



Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

journal homepage: www.elsevier.com/locate/jbtep



Disconfirming contamination-related threat beliefs by exposure plus safety behavior



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ARTICLE INFO

Article history:

Received 14 September 2016

Received in revised form

14 November 2016

Accepted 14 November 2016

Available online 16 November 2016

Keywords:

Contamination

Disgust

Threat beliefs

Exposure

Safety behavior

ABSTRACT

Background and objectives: Safety behavior (SB) is detrimental to the beneficial effects of exposure, because it prevents patients from obtaining evidence that disconfirms their excessive threat beliefs. However, previous studies showed that cleaning SB during exposure to a contaminant does not prevent a reduction in feelings of contamination, fear of contamination, danger, and disgust (CFDD). We aimed to directly examine the effect of SB during exposure to a contaminant on threat beliefs associated with CFDD.

Method: Healthy participants were randomly assigned to one of three groups: repeated exposure to a contaminant whilst abstaining from SB (exposure plus response prevention; E + RP); with the use of disinfectant wipes after each instance of exposure (exposure plus SB; E + SB); or no exposure or safety behavior (control condition). Participants identified their threat belief associated with the contaminant and rated CFDD and the degree to which they believed their threat belief at the pre- and post-test.

Results: The E + RP and E + SB condition resulted in a larger decrease of CFDD and threat belief ratings than the control condition, whereas these reductions did not differ between the E + RP and E + SB condition.

Limitations: Results were obtained from a nonclinical sample, and with a single session of exposure.

Conclusion: Cleaning SB did not impede the beneficial effects of exposure.

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1. Introduction

In patients with anxiety disorders safety behavior (SB) maintains threat beliefs, and thereby anxiety, because it prevents them from obtaining evidence that disconfirms their excessive threat beliefs (e.g., Salkovskis, 1991). Patients are therefore encouraged to inhibit their SB during exposure (i.e., exposure response prevention or ERP), in order not to misattribute the non-occurrence of a catastrophe to the SB. Rachman, Radomsky, and Shafraan (2008), however, called for a reconsideration of the categorical rejection of SB during treatment. They argued that there is no evidence that all SBs necessarily prevent disconfirmatory experiences, and that the incorporation of SB in exposure could facilitate treatment and may reduce drop-out and refusal. Recent research suggests that adding SB to exposure can indeed enhance treatment acceptability (Levy &

Radomsky, 2014; Levy, Senn, & Radomsky, 2014; Milosevic & Radomsky, 2013a), although other studies did not find differences in acceptability between exposure with SB (E + SB) and without SB (E + RP; see, for example, Deacon, Sy, Lickel, & Nelson, 2010; Milosevic & Radomsky, 2013b). Additionally, although several studies have shown unfavorable effects E + SB compared to E + RP (e.g., McManus, Sacadura, & Clark, 2008; Salkovskis, Clark, Hackmann, Wells, & Gelder, 1999), other studies suggest that SB is not always detrimental to the beneficial effects of exposure. E + SB and E + RP resulted in comparable reductions in fear of snakes (Milosevic & Radomsky, 2008), fear of spiders (Hood, Antony, Koerner, & Monson, 2010; Milosevic & Radomsky, 2013b), claustrophobic fear (Deacon et al., 2010; Sy, Dixon, Lickel, Nelson, & Deacon, 2011), and feelings of contamination (Rachman, Shafraan, Radomsky, & Zysk, 2011; Van den Hout, Engelhard, Toffolo, & van Uijen, 2011; Van den Hout, Reininghaus, van der Stap, & Engelhard, 2012). Overall, findings concerning SB effects on exposure outcomes are mixed. In a recent literature review, Blakey and Abramowitz (2016) concluded that while SB is not

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always detrimental to the beneficial effects of exposure, it does tend to interfere with therapeutic effects. However, a meta-analysis did not find evidence in favor of either the incorporation or removal of SB during exposure (Meulders, Van Daele, Volders, & Vlaeyen, 2016).

How can the beneficial effects of E + SB be explained? From a cognitive perspective, it seems unlikely that participants' fears would decrease if their threat beliefs remained unchanged. Closer inspection of the operationalization of SB in these studies suggests that the behavior may not have prevented disconfirmation of threat beliefs. For example, in the studies by Milosevic and Radomsky (2008, 2013b), participants in the E + SB condition could wear protective gear, such as gloves and goggles, during exposure to a harmless snake (2008) or spider (2013b). This would not have prevented the corrective learning experience of, for example, not getting attacked by the snake. Additionally, Milosevic and Radomsky (2013b) directly assessed threat beliefs which indeed decreased not only in the E + RP condition, but also during E + SB. It thus appears that if SB does not preclude learning about the non-occurrence of the feared catastrophe, it does not impede the effects of exposure.

Notable exceptions to this explanation seem to be studies on feelings of contamination (Rachman et al., 2011; Van den Hout et al., 2011; 2012). During two sessions, separated by a two-week interval, healthy participants repeatedly touched a contaminated stimulus, either while abstaining from any form of SB (E + RP) or with the use of disinfectant wipes after each instance of exposure (E + SB). At the post-test after each session, none of the participants could clean themselves. E + SB and E + RP produced comparable, large, and stable reductions in feelings of contamination, fear of contamination, danger and disgust (CFDD). However, cleaning oneself with a wipe after exposure to a contaminant should logically *prevent* disconfirmatory learning experiences about the feared consequences of contamination. Participants should misattribute the non-occurrence of contamination and subsequent infection or illness to the use of SB: "Nothing bad happened, because I cleaned myself".

Several explanations for the positive effect of using wipes after exposure to a contaminant have been provided. First, Van den Hout et al. (2012) hypothesized that SB did not prevent a reduction of contamination fear through the commitment to future exposures: the knowledge that one would re-contaminate oneself again after wiping may have made the SB irrelevant. An E + SB and an E + RP condition with high commitment to exposure were compared to an E + SB condition with low commitment to exposure. Participants signed a declaration stating that they would do their utmost best to finish the series of twenty exposure trials, because the data would otherwise be unusable (high commitment), or stating that they could quit at any moment, because finishing the experiment was not necessary for the usability of the data (low commitment). Contrary to the hypothesis, the effects of E + SB with a strong commitment to exposure were comparable to the effects of E + SB with a small commitment to exposure and to E + RP (Van den Hout et al., 2012). Second, Levy and Radomsky (2016) argued that the beneficial effects of E + SB are due to the novelty of the SB: SB that has never been used before has not been associated with prevention or avoidance of feared outcomes, and may therefore not cause a misattribution of safety to the behavior. In their study, patients with obsessive-compulsive disorder (OCD) and contamination fear received one exposure session to a contaminant without the use of SB (E + RP), with SB they routinely used, or with SB they had never used before. The three conditions showed comparable reductions in contamination fear on a behavioral approach test and on subjective anxiety ratings. Notably, exposure with never-used SB resulted in a greater reduction of self-reported contamination fear

