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The effects of safety behaviors on the fear of contamination: An experimental investigation

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Abstract

The strategies used by anxious individuals to prevent feared outcomes, known as safety behaviors, are thought to maintain pathological anxiety by preventing the disconfirmation of inaccurate threat beliefs. However, it is possible that safety behaviors might also contribute to the development and exacerbation of anxiety symptoms. The present study tested this notion in a sample of undergraduate participants with either low ($n = 30$) or high ($n = 26$) levels of contamination fear. After a week-long baseline period, participants spent 1 week engaging in a clinically representative array of contamination-related safety behaviors on a daily basis, followed by a second baseline period. Subsequent to the safety behavior manipulation, participants evidenced statistically significant increases in threat overestimation, contamination fear symptoms, and emotional and avoidant responses to three contamination-related behavioral avoidance tasks (BATs). In contrast, anxiety and depressive symptoms remained stable. The magnitude of change in contamination concerns was equivalent among participants in both contamination fear groups. Our findings suggest that contamination-related safety behaviors elicit a modest and specific increase in the fear of contamination. Possible mechanisms for this effect, as well as implications for the role of safety behaviors in the psychopathology of anxiety disorders, are discussed.

Keywords: Safety behaviors; Avoidance; Contamination; Obsessive–compulsive disorder; Anxiety

Actions intended to detect, avoid, or escape a feared outcome, known as "safety behaviors," are ubiquitous, often adaptive, and inherently normal and logical responses to the perception of threat. Whereas the judicious use of safety behaviors in the presence of actual threat is essential for survival, such behaviors are often employed in the absence of objective danger by individuals with anxiety disorders (Clark, 1999; Salkovskis, 1991). Common clinical examples include frequent hand washing in obsessive–compulsive disorder (OCD), avoidance of eye contact in social phobia, and the use of safety aids such as a cell phone and prescription anti-anxiety medication in panic disorder. Despite their distinct topography, these behaviors are considered functionally equivalent in that they are intended to prevent disaster, and also serve to prevent the disconfirmation of inaccurate threat beliefs that would otherwise take place (Salkovskis, Clark, Hackmann, Wells, & Gelder, 1999).

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Cognitive-behavioral theorists have emphasized the role of safety behaviors in explaining why irrational fears do not self-correct in the face of repeated disconfirmation (Clark, 1999; Salkovskis, 1991; Thwaites & Freeston, 2005). Two mechanisms have been proposed to explain how safety behaviors maintain pathological anxiety. One possibility highlighted by Salkovskis (1991) is that safety behaviors cause a misattribution of safety. In this manner, the non-occurrence of a feared catastrophe (e.g., heart attack) may be erroneously attributed to a safety behavior (e.g., sitting down). A second possibility is that safety behaviors divert attentional resources away from disconfirming information (Powers, Smits, & Telch, 2004; Sloan & Telch, 2002). To illustrate, a socially phobic individual whose attention is focused on his or her performance during a speech may not notice the audience's favorable reaction.

Although the precise mechanisms underlying the role of safety behaviors in threat disconfirmation remain to be elucidated, numerous clinical studies attest to their harmful effects. Patients who engage in safety behaviors during exposure therapy show less belief change and fear reduction (Salkovskis et al., 1999) as well as lower between-trial habituation (Sloan & Telch, 2002). Safety aids merely need to be available—not utilized—in order for them to interfere with the therapeutic benefits of exposure (Powers et al., 2004; Schmidt, Richey, Maner, & Woolaway-Bickel, 2006). Conversely, exposure therapy appears to be more effective when patients attempt to forego their safety behaviors (Kim, 2005; Morgan & Raffle, 1999; Wells et al., 1995), although there may be circumstances under which some safety behaviors facilitate engagement in exposure therapy (Rachman, Radomsky, & Shafran, in press).

In addition to their hypothesized role in the *maintenance* of pathological anxiety, it is possible that safety behaviors may directly *exacerbate* anxiety symptoms. Clinically, it is often observed that safety behaviors paradoxically worsen the very concerns they were intended to alleviate. For example, efforts to deliberately suppress unwanted mental content may increase the frequency of the suppressed thoughts and intensify negative emotional responses to them (Purdon, 1999). More generally, as suggested by the findings of Lavy and van den Hout (1994), safety behaviors may serve to increase attention toward feared stimuli. This shift in attention may lead to increased perception of threat cues and threat overestimation. For example, the frequent body scanning and checking observed in panic disorder patients might amplify the perception of body sensations, leading to an increase in concerns about heart attack, passing out, and other feared consequences (Schmidt, Lerew, & Trakowski, 1997).

