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The Effect of Modifying Automatic Action Tendencies on Overt Avoidance Behaviors

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Abstract

We used the Approach–Avoidance Task (AAT) to examine the role of automatic action tendencies. We hypothesized that, after manipulation of automatic action tendencies, participants would be more likely to approach feared objects when compared with participants in a control condition. Participants were instructed to push or pull a joystick, resulting in contamination-related and neutral pictures moving progressively away from or toward them, respectively. We manipulated approach by building a contingency between the arm movement and the picture type in the active condition but not in the control condition. Consistent with our hypothesis, participants in the active manipulation group showed facilitated automatic approach tendencies and reduced avoidance tendencies for contamination-related stimuli and completed more steps approaching their feared objects in a behavioral approach test compared with participants in the control group. Our results suggest that automatic action tendencies may play an important role in the maintenance of fear-related behavioral avoidance.

Keywords

training of automatic action tendencies; Approach–Avoidance Task; behavioral approach test

We approach desired objects and avoid undesired ones. Moreover, repeated approach toward an object induces positive evaluation of that object, whereas repeated avoidance of the same object induces negative evaluation (Cacioppo, Priester, & Berntson, 1993). Consistent with this observation, the reflective–impulsive model of behavior (Strack & Deutsch, 2004) states that stimuli from the environment elicit automatic evaluations that activate affectively congruent behavioral schemas of approach (associated with positive affect) and avoidance (associated with negative affect). These behavioral schemas can be assessed using overt action tendencies: arm flexion (approach—i.e., pulling toward oneself) and extension (avoidance—i.e., pushing away from oneself). Positive stimuli are associated with faster arm flexion than arm extension, whereas negative stimuli are associated with faster arm extension than arm flexion (e.g., Cacioppo et al., 1993; Solarz, 1960).

The Approach–Avoidance Task (AAT) coordinates arm movements with the size of an image on a computer screen. Pulling a joystick by arm flexion increases the size of the picture on the computer screen and pushing a joystick by arm extension decreases the size of the picture on the screen (Rinck & Becker, 2007). By asking participants to move the joystick in response to a feature of the display unrelated to its content (e.g., different colored

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borders surrounding the target stimuli) and measuring response latency for this movement, the AAT can capture relatively automatic action tendencies that may be outside conscious awareness.

Researchers have used variations of the AAT to measure automatic behavioral tendencies. In these studies, participants see pictures depicting either negative (e.g., frowning face for individuals with social anxiety, a dirty toilet for individuals with contamination fears) or neutral (household items, e.g., chair) objects. They are asked to pull a joystick toward themselves or push it away depending on a feature of the picture unrelated to its content. Consistent with the reflective–impulsive model (Strack & Deutsch, 2004), individuals with social fears (Heuer, Rinck, & Becker, 2007), spider fears (Rinck & Becker, 2007), and contamination fears (Najmi, Kuckertz, & Amir, 2010) are slower when pulling negative pictures toward themselves than when pulling neutral pictures. Hazardous drinkers (Wiers, Rinck, Dictus, & van den Wildenberg, 2009) on the other hand are faster when pulling alcohol-related pictures toward themselves than neutral pictures. In summary, there is evidence that the AAT is sensitive to automatic avoidance and approach behaviors.

Are these action tendencies a result of "pathological motive," or can they be generalized to "normal" populations? There are at least two reasons to believe that these approach and avoidance motives are general in nature. First, studies using unselected college students have shown that similar motives exist regarding diverse concepts such as race (Kawakami, Phills, Steele, & Dovidio, 2007), disease (Neumann, Hülsenbeck, & Seibt, 2004), famous/infamous persons (Marsh, Ambady, & Kleck, 2005), and so forth. Second, the reflective–impulsive model of behavior (Strack & Deutsch, 2004) concerns these motives in general and not simply in pathological states. It is, however, likely that to the extent that one experiences excessive fears or desire for an object, these automatic motives are also exaggerated. Thus, pathological populations make the ideal group to study the relationship between automatic motives and overt behaviors.