than exposure with routinely-used SB and E + RP. Third, Goetz and Lee (2015) showed that it is important to distinguish whether SB is aimed at preventing future distressing emotional responses or increases in anxiety, or performed to decrease the emotional experience in a feared situation (i.e., restorative), as is the case with cleaning yourself after touching a contaminating object. In their study, healthy participants repeatedly touched a contaminant without the use of SB (E + RP), with the use of preventive SB (e.g., holding a tissue while touching), or with the use of restorative SB (e.g., using hand sanitizer after touching). Exposure with restorative SB resulted in greater reductions in fear and behavioral avoidance than exposure with preventive SB and E + RP, and E + RP outperformed exposure with preventive SB. Goetz and Lee (2015) reasoned that using restorative SB after exposure can decrease fear of contamination, because it enables patients to learn about their ability to tolerate distress during exposure and to cope with feelings of contamination. However, they defined SB based on its function in relation to emotional distress (cf. Helbig-Lang & Petermann, 2010), which may not be synonymous with SB aimed at preventing feared outcomes. Restorative SB can still be expected to prevent the disconfirmation of threat beliefs about future catastrophes.

Whether cleaning SB prevents the disconfirmation of threat beliefs associated with touching a contaminant is an empirical question that can be assessed directly. We therefore aimed to extend the findings by Rachman et al. (2011) and Van den Hout et al. (2011) by incorporating a direct examination of the effect of SB on threat beliefs associated with feelings of contamination, fear of contamination, danger and disgust (CFDD). We expected that the results for feelings of CFDD would be replicated, that is, that the E + RP and E + SB condition would show a pre-to post-test decrease in CFDD ratings, compared to a no-exposure control condition (cf. Van den Hout et al., 2011). Furthermore, in line with cognitive theory, we hypothesized that participants in the E + RP condition would show a larger pre-to post-test decrease in the degree to which they believed a threat belief related to the contaminant than participants in the E + SB condition and participants in a no-exposure control condition. Additionally, we explored the time course of effects on CFDD in the E + RP and E + SB condition, and effects of the interventions on perceived control (cf. Van den Hout et al., 2011; 2012).

2. Method

2.1. Participants

Participants were recruited using posters, flyers and online advertisement on the university website. A total of 297 students were screened for contamination fear with the Padua Inventory - Contamination Obsessions and Washing Compulsions subscale (PI-COWC; Burns, Keortge, Formea, & Sternberger, 1996; see 2.3.1). Individuals who scored 3 or higher ($n = 225$, above the lowest-quartile range, to decrease the likelihood that participants had to be excluded after the pre-test, see 2.2.1) and indicated willingness to participate ($n = 180$) were invited to participate, of whom 103 agreed to make an appointment. Exclusion criteria were past or current OCD diagnosis ($n = 1$); contamination scores for all six contaminants (see 2.4) at the pre-test below 60 ($n = 11$, cf. Van den Hout et al., 2011); and a score below 60 for the threat belief at the pre-test ($n = 25$; see 2.2.1), because this indicated that participants considered their threat belief largely unbelievable. This resulted in a final sample of 66 participants (13 men; $M_{age} = 21.68$, $SD = 2.95$; $M_{PI-COWC} = 8.89$, $SD = 5.54$), who were randomly assigned to the E + RP ($n = 22$; 4 men), E + SB ($n = 22$; 5 men), or control ($n = 22$; 4 men) condition. Participants gave written informed consent and

received money or course credit for their cooperation.

2.2. Procedure

The procedure for session 1 by Van den Hout et al. (2011; see also Rachman et al., 2011) was replicated, with the addition of the identification of a threat belief and rating it at the pre- and post-test.

2.2.1. Pre-test measurement

The contaminant (see 2.4) that evoked the highest feeling of contamination was selected as the contamination stimulus for the experimental trials (see Van den Hout et al., 2011, Baseline measurement). The experimenter put the contaminant in front of the participant and asked “What did you feel when you just touched this object? Can you describe this feeling in one word?” (e.g., disgust) “Can you rate the intensity of this feeling on a scale of 0–100?” The experimenter asked as many of the following questions as necessary to identify the catastrophic belief: “Which thought went through your head when you touched this object and felt ... (e.g., disgusted)?”; “What might happen when you touch this object? And what would happen next?”; “What is the worst thing that might happen when you touch this object?”. After the participant had identified his or her threat belief (e.g., if I touch this object, I will get ill), the experimenter repeated it to the participant, and asked “How believable is this statement to you?”, and to rate this on a 0 (*not at all believable*) to 100 (*extremely believable*) scale.

2.2.2. Experimental trials

A detailed description of the procedure for the experimental trials can be found in Van den Hout et al. (2011). Participants in the E + RP and E + SB condition touched the contaminant 20 times, and rated CFDD right after touching it and after a 30s delay. During this delay, participants in the E + SB condition cleaned their hands with a hygienic wipe, except at the final (20th) trial, when they did not use a wipe. Participants in the control condition waited for 20 min while reading a magazine or newspaper. After this, they touched the selected contaminant and rated CFDD. None of the participants in the E + RP and the control condition washed or cleaned themselves.

2.2.3. Post-test measurement

After the final experimental trial, the threat belief that participants had identified at the pre-test was repeated to them, and they were asked to rate how believable they thought it was again. Participants were then asked to describe why they thought the degree to which they believed their threat belief had decreased/increased/stayed the same from the pre-test to the post-test. We did this to gain insight in the reasons for potential changes in these belief ratings. Participants were thanked, debriefed, and rewarded for their participation.

2.3. Measures

CFDD, expectations regarding the effectiveness of the intervention, and perceived control were measured cf. Van den Hout et al. (2011; Measures).

2.3.1. Padua Inventory – Contamination Obsessions and Washing Compulsions subscale (PI-COWC)

The PI-COWC (Burns et al., 1996) was used for screening individuals on contamination fear. This 10-item (rated on a scale from 0 [*not at all*] to 4 [*very much*]) self-report measure was translated to Dutch, and item 6 was modernized by changing it from “I avoid using public telephones, because I am afraid of contagion and

disease” to “I avoid using handrails in public places, because I am afraid of contagion and disease”. The PI-COWC shows good test-retest reliability, $r = 0.72$, and internal consistency, $\alpha = 0.85$ (Burns et al., 1996), in this sample, Cronbach's $\alpha = 0.88$.

