conducted ANOVAs to probe differences in peanut, positive, negative, and neutral words between groups.

To test our second hypothesis that rumination would exacerbate attentional bias for food- and body-related words for individuals with disordered eating (compared to those with peanut allergies and healthy controls), we conducted two 3 × 2 ANOVAs to test for main effects and interactions of participant group and experimental condition on changes in Stroop task performance from Time 1 to Time 2 for food- and body-related words. We additionally conducted 3 × 2 ANOVAs to probe differences from Time 1 to Time 2 in peanut, positive, negative, and neutral words between groups. For all between-group comparisons, we then used Cohen's *d* to estimate effect sizes.

3. Results

3.1. Baseline differences in sample characteristics and mood changes

There were no significant differences in demographics between groups (see Table 1 for baseline and clinical characteristics and Table 2 for correlations among all variables in the study). However, individuals with disordered eating displayed higher body mass index (BMI) than individuals with peanut allergies ($p < .001$, $d = 0.68$) and healthy

Table 1
Sample characteristics.

	Group		
	Disordered Eating (N = 139)	Healthy Controls (N = 122)	Peanut Allergies (N = 60)
Age, mean (SD)	33.77 (9.19)	35.91 (13.12)	37.05 (11.94)
Race/ethnicity			
Asian	1 (0.7%)	5 (4.1%)	3 (5%)
Black/African American	11 (7.9%)	13 (10.7%)	8 (13.3%)
Hispanic/Latino	7 (5%)	2 (1.3%)	5 (8.3%)
More than one race/ethnicity	9 (6.5%)	8 (6.6%)	4 (6.7%)
Native American/American Indian	0 (0%)	2 (1.3%)	0 (0%)
White	111 (79.9%)	92 (75.4%)	40 (66.7%)
Body Mass Index (BMI), mean (SD)	29.86 (10.54)	24.44 (6.21)	23.65 (4.34)
Eating Disorders Examination Questionnaire, mean (SD)	3.93 (0.99)	0.71 (0.55)	0.67 (0.56)
Beck Depression Inventory, mean (SD)	27.80 (13.69)	9.47 (11.69)	11.57 (12.08)
Ruminative Responses Scale, mean (SD)	54.01 (15.34)	37.38 (14.54)	39.42 (14.06)
Emotion Regulation Questionnaire, mean (SD)			
Suppression subscale	4.11 (1.48)	3.27 (1.38)	3.74 (1.46)
Reappraisal subscale	4.73 (1.28)	5.08 (1.21)	5.23 (1.20)
Positive mood, mean (SD)			
Baseline positive mood	4.10 (1.74)	5.00 (1.63)	5.07 (1.63)
Positive mood following rumination task	2.16 (1.99)	3.90 (2.36)	3.73 (2.38)
Positive mood following distraction task	3.01 (1.66)	3.45 (2.06)	3.86 (2.05)
Negative mood mean, (SD)			
Baseline negative mood	2.61 (1.97)	1.52 (1.79)	1.36 (1.64)
Negative mood following rumination task	4.33 (2.20)	2.65 (2.30)	2.79 (2.37)
Negative mood following distraction task	2.93 (1.86)	2.81 (2.25)	1.93 (1.90)
Reaction time for food words in milliseconds, mean (SD)	1006.01 (319.64)	909.01 (272.07)	1085.82 (529.10)
Reaction time for body words in milliseconds, mean (SD)	1007.57 (311.45)	900.72 (254.24)	1043.30 (328.82)

	Food words	Body words	Peanut words	Positive words	Negative words	Neutral words
Sample included after removing outliers[a] (%)	308 (96.0)	307 (95.6)	318 (99.1)	309 (96.3)	316 (98.4)	309 (95.6)
Error rates, mean (SD)	4.63 (2.20)	4.38 (2.26)	4.75 (1.28)	5.53 (2.67)	5.00 (3.12)	4.88 (3.56)

Note. SD is used to represent standard deviation. Reaction times reflected in the table reflect raw means and standard deviations. Means/standard deviations after removing outliers are included in the main text.
Error rates indicate the mean number of incorrect key presses per word type.
[a] Outliers were defined as any participant who scored above or below two standard deviations from the mean for a given word type.

controls ($p < .001$, $d = 0.62$). This is in accordance with epidemiological research noting the prevalence of eating disorder symptoms across the weight spectrum, with particular prevalence among individuals whose BMIs are in the overweight and obese ranges (Hughes et al., 2019). Individuals with disordered eating also displayed higher levels of depression ($p < .001$, $d = 1.22$), trait rumination ($p < .001$, $d = 0.97$), emotional suppression, and lower levels of emotional reappraisal than those with peanut allergies and healthy controls. Individuals with peanut allergies reported higher levels of depressive symptoms ($p < .001$, $d = 0.18$), rumination ($p = .006$, $d = 0.14$), emotional suppression ($p < .001$, $d = 0.33$), and higher levels of reappraisal than healthy controls ($p < .001$, $d = 0.12$). Due to these differences, we added these variables as covariates in our ANOVA models to account for their variance. Since weight status may influence attentional biases to food and body stimuli (Werthmann et al., 2015), we ran all analyses a second time where groups were matched on BMI. In this iteration, the disordered eating group was reduced to 113 individuals such that $M_{BMI} = 25.66$, $SD_{BMI} = 5.42$ among this group. Of note, findings did not differ for BMI-matched analyses, and thus we report findings from the full sample below.

