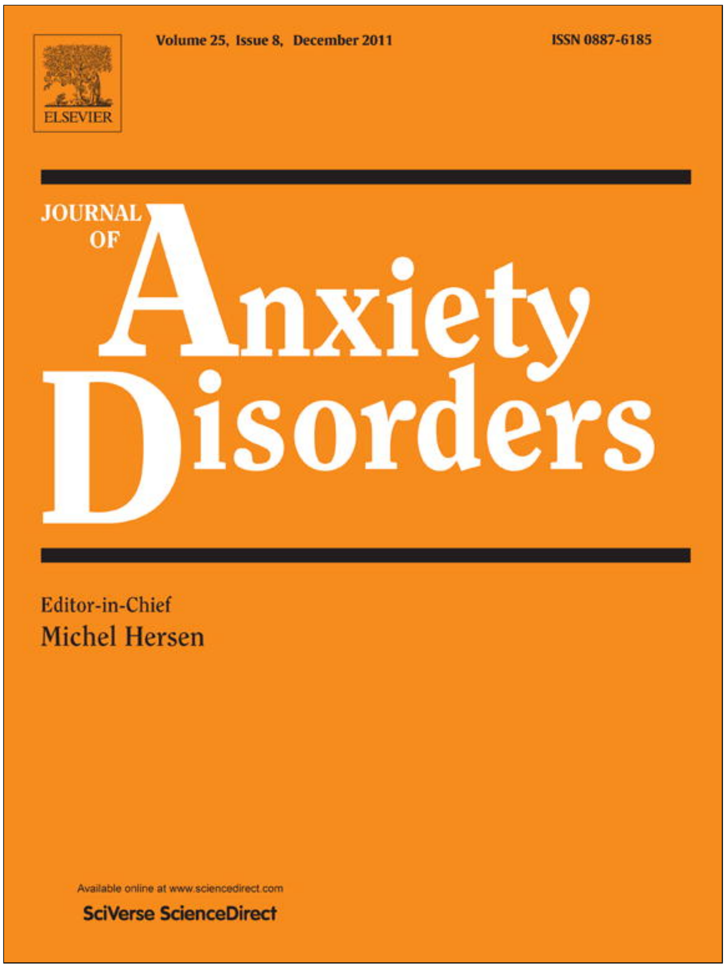
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How does attention training work in social phobia: Disengagement from threat or re-engagement to non-threat?

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ABSTRACT

Social phobics exhibit an attentional bias for threat in probe detection paradigms. Attention training, whereby probes always replace non-threat in a display presenting both threat and non-threat, reduces attentional bias for threat and social anxiety. However, it remains unclear whether therapeutic benefits result from learning to disengage attention from threat or learning to orient attention towards non-threat. In this experiment, social phobics were randomly assigned to one of four training conditions: (1) disengagement from threat, (2) engagement towards non-threat, (3) disengagement from threat and re-engagement towards non-threat, and (4) a control condition. Effects were examined on subjective and behavioral responses to a subsequent stressor. Data revealed that training to disengage from threat reduces behavioral indices of anxiety. Engagement towards non-threat faces did not have effects in itself. These results support that the difficulty in disengaging attention from threat is a critical process in maintenance of the disorder.

1. Introduction

Most cognitive models of anxiety propose that selective attention to threat cues contributes to development and maintenance of emotional disorders (e.g., Mathews & MacLeod, 1994). For people with social phobia, these cues include threatening facial expressions displaying anger or disgust, and words signifying social threat (e.g., humiliation). In probe detection and probe discrimination tasks, individuals with social anxiety or social phobia respond faster to probes replacing these cues than to probes replacing neutral cues, thereby exhibiting an attentional bias for threat that is absent in nonanxious control individuals (e.g., Mogg, Philippot, & Bradley, 2004; Pishyar, Harris, & Menzies, 2004).

