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Associations among Fear, Disgust, and Eating Pathology in Undergraduate Men and Women

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Abstract

Fear and disgust are distinct emotions that have been independently linked with EDs and may motivate avoidance behaviors that may be relevant targets for ED interventions (e.g., food rejection). Despite similar motivational function, it is possible that one emotion is more strongly associated with ED symptoms, relative to the other. Given that emerging evidence suggests that disgust-based behavior may be more difficult to change than fear-based behaviors, research is needed to evaluate whether each emotion differentially relates to ED symptoms. Therefore, the current study tested the relative importance of fear and disgust in accounting for variance in ED symptoms. Participants included undergraduate men ($n=127$) and women ($n=263$) from a university in the northeast US. Participants completed self-report measures assessing

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Conflict of Interest Disclosure Statement

The authors have no conflicts of interest to declare.

Authors' Contributions

Authors LA, ER, and DA collaborated in designing the study. The data were analyzed by LA, who also drafted the manuscript with substantial contributions from ER, JT, KE, DF, JM, and DA. All authors read and approved the final manuscript.

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demographics, disordered eating attitudes and behaviors, and visual analog scales assessing fear and disgust responses to high-calorie food images, low-calorie food images, and non-food fear and disgust images. Bivariate correlations revealed significant positive associations among fear, disgust, and EDE-Q global symptom scores. Relative weights analysis results yielded relative importance weights that suggested disgust responding to high calorie food images accounts for the greatest total variance in EDE-Q global symptom scores in men, and fear responding to high calorie food images accounts for the greatest total variance in EDE-Q scores in women. Findings provide initial evidence that investigative and clinical efforts should consider fear and disgust as unique facets of negative affect with different patterns of relative importance to ED symptoms in undergraduate men and women.

Keywords

Eating Disorders; Emotion; Fear; Disgust; Negative Affect

Eating disorders are psychiatric conditions with elevated morbidity (Hudson, Hiripi, Pope, & Kessler, 2007; Ulfvebrand, Birgegård, Norring, Högdahl, & von Hausswolff-Juhlin, 2015) and mortality rates (Crow et al., 2009), yielding great need for targeted treatment approaches for individuals with eating pathology. However, a significant portion of patients receiving empirically-supported treatments do not demonstrate clinically significant symptom reduction or remission (Wilson, Grilo, & Vitousek, 2007). Given this, further investigation is needed to better elucidate key factors and potential treatment targets within theoretical models of eating disorders, in order to inform future intervention development and enhance treatment outcomes. One avenue of research that has received increased attention in recent years includes efforts to identify potential targets for exposure-based interventions, including anxiety-related factors that theoretically relate to central features of eating disorders, such as avoidance of food consumption and body checking (see Murray, Loeb, & Le Grange, 2016; Pallister & Waller, 2008; Reilly, Anderson, Gorrell, Schaumberg, & Anderson, 2017 for reviews). Developments within the anxiety disorders intervention field indicate that maladaptive disgust-based behaviors are more difficult to extinguish than fear-based behaviors (Cisler, Olatunji, & Lohr, 2009; McNally, 2002), therefore, suggesting that there may be emotion-specific nuances to consider when studying eating disorder behaviors.

Extending initial research on the overlap between anxiety and eating disorder psychopathologies, in combination with findings from the anxiety disorders literature, the current study will evaluate the roles of fear and disgust in eating pathology, as each emotion is posited to motivate avoidance behaviors (Plutchik, 1980). To do so, the present work will examine associations between fear, disgust, and eating disorder symptoms among college-aged, young adults – a population associated with elevated risk for eating disorder onset (Eisenberg, Nicklett, Roeder, & Kirz, 2011). Moreover, given calls to increase examination of ED symptoms in men (Murray et al., 2017), along with evidence that suggests gender differences exist in the experience and reporting of emotion states (McLean & Anderson, 2009), these associations will be evaluated and discussed with potential gender-specific differences in mind.

Fear, Disgust, and Eating Disorder Symptoms

Etiological models of eating disorders often highlight functional associations between emotions and eating disorder symptom, such that maladaptive eating disorder behaviors are often believed to provide an emotional avoidance function. For this reason, recent efforts have begun to elucidate the relations between aversive emotion states and eating disorder symptomatology, in an effort to identify specific emotion-behavior associations that might be targeted in treatment (e.g., Berg et al., 2013). In the context of eating disorders research, anxiety-related emotions believed to motivate avoidance behaviors present potential treatment targets worthy of study, as current research not only demonstrates strong overlap between anxiety disorders and eating disorders (Kaye, Bulik, Thornton, Barbarich, Masters, & Price Foundation Collaborative Group, 2004), but also suggests that a variety of disordered eating attitudes and behaviors function in ways similar to cognitive avoidance strategies and safety behaviors observed in anxiety disorders (Pallister & Waller, 2007).

