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Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear

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Abstract

This study examined the specificity of disgust sensitivity in predicting contamination-related anxiety and behavioral avoidance. Participants high ($n = 26$) and low ($n = 30$) in contamination fear completed self-report measures of disgust sensitivity, contamination cognitions (overestimation of the likelihood and severity of contamination from everyday objects), anxiety, and depression. They then completed three randomly presented contamination-based behavioral avoidance tasks (BATs) that consisted of exposure to a used comb, a cookie on the floor, and a bedpan filled with toilet water. Results indicated that disgust sensitivity was significantly associated with anxious and avoidant responding to the contamination-related BATs. This association remained largely intact after controlling for gender, contamination fear group membership, anxiety, and depression. Contamination cognitions were also significantly related to BAT responses. However, this relationship was fully mediated by disgust sensitivity. These findings indicate that disgust sensitivity has a specific and robust association with contamination concerns commonly observed in obsessive compulsive disorder. The findings are discussed in the context of a disease-avoidance model.

Keywords: Disgust; Fear; Contamination; Avoidance; OCD

Introduction

The fear of contamination is the most common theme observed in obsessive–compulsive disorder (OCD; Rachman & Hodgson, 1980; Rasmussen & Eisen, 1992; Rasmussen & Tsuang, 1986). Recent theoretical developments have highlighted the complex, powerful, and persistent nature of this fear (Rachman, 2004). Obsessive thoughts regarding contamination in OCD often lead to compulsive safety behaviors (i.e., excessive washing, cleaning rituals) geared toward disinfection of the self and the environment (Rachman & Shafran, 1998). Safety behaviors in contamination-based OCD function to reduce fear and anxiety associated with distressing contamination-related obsessive thoughts (“I am filthy”). Safety behaviors associated with contamination fear may also consist of active (frequent hand-washing) and passive (always wearing gloves)

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avoidance strategies that function to prevent contact with potential contaminants. Safety behaviors in contamination-based OCD are likely related to overestimation of vulnerability to contaminants (i.e., dirt, germs, bacteria) and fear of rapid, spreading infection following contact with contaminants (Rachman, 1994; Riskind, Abreu, Strauss, & Holt, 1997; Tolin, Worhunsky, & Maltby, 2004).

The complexity and enduring nature of contamination fear has led to renewed interest in identifying factors that contribute to its development and maintenance (Rachman, 2004). Evidence suggests that specific cognitive vulnerability factors, such as the propensity to overestimate threat, may contribute to the onset of OCD (OCCWG, 2001). Thus, the tendency to overestimate the likelihood (''I will get sick if I don't wash my hands'') and severity (''if I get sick I will die'') of contamination may contribute to contamination-based OCD. Although contemporary models highlight the regulation of fear and anxiety and specific cognitive vulnerabilities in the development of contamination fear, recent theoretical and research developments suggests that disgust may also contribute to the fear of contamination (Olatunji & Sawchuk, 2005; Woody & Teachman, 2000).

Disgust, as a basic emotion, elicits a reliable physiological response, facial expression, and withdrawal/avoidance pattern (Olatunji & Sawchuk, 2005; Rozin & Fallon, 1987). The adaptive function of disgust is to protect the organism from contact with contaminated stimuli (Izard, 1993). Thus, it was proposed that disgust may contribute to the etiology of contamination fear in OCD (Phillips, Senior, Fahy, & David, 1998; Power & Dalgleish, 1997). Correlational studies have found support for this claim as measures of the general propensity to experience disgust (i.e., ''disgust sensitivity'') have been repeatedly shown to correlate with measures of contamination fear (Olatunji, Sawchuk, Lohr, & de Jong, 2004; Olatunji, Williams, Lohr, & Sawchuk, 2005; Sawchuk, Lohr, Tolin, Lee, & Kleinknecht, 2000; Schienle, Start, Walter, & Vaitl, 2003). Disgust also appears to predict contamination fear over and above anxiety and depression (e.g., Mancini, Gragnani, & D'Olimpio, 2001; Olatunji, Sawchuk, Arrindell, & Lohr, 2005; Thorpe, Patel, & Simonds, 2003; Tolin, Woods, & Abramowitz, 2006). One study examining disgust in patients with OCD found that OCD washers showed significantly higher disgust levels than non-anxious controls, and marginally higher disgust levels than a sample of non-washing OCD patients (Woody & Tolin, 2002).