Recent studies have attempted to dismantle this bias to identify which attention component underlies it. Most of these studies used the modified Posner (1980) spatial cueing task, in which a threat (or non-threat) cue appears on either the left or right side of a computer screen, followed by a probe that either replaces the cue or appears on the other side of the screen (e.g., Amir, Elias, Klumpp, & Przeworski, 2003; Fox, Russo, Bowles, & Dutton, 2001). These studies showed that anxious participants are no faster to respond to probes replacing threat than non-threat cues, but they are slower to respond to probes that appear opposite to threat cues relative to non-threat ones. This pattern of results suggests that anxious participants have difficulty disengaging attention from threat (e.g., Amir et al., 2003), rather than being faster to engage attention to threat.

Attentional bias for threat has clinical consequences. Its re-emergence predicts return of anxiety at follow-up among patients treated for generalized anxiety (Mogg, Bradley, Millar, & White, 1995) and social phobia (Lundh & Öst, 2001). Moreover, threat-related bias causally influences vulnerability to anxiety (MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002). Using a dot-probe detection task, MacLeod and colleagues trained non-anxious participants to attend either to neutral or to threatening stimuli. The task comprised 672 trials in which pairs of words (one threatening and one neutral) appeared on a computer screen. In the attend-to-threat condition, probes replaced threat words, whereas in the attend-to-neutral condition, probes replaced neutral words. Participants pushed a button as soon as they detected the probe. Relative to those trained to attend to neutral material, participants trained to attend to threat material reported more anxiety and negative mood after performing a stressful anagram task. This study provides causal evidence that selective attention to negative information increases anxiety reactivity to an experimental stressor.

Regarding social anxiety, Li, Tan, Qian, and Liu (2008) have observed that 7-days of attention training towards positive faces

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diminished attentional bias for negative faces. Moreover, such training reduced self-reported fear of social interaction. Similarly, Amir, Weber, Beard, Bomyea, and Taylor (2008) trained, in a single-session, socially phobic individuals either to attend to neutral faces or to a control task in which there were no contingency between probe and cues. As compared to the latter condition, the former reduced anxiety in response to an impromptu speech. Blind raters judged the speeches of those in the non-threat attention training group more positively than those of the control group. Further, using a modified Posner paradigm after attention training, these authors observed that improvement in the ability to disengage attention from threat mediated the effects of the training on anxiety reactivity, and that this decrease in anxiety, in turn, improved speech performance. Recently, Heeren, Reese, McNally, & Philippot (submitted for publication) have fully replicated these observations and extended these findings to sympathetic activation to stressors occurring after the training. They reported that change in attentional bias occurring after attention training mediated changes in skin conductance reactivity to an impromptu speech. Likewise, Schmidt, Richey, Buckner, and Timpano (2009) have observed that training individuals with social phobia to attend to neutral faces led to a significant reduction in social anxiety and trait anxiety, in comparison to a control group. At a 4-month follow-up, the treatment group had improved further on measures of anxiety. Amir et al. (2009) have replicated these results.

These studies suggest that reducing attentional bias for threat in social phobia diminishes emotional vulnerability to subsequent social stressors. However, uncertainty remains regarding the mechanisms that mediate the reduction of emotional vulnerability via attention training. According to Amir et al. (2008), the improvement in the ability to disengage attention from threatening stimuli mediates the reduction of emotional reactivity to stressors (disengagement hypothesis). As mentioned above, studies show that anxious participants are no faster to respond to probes replacing threat as compared to non-threat cues. However, they are slower to respond to probes that appear opposite to threat cues as compared to non-threat cues, implying difficulties in disengaging attention from threat (e.g., Amir et al., 2003; Fox et al., 2001). Hence, disengagement difficulty would be the underlying process mediating attentional bias for threat in the probe detection and probe discrimination paradigms.

