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Anxiety sensitivity, disgust sensitivity and aversive reactions to four stimuli

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Abstract

Background: Prior theory and research has implicated disgust as relevant to some, but not all phobias.
Aims: The current study examined whether anxiety sensitivity is more relevant to certain specific phobias and whether disgust sensitivity is more relevant to other specific phobias.
Method: Participants ($n = 201$) completed measures of anxiety sensitivity, disgust sensitivity and measures of aversive reactions in the presence of two fear-relevant stimuli (i.e. heights and small, enclosed spaces) and two disgust-relevant stimuli (i.e. spiders and blood/injury).
Results: Results of multiple linear regression analyses revealed that disgust sensitivity showed significant associations with aversive reactions in all four stimulus domains after controlling for anxiety sensitivity. After controlling for disgust sensitivity, anxiety sensitivity showed associations with the two fear-relevant phobias but not with the two disgust-relevant phobias included in this study. Anxiety sensitivity also showed an association with variance specific to one of the two fear-relevant specific phobias included in the study. Disgust sensitivity also showed associations with variance specific to both of the disgust-relevant phobias included in the study but not with variance specific to either of the fear-relevant specific phobias.
Conclusions: These results provide evidence that the distinction between fear-relevant and disgust-relevant specific phobias is meaningful and also implicate disgust sensitivity as relevant to aversive reactions to all stimuli included in this study.

Keywords: acrophobia; anxiety sensitivity; arachnophobia; blood phobia; claustrophobia; disgust sensitivity; specific phobia

Introduction

Specific phobias are characterized by an intense and irrational aversive reaction to and avoidance of exposure to or anticipation of a particular stimulus or situation [American Psychiatric Association (APA), 2013]. These aversive reactions are usually characterized as fear, but disgust is increasingly recognized as a feature of aversive reactions to at least some stimuli (Woody and Teachman, 2000). Specific phobias affect a significant proportion of the population, with epidemiological studies in the United States estimating 12-month prevalence rates ranging up to 11.1% and lifetime prevalence rates ranging up to 13.8% (Bandelow and Michaelis, 2015). Given the high prevalence, it is not surprising that there has been substantial research dedicated to specific phobias. Despite these efforts, the development and maintenance of these phobias is not entirely understood. Using Davey's (1994) distinction between fear- and disgust-relevant phobias, this study examines whether aversive reactions to these different classes of stimuli have distinct correlates.

Conceptualization of aversive reactions to specific stimuli

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA, 2013) adopts a categorical approach to specific phobias even though a dimensional approach is more scientifically defensible than a categorical one for most domains of psychopathology (Haslam *et al*., 2012; Widiger and Gore, 2014). We do not know of any study that has examined whether taxons (i.e. categorically and qualitatively distinct classes) underlie fear, anxiety and related aversive reactions to specific stimuli, or whether such reactions are better conceptualized as dimensional/continuous. For the current study, we view the severity of aversive reactions to specific stimuli as continuous rather than categorical. This approach is consistent with the view that the difference between subclinical and diagnosable specific phobias is a matter of quantity rather than quality, a matter of degree rather than kind. Doing so has the advantage of not only being more scientifically justifiable, but also allows for an examination of the severity of aversive reactions at subclinical levels, which are consequential in their own right (see Widiger and Gore, 2014). Studying aversive reactions in non-clinical samples allows for an examination of a broader range of the continuum.

The DSM-5 (APA, 2013) also categorizes specific phobias into five subtypes: animal (e.g. spiders, snakes, dogs), natural environment (e.g. heights, storms), blood-injection-injury (e.g. drawing blood, receiving vaccinations), situational (e.g. small spaces, darkness), and other (e.g. clowns, doctors). As the field moves towards a more comprehensive understanding of the processes underlying aversive reactions to specific stimuli and specific phobias, the current subcategorization of specific phobias may need to be reconsidered. Although a general factor appears to underlie fears of all or many specific stimuli (McDonald *et al*., 2008; McCraw and Valentiner, 2015), the factor structure underlying aversive reactions to various stimuli appears to include multiple factors and factors unique to each stimulus (De Jongh *et al*., 2011). The current study examines whether a distinction between aversive reactions to fear-relevant stimuli and disgust-relevant stimuli is important. Fear-relevant stimuli are those that potentially involve harm from physical injury, and disgust-relevant stimuli are those that potentially involve harm from contamination.

