Is “Cootie” in the Eye of the Beholder? An Experimental Attempt to Modify Implicit Associations Tied to Contamination Fears

Jennifer S. Green and Bethany A. Teachman
University of Virginia

Abstract

To examine the causal link between implicit associations and fear reduction, a conditioning paradigm was used in an attempt to modify contamination-related implicit associations for individuals high in contamination fear. Individuals (N = 81) were assigned to a Positive, Neutral, or No Training condition. In the Positive training condition, individuals clicked on images of potential contaminants that were followed by images of the individual’s smiling face or by an approach-related word. Positive training was hypothesized to result in decreased behavioral avoidance and emotional vulnerability ratings during subsequent behavioral avoidance tasks. In the Neutral training control condition, the images of potential contaminants were followed by an equal mix of the individual’s smiling, disgusted, and fearful faces or an avoidance-related word. The No Training condition served as an additional control group. Contrary to expectations, training did not shift implicit associations, nor did it affect avoidance or emotional vulnerability ratings. These results raise questions about the most appropriate form and dosage of training for this population – we conclude with suggestions for researchers to learn from these null findings when developing new training programs.

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Keywords: Implicit associations, Information processing, Contamination fear

Correspondence to: Jennifer Green, Department of Psychology, University of Virginia, P.O. Box 400400, Charlottesville, VA 22904-4400. Email: jws5be@virginia.edu

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Introduction

Rachman (2004) defines contamination as “an intense and persisting feeling of having been polluted or infected or endangered as a result of contact, direct or indirect, with a person/place/object that is perceived to be soiled, impure, infectious, or harmful” (p. 1229). In their most severe form, contamination concerns can fuel obsessive-compulsive disorder (OCD) and result in compulsive cleaning. The current “gold-standard” OCD treatment, exposure and response prevention (ERP) boasts a high response rate (Whittal, Robichaud, Thordarson, & McLean, 2008). However, many people refuse this form of treatment (Rosqvist, Sundsmo, MacLane, Cullen, & Cartinella, 2005), and others do not respond or do so only partially (Eddy, Dutra, Bradley, & Westen, 2004). Moreover, initial treatment success is by no means a guarantee that the disorder will not resurface (Rachman, 2004), indicating that, for some, behavioral exposure alone may not be powerful enough to alter the factors that maintain their fear and lead to their symptoms.

Cognitive therapy (CT) has served as another strong treatment approach for OCD (e.g., Wilhelm et al., 2009). Often used in conjunction with ERP (Steketee & Barlow, 2002), on its own, CT provides another form of intervention for those who are reluctant to undergo the anxiety-arousing situations ERP requires. While CT is in many cases an effective treatment approach, like ERP, it does not work for everyone (Baer & Minichiello, 1990; Rachman & Hodgson, 1980), thus leaving open the potential for alternative or complementary methods of treatment.

Cognitive models hold that anxious individuals process fear-relevant information through a maladaptive schema or interconnected associations stored in memory (e.g., Beck & Clark, 1997), as evidenced by their paying greater attention to threatening information than to neutral information (e.g., Foa & McNally,
1986; Mogg, Mathews, & Eysenck, 1992) and interpreting ambiguous information in a threatening way (e.g., Butler & Mathews, 1983; Richards & French, 1992). The resultant biased information processing keeps fear-relevant information prominent for these individuals, fueling their anxiety and avoidance behavior (e.g., Beck & Clark, 1997; Williams, Watts, MacLeod, & Mathews, 1997).

It follows that interventions explicitly designed to target the interconnected associations stored in memory that underlie schematic processing may enhance our current treatment approaches. While ERP and CT both seem to help alter associative processing, they are presumed to do so indirectly via new learning and corrective emotional experiences that occur during exposure and explicit cognitive restructuring, rather than through direct attempts to change associations in memory. One means of more directly targeting such associations may be through the modification of implicit associations. These associations are also thought to reflect automatic (in the sense of being relatively uncontrollable) interconnections stored in memory (Teachman & Woody, 2004), suggesting some overlap with the construct of schemas. To the extent that implicit associations reflect biased schematic processing, cognitive models would suggest that implicit associations are likely to be causally and not merely correlationally related to symptoms of anxious psychopathology.

Indeed, research is beginning to yield evidence for the theorized link between implicit associations and anxious symptomatology. While research in this area is in its very early stages, four studies are of note. Using a paradigm similar to the current study’s, Baccus, Baldwin, and Packer (2004) modified implicit self-esteem in an unselected sample. Moreover, those who entered their study with low implicit self-esteem and who were assigned to the Positive training condition (pairing self-relevant words with smiling photographs) displayed lower levels of aggression than did participants who began the study with low explicit self-esteem who were assigned to the control condition. Though Baccus et al.’s sample and methodology precludes our making any strong claims about symptom reduction, their study does indicate a likely link between change in implicit associations and behavior change. Teachman, Marker, and Smith-Janik (2008) carried this link a step further by demonstrating a temporal connection between change in implicit associations and symptom improvement in individuals with panic disorder. Though they did not directly modify implicit associations using a conditioning paradigm, the authors examined change trajectories over the course of a 12-week cognitive behavioral treatment for panic disorder and found that change in automatic panic associations was a significant predictor of subsequent panic symptom improvement. This finding suggests that changes in automatic associations precede and contribute to symptom reduction. Extending the follow-up period to one year, Wiers, Eberl, Rink, Becker, and Lindenmeyer (2011) showed that alcoholic inpatients who were trained to associate images of alcohol with avoidance demonstrated the expected change in implicit associations, as well as improved treatment outcomes one year later, as compared to those in the No Training or Sham Training conditions.