The relation between disgust and contamination fear may be innate as OCD patients with contamination concerns often describe threat-relevant objects as ''disgusting'' rather than ''frightening'' (Sieg & Scholz, 2001; Tolin et al., 2004). The function of disgust in contamination fear has been described in the context of a disease-avoidance model given that disgust serves the adaptive function of preventing disease acquisition through avoidance of contact with and subsequent infection by contaminants (Matchett & Davey, 1991; Ware, Jain, Burgess, & Davey, 1994). However, evidence for this model is largely limited to correlational studies of self-report data. In efforts to extend the findings derived from self-report measures, neuroimaging studies have also begun to implicate disgust in contamination based OCD (Husted, Shapira, & Goodman, 2006; Phillips et al., 2000; Stein, Liu, Shapira, & Goodman, 2001). For example, Shapira et al. (2003) found that whereas brain activation during a threat-inducing task was similar across participants with OCD and healthy volunteers, the pattern of activation during a disgust-inducing task was significantly different in OCD subjects, including greater increases in the right insula, parahippocampal region, and inferior frontal sites.

Few studies have attempted to extend findings derived from self-report measures regarding the disgust–contamination fear relation to behavioral measures. In one study, Tsao and Mckay (2004) compared contamination fearful, high-trait anxiety, and low trait anxiety participants on six different behavioral avoidance tasks (BATs) corresponding to six domains of disgust (food, animals, body products, body envelope violations, death, and sympathetic magic). The authors reported that the contamination fearful group was more avoidant than the high trait anxiety group on the animal and sympathetic magic BATs and more avoidant than the low-trait anxiety group on the food, animal, body envelope violations, and death BATs. Similarly, Olatunji, Lohr, Sawchuk, and Tolin (2007) found that high contamination fearful participants demonstrated less compliance and less approach behavior than low contamination fearful participants on a series of eight disgust BATs. Furthermore, disgust emerged as a mediator of avoidance on the BATs among high contamination fearful participants.

Although there is mounting evidence in the literature implicating disgust in contamination fear, there are few experimental examinations of this relationship. Furthermore, there is a need for additional studies that examine the extent to which potential third variables (i.e., anxiety, depression) explain the

disgust–contamination fear association. The present study attempted to address these limitations by examining the specificity of disgust sensitivity in predicting contamination fear as operationalized by performance on three contamination-based BATs. It was predicted that disgust sensitivity would be significantly associated with anxious and avoidant responding on the BATs. It was further predicted that the disgust sensitivity-BAT response relationship would remain significant when controlling for numerous potential third variables that might explain the association. Because the tendency to overestimate the likelihood and severity of threat has been implicated as a contributing factor to OCD, we examined the relation between this form of "contamination cognitions," BAT responses, and disgust sensitivity. We predicted that contamination cognitions would be significantly associated with BAT responses and disgust sensitivity. Lastly, we hypothesized that disgust sensitivity would mediate the relationship between contamination cognitions and anxious and avoidant responses to the BATs.

Method

Participant selection

Participants were selected from a pool of 636 undergraduate students enrolled in introductory psychology courses at the University of Wyoming. Individuals were selected based on their scores on the 10-item contamination fear subscale from the Padua Inventory (PI; Burns, Keortge, Formea, & Sternberger, 1996). Using normative data reported by Burns et al. (1996), we identified participants with scores below the non-clinical mean ($\leqslant 6$; $n = 379$) or above the OCD patient mean ($\geqslant 14$; $n = 84$). From these individuals we recruited similar numbers of randomly selected men and women at each level of contamination fear. Because women constituted the majority of those with low contamination fear (58.3%) and high contamination fear (81.0%), a higher percentage of men were invited to participate. The final sample consisted of 56 participants, including 30 with low contamination fear (53.3% women; $n = 16$) and 26 with high contamination fear (53.8% women; $n = 14$). The mean age was 20.0 (SD = 3.2) and 93.0% of participants described themselves as Caucasian.