2.4. Contaminants

In a pilot study prior to the experiment, 10 contaminants that were used in previous studies (Rachman et al., 2011; Van den Hout et al., 2011; Levy & Radomsky, 2014) were presented to 10 student volunteers. The procedure was similar to the pre-test measurement procedure (see 2.2.1). The six items that elicited the highest contamination ratings were selected for the experiment¹:

- 1) Shoe: Participants were asked to rub the bottom of their shoe with one hand.
- 2) Hair: Human hair was collected and placed in a small plastic container.
- 3) Garbage: A small garbage can was presented to the participant. The items inside included actual (safe) garbage collected by the experimenters, such as food wrappers, used coffee cups, a diaper made to look dirty with tea, an unused condom with hand gel inside, and a clean tampon wrapped in toilet paper.
- 4) Dirty laundry: A plastic laundry basket filled with items of clothing, underwear, old cleaning cloths and an old oven glove was presented. All items were made to look dirty using coffee.
- 5) Bedpan: A white plastic bedpan that was made to look dirty with tea and yellow food coloring was presented to the participant. It contained yellow liquid made with food coloring to resemble urine.
- 6) Lab specimen: A small biohazard zip bag containing the following items was presented to the participant: surgical gloves, oral thermometer, open grimy looking plaster, 2 ml micro-tube containing a drop of hand sanitizer, small piece of ripped rolled-up gauze, and a cotton stick.

2.5. Data analysis

Pre-test differences between conditions were analyzed with one-way ANOVAs and one-way MANOVAs for CFDD, perceived control, and expectations. 2 (Time, pre-test vs. post-test) \times 3 (Condition, E + RP vs. E + SB vs. control) mixed MANOVAs, and subsequent 2 \times 3 mixed ANOVAs were used to analyze CFDD and perceived control. Pre-test CFDD ratings (see Van den Hout et al., 2011) for the selected contaminant were used as pre-test ratings. Post-test ratings were CFDD ratings for trial 20 before the 30s delay (E + RP and E + SB), or trial 2 (control). Threat belief ratings were analyzed with a 2 (Time, pre-test vs. post-test) \times 3 (Condition, E + RP vs. E + SB vs. control) mixed ANOVA. The relationship between pre-to post-test changes in threat beliefs and CFDD ratings was explored with Pearson r correlations. To explore the time course of effects in CFDD in the E + RP and E + SB condition, quadratic trends were analyzed with 21 (Time, pre-test to trial 20) \times 2 (Condition, E + RP vs. E + SB) ANOVAs. The immediate effects of wiping (E + SB) and waiting (E + RP) on CFDD were assessed by comparing CFDD ratings at the moment right after touching the contaminant (i.e., before wiping or the 30s delay) and after wiping or the 30s delay. This was analyzed with 19 (Trial, trial 1 to 19) \times 2 (Moment, before vs. after wiping or the 30s delay) \times 2 (Condition, E + RP vs. E + SB) mixed ANOVAs. Planned comparisons were

¹ Details about the nature and findings of the pilot study can be obtained from the first author.

performed with independent and paired t-tests. For all analyses we used $\alpha = 0.05$.

3. Results

3.1. Pre-test measures

At the pre-test, participants described that they felt disgusted ($n = 29$; 44%), dirty ($n = 27$; 41%), or fearful ($n = 9$; 14%) while touching the contaminant. There were no pre-test differences between conditions in the intensity of these feelings ($M = 78.41$, $SD = 13.91$), threat belief ratings, and PI-COWC, $F(2,63) < 0.57$, p 's $> .56$; or in CFDD feelings and perceived control, $F(8,122) < 1.18$, p 's $> .31$. All participants identified threat beliefs along the lines of "If I touch this object, then I will get contaminated and get ill".

Expectation ratings regarding the effectiveness of the intervention differed between conditions, $F(8,122) = 2.31$, $p = 0.02$, $\eta_p^2 = 0.13$, see Table 1. This effect was found for contamination, fear of contamination, and danger, $F(2,63) > 5.36$, p 's $< .008$, η_p^2 's $> .14$, but not for disgust, $F(2,63) = 2.31$, $p = 0.13$. For contamination, fear of contamination, and danger, expectations were higher in the E + RP condition than in the control condition, $t(42) > 2.59$, p 's $< .02$, d 's > 0.78 , and were higher in the E + SB than in the control condition, $t(42) > 2.75$, p 's $< .010$, d 's > 0.83 . Expectations did not differ between the E + RP and E + SB condition, $t(42) < 0.66$, p 's $> .51$. Results for CFDD ratings were similar when analyses were performed with 2×3 mixed ANCOVAs with expectations included as covariates, which suggests that the differences between conditions in the expected effectivity of the intervention did not influence the changes found in CFDD ratings.

3.2. Effects of the intervention

3.2.1. CFDD

3.2.1.1. Multivariate analyses. There was a pre-to post-test decrease in CFDD, $F(4,60) = 62.65$, $p < .001$, $\eta_p^2 = .81$, which differed between conditions, $F(8,122) = 6.27$, $p < .001$, $\eta_p^2 = .29$. CFDD decreases were larger in the E + RP and E + SB condition than in the control condition, see Fig. 1. The main effect of Condition, $F(8,122) = 3.66$, $p = .001$, $\eta_p^2 = .19$, appears to be caused by the lower scores at the post-test in the E + RP and E + SB conditions compared to the control condition.

3.2.1.2. Univariate analyses. There was a main effect of Condition for contamination, fear of contamination, and disgust, $F(2,63) > 4.41$, p 's $< .02$, η_p^2 's $> .12$, but not for danger, $F(2,63) = 2.38$, $p = .10$. Contamination, fear of contamination, danger, and disgust decreased from pre-to post-test, $F(1,63) > 130.50$, p 's $< .001$, η_p^2 's $> .67$. For all four measures, this decrease differed between conditions, $F(2,63) > 19.26$, p 's $< .001$, η_p^2 's $> .37$. Compared to the control condition, decreases were larger for the E + RP, $t(29.87) > 4.68$, p 's $< .001$, d 's > 1.41 , and E + SB condition, $t(42) > 5.51$, p 's $< .001$, d 's > 1.66 . They did not differ between the

E + RP and E + SB condition, $t(42) < 1.18$, p 's $> .25$. Correlations between pre-to post-test changes in threat belief and CFDD ratings were medium to large, see Table 2.

3.2.1.3. E + RP vs. E + SB: time course of effects. Fig. 2 depicts the CFDD ratings at the pre-test (trial 0), and before and after wiping (E + SB) or the 30s delay (E + RP) at each exposure trial. The curves suggest that the largest reductions in CFDD took place in the first trials. When looking at the ratings immediately after touching the contaminant, the curves indeed followed a quadratic trend over Time, $F(1,42) > 68.67$, p 's $< .001$, η_p^2 's $> .62$, for all four measures. These quadratic trends were stronger in the E + SB condition than in the E + RP condition for contamination and disgust, indicated by Time \times Condition interactions in quadratic trends, $F(1,42) > 5.31$, p 's $< .03$, η_p^2 's $> .11$. These interactions were not significant for fear of contamination and danger, $F(1,42) < 0.21$, p 's $> .65$. As can be seen in Fig. 2, CFDD ratings in the E + SB condition increased slightly from trial 19 to trial 20, when participants did not use a wipe after touching the contaminant. These increases were significant for contamination, fear, and disgust, $F(1,21) > 6.90$, p 's $< .02$, η_p^2 's $> .24$, and showed a trend for danger, $F(1,21) = 4.00$, $p = .059$, $\eta_p^2 = .16$. However, CFDD ratings did not differ between the E + SB and E + RP condition in trial 20, $t(42) < 0.68$, p 's $> .50$.

