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The Effect of Attention Training on a Behavioral Test of Contamination Fears in Individuals with Subclinical Obsessive-Compulsive Symptoms

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Abstract

In the current study, we evaluated the effectiveness of attention training in individuals with subclinical obsessive-compulsive symptoms. We hypothesized that after completing attention training, participants would be more likely to complete steps in a hierarchy approaching their feared contaminant compared to participants in the control condition. Participants completed a probe detection task by identifying letters replacing one member of a pair of words (neutral or contamination-related). We trained attention by building a contingency between the location of the contamination-related word in the active condition and not in the control condition. Participants in the active group showed a significant reduction in attention bias for threat and completed significantly more steps approaching their feared objects compared to participants in the control group. Our results suggest that attention disengagement training may facilitate approaching feared objects in individuals with obsessive-compulsive symptoms.

Keywords

Obsessive Compulsive Disorder; Attention Training; Attention; Behavioral Approach Test

Obsessive-compulsive disorder (OCD) is a severe mental disorder that has a chronic course unless treated. Although cognitive models of OCD emphasize the role of dysfunctional beliefs (Rachman, 1997; Salkovskis, 1985, 1989) in the etiology and maintenance of the disorder, others have proposed that OCD symptoms may be the result of aberrant processing of threat-relevant information (e.g., Tallis, 1997; for reviews see Muller & Roberts, 2005; Summerfeldt & Endler, 1998). According to this model, selective attention to threatening information heightens anxiety and anxiety-related avoidance of the perceived threat, and the avoidance behaviors, in turn, prevent disconfirmation of fear-related beliefs and serve to maintain anxiety. Thus, attention bias towards threat may be *causally* related to behavioral avoidance of perceived threat and the anxiety experienced in the context of the approach behavior.

Several researchers have reported that individuals with subclinical or clinical OCD show an attention bias for OCD-relevant material (Amir, Najmi, & Morrison, 2009; Foa, Ilai, McCarthy, Shoyer, & Murdock, 1993; Lavy, van Oppen, & van den Hout, 1994; Tata, Liebowitz, Prunty,

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Cameron, & Pickering, 1996). In a seminal study, Foa and McNally (1986) used a dichotic listening task to examine attention bias towards OCD-relevant material before and after exposure and response prevention treatment in individuals with OCD. In the dichotic listening task, participants are presented simultaneously with distinct passages of prose to each ear and asked to shadow the passage presented to the dominant ear while also detecting target words included in each passage. Results revealed that patients with OCD were better at detecting fear-relevant words in the unattended passage compared to detecting neutral words in the unattended passage. Moreover, after completing exposure and response prevention treatment, participants with OCD did not detect fear-relevant and neutral words differentially. These results suggest that attention bias towards OCD related material is present in OCD, and ameliorates after treatment, thus highlighting that attention bias is malleable.

Nevertheless, the critical question remains whether a reduction in attention bias *causes* a reduction in OCD symptoms or whether attention bias is an epiphenomenon of the symptoms. Although cognitive models assume that attention bias towards threat is causally involved in the maintenance of anxiety and avoidance, this causal hypothesis remains speculative given that previous research has relied exclusively on correlational designs. The most direct test of the causal role of attention bias in the maintenance of anxiety symptoms is with the use of research designs in which participants are randomly assigned to experimental and control conditions and their attention bias is manipulated experimentally. In the next section, we review studies that use this design.

In a seminal study, MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) used a modified probe detection paradigm to examine the effect of attention training on anxiety. In a typical probe detection task, participants are presented with pairs of words, one above the other, on a computer screen. On some trials a probe (e.g., a dot or letter) replaces the location of one of the words. Participants are instructed to respond to the probe by pressing a key as soon as it is detected. Using a modified version of this task, MacLeod et al. (2002) manipulated attention towards general anxiety words in individuals in the mid range of anxiety. In their study participants were randomly assigned to an Attend Threat condition, in which probes appeared in the position of the threat word on 93% of the trials or an Attend Neutral condition, in which probes appeared in the position of the neutral word on 93% of the trials. After the training, the authors induced stress by presenting their participants with a series of unsolvable anagrams and telling them that their videotaped performance would be shown in other classes should they perform particularly well or poorly. MacLeod et al. (2002) found that participants in the Attend Threat condition showed faster response latencies when detecting probes following threat words than neutral words after training. Participants in the Attend Neutral condition showed the opposite pattern of results. Moreover, participants in the Attend Threat condition responded with more elevated negative mood to the experimental stressor than did those in the Attend Neutral condition. However, in this study both conditions contained contingencies that, in principle, could have trained attention. Therefore, without a baseline condition it is not possible to determine whether only one, or both, of these conditions trained attention.