Measurement of aversive reactions to specific stimuli

Past research on specific phobias and fears of specific stimuli has been limited by the lack of comparable measures to assess reactions to different stimuli. The Circumscribed Fear Measure (CFM; McCraw and Valentiner, 2015) was developed to address this deficit in the literature. The CFM has the advantage of being able to assess severity of aversive reactions to a wide variety of stimuli or situations as a continuous variable using the same questionnaire content. By comparing the associations of various versions of the CFM (e.g. an aversive reaction to heights version of the CFM *versus* an aversive reactions to spiders version of the CFM), differences in associations can be attributed to differences in stimuli (e.g. heights *versus* spiders) and not attributed to content-specific features of the measures.

Anxiety sensitivity, disgust sensitivity and the disease avoidance model

Like other anxiety disorders, specific phobias appear to be related to the construct of anxiety sensitivity (AS; Taylor, 2014). AS has been conceptualized as a trait variable that represents relatively stable individual differences in the negative valence of symptoms of anxiety (e.g. racing heart, muscle tension, etc.). AS is often viewed as the facet of trait anxiety that is most relevant to anxiety disorders (Taylor, 2014). The relevance of AS to specific phobias is not surprising because confronting feared stimuli involves experiencing anxiety symptoms and AS is proposed to play an important role in how one processes those symptoms.

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Specific phobias also involve disgust in addition to fear/anxiety (see Woody and Teachman, 2000). In one study, individuals with spider phobias who viewed images of spiders reported comparable levels of fear and disgust, both of which were elevated compared with individuals without spider phobias (Tolin *et al.*, 1997). Additionally, trait anxiety and the trait of disgust sensitivity have both been shown to be related to social fears and claustrophobia (McDonald *et al.*, 2008). Prior research findings (Matchett and Davey, 1991; McDonald *et al.*, 2008) suggest that the distinction between fear- and disgust-relevant phobias is important, but the distinction is not currently included in our diagnostic system. This distinction is potentially important because fear and disgust processes involve distinguishable neurological pathways (Tettamanti *et al.*, 2012), suggesting that cognitive processes and optimal treatment may differ between fear- and disgust-relevant phobias.

The disease-avoidance model of animal phobias was an early attempt to explain the relevance of disgust to phobic reactions to specific animals (Matchett and Davey, 1991). These researchers suggested that an underlying relationship between common animal fears and the experience of disgust may have an adaptive function. That is, disgust in response to animals that are associated with dirt and contamination promotes avoidance. That avoidance helps prevent transmission of disease to humans. In support of this view, participants with spider phobias gave higher ratings of disgust evoked by spiders than those without phobias (de Jong and Muris, 2002). In addition, spiders evoke specific disgust and avoidance reactions among individuals with and individuals without spider fears (Vernon and Berenbaum, 2002). Although the realistic probability of fatal harm from a spider is relatively rare (Centers for Disease Control and Prevention, 2018), in accordance with the disease avoidance model, spider phobia symptoms may be due to natural selection (i.e. the adaptive advantage associated with avoidance of contamination carried by some animals).

Individuals who reported high food-related disgust also reported greater fear of snakes in one study and greater spider phobia symptoms in another (Klieger and Siejak, 1997; Merckelbach *et al.*, 1993). These findings are consistent with the disease avoidance model as consuming contaminated food product causes illness, which has adaptive significance. Research has also demonstrated that aversion to eating food that had been contaminated is related to greater fears of non-predatory and revulsive animals but not of predatory animals (Matchett and Davey, 1991). This finding suggests that disgust may be the primary emotion behind phobias of animals that lack fear-provoking qualities (Matchett and Davey, 1991). Disgust has also been implicated in non-animal phobia symptom measures, such as emetophobia (van Overveld *et al.*, 2008), blood-injection-injury phobia (Tolin *et al.*, 1997), and height and claustrophobia (Davey and Bond, 2006).