Recently, researchers have begun to explore whether direct modification of implicit associations will result in symptom change. Clerkin and Teachman (2010) modified implicit social anxiety associations in an undergraduate sample high in social anxiety. Participants viewed images of themselves pretending to give a speech, as well as images of strangers doing non-socially relevant tasks, and were instructed to click on each image as it appeared on a computer screen as quickly as possible, revealing an emotional face. Participants who were trained to associate images of the self speaking with positive faces displayed less negative implicit social anxiety associations following the training (relative to a Neutral and a Sham Training condition) and were more likely than participants in the other conditions to complete an impromptu speech task, though they did not self report lower anxiety during the speech.
Using a similar conditioning paradigm to Clerkin and Teachman (2010), in the current study, we attempted to directly modify implicit associations tied to contamination fears in an analogue contamination-fearful sample and to thereby decrease avoidance and emotional vulnerability in response to later contamination-relevant stressors. We used a two-session Cognitive Bias Modification (CBM) task involving pairing ideographically-selected, disorder-relevant images with images of emotional responses or behavioral words that was modeled off a conditioning paradigm used in previous studies that have attempted to change implicit associations tied to self-esteem and social anxiety (Baccus et al., 2004; Clerkin & Teachman).

For individuals with contamination fears, implicit associations tied to fear, disgust, and avoidance all likely play a prominent role in the maintenance of the fears (e.g., Deacon & Olatunji, 2007; Olatunji, Lohr, Sawchuk, & Tolin, 2007a; Rachman & Hodgson, 1980; Tolin, Woods, & Abramowitz, 2006) and are, therefore, each targeted separately in our intervention. Specifically, the current study tries to reduce the exaggerated association of fear with potential contaminants by pairing images of each individual’s happy expression (a facial expression that is easily identifiable and contrary to fear) with images of potential contaminants and by pairing individuals’ fearful expressions with control stimuli. In addition, to reduce disgust reactions to potential contaminants, we will pair images of each individual’s happy expression with images of potential contaminants and pair images of individuals’ disgusted faces with control stimuli. Finally, to reduce avoidance associations with potential contaminants, we will pair approach-related words with images of potentially contaminated objects and pair avoidance-related words with control stimuli. By directly manipulating these various contamination associations, we aim to test their causal role in decreasing anxious symptomatology and emotional vulnerability to subsequent potential contaminants.

Overview of Current Study

Individuals with contamination fears were randomly assigned to a Positive, Neutral, or No Training condition. In the Positive Training condition, images of ideographically-selected potentially contaminated objects were followed by images of the individual smiling or by approach-related words. In the Neutral Training condition, half of the trials trained this positive association, and in the other half, individuals’ disgusted or fearful faces or avoidance-related words followed the images, with the expected net result being no training contingency. In the No Training condition, participants completed identical measures without going through any training procedure. Following training, we hypothesized that individuals in the Positive Training condition, compared to those in the Neutral and No Training control conditions, would exhibit weaker maladaptive implicit associations tied to contamination fears, as measured by the Brief Implicit Association Test (B-IAT; Sriram & Greenwald, 2009). We further hypothesized that individuals in the Positive Training group would exhibit less avoidance and distress (relative to those in the Neutral and No Training conditions) when engaging in behavioral avoidance tasks involving potential contaminants, and report lower disgust and contamination cognitions. Lastly, we expected the effects of Positive Training to endure, resulting in lower self-report of contamination fear symptoms and avoidance/cleaning behaviors one week post-training, relative to those in the Neutral and No Training conditions.

Method

Participants

Participants (N = 81) were undergraduates who were recruited from the psychology department’s participant pool based on their responses to the Contamination Fear Subscale of the Padua Inventory – Washington State University Revision (PI-WSUR-C; Burns, Keortge, Formea, & Sternberger, 1996). This
measure was included in a larger battery of unrelated questionnaires that were given online and in random order over three consecutive semesters. Students were free to complete the questionnaire battery individually on their own time, and they were unaware of how their responses to the measure would impact their study eligibility. Those who scored higher than the mean of a diagnosed OCD sample (13.87; Burns et al.) on the PI-WSUR-C were invited to participate. An analogue population was used in the current study, owing to the brief nature of the training intervention. We assumed that an analogue sample would have somewhat less severe symptoms than a diagnosed sample and, consequently, more malleable implicit associations. The final sample (N = 81, n = 27 Positive Training, n = 29 Neutral Training, n = 25 No Training, 56 women) reported a mean age of 18.64 (SD = .93). Individuals reported race as 45.7% Caucasian, 16.0% African-American, 16.0% Asian/Pacific Islander, 13.6% Hispanic/Latino, 3.7% biracial, and 3.7% Middle Eastern (1.2% did not report race).