Measures

Padua inventory contamination fear subscale (PI; Burns et al., 1996)

Participants completed the 10-item subscale of the PI assessing contamination obsessions and washing compulsions. Items are scored on a 5-point scale ranging from 0 ("not at all") to 4 ("very much"). Burns et al. reported mean scores of 6.54 and 13.87 for students and patients with OCD, respectively. In accordance with these norms and previous research (Olatunji et al., 2007; Olatunji et al., 2004), participants in the present study with scores $\leqslant 6$ were assigned to the low contamination fear group, while those with scores of $\geqslant 14$ were assigned to the high contamination fear group. Burns et al. (1996) reported good internal consistency ($\alpha = 0.85$) and test–retest reliability (0.72) for the contamination fear subscale. Internal consistency was adequate in the present study ($\alpha = 0.87$).

Because participants completed the PI contamination fear subscale at two time points (screening and the laboratory assessment), we were able to examine the temporal stability of scores on this measure. In the low contamination fear group, scores significantly increased from $M = 3.57$ (SD = 1.70) to $M = 6.67$ (SD = 5.89), $t\ (29) = 2.97$, $p < 0.01$. Among high contamination fear participants, scores significantly decreased from $M = 19.50$ (SD = 4.80) to $M = 16.42$ (SD = 6.26), $t\ (26) = 3.02$, $p < 0.01$. Despite this apparent regression to the mean, at the time of the laboratory assessment the low and high contamination fear groups had mean scores that closely approximated non-clinical and OCD patient norms, respectively.

Disgust scale (DS; Haidt, McCauley, & Rozin, 1994)

The DS is a 32-item questionnaire assessing sensitivity to a range of disgust elicitors, including animals, body products, death, body envelope violations (e.g., injuries), food, hygiene, and sex. The DS yields a total score and eight subscale scores. Because the subscale scores have consistently been shown to possess

unsatisfactory internal consistencies (e.g., range in α's = 0.34–64 in Haidt et al., 1994), only the total score was used in the present study. The DS had adequate internal consistency ($\alpha = 0.87$).

Beck anxiety inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988)

The BAI assesses 21 common symptoms of clinical anxiety (e.g., sweating, fear of losing control). Respondents indicate the degree to which they have recently been bothered by each symptom during the past week. The BAI was designed to assess anxiety symptoms independently from depression symptoms and has good reliability and validity (Beck, Epstein, Brown, & Steer, 1988; Beck, Steer, & Garbin, 1988). The BAI had good internal consistency in the present study ($\alpha = 0.92$).

Beck depression inventory (BDI) (Beck, Ward, Mendelsohn, Mock, & Erlbaugh, 1961)

The BDI is a 21-item self-report scale that assesses the severity of depressive symptoms experienced during the past week. The BDI has excellent reliability and validity and is widely used in clinical research (Beck et al., 1988). The BDI had adequate internal consistency in the present study ($\alpha = 0.89$).

Contamination cognitions scale (CCS)

The CCS was constructed for the present study to assess the tendency to overestimate the likelihood and severity of contamination, a proposed cognitive vulnerability factor in OCD (OCCWG, 2001). The scale presented respondents with a list of 13 objects OCD patients often associate with germs (toilet handles, toilet seats, sink faucets, door handles, workout equipment, telephone receivers, stairway railings, elevator buttons, animals, raw meat, money, unwashed produce, foods that others have touched). Participants were asked to imagine what would happen if they touched each object and were unable to wash their hands afterwards. For each object, participants provided two ratings: the likelihood that touching the object would result in contamination, and "how bad it would be" if they were actually contaminated. Ratings were given on a 0–100 scale, where 0 = "not at all likely," 50 = moderately likely," and 100 = "extremely likely" (likelihood ratings) and 0 = "not at all bad," 50 = "moderately bad," and 100 = "extremely bad" (severity ratings). Likelihood and severity summary scores were calculated by averaging responses across the 13 items on each scale. Because these two subscales were highly correlated ($r = 0.83$), we elected to report only a total score on this measure. CCS total scores were calculated by averaging ratings for all 26 items. The CCS had excellent internal consistency ($\alpha = 0.97$). All participants completed the CCS one week after the present study during a second laboratory assessment in the context of a prospective study on the effects of safety behaviors on contamination fear (Deacon & Maack, 2007). Test–retest reliability for the CCS was excellent ($r = 0.94$).