Fig. 2 also depicts the immediate effects of wiping (E + SB) and waiting (E + RP) at each exposure trial. The E + SB curve shows a distinct saw tooth pattern, whereas this pattern is less pronounced in the E + RP curve. Compared to the ratings immediately after touching the contaminant, decreases in CFDD ratings were larger after wiping (trial 1 to 19 in the E + SB condition) than after the 30s delay (in the E + RP condition), $F(1,42) > 8.69$, p 's $< .01$, η_p^2 's $> .17$.

3.2.2. Perceived control

Perceived control did not change from pre-to post-test, $F(4,60) = 0.62$, $p = .65$, or differ between conditions, $F(8,122) = 0.86$, $p = .55$. There was no Time \times Condition interaction, $F(8,122) = 1.01$, $p = .43$. Mean perceived control ranged from 52.62 ($SD = 24.42$; pre-test disgust) to 71.64 ($SD = 21.87$; post-test danger).

3.2.3. Threat belief

There was a pre- to post-test decrease in threat belief ratings, $F(1,63) = 67.98$, $p < .001$, $\eta_p^2 = .52$, which differed between conditions, $F(2,63) = 3.51$, $p = .04$, $\eta_p^2 = .10$, see Fig. 1. There was no main effect of Condition, $F(2,63) = 0.87$, $p = .42$. Compared to the control condition, the decrease was larger in the E + RP, $t(42) = 2.49$, $p = .02$, $d = 0.75$, and E + SB condition, $t(42) = 2.16$, $p = .04$, $d = 0.65$. The decrease in the E + RP and E + SB condition did not differ, $t(42) = 0.38$, $p = .70$. Paired-tests show that threat beliefs decreased significantly and substantially in each condition: E + RP $t(21) = 5.65$, $p < .001$, $d = 1.52$; E + SB $t(21) = 5.46$, $p < .001$, $d = 1.36$; and control $t(21) = 2.94$, $p = .008$, $d = 0.66$.

3.3. Reasons for change in belief ratings

Participants' explanations of why the degree to which they believed their threat belief had decreased/increased/stayed the same from the pre-test to the post-test are summarized in Table 3. Participants could provide more than one reason. The reported reasons for decrease could conveniently be divided into five categories. The first was a habituation and emotional reasoning (Arntz, Rauner, & van den Hout, 1995; Engelhard & Arntz, 2005) pattern: participants explained that their feelings of CFDD had decreased due to repeated exposure to the contaminant, and that they therefore considered it less likely that they would get ill after touching the contaminant. The second argument related to

Table 1
Mean (SD) expectations and between-group comparisons regarding the effectiveness of the intervention for contamination, fear of contamination, danger, and disgust for the exposure plus response prevention (E + RP), exposure plus safety behavior (E + SB), and control condition.

	E + RP ¹	E + SB ²	Control ³	Comparisons
Contamination	61.59 (20.55)	66.14 (25.45)	44.55 (22.88)	1, 2 > 3
Fear	58.18 (25.57)	55.91 (21.42)	35.00 (26.55)	1, 2 > 3
Danger	62.18 (29.02)	57.05 (26.84)	35.91 (23.89)	1, 2 > 3
Disgust	42.73 (30.54)	52.05 (20.85)	36.82 (27.45)	1, 2, 3

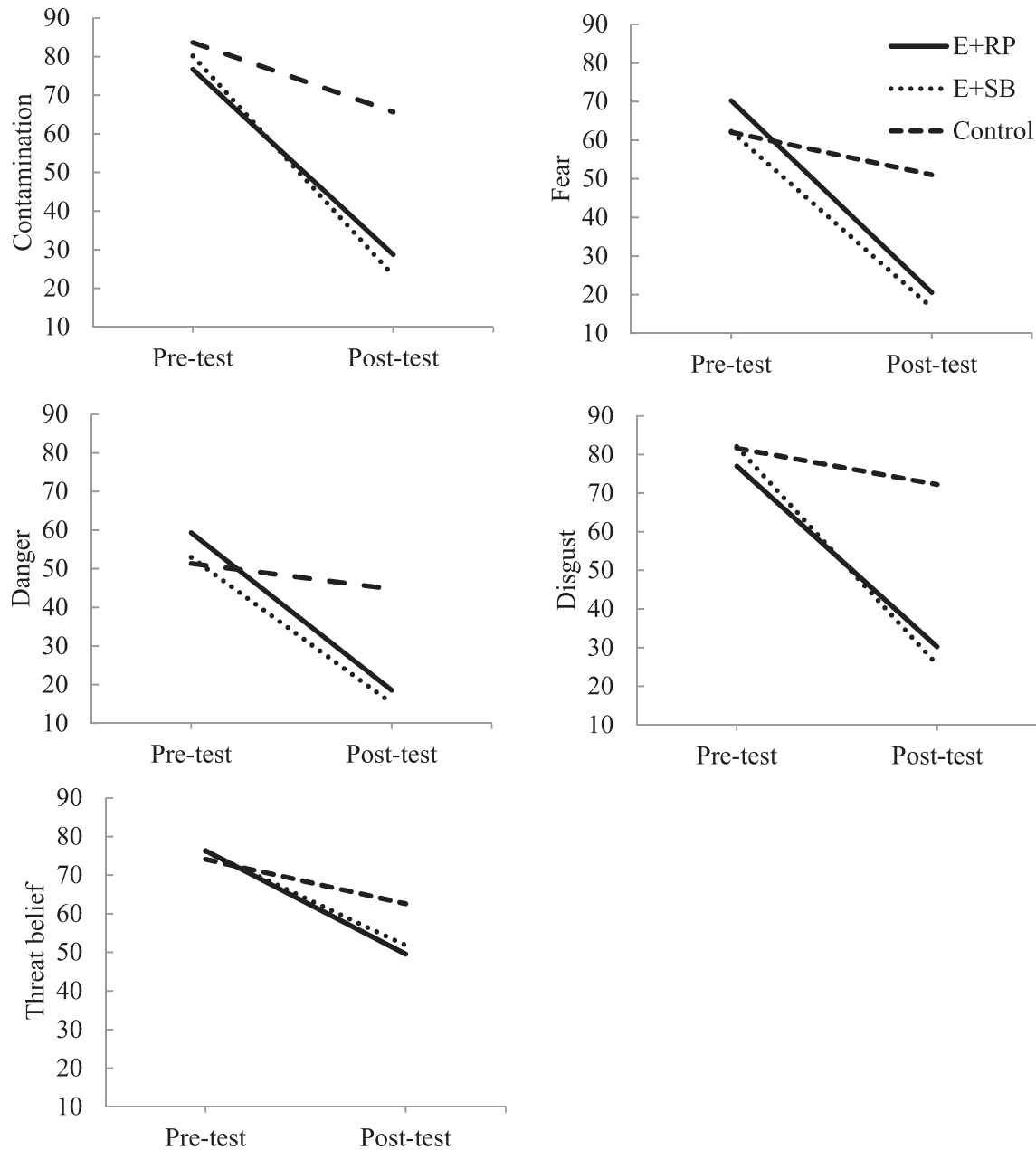


Fig. 1. Pre- to post-test changes in contamination, fear of contamination, danger, disgust, and threat belief ratings for the exposure plus response prevention (E + RP), exposure plus safety behavior (E + SB), and control condition.