Materials

Baseline sample characteristics and contamination concerns.

The PI-WSUR is a 10-item measure of cognitions and avoidance associated with contamination fears that was included for screening and as an outcome measure. It has been shown to be appropriate for use in a nonclinical population (e.g., Burns et al., 1996; Jónsdóttir & Smári, 2000). Using a 5-point Likert scale ranging from 0 to 4 (0 = Not at all, 4 = Very much), participants rated their agreement with contamination-relevant statements or the degree of disturbance the thought or behavior could create (e.g., “I avoid using public toilets because I am afraid of contagion and disease”). Scores range from 0 to 40. (Cronbach’s alpha = .64 for screening assessment, and .85 for follow-up assessment.)

The Vancouver Obsessional Compulsive Inventory (VOCI; Thordarson et al., 2004) is a 55-item measure of obsessive-compulsive symptoms that has been shown to have strong psychometric properties in both diagnosed and undiagnosed samples (Thordarson et al.). Participants provide a rating based on a 5-point Likert scale (0 = Not at all, 4 = Very much), with scores ranging from 0 to 220. (Cronbach’s alpha = .97 in the current study).

The Disgust Scale – Revised (DS-R; Haidt, McCauley, & Rozin, 1994, modified by Olatunji et al., 2007b), is a 27-item measure that assesses disgust sensitivity that was given at baseline and immediately following training. Participants in the No Training condition completed the measure at the same two points in the study as participants in the Positive or Neutral Training conditions. The scale has demonstrated adequate psychometric properties in an unselected sample (Haidt et al.) and has been used in an analogue OCD contamination fearful sample (Olatunji, Wolitzky-Taylor, Willems, Lohr, & Armstrong, 2009). The first half consists of statements pertaining to disgust sensitivity (e.g., “I never let any part of my body touch the toilet seat in a public restroom) to which participants respond using a 5-point Likert scale [0 = Strongly disagree (very untrue about me), 4 = Strongly agree (very true about

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1 Participants from the first two semesters were assigned to either the Positive or Neutral Training condition. Due to concerns as to whether the Neutral Training condition provided an adequate control, there was a separate data collection in the third semester using the same recruitment procedures. All participants from the third semester were assigned to the No Training condition. During the first two semesters, 994 students were given the PI-WSUR-C. Of those, 223 were eligible (156 from the first semester and 67 from the second semester). We emailed this pool of eligible participants in batches of approximately 20 individuals per email, beginning with the most contamination fearful, until we reached 56 participants. In the third semester, 671 students were given the PI-SWUR-C. Of these, 51 were eligible and were emailed in batches, resulting in a final sample of 25.

2 Only measures relevant to the current hypotheses are described here. Individuals also completed two questionnaire measures of looming vulnerability, an exposure task involving a seemingly used Band Aid, and a perceptual bias measure. Further detail on these measures is available from the first author.
me). On the second half, participants rate how disgusting they would find certain situations (e.g., “While you are walking through a tunnel under a railroad track, you smell urine”) using a 5-point Likert scale (0 = Not disgusting at all, 4 = Extremely disgusting). The measure includes two items used to screen out untruthful responding. These items are not included in the measure’s mean (means range from 0 to 4). Additionally, the measure can be divided into three subscales (i.e., core disgust, animal-reminder disgust, and contamination disgust; scores range from 0 to 4). The current study only reports the total score and the contamination disgust subscale, which is the average of 5 items. (Cronbach’s alpha for total scale at initial assessment = .92; for second assessment = .92).

The Spielberger State-Trait Anxiety Inventory – Trait Form (STAI; Spielberger, 1983) is a well-validated, 20-item measure that assesses frequency of somatic and cognitive symptoms of anxiety. Participants use a 4-point Likert scale (1 = Almost always, 4 = Almost never) to indicate how they “generally feel” in response to statements. Possible scores range from 20 to 80. (Cronbach’s alpha in the current study = .96).

The Depression Anxiety Stress Scales Short Form – Depression Subscale (DASS21-D; Lovibond & Lovibond, 1995) is a 7-item measure of the core affective and physiological symptoms of depression. Participants use a 4-point Likert scale (0 = Did not apply to me at all, 3 = Applied to me very much, or most of the time) in reference to how they felt over the past week (e.g., “I felt down-hearted and blue.”) Scores are totaled and then multiplied by two, and they range from 0 to 42. It is a well-validated measure that is appropriate for use in a nonclinical sample (Henry & Crawford, 2005). (Cronbach’s alpha in current study = .86).

The Object Rating Form was designed for the current study. Individuals were provided with a list of 20 potentially contaminated objects often encountered in daily life and were asked to select three objects from the list “that most arouse a sense of contamination and ‘germiness’” for them and to rate the degree of “germiness.” All individuals were instructed to rate “public toilet,” even if it was not one of their three chosen objects. Notably, the vast majority of participants included “public toilet” among their three chosen objects.

Training of implicit associations.