Although the potentially harmful effects of safety behaviors may be most salient in individuals with anxiety disorders, they may also be present prior to the development of clinical anxiety symptoms. Individuals in the general population vary in their propensity to engage in safety behaviors commonly observed among anxious patients, such as frequent hand washing and avoidance of contact with potential contaminants. Indeed, many individuals are likely encouraged from a young age to habitually engage in such behaviors from concerned parents or other sources. It is possible that these behaviors may contribute to the development of anxiety symptoms and inaccurate threat beliefs, or exacerbate existing anxiety problems, via the same mechanisms observed in individuals with anxiety disorders. Unfortunately, the possible role of safety behaviors in the development of anxiety symptoms is largely unknown at present.

The present study was conducted to experimentally investigate the effects of safety behaviors on the development and exacerbation of anxiety symptoms. We elected to study this issue in the context of the fear of contamination because of the ubiquity of contamination concerns (Rachman, 2004), the ease with which individuals may incorporate contamination-related safety behaviors into their daily routine, and our suspicion that such behaviors might increase individuals' awareness of, and concerns about, potential sources of contamination in their environment. Undergraduate participants with either low or high levels of self-reported contamination fear were instructed to engage in a large number of contamination safety behaviors (e.g., washing, cleaning, and avoidance of contaminants) each day for one week, thereby simulating the behavior of individuals with contamination-related OCD. Week-long baseline periods during which participants were instructed to behave normally occurred immediately before and after the safety behavior manipulation. We hypothesized that compared to the initial baseline week, participants would evidence significantly higher levels of contamination fear following the safety behavior manipulation. We also hypothesized that responses to the manipulation would be similar among participants with low and high levels of baseline contamination concerns.

Method

Participants

Introductory psychology students ($N = 636$) completed a mass testing questionnaire packet for course credit that included the Padua Inventory (PI) contamination fear subscale (Burns, Keortge, Formea, & Sternberger, 1996). Individuals with scores below the nonclinical mean ($\leqslant 6$; $n = 379$) or above the OCD patient mean ($\geqslant 14$; $n = 84$) reported by Burns et al. were invited to participate via e-mail solicitations. The final sample consisted of 56 participants, including 30 with low contamination fear (53.3% women) and 26 with high contamination fear (53.8% women). The mean age was 20.0 (S.D. = 3.2) and 93.0% of participants were Caucasian.

Experimental design

This study utilized a within-subjects, simple phase change A/B/A design (Hayes, Barlow, & Nelson-Gray, 1999). The 3-week study period consisted of the following week-long phases (described in further detail below): (a) *baseline phase*, during which participants were asked to engage in their normal frequency of contamination-related safety behaviors; (b) *safety behavior phase*, during which participants were instructed to engage in frequent, daily contamination-related safety behaviors; and (c) *return to baseline phase*, during which participants were asked to once again engage in their normal frequency of safety behaviors. Assessments were conducted before and after each phase, yielding a total of four assessment timepoints.

Measures

Padua Inventory Contamination Fear subscale (Burns et al., 1996)

Participants completed the 10-item subscale of the PI assessing contamination obsessions and washing compulsions. Burns et al. (1996) reported adequate internal consistency ($\alpha = .85$) and test–retest reliability (.72) for this subscale, and means of 6.54 and 13.87 for students and OCD patients, respectively. In accordance with these norms and previous research (Olatunji, Lohr, Sawchuk, & Tolin, 2007; Olatunji, Sawchuk, Lohr, & de Jong, 2004), participants in the present study with scores $\leqslant 6$ were deemed to have low contamination fear, while those with scores of $\geqslant 14$ were considered to have high contamination fear. Internal consistency was adequate at each assessment timepoint (α's = .87, .90, .92, and .92), as was test–retest reliability before and after the baseline week (.88).

Contamination Cognitions Scale (CCS)

This measure was constructed for the present study to assess the overestimation of threat from potentially contaminated objects. The CCS lists 13 common objects often associated with germs (e.g., door handles and toilet seats) and asks participants to rate the likelihood and severity of contamination if they were to touch each object and subsequently refrain from washing their hands (see Deacon & Olatunji, 2007, for more information). Because likelihood and severity ratings were highly correlated at each assessment timepoint (r's ranged from .81 to .86; all p's $< .001$), we calculated CCS total scores by averaging ratings across all 26 items. The CCS had excellent internal consistency at each assessment timepoint (α's = .97, .98, .99, and .95) and excellent test–retest reliability before and after the baseline week (.94).