To address this issue, Amir, Weber, Beard, Bomyea, and Taylor (2008) compared the effects of a single-session Attention Modification Program (AMP) on behavioral responses to a public speaking challenge in a sample of individuals with social anxiety. In contrast to the conditions described above, participants in the AMP condition (attention trained *away from* threat) were compared to participants in an Attention Control Condition (ACC) in which there was no contingency between the location of the probe and the location of the threat-relevant information. As predicted, these researchers found that AMP led to a decrease in attention bias towards threat compared to the control condition. Moreover, participants in the AMP group reported lower levels of anxiety in response to the public speaking task and were judged as

having superior speech performance relative to participants in the control group. These results are consistent with the hypothesis that attention plays a causal role in the maintenance of anxiety disorders and suggest that altering attention mechanisms may effectively improve behavioral performance in anxiety-inducing tasks.

Three studies have now demonstrated that a multi-session AMP—training attention *away from* threat— can reduce symptoms in clinical samples. Amir, Beard, Burns, and Bomyea (2009) have shown that an eight-session AMP was effective in reducing attention bias towards threat as well as symptoms of Generalized Anxiety Disorder. Using Amir et al.'s (2008) AMP procedure, Schmidt, Richey, Buckner, and Timpano (2009) showed significantly greater reductions in social anxiety and trait anxiety in patients with social anxiety disorder compared to patients in the control condition. Finally, Amir et al. (in press) replicated the Schmidt et al. (2009) study in individuals with Generalized Social Phobia.

Despite recent research on attention training in anxiety, researchers have not yet examined whether training procedures such as AMP are capable of modifying attention biases in individuals with obsessive-compulsive symptoms. Moreover, although the attention training studies outlined above demonstrate the efficacy of AMP on self-reported anxiety, none have tested directly the effect of AMP on behavioral approach towards feared situations. One study (Amir et al., 2008) examined performance during a stressful task, but most studies have relied strictly on self-report measures of anxiety, and hence cannot address the criticism that attention bias may influence self-reporting bias without actually affecting anxiety. Avoidance of feared stimuli is the hallmark behavioral symptom of anxiety and demonstrating that AMP impacts this symptom can clearly counter the aforementioned criticism.

Thus, in the current study we examined the effect of a single AMP session on behavioral approach towards feared stimuli. We measured behavioral approach by the number of steps completed in a behavioral approach test. Given the heterogeneity of subtypes in OCD, we limited our investigation to individuals with contamination-related obsessive-compulsive symptoms in order to standardize our behavioral approach test. We hypothesized that training attention away from threat would decrease attention bias towards threat and that, if attention bias is indeed causally related to anxiety symptoms, this decrease in bias would lead to a decrease in avoidance of threatening stimuli. Alternatively, if attention bias is not causally related to anxiety symptoms, we would expect training attention bias away from threat to not be associated with a change in behavioral avoidance. More specifically, we predicted that, compared to the control condition (ACC), AMP would decrease attention bias towards threat and facilitate behavioral approach towards feared contaminants in individuals with contamination-related obsessive-compulsive symptoms.

Method

Participants

Participants comprised 52 individuals (AMP = 26; ACC = 26) recruited with an advertisement for individuals who “have concerns about germs, dirt, or contamination.” These participants were drawn from a pool of undergraduate students at a large university. Participants were further screened based on their score on the Maudsley Obsessive-Compulsive Inventory (MOCI: Hodgson & Rachman, 1977) and included in the study if they scored a 4 or higher on the cleaning subscale of the MOCI. This cutoff is approximately two standard deviations from the mean for the normal population (Emmelkamp, Kraaijkamp, & van den Hout, 1999). This resulted in a mean MOCI total score of 13.69 ($SD = 4.00$) and a mean MOCI-Cleaning subscale score of 6.15 ($SD = 1.78$) for our study sample.