The training paradigm was designed to condition more positive associations with potential contaminants. It was patterned off of the similar training paradigms described in Baccus et al. (2004) and in Clerkin and Teachman (2010). Potentially contaminated objects (hereafter referred to as “everyday objects”) were repeatedly paired with either positive or negative words (Approach, Avoid, and their synonyms) or emotional faces (disgusted, fearful, and happy; standardized descriptions taken from Ekman, 2007). Owing to the difficulty of selecting relevant control stimuli that could not potentially be seen as contaminated, we used images of the same everyday objects in an unrecognizable, scrambled form. This allowed us to control for the color composition of each image.

The everyday object images were pictures of toilets and exemplars from the two categories that individuals rated as the most contaminated on the Object Rating Form. For example, if an individual chose hairbrushes and money to be the most contaminated everyday objects, then his or her version of the training task included images of hairbrushes and money, in addition to the standard toilet images that were included in all versions of the training task. This idiographic element of training was included to account for the heterogeneous nature of contamination fears, while the standardized toilet images provided a means of having a comparable training focus across individuals. Five different images were included for each everyday object category, for a total of 15 images that were repeated in a training session. Independent raters (N = 14) had previously rated each picture for degree of contamination on a
Likert-type scale ranging from 1 (not at all contaminated) to 7 (the most contaminated I can imagine something being) so that we could select stimuli that were somewhat ambiguous in terms of whether they were contaminated. All everyday object category means for the final, selected stimuli received ratings between 2 and 5 to ensure we were not selecting objects at the extreme ends of the scale, with no single image (within a given category) receiving a mean rating above 5.7. The average rating across all objects was 3.09.

Individuals were instructed that images of everyday objects would appear randomly in one quadrant on a computer screen and that they were to click on the image as quickly as possible. This was to ensure that they were actively engaged in the training. Each training session took approximately 30 minutes and consisted of 720 trials that were divided equally into three randomly ordered blocks (n = 240 trials). In one block (Approach/Avoid), after individuals clicked on an everyday object, it was either replaced by an approach-related word (Approach, Contact, Touch, Near, Reach) or by an avoidance-related word (Avoid, Escape, Evade, Recoil, Withdraw), depending on training condition. After the word was displayed for 400 ms, it disappeared, and another image of an everyday object appeared in a randomly selected quadrant to begin the next trial. The other two blocks included the same everyday objects but, in place of approach- or avoidance-related words, included images of the individual making different emotional faces. In one of these blocks (Disgust/Happy), clicking on an everyday object revealed in its place an image of the individual making a disgusted or happy face, depending on training condition. The third block (Fear/Happy) was quite similar to the Disgust/Happy block; however, the individual's fearful face was used instead of his or her disgusted face. By using the individuals' emotional faces as opposed to standardized faces, we aimed to condition their positive or less fearful responses to the stimuli and to increase the personal relevance of the task.

**Post-training measures.**

**Implicit associations.**

Implicit associations tied to contamination fears were assessed using the Brief Implicit Association Test (B-IAT; Sriram & Greenwald, 2009). This measure is an abbreviated version of the widely used and well-validated Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). Like the IAT, it is a reaction time test in which individuals must quickly categorize various stimuli along categorical and evaluative dimensions, resulting in a relative measure of the strength of associations between tested concepts. In one critical block, the participant was told to classify Everyday Objects and Safe stimuli together using one key and to reject any other stimuli using another key (in this example, the other stimuli would be the scrambled control images and Dangerous words). In the other critical block, the pairing was switched such that the individual's task was to classify Everyday Objects and Dangerous stimuli using one key and reject any other stimuli (scrambled control images and Safe words) using another key. Therefore, while individuals still saw stimuli that belonged to each of the four categories (Everyday Objects, scrambled images, Safe words, Dangerous words), only three of the categories were explicitly labeled (the scrambled images were simply background stimuli to be rejected).

The images used in the B-IAT were toilet images and exemplars from each individual’s two most highly rated categories on the Object Rating Form (thus, the categories matched those used in training). The images were not the same as those used during training, though they were similarly rated. These images collectively were labeled “Everyday Objects.” The “Safe” category included the words “Safe,” “Protected,” and “Secure.” Conversely, individuals were to classify “Dangerous,” “Perilous,” and “Risky” into the “Dangerous” category.
Emotional vulnerability on BATs.

Individuals were asked to engage in two BATs; the first was an idiographic BAT involving an object that participants rated as highly contaminated on the Object Rating Form (Personal Object BAT), and the second was a standardized BAT involving a public toilet in a single stall bathroom. To reduce the influence of residual anxiety from the first BAT on the Toilet BAT, individuals engaged in diaphragmatic breathing for 30 seconds in between the BATs. Despite differences in specific contaminant content among the idiographic BATs, all BATs followed the same general structure. Each began with the participant providing a rating of anticipatory fear and disgust levels using a 0 to 100 verbal analogue Subjective Units of Distress Scale (SUDS; Wolpe, 1990), where 0 represents no fear and 100 signifies the most fearful they can imagine being, like panic. Participants began the BAT in close proximity to the object so that they could complete the first stage by touching a specified part of the object, if they desired. Given that each of the objects differed, the six stages of the idiographic BATs differed slightly across objects. However, the structure was the same across BATs, following a gradual progression of increasing participant contact with the object (i.e., from hand to lips contact). For example, participants who rated trash cans as highly contaminated would have the option to progress through the following six stages: (1) Touch the rim of a trashcan that is lined with a trash bag with your dominant hand, (2) Touch the rim of the trashcan with the palms of both of your hands, (3) Lift the trash bag out of the trashcan using both hands, and pull the bag closed using the drawstrings, (4) Rub your forearms along the outside of the trash bag, (5) Rub the palms of both of your hands across your cheeks and forehead, and (6) Rub the palms of both of your hands across your lips. At the end of the idiographic and standardized Toilet BATs, individuals provided their peak fear and disgust SUDS ratings and were given a chance to wash their hands using either hand sanitizer or soap and water.