Safety behavior checklist

Participants were instructed to complete a safety behavior checklist at the end of each day during the 3 -week study period. Respondents noted whether or not they performed each of 27 contamination-related safety behaviors that day by indicating "Yes" or "No." Table 1 presents each contamination-related safety behavior on the checklist. Total scores were derived by calculating the average number of "Yes" responses on each completed checklist per day during a given study phase.

Table 1
Suggested contamination-related behaviors to be used each day during the safety behavior manipulation

Carrying anti-bacterial hand sanitizer at all times
Washing/disinfecting hands each time after using the toilet
Washing/disinfecting hands each time before eating
Washing/disinfecting hands each time after eating
Washing/disinfecting hands each time after handling raw meat
Washing/disinfecting hands after using workout equipment
Trying to avoid touching public door handles
Washing/disinfecting hands after touching public door handles
Trying to avoid touching stairway railings
Washing/disinfecting hands after touching stairway railings
Trying to avoid touching money
Washing/disinfecting hands after touching money
Trying to avoid touching animals
Washing/disinfecting hands after touching animals
Trying to avoid touching foods that might have pesticides on them (e.g., unwashed produce)
Washing/disinfecting hands after touching foods that might have pesticides on them
Trying to avoid touching elevator buttons
Washing/disinfecting hands after touching elevator buttons
Trying to avoid touching public telephone receivers
Washing/disinfecting hands after touching public telephone receivers
Trying to avoid eating foods that other people have touched
Washing/disinfecting hands after eating foods that other people have touched
Taking two or more showers for at least 20 min each
Disinfecting telephone receivers at home with Clorox wipes
Disinfecting toilet seat and handle at home with Clorox wipes
Disinfecting bathroom doorknobs and faucets at home with Clorox wipes
Disinfecting kitchen counters at home with Clorox wipes

Behavioral avoidance tasks (BATs)

Three BATs, presented in random order, 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 BAT 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."

Participants provided verbal ratings of current anxiety and current feelings of contamination on a 0–10 scale (0 = none, 5 = moderate, and 10 = extreme) after each completed step. The following indices were calculated for each BAT: (a) avoidance, measured by the number of steps the participant refused to complete; (b) anxiety, assessed by the average anxiety rating for each completed step; and (c) contamination, assessed by the average contamination rating for each completed step. Responses across the three BATs at baseline were highly comparable as evidenced by strong correlations between avoidance (range in r's = .53–.76; all p's < .001), anxiety ratings (range in r's = .56–.67; all p's < .001), and contamination ratings (range in r's = .71–.92; all p's < .001). Accordingly, for purposes of clarity and parsimony we combined responses across the three BATs into composite scores for anxiety, contamination, and avoidance which were constructed by summing (avoidance) or averaging (anxiety and contamination ratings) the respective scores across each BAT.

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988)

The BAI assesses 21 common symptoms of clinical anxiety during the past week. The BAI evidenced good internal consistency at each assessment timepoint (α's = .92, .91, .93, and .90) and adequate test–retest reliability before and after the baseline week (.82).

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 had adequate internal consistency at each assessment timepoint (α's = .89, .88, .90, and .91) and satisfactory test–retest reliability before and after the baseline week (.86).

Exit interview

At the end of the study, participants were asked two open-ended questions: (a) "How did engaging in the cleanliness-related behaviors during the second week of the study affect your level of contamination fear?" and (b) "Why do you think engaging in the cleanliness-related behaviors had this effect on your level of contamination fear?" Participants' responses were recorded verbatim.

Procedure

After providing informed consent, participants completed the study measures and the three BATs. These assessments were repeated during the second, third, and fourth laboratory meetings. Participants were also asked to complete the safety behavior checklist each day during the 3-week study period and turn them in to the experimenter after each week. At the end of the first assessment, participants were instructed to engage in their typical frequency of contamination-related safety behaviors for the upcoming week. At the end of the second laboratory assessment, participants were instructed to engage in the safety behaviors identified in Table 1, at every possible opportunity, on a daily basis for the upcoming week. To facilitate this task, participants were given two small (1.5 fluid ounce) bottles of Germ-X® hand sanitizer. The experimenter demonstrated its correct manner of usage and instructed participants to carry it on their person at all times. Participants were also supplied with a canister of Clorox® Disinfecting Wipes to be used at home for disinfecting telephone receivers, toilet seats and handles, bathroom doorknobs and faucets, and kitchen countertops. Participants were instructed to disinfect their hands, either with soap and water or hand sanitizer, after coming into contact with each object identified on the checklist. In recognition of the difficulty in refraining from touching some of these objects for an entire week, participants were allowed to make occasional contact with some items but were urged to immediately wash or disinfect their hands afterwards. Lastly, participants were asked to make a concerted effort to avoid touching, or to disinfect their hands upon touching, any other objects they thought might be contaminated by germs. No information was provided regarding the ubiquity of germs, the potential dangers of contamination, or the need to engage in safety behaviors to prevent any negative consequences.