More recently, researchers have modified the AAT in order to experimentally induce an automatic approach or avoidance tendency with the aim of examining corresponding changes in overt behavioral tendencies. For example, Wiers, Rinck, Kordts, Houben, and Strack (2010) instructed participants to either push or pull pictures based on their format (portrait or landscape), and showed that by implicitly training participants to push mostly pictures of alcohol (presented in push format, e.g., portrait) and to pull mostly pictures of soft drinks (presented in pull format, e.g., landscape), it is possible to decrease approach bias from pre- to posttraining (see also Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). Similarly, researchers have also examined the effects of approach training on positive social behavior (Kawakami et al., 2007; Taylor & Amir, 2012), showing that manipulating automatic approach tendencies increased observable social behavior.

In summary, there is ample evidence for the relationship between automatic action tendencies and positive and negative stimuli. Moreover, manipulating automatic action tendencies affects social and drinking behaviors. However, studies have not examined the efficacy of automatic approach tendencies in increasing overt approach of negatively valenced items. Such a finding would have clear theoretical and practical implications. Moreover, if the mechanism of change in these training studies is change in automatic approach–avoidance, then it should be possible to demonstrate, through formal mediational analysis, that training exerts its influence on overt behavior through change in automatic approach tendencies.

In the current study, we examined the relationship between automatic approach tendencies and overt approach behavior of negative items by using the AAT in individuals with contamination fears. We hypothesized that the approach training of contamination-related pictures using the AAT would result in (a) faster pulling of novel contamination-related pictures, relative to neutral pictures; and (b) more steps completed in a contamination-related BAT when compared with participants in a control (i.e., no-contingency) condition. Finally, we hypothesized that approach index following training would mediate the relationship between group assignment and overt behavior.

Method

Participants

Participants were 44 individuals (approach training condition n = 22; control condition n = 22) who had "concerns about germs, dirt, or contamination." These participants were drawn from a pool of undergraduate students at a large university, screened on the basis of their score on the Maudsley Obsessional 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 2 standard deviations above the mean for the normal population (Emmelkamp, Kraaijkamp, & van den Hout, 1999). This resulted in a mean MOCI total score of 14.07 (SD = 4.13) and a mean MOCI–Cleaning subscale score of 6.32 (SD = 1.79) for our study sample.

Stimuli for AAT Assessment and Manipulation Tasks

The AAT comprised pictures of contamination-related scenes (e.g., dirty toilet, garbage) and neutral pictures (household objects) taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). Each contamination-related picture was matched to a paired neutral picture in terms of color and shape. We created two sets from 12 contamination-related and 12 neutral pictures (Sets A and B). Half of the participants in each group saw a particular picture set during the manipulation (e.g., Set A) and were tested using a different picture set (Set B). We divided the picture set used for assessment into two equal sets, with one subset used for premanipulation assessment and one subset used for postmanipulation assessment. Thus, each of the two assessments of action tendencies was conducted with a novel set of pictures, allowing us to test for generalizability of the manipulation. Moreover, the testing sets were counterbalanced across pre- and postmanipulation assessments. In addition, we asked participants to rate the emotionality of each picture from the two sets, from −3 ("Rate the picture in terms of its emotionality *for you personally*, not for people in general, that is, how disturbing the picture is for you") to +3 ("how pleasant is the picture *for you*").

Measures

Assessment AAT—We used the AAT to assess automatic action tendencies in response to contamination-related pictures and neutral pictures. Consistent with previous research using the AAT (e.g., Najmi et al., 2010), we used colored frames to guide the participants' direction of movement. All pictures were framed by a blue or green border in the experimental trials. To remain consistent with previous research, we included filler trials in which pictures were framed by a beige border, although these trials were not analyzed for the present study (cf. Kawakami et al., 2007). Participants were seated in front of a computer screen, with a joystick situated on the desk. Participants were told that they would see a series of pictures with different colored borders, and that for each picture they should pull the joystick if the border was green, push the joystick if the border was blue, and move it to the side if the border was beige. Thus, participants were asked to respond only to the color of the border framing each picture rather than to the content within the image itself. Half the pictures with each of the three border colors were contamination-related and half were neutral.