Positive and negative mood changed significantly throughout the study ($ps < .001$). All participants reported higher positive mood ($p < .001$, $d = 0.83$) and lower negative mood ($p < .001$, $d = 0.82$) before the Time 1 Stroop task, prior to the negative mood induction, compared to the Time 2 Stroop task, after the negative mood induction. Among individuals with disordered eating, those assigned to ruminate reported lower positive ($p = .006$, $d = 0.47$) and higher negative mood ($p < .001$, $d = 0.68$) than those assigned to distract, but there were no differences in mood by condition for individuals with peanut allergies or healthy controls.

3.2. Baseline differences in stroop task performance

3.2.1. Food-related words

Groups significantly differed on Time 1 Stroop performance for food-related words, $F(8, 311) = 5.12$, $p < .001$, η^2 partial = .03 (see Fig. 1; note: Stroop task reaction time was measured in milliseconds). Individuals with disordered eating ($M = 968.79$, $SD = 220.88$) and individuals with peanut allergies ($M = 987.41$, $SD = 249.16$) had slower reaction times ($p = .04$, $d = 0.25$, and $p = .02$, $d = 0.32$, respectively) relative to healthy controls ($M = 913.71$, $SD = 221.68$), as expected. There was no significant difference in reaction times for individuals with disordered eating relative to individuals with peanut allergies ($p = .36$, $d = 0.08$).

3.2.2. Body-related words

Groups significantly differed on Time 1 Stroop performance for body-related words, $F(8, 311) = 5.67$, $p < .001$, η^2 partial = .04 (see Fig. 2). Individuals with disordered eating ($M = 962.43$, $SD = 222.21$) and individuals with peanut allergies ($M = 1000.79$, $SD = 276.07$) had significantly slower reaction times ($p = .03$, $d = 0.22$ and $p = .008$, $d = 0.36$, respectively) for body-related words relative to healthy controls ($M = 914.46$, $SD = 216.36$). There was no significant difference between reaction times for individuals with disordered eating relative to individuals with peanut allergies ($p = .27$, $d = 0.16$).

3.2.3. Peanut-related words

There were no significant differences between groups on Time 1 Stroop performance for peanut-related words, $F(8, 311) = 1.99$, $p = .06$, η^2 partial = .02.

3.2.4. Positive, negative, and neutral words

There were no significant differences between groups on positive words, $F(8, 311) = 0.75$, $p = .61$, η^2 partial > .001, negative words, $F(8, 311) = 1.88$, $p = .08$, η^2 partial = .01, or neutral words $F(8, 311) = 1.99$, $p = .07$, η^2 partial = 006.

3.3. Effect of rumination on attentional bias

There were no significant group (disordered eating, peanut allergy, healthy control) x condition (rumination, distraction) interactions on change in Stroop-task performance from Time 1 to Time 2 for any of the categories of words. Namely, there were no differences in performance on the Stroop task, for individuals in the disordered eating group, between those who had been assigned to the rumination task and those who had been assigned to the distraction task.

Table 2
Pearson correlations of stroop task performance on food- and -related words, performance on questionnaires, and demographic data.

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. ERQ Reappraisal	4.96	1.26							
2. ERQ Suppression	3.72	1.49	-.15**						
3. RRS	44.96	16.82	-.27**	.37**					
4. BDI	17.79	15.43	-.32**	.39**	.81**				
5. EDE-Q	2.09	1.78	-.21**	.29**	.56**	.65**			
6. Age	35.42	11.20	.11*	-.13*	-.29**	-.23**	-.17**		
7. Food words	984.06	357.72	.04	-.03	.01	.08	.04	.24**	
8. Body words	973.64	299.41	.02	.00	.04	.08	.06	.32**	.61**

Note. M and *SD* are used to represent mean and standard deviation, respectively. ERQ = emotion regulation questionnaire, RRS = ruminative responses scale, BDI = beck depression inventory, EDE-Q = eating disorder examination-questionnaire. * $p < .05$, ** $p < .001$