When Reiss and McNally (1985) first proposed the construct of anxiety sensitivity, they conceptualized anxiety sensitivity as a relatively enduring individual difference (i.e. trait) variable and hypothesized that it interacts with the situation-specific appraisal variable of expected anxiety to predict avoidance behaviour (e.g. Valentiner *et al.*, 1996). Although disgust sensitivity appears to be patterned after anxiety sensitivity, early attempts to measure disgust sensitivity included items that appear to measure a different construct, leading van Overveld *et al.* (2006) to distinguish disgust propensity from disgust sensitivity. Just as anxiety sensitivity can be viewed as the reinforcing effectiveness of sensations of anxiety (Reiss and McNally, 1985), disgust sensitivity can be viewed as the reinforcing effectiveness of sensations of disgust. In contrast, disgust propensity can be viewed as the likelihood of experiencing those sensations (van Overveld *et al.*, 2006). Disgust propensity can be viewed as a trait variable in the disgust domain that corresponds with expected anxiety, a situation-specific appraisal in the anxiety domain. Propensity trait variables are not likely to be relevant for understanding variation in reactions across stimuli. This study focuses on the trait variables of anxiety sensitivity and disgust sensitivity to determine if aversive reactions to fear-relevant and disgust-relevant stimuli involve difficulties processing anxiety, difficulties processing disgust,

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or both. Evidence that anxiety sensitivity is particularly relevant to aversive reactions to fear-relevant stimuli and disgust sensitivity is particularly relevant to aversive reactions to disgust-relevant stimuli would provide additional support for the distinction between fear-relevant and disgust-relevant phobias.

Like the studies by McDonald *et al.* (2008), the current study examines whether disgust sensitivity accounts for significant variance in aversive reactions to a variety of stimuli. This study differs from those prior studies because it uses a measure of anxiety sensitivity, the facet of trait anxiety that is most relevant to anxiety disorders (Taylor, 2014) and the prior studies used a measure of general trait anxiety. In addition, the aversive reactions to stimuli chosen for the prior studies do not segregate along the distinction between fear-relevant and disgust-relevant stimuli. Aversive reactions to two fear-relevant and two disgust-relevant stimuli were selected for the current study to examine the distinction.

The current study

The current study uses the CFM to further examine the relationships of anxiety sensitivity and disgust sensitivity with aversive reactions to specific stimuli. Consistent with our interest in aversive reactions as a continuum that includes normative and subclinical levels, a non-clinical sample was used. The aim of this study was to provide a test of the distinction between aversive reactions to fear- and disgust-relevant stimuli. This study examines the associations of anxiety sensitivity and disgust sensitivity with aversive reactions to two stimuli in the fear-relevant domain (i.e. heights and small, enclosed spaces) and aversive reactions to two stimuli in the disgust-relevant domain (i.e. spiders and blood/injury). We hypothesized that anxiety sensitivity would be associated with aversive reactions in the fear-relevant domains even after controlling for disgust sensitivity. We also hypothesized that disgust sensitivity would be associated with aversive reactions in the disgust-relevant domains even after controlling for anxiety sensitivity. In the most stringent test of the distinction between aversive reactions to fear- *versus* disgust-relevant stimuli, we hypothesized that anxiety sensitivity would be associated with variance specific to aversive reactions to fear-relevant stimuli, and disgust sensitivity would be associated with variance specific to aversive reactions to disgust-relevant stimuli.

Method

Participants

Participants ($n = 201$) were recruited from Amazon Mechanical Turk (MTurk). Only individuals located in the United States and fluent in English were eligible to participate. Each participant was paid $1.00 for completing the study. This sample size was targeted based on logistical considerations, including the relatively high stability of correlations observed at samples sizes of 200 and the availability of funds, and a recognition that the sample size was adequate to detect small effects. The sample was predominantly female (51.5%) and ranged in age from 18 to 77 years (mean = 37.83, $SD = 12.75$); 78.6% of the sample identified as Caucasian, 17.3% as Hispanic and 5.9% as Black/African-American; 40.1% were married and 36.6% had never married. Participants were diverse in their level of educational attainment, with 38.3% obtaining a bachelor's degree, 48.3% below a bachelor's degree, and 13.4% above a bachelor's degree. These sample characteristics are similar to those of other samples we have obtained using this recruitment approach. Participants were given the option not to respond for each question, but missing data were not common (i.e. <0.1%). Mean imputation was used for missing item data when constructing scale scores.