Fear is commonly acknowledged as an emotion central to eating pathology within the clinical and diagnostic nomenclature. Indeed, “fear of weight gain” has long been incorporated as a key diagnostic characteristic for eating disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychological Association, 2013), and has been incorporated into a common psychological construct often referred to as “fear of fat” or fear of weight gain (Goldfarb, Dykens, Gerrard, 1985). Empirical evidence further suggests that fear plays a role in eating disorder symptoms, such that elevated fear responses to images of foods relate to increased body image concerns and eating concerns in adolescents and young adults (McNamara, Hay, Katsikitis, & Chur-Hansen, 2008) and appear to drive food avoidance among dieting and non-dieting college women (Gonzalez & Vitousek, 2004). Recent treatment efforts have also begun to target fear within the context of eating pathology, as clinical trials examining exposure with response prevention for anorexia nervosa have utilized hierarchies designed to target feared foods and related consequences in individuals with anorexia nervosa (Steinglass, Albano, Simpson, Carpenter, Schebendach, & Attia, 2012).

Disgust presents another emotion with strong links to disordered eating avoidance behaviors, as it is theorized to motivate an evolutionary drive of food aversion and rejection (Plutchik, 1980). Despite the seemingly intrinsic links among fear, disgust, and eating disorder symptoms, research and theory to date have infrequently incorporated the role of disgust as compared to the more frequently highlighted role of fear in eating pathology (Cisler et al., 2002). However, initial investigations that have tested relations between disgust and eating attitudes and behaviors have demonstrated significant, positive associations between disgust and dietary restraint (Houben & Havermans, 2012), while other research has established strong links between elevated disgust sensitivity and food rejection in adults who identified as picky eaters (Kauer, Pelchat, Rozin, & Zickgraf, 2015). These findings suggest that disgust may, indeed, influence food rejection and eating disorder symptomatology. Although disgust appears similar in function to fear, a recent pilot study demonstrated that disgust reactions to food are more resistant to change than fear reactions to food in individuals with anorexia nervosa. This finding suggests that disgust may present a particularly powerful emotion that may contribute to the development and maintenance of conditioned food

avoidance (Hildebrandt et al., 2015), more so than fear. Past these findings, research on disgust and eating disorder symptoms remains limited; therefore, additional investigation is needed, as Hildebrandt and colleagues' findings suggest that targeted treatment efforts may be needed to extinguish disgust-specific food avoidance in individuals with eating disorders.

When observed in clinical settings, disgust-driven avoidance and fear-driven avoidance behaviors may appear indistinguishable from one another. For example, food avoidance and refusal in eating disorders may be motivated by disgust or fear. However, disgust and fear are distinct from one another in several ways. One, disgust motivates rejection of contamination, disease or moral offenses, whereas fear facilitates escape from current danger or imminent threat (Cisler et al., 2009; McNally, 2002; Plutchik, 1980). Two, as basic emotions, disgust and fear are differentiated by unique facial expressions, parasympathetic nervous system activity, psychological responses, and cognitive tendencies (Cisler et al., 2009; McNally, 2002; Olatunji & Sawchuk, 2005; Woody & Teachman, 2000). For example, disgust responses are identifiable by a specific facial expression, a decrease in heart rate, and a cognitive and behavioral urge to repel disgusting stimuli (Ekman, 1992; Davey, 2011). Fear is associated with a universally-recognized facial expression that differs from disgust, an increase in heart rate, and a cognitive and behavioral urge to escape from frightening stimuli (e.g., run away, remove the self; Ekman, 1992; Plutchik, 1980). Despite having distinct features, disgust and fear often share remarkably similar behavioral characteristics and function to motivate avoidance behaviors related to anxiety; these similarities pose a challenge to those seeking to assess and study disgust and fear (Cisler et al., 2009). Given this challenge, in combination with common clinical observations that avoidance is characteristic of many key eating disorder symptoms (e.g., avoidance of foods, avoidance of future weight gain), research must strive to better clarify the relations between fear, disgust, and ED symptomatology. Additional insight should increase understanding of emotion-driven symptoms and inform future treatment efforts, as efforts to delineate between fear and disgust within the anxiety disorders intervention literature indicates that disgust-related anxiety symptoms may require a more effective intervention approach than what is typically used to extinguish fear-related symptoms (de Jong, Vorage, & van den Hout, 2000; Olatunji, Forsyth, & Cherian, 2007; Smits, Telch, & Randall, 2002).

Fear and disgust to disorder-relevant stimuli

To date, several studies have demonstrated significant positive correlations between eating disorder symptoms and disorder-relevant fear and disgust ratings of food and body stimuli in women with current and past eating disorder diagnoses (Troop, Murphy, Bramon, & Treasure, 2000; Troop, Treasure, & Serpell, 2002). Initial investigations also examined subjective fear and disgust ratings of visual stimuli, including disgusting images, high fat/high calorie and low fat/low calorie food items, and overweight and underweight bodies within a small nonclinical sample of women (Harvey, Troop, Treasure, & Murphy, 2002; Griffiths & Troop, 2006); findings indicated that participants' disgust-specific and fear-specific responses to high energy foods and overweight bodies were significantly greater than those for low fat food and underweight bodies. In addition, investigators compared self-report items assessing emotion-specific heart rate reaction, facial expression, cognitions, and behavioral urges, yielding results that indicated participants reported similar levels of fear

and disgust in response to high fat foods and overweight bodies. In contrast, investigations FEAR, DISGUST, AND DISORDERED EATING 5 testing relations between disgust responses to ED-irrelevant stimuli and measures of eating pathology have yielded little to no evidence of significant associations between disorder-irrelevant disgust and eating pathology (e.g., Mayer, Muris, Bos, & Suijkerbuijk, 2008; Mayer, Muris, & Wilschut, 2011). Altogether, findings indicate that disgust may play a role in eating pathology when elicited by stimuli with theoretically aversive associations such as high calorie foods with potential links to unwanted outcomes such as weight gain or aversive interoceptive sensations (e.g., bloating, feelings of fullness).