Following the third assessment, participants were encouraged to spend the upcoming week engaging in their normal, baseline frequency of contamination-related safety behaviors. As the fourth assessment took place following the final week of the study, no further instructions regarding safety behaviors were provided. Participants completed the exit interview and were paid $50. This study was approved by the University of Wyoming institutional review board, and all individuals who received informed consent volunteered to participate.

Results

Manipulation check

A 3 (study phase) $\times$ 2 (contamination fear group) mixed ANOVA was conducted to examine self-reported compliance with the safety behavior manipulation. A significant main effect of phase was evident, $F(2, 51) = 280.42$, $p < .001$. A priori univariate contrasts indicated higher self-reported frequency of contamination-related safety behaviors during the *safety behavior phase* compared to the *baseline phase*

($F[1, 51] = 345.54$, $p < .001$, $d = 3.32$) and the *return to baseline phase* ($F[1, 51] = 265.96$, $p < .001$, $d = 2.55$). Participants reported engaging in an average of 4.04 (S.D. = 3.39), 17.55 (S.D. = 4.57), and 6.51 (S.D. = 3.92) safety behaviors during the three study phases, respectively. The self-reported frequency of safety behaviors during the *safety behavior phase* was comparable between the high ($M = 18.18$, S.D. = 3.65) and low ($M = 17.10$, S.D. = 5.25) contamination fear groups ($p > .30$).

Effects of safety behaviors on contamination concerns

To test the study hypotheses, we conducted a series of 4 (assessment timepoint) × 2 (contamination fear group) mixed ANOVAs examining the effects of the safety behavior manipulation on indices of contamination concerns. These results are summarized in Table 2. A significant main effect of contamination fear group was evident on each index of contamination concerns, indicating higher scores (averaged across all assessment timepoints) among those in the high vs. low contamination fear groups. A significant within-subjects main effect of assessment timepoint was also observed in each analysis. A priori univariate contrasts tested the

Table 2
Descriptive statistics for the study measures at each assessment timepoint and F-tests of main effects of time, baseline contamination fear group, and their interaction

Variable	Time 1		Time 2		Time 3		Time 4		Main Effect of Time	Main Effect of CF group	Time × group interaction
	Low CF	High CF	Low CF	High CF	Low CF	High CF	Low CF	High CF	$F(3, 54)$	$F(1, 54)$	$F(1, 54)$
PI CF subscale									13.26***	35.14***	.34
M	6.67	16.42	6.33	16.56	10.37	19.38	7.93	17.35			
S.D.	5.89	6.26	4.35	6.93	6.20	8.92	5.77	8.55			
CCS									3.74*	16.09***	1.15
M	28.03	51.96	28.58	52.32	33.74	53.51	31.89	53.65			
S.D.	19.33	18.32	19.97	19.93	23.46	21.79	23.72	23.19			
BAT anxiety									5.19**	4.45*	.10
M	1.47	2.32	.96	1.94	1.53	2.37	1.34	2.21			
S.D.	1.39	1.91	1.27	1.65	1.71	2.09	1.45	2.05			
BAT contamination									4.05**	7.28**	.28
M	1.42	2.53	1.17	2.43	1.84	2.82	1.54	2.72			
S.D.	1.41	1.65	1.11	1.78	1.55	2.28	1.56	2.30			
BAT avoidance									3.13*	3.94*	.69
M	3.23	4.27	3.27	4.31	3.57	4.46	3.40	4.62			
S.D.	2.06	1.85	2.12	1.87	2.21	1.88	2.26	1.92			
BAI									14.10***	6.77*	.79
M	11.57	17.19	8.00	14.73	8.03	13.23	6.80	10.88			
S.D.	9.90	10.50	6.54	9.46	7.59	10.86	6.39	7.85			
BDI									6.39***	2.56	.13
M	8.33	10.81	6.80	9.77	6.03	9.15	6.00	8.69			
S.D.	7.37	7.68	5.42	7.99	5.35	8.63	6.15	7.56			

Notes: CF, contamination fear; low CF, low baseline contamination fear group; high CF, high baseline contamination fear group; PI CF subscale, Padua Inventory contamination fear subscale; CCS, Contamination Cognitions Scale; BAT, behavioral avoidance tasks; DS, Disgust Scale; BAI, Beck Anxiety Inventory; and BDI, Beck Depression Inventory.

*$p < .05$.