Questionnaire measures.

The Contamination Cognitions Scale (CCS; Deacon & Olatunji, 2007) is a 26-item measure of cognitions related to the perceived likelihood of contamination from 13 common objects such as elevator buttons, raw meat, and sink faucets in public restrooms, as well as cognitions tied to how “bad” this contamination would be if it occurred. Participants use an 11-point Likert scale ranging from 0 = (Not at all likely / Not at all bad) to 100 (Extremely likely / Extremely bad) to rate the likelihood of one becoming contaminated by touching the object, as well as how bad it would be, were one to become contaminated (the scale we used was slightly modified from the original in that our response options were divided into blocks of 10s as opposed to being continuous; e.g., 0, 10, 20). In keeping with Deacon and Maack (2008), participants’ scores on this measure were calculated by averaging ratings across all 26 items. Possible scores range from 0 to 100. It has been shown to have good psychometric properties in an analogue OCD contamination fearful sample (Deacon & Maack; Cronbach’s alpha in current study = .96).

The Safety Behavior Checklist (SBC; Deacon & Maack, 2008) is a 27-item measure that was emailed to participants one week after their second visit to provide a measure of the duration of training effects and to give individuals time to implement the new associations. Participants responded “yes” or “no” to whether they had engaged in any behaviors over the past week (e.g., “Tried to avoid touching public door handles”). Scores range from 0-27. Scores on this measure have been shown to positively correlate with contamination fears in an analogue OCD contamination fearful sample (Deacon & Maack; Cronbach’s alpha in current study = .88).

Procedure

Individuals from the first two semesters of data collection were randomly assigned to the Positive or Neutral Training condition (experimenters were blind to training condition). Individuals who were
recruited during the third semester were assigned to the No Training control condition. The procedure followed in the No Training condition was identical to that followed in the Positive and Neutral Training conditions with two exceptions: 1) the training protocol (and associated self-photographs) were omitted in the No Training condition, and 2) participants in the Positive and Neutral Training conditions completed the study over the course of two lab visits spaced approximately 48 hours apart, whereas participants in the No Training condition completed the study during a single lab visit.

During informed consent, participants were made aware of the goal of the experiment in broad terms so that any potential role of demand effects would be made more comparable across the groups. Following informed consent, those provided baseline ratings of fear and disgust (SUDS) and rated the objects that they viewed as the most contaminated (Object Rating Form). Next, individuals in the Positive and Neutral Training conditions had their pictures taken making a disgusted, fearful, and happy face for use in the training task. Notably, research assistants were extensively trained on how to judge the adherence of these emotional expressions to the descriptions provided by Ekman (2007) and achieved high inter-rater reliability ($ICC = 0.86$) in their ratings before the start of the experiment. Research assistants coached participants on how to make each face and worked with them until each expression closely approximately Ekman's descriptions. Participants then completed baseline questionnaire measures in random order, before engaging in the training task.

During the second lab visit (or the second half of the first visit, for those in the No Training condition), baseline levels of fear and disgust were again measured. Individuals in the Positive or Neutral Training conditions completed the same training task as before. Then, to measure the effectiveness of training in modifying implicit associations, all individuals completed the B-IAT. Next, to measure the effectiveness of training on behavior and distress, individuals engaged in the idiographic and toilet BATs. They were then fully debriefed and reminded that one week later, they would be emailed a brief survey asking about their cleaning habits. Notably, we debriefed participants prior to the completion of the follow-up questionnaires to ensure that all participants would be properly debriefed, given that contacting participants following the completion of the study can be challenging. Individuals were told that as a reward for returning the completed questionnaires (SBC and PI-WSUR-C), their name would be entered into a raffle to win fifty dollars.

Results

Data Scoring and Reduction

The B-IAT data were scored according to an adapted version of the algorithm developed by Greenwald, Nosek, and Banaji (2003) for the IAT. A $D$ score was calculated, representing the difference in mean response time across critical blocks divided by the standard deviations across blocks. Following the recommendations of Greenwald et al., we excluded data if the individual's error rate was more than 30% overall or if an individual took less than 300 ms to respond to more than 10% of trials. On the basis of these criteria, one individual's B-IAT data were excluded.