Table 2

Pearson r correlations between pre- to post-test changes in contamination, fear of contamination, danger, disgust, and threat belief ratings; $df = 66$, all $ps < .001$.

	Fear	Danger	Disgust	Threat belief
Contamination	.77	.67	.88	.58
Fear		.76	.77	.50
Danger			.68	.44
Disgust				.45

disconfirmation: participants noticed that they did not get ill immediately after touching the contaminant, and they therefore considered it less likely that they would get ill on the long-term. The third process entailed stimulus (conditioned stimulus or CS) reevaluation: participants reported that they had noticed that the contaminant was not as dirty or dangerous as they had originally

thought. The fourth process involved threat (unconditioned stimulus or US) reevaluation: participants reported that they had cognitively reevaluated their threat belief, for example, by relating it to other instances when they had to touch something disgusting (e.g., while cleaning a toilet), which had not resulted in catastrophe either. The fifth process was only reported by participants in the E + SB condition, and is related to the use of SB: participants reported that they considered it less likely that they would get ill, because they had learned that they could easily clean their hands.

4. Discussion

We aimed to extend the findings by [Rachman et al. \(2011\)](#) and [Van den Hout et al. \(2011\)](#) by directly examining the effect of using cleaning SB during exposure to a contaminant on threat beliefs. In

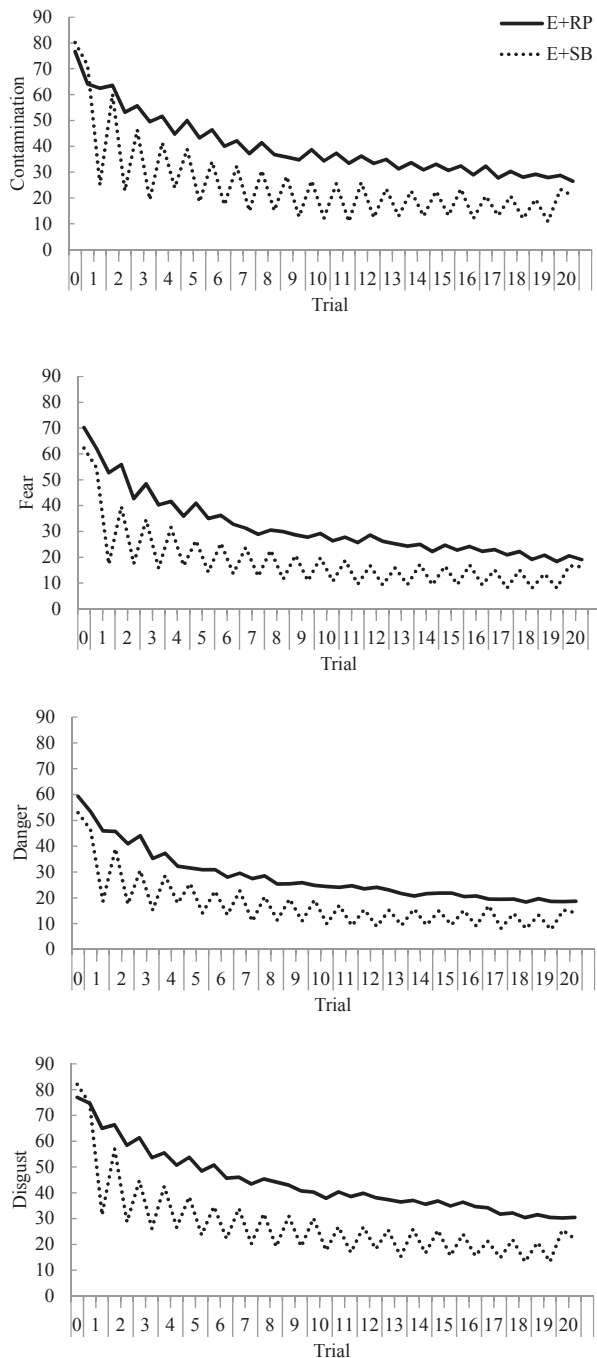


Fig. 2. Contamination, fear of contamination, danger, and disgust (CFDD) ratings for the exposure plus response prevention (E + RP) and exposure plus safety behavior (E + SB) condition at the pre-test (trial 0), and before and after wiping (E + SB) or the 30s delay (E + RP) at each of the 20 exposure trials. Note that in the participants E + SB condition did not use a wipe at trial 20 either.

line with our hypothesis, we replicated the finding that the E + RP and E + SB condition resulted in a larger pre- to post-test decrease of CFDD than a no-exposure control condition, whereas this decrease did not differ between the E + RP and E + SB condition. We want to emphasize that none of the participants used SB at the post-test. Remarkably, and contrary to our hypothesis, we found a similar effect for threat beliefs: the E + RP and E + SB condition showed a larger pre- to post-test decrease in threat belief ratings than the control condition, and this decrease did not differ between

the E + RP and E + SB condition. It appears that using wipes after exposure did not prevent a reduction in the degree to which participants believed their threat belief. CFDD ratings before and after wiping (E + SB) or the 30s delay (E + RP) at each exposure trial showed a distinct saw tooth pattern in the E + SB curve, which was less pronounced in the E + RP condition. It is notable that the within-trial return of CFDD in the E + SB condition did not prevent an over-trial decrease.

We regard the finding that cleaning SB after exposure did not prevent a reduction in threat beliefs as unusually curious for various reasons. A theoretical reason is that cleaning SB logically prevents the acquisition of information that disconfirms inaccurate threat beliefs associated with contamination and illness (Salkovskis, 1991), and impedes inhibitory learning by preventing the maximal violation of negative expectancies (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). An empirical reason is that several studies have shown unfavorable effects of using SB during exposure compared to ERP (for an overview, see Meulders et al., 2016; and Blakey & Abramowitz, 2016). SBs in and by itself even appear sufficient to induce threat beliefs (Engelhard, van Uijen, van Seters, & Velu, 2015; Van Uijen & Toffolo, 2015), health anxiety (Olatunji, Etzel, Tomarken, Ciesielski, & Deacon, 2011), and contamination fear (Deacon & Maack, 2008). How can we reconcile these findings, and explain the decrease in threat belief ratings in the E + SB condition?