Materials and Tasks

Self-Report Measures—The MOCI is a 30-item true/false measure of general obsessive-compulsive symptoms. The MOCI consists of four subscales: Cleaning, Checking, Slowness, and Doubting. The scale has acceptable psychometric properties (Taylor, 1998). In nonclinical samples, the MOCI has been shown to have internal consistency, with Chronbach's alpha coefficients ranging from 0.40 to 0.77 for the full scale (Sternberger & Burns, 1990; Taylor, 1998) and from 0.39 to 0.54 for the Cleaning subscale (Emmelkamp et al., 1999; Sternberger & Burns, 1990). In the present study, internal consistency for the sample was Cronbach's alpha = .62 for the total scale and .30 for the Cleaning subscale. Additionally, given that the MOCI is a multidimensional scale, we computed the coefficient omega_{hierarchical} (Zinbarg, Revelle, Yovel, & McDonald, 2006) for the MOCI total scale ($\omega_h = .31$). The low values for internal consistency of the MOCI likely reflect a restriction of range because for our study sample we excluded participants who scored less than approximately 2 standard deviations or more above the mean for the normal population. Including data from these participants for the reliability analysis resulted in Cronbach's alpha = .79 and $\omega_h = .54$ for the MOCI total scale, and Cronbach's alpha = .72 for the Cleaning subscale.

Participants also completed the Spielberger State-Trait Anxiety Inventory (STAI-S/T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), a self-report measure of anxiety symptoms with adequate psychometric characteristics. Both state and trait versions were administered. Participants also completed the Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996), a reliable and well-validated, self-report measure of symptoms of depression.

Stimuli for Probe Detection Tasks—The stimuli used in the attention bias assessment and training procedures were derived from words used in previous studies of attention bias in OCD (Amir et al., 2009; Foa et al., 1993; Lavy et al., 1994). We created two sets of 12 word-pairs (sets A and B). Each pair comprised one threat word (i.e., contamination-related) and one neutral word, matched in frequency and length to the threat word (Francis & Kucera, 1982). Half of the participants in each group saw a particular word set during training (set A) and were tested using words from the other word set (set B); the testing set (set B) was divided into half for the pre-training assessment and half for the post-training assessment. Thus, each of the two assessments of attention were conducted on a different set of words than the one used during training, thereby allowing us to test for generalizability of the training to a new set of materials. Moreover, the testing sets were counterbalanced across pre- and post-training assessments. Additionally, we asked each participant to rate the emotionality of each word from the two sets, from -3 ("How disturbing is the word *for you*, not for people in general") to +3 ("How pleasant is the word *for you*, not for people in general"). As expected, OCD-related words were rated as significantly more personally disturbing ($M = -2.0$) than the neutral words ($M = .52$), $t(51) = -22.63, p < .001$.

Attention Bias Assessment Task—In order to assess the effect of training on participants' attention bias, we used a probe detection task similar to the original task used by MacLeod, Mathews, and Tata (1986). Each trial began with a fixation cross presented in the center of the computer screen for 500ms. Then the cross was replaced by a word pair presented in the center of the screen, one word 3cm above the other, for 500ms. The words then disappeared and a probe (i.e., the letter "E" or "F") appeared immediately in the location of one of the two words. Participants were instructed to decide whether the letter was an E or an F and press the corresponding mouse button. The letter probe remained on the screen until the participants responded. Response latencies to identify the probe were recorded from the onset of the presentation of the letter probe to the button press. After the response, there was a 500ms interval of a blank screen before the next trial began with a fixation cross. Participants were

presented 48 trials—each consisting a threat-neutral word pair—comprising all combinations of Probe Type (E or F), Probe Location (Top or Bottom), and Threat Location (Top or Bottom): $2 \text{ (Probe Type)} \times 2 \text{ (Probe Location)} \times 2 \text{ (Threat Location)} \times 6 \text{ Threat-Neutral Word Pairs}$. Trials were presented in a new random order to each participant. Participants were seated approximately 30 cm from the computer screen. Stimuli were presented in 12-point Arial font in black on a grey background. The computer program was written in Delphi (Borland, Inc.) for this experiment. To assess changes in attention bias, the probe detection task was administered once before and once after the training procedure. The first 10 trials were excluded from the pre-training attention bias assessment to reduce practice effects.