An alternative account is based on results of MacLeod et al. (2002) and Li et al. (2008). According to this explanation (the counter-bias hypothesis), the development of a counter-bias during training, in which attention is trained to be oriented towards non-threat cues, constitutes an alternative explanation. For instance, Li et al. (2008) have observed that training socially anxious individuals to focus more on positive faces reduces bias towards threatening faces but increases attentional bias towards non-threat cues. The therapeutic benefits of attention training would thus result from orienting attention towards non-threat cues. In other words, the critical component of attentional training would be the reallocation of attention towards non-threat rather than the disengagement from threat.

Finally, one cannot exclude the possibility that both processes (disengagement from threat and attention allocation to non-threat) are necessary for attentional training to be effective. Indeed, it could be argued that attention allocation to non-threat is only possible if one can disengage from threat.

However, to date, paradigms used do not allow us to determine the process of change. The present double-blind experiment addresses this question by crossing the presence/absence of disengagement from threat and allocation to non-threat in four different attention training conditions. Participants diagnosed as having generalized social phobia were randomly assigned to one of four attention training conditions: (1) disengaging attention from threat cues, (2) only attending to non-threat cues, (3) disengaging attention from threat cues and re-engaging it to non-threat cues, or (4) control condition (i.e., no contingencies between cues and probes).

If the disengagement hypothesis is true, participants who are trained to disengage their attention from threat cues, and those trained to disengage it from threat cues and re-engage it to non-threat cues, should show more reduction in anxiety than the two other groups. Indeed, these two conditions share the same process: attentional disengagement from threat cues. In contrast, if the counter-bias hypothesis is true, participants who are trained to engage attention to non-threat and those trained to disengage it from threat cues and re-engage it to non-threat cues should show more reduction in anxiety than the two other groups. Indeed, these two conditions share the same process: engagement of attention to non-threat cues. Finally, if attention training involves both disengagement from threat cues and the re-engagement to non-threat cues, we expect a significant decrease of anxiety for participants in this condition only.

2. Method

2.1. Participants

We recruited 79 individuals with a primary DSM-IV (American Psychiatric Association, 1994) diagnosis of Generalized Social Anxiety Disorder from the Université catholique de Louvain community. A total of 398 volunteers responded to our invitation to take part in an investigation of the mechanisms underlying social interaction among shy people. Eighty-nine individuals met the initial eligibility criteria assessed via a screening questionnaire (i.e., Liebowitz Social Anxiety scale, Liebowitz, 1987) and subsequently completed a structured interview to assess diagnostic eligibility. The Mini International Neuropsychiatric Interview (MINI; Lecrubier, Weiller, Bonora, Amorin, and Lépine (1998), a structured interview assessing specific DSM-IV axis I disorders, was used for diagnostic eligibility. One clinical psychologist administered the MINI. A second independent clinical psychologist rated a randomly selected portion of the interview (15%). Inter-rater agreement for the diagnosis was good ($\kappa = .83$). Ten of the 88 pre-selected volunteers met criteria for other diagnoses than social anxiety disorder and one declined to participate. The remaining 79 participants only met the DSM-IV diagnosis of Social Anxiety Disorder and were included in the study; their characteristics are displayed in Table 1. We obtained written informed consent from each participant.

In addition to the DSM-IV diagnosis of Social Anxiety Disorder, all participants had to fulfil several inclusion criteria: (a) no current substance abuse or dependency, (b) no current heart, respiratory, neurological problems or use of psychotropic medications, (c) no current psychological or psychiatric treatment and (d) normal or corrected-to-normal vision. Each participant was tested individually in a quiet room and all sessions were completed in the same laboratory. Participants received compensation (5 euros and a lottery ticket) for their participation. The study conformed to the ethical standards of the American Psychological Association.

2.2. Materials

2.2.1. Attention training stimuli

We randomly selected 70 face pairs without hairlines (35 men, 35 women) from the Karolinska Emotional Directed Faces database (Lundqvist, Flykt, & Öhman, 1998), which is a standardized set of emotional expressions. The faces displayed either threatening (i.e., disgust) or neutral facial expressions. We chose disgust faces as threat cues for several reasons. First, previous studies have found that socially anxious individuals exhibit an attentional bias

Table 1
Participants' characteristics as a function of group allocation (standard deviations in parentheses).