The Relative Importance of Fear and Disgust in Eating Disorder Symptoms

Taken together, prior findings suggest that fear and disgust may be equally important when accounting for avoidance-driven eating disorder cognitions and behaviors. However, among prior studies that concurrently evaluated fear and disgust within a single sample, no investigations have explicitly tested whether disgust and fear are equally important in accounting for variance in eating disorder symptomatology. Such efforts may have been stymied by statistical limitations associated with commonly-used ordinary least squares (OLS) regression approaches that utilize only unique variance and are not appropriate for drawing conclusions regarding the contribution of one variable to an outcome, relative to another collinear variable. Given this, research is still needed to expand prior findings that fear and disgust positively correlate with measures of eating pathology in nonclinical samples (Griffiths & Troop, 2006; Harvey et al., 2002) and individuals with eating disorders (Troop et al., 2000; Troop et al., 2002), and begin to evaluate whether one emotion explains more variance in eating disorder symptomatology, as compared to the other.

Current Study

Given the overlap in behavioral and emotional correlates of fear and disgust (Cisler et al., 2009; McNally, 2002; Woody & Teachman, 2000), we sought to evaluate whether fear or disgust ratings of high calorie food, low calorie food, and non-food images accounted for greater total variance in eating disorder symptoms relative to other fear or disgust ratings. Because college students have been identified as a group with high prevalence of subthreshold eating disorder symptoms and elevated risk for full-threshold eating disorder onset (e.g., Eisenberg et al., 2011), these associations were assessed among participants recruited from an undergraduate population. To account for multicollinearity between fear and disgust ratings, relative weights analyses (RWA) were used to assess the independent contributions of fear and disgust responses to images of high calorie food, low calorie food, and non-food stimuli. RWA was also used to assess which emotional responses, if any, account for the most total variance relative to others when accounting for eating disorder symptoms in undergraduate men and women. Therefore, the current work sought to determine whether fear or disgust accounted for similar or different amounts of total variance in eating disorder symptoms in undergraduate men and women.

The present study also aimed to expand prior findings conducted in relatively small samples and possibly underpowered samples, which evaluated relations between eating disorder

symptoms and fear and disgust responses to stimuli that were both theoretically relevant and irrelevant to eating pathology (e.g., Harvey et al., 2002). Therefore, the current study examined associations between eating disorder symptoms and fear and disgust responses to eating disorder relevant images (e.g., high calorie food) and general, eating disorder irrelevant images (e.g., snake eating dead frog) within significantly larger samples of college students.

Finally, given that previous studies of fear, disgust, and eating disorder symptoms in college-aged adults have generally included only women (e.g., Harvey et al., 2002), this investigation sought to examine these associations in undergraduate men. Drawing from recent findings that have demonstrated that eating disorder symptoms affect men within this age range (Lavender, De Young, & Anderson, 2010; Strother, Lemberg, Stanford, & Tuberville, 2014), this study aimed to test whether facets of negative affect similarly relate to eating disorder symptoms in undergraduate men. Based on proposals suggesting that anxiety-related emotion states may function to motivate eating disorder behaviors in both men and women with (e.g., eating disorder symptoms that function to avoid an aversive weight or shape outcome; Murray et al., 2016; Reilly et al., 2017), we expected that fear and disgust would function to motivate eating disorder attitudes and behaviors similarly in men, as compared to women. Specifically, we hypothesized similar patterns would emerge between fear, disgust, and eating disorder symptoms in men and women, such that high calorie fear and high calorie disgust would demonstrate account for the greatest total variance in eating disorder symptoms, as compared to fear and disgust to low calorie or general, non-food fear- and disgust-image stimuli.

Material and Methods

Participants and Procedures

Participants included undergraduate students ($N = 390$, $n = 263$ women, 127 men) recruited through an online posting on the university's psychology research pool webpage between August 2013 – December 2013. Self-reported age and body mass index (BMI) indicated participants were generally non-overweight, young adults (men: $M_{age} = 18.9 \pm 1.3$ years; Range = 18–24 year; $M_{BMI} = 23.8 \pm 4.1$ kg/m²; women: $M_{age} = 18.9 \pm 1.3$ years; Range = 18–28 years; $M_{BMI} = 23.2 \pm 4.1$ kg/m²). Men identified as White (63%), Asian (13.4%), Black (9.4%), Hispanic/Latino (4.7%), more than one race (4.7%), unknown/other (3.9%), and American Indian/Alaskan Native (.8%). Women identified as White (47.5%), Black (19%), Hispanic/Latino (14.4%), Asian (13.3%), more than one race (3.8%), and unknown/other (1.9%). Mean EDE-Q global scores were $.82 \pm .80$ in men and 1.64 ± 1.14 in women. Altogether, the current sample was generally representative of the US college population with levels of eating disorder symptoms similar to established undergraduate norms (e.g., Quick & Byrd-Bredbenner, 2013).