Behavioral avoidance tasks (BATs)

Three BATs were administered to assess the emotional and behavioral features of contamination fear. Each BAT consisted of three steps which participants were encouraged to complete. One task consisted of exposure to a used comb, with the steps involving holding the comb in one's hand, brushing the comb through one's hair, and touching the comb to one's lips. A second BAT involved exposure to a cookie on the floor, with the steps involving holding the cookie in one's hand, touching the cookie to one's lips, and eating the cookie. The third BAT exposed participants to a bedpan filled with toilet water. The steps included putting on a protective glove and touching the top surface of the bedpan, submerging one's gloved hand in the water, and removing the glove and submerging one's hand in the water. Participants were instructed that the tasks were "designed to test your ability to approach potentially contaminated objects and proceed as far as you can. However, they are not tests of courage, and you are free to refuse to do all or any part of the tasks or to do them only partially."

The experimenter recorded whether or not participants refused any steps and asked participants to verbally rate their current anxiety on a 0–10 scale (0 = "no anxiety at all," 5 = "moderate anxiety," 10 = extremely intense anxiety") for each completed step. The following indices were calculated for each BAT: (a) avoidance, measured by the number of steps the participant refused to complete, and (b) anxiety, assessed by the average anxiety rating for each completed step. Responses across the three BATs were similar as evidenced by strong correlations between indices of avoidance (range in r's = 0.53–0.76, all p's < 0.001) and anxiety (range in r's = 0.56–0.67, all p's < 0.001). Accordingly, for purposes of clarity and parsimony we elected to combine

responses across the BATs into composite scores for anxiety and avoidance, which were constructed by summing (avoidance) or averaging (anxiety ratings) the respective scores from each BAT. These two composite scores served as the primary measures of BAT responses.

Procedure

Following the informed consent process, participants completed self-report measures of anxiety, depression, disgust sensitivity, contamination fear, and contamination cognitions. Participants then completed the three BATs in random order determined by the roll of a die, with one of the six possible permutations corresponding to each number on the die. Participants received course credit for their participation and were reimbursed $50. This study was approved by the University of Wyoming IRB, and all individuals who received informed consent volunteered to participate.

Results

Participant characteristics

Table 1 presents descriptive statistics on each measure for the total sample. Separate scores are also presented for participants in the low and high contamination fear groups along with the results of between-group comparisons (independent samples *t*-tests and effect size estimates). The contamination fear groups did not differ with respect to age, $t(54) = 0.69$, $p > 0.10$, or gender, $\chi^2 = 0.00$, $p > 0.10$.

Validation of group membership

To establish the validity of the distinction between the low and high contamination fear groups, we examined group differences on the PI contamination fear subscale, DS, CCS, and BAT responses. To control for inflated Type I error, a Bonferroni-corrected alpha level of 0.01 (0.05 divided by 5 between-group comparisons) was employed. As shown in Table 1, statistically significant ($p < 0.001$) and large between-group effect sizes were evident on measures of contamination fear, disgust sensitivity and overestimation of the likelihood and severity of contamination. Marginally significant group differences failing to meet the Bonferroni-corrected alpha level were also evident for BAT anxiety ($p < 0.06$) and BAT avoidance ($p < 0.06$) during the BATs. These findings indicate that the high contamination fear group generally exhibited characteristics theoretically expected to discriminate between individuals with and without clinical levels of contamination fear.

Zero-order correlations between BAT responses and study variables

Zero-order Pearson correlations between the study measures are presented in Table 2. To control for inflated Type I error, a Bonferroni-corrected alpha level of 0.003 (0.05 divided by 15 correlations) was used. As

Table 1
Group means (standard deviations) on study measures among participants low and high in contamination fear and the total sample

Measure	All participants ($n = 56$)	Low CF ($n = 30$)	High CF ($n = 26$)	t (54)	d
PI Contamination fear scale	11.20 (7.76)	6.67 (5.89)	16.42 (6.26)	6.01***	1.28
Disgust scale	17.50 (5.55)	15.27 (5.02)	20.08 (5.06)	3.56***	0.90
Contamination cognitions scale	38.91 (22.23)	28.03 (19.33)	51.96 (18.32)	4.68***	1.10
BAT composite scores					
Anxiety (range = 0–10)	1.87 (1.69)	1.47 (1.39)	2.32 (1.91)	1.93±	0.48
Avoidance (range = 0–9)	3.71 (2.02)	3.23 (2.06)	4.27 (1.85)	1.97±	0.53

Note: ±$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. CF, contamination fear; PI, Padua Inventory; BAT, behavioral avoidance task. Cohen's *d* was calculated as the difference between the mean scores in each group divided by the pooled standard deviation.

predicted, DS scores were significantly ($p<0.001$) associated with anxiety and behavioral avoidance during the BATs. The DS was not unique in this regard, as scores on the CCS were also significantly ($p<0.001$) associated with BAT responses. While failing to meet Bonferroni-corrected significance in three of four correlations, BAI and BDI scores also evidenced mild-to-moderate positive associations with BAT responses. However, the DS, CCS, BAI, and BDI were also moderately correlated with each other. As a result, these correlational analyses cannot distinguish the extent to which any given measure's association with BAT responses reflected a unique relationship or shared variance with other measures.