	Disengage/Re-engage	Disengage	Re-engage	Control
n	20	22	18	19
Age	22.50 (5.75)	20.95 (2.34)	20.72 (2.39)	21.89 (2.18)
% Female	70.00	63.90	50.00	78.90
Years of education	10.50 (1.54)	9.91 (2.25)	11.22 (1.31)	10.37 (2.50)
BDI-II	12.80 (7.96)	12.86 (7.35)	17.33 (10.47)	13.68 (5.907)
STAI-T	34.80 (4.41)	35.36 (5.27)	37.39 (7.38)	34.00 (3.97)
LSAS	78.90 (16.18)	75.09 (16.18)	86.39 (22.678)	75.58 (12.33).

Note. BDI-II is Beck Depression Inventory-II, STAI-T is Spielberger State-Trait Anxiety Inventory-Trait; LSAS is Liebowitz Social Anxiety Scale.

towards disgust faces (Pishyar et al., 2004). Second, disgust conveys a message of aversion or rejection (e.g., Rozin, Lowery, & Ebert, 1994), a central concern of individuals with social phobia (American Psychiatric Association, 1994). Finally, previous studies indicating the effectiveness of attention training programs in reducing attentional bias towards threat cues in social anxiety have used faces expressing disgust as threatening stimuli. We thus used disgust faces to remain consistent with previous work.

2.2.2. Attention bias assessment stimuli

The stimuli used for the attention bias assessment task (modified Posner task) were eight social threat words (e.g., stupid, humiliation, embarrassed) and eight neutral words (e.g., book, radiator, procession). These proportions were based on previous studies on attentional bias in social anxiety (e.g., Amir et al., 2010). Word types were matched on frequency and usage in French (Lambert & Chesnet, 2001; New, Pallier, Ferrand, & Matos, 2001). There was no significant difference in word length between social threat and neutral words, $t(14) = .44$, $p > .66$, $d = .23$. We used words, rather faces, in the assessment trials in order to show that the effects of training with one type of stimuli can be generalized to another type of stimuli.

2.3. Measures

2.3.1. Questionnaires

Participants were selected according to their responses on the Liebowitz Social Anxiety Scale (LSAS; Liebowitz, 1987). Participants were also asked to complete the Trait Anxiety Inventory (STAI-Trait; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) and the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) at the beginning of the first training session.

The LSAS is a 24-item scale that measures the anxiety induced by, and the avoidance of, social interaction and performance situations. Yao et al. (1999) have reported good psychometric properties of the French adaptation of the scale. Recently, the structural validity of the French version has been demonstrated (Heeren, Maurage, et al., submitted for publication). Cronbach's alpha in the current sample was .91.

The STAI-Trait is a 20-item self-report questionnaire assessing anxiety trait vulnerability. Bruchon-Schweitzer and Paulhan (1993) have reported good psychometric and structural properties of the French adaptation of the scale. Cronbach's alpha in the current sample was .84.

The BDI is a 21-item self-report measure of symptoms of depression. Beck et al. (1996) have reported good psychometric and structural properties of the French adaptation of the scale. Cronbach's alpha in the current sample was .80.

2.3.2. Visual analogue scales

To assess level of negative mood and anxiety states at baseline, at post-training and during the stress phase, participants completed two visual analogue scales on a computer. Each scale consisted of a 740-pixel horizontal line. One was an anxiety scale anchored from *relaxed* to *anxious* and the other was a mood scale anchored from *happy* to *depressed*. Previous work on attention training has used similar scales (e.g., MacLeod et al., 2002). To complete theses scales, participants used the mouse to move a cursor along the line corresponding to their current state. This yielded a score between 0 and 740 pixels, depending on which point on the line was selected. For each response, the presentation order of the scales and localization of the anchor label (i.e., from happy to relaxed vs. from relaxed to happy) were randomised.