Participants completed 16 practice trials with a different set of neutral pictures than those used in the assessment. In the assessment task, participants completed 72 trials (3 Pictures × 2 Picture Type [contamination-related, neutral] × 3 Border Color [green, blue, beige] × 4 Repetition). Trials were presented in a new random order to each participant. To begin each trial, participants were required to press a button on the joystick that resulted in the appearance of a medium-sized picture in the center of the screen. In each trial, the pictures became increasingly larger if the participant pulled the joystick, simulating approach, and decreasingly smaller if the participant pushed the joystick, simulating avoidance. When the joystick reached approximately a 30° position in either direction, the picture disappeared, regardless of whether the participant responded correctly. For the filler trials in which participants moved the joystick to the side, the size of the picture remained constant. The next trial began when the joystick was brought fully back to the central position. Response latencies were calculated on the basis of the length of time the image remained on the screen, that is, from the time the picture appeared on the screen to the time it disappeared. To assess changes in automatic action tendencies, we administered the assessment AAT once before and once after the manipulation procedure.

Manipulation AAT—Pictures were framed by either a blue or a green border. There were no pictures with beige borders (filler trials) in the manipulation version of the AAT. As in the assessment AAT, participants were told that they would see a series of pictures with different colored borders, and that for each picture they should pull the joystick if the border was green and push the joystick if the border was blue. Participants completed 288 trials (6 Pictures × 2 Picture Type [contamination-related, neutral] × 2 Border Color [green, blue] × 12 Repetition). Trials were presented in a new random order to each participant. In the approach tendency training condition, participants pulled contamination-related pictures toward them during 92% of the pull trials and pushed neutral pictures away from them during 92% of the push trials. In the control condition, as in the assessment task described above, participants pushed and pulled contamination-related pictures and neutral pictures with equal frequency. In both active and control conditions, the total percentage of push and pull trials was 50%.

Behavioral approach test (BAT)—Our BAT was based on a previous study (Najmi & Amir, 2010) and adapted from Cougle, Wolitzky-Taylor, Lee, and Telch (2007). It comprised three different tests to assess avoidance of a variety of contaminants. The first test consists 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 test included a mixture of "dirt, dead insects, and cat hair." This mixture was made from potting soil, dead crickets, and cat hair. The third test involved a toilet that was made to look unclean with blotches of potting soil on the inside of the bowl. Each of the three BAT tests comprised six steps in a graduated hierarchy. 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 part of the BAT. This task has good psychometric properties (Najmi, Tobin, & Amir, 2012).

Procedure

Participants were randomly assigned to either the automatic approach training (n = 22) or the control (n = 22) condition. Condition assignment was determined using four numbers (one for each combination of condition and stimuli set) using 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 each participant's condition.

Participants first completed a demographics sheet and MOCI. Next, they completed the AAT assessment task, comprising 72 trials to assess automatic action tendencies premanipulation, followed by 288 trials for the AAT manipulation or control condition (depending on condition assignment), followed by 72 trials to assess automatic action tendencies postmanipulation. Thus, participants completed a total of 432 trials, which took less than 15 min to complete. The instructions for the AAT assessment and manipulation tasks were presented on the computer and were identical for the active manipulation and control conditions.

After completing the computer tasks, participants completed the emotionality ratings for the stimuli used in the computerized tasks. Next, they completed the BAT. Finally, participants were debriefed.

Results

Demographics and Baseline Data

To ensure that randomization created equivalent groups, we compared the participants in the two groups on demographics and obsessive–compulsive symptoms. Groups did not differ significantly on any of these measures (see Table 1).