Specificity of disgust sensitivity and contamination fear: prediction of BAT responses

We conducted two hierarchical multiple regression analyses to examine the specific contribution of disgust sensitivity to anxiety and avoidance experienced during the BATs. Sets of predictor variables were entered in three blocks. In the first block, contamination fear group (low versus high) and gender were simultaneously entered as predictors. In the second block, the BAI and BDI were simultaneously entered as predictors. Lastly, DS scores were entered in the third block. In this manner, we determined the contribution of disgust sensitivity to BAT responses after controlling for level of contamination fear, gender, anxiety symptoms, and depression symptoms. Given the positive associations between contamination fear group, BAI, and the BDI with BAT responses, this analytic strategy provided a very stringent test of the incremental validity of disgust sensitivity.

Table 3 presents the results of these analyses. In the hierarchical regression predicting BAT anxiety, gender and contamination fear group were entered in the first step and explained a marginally significant portion of the variance, $F(2, 53) = 3.08$, $p<0.10$. In the second step, the BAI and BDI explained an additional 13.2% of the variance in BAT anxiety, $F(2, 51) = 4.43$, $p<0.05$. Lastly, in the third step the DS accounted for an additional 6.5% of the variance in BAT anxiety, $F(1, 50) = 4.67$, $p<0.05$. Only the DS emerged as a significant, unique predictor of BAT anxiety in the final equation. In the second hierarchical regression, gender and contamination fear group did not account for a significant portion of the variance in BAT avoidance, $F(2, 53) = 2.24$, $p>0.10$. Predictors added in the second step explained an additional 6.2% of the variance, $F(2, 51) = 1.85$, $p>0.10$. As with BAT anxiety, the DS explained significant additional variance in step 3 (7.3%), $F(1, 50) = 4.66$, $p<0.05$ and emerged as the only significant, unique predictor of BAT avoidance in the final equation.

Disgust sensitivity as a mediator of the relationship between the overestimation of threat and BAT responses

We followed the recommendations of Baron and Kenny (1986) to test whether disgust sensitivity mediated the relationship between the tendency to overestimate the likelihood and severity of contamination and responses to the BATs. Evidence of mediation requires the following conditions to be present: (a) a significant relationship between disgust sensitivity and contamination cognitions, (b) a significant association between BAT responses and contamination cognitions, (c) a significant relationship between disgust sensitivity and BAT responses, and (d) the statistically significant relationship between BAT responses and contamination

Table 2
Pearson correlations between the study measures

Measure	DS	CCS	BAI	BDI	BAT anxiety	BAT avoidance
DS	—					
CCS	0.59***	—				
BAI	0.58***	0.57***	—			
BDI	0.40**	0.32*	0.65***	—		
BAT anxiety	0.50***	0.42***	0.45***	0.37**	—	
BAT Avoidance	0.44***	0.40**	0.32*	0.19	0.18	—

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$. Correlations $\geqslant 0.40$ were significant at the Bonferroni-corrected alpha level of 0.003. DS, disgust scale; CCS, contamination cognitions scale; BAI, beck anxiety inventory; BAI, beck depression inventory; BAT, behavioral avoidance task.

Table 3
Specificity of disgust sensitivity in predicting behavioral avoidance task (BAT) responses

Measure	R^2	B	SE B	β	t
Predicting BAT anxiety					
Step 1	0.10±				
Contamination fear group		0.81	0.43	0.24	1.87±
Gender		−0.70	0.43	−0.21	−1.62
Step 2	0.13*				
Beck anxiety inventory		0.05	0.03	0.30	1.75±
Beck depression inventory		0.03	0.04	0.14	0.86
Step 3	0.07*				
Disgust scale		0.10	0.05	0.35	2.16*
Predicting BAT avoidance					
Step 1	0.08				
Contamination fear group		1.07	0.54	0.26	2.01±
Gender		−0.36	0.54	−0.09	−0.67
Step 2	0.06				
Beck anxiety inventory		0.06	0.04	0.30	1.64
Beck depression inventory		−0.01	0.05	−0.03	−0.19
Step 3	0.07*				
Disgust scale		0.14	0.06	0.37	2.16*

Note: ±$p<0.10$, *$p<0.05$, **$p<0.01$, ***$p<0.001$. Coding for dichotomous variables: 1 = low contamination fear, 2 = high contamination fear (contamination fear group); 1 = female, 2 = male (gender).