Procedure

In MTurk, participants first completed a demographics measure and four versions of the Circumscribed Fear Measure (CFM; McCraw and Valentiner, 2015) online to assess responses to specific feared stimuli. The four versions were presented in random order. The participants then completed the Disgust Propensity and Sensitivity Scale-12 (DPSS-12; Fergus and Valentiner, 2009), the Anxiety Sensitivity Index-3 (ASI-3; Taylor *et al.*, 2007), and other questionnaires not included in this study (the Revised Reinforcement Sensitivity Test Scale, the Disruption of Functioning Index, the Sheehan Disability Scale, the Severity Measure of Specific Phobia, the Center for Epidemiologic Studies-Depression scale, and a picture rating task). These data were not included in the current study.

Measures

Circumscribed Fear Measure

To determine participants' level of fear for each of the fears assessed in this study (heights; small, enclosed spaces; spiders; and blood/injury), four versions of the Circumscribed Fear Measure (CFM; McCraw and Valentiner, 2015) were administered. On each version of the CFM, participants provide ratings on a set of 25 statements reflective of specific phobia symptoms using a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The higher the score, the greater the severity of the phobia symptoms. The CFM can be scored to assess a single, higher-order construct (i.e. using a Total Scale score) or to assess five lower-order constructs (i.e. using component scale scores to assess Risk Analysis, Physiological Symptoms, Fear/Anxiety, Escape/Avoidance, and Control; McCraw and Valentiner, 2015). As we did not have any lower-order hypotheses, the current study conducted initial tests using Total Scale scores. The results of exploratory follow-up analyses at the lower-order level, available upon request, were generally uninformative. The CFM Total Scale scores have shown strong convergent and discriminant validity and internal consistency across multiple fears (McCraw and Valentiner, 2015). Cronbach's alphas for the CFM Total Scale scores in this study were all greater than or equal to .97 [Height Fear ($\alpha = .98$); Small, Enclosed Spaces Fear ($\alpha = .98$); Spider Fear ($\alpha = .98$); and Blood/Injury Fear ($\alpha = .97$)].

Disgust Propensity and Sensitivity Scale-10

The Disgust Propensity and Sensitivity Scale-12 (DPSS-12; Fergus and Valentiner, 2009; derived from Cavanagh & Davey, 2000) was administered to assess disgust-relevant traits. Following Goetz *et al.* (2013), a four-item index of disgust sensitivity and a six-item index of disgust propensity were constructed. These scales present four statements and ask participants to rate how often the statement is true for them using a 5-point scale ranging from 0 (*never*) to 4 (*always*). These scales showed adequate internal consistency ($\alpha = .77$–$.78$) and good factorial validity (Goetz *et al.*, 2013). Using data from the current study, Cronbach's alpha for the Disgust Sensitivity scale was .81, and for the Disgust Propensity scale was .89.

Anxiety Sensitivity Index-3

The Anxiety Sensitivity Index-3 (ASI-3; Taylor *et al.*, 2007) assesses sensitivity to anxiety-related symptoms and fear of negative outcomes as a result of that anxiety. The scale presents the participant with 18 statements and asks them to rate how much they agree using a 5-point scale ranging from 0 (*very little*) to 4 (*very much*). Anxiety sensitivity has been conceptualized and studied as a unitary construct and as consisting of three lower-order constructs. Given the lack of evidence of the differential relevance of the lower-order constructs in the specific

Table 1. Mean and standard deviations of study variables, and correlations among them

	Mean (*SD*)	Correlations 1	2	3	4	5
Circumscribed Fear Measure Indices						
(1) Heights	44.80 (29.94)					
(2) Small, enclosed Spaces	36.64 (30.04)	.428				
(3) Spiders	38.18 (30.52)	.372	.282			
(4) Blood/injury	43.51 (27.28)	.441	.388	.399		
Theoretically related constructs						
(5) Anxiety sensitivity	45.02 (16.99)	.458	.301	.344	.349	
(6) Disgust sensitivity	10.88 (3.98)	.447	.340	.480	.537	.589

$n = 201$. All correlations are significant at the two-tailed alpha $< .01$ level.

phobia domain, as well as the high intercorrelations among the three ASI-3 component scales in the current data set (i.e. ranging from .89 to .92, all *p*-values $< .01$), the current study used the ASI-3 total scale score. This and other indices of the higher-order AS construct have shown strong internal consistency and factorial validity, and relevance to symptoms of each of the major anxiety disorders (Taylor *et al*., 2007). Cronbach's alpha for the Anxiety Sensitivity scale in the current study was .95.