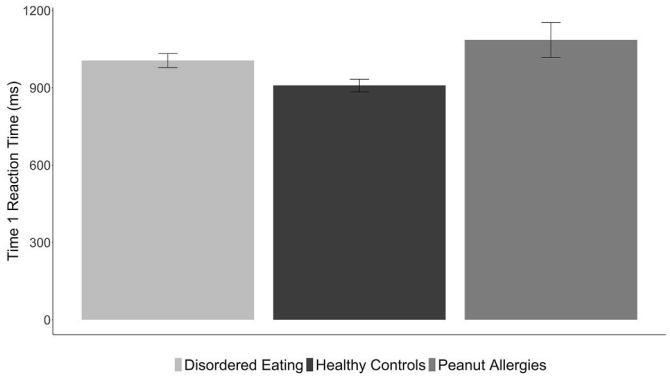

Fig. 1. Performance on food-related Stroop words.
Note. ms = milliseconds.

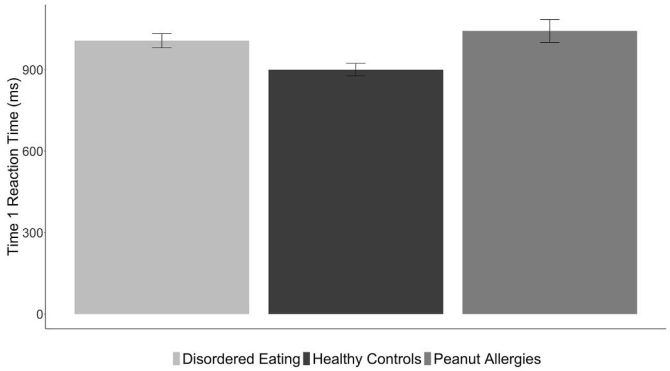

Fig. 2. Performance on body-related Stroop words.
Note. ms = milliseconds.

4. Discussion

This study investigated attentional biases towards food and body stimuli in individuals with disordered eating and individuals with peanut allergies, providing insight into a novel area of research. Findings suggest that individuals with disordered eating and individuals with peanut allergies exhibit greater attentional biases towards food and body stimuli compared to healthy controls. The current results are particularly notable as they demonstrate that individuals with peanut allergies displayed biases towards *both* food and body stimuli. The fact that these differences were not present for other types of words (e.g., positive and negative) supports the idea that these biases are more specific than general and involve food and body stimuli.

For both individuals with disordered eating and individuals with peanut allergies, food is not only a salient cue, but may represent an anxiety-provoking construct, whether due to maladaptive eating behaviors or an allergy. For individuals with disordered eating, the body also represents an anxiety-provoking construct. It is unknown, however, whether attentional biases towards body-related stimuli are linked to anxiety surrounding the body. Individuals with food allergies may attend acutely to bodily cues in stressful situations surrounding food (i.e., when there is a potential for an allergic reaction). For example, when individuals with food allergies consume a food that they later learn may contain their allergen, they may attend very closely to their bodies and how they are feeling, all while experiencing anxiety surrounding the food they have consumed.

Findings demonstrate that biases towards food- and body-related stimuli may not be specific to individuals with disordered eating. Given these findings, it is possible that heightened attentional biases towards food and body stimuli among individuals with food allergies may result in a higher risk of developing maladaptive behaviors towards food and the body. If individuals with food allergies develop attentional biases towards food and the body due to high frequency of thoughts surrounding food, they may be at higher risk for those biases to translate to maladaptive behaviors. This is supported by Wróblewska et al. (2018), who showed that individuals with food allergies have significantly higher levels of disordered eating than healthy controls. We also found some evidence for this hypothesis when examining the recruitment data for this study. We found that 61% of individuals with peanut allergies did not qualify for participation due to their EDE-Q scores being above the cut-off. Taken together, these findings support further investigation into whether individuals for whom food is a salient cue may be at risk for the development of disordered eating.

It is also possible that biases towards food and body stimuli may not represent an inherently maladaptive relationship with these constructs, as prior studies have suggested in their comparisons of individuals with disordered eating versus healthy controls. Individuals with food allergies think about food often for the adaptive purpose of staying healthy and avoiding an allergic reaction. Despite the high overlap between food allergies and disordered eating detected in screening, it is possible that individuals with peanut allergies in this study (without disordered eating) present differently than those with both peanut allergies and disordered eating. In other words, for the peanut allergy group in this study, these biases may be a byproduct of frequent thoughts surrounding food (whether due to food allergies or disordered eating), and the biases alone may not be indicative of a maladaptive relationship with food or the body. Future work should examine attentional biases to food and body stimuli longitudinally. This may help discern whether individuals for whom food and/or the body are salient cues (e.g., those with peanut allergies) are at risk for developing disordered eating over time or whether this may only be true for a subset of those with food allergies.

Although findings indicated that both individuals with disordered eating and peanut allergies displayed heightened attentional bias to food- and body-stimuli, mood ratings throughout the study provide insight into how these groups differentially respond to emotional stressors. Individuals with disordered eating were the only group who reported worse mood following the rumination versus distraction task.