Table 4
Reductions in standardized regression coefficients for overestimation of threat in the prediction of behavioral avoidance task (BAT) responses after controlling for disgust sensitivity

Measure	BAT composite score	
	Anxiety	Avoidance
Step 1		
R^2 change for CCS	0.18**	0.16**
β for CCS	0.42**	0.40**
Step 2		
R^2 change for DS	0.10**	0.07*
β for CCS controlling for DS	0.19	0.21
β for DS	0.39**	0.32*
Overall R^2	0.25	0.22
F (2, 52)	9.95***	7.37**

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$. CCS, contamination cognitions scale; DS, disgust scale.

cognitions diminishes or disappears when disgust sensitivity is controlled. As shown in Table 2, Pearson correlation coefficients indicated that conditions (a), (b), and (c) above were met.

We investigated condition (d), the critical test of mediation, by examining the magnitude of the relationship between contamination cognitions and BAT responses after controlling for disgust sensitivity. A two-step regression equation was estimated for each BAT composite score by entering, in order, the CCS and DS as predictors. The key comparison involved the change in standardized regression coefficients for the CCS from step 1 (total effect) to step 2 (direct effect controlling for disgust sensitivity). Results of these analyses appear in Table 4. As can be seen, the highly significant relationship between contamination cognitions and each BAT composite score became non-significant after controlling for disgust sensitivity. Moreover, disgust sensitivity emerged as a significant, unique predictor in both analyses. Thus, all a priori conditions were met, indicating

that disgust sensitivity fully mediated the relationship between the tendency to overestimate the likelihood and severity of contamination and emotional and behavioral responses to the BATs.

Discussion

Recent studies have implicated disgust sensitivity in the development of contamination fear observed in OCD (e.g., Olatunji et al., 2004; Schienle et al., 2003). However, the majority of the available evidence on the disgust sensitivity–contamination fear association comes from correlational studies. The present study attempted to replicate and extend prior findings by examining the specificity of disgust sensitivity in the prediction of contamination fear as defined by responses to three contamination based BATs among participants high and low in contamination fear. Consistent with previous research (e.g., Tsao & Mckay, 2004), the present findings showed that disgust sensitivity was associated with anxious and avoidant responding to BATs involving exposure to a used comb, a cookie on the floor, and a bedpan filled with toilet water. These findings lend further support to the notion that the general predisposition towards experiencing disgust is associated with anxiety towards and avoidance of contamination-relevant stimuli.

Some authors have suggested that the relation between disgust and anxiety disorder symptoms is illusory and mediated by symptoms of negative affective (Muris, Merckelbach, Schmidt, & Tierney, 1999; Thorpe & Salkovskis, 1995). Furthermore, recent research has highlighted the importance of controlling for third party variables when examining the relation between disgust and psychopathology symptoms (Davey & Bond, 2006). In the present study, the tendency to overestimate the likelihood and severity of contamination, anxiety, and depression were positively associated with anxious and avoidant responses to the BATs. Thus, it was important to clarify whether the association between disgust sensitivity and anxiety and avoidance on the contamination-based BAT reflected a unique relationship or shared variance with other variables. Hierarchical multiple regression analyses in the present study revealed that only disgust sensitivity remained a significant, unique predictor of BAT anxiety and avoidance when controlling for gender, contamination fear group membership, anxiety, and depression. As such, the relationship between disgust sensitivity and contamination fear does not appear to be illusory or attributable to these third variables. Rather, disgust sensitivity may operate as a specific and unique vulnerability factor for contamination anxiety and avoidance.