The common denominator in the E + RP and E + SB condition was repeated exposure to the contaminant and to the subsequent feelings of contamination and disgust this induced, albeit short in the E + SB condition. It seems unlikely that expectancies about a feared future catastrophe were violated in this short period of exposure. However, it is possible that expectancies about the acute feelings of contamination evoked by touching the contaminant, the amount of distress, and the ability to tolerate this distress were violated, which caused inhibitory learning (Blakey & Abramowitz, 2016). CFDD ratings remained relatively low at the post-test when participants no longer used SB, which suggests that the inhibitory associations generalized to exposure without SB. Future studies that assess negative expectancies about immediate consequences of exposure to a contaminant are needed to give insight into the role of inhibitory learning in the reduction of CFDD and associated threat beliefs in E + SB.

Additionally, it may be relevant that the role of SB was examined in the context of contaminated objects that give rise to disgust. In the case of fear, a stimulus (e.g., heart palpitations in panic disorder) evokes fear, because it activates an expectancy of a threatening outcome (e.g., dying). A contaminated object may not (only) activate a representation of threat, but may directly evoke disliking and motivate avoidance of the stimulus. In other words, whereas fear may be best explained by Pavlovian (classical) conditioning, disgust may be better understood in terms of evaluative conditioning, which involves a hedonic judgment about the stimulus itself (i.e., like or dislike; see Engelhard, Leer, Lange, & Olatunji, 2014). Evaluative responses (like disgust) are more resistant to extinction than fear and threat expectancies (see Engelhard et al., 2014). However, evaluative-conditioned disgust may be reduced counterconditioning (Engelhard et al., 2014), and habituation (Mason & Richardson, 2012). Unlike extinction, which involves inhibitory learning (Myers & Davis, 2007), habituation entails a reduction in responding to the stimulus. This can be achieved by repeated physical contact with the disgust-eliciting stimulus (Bosman, Borg, & de Jong, 2016), and may explain why the CFDD ratings decreased. We should note that this is different from the assumed mechanism of change in habituation-based models of exposure therapy (Foa & Kozak, 1986). Participants in the E + SB condition did not remain in the fearful situation (i.e., contaminated state) until fear decreased,

Table 3

Participants' explanations for the pre- to post-test change in threat belief ratings in the exposure plus response prevention (E + RP), exposure plus safety behavior (E + SB) and control condition.

Change	Explanation	Example	E + RP	E + SB	Control
Increase	ER	"The longer I looked at it, the more disgusted I became."	2	2	5
No change	No disconfirmation	"The duration was not long enough to find out if I will get ill or not."	1	1	3
Decrease	Habituation/ER	"My feelings of disgust and contamination decreased, I got used to it. The risk seems less severe now."	11	12	9
	Disconfirmation	"I have not gotten ill immediately."	5	3	1
	CS reevaluation	"I got to take a better look at the object, which made me see that it was not as dangerous as I thought."	2	2	3
	US reevaluation	"I associated it with cleaning a toilet: You do not get ill from that either."	6	2	4
	SB availability	"Because I know I can clean my hands, the risk felt less severe".	—	5	—

Note. Change = the pre- to post-test change threat belief ratings; No. = the number of participants who reported an increase, no change, or a decrease in plausibility of their threat belief; Explanation = the category of the explanation participants reported; ER = emotional reasoning; CS reevaluation = reevaluation of the contaminant; US = reevaluation of the expected catastrophe; Fr. = the frequency with which each category of explanation was given by participants. Note that some participants reported more than one explanation.

but "wiped away" their feelings of CFDD. Moreover, the within-trial returns of CFDD at each exposure trial did not prevent over-trial reductions.

The reduction in CFDD ratings may have subsequently influenced threat belief ratings. Participants may have inferred danger from the emotions evoked by the judgment of the stimulus, that is, used emotional reasoning: "I feel disgusted, therefore this contaminant must be dangerous". Indeed, [Verwoerd, de Jong, Wessel, and van Hout \(2013\)](#) found that students with a high fear of contamination inferred the risk of becoming ill on the basis of experienced disgust. As CFDD decreased over the exposure trials, perhaps emotional reasoning, and thus threat beliefs, declined too. This line of reasoning fits with the explanation the majority of participants gave for the decrease in threat beliefs (see [Table 3](#)).

Furthermore, the results may, at least partly, be explained by measurement issues. The semantic distinction between CFDD ratings and belief ratings is crucial for this study. However, participants may not have made a strict distinction between these measurements, but a more crude and general evaluation based on negative valence and arousal. Possibly, touching the contaminant became less unpleasant over the various trials, and participants may have subsequently rated all related items, i.e., CFDD and threat beliefs, as less negative. The moderate to high correlations between declines in CFDD ratings and declines in threat belief ratings (see [Table 2](#)) suggest that this may be the case. Additionally, several participants reported that they had difficulty explaining why the degree to which they believed their threat belief had decreased. The explanations (see [Table 3](#)) could be a case of "telling more than we can know" ([Nisbett & Wilson, 1977](#)): participants may have attempted to report on cognitive processes that are largely or entirely inaccessible by introspection.

Perceived control did not change from the pre- to the post-test for any of the conditions, or differ between conditions. [Van den Hout et al. \(2011\)](#) found an increase in perceived control over contamination, danger, and disgust after E + SB and E + RP, which was larger for the E + SB than for the E + RP condition for disgust in the first session. However, [Van den Hout et al. \(2012\)](#) did not find any pre- to post-test changes or interactions with condition in perceived control. It thus remains unclear whether using SB during exposure affects perceived control, but it is unlikely that perceived control explains the findings in this study.

The generalizability of the current findings should be put to test in a clinical sample. However, results obtained with analogue samples are useful for understanding OC-related phenomena ([Abramowitz et al., 2014](#)). OC symptoms are prevalent in nonclinical populations, and the maintenance factors are similar to those in clinical populations. There are quantitative differences in the severity of OC symptoms between clinical and nonclinical populations, but qualitatively, symptoms appear to be largely similar ([Abramowitz et al., 2014](#)). Furthermore, [Rachman et al. \(2011\)](#)

initiated the investigation of E + SB in healthy participants after successfully treating patients with a fear of contamination and compulsive washing with this method. [Levy & Radomsky, 2016](#)) also obtained beneficial effects of E + SB in a clinical sample.