All participants attended a 30–45 minute, in-laboratory appointment where they completed informed consent, followed by a series of self-report questionnaires presented on a lab computer. Self-report questionnaires assessed demographic data and disordered eating attitudes and behaviors. Visual analog scales (VASs) were used to assess subjective fear and disgust responses to food and non-food images. Images were presented on a 15" computer

screen and remained on the screen for as long as participants needed in order to complete the VAS ratings. Image presentation order was randomized to control for ordering effects. All participants viewed one image at a time and completed the fear and disgust VAS ratings before continuing to the following image. All participants were granted course extra credit. All methods and procedures were approved by the university's Institutional Review Board and are in accordance with the Declaration of Helsinki.

Measures

Demographics—Participants completed a demographics form, including questions assessing age, gender, racial and ethnic background, and self-reported height and weight.

Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 2008)

—The EDEQ is a 28-item self-report assessment of eating pathology that generates an overall global symptom score based on a 28-day recall of disordered eating attitudes and behaviors. Possible global scores range from 0 to 6, with high scores indicating greater eating disorder symptoms. Overall, psychometric evidence suggests good reliability and validity for this measure (Fairburn & Beglin, 2008). Cronbachs α for the EDE-Q global score was .88 and .90 for men and women, respectively.

Visual Analog Scales (VAS): Assessment of Momentary Fear and Disgust

Response—VAS ratings were used to assess momentary disgust and fear responding to food-specific and non-food/general images. Participants viewed a total of 12 images consisting of high calorie foods, low calorie foods, nonfood fear, and non-food disgust stimuli and completed VAS rating scales 100mm in length, anchored with “0 – Not at all” to “100 – Extremely,” to indicate how fearful or disgusted they felt while viewing an image. VAS items used in this study were selected in attempt to replicate fear and disgust response assessment methods employed by previous work (Harvey et al., 2002), and items assessed subjective/self-reported feelings, behavioral tendencies, physiological responses, and cognitive appraisals uniquely associated with each emotion (Ekman, 1992). For each image presented, participants completed four VASs assessing unique characteristics of disgust: “This picture makes me feel disgusted;” “This picture makes me feel like pushing the picture away;” “This picture makes me feel sick to my stomach;” and “This picture makes me feel like I might be contaminated or infected.” Four fear VASs assessed unique characteristics of fear: “This picture makes me feel afraid;” “This picture makes my heart pound;” “This picture makes me feel like running away;” and “This picture makes me feel like I’m in danger.” For the purposes of this study, VAS disgust ratings were aggregated as a mean disgust score per image; VAS fear ratings were aggregated to compute a mean fear score per image. The aggregate scores were then used to compute mean VAS fear and VAS disgust scores for each image type: high calorie food images, low calorie food images, and general/non-food images. Mean VAS scores for each image category are presented in Table 1.

Similar to image selection methods described by Harvey et al. (2002), all food images were selected via web search using the terms “high calorie food” and “low calorie food” – a method that has been used in prior studies assessing emotional reactions to food stimuli searches (e.g., Davey & Chapman, 2009; Harvey et al., 2002). Food images were

conceptualized as ED-relevant stimuli and primarily varied in calorie and fat content; this was verified using a calorie counting reference, CalorieKing (Borushek & Joslin Diabetes Center, 2011). High calorie food images included a cheeseburger, french fries, and donuts; low calorie food images included bell peppers, apples, and green beans. General fear- and disgust-eliciting images that did not include food were selected from the International Affective Pictures System (IAPS; Lang, Bradley, & Cuthbert, 2008) and were conceptualized as ED-irrelevant stimuli. IAPS images were classified as “fear” or “disgust” images based on prior research (e.g., Van Hooff, Devue, Vieweg, & Theeuwes, 2013). Analyses were conducted to verify Van Hooff and colleagues’ categorization of IAPS images (see Results section). Altogether, participants viewed three images per stimulus type; stimulus types included high calorie food, low calorie food, fear-specific non-food image, disgust-specific non-food image. Internal consistency ranged between acceptable and excellent values for fear VAS and disgust VAS ratings for each Emotion VAS $\times$ Stimulus Type category (Cronbachs $\alpha = .73-.94$ and $.74-.93$ in men and women, respectively).