Picture Stimuli Ratings

To check that participants differed in their ratings of neutral versus contamination-related pictures and to examine potential differences based on group or stimuli set, we conducted a 2 (group: active manipulation condition, control condition) × 2 (picture type: contamination-related, neutral) × 2 (stimuli set: A, B) analysis of variance (ANOVA) with repeated measurement on picture type. This analysis revealed a main effect of stimuli set, $F(1, 40) = 4.30$, $p < .05$, and a main effect of picture type, $F(1, 40) = 467.38$, $p < .001$, such that participants rated contamination-related pictures as more personally disturbing than neutral pictures (mean contamination = −2.34, $SD = 0.44$; mean neutral = 0.60, $SD = 0.71$). No other significant effects were found (ps > .19). Because stimuli set did not interact with any variables of theoretical interest to the current study, we did not conduct additional analyses with this factor.

Assessment AAT

We removed inaccurate response trials from analyses (premanipulation assessment: 2.5%; postmanipulation assessment: 3.2%). We also removed response time outliers by eliminating response latencies less than 100 ms or greater than 2,000 ms (5.7% of trials from premanipulation assessment and 3.7% of trials from postmanipulation assessment; Ratcliff, 1993). Mean number of excluded trials did not differ between the active and control groups for premanipulation assessment (active manipulation group: 4 trials; control group: 3 trials), $t(42) = 1.03$, $p = .30$, or for postmanipulation assessment (active manipulation group: 3 trials; control group: 2 trials), $t(42) = 1.04$, $p = .30$. Accuracy rates also did not differ between groups for postmanipulation assessment, $t(42) = -1.56$, $p = .13$ (mean accuracy for active manipulation group = 96%; mean accuracy for control group = 98%). However, groups did differ in accuracy rate for premanipulation assessment, $t(42) = -2.21$, $p = .03$ (mean accuracy for active manipulation group = 97%; mean accuracy for control group = 99%).

Table 2 presents response latencies by picture type (contamination-related, neutral), response direction (push, pull), and time (premanipulation, postmanipulation) for each group. At premanipulation, groups did not differ on any of their four reaction time scores (pushing/pulling of contamination-related/neutral pictures).

Consistent with previous research, we also computed separate AAT indices for each response direction. For pull trials, the bias index was based on the hypothesis that individuals with contamination fears should be faster when pulling neutral pictures toward themselves than when pulling contamination-related pictures toward themselves. Therefore, we subtracted response latencies for neutral trials from response latencies for contamination trials, with larger scores indicating greater difficulty approaching contamination-related pictures than neutral pictures.

For push trials, the bias index was based on the hypothesis that individuals with contamination fears should be faster when pushing contamination pictures away from themselves than when pushing neutral pictures away from themselves. Therefore, we subtracted response latencies for neutral trials from response latencies for contamination trials, with smaller scores indicating more avoidance of contamination-related pictures than neutral pictures.

Participants' pull bias scores at premanipulation differed from zero, $t(43) = 1.98$, $p = .06$, but this difference was only marginally significant. Participants did not demonstrate a push bias that differed from zero at premanipulation, $t(43) = 1.12$, $p = .27$.

To examine the effects of our manipulation, we submitted median response latencies to a 2 (group: active manipulation condition, control condition) × 2 (time: premanipulation, postmanipulation) × 2 (picture type: contamination-related, neutral) × 2 (response direction: pull, push) ANOVA with repeated measurement on time, picture type, and response direction. Results revealed a significant Group × Time × Picture Type × Response Direction interaction, $F(1, 42) = 8.90$, $p < .01$, $\eta_p^2 = .18$. The main effects of time, $F(1, 42) = 29.66$, $p < .001$, $\eta_p^2 = .41$, picture type, $F(1, 42) = 16.71$, $p < .001$, $\eta_p^2 = .29$, and response direction, $F(1, 42) = 56.47$, $p < .001$, $\eta_p^2 = .57$, were significant. No other main or interaction effects were significant.