Five participants in the E + SB condition provided an explanation for the decrease in threat belief ratings that was related to the availability of SB, which may have implications for the beneficial effects obtained with E + SB. Even though participants did not clean themselves in the final exposure trial, they may have realized that they could clean their hands immediately after the experiment was finished, and taken this into account when they rated their threat belief at the post-test. Their threat beliefs may not have decreased in situations in which SB is not available for a longer period of time ([Engelhard et al., 2015](#); [Lovibond, Mitchell, Minard, Brady, & Menzies, 2009](#)). It is a limitation of this study that we did not ask participants *when* they expected the catastrophe (i.e., contamination or illness) to happen, and that we only included a single session of exposure. All participants identified a threat belief related to getting contaminated and ill. Disconfirmation of the threat belief may therefore not have been fully possible during the experiment. Moreover, participants may have hindered a long-term reduction of threat beliefs by washing their hands after the experiment. Despite these limitations and the use of a nonclinical sample, threat belief ratings decreased significantly and substantially, with large effect sizes in the E + RP and E + SB condition. We therefore think that we did manage to capture cognitive change. It is clinically relevant that the beneficial effects of E + SB are maintained over time and generalize to the clinical population, and therefore further research with a clinical sample and multiple sessions of exposure is needed to investigate the long-term effect of E + SB on threat beliefs related to contamination.

Finally, it is remarkable that the within-trial return of CFDD in the E + SB condition did not prevent over-trial reductions of CFDD (see [Fig. 2](#)). In line with findings of [Van den Hout et al. \(2011, 2012\)](#), the reductions in CFDD in both the E + SB and the E + RP condition followed a quadratic curve. Furthermore, in the current study, contamination and disgust declined faster in the E + SB condition than in the E + RP condition. CFDD increased in the E + SB condition at the final trial, when wipes were no longer used, which resulted in similar CFDD ratings at the post-test for the E + RP and E + SB condition. CFDD ratings after wiping or after the 30s delay were measured, but not reported in previous studies ([Rachman et al., 2011](#); [Van den Hout et al., 2011; 2012](#)). We revisited the data obtained by [Van den Hout et al. \(2011\)](#), and found highly similar results: CFDD ratings showed a distinct saw tooth pattern in the E + SB condition, which was less pronounced in the E + RP condition.² This suggests that cleaning SB is indeed restorative, and

² More information is available on request from the first author.

that restorative SB does not necessarily prevent an over-trial reduction in emotional responses, which is in line with the findings by Goetz and Lee (2015).

To conclude, the use of cleaning SB during exposure to a contaminant did not prevent a reduction in CFDD and threat beliefs. Wiping after each instance of exposure resulted in an immediate decrease in CFDD, and subsequent return of CFDD at the next exposure trial. Remarkably, the within-trial return of CFDD did not prevent an over-trial reduction in emotional responses. Future research with a clinical sample, and looking into the long-term effects of using cleaning SB during exposure to a contaminant on threat beliefs is needed.

5. Acknowledgements

We thank Prof. Jack Rachman for his help with the interpretation of the results. This study was funded by a Research Talent Grant from the Netherlands Organisation for Scientific Research (NWO) awarded to Sophie van Uijen (No. 403-11-406). There were no conflicts of interest.