Three participants did not return for the second session and, therefore, were not included in any analyses, and 23 participants did not return the emailed follow-up questionnaires 1-week post-training. There was no significant difference in baseline contamination fears between those who did or did not return for the second session, $t(57) = 1.67, p = .10, d = 1.13$, or between those who did or did not complete the follow-up questionnaires, $F(1, 79) = 1.89, p = .177, d = -.34)$. 
Sample Characteristics and Comparison of Groups at Baseline

The results of chi-square tests indicated no significant differences among the three groups in gender, $\chi^2(2) = .57, p = .75$, or ethnicity (Caucasian compared to all other ethnicities), $\chi^2(2) = 2.81, p = .25$. Further, one-way analyses of variance (ANOVAs) revealed that the groups did not significantly differ in age, nor in baseline contamination fears (on the PI-WSUR-C), obsessive-compulsive symptoms (on the VOCI), trait anxiety (on the STAI), general trait disgust sensitivity (on the DSR), contamination-related trait disgust sensitivity (on the DSR-C), or depression symptoms (on the DASS-21-D), all $p$s $\geq .10$; see Table 1.

Table 1: Descriptive statistics (Means and Standard Deviations) for pre-training measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>No Training</th>
<th>Positive Training</th>
<th>Neutral Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Padua Inventory Washington State University Revision</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Contamination Fear Subscale (PI-WSUR-C)</td>
<td>21.34</td>
<td>21.26</td>
<td>22.47</td>
</tr>
<tr>
<td>Vancouver Obsessional Compulsive Inventory (VOCI)</td>
<td>71.88</td>
<td>52.22</td>
<td>69.21</td>
</tr>
<tr>
<td>Spielberger State-Trait Anxiety Scale - Trait Version (STAI)</td>
<td>45.72</td>
<td>41.74</td>
<td>45.71</td>
</tr>
<tr>
<td>Disgust Scale - Revised (DS-R)</td>
<td>2.38</td>
<td>2.58</td>
<td>2.39</td>
</tr>
<tr>
<td>Disgust Scale- Revised - Contamination Subscale</td>
<td>2.18</td>
<td>1.92</td>
<td>1.84</td>
</tr>
<tr>
<td>Depression Anxiety Stress Scale - Depression Scale (DASS-21-D)</td>
<td>9.67</td>
<td>9.92</td>
<td>12.07</td>
</tr>
</tbody>
</table>

Object Choice and Ratings

Overall, individuals across training conditions selected similar objects and rated them comparably on the Object Rating Form (see Table 2), suggesting equivalent evaluations of the “germiness” of the objects between groups prior to implicit association training. Surprisingly, there was a significant group difference on public toilet “germiness” ratings, $F(2, 77) = 3.30, p = .042, \eta^2_p = .08$ with follow-up tests indicating that individuals in the Positive Training condition ($M = 5.74, SD = .90$) rated them as less “germy” than did individuals in the Neutral Training condition ($M = 6.39, SD = .79$), $p = .014$. Given this difference at baseline, the toilet “germiness” rating was used as a covariate for all analyses comparing the training conditions that involved toilet stimuli.
### Table 2: Object Selection and “Germiness” Ratings

<table>
<thead>
<tr>
<th>Object*</th>
<th>% Participants Selecting Object as one of the 2 most “Germy”</th>
<th>Mean “Germiness” Rating (1-7) Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Training</td>
<td>Positive Training</td>
</tr>
<tr>
<td>Public transportation handrail</td>
<td>60.0</td>
<td>55.6</td>
</tr>
<tr>
<td>Trashcan</td>
<td>36.0</td>
<td>55.6</td>
</tr>
<tr>
<td>Public phone</td>
<td>24.0</td>
<td>25.9</td>
</tr>
<tr>
<td>Kitchen sponge</td>
<td>8.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Money</td>
<td>16.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Dirty laundry</td>
<td>12.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Handrail</td>
<td>0</td>
<td>7.4</td>
</tr>
<tr>
<td>Doorknob</td>
<td>8.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>4.0</td>
<td>7.4</td>
</tr>
<tr>
<td>Faucet</td>
<td>4.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Toothbrush</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>Hairbrush</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>Beer bottle</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>Shopping cart</td>
<td>4.0</td>
<td>0</td>
</tr>
<tr>
<td>Computer keyboard</td>
<td>12.0</td>
<td>7.4</td>
</tr>
</tbody>
</table>

* The following objects were not selected by any participants: Hand towel, Pen, Light switch, Hand

### Effects of Training

See Table 3 for descriptive statistics for post-training measures.