Analytic Approach

Preliminary Analyses—Data were screened to ensure normality and homogeneity of variance for variables of interest. Variables evincing high levels of skewness were transformed prior to analyses, using box-cox power transformations as recommended by Osborne (2010). Missing data were treated as missing at random. Fear and disgust ratings of IAPS images were assessed prior to conducting primary analyses to ensure that participants were responding with significantly greater fear or disgust in response to the matching IAPS image category (e.g., higher fear ratings, as compared to disgust ratings of fear-specific IAPS images). Paired-samples t-tests were also used to verify IAPS fear image ratings differed from IAPS disgust image ratings (e.g., significantly greater fear ratings in response to IAPS fear images, as compared to fear ratings for IAPS disgust images). Because prior research has demonstrated that women are more likely to endorse elevated fear and disgust biases, as well as greater eating disorder symptoms than men, variables of interest were assessed for gender differences to verify rationale for gender-specific analytic approach. Paired-samples t-tests were employed to evaluate differences in mean fear VAS and disgust VAS scores in men and women, respectively. Mann-Whitney U tests were conducted to evaluate whether expected gender differences were present for VAS fear scores, VAS disgust scores, and EDE-Q global symptom scores prior to conducting gender-specific relative weights analysis models. Finally, Pearson-product bivariate correlations were used to evaluate the magnitude of intercorrelation between VAS fear scores, VAS disgust scores, and EDE-Q global scores in men and women, respectively. All preliminary analyses were computed using SPSS v. 24.

Relative Weights Analysis—The current study tested the relative contributions of disgust and fear to eating disorder outcomes, while addressing multicollinearity concerns. In many cases, OLS regression approaches can be used to assess whether one independent variable accounts for a significant amount of unique variance in an outcome variable score (Field, 2009). However, high intercorrelation between independent variables within a regression model can greatly limit interpretations regarding the importance of one independent variable relative to others, as a shift in predictor variables and their shared

variance can influence other beta weights in the model. For this reason, we employed relative weights analysis (RWA), which is an approach that can be used to address issues of multicollinearity and provide unbiased assessment of the relative contributions of collinear variables (Braun & Oswald, 2011; Tonidandel & Le Breton, 2011).

RWA generates a metric referred to as a “relative importance weight” for each independent variable in the model; this metric allows for the direct comparison of total variance accounted by individual variables within a RWA model. Relative importance weight statistics can be considered equivalent to beta weights in a traditional regression approach, with a key difference being that relative importance weights represent the proportion of variance explained in the outcome variable that is accounted for by each independent variable, after correcting for multicollinearity between all independent variables within the overall model. Altogether, a variable’s relative importance weight may be interpreted as its overall importance, or relative contribution, to the outcome variable, such that larger relative importance weight values indicate greater contribution to variance explained in the outcome variable, independent from other independent variables within the RWA model.

As recommended by Braun and Oswald (2011), LeBreton’s relative weights macro for Microsoft Excel (<http://www1.psych.purdue.edu/~jlebreton/relative.htm>) was used to calculate relative importance weights for the current investigation. The macro’s calculation of relative importance weights follows the following protocol recommended by Tonidandel and LeBreton (2011): (1) establish an orthogonal set of predictor variables, eliminating the influence of multicollinearity; (2) calculate a standardized weight for each orthogonal predictor variable by regressing orthogonal predictor variables onto the criterion variable; (3) establish correlations between the orthogonal predictors and original predictor variables; (4) calculate relative importance weights by multiplying the squared correlation of the original predictor variables and orthogonal predictor variables with the squared, standardized weights of the orthogonal predictor variables. Relative importance weights were then examined to determine relative importance of independent variables within each model (e.g., if one variable outperforms others in accounting for variance in the dependent variable). In the present analyses, fear and disgust VAS ratings to high calorie food images, low calorie food images, and non-food images were entered as independent variables; EDEQ global score was designated as the dependent variable.

Results

Preliminary Analyses

Paired-samples t-test results indicated that fear ratings were significantly higher than disgust ratings for IAPS fear images, and disgust ratings were significantly higher than fear ratings for IAPS disgust images; this was true for analyses conducted with data from men and data from women ($p < .001$). Together, these results indicated that the IAPS fear images indeed elicited stronger fear responses than IAPS disgust images, and that IAPS disgust images elicited stronger disgust responses than IAPS fear images. Shown in Table 1, paired-sample t-tests that assessed differences between fear VAS and disgust ratings of each image category revealed that fear and disgust ratings significantly differed for each image category.

Mann-Whitney U tests and graphical representation of variables of interest indicated men and women differed significantly on most variables of interest. In particular, women reported significantly higher EDE-Q global scores ($M = 1.64$, $SD = 1.14$) than men ($M = .82$, $SD = .80$) ($U = 6303$, $p < .001$). Men and women also significantly differed in VAS ratings for high calorie food disgust, low calorie food fear, general IAPS image disgust, and general IAPS image fear (see Table 1). Given the significant differences in variables of interest across gender, separate relative weights analysis models were conducted for men and women.

Bivariate correlations revealed high intercollinearity between fear VAS and disgust VAS ratings, with statistically significant correlations ranging up to .82 in women and up to .77 in men (see results presented above diagonal in Table 2 for women, and under diagonal for men). Examination of correlations among fear, disgust, and eating disorder symptoms indicated that fear and disgust VAS ratings for high calorie food, high calorie food disgust, non-food IAPS fear images, and non-food IAPS disgust images demonstrated significant, small-to-moderate positive correlations with EDEQ global symptom scores; in contrast, fear and disgust VAS ratings for low calorie food images were not significantly associated with EDEQ global symptom scores.