To simplify the four-way interaction, we submitted AAT bias scores to a 2 (group: active manipulation condition, control condition) × 2 (time: premanipulation, postmanipulation) × 2 (response direction: pull, push) ANOVA with repeated measurement on time and response direction. Results revealed a significant Group × Time × Response Direction interaction, $F(1, 42) = 8.90$, $p < .01$, $\eta_p^2 = .18$, and a significant Group × Response Direction interaction, $F(1, 42) = 4.00$, $p = .05$, $\eta_p^2 = .09$. No other main or interaction effects were significant.

To follow up the three-way interaction, we submitted AAT bias scores to a 2 (group: active condition, control condition) × 2 (response direction: pull, push) repeated measures ANOVA separately for each time point. For preassessment, the main effect of group was not significant, $F(1, 42) = 0.85$, $p = .36$, $\eta_p^2 = .02$, nor was the main effect of response direction, $F(1, 42) = 0.76$, $p = .39$, $\eta_p^2 = .02$, or the Group × Response Direction interaction, $F(1, 42) = 0.64$, $p = .43$, $\eta_p^2 = .02$.

However, for postassessment, there was a significant Group × Response Direction interaction, $F(1, 42) = 12.24$, $p < .01$, $\eta_p^2 = .23$. The main effect of response direction was not significant, $F(1, 42) = 1.40$, $p = .24$, $\eta^2_p = .03$, nor was the main effect of group, $F(1, 42) = 0.28$, $p = .60$, $\eta^2_p = .01$. Simple effects revealed that the active manipulation group showed significantly smaller AAT pull bias at postmanipulation than did the control group, $t(42) = -2.76$, $p < .01$, $d = 0.85$. Groups also differed in AAT push bias postmanipulation, $t(42) = 2.15$, $p = .04$, $d = 0.66$, such that the active manipulation group showed less avoidance of contamination pictures, relative to neutral pictures, compared with the control group. Furthermore, within-group comparisons showed that the active group demonstrated a significantly greater AAT push bias than AAT pull bias postmanipulation, $t(21) = -3.24$, $p < .01$, whereas the control group did not, $t(21) = 1.67$, $p = .11$.

We also examined effects of the manipulation within each group in terms of bias change from pre- to postmanipulation. In the active condition, participants displayed a marginally significant reduction in AAT pull bias scores from pre- to postmanipulation, $t(21) = 1.87$, $p = .08$, and a significant change in AAT push bias scores, $t(21) = -2.58$, $p = .02$. In the control condition, participants' bias scores did not change from pre- to postmanipulation for either pulling, $t(21) = -0.68$, $p = .51$, or pushing, $t(21) = 0.67$, $p = .51$.Figure 1 presents participants' AAT pull and push bias scores pre- and posttraining for the active manipulation and control conditions.

Performance on Behavioral Approach Tests

To test our hypothesis concerning the effect of the manipulation on overt behavioral approach in the BAT, we conducted a 2 (group: active manipulation condition, control condition) × 3 (BAT type: BAT1, BAT2, BAT3) ANOVA with repeated measurement on the second factor. The main effect of group was significant, $F(1, 42) = 4.69$, $p = .04$, $\eta^2_p = .10$. Participants who completed the active manipulation task completed significantly more steps on the BATs (63% of total steps for the three BATs) than did participants who completed the control task (42%). The main effect of BAT type was also significant, $F(2, 84) = 14.99$, $p < .001$, $\eta^2_p = .26$. However, the Group × BAT Type interaction was not significant, $F(2, 84) = 0.47$, $p = .62$, $\eta^2_p = .01$. Participants who completed the active manipulation task completed 69% of steps in the dirty laundry BAT, 67% of steps in the BAT with the dirt, dead insects, and cat hair mixture, and 52% of steps in the dirty toilet BAT, whereas participants who completed the control task completed 51% of steps in the dirty laundry BAT, 48% of steps in the mixture BAT, and 26% of steps in the dirty toilet BAT.