Contemporary cognitive-behavioral models of OCD implicate the tendency to overestimate the likelihood and severity of threat in the development and maintenance of the disorder (e.g., Rachman, 1997; Rachman, 1998). In the present study, a measure of the tendency to overestimate the likelihood and severity of contamination from everyday objects was significantly related to contamination fear group (low versus high) as well as anxious and avoidant responses to the BATs. While the aforementioned results are consistent with the proposed role of threat overestimation in contamination fear, they do not clarify the mechanism through which this cognitive bias contributes to the fear of contamination. Given the robust relationship between disgust sensitivity and contamination fear, we predicted that threat overestimation might elicit anxiety toward and avoidance of contaminants via its effects on disgust. In this study, the significant association between threat overestimation and BAT responses became non-significant and was substantially diminished after controlling for disgust sensitivity. In contrast, disgust sensitivity remained a significant predictor of BAT anxiety and avoidance after controlling for threat overestimation. Accordingly, our hypothesis that disgust sensitivity would mediate the relationship between threat overestimation and both domains of responding to the BATs was supported. The present study suggests that contamination fear observed in OCD may develop in the context of threat overestimation which evokes disgust and motivates efforts to reduce distress via avoidance or neutralizing behavior (e.g., washing rituals). To our knowledge, the present study is the first to suggest that disgust sensitivity mediates the relationship between threat overestimation and contamination fear. Research on the role of disgust sensitivity and cognitive biases in OCD has typically been conducted in a separate and parallel fashion. Our findings highlight a possible means of integrating the important contributions of these two putative risk factors. Additional research is needed to replicate and clarify the joint contributions of disgust sensitivity and cognitive biases in the fear of contamination.

The present findings highlight the possibility that disgust sensitivity may be functional, perhaps more so than other relevant variables (i.e., contamination fear, contamination cognitions, anxiety, depression, gender), in the etiology and/or maintenance of contamination-related OCD (Olatunji et al., 2004). The unique

association between disgust sensitivity and anxiety and avoidance of contaminants may be partially explained by the disease avoidance model (Matchett & Davey, 1991). This model, originally articulated in the context of animal fears, suggests that certain small animals (e.g. rat, spider, cockroach, maggot, snail, slug) may be avoided due to their perceived disgust and contamination properties. Recent applications of the disease avoidance model to contamination-related OCD emphasize health concerns. Specifically, it has been proposed that disgust may motivate avoidance of objects and situations in which contact with potential contaminants (e.g., germs, bacteria) may be particularly high due to concerns of disease acquisition (e.g., Olatunji et al., 2007). In support of this, several studies have reported that disgust sensitivity is related to health anxiety (Davey & Bond, 2006; Thorpe et al., 2003). For example, Deacon and Abramowitz (2006) reported that disgust regarding hypodermic needles was strongly associated with the concern that injections might pose a health hazard. Future research on the disgust sensitivity–contamination fear association should examine the extent to which this relationship is influenced by individuals' health concerns.

Our findings should be interpreted in the context of several limitations. First, because no published measure of the tendency to overestimate the likelihood and severity of contamination existed at the time of this investigation, we used a measure constructed for the present study with unknown psychometric properties and validity. Though our results provide initial support for the CCS's internal consistency, test–retest reliability, and criterion validity, more comprehensive research is necessary to demonstrate this scale's utility as a measure of contamination cognitions. Second, the BATs elicited relatively little anxiety. Because participants were free to refuse any of the BAT steps, they most likely attempted only those that elicited a manageable degree of anxiety. A more intense BAT that permits fewer opportunities for avoidance, such as that utilized by Jones and Menzies (1997, 1998), would probably have elicited substantially higher anxiety ratings. A third limitation concerns our use of undergraduate students with high contamination fear as an analogue to patients with OCD. Although mean scores on the PI contamination fear subscale for these participants approximated clinical norms, it is likely that our participants had generally less severe symptoms than individuals with a formal diagnosis of OCD. As a result, replication of this study in a sample of OCD patients would help to establish the generalizability of our findings.

In concert with previous research, the present findings support the systematic focus on disgust in the treatment of contamination-related OCD. In one such study, McKay (2006) found that OCD patients with primary contamination fear habituated to disgust more slowly and to a lesser degree than OCD patients with other symptoms. It has been suggested that the fear of contamination is very persistent (Rachman, 2004) and the present findings and those of McKay (2006) suggest that the persistence of contamination concerns may be partially a function of heightened disgust reactions. Future experimental research with OCD patients may advance our understanding of the role of disgust in the development of contamination fear observed in this disorder.

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