Attention Modification Program (AMP)—The AMP consisted of the probe detection paradigm described above, modified to facilitate an attention bias away from threatening material. In this case, the probe always replaced the neutral word. As in the probe detection task described above, the neutral and threat words appeared equally often in the top and bottom positions. Participants completed 288 trials: $2 \text{ (Probe Type)} \times 2 \text{ (Probe Location)} \times 2 \text{ (Threat Location)} \times 12 \text{ Threat-Neutral Word Pairs}$, repeated 3 times. Thus, although there was no specific instruction to direct attention away from the threat word, on all trials, the position of the neutral word indicated the position of the probe.

Attention Control Condition (ACC)—The ACC was identical to the AMP procedure except that during the presentation of the trials, the probe appeared with equal frequency in the position of the threat and neutral word. As a result, neither threat nor neutral words provided information regarding the position of the probe, and there was no contingency between the position of either threat or neutral words, and the position of the probes.

Behavioral Approach Tests (BATs)—We adapted the BATs for this study from Cougle, Wolitzky-Taylor, Lee, and Telch (2007), by removing the first step used in their study and adding a last step in each of the three BATs in order to increase the range of responses. Three different BATs were used to assess avoidance of a variety of contaminants. The first BAT consisted of a pile of dirty underwear and other clothes. Participants were told that “some of these items may have been touched with bodily fluids.” The second BAT included a mixture of “dirt, dead insects, and cat hair.” This mixture was made of potting soil, dead crickets, and cat hair. The third BAT involved a toilet (with an open lid) that was made to look unclean with blotches of potting soil on the inside of the bowl. Each BAT comprised six steps in a graduated hierarchy (see Table 1).

If participants were able to complete the first item, they were asked to complete the next one on the hierarchy and if they refused to perform an item, the experimenter terminated that BAT. Instructions for each BAT were as follows:

What I’m going to ask you to do now is a test of your ability to approach a feared situation for as long as you comfortably can. It is not a test of courage. You are free to refuse to engage in the task, so you can end the task at any point. If you do wish to stop the task, please let me know.

Participants rated their peak anxiety during each step on a 0 to 100 scale. After each BAT, participants were given a tissue and instructed to wipe their hands for up to 10 seconds in order to minimize carry-over effects between the BATs, as recommended by Cougle et al. (2007).

Procedure

Participants were randomly assigned to either the AMP ($n = 26$) or the ACC ($n = 26$) condition. Condition assignment was determined using four numbers (one for each combination of condition and stimuli set) and a random number generator. At the beginning of the study, the

research coordinator entered the randomly assigned condition numbers into a spreadsheet with participant IDs. Prior to each experimental session, the experimenter entered the number corresponding to the participant's ID into the computer, which began the appropriate program. Neither participants nor experimenters were aware of which condition the numbers represented. Thus, the participants and experimenters working with the participants were blind to the participants' condition.

Participants first completed a demographics sheet and self-report questionnaires in the following order: STAI-State, STAI-Trait, MOCI, and BDI. Next they were asked to complete the probe detection task, which comprised 48 trials for the pre-training attention bias assessment, followed by 288 trials for the AMP or ACC (depending upon condition assignment), followed by 48 trials for the post-training attention bias assessment. Thus, participants completed a total of 384 trials. They were allowed to take a short break after every 100 trials. The instructions for the probe detection task were presented on the computer and were identical for the attention bias assessment tasks and for the AMP and ACC conditions.

After completing the computer tasks, participants completed self-report measures (STAI-State and MOCI) and emotionality ratings for the stimuli used in the probe detection tasks. Next, they completed the three BATs. Finally, participants were debriefed.

Results

Demographics and Baseline Data

The AMP and ACC groups did not differ on demographic or self-report measures of obsessive-compulsive symptoms, general anxiety, or depression at baseline ($ps > .2$). Table 2 summarizes these results.

Change in Attention Bias

Trials with incorrect responses were removed (4.04%). Outliers were removed in keeping with recommendations from Ratcliff (1993). Response latencies less than 100ms or greater than 2000ms were eliminated from analysis of the pre- and post-training assessment tasks (1.21% of trials with correct responses). Response latencies ± 2 SD from each participant's mean response latency were also eliminated from analysis of the pre- and post-training assessment tasks (4.59% of remaining trials). There was no significant difference between the mean number of trials eliminated in the AMP and ACC groups from the pre-training assessment task [3 trials from AMP, 3 trials from ACC], $t(50) = 1.30, p > .20$, and from the post-training assessment task [4 trials from AMP, 4 trials from ACC], $t(50) = .21, p > .83$. Finally, there was no significant difference between accuracy rates in the AMP and ACC groups, $t(50) = .11, p > .91$ [mean accuracy for the AMP group = .97, mean accuracy for the ACC group = .97].