Relative Weights Analysis: Fear, Disgust, and EDE-Q Global Scores in Men

Examination of relative importance weights for EDE-Q global scores in men indicated that disgust VAS rating of high calorie food images accounted for approximately 46% variance in the overall model and accounted for the greatest total variance in EDE-Q global scores, relative to other fear and disgust variables (see Table 3). Specifically, the relative importance weight for disgust ratings of high calorie food images was .12, suggesting that a 1-unit increase in EDE-Q global scores was associated with an .12 increase in disgust VAS rating of high calorie foods. Direct comparison of relative importance weights indicated that disgust VAS ratings accounted for 2.5 to 60 times more variance in EDE-Q global scores than other fear VAS or disgust VAS ratings.

Relative Weights Analysis: Fear, Disgust, and EDE-Q Scores in Women

Fear VAS rating of high calorie food images emerged as the most important variable for EDE-Q global scores in undergraduate women, accounting for approximately 43% variance in the overall model, with a relative importance weight of .08 (see Table 3). Therefore, a 1-unit increase in EDE-Q global scores was associated with a .08 increase in fear VAS rating of high calorie foods. Altogether, the relative importance weight for fear VAS rating of high calorie foods was between 1.6 and 9.2 times greater than all other variables included in the model.

Discussion

The current study sought to fill a gap in the literature evaluating the nuanced relations between fear and disgust in eating pathology by employing an analytic approach that allowed for direct comparison of the importance of each emotion for eating disorder symptoms, relative to the other emotion. Findings provide initial evidence that fear and disgust ratings for specific types of stimuli are associated with distinct relative importance

patterns for eating disorder symptoms and that these relative importance patterns may differ across gender. In particular, results revealed that fear ratings of high calorie food images accounted for the greatest total variance in women's EDE-Q global scores, whereas disgust ratings of high calorie food images accounted for the greatest total variance in men's EDE-Q global scores.

When assessed in college women, findings contrast with the hypothesis that fear and disgust would emerge as equally important factors for eating disorder symptoms. Instead, fear ratings of high calorie food images accounted for 1.6 times greater variance in eating disorder symptom scores than disgust ratings of high calorie food images, and up to 9.2 times greater variance than fear and disgust to low calorie food images and disorder-irrelevant variables. These findings did not support the hypothesis that fear and disgust, aversive emotion states that have each been posited to motivate food avoidance behaviors and subsequent eating disorder symptoms, would demonstrate equivalent levels of relative importance in eating disorder symptomatology. Rather, results indicate that fear ratings of high calorie food accounted for the most variance in eating disorder symptom scores in women, as compared to all other fear and disgust factors examined. This finding appears to coincide with some clinical nomenclature and diagnostic standards that implicate fear as a central emotion underlying various eating disorder symptoms, such as fear of foods or fear of weight gain (American Psychiatric Association, 2013) as well as theories implicating fear as a key emotion underlying pathological food fears and fear of weight gain or shape change (e.g., Pallister & Waller, 2008; Steinglass et al., 2011). Unlike relative importance patterns observed in women, disgust ratings of high calorie food accounted for the greatest proportion of total variance in eating disorder symptoms in men. Findings that disgust to high calorie food images accounted for the greatest variance in global eating disorder symptoms contrasted with hypotheses, as well as with earlier work that did not support the role of disgust in eating disorders among a small sample of men (Davey, Buckland, Tantow, & Dallos, 1998).

Although unexpected, there are several possible explanations for the differences in relative importance patterns between men and women. First, the differences in relative importance patterns may coincide with recent work that has demonstrated that eating disorder symptoms present differently in men, as compared to women. For example, research suggests that women are more likely to endorse feelings of loss of control while eating, as compared to men (Striegel-Moore, et al., 2009). In the case that this is experienced as an imminent threat during the presentation of a food (e.g., threatened sense of control), then fear may be expected to relate to eating disorder symptoms, over and above that of disgust – an emotion that is less related to imminent threat and more related to rejection of potential harm. Alternatively, there may be distinctions in the relations among fear, disgust, and particular eating disorder symptoms that we did not explicitly assess in the current investigation. In addition, recent work suggests that male presentations of eating disorders are often characterized by muscularity-related disordered eating and exercise behaviors (Murray et al., 2017). In the case that male eating disorder pathology is primarily driven by avoidance of unwanted body weight or shape (e.g., overweight or obese body), it is possible that disgust related to anti-obesity biases and negative weight stigma (De Brún, McCarthy, McKenzie, & McGloin, 2014) may contribute to the relative importance pattern observed in men.