Demographics

A demographics questionnaire was administered to assess age, race, gender, marital status and education level.

Results

Table 1 presents the means and standard deviations of the study variables, and the correlations among them. As expected, the correlations were all positive and significant.

Four hierarchical regression analyses were conducted, one with each of the four aversive reaction indices (i.e. two fear-relevant aversive reactions: height reactions and small space reactions, and two disgust-relevant aversive reactions: spider reactions and blood/injury reactions) as dependent variables. Visual inspection of residual plots confirmed that there were no significant assumption violations. In addition, repeating these analyses using PROCESS with 5000 bootstraps (Hayes, 2012) resulted in estimates (not reported here) that are identical (within rounding) and an identical pattern of significance to those reported here.

On Step 1 of these analyses, anxiety sensitivity was entered as a predictor. In each of the four hierarchical regressions, the Step 1 variable accounted for significant variance of the aversive reaction index (see Table 2 for complete results). On Step 2 of these analyses, disgust sensitivity was entered as a predictor. Disgust sensitivity overall accounted for significant variance across all four aversive reactions after controlling for the Step 1 variables. On Step 2, anxiety sensitivity significantly accounted for unique variance among fear-relevant aversive reactions.

For each of the four regression analyses (i.e. with CFM-Heights, CFM-Small, Enclosed Spaces, CFM-Spider, and CFM-Blood/Injury Reactions as dependent variables), the remaining three fear indices were entered on Step 3. For example, in the regression with CFM-Heights Reactions as the dependent variable, the Step 3 variables were CFM-Small, Enclosed Spaces, CFM-Spiders and CFM-Blood/Injury Reactions. This strategy allowed for an examination of which Step 1 and Step 2 variables showed specific relationships with each dependent variable (i.e. not shared by other aversive reaction indices).

Disgust sensitivity accounted for significant variance only for the disgust-relevant aversive reactions (i.e. Spider Fear and Blood/Injury Reactions) and not the fear-relevant aversive

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Table 2. Hierarchical regression analysis of disgust, anxiety and specific phobias

	Non-disgust relevant fears								Disgust relevant fears							
	Height Fear				Small, Enclosed Spaces Fear				Spider Fear				Blood/Injury Fear			
	Change in R^2	Step 1 p-*r*	Step 2 p-*r*	Step 3 p-*r*	Change in R^2	Step 1 p-*r*	Step 2 p-*r*	Step 3 p-*r*	Change in R^2	Step 1 p-*r*	Step 2 p-*r*	Step 3 p-*r*	Change in R^2	Step 1 p-*r*	Step 2 p-*r*	Step 3 p-*r*
Step 1	.210**				.090**				.118**				.122**			
Anxiety sensitivity		.458**	.275**	.241**		.301**	.136*	.058		.344**	.081	.031	.349**	.051	−.025	
Step 2	.044**				.038**				.124**				.164**			
Disgust sensitivity			.235**	.072			.204**	.044			.375**	.265**			.432**	.322**
Step 3	.088**				.101**				.038*				.068**			
Height Fear				—				.240**				.122				.140*
Small, Enclosed Spaces Fear				.240**				—				.045				.178**
Spider Fear				.122				.045				—				.130
Blood/Injury Fear				.140*				.178**				.130				

n = 201. *$p < .05$, **$p < .01$. p-*r*, partial correlation. Underlined partial correlations provide the strongest test of the differential relevance hypothesis.

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reactions (i.e. Height Fear and Small, Enclosed Spaces Reactions) when controlling for Step 3 variables. Anxiety sensitivity continued to significantly account for unique variance among height fear only. After controlling for each of the Step 3 variables, Small, Enclosed Spaces Reactions and Blood/Injury Reactions accounted for significant variance in Height Reactions. Height Reactions and Blood/Injury Reactions accounted for significant variance in Small, Enclosed Spaces Reactions. Small, Enclosed Spaces Reactions and Height Reactions accounted for significant variance in Blood/Injury Reactions.