Mediational Analyses

We hypothesized that the difference between speed of pulling contamination-related pictures and pulling neutral pictures (i.e., AAT pull bias) postmanipulation would mediate the relationship between experimental condition and percentage of steps completed in the BAT. To test this hypothesis, we conducted a mediation analysis following the procedure described by MacKinnon, Fritz, Williams, and Lockwood (2007). The MacKinnon et al. procedure tests the product of the coefficients for the effects of (a) the independent variable (group: active manipulation condition, control condition) to the mediator (AAT pull bias postmanipulation; α path: β = .39, *SE* = .14), and (b) the mediator to the dependent variable (performance on the BAT) when the independent variable is taken into account (β path: β= −.33, *SE* = .15). This procedure is a variation on the Sobel (1982) test that accounts for the nonnormal distribution of the αβ path through the construction of asymmetric confidence intervals. Results revealed that the 95% confidence interval of the indirect path (αβ) did not overlap with zero for performance on the BAT (lower limit = −0.31, upper limit = −0.01), indicating a mediation effect. Thus, consistent with our hypothesis, the difference in pulling contamination-related versus neutral pictures postmanipulation mediated the relationship between AAT manipulation condition and percentage of steps completed in the BAT.

Discussion

In the current study, we found that manipulating automatic approach tendencies was effective in facilitating automatic approach of novel contamination-related pictures. Moreover, AAT manipulation affected overt behavioral approach toward feared stimuli on a BAT, such that individuals with greater automatic approach tendencies (i.e., faster response latencies for pulling contamination-related pictures) following the manipulation also demonstrated more overt approach behaviors. To our knowledge, this is the first study to show that automatic action tendencies can be experimentally modified and affect overt behavioral approach toward negatively valanced stimuli. Our mediation results suggest that a potential mechanism of overt behavioral avoidance of feared items may be an inhibited automatic approach tendency and that manipulation of this mechanism can change overt behavior. However, we note that meditational analyses are limited in their ability to demonstrate causation, as temporal precedence—a prerequisite for causality—is missing when the manipulation and the mediator are measured at the same time.

Our results are consistent with extant research using the AAT to assess and to modify automatic action tendencies. That is, there is now ample evidence that negatively valenced items (Heuer et al., 2007; Najmi et al., 2010; Rinck & Becker, 2007) result in slower arm flexion than neutral items. Similarly, positively valenced items result in faster arm flexion (Wiers et al., 2009). Our results replicate and extend earlier work in this area.

Our results have clinical implications. If automatic action tendencies are involved in the maintenance of anxiety-related overt behaviors, then any procedure that normalizes this bias should also facilitate approach. Consistent with this hypothesis, participants in the active manipulation group showed a facilitated automatic approach bias toward threat and showed significantly greater approach toward feared stimuli. Moreover, this bias in action tendencies mediated the association between manipulation group and performance on the BAT. Just as alcoholism is characterized by the presence of automatic approach action tendencies for alcohol, as assessed by an AAT (Wiers et al., 2009), contamination-related fears are characterized by reduced automatic approach action tendencies for contamination-related stimuli on an AAT, relative to controls (Najmi et al., 2010).

In contrast to the procedure used by Wiers and colleagues (2010,2011) that was designed to increase automatic avoidance for alcohol-related information, we were able to increase automatic approach tendency for contamination-related stimuli in individuals with contamination-related symptoms. Given the diverse populations and the direction of training of automatic tendencies in these studies, they provide strong support for the role of automatic action tendencies in determining overt behavior. Moreover, given the evidence for biased automatic action tendencies assessed by the AAT in other forms of anxiety, such as spider phobia (Rinck & Becker, 2007) and social anxiety (Heuer et al., 2007), the success of our manipulation holds promise for the utility of AAT training in facilitating automatic approach action tendencies in clinical anxiety.

In the present study, at postmanipulation, groups differed on AAT push bias as well as AAT pull bias. We note that caution is needed in interpreting these differences in push bias, as our manipulation was designed to facilitate approach of contamination-related stimuli (i.e., pulling) rather than to affect response latencies for pushing contamination-related stimuli. This training was based on previous literature suggesting differences between individuals with contamination symptoms and controls in speed of pulling, but not in pushing, contamination-related pictures (Najmi et al., 2010). Thus, group differences in push bias at postmanipulation likely resulted from the active group being faster at pushing neutral pictures (770 ms; see Table 2) relative to the control group (873 ms). Future research should examine the utility of directly manipulating response latencies for pushing contamination-related stimuli.