### Table 3: Descriptive statistics (Means and SDs) for post-training measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>No Training</th>
<th>Positive Training</th>
<th>Neutral Training</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Brief Implicit Association Test (Brief-IAT) D score</td>
<td>−.24</td>
<td>.37</td>
<td>−.015</td>
</tr>
<tr>
<td>Toilet behavioral avoidance task - Steps taken (Range: 1-6)</td>
<td>2.67</td>
<td>2.04</td>
<td>3.00</td>
</tr>
<tr>
<td>Personal object behavioral avoidance task - Steps taken (Range: 1-6)</td>
<td>4.64</td>
<td>1.47</td>
<td>4.74</td>
</tr>
<tr>
<td>Toilet anticipatory fear (SUDS measure)</td>
<td>33.00</td>
<td>24.83</td>
<td>21.96</td>
</tr>
<tr>
<td>Toilet anticipatory disgust (SUDS measure)</td>
<td>56.00</td>
<td>26.10</td>
<td>44.65</td>
</tr>
<tr>
<td>Personal object peak fear (SUDS measure)</td>
<td>26.20</td>
<td>23.32</td>
<td>18.52</td>
</tr>
<tr>
<td>Personal object peak disgust (SUDS measure)</td>
<td>45.64</td>
<td>23.86</td>
<td>36.52</td>
</tr>
<tr>
<td>Contamination cognitions scale (CCS)</td>
<td>46.80</td>
<td>17.17</td>
<td>36.99</td>
</tr>
<tr>
<td>Disgust Scale - Revised (DS-R)</td>
<td>2.37</td>
<td>.54</td>
<td>2.51</td>
</tr>
<tr>
<td>Disgust Scale - Revised - Contamination Subscale</td>
<td>2.17</td>
<td>0.68</td>
<td>2.20</td>
</tr>
<tr>
<td>Padua Inventory - Washington State University Revision - Contamination Fear Subscale (PI-WSUR-C)</td>
<td>21.26</td>
<td>10.36</td>
<td>19.35</td>
</tr>
<tr>
<td>Safety Behavior Checklist (SBC)</td>
<td>13.17</td>
<td>7.22</td>
<td>10.07</td>
</tr>
</tbody>
</table>

Note. SUDS = Subjective units of distress from 0-100.
**Implicit associations.**

Contrary to expectations, the results of a univariate analysis of covariance (ANCOVA) test covarying the toilet “germiness” rating revealed that training did not lead to significant differences in implicit contamination associations, $F(2,75) = .53, p = .59, \eta^2_p = .01$. Notably, the absolute value of the D score (less than zero) represents stronger automatic associations between everyday objects and danger-words, relative to safety words, for all three groups. T-tests comparing each condition’s B-IAT mean to zero showed that each was significantly different from zero (No Training, $t(24) = -3.28, p = .003$; Positive Training, $t(26) = -2.67, p = .013$; Neutral Training, $t(27) = -2.40, p = .023$).

**Subsequent emotional vulnerability: Avoidance on BATs.**

Though training did not have a direct effect on implicit associations as measured by the B-IAT, it is still plausible that training more positive and approach-related associations to potentially contaminated objects may have resulted in less behavioral avoidance among individuals in the Positive Training condition. We tested this hypothesis for both the Toilet and the Personal Object BATs using a repeated measures ANCOVA test with three levels for the between-subjects factor (Condition: Positive, Neutral, or No Training) and one within-subjects factor (Object: Toilet or Personal Object), covarying individuals’ “germiness” ratings for public toilets. Again, contrary to expectations, there was no significant main effect of Training Condition, $F(2,73) = .10, p = .91, \eta^2_p = .00$, or interaction between Training Condition and Object, $F(2,73) = 1.80, p = .173, \eta^2_p = .05$, indicating that implicit association training did not affect behavioral avoidance.

**Subsequent emotional vulnerability: Affect during BATs.**

We examined whether implicit association training had an effect on self-reported SUDS ratings of anticipatory and peak fear and disgust experienced during the BATs. We conducted a repeated measures ANCOVA with one between-subjects factor (Condition: Positive, Neutral, or No Training) and three within-subjects factors (Object: Toilet or Personal Object; Emotion: Disgust or Fear; Time: Anticipatory or Peak), and the toilet “germiness” covariate. Standardized residuals were used for the SUDS variables (taking into account baseline fear and disgust levels).

Contrary to our hypothesis, there was no significant main effect for Training Condition, $F(2,66) = 1.96, p = .149, \eta^2_p = .06$, and no interactions between Training Condition and Emotion, Object, or Time (all $p$s > .05). Therefore, training did not lead to less reported distress during the BATs.

**Post-training Self-reported Contamination Concerns and Associated Symptoms**

To investigate whether training had an effect on self-reported contamination concerns, we conducted a multivariate analysis of variance (MANOVA) with scores on the Contamination Cognitions Scale and on the contamination subscale of the Disgust Scale – Revised as the dependent variables. For the latter measure, we used a standardized residual, accounting for baseline contamination disgust sensitivity as reported during the first session. Contrary to expectations, there was no significant effect of training condition, $F(4,136) = .64, p = .64, \eta^2_p = .02$. Finally, we examined effects one week post-training, using a MANOVA to examine the effect of training condition on scores on the PI-WSUR-C and the SBC. Again, results revealed no effect of Training Condition, $F(4,110) = .81, p = .52, \eta^2_p = .03$, indicating that individuals did not exhibit a delayed response to training one week later.
Discussion

The current study was designed to test whether implicit associations tied to contamination fears are causally related to anxious responding and emotional vulnerability when contamination fearful individuals are in the presence of potential contaminants. By attempting to alter implicit associations, which are conceptually similar to schemas, we aimed to evaluate cognitive theories of OCD that emphasize the role of maladaptive schemas in maintaining anxious symptomatology. Contrary to expectations, we found no effect of training on implicit associations, raising doubts as to whether we had effectively modified the expected cognitive bias. Not surprisingly, given the lack of a training effect on implicit associations, we also saw no evidence for training effects on emotional vulnerability (based on measures of avoidance and self-reported fear and disgust), nor on questionnaire measures tied to disgust or contamination cognitions and symptoms.