**$p < .01$.

***$p < .001$.

hypothesis that contamination fear would be significantly higher immediately following the *safety behavior phase* (time 3) than the *baseline phase* (time 2). As hypothesized, scores were significantly higher at time 3 compared to time 2 for the PI contamination fear subscale, $F(1, 54) = 28.54$, $p < .001$, $d = .42$; BAT contamination, $F(1, 54) = 14.66$, $p < .001$, $d = .31$; BAT anxiety, $F(1, 54) = 14.63$, $p < .001$, $d = .29$; the CCS, $F(1, 54) = 7.07$, $p < .01$, $d = .14$; and BAT avoidance, $F(1, 54) = 4.60$, $p < .05$, $d = .11$. Also consistent with our hypothesis, the interaction between contamination fear group and assessment timepoint was non-significant in each analysis (all p's$>.10$). Fig. 1 graphically depicts scores on measures of contamination fear at each assessment timepoint for participants in each baseline contamination fear group.

Secondary a priori univariate contrasts were conducted to examine the extent to which contamination concerns decreased following the *return to baseline phase*. Scores on the PI contamination fear subscale significantly decreased from time 3 to time 4, $F(1, 54) = 17.36$, $p < .001$, $d = .26$. In contrast, scores on the other indices of contamination fear did not decline to a statistically significant extent following the manipulation (all p's$>.10$). A final set of univariate contrasts compared levels of contamination concerns following each baseline phase. Compared to time 2, significantly higher scores at time 4 were observed on the PI contamination fear subscale, $F(1, 54) = 5.94$, $p < .05$, $d = .15$; BAT anxiety, $F(1, 54) = 6.05$, $p < .01$, $d = .20$; and BAT contamination, $F(1, 54) = 6.18$, $p < .05$, $d = .19$. A trend was also evident for higher levels of BAT avoidance, $F(1, 54) = 3.95$, $p < .10$, $d = .10$; and higher CCS scores, $F(1, 54) = 3.75$, $p < .10$, $d = .10$. Thus, contamination concerns remained somewhat elevated following the *safety behavior phase* and did not decline to their initial baseline levels.

Effects of safety behaviors on anxiety and depressive symptoms

To examine the specificity of the manipulation, we examined changes in anxiety and depressive symptoms during the study phases. Mixed ANOVAs yielded a significant main effect of assessment timepoint for the BAI and BDI (see Table 2). A priori univariate contrasts failed to reveal significant changes in scores during the *safety behavior phase* or *return to baseline phase* (all p's$>.05$). Rather, significant declines were observed during the *baseline phase* for the BAI, $F(1, 54) = 13.86$, $p < .001$, $d = .32$; and BDI, $F(1, 54) = 5.96$, $p < .05$, $d = .18$.

Qualitative responses to the safety behavior manipulation

Thirty-two participants (57.1%) reported increased contamination fear following the *safety behavior phase*. The remainder described either little or no change ($n = 21$; 37.5%), or a decrease in contamination fear ($n = 3$; 5.4%). Increased contamination fear was reported by 56.7% and 57.7% of participants with low and high contamination fear, respectively. Among those reporting increased contamination fear, 31 (96.9%) attributed this to increased awareness of contaminants and/or contamination (e.g., "I noticed how dirty things actually get, especially when cleaning the bathroom every day," "It made me aware of all the germs everywhere"). The majority of participants ($n = 46$; 82.1%), including those who did not experience an increase in contamination fear, reported increased awareness of contaminants in their responses to one of the two open-ended questions.

Discussion

The present study investigated the effects of safety behaviors on the fear of contamination. As hypothesized, following 1 week spent performing a clinically representative array of contamination-related safety behaviors participants evidenced statistically significant increases in threat overestimation, contamination fear symptoms, and emotional and avoidant responses to contamination-related BATs. The magnitude of these increases was equivalent among participants with both low and high baseline levels of contamination fear. Responses to the manipulation were specific to contamination-related outcomes, as anxiety and depressive symptoms remained unchanged. Overall, our findings suggest that safety behaviors may actively contribute, albeit modestly, to the emotional, cognitive, and behavioral aspects of contamination fear.