Our study has limitations. For example, the control group was significantly more accurate in its premanipulation responses than was the active group. This difference between highly accurate responses in both groups likely reflects small variability in accuracy rates. Although not significant ($p = .14$), the active group had slightly higher MOCI total scores than the control group (*Ms* = 15.00 and 13.14, respectively). Despite higher obsessive–compulsive symptoms in the active group, training was still effective and participants completed more BAT steps, relative to the control group with slightly lower scores. Thus, this difference in MOCI scores worked against our hypothesis. Finally, we did not check for participants' awareness of group assignment or picture type response contingencies. It is possible that awareness of such contingencies may have influenced the training group.

The above limitations notwithstanding, our study is the first to demonstrate the effect of training automatic action tendencies on overt behavioral approach in individuals with contamination fears. Moreover, our results provide support for the effectiveness of this AAT manipulation procedure in increasing observable approach behaviors.

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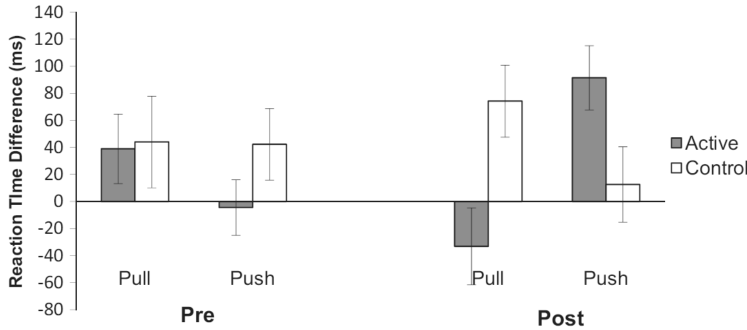

Figure 1.
Approach–Avoidance Task pull and push bias scores by group and time. Bias scores for both response directions are calculated as follows: response latency for contamination-related pictures – response latency for neutral pictures. Higher pull bias scores indicate greater relative difficulty approaching threat, whereas smaller push bias scores indicate greater relative avoidance of threat.

Table 1

Demographics and Questionnaire Data at Baseline

Variable	Group: Active manipulation (*n* = 22)	Group: Control (*n* = 22)	
Female (%)	68	55	$\chi^2(1) = 0.86$, $p = .35$
Mean (*SD*) age (years)	19.09 (1.88)	18.82 (1.05)	$t(42) = 0.60$, $p = .56$
Mean (*SD*) education (years)	13.59 (1.40)	13.23 (1.19)	$t(42) = 0.93$, $p = .36$
MOCI total	15.00 (4.93)	13.14 (2.98)	$t(42) = 1.52$, $p = .14$
MOCI–Cleaning	6.27 (1.91)	6.36 (1.71)	$t(42) = -0.17$, $p = .87$

Note. MOCI = Maudsley Obsessional Compulsive Inventory.

Table 2

Response Latencies (ms) by Picture Type, Response Direction, Time, and Group

			Group	
Picture type	**Response direction**	**Time**	**Active manipulation *M* (*SD*)**	**Control *M* (*SD*)**
Contamination	Pull	Pre	1,033 (186)$_a$	1,082 (180)$_a$
		Post	880 (141)$_a$	1,018 (192)$_b$
	Push	Pre	884 (157)$_a$	961 (195)$_a$
		Post	861 (152)$_a$	886 (154)$_a$
Neutral	Pull	Pre	994 (200)$_a$	1,038 (151)$_a$
		Post	913 (125)$_a$	944 (171)$_a$
	Push	Pre	888 (190)$_a$	919 (156)$_a$
		Post	770 (95)$_a$	873 (148)$_b$

Note. Within rows, means with different subscripts are significantly different between active and control conditions ($p < .01$).