References

- Abramowitz, J. S., Fabricant, L. E., Taylor, S., Deacon, B. J., McKay, D., & Storch, E. A. (2014). The relevance of analogue studies for understanding obsessions and compulsions. *Clinical Psychology Review*, 34, 206–217. <http://dx.doi.org/10.1016/j.cpr.2014.01.004>.
- Arntz, A., Rauner, M., & van den Hout, M. (1995). "If I feel anxious, there must be danger": Ex-consequential reasoning in inferring danger in anxiety disorders. *Behaviour Research and Therapy*, 33, 917–925. [http://dx.doi.org/10.1016/0005-7967\(95\)00032-S](http://dx.doi.org/10.1016/0005-7967(95)00032-S).
- Blakey, S. M., & Abramowitz, J. S. (2016). The effects of safety behaviors during exposure therapy for anxiety: Critical analysis from an inhibitory learning perspective. *Clinical Psychology Review*, 49, 1–15. <http://dx.doi.org/10.1016/j.cpr.2016.07.002>.
- Bosman, R. C., Borg, C., & de Jong, P. J. (2016). Optimising extinction of conditioned disgust. *PLoS ONE*, 11(2), e0148626. <http://dx.doi.org/10.1371/journal.pone.0148626>.
- Burns, G. L., Keortge, S. G., Formea, G. M., & Sternberger, L. G. (1996). Revision of the Padua Inventory of obsessive compulsive symptoms: Distinctions between worry, obsessions, and compulsions. *Behaviour Research and Therapy*, 34, 163–173. [http://dx.doi.org/10.1016/0005-7967\(95\)00035-6](http://dx.doi.org/10.1016/0005-7967(95)00035-6).
- Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy*, 58, 10–23. <http://dx.doi.org/10.1016/j.brat.2014.04.006>.
- Deacon, B., & Maack, D. J. (2008). The effects of safety behaviors on the fear of contamination: An experimental investigation. *Behaviour Research and Therapy*, 46, 537–547. <http://dx.doi.org/10.1016/j.brat.2008.01.010>.
- Deacon, B. J., Sy, J. T., Lickel, J. J., & Nelson, E. A. (2010). Does the judicious use of safety behaviors improve the efficacy and acceptability of exposure therapy for claustrophobic fear? *Journal of Behavior Therapy and Experimental Psychiatry*, 41, 71–80. <http://dx.doi.org/10.1016/j.jbtep.2009.10.004>.
- Engelhard, I. M., & Arntz, A. (2005). The ex-consequential reasoning fallacy and the persistence of PTSD. *Journal of Behavior Therapy and Experimental Psychiatry*, 36, 35–42. <http://dx.doi.org/10.1016/j.jbtep.2004.11.004>.
- Engelhard, I. M., Leer, A., Lange, E., & Olatunji, B. O. (2014). Shaking that icky feeling: Effects of extinction and counterconditioning on disgust-related evaluative conditioning. *Behavior Therapy*, 45, 708–719. <http://dx.doi.org/10.1016/j.beth.2014.04.003>.
- Engelhard, I. M., van Uijen, S. L., van Seters, N., & Velu, N. (2015). The effects of safety behavior directed towards a safety cue on perceptions of threat. *Behavior Therapy*, 46, 604–610. <http://dx.doi.org/10.1016/j.beth.2014.12.006>.
- Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, 99, 20–35. <http://dx.doi.org/10.1037/0033-2909.99.1.20>.
- Goetz, A. R., & Lee, H. (2015). The effects of preventive and restorative safety behaviors on a single-session of exposure therapy for contamination fear. *Journal of Behavior Therapy and Experimental Psychiatry*, 46, 151–157. <http://dx.doi.org/10.1016/j.jbtep.2014.10.003>.
- Helbig-Lang, S., & Petermann, F. (2010). Tolerate or eliminate? A systematic review on the effects of safety behavior across anxiety disorders. *Clinical Psychology Science and Practice*, 17, 218–233. <http://dx.doi.org/10.1111/j.1468-2850.2010.01213.x>.
- Hood, H. K., Antony, M. M., Koerner, N., & Monson, C. M. (2010). Effects of safety behaviors on fear reduction during exposure. *Behaviour Research and Therapy*, 48, 1161–1169. <http://dx.doi.org/10.1016/j.brat.2010.08.006>.
- Levy, H. C., & Radomsky, A. S. (2014). Safety behaviour enhances the acceptability of exposure. *Cognitive Behaviour Therapy*, 43, 83–92. <http://dx.doi.org/10.1080/16506073.2013.819376>.
- Levy, H. C., & Radomsky, A. S. (2016). Are all safety behaviors created equal? A comparison of novel and routinely-used safety behaviours in obsessive-compulsive disorder. *Cognitive Behaviour Therapy*, 45, 367–369. <http://dx.doi.org/10.1080/16506073.2016.1184712>.
- Levy, H. C., Senn, J. M., & Radomsky, A. S. (2014). Further support for the acceptability-enhancing roles of safety behavior and a cognitive rationale in cognitive behavioral therapy for anxiety disorders. *Journal of Cognitive Psychotherapy: An International Quarterly*, 28, 303–316. <http://dx.doi.org/10.1891/0889-8391.28.4.303>.
- Lovibond, P. F., Mitchell, C. J., Minard, E., Brady, A., & Menzies, R. G. (2009). Safety behaviours preserve threat beliefs: Protection from extinction of human fear conditioning by an avoidance response. *Behaviour Research and Therapy*, 47, 716–720. <http://dx.doi.org/10.1016/j.brat.2009.04.013>.
- Mason, E. C., & Richardson, R. (2012). Treating disgust in anxiety disorders. *Clinical Psychology: Science and Practice*, 19, 180–194. <http://dx.doi.org/10.1111/j.1468-2850.2012.01282.x>.
- McManus, F., Sacadura, C., & Clark, D. M. (2008). Why social anxiety persists: An experimental investigation of the role of safety behaviours as a maintaining factor. *Journal of Behavior Therapy and Experimental Psychiatry*, 39, 147–161. <http://dx.doi.org/10.1016/j.jbtep.2006.12.002>.
- Meulders, A., Van Daele, T., Volders, S., & Vlaeyen, J. W. (2016). The use of safety-seeking behavior in exposure-based treatments for fear and anxiety: Benefit or burden? A meta-analytic review. *Clinical Psychology Review*, 45, 144–156. <http://dx.doi.org/10.1016/j.cpr.2016.02.002>.
- Milosevic, I., & Radomsky, A. S. (2008). Safety behaviour does not necessarily interfere with exposure therapy. *Behaviour Research and Therapy*, 46, 1111–1118. <http://dx.doi.org/10.1016/j.brat.2008.05.011>.
- Milosevic, I., & Radomsky, A. S. (2013a). Incorporating the judicious use of safety behavior into exposure-based treatments for anxiety disorders: A study of treatment acceptability. *Journal of Cognitive Psychotherapy: An International Quarterly*, 27, 155–174. <http://dx.doi.org/10.1891/0889-8391.27.2.155>.
- Milosevic, I., & Radomsky, A. S. (2013b). Keep your eye on the target: Safety behavior reduces targeted threat beliefs following a behavioral experiment. *Cognitive Therapy Research*, 37, 557–571. <http://dx.doi.org/10.1007/s10608-012-9483-2>.
- Myers, K. M., & Davis, M. (2007). Mechanisms of fear extinction. *Molecular Psychiatry*, 12, 120–150. <http://dx.doi.org/10.1038/sj.mp.4001939>.
- Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, 84, 231–259. <http://dx.doi.org/10.1037/0033-295X.84.3.231>.
- Olatunji, B. O., Etzel, E. N., Tomarken, A. J., Ciesielski, B. G., & Deacon, B. (2011). The effects of safety behaviors on health anxiety: An experimental investigation. *Behaviour Research and Therapy*, 49, 719–728. <http://dx.doi.org/10.1016/j.brat.2011.07.008>.
- Rachman, S., Radomsky, A. S., & Shafraan, R. (2008). Safety behaviour: A reconsideration. *Behaviour Research and Therapy*, 46, 163–173. <http://dx.doi.org/10.1016/j.brat.2007.11.008>.
- Rachman, S., Shafraan, R., Radomsky, A. S., & Zysk, E. (2011). Reducing contamination by exposure plus safety behaviour. *Journal of Behavior Therapy and Experimental Psychiatry*, 42, 397–404. <http://dx.doi.org/10.1016/j.jbtep.2011.02.010>.
- Salkovskis, P. M. (1991). The importance of behaviour in the maintenance of anxiety and panic: A cognitive account. *Behavioural Psychotherapy*, 19, 6–19. <http://dx.doi.org/10.1017/S0141347300011472>.
- Salkovskis, P. M., Clark, D. M., Hackmann, A., Wells, A., & Gelder, M. G. (1999). An experimental investigation of the role of safety-seeking behaviours in the maintenance of panic disorder with agoraphobia. *Behaviour Research and Therapy*, 37, 559–574. [http://dx.doi.org/10.1016/S0005-7967\(98\)00153-3](http://dx.doi.org/10.1016/S0005-7967(98)00153-3).
- Sy, J. T., Dixon, L. J., Lickel, J. J., Nelson, E. A., & Deacon, B. J. (2011). Failure to replicate the deleterious effects of safety behaviours in exposure therapy. *Behaviour Research and Therapy*, 49, 305–314. <http://dx.doi.org/10.1016/j.brat.2011.02.005>.
- Van Uijen, S. L., & Toffolo, M. B. (2015). Safety behavior increases obsession-related cognitions about the severity of threat. *Behavior therapy*, 46, 521–531. <http://dx.doi.org/10.1016/j.beth.2015.04.001>.
- Van den Hout, M. A., Engelhard, I. M., Toffolo, M. B. J., & van Uijen, S. L. (2011). Exposure plus response prevention versus exposure plus safety behaviours in reducing feelings of contamination, fear, danger and disgust. An extended replication of Rachman, Shafraan, Radomsky & Zysk (2011). *Journal of Behavior Therapy and Experimental Psychiatry*, 42, 364–370. <http://dx.doi.org/10.1016/j.jbtep.2011.02.009>.
- Van den Hout, M. A., Reininghaus, J. K., van der Stap, D., & Engelhard, I. M. (2012). Why safety behaviour may not be that bad in the treatment of anxiety disorders: The commitment to future exposures. *Psicoterapia Cognitiva e Comportamentale*, 18, 111–126.
- Verwoerd, J., de Jong, P. J., Wessel, I., & van Hout, W. J. (2013). "If I feel disgusted, I must be getting ill": Emotional reasoning in the context of contamination fear. *Behaviour Research and Therapy*, 51, 122–127. <http://dx.doi.org/10.1016/j.brat.2012.11.005>.