The effects of the safety behavior manipulation on contamination concerns varied from small (threat overestimation and BAT avoidance) to medium (PI contamination fear subscale scores) based on the criteria

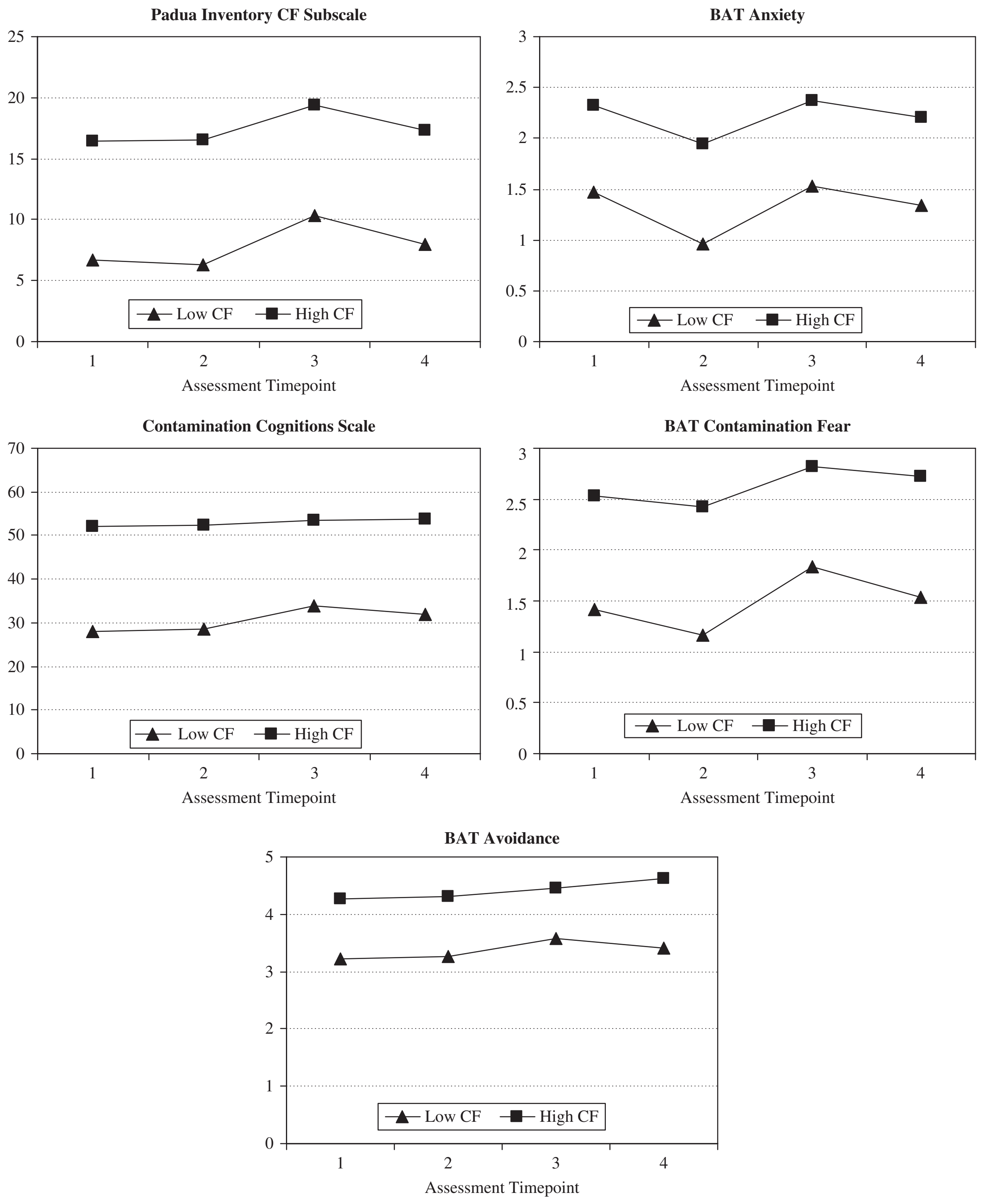

Fig. 1. Measures of contamination concerns at each assessment timepoint for participants with low and high levels of baseline contamination fear. Note: CF, contamination fear; low CF, low baseline contamination fear group; high CF, high baseline contamination fear group; and BAT, behavioral avoidance tasks. Assessment timepoints 1–2, baseline phase; assessment timepoints 2–3, safety behavior phase; and assessment timepoints 3–4, return to baseline phase.

suggested by Cohen (1988). In contrast, the two baseline phases tended to produce either no change or a reduction in contamination concerns. Self-reported anxiety and feelings of contamination during the BATs decreased somewhat from the first to the second assessment, likely as a result of increased familiarity due to repeated exposure to the same behavioral tasks. This apparent habituation was reversed after the safety behavior manipulation, with scores on each index increasing significantly. Although levels of contamination fear decreased somewhat during the second baseline week, they remained elevated and significantly higher than their initial baseline levels. It is possible that the psychological effects of engaging in contamination-related safety behaviors, such as heightened awareness of contaminants, persist somewhat even after safety behaviors are decreased. Overall, engaging in frequent, daily contamination-related safety behaviors appears to elicit a modest and specific increase in contamination concerns that is independent of one's initial level of contamination fear and persists after the return to normal patterns of behavior.