We calculated attention bias scores using response latencies for critical trials as follows: $0.5 * (\text{Threat Location-Bottom/Probe Location-Top} + \text{Threat Location-Top/Probe Location-Bottom} - \text{Threat Location-Bottom/Probe Location-Bottom} - \text{Threat Location-Top/Probe Location-Top})$ (MacLeod & Mathews, 1988). We first conducted all analyses with Stimuli Set (set A, set B) included as a factor. However, because Stimuli Set did not appear in any significant effects (all $ps > .5$), the analyses reported below do not include Stimuli Set as a factor. To test our hypothesis concerning the effect of training on attention bias, we submitted attention bias scores to a 2 (Group: AMP, ACC) $\times$ 2 (Time: pre-training, post-training) ANOVA with repeated measurement on the second factor. Figure 1 presents participants' attention bias towards threat measured pre- and post- AMP and ACC conditions.

Results revealed a significant main effect of Group, $F(1, 50) = 4.25, p = .04, \eta^2 = .14$, modified by a significant Group $\times$ Time interaction, $F(1, 50) = 8.12, p < .01, \eta^2 = .14$. The main effect

of Time was not significant, $F(1, 50) = .24, p > .62, \eta^2 = .01$. Simple effects revealed that groups did not differ in attention bias towards threat pre-training, $t(50) = .69, p > .49, d = .19$. However, post-training, the AMP group showed significantly smaller attention bias towards threat than did the ACC group, $t(50) = 3.01, p < .01, d = .83$. Furthermore, the AMP group demonstrated a significant reduction in attention bias towards threat pre- to post-training, $t(25) = 3.30, p < .01, d = 1.10$. The ACC group showed no such reduction, and indeed their attention bias scores were nominally greater post- relative to pre-training, though there was no statistically significant difference between bias scores obtained by this group on these two occasions, $t(25) = -1.37, p = .18, d = .47$. Additionally, we used one-sample t-tests to compare post-training attention bias scores to zero. Results showed that post-training attention bias for threat in the AMP group was significantly less than zero, $t(25) = -2.72, p = .01$, whereas in the ACC group it was not significantly different from zero $t(25) = 1.81, p > .08$. Taken together, results are consistent with our hypothesis: Compared to the ACC, the AMP was successful in reducing attention bias towards contamination-related threat in individuals with contamination-related obsessive-compulsive symptoms.

Performance on Behavioral Approach Tests

We did not attempt the BAT with the dirt, dead insects, and cat hair mixture with three participants who reported having cat allergies. Additionally, we did not attempt the toilet seat BAT with one participant who had insufficient time to complete the experiment. To test our main hypothesis concerning the effect of training on behavioral approach in the BAT, we conducted a 2 (Group: AMP, ACC) $\times$ 3 (BAT-Type: BAT1, BAT2, BAT3) ANOVA with repeated measurement on the second factor. The main effect of Group was significant, $F(1, 50) = 7.84, p < .01, \eta^2 = .12$. Participants who completed the AMP task completed significantly more steps on the BATs [68% of total steps for the three BATs] than did participants who completed the ACC task [45%]. The main effect of BAT-Type was also significant, $F(2, 100) = 14.26, p < .01, \eta^2 = .22$. However, the Group $\times$ BAT-Type interaction was not significant, $F(2, 100) = .12, p > .88, \eta^2 = .002$, thereby failing to provide any evidence of differences across the three BATs. Participants who completed the AMP task completed 81% of steps in the dirty laundry BAT, 75% of steps in the BAT with the dirt, dead insects, and cat hair mixture, and 53% of steps in the toilet seat BAT, whereas participants who completed the ACC task completed 56% of steps in the dirty laundry BAT, 47% of steps in the mixture BAT, and 34% of steps in the toilet seat BAT. Taken together, consistent with our hypothesis, participants in the AMP group showed significantly greater approach towards a variety of feared contaminants than did participants in the ACC group.