2.3.3. Measure of attention bias

For assessing effects of training on attention to threat cues, participants were asked to complete an independent measure of attention bias at baseline and post-training. We used a modified version of the Posner spatial cueing task identical to that reported in Amir et al. (2008). Words were presented in lowercase (5–8 mm in height) white letters against a black background in the center of the screen. Social threat or neutral cue words appeared in one of two locations on the computer screen (i.e., rectangles located to the right or left of a central fixation cross), thereby directing attention to one of two screen locations (i.e., right or left). After 600 ms, the cue word disappeared, and participants were instructed to detect a probe ("*") that immediately appeared in one of the two locations. The probe remained onscreen until the participant responded, and response latencies were recorded from the onset of the probe to the button press. The inter-trial interval from the target offset to the next fixation cross was 1650 ms. On some trials, the cue word was valid (i.e., the probe appeared in the same location as the cue word). On other trials, the cue word was invalid (i.e., the probe appeared in the location opposite to the cue word).

Participants were exposed to 192 experimental trials, two thirds of which were validly cued (128 = 8 words × 2 word types × 2 word positions × 4 repetitions), one sixth were invalidly cued (32 = 8 words × 2 word types × 2 word positions), and one sixth were uncued (32 = 8 words × 2 word types × 2 word positions). The decision to use these proportions was based on previous research (Stormark, Nordby, & Hugdahl, 1995). Trials were presented in a different random order for each participant.

Participants completed four practice trials (including four neutral words) prior to the experimental trials. During the practice trials, participants received feedback regarding the accuracy of their response. Feedback was not provided during the experimental trials. Participants sat approximately 30 cm from the computer screen. In previous research using this task (e.g., Amir et al., 2003), socially anxious participants showed significantly longer response latencies on invalid cued social threat trials compared to non-anxious controls, suggesting that an attentional bias may be due to difficulty in disengaging from threatening stimuli.

2.3.4. Speech task

We administered a speech task to assess self-report and behavioral responses to a social stressor at baseline and post-training. Each participant began the task, sitting in a comfortable chair 30 cm from a computer screen. A set of instructions then appeared and displayed a list of five topics that were widely discussed in the national media at the time of data collection (i.e., global warming, the AH1N1 vaccination program, wearing of the Islamic veil in high-school, alcohol prohibition among minors, the come-back of a former Prime Minister on the national political scene). They were asked to choose one of the five topics. There were no significant choice differences in topics among conditions, χ^2 (3, N = 79) = 15.44, p > .21. The next screen informed participants that they would have to make a 2-min speech about their chosen topic and that their performances would be video-recorded. They were given 2 min to prepare and a sheet of paper to write down their notes; however, they were told that they would not be allowed to use these notes during the speech. After participants had prepared their speech, they were directed to stand in front of a video camera in another room. Just before starting the speech, the experimenter asked participants to rate their mood and level of situational anxiety using computerized visual analogue scales. The participants then performed the speech while being videorecorded.

Speech performance was rated by two independent judges blind to the hypotheses of the present study, who each had at least three years of CBT training. The rating scale was the Behavioral Assessment of Speech Anxiety (BASA; Mulac and Sherman, 1977), which includes 18 molecular categories (e.g., having a clear voice; searching for the words). The total score of these categories has shown excellent concurrent validity with experts' ratings of speech anxiety (Mulac and Sherman, 1977). As the inter-rater reliability of the total score was high (r = .94), a mean score of the two raters was computed. Internal consistency of the present data was good (α = .79).

2.4. Attention training

Attention training consisted of a standard probe discrimination task, modified to promote either: (1) the re-engagement to non-threat cues without disengagement from threat cues (Re-engage condition), (2) the disengagement from threat cues without re-engagement to non-threat cues (Disengage condition), (3) the disengagement of attention from threat cues and the re-engagement to non-threat cues (Disengage/Re-engage condition), or (4) Control condition. According to the condition, a fixation cross-appeared during 500-ms followed either by one or two facial expressions presented for 500 ms. Then a probe appeared (i.e., a white arrow), pointing either up or down. The probe remained onscreen until the participant indicated the direction of the arrow by pressing the corresponding button. The inter-trial interval was 1500 ms.