Given prior findings that disgust propensity and disgust sensitivity have distinct unique associations with different phobias, follow-up analyses were conducted. Predicting the aversive reaction indices using three predictors (anxiety sensitivity, disgust sensitivity and disgust propensity), the pattern of significance for anxiety sensitivity and disgust sensitivity was unchanged from those reported above. After controlling for disgust sensitivity and anxiety sensitivity, disgust propensity did not significantly predict aversive reactions to any of the four stimuli.

Discussion

This study examined the validity of the distinction between aversive reactions to fear- *versus* disgust-relevant stimuli. Providing support for the distinction between aversive reactions to fear- and disgust-relevant stimuli, after controlling for disgust sensitivity, anxiety sensitivity was related to aversive reactions to one but not both fear-relevant stimuli (i.e. height fear but not small, enclosed space reactions), and not related to aversive reactions to either disgust-relevant stimuli. In the most stringent tests of anxiety sensitivity and the distinction between aversive reactions to fear- and disgust-relevant stimuli, anxiety sensitivity was not associated with variance specific to aversive reactions to fear-relevant stimuli. Anxiety sensitivity was also not associated with variance specific to aversive reactions to disgust-relevant stimuli. Overall, these findings provide evidence that disgust sensitivity is relevant to aversive reactions to a broad range of stimuli, and especially relevant to aversive reactions to spider and blood/injury stimuli; and that anxiety sensitivity is relevant to aversive reactions to height stimuli.

Also supporting the distinction between aversive reactions to fear- and disgust-relevant stimuli, after controlling for anxiety sensitivity, disgust sensitivity was associated with aversive reactions to disgust-relevant stimuli. Unexpectedly, after controlling for anxiety sensitivity, disgust sensitivity was also associated with aversive reactions to fear-relevant stimuli. In the most stringent tests of disgust sensitivity and the distinction between aversive reactions to fear- and disgust relevant stimuli, disgust sensitivity was associated with variance specific to aversive reactions to disgust-relevant stimuli and not associated with variance specific to aversive reactions to fear-relevant stimuli. Related to his finding, two prior studies (McDonald *et al*., 2008; Muris *et al*.,1999) found that disgust's associations with symptoms of specific phobias were not statistically mediated by trait anxiety. Overall, the results of the current study support the distinction between fear- and disgust-relevant specific phobias, and like findings from prior studies, the current findings suggest that disgust is a central part of all phobias (e.g. Woody and Teachman, 2000).

Given the design and methods of the current study, the view that method variance common to all of these aversive reaction scales (i.e. method variance associated with the CFM) is responsible for these findings is a possibility that cannot be ruled out. The inclusion of other scales using the same method in the regression model partially ameliorates this concern, but a full examination requires another approach, such as the use of multiple methods. The pattern of results, like those of McDonald *et al.* (2008), is strongly suggestive of a relationship between disgust and variance common to fears of the four stimulus domains included in this study but does not conclusively establish such a relationship. The hierarchical model proposed by McDonald *et al.* (2008) offers a

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way to conceptualize such a relationship using a general phobia factor. The current study's reliance on self-report data raises concerns about the possibility that these results might be limited to individuals' perceptions of their individual differences and fears. For example, future research might examine emotion expression (de Jong *et al.*, 2002) or behavioral indices.

Anxiety sensitivity was associated with aversive reactions to heights after controlling for disgust sensitivity but did not show such relations with aversive reactions to disgust-relevant stimuli. This study did not confirm the hypothesis that anxiety sensitivity would also show a specific relationship with aversive reactions to small, enclosed spaces. The change in R^2 associated with Step 2 in the regression with aversive reactions to small, enclosed spaces as the dependent variable was not significant, but is also not inconsistent with a Type II error explanation. Overall, the findings for anxiety sensitivity provide partial support for the distinction between aversive reactions to fear- *versus* disgust-relevant stimuli. Future research might consider a more powerful test of the specific association between disgust and fear of small, enclosed spaces.