Furthermore, those in the disordered eating group reported being in a significantly worse mood throughout the study, relative to those in the peanut allergy and healthy control groups. These findings highlight specific emotion regulation deficits present for individuals with disordered eating. This is in line with research demonstrating that individuals with eating pathology have a tendency to engage in maladaptive emotion regulation strategies, like rumination (Haynos et al., 2018; Haynos & Fruzzetti, 2011; Smith et al., 2018; Wang & Borders, 2018; Wang et al., 2017). This also mirrors findings that individuals who engage in non-suicidal self-injury demonstrate greater mood deterioration following this negative mood induction task, relative to healthy controls (Fox et al., 2019). Although the distraction task used in this study has proved an effective mood repair task in prior research (Fox et al., 2017), it is possible, especially among individuals with heightened emotion dysregulation, that a more robust mood repair task would more effectively heighten or neutralize mood.

Results of the current study should be considered in light of several limitations. First, participants self-reported their food allergies. However, our screening questionnaire included a list of various different allergies as well as other distractor items about food, diet, and alcohol consumption. This was done to reduce the likelihood that participants would infer our inclusion criteria and respond accordingly to be entered into the study. Second, only individuals in the disordered eating group reported increased negative mood following the rumination task relative to the distraction task. This limited our ability to interpret the findings of the Time 2 Stroop task. Nonetheless, the heightened emotional response to cognitive rumination in the disordered eating group provides insight into difficulty with emotion regulation among these individuals. These findings highlight the need for more precise future research examining what role poor emotion regulation and negative mood play in these attentional biases. Third, the use of the Stroop task to measure attentional bias precluded interpretation of approach versus avoidance motivation that may have been underlying attentional biases. It is also possible that visual or pictural stimuli would elicit different responses than words. Other tasks to measure attentional bias that can probe these underlying motivations and/or may have allowed for the use of pictural stimuli, like the dot-probe task, have limitations of reliability (Chapman et al., 2019). Accompanied measurement techniques, like eye-tracking, were not feasible due to the online study format. Nonetheless, it is important that future research use visual/pictural stimuli and other tasks to replicate these findings and provide further dimension to our understanding of attentional bias to food and body among those with disordered eating versus food allergies. Fourth, it is important to acknowledge that many of the food and body words used in this study may have elicited body dissatisfaction, carrying a more negative weight than positive or neutral food or body terms might. To rectify partially for this limitation, we included positive, negative, and neutral Stroop words that were unrelated to food or body to tease apart the influence of valence versus word type on Stroop performance. Importantly, there were no differences between groups on positive and negative words. Future research should validate and test attentional biases for food and body words of a variety of valences. Fifth, although all results remained the same after matching groups on BMI, future research should recruit samples matched initially on BMI in order to fully parse the effect of weight status versus eating pathology on attentional biases to food and body stimuli. Finally, generalizability of these findings is limited by the fact that we included only female-identifying individuals. Future work should investigate whether these findings generalize across genders. Generalizability is also limited by lack of racial and ethnic diversity in the current sample. Individuals of minoritized races and ethnicities experience unique risk factors for disordered eating (Egbert et al., 2020; Goel et al., 2020; Gordon et al., 2010; Monterubio et al., 2020), and future research should examine how attentional bias to food and body functions among those with disordered eating or food allergies within these communities.

5. Conclusions

This study provides important new information on the relationship between attentional biases towards food and body stimuli and engagement in maladaptive behaviors related to these constructs. It is already well established that individuals with disordered eating display heightened attentional biases towards food (Dobson & Dozois, 2004; Johansson et al., 2005; Pinhas et al., 2014; Ralph-Nearman et al., 2019; Werthmann et al., 2015) and body stimuli (Allen et al., 2018; Dobson & Dozois, 2004; Johansson et al., 2005; Ralph-Nearman et al., 2019) relative to healthy controls. However, the inclusion of the peanut allergy group in this study demonstrates that these biases may also be present in others for whom food is a salient cue. Findings provide more nuanced information about the potential relationship between food and body stimuli and their relationship with maladaptive behaviors.

CRediT authorship contribution statement

Melissa J. Dreier: Conceptualization, Software, Funding acquisition, Project administration, Formal analysis, Writing – original draft. **Shirley B. Wang:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Matthew K. Nock:** Conceptualization, Writing – review & editing. **Jill M. Hooley:** Conceptualization, Supervision, Writing – review & editing.

Declaration of competing interest

Dr Nock receives textbook royalties from Macmillan and Pearson publishers and has been a paid consultant in the past year for Microsoft, the Veterans Health Administration, and for a legal case regarding a death by suicide. He is an unpaid scientific advisor for TalkLife and Empatica. The other authors declare that they have no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbtep.2021.101657.

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