Why might safety behaviors increase the fear of contamination? One possibility is that contamination-related safety behaviors increase selective attention toward potential contaminants. In the same manner that attempting to suppress an unwanted thought requires one to first recall the thought, trying to neutralize contamination requires one to notice when contact with a contaminant has occurred, or may occur. As such, the safety behavior phase may be viewed as a manipulation of both overt behavior and the attentional allocation necessary for the application of such behavior.

Because contact with contaminants is ubiquitous and impossible to avoid (Rachman, 2004), increased attention toward contaminants should increase their perception. Nearly all participants in this study who reported increased contamination fear attributed this to heightened awareness of contaminants. This increased perception, in turn, might have led individuals to view themselves as at increased risk for contamination. Consistent with this notion, the safety behavior manipulation led to significant increases in the perceived likelihood and severity of contamination (i.e., threat overestimation)—a proposed vulnerability factor in OCD (OCCWG, 2001) and one that appears central to the experience of contamination fear (Jones & Menzies, 1997, 1998). This hypothesized process is analogous to Schmidt et al.'s (1997) model of panic disorder wherein body checking and scanning elicit hypervigilance to feared body sensations, thereby increasing their perception and producing heightened concerns about their potential consequences. It is also consistent with the observation that as-needed use of benzodiazepine medications, often considered a safety behavior (Westra & Stewart, 1998), is associated with increased selective attention toward physical threat cues among anxiety disorder patients (Stewart, Westra, Thompson, & Conrad, 1998). Future research should examine the extent to which the effects of safety behaviors on selective attention and threat overestimation contribute to the development and maintenance of anxiety symptoms.

Strengths of the present study include an ecologically valid safety behavior manipulation, multi-trait, multi-method assessment of contamination concerns, and an experimental design that maximizes internal validity by ruling out confounds associated with a traditional A/B designs such as the passage of time, reactivity to repeated assessment, and regression to the mean (Hayes et al., 1999). This study also has several limitations. Owing to our use of an undergraduate analog sample, the extent to which our findings generalize to the experience of individuals with OCD is unclear. Second, the three BATs elicited relatively little 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 and contamination ratings. Third, we cannot rule out the influence of demand characteristics on our findings. It is possible that participants deduced the study hypotheses and complied by reporting higher levels of contamination concerns following the safety behavior manipulation. This possibility should be considered alongside the observations that contamination concerns did not increase during the two week-long periods of daily monitoring of contamination-related safety behaviors, and that the effects of the manipulation were specific to contamination-related outcomes. Lastly, because of the possibility that carryover effects prevented participants' levels of contamination fear from returning to their original levels after the manipulation, the *return to baseline phase* did not serve as an adequate control. Replication using a between-subjects design would bolster confidence in the validity of our findings.

In summary, contamination-related safety behaviors appear to exert a modest increase in the fear of contamination. If replicated, this effect suggests that a modification to theoretical conceptualizations of safety behaviors may be in order. Safety behaviors are currently conceptualized as the result of learning experiences, maladaptive cognitions, and anxiety symptoms and are assigned the role of a maintenance factor. However, safety behaviors such as frequent washing and avoidance of contaminants can exist prior to the development of clinical anxiety symptoms, and may exert a causal effect on psychological processes such as selective attention toward fear cues and threat overestimation that are considered important in the development and maintenance of anxiety disorders (Clark, 1999). Future research might examine how, and under what circumstances, safety behaviors contribute to the development and exacerbation of different manifestations of anxiety and threat beliefs.

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References

Beck, A. T., Epstein, N., Brown, G., & Steer, R. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*, *56*, 893–897.

Beck, A. T., Ward, C. H., Mendelsohn, M., Mock, J., & Erlbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry*, *4*, 561–571.

Burns, G. L., Keortge, S. G., Formea, G. M., & Sternberger, L. G. (1996). Revision of the Padua inventory of obsessive compulsive disorder symptoms: Distinctiveness between worry, obsessions, and compulsions. *Behaviour Research and Therapy*, *34*, 163–173.

Clark, D. M. (1999). Anxiety disorders: Why they persist and how to treat them. *Behaviour Research and Therapy*, *37*, S5–S27.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New York: Academic Press.

Deacon, B. J., & Olatunji, B. O. (2007). Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear. *Behaviour Research and Therapy*, *45*, 2110–2120.