Lack of Change in Implicit Associations

Given Clerkin and Teachman’s (2010) positive findings pertaining to the malleability of implicit rejection associations in a socially anxious sample, it is somewhat perplexing that training had no effect on implicit associations in the current study. One possibility, however, is that training may have been more effective had it focused on individuals’ feared consequences of contamination, rather than on their reactions toward the objects. For example, training could have focused on the feared health consequences that may drive avoidant, disgusted, and fearful reactions. If the training task had targeted these biased contamination-relevant beliefs (e.g., overestimation of threat) instead of emotional reactions (i.e., fear and disgust), it may have been more apt to modify fear schema. Clerkin and Teachman targeted implicit associations tied to social anxiety by pairing images of the self pretending to give a speech with images of a stranger's positive/smiling face – stimuli that contradict the negative facial reaction socially anxious people would likely expect in reaction to their giving a speech. Therefore, Clerkin and Teachman likely targeted biased beliefs (i.e., likelihood of negative evaluation from others) more directly than the current study.

While it seems likely that this version of implicit association training did not train implicit associations, it is also plausible that the stimuli used on the B-IAT to assess the effectiveness of implicit association training were not well matched with the training paradigm. For contamination-fearful individuals, an object’s relative safety or danger, as assessed with the B-IAT, may not be as closely related to the disgust, fear, and avoidance reactions that were trained (and may, indeed, be more closely related to health consequences, as previously discussed). Nevertheless, training’s null effect on behavioral measures indicates that it is more likely that training was ineffective, rather than that the B-IAT simply tested untrained associations.

Lack of Change on Emotional Vulnerability and Contamination Symptoms

Similar to Najmi and Amir (2010) and Clerkin and Teachman (2010), we did not find a significant effect of training condition on self-reported emotional vulnerability during the BATs, though it should be noted that in both of these previous studies, training had an effect on behavioral outcomes. Individuals receiving positive training in the current study did not report decreased fear or disgust ratings, relative to those in the Neutral Training group. The replicated null effect of training on self-report measures of anxiety (in addition to self-reported measures of disgust, in the current study) leads to speculation that perhaps training implicit associations does not immediately alter aspects of emotional vulnerability that require conscious introspection. It is possible, as noted by Najmi and Amir, that training impacts a third variable, such as willingness to withstand anxiety, instead of directly reducing the reported anxiety level.
experienced during behavioral tests. It may also be that training does affect subjective anxiety and reported symptoms, but only after opportunities for training to be rehearsed and then to generalize, or with a greater dose of training than used in the current study.

Limitations and Conclusions

The results of this study should be considered in light of several limitations, including the lack of a baseline implicit association measure. Though inclusion of such a measure could have been helpful, our concerns regarding practice effects (given the short time between the pre- and post-training assessments) led us to rely on a single post-intervention measure, assuming that random assignment to condition would produce groups comparable in baseline implicit association bias scores. While not the same as collecting a true baseline measure, the comparability of the groups on numerous other baseline measures and the comparable scores in the No Training condition suggest it is unlikely that differences in baseline implicit bias could fully explain the null findings.

It may be the case that we attempted to alter too many associations (disgust, fear, avoidance) in too few training sessions. Future researchers may instead focus on altering a single association. Given the heterogeneity in OCD, effective implicit association training in a contamination fearful sample may require focusing on training the one association that is most central for that individual (so that training effects are not diluted across targets). Additionally, though matching participants’ facial expressions to those validated by Ekman (2007) allowed for the degree of emotional expression to be similar across groups, it may have led participants to create facial expressions that differed from the ones that they would spontaneously produce, which could have affected training results. Last, the inclusion of an Approach/Avoidance block in the training was, in hindsight, likely not ideal within the framework of operant conditioning, because individuals had to approach each stimulus to complete the task, but, in response, often saw avoidance-related words.

Despite these limitations, the current study makes a unique contribution to the literature through its use of an implicit association training paradigm in a contamination-fearful sample. The idiographic nature of the training, as well as the multiple training sessions and BAT assessments, are strengths of this study, despite the null results. Future research may focus on designing a more active implicit association training paradigm. Perhaps necessitating a physical response (e.g., moving a joystick toward or away from a stimulus as occurs in the Approach Avoidance Task; see Wiers et al., 2011) or having participants answer a yes or no question about the relationship between a potential contaminant and a given word or facial expression may better train new implicit associations, partially as a result of being more engaging for participants. Moreover, future researchers may choose to pair others’ facial expressions, as opposed to one’s own, with the potential contaminants, given that one rarely sees one’s own reflection in daily life when encountering these objects. Notwithstanding these null results, prior research leads us to be cautious in concluding that implicit associations cannot be modified in this population. Rather, it appears to be a question of finding the appropriate form and dose of training to effect change.

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References


Wiers, R.W., Eberl, C., Rinck, M., Becker, E.S., & Lindenmeyer, J. (2011). Retraining automatic action tendencies changes alcoholic patients’ approach bias for alcohol and improves treatment outcome. *Psychological Science, 22*, 490-497. [http://dx.doi.org/10.1177/0956797611400615](http://dx.doi.org/10.1177/0956797611400615)