It is also possible that the differences in relative importance patterns observed in men and women might be explained by gender norms and gender differences in emotional experiences, processing, and reporting. For instance, Bem's (1981) gender schema theory suggest that men and women are socialized to develop in ways consistent with social norms and stereotypes, such that boys and men are more often discouraged from expressing fear and avoidance and encouraged to engage in active problem solving and actions to increase control in threatening situations, whereas girls and women are traditionally not discouraged from expressing anxiety and fear (McLean & Anderson, 2009). Considered alongside evidence that suggests that sociocultural factors can influence body image and eating disturbances throughout adolescence and young adulthood (e.g., Keery, van den Berg, & Thompson, 2004; Smolak, Murnen, & Thompson, 2005), it is possible that fear reporting among men was restricted, while fear reporting among women was not due to the effect of social norms and gender role socialization. In contrast, disgust reporting may not have been as restricted in men, given that endorsement of the items assessing disgust may have been more consistent with stereotypical masculine gender roles than those assessing fear (e.g., behavioral correlate of disgust was pushing the image away, behavioral correlate of fear was running away). This, of course, is speculative and would require further research. However, if men are more likely to endorse disgust than fear, it would make sense that disgust ratings of high calorie foods appear to account for more variance in eating disorder symptoms than fear among that group.

Altogether, the current findings suggest that additional work is needed to better elucidate the differential relations of fear and disgust with eating pathology in both men and women. Such work may prove particularly beneficial to better understanding emotion-related factors that may underlie eating disorder symptoms and perhaps provide new treatment targets for future intervention efforts. However, given the overall dearth of research examining fear and disgust in eating pathology, and the fact that most prior examinations have been limited to samples of girls and women, additional study of disgust and eating pathology is still needed to fully understand why disgust may be "most important" in men and current explanations for the current findings are speculative at best.

Limitations

Several limitations should be noted. The current sample consisted of generally healthy young adults, within the normal-weight BMI range. Therefore, results may not generalize to other populations including individuals with full-threshold eating disorders. Additional research in clinical populations is needed to better elucidate the importance of fear, relative to disgust, to eating pathology among treatment-seeking individuals. In addition, the cross-sectional nature of the current study limits the ability to draw conclusions related disgust's possible role as a mechanism; prospective work is needed to assess temporal relations between fear, disgust, and eating disorder symptoms, and to evaluate the process through which individuals at risk for EDs learn or acquire fear or disgust responses to various stimuli. Finally, further improvements could be made to improve assessment methodology. Although the current study employed fear VAS and disgust VAS assessment items that have been used in similar study designs (Harvey et al., 2002), these items have not been validated as a formal fear and disgust assessment method. In addition, the current work included a

limited number of food images. It is possible that individuals acquire specific fear and disgust associations with particular food items based on individual learning history (e.g., one individual may experience increased disgust when presented with images of any fried foods and baked goods, while another individual may have developed a fear- or disgust-based avoidance of pasta items). Moreover, the presentation of images was completely random and generated by a randomization function within the SurveyMonkey.com online survey; because of this, we were unable to track and assess for carry-over effects of fear or disgust reactions. Given these methodological limitations, replication and extension of the current study would allow future investigations to better assess for potential carry-over effects and include varying cues or stimuli representative of divergent learning histories.

Future Directions

Given the current findings which suggest fear *and* disgust may be key anxiety-related emotions associated with eating disorder symptoms, we believe there exists a need to establish a systematic program of research related to the study of disgust in eating disorders. In particular, future efforts to elucidate the relations between fear, disgust and eating pathology, as well as examine the development of related problematic disordered eating behaviors may be particularly useful for informing future intervention efforts in individuals with eating disorders. To do so, several initial investigational aims may prove particularly fruitful for building a systematic program of research dedicated to better understanding the relations between anxiety-related emotions and eating disorder symptomatology. For example, future research might test fear and disgust responding to additional eating disorder-relevant stimuli, including avoided foods, body images, or aversive physical sensations such as bloating or fullness. Research is also needed to delve into the idiographic nature of fear and disgust conditioning, as individual learning histories may differentially influence fear and disgust responding. Additional work should strive to evaluate the process through which fear and disgust to disorder-relevant stimuli may develop in eating disorders, as initial evidence from a recent pilot study suggests that fear and disgust conditioning play a role in the development of eating disorder symptoms (Hildebrandt et al., 2015). Moreover, given evidence from this same study which indicated that conditioned food disgust may more difficult to extinguish than conditioned food fear in anorexia nervosa, future research should examine if disgust presents a potent treatment target for future intervention efforts. Additional research should also seek to better understand the functional relations between each emotion and eating pathology, as fear and disgust may differentially motivate distinct behaviors (Espeset, Guliksen, Nordbø, Skårderud, & Holte, 2012). In the case that each emotion could be targeted differently to effectively reduce various eating disorder symptoms or behaviors, additional effort to elucidate associations between fear, disgust, and eating pathology may yield findings with valuable clinical implications. Finally, noting differential gender-specific relative importance patterns, future investigations should expand the definition of gender identity to assess how gender, if measured as a non-binary, continuous construct, might relate to the associations between fear- and disgust-related constructs and eating disorder symptoms.