Mediational Analyses

We hypothesized that a change in attention bias would mediate the relationship between AMP and the number of steps completed on the BAT. To test this hypothesis, we conducted a mediation analysis following the procedure described by MacKinnon and colleagues (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Change in the proposed mediator was computed using simple difference scores. The MacKinnon et al. (2002) procedure tests the product of the coefficients for the effects of (1) the independent variable (group: AMP, ACC) to the mediator (change in attention bias from pre- to post-assessment) (α path: $\beta = -.37, SE = .13$), and (2) the mediator to the dependent variable (performance on the BAT) when the independent variable is taken into account (β path: $\beta = -.004, SE = .13$). This procedure accounts for the non-normal distribution of the $\alpha\beta$ path through the construction of asymmetric confidence intervals (MacKinnon, Fritz, Williams, & Lockwood, 2007). Results revealed that the 95% confidence interval of the indirect path ($\alpha\beta$) did not overlap with zero for performance on the BAT (lower limit = .003, upper limit = .240), indicating a mediation effect.

Self-report Symptom Measures

To test the effect of training on self-reported anxiety, we compared mean anxiety on the BAT steps completed using an independent samples (Group: AMP, ACC) *t*-test. There was no significant difference between mean anxiety on the BAT steps completed in the AMP group [$M = 41.29$, $SD = 29.72$] and the ACC group [$M = 43.14$, $SD = 27.46$], $t(50) = .23$, $p > .81$. However, because participants in the AMP and ACC groups completed a different number of steps, they exposed themselves to differing degrees of stress, and hence the meaning of the mean anxiety score is compromised. Because all participants completed the first BAT step, we conducted additional analyses to compare self-reported anxiety on this step. Results revealed no significant difference between anxiety reported for the first BAT step in the AMP group [$M = 34.77$, $SD = 35.94$] and the ACC group [$M = 34.40$, $SD = 29.56$], $t(50) = .04$, $p > .96$.

Additionally, we conducted an independent samples *t*-test to compare STAI-State scores for the two groups post-training. Results did not show a significant difference between the groups, $t(50) = .50$, $p > .62$. Thus, our single-session AMP intervention did not result in a significant difference in self-reported anxiety symptoms as compared to the ACC group. However, the finding that STAI-State scores were not different between the groups indicates that the BAT results were not an epiphenomenon of mood change induced by the training.

Discussion

Attention training was effective in reducing attention bias to threat and increasing behavioral approach towards feared stimuli in individuals with contamination-related fears. Because groups did not differ in their level of anxiety or obsessive-compulsive symptoms post-training, but did differ in their level of attention bias for threat, we conclude that the difference between the two groups post-training reflects the creation of differing vulnerability to the behavioral challenge. This finding is consistent with previous research suggesting that attention training procedures affect vulnerability to laboratory stressors (e.g., working on an unsolvable anagram, giving a speech). Similar to the current study, Macleod et al. (2002) and Amir et al. (2008) found that groups did not differ in their levels of anxiety after the attention modification training procedure prior to the behavioral challenge, but that the training affected response to the anxiety-producing laboratory stressor. To our knowledge, the current study is the first to suggest that attention training can improve behavioral approach towards anxiety-producing stimuli. Furthermore, the current study is the first to show attention modification in individuals with obsessive-compulsive symptoms.

Results of our study suggest that a potential mechanism for the facilitation of behavioral approach towards feared stimuli is that the AMP task successfully enabled the participants to reduce their attention bias for threat-relevant information. If attention bias is causally involved in the maintenance of anxiety-related avoidance behaviors, then any procedure that normalizes this bias should also reduce avoidance. Consistent with this hypothesis, participants in the AMP group showed a reduction in their attention bias towards threat pre- to post- training and showed significantly less avoidance of feared stimuli. Moreover, the pre- to post-training change in attention bias mediated the association between AMP and performance on the behavioral approach test.