In the disengage condition, only one threatening face appeared, followed by an arrow in the location opposite to the threatening face on 95% of the trials. In the Re-engage condition, a single non-threatening face was presented followed by an arrow in the location of the non-threatening face on 95% of the trials. In the Disengage/Re-engage condition, a neutral and a threatening face appeared followed by an arrow in the location previously occupied by the neutral face on 95% of the trials. In the control condition, there were threatening and non-threatening faces and no contingency between cues and probes.

Participants completed 560 trials in one block. Each of the 70 identity-faces was presented four times, either presented alone expressing a neutral face, or presented alone expressing a disgust face, or both simultaneously (according to the condition). This allowed all combinations of the locations and probe types to be represented, and this procedure was repeated 2 times (i.e., 560 = 70 stimuli × 2 positions × 2 arrow directions × 2 repetitions). Instructions were presented on the computer and were identical for all conditions. Faces were positioned 4 cm from the top/bottom of the screen, 8 cm from the ipsi-lateral edge, 22.5 cm from the contro-lateral edge, and centered vertically. Each face was 7.5 cm tall by 7.5 cm wide.

2.5. General procedure

The procedure was based on a previous study examining the effect of a single-session of attention training on reactions to performing a speech in social anxiety (Amir et al., 2008). Participants were randomly assigned to one of the four conditions. The participants and the experimenters were blind to condition. Participants first completed a demographic questionnaire, the STAI (Trait version) and the BDI-I, and the anxiety and depression visual analogue scales. Next, they were asked to complete the modified Posner spatial cueing task, which provided a baseline index of attention bias. Participants then completed the training task. The training task lasted around 30 min. After completing the training, participants filled in the second anxiety and depression visual analogue scales to assess the immediate effect of the training task on participants' mood and anxiety. Next, participants completed the second modified Posner spatial cueing task to examine the influence of attention training on an independent measure of attention bias. Finally, participants were completed the speech task, including the third anxiety and depression visual analogue scales and the video-recorded performance. Participants were fully debriefed at the end of the experiment.

3. Results

3.1. Group equivalence

Preliminary analyses indicated no differences among the groups at baseline on STAI-trait, $F(3,78)$ = 1.38, p > .26, η_p^2 = .05, BDI-II, $F(3,78)$ = 1.34, p > .27, η_p^2 = .05, and LSAS, $F(3,78)$ = 1.72, p > .17, η_p^2 = .06. All groups were similar in terms of age $F(3,78)$ = .27, p > .76, gender, χ^2 (3, N = 79) = 5.17, p > .16, and years of education, $F(3,78)$ = 1.59, p > .19, η_p^2 = .06.

3.2. Compliance monitoring of the training task

Performance in the training task was investigated to check compliance with instructions (errors and outliers). Participants made very few errors on the training task (M = 1.70%, SD = .09) and there were few outliers (M = 2.24%, SD = .90). The different training conditions did not differ with regards to the number of erroneous responses nor outliers (all ps > .10).

3.3. Independent measure of attentional bias

3.3.1. Data reduction

Latencies from trials with errors were excluded (2.5% of the data). Data beyond 2 standard deviations below or above each participant's mean were discarded as outliers (4.5% of the data). At baseline, the four groups did not differ significantly in error rates, $F(3,78)$ = 2.13, p > .10, η_p^2 = .08.

3.3.2. Change in attentional bias

We subjected response latencies to a 4 (groups) × 2 (time: baseline, post-training) × 2 (validity: valid, invalid) × 2 (word type: social threat, neutral) analysis of variance (ANOVA) with repeated measurement on the last three factors. Due to a leptokurtic distribution, a logarithmic transformation was used. The ANOVA revealed a significant group × time × word type × validity interaction, $F(3,75)$ = 6.338, p < .002, η_p^2 = .20.