Conclusions

Altogether, varying importance patterns of fear and disgust responding to high calorie food images for men and women demonstrated in the current study indicate that fear and disgust differentially relate to eating disorder symptoms in undergraduates. Gender-specific patterns of relative importance emerged, such that fear responses to high calorie food images are most important for eating disorder symptoms in women, whereas disgust responses to high calorie food images are most important for eating disorder symptoms in men; these differences suggest that emotions most important to eating disorder symptoms may vary across gender. Future research might seek to clarify these patterns in men and women, as the current findings suggest differential importance patterns for fear and disgust may exist, across genders. Future work could also focus on the development of eating disorder-relevant fear and disgust reactions, as the current findings may indicate that fear and disgust conditioning play a role in eating disorder symptomatology. In the case that fear and disgust conditioning processes uniquely contribute to the development and maintenance of eating pathology, it may be valuable to evaluate more nuanced associations among emotions and specific eating disorder symptoms. Finally, given that this work was conducted in a non-clinical sample, replication and extension of these findings within clinical samples of individuals with sub- and full-threshold eating disorders may yield greater insight to the associations between pathological fear, disgust, and eating pathology. Such findings may inform efforts to develop novel treatment techniques and improve existing treatment of eating pathology for individuals struggling with fear- and disgust-driven symptoms.

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Table 1

Means and Standard Deviations for Visual Analogue Scales Assessing Fear and Disgust Ratings of Food and IAPS Images, in Undergraduate Men and Women

Image Category	VAS Emotion	Men (<i>n</i> = 129)		Women (<i>n</i> = 262)	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Low Calorie Food Image	Fear ^a	3.64	1.05	2.90	1.27
	Disgust	6.97	1.89	3.44	1.14
High Calorie Food Image	Fear	21.63	4.59	23.55	4.92
	Disgust ^a	36.29	5.83	51.58	6.77
General Fear IAPS Image	Fear ^a	12.26	9.62	15.75	11.2
	Disgust ^a	8.96	8.62	12.54	9.06
General Disgust IAPS Image	Fear ^a	15.91	13.02	20.95	12.54
	Disgust ^a	21.48	11.45	25.66	10.27

Note.

^aStatistically significant group difference between undergraduate men and women (Mann-Whitney U test, $p < .001$).

Differences in mean fear and disgust VAS ratings were statistically significant for every image category (fear VAS vs. disgust VAS; paired-samples t-test, $p < .001$). *M* = mean. *SD* = standard deviation. VAS = visual analog scale assessing subjective fear and disgust responding to images (100mm VAS, anchored at 0 and 100).

Table 2
Pearson Product Bivariate Correlations for Variables of interest in Men and Women

	1	2	3	4	5	6	7
1 High Calorie Food Disgust VAS	--	.79**	.09	.16*	.36**	.43**	.35**
2 High Calorie Food Fear VAS	.77*	--	.26**	.36**	.29**	.39**	.40**
3 Low Calorie Food Disgust VAS	-.03	.12	--	.82**	.18*	.26**	.02
4 Low Calorie Food Fear VAS	.10	.26*	.73**	--	.19*	.22*	.14
5 Non-food, General Disgust VAS	.27*	.30*	.26*	.24*	--	.67**	.23*
6 Non-food, General Fear VAS	.38**	.41**	.20*	.19*	.71**	--	.18*
7 EDE-Q Scores	.46**	.35**	-.02	.02	.32*	-.36**	--

Note.

* $p < .01$,

** $p < .001$.

Italicized region under diagonal = correlations in undergraduate men ($n = 127$); **Bolded region** above diagonal = correlations in undergraduate women ($n = 263$). EDE-Q = Eating Disorder Examination Questionnaire. VAS = Visual Analog Scale assessing strength of subjective disgust or fear experienced when viewing image type listed in table (100mm VAS, anchored at "0 – Not at all" and "100 – Extremely").

Table 3

Relative Weights and Percentage of Variance Explained for Fear and Disgust Ratings Related to EDE-Q Global Scores

	Relative Importance Weights and Percentage Variance Explained (%) by Variable within Model							
	High Calorie Food Image – Fear Rating	Low Calorie Food Image – Fear Rating	Fear IAPS Image – Fear Rating	High Calorie Food Image – Disgust Rating	Low Calorie Food Image – Disgust Rating	Disgust IAPS Image – Disgust Rating	Total R ²	
Women (<i>n</i> = 263)	.083 (43%)	.016 (8.3%)	.009 (4.7%)	.051 (26.4%)	.011 (5.7%)	.023 (11.9%)	.193	
Men (<i>n</i> = 127)	.046 (17.5%)	.002 (.8%)	.048 (18.3%)	.120 (45.8%)	.002 (.8%)	.044 (16.8%)	.262	

Note. Relative importance weight = statistic indicative of relative “importance” of variable in regression model, as compared to other variables. Percentage variance explained (%) = percent unique *and* shared variance accounted for within overall relative importance model. **Bolded** relative importance weight indicates variable accounts for greatest amount of variance in EDE-Q scores, relative to other variables in model. EDEQ = Eating Disorder Examination Questionnaire; EDs = eating disorders; VAS = Visual Analogue Scale; VAS rating = Average subjective fear or disgust rating for image category based on Visual Analogue Scales, anchored at 0 and 100.