Hayes, S. C., Barlow, D. H., & Nelson-Gray, R. O. (1999). *The scientist-practitioner: Research and accountability in the age of managed care*. Boston: Allyn and Bacon.

Jones, M. K., & Menzies, R. G. (1997). The cognitive mediation of obsessive–compulsive handwashing. *Behaviour Research and Therapy*, *35*, 843–850.

Jones, M. K., & Menzies, R. G. (1998). Role of perceived danger in the mediation of obsessive–compulsive washing. *Depression and Anxiety*, *8*, 121–125.

Kim, E. J. (2005). The effect of decreased safety behaviors on anxiety and negative thoughts in social phobics. *Journal of Anxiety Disorders*, *19*, 69–86.

Lavy, E. H., & van den Hout, M. A. (1994). Cognitive avoidance and attentional bias: Causal relationships. *Cognitive Therapy and Research*, *18*, 179–191.

Morgan, H., & Raffle, C. (1999). Does reducing safety behaviors improve treatment response in patients with social phobia? *Australian and New Zealand Journal of Psychiatry*, *33*, 503–510.

Obsessive Compulsive Cognition Working Group. (2001). Development and initial validation of the obsessive beliefs questionnaire and the interpretation of intrusions inventory. *Behaviour Research and Therapy*, *39*, 987–1006.

Olatunji, B. O., Lohr, J. M., Sawchuk, C. N., & Tolin, D. F. (2007). Multimodal assessment of disgust in contamination-related obsessive–compulsive disorder. *Behaviour Research and Therapy*, *45*, 263–276.

Olatunji, B. O., Sawchuk, C. N., Lohr, J. M., & de Jong, P. J. (2004). Disgust domains in the prediction of contamination fear. *Behaviour Research and Therapy*, *42*, 93–104.

Powers, M. B., Smits, J. A. J., & Telch, M. J. (2004). Disentangling the effects of safety-behavior utilization and safety-behavior availability during exposure-based treatment: A placebo-controlled trial. *Journal of Consulting and Clinical Psychology*, *72*, 448–454 (Purdon, 1999).

Purdon, C. (1999). Thought suppression and psychopathology. *Behaviour Research and Therapy*, *37*, 1029–1054.

Rachman, S. (2004). Fear of contamination. *Behaviour Research and Therapy*, *42*, 1227–1255.

Rachman, S., Radomsky, A. S., & Shafran, R. (in press). Safety behaviour: A reconsideration. *Behaviour Research and Therapy*.

Salkovskis, P. M. (1991). The importance of behaviour in the maintenance of anxiety and panic: A cognitive account. *Behavioural Psychotherapy*, *19*, 6–19.

Salkovskis, P. M., Clark, D. M., Hackmann, A., Wells, A., & Gelder, M. G. (1999). An experimental investigation of the role of safety behaviors in the maintenance of panic disorder with agoraphobia. *Behaviour Research and Therapy*, *37*, 559–574.

Schmidt, N. B., Lerew, D. R., & Trakowski, J. H. (1997). Body vigilance in panic disorder: Evaluating attention to bodily perturbations. *Journal of Consulting and Clinical Psychology*, *65*, 214–220.

Schmidt, N. B., Richey, J. A., Maner, J. K., & Woolaway-Bickel, K. (2006). Differential effects of safety in extinction of anxious responding to a CO_2 challenge in patients with panic disorder. *Journal of Consulting and Clinical Psychology*, *115*, 341–350.

Sloan, T., & Telch, M. J. (2002). The effects of safety-seeking behavior and guided threat reappraisal on fear reduction during exposure: An experimental investigation. *Behaviour Research and Therapy*, *40*, 235–251.

Stewart, S. H., Westra, H. A., Thompson, C. E., & Conrad, B. E. (1998). Effects of naturalistic benzodiazepine use on selective attention to threat cues among anxiety disorder patients. *Cognitive Therapy and Research*, *24*, 67–85.

Thwaites, R., & Freeston, M. H. (2005). Safety-seeking behaviours: Fact or function? How can we clinically differentiate between safety behaviors and adaptive coping strategies across anxiety disorders? *Behavioural and Cognitive Psychotherapy*, *33*, 177–188.

Wells, A., Clark, D. M., Salkovskis, P., Ludgate, J., et al. (1995). Social phobia: The role of in-situation safety behaviors in maintaining anxiety and negative beliefs. *Behavior Therapy*, *26*, 153–161.

Westra, H. A., & Stewart, S. H. (1998). Cognitive behavioral therapy and pharmacotherapy: Complimentary or contradictory approaches to the treatment of anxiety disorders? *Clinical Psychology Review*, *18*, 307–340.