The behavioral approach test that we used for individuals with contamination-related concerns in the current study is similar to the public-speaking challenge for individuals with social anxiety in the earlier study by Amir et al. (2008) in that both tests comprise exposure to feared situations. As such, our finding that AMP resulted in better performance on the BAT is consistent with the finding in the earlier study that AMP resulted in better performance on the public-speaking challenge, as measured by the quality of the speeches (assessed by blind raters). The point of departure between the current study and the Amir et al. (2008) study is

their focus on self-reported anxiety and our focus on observable, behavioral approach. In the current study, we assessed self-reported anxiety at each step in the BAT and found that, although the AMP group completed a greater number of BAT steps than did the ACC group, there was no difference between mean anxiety ratings across the BAT steps completed by each group. This may reflect a difficulty inherent in the assessment of anxiety on the BAT measure: Because participants were allowed to terminate the BAT at any step, the AMP and ACC groups varied in the number of steps they completed, and because the measure of anxiety is necessarily yolked to the number of steps completed by each participant, it cannot be as informative a measure by itself. Alternatively, although we did not measure distress tolerance per se, it is plausible that AMP resulted in a reduction in behavioral avoidance by means of impacting a third variable, such as increasing the willingness to tolerate anxiety, rather than by means of reducing anxiety in the context of the behavioral challenge.

Our study has limitations. First, our findings are in a non-clinical sample and therefore may not generalize to individuals with a clinical diagnosis of OCD. Follow-up studies conducted with individuals with OCD would greatly improve the conclusions that can be drawn regarding the effectiveness of AMP in OCD. Second, the only measure of attention bias included in this study was provided by an assessment variant of the same task that was employed to manipulate attention. However, we used a novel set of stimuli for testing attention bias pre- and post-training. Nevertheless, future work should include different measures of attention bias (e.g., Posner cueing task, Posner, 1980; Fox, Russo, & Dutton, 2002; Yiend & Mathews, 2001) to examine the generalizability of attention training to other measures of attention. A third limitation of our study is that we did not administer a BAT pre-training. Given the brevity of our intervention, we were concerned that repeating the BAT within a short period would likely affect the results of the post-training BAT. Future studies should employ a multi-session design (e.g., Amir et al., 2009; Schmidt et al., 2009), which lends itself more readily to pre- and post-training administration of the BAT. Finally, we restricted our sample to the contamination subtype of OCD so that we could standardize our behavioral approach tests. It may be the case that our results generalize more readily to other forms of specific fear than to other symptoms of OCD. Additional research with the various OCD subtypes is needed to determine the generalizability of our findings for this heterogeneous disorder.

The above limitations notwithstanding, our study is the first to demonstrate the effects of an attention bias manipulation in individuals with obsessive-compulsive symptoms. Moreover, our results provide support for the effectiveness of attention modification procedures in decreasing observable avoidance behaviors. If replicated in a clinical sample of OCD patients, these findings may have promising implications for the treatment of OCD. The behavioral treatment of exposure with response prevention is considered the psychological treatment of choice for OCD, but a large percentage of patients are either resistant to this form of treatment or refuse it. Our preliminary results from the current study suggest that the behavioral approach required for exposure therapy may be facilitated by attention bias modification procedures.

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Figure 1.
Attention Bias score on the probe detection task by Group and Time

Table 1

Behavioral Approach Tests (adapted from Cougle et al., 2007)

	Dirty laundry	Dirt, dead insects, and cat hair mixture	Toilet seat
Step 1	Touch laundry with sheet of tissue	Touch mixture with a sheet of tissue	Touch toilet seat with a sheet of tissue
Step 2	Touch laundry with a finger	Touch mixture with a finger	Touch toilet seat with a finger
Step 3	Touch laundry with one hand	Touch mixture with one hand	Touch toilet seat with one hand
Step 4	Touch laundry with both hands	Touch mixture with both hands	Touch toilet seat with both hands
Step 5	Touch laundry, then touch arms and chest	Touch mixture, then touch arms and chest	Touch toilet seat, then touch arms and chest
Step 6	Touch laundry, then touch face	Touch mixture, then touch face	Touch toilet seat, then touch face

Table 2

Demographics and questionnaire data at baseline

	Group	
	AMP (n = 26)	ACC (n = 26)
% Female	81	88
Age	18.50 (1.42)	18.62 (1.17)
Education	12.68 (0.95)	13.15 (1.22)
MOCI Total	13.38 (3.81)	14.00 (4.23)
MOCI-Cleaning	6.15 (1.80)	6.15 (1.78)
STAI-State	39.11 (10.80)	39.16 (12.86)
STAI-Trait	41.23 (9.92)	41.40 (12.86)
BDI	13.12 (9.33)	12.46 (8.88)

MOCI = Maudsley Obsessive-Compulsive Inventory; STAI = Spielberger state trait anxiety inventory; BDI = Beck Depression Inventory