In addition to the relevance of disgust sensitivity to aversive reactions to all four stimulus domains included in this study after controlling for anxiety sensitivity, disgust sensitivity showed associations with variance specific to aversive reactions to disgust-relevant stimuli and did not show associations with variance specific to aversive reactions to fear-relevant stimuli. For aversive reactions to fear-relevant stimuli, the magnitude of the association with disgust sensitivity were greatly reduced and became negligible after controlling for aversive reactions to other stimuli. For aversive reactions to disgust-relevant stimuli, the magnitude of the association with disgust sensitivity was greatly reduced but remained significant. The relevance of disgust sensitivity to disgust-relevant reactions is consistent with Matchett and Davey's (1991) disease avoidance model and with past findings from studies of fears of spider and blood stimuli (de Jong and Muris, 2002; Klieger and Siejak, 1997; McDonald *et al.*, 2008).

The results of the current study contribute to the current understanding of the correlates of specific phobias and may have implications for improved treatment of specific phobias. The treatment of fear-relevant phobias has not typically included a focus on disgust. However, because disgust showed significant associations with fears of all four stimuli in the current study, disgust may be a construct worth considering when targeting specific phobias in treatment, regardless of the fear or disgust relevancy of the phobia. This idea is consistent with the inhibitory learning model (Craske *et al.*, 2008), which proposes that exposure therapy works by increasing distress tolerance. Building tolerance of disgust may be a mechanism of effective phobia treatments.

Additionally, the results of this study suggest that disgust may play a role in classifying specific phobias. More research needs to be conducted to solidify disgust's role across other specific phobias. We note, however, that studies of the structure of specific phobias have not found fear-relevant and disgust-relevant factors (e.g. De Jongh *et al.*, 2011). It should also be observed that the labels of fear- and disgust-relevant phobias, as well as 'disgust-irrelevant' (Davey and Bond, 2006) are not optimal. The findings in this study suggest that disgust sensitivity is relevant to fears of stimuli in both classes. In addition, differentiation on the nature of threat appraisals may be more meaningful.

This study has several limitations in addition to those already discussed. First, the design of the study limits inferences about the direction of causation. Second, this study used measures of traits, rather than the emotional experiences that traits were conceptualized to predict. Future research might consider a more direct approach, such as assessing situation-specific threat appraisals associated with anxiety symptoms and affected states experienced in the presence of stimuli that elicit aversive reactions.

Third, the specificity examined in the current study was limited by the study's variable set. For example, Step 2 of the regressions only controlled for anxiety sensitivity, so specificity was only established relative to that single Step 1 variable. Similarly, the variance specific to aversive reactions to each of the four stimuli was only specific with regard to aversive reactions to the other stimuli included in this study. Although assessing aversive reactions to a limited number of stimuli allows for a manageable and straightforward test of the hypotheses, additional work is needed examining aversive reactions to a wider range of stimuli. Fourth, we also note that although the pattern of findings (i.e. disgust sensitivity showed significant links with variance specific to aversive reactions to disgust-relevant stimuli and not to variance specific to aversive reactions to fear-relevant stimuli), no test of differential association was included in this study. Furthermore, the parameter estimates for unique associations, and the differences between the estimates, were small in magnitude. Related to this issue, the anxiety sensitivity and disgust sensitivity measures differed in many ways; these two measures were not created to control for effects of instructions, response format, length, etc. Despite having fewer items and a more modest internal consistency, the measure of disgust sensitivity showed stronger associations with the outcomes than those of the measure of anxiety sensitivity. Future research might consider conducting a stronger test of the differential association hypothesis.

Fifth, the current study adopted a dimensional approach to conceptualizing and measuring specific phobias. Although there is good reason to believe that a dimensional approach is appropriate, as far as we know there have been no studies that examine the underlying structure of fear pathology in response to specific stimuli. If a categorical approach is found to be more appropriate, then these results may not apply to clinical levels of specific fears. This study did not examine a clinical sample, precluding any strong statements about the applicability of these findings to in clinical populations. Finally, and related to this last issue, the use of an unselected convenience sample raises concerns about the generalizability of these findings to other (e.g. clinical and culturally distinct) populations.

The results of this study add to the body of evidence distinguishing aversive reactions to fear- and disgust-relevant stimuli. If aversive reactions to fear- *versus* disgust-relevant stimuli have distinct correlates, as found in the current study, they might have distinct causes. If so, then this distinction has potential implications for the prevention and classification of specific phobias.

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Ethical statements. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants included in the study. No animal studies were carried out by the authors of this article.

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