To follow-up this third level interaction, we computed separate group × time × validity ANOVAs for social threat and neutral words. The three-way interaction was significant for social threat

Table 2
Means of response latencies in milliseconds by group on the spatial cueing task (standard deviations in parentheses).

Condition									
Trials		Disengage/Re-engage		Disengage		Re-engage		Control	
Cue validity	Word type	Pretraining	Postraining	Pretraining	Postraining	Pretraining	Postraining	Pretraining	Postraining
Valid	Threat	354.95 (77.12)	307.66 (65.20)	360.55 (66.39)	302.62 (38.61)	349.24 (22.25)	361.95 (50.85)	349.77 (82.76)	309.31 (70.32)
	Neutral	358.39 (73.73)	328.62 (64.28)	359.00 (65.64)	311.52 (51.37)	362.12 (50.11)	272.21 (56.29)	350.39 (93.10)	312.54 (71.37)
Invalid	Threat	396.56 (67.21)	340.77 (37.53)	403.63 (66.27)	350.28 (39.50)	397.44 (31.74)	389.90 (75.28)	400.49 (93.24)	386.18 (52.95)
	Neutral	399.02 (69.03)	365.02 (63.17)	403.23 (84.01)	357.97 (71.00)	408.71 (26.62)	370.74 (63.98)	394.63 (98.22)	373.26 (69.52)

words, $F(3,75) = 3.52$, $p < .02$, $\eta_p^2 = .12$, as well as for neutral words, $F(3,75) = 6.50$, $p < .01$, $\eta_p^2 = .21$. To follow-up these three-way interactions, we conducted separate group × time ANOVAs for valid and invalid trials, for social threat and neutral words separately. For invalid social threat words, this analysis revealed a significant time × condition interaction, $F(3,75) = 3.81$, $p < .02$, $\eta_p^2 = .13$. For valid neutral words, this analysis revealed a significant time × group interaction, $F(3,75) = 6.28$, $p < .001$, $\eta_p^2 = .20$. For invalid neutral words and for valid social threat words, the interactions were not significant ($p > .38$).

For invalid social threat words, follow-up paired *t*-tests revealed that participants from the disengage condition and those from the Disengage/Re-engage condition became faster on invalid social threat words from pre- to post-training, $t(1,21) = 4.25$, $p < .001$, and, $t(1,19) = 5.63$, $p < .001$, respectively. There were no significant changes from pre- to post-training for participants who were in the control condition and for those in the re-engage condition, $t(1,18) = .57$, $p > .57$ and $t(1,17) = .74$, $p > .47$, respectively. One-way ANOVAs revealed that although groups did not differ in their responses latency to invalid social threat words before training, $F(3,78) = .72$, $p > .975$, $\eta_p^2 < .001$, there were a significant group difference at post-training, $F(3,78) = 4.51$, $p < .01$, $\eta_p^2 = .15$. Post hoc comparisons, using the LSD procedure, revealed that the Disengage/Re-engage group as well as the Disengage group were significantly faster in their response latency to invalid social threat words than the Re-engage and Control groups. These results suggest that participants from the Disengage/Re-engage training and those from the Disengage training increased their capacity to disengage attention from socially threatening stimuli. This pattern of results is displayed in Table 2.

For valid neutral words, follow-up paired *t-tests* revealed that participants from all groups became faster on valid neutral words from pre- to post-training (*ps* < .03). One-way ANOVAs revealed that although groups did not differ in their response latencies to valid neutral words before training, $F(3,78) = .28$, $p > .84$, $\eta_p^2 = .01$, there was a significant group difference at post-training, $F(3,78) = 3.23$, $p < .03$, $\eta_p^2 = .11$. Post hoc comparisons, using the LSD procedure, revealed that the Re-engage group responded significantly faster to valid neutral words than the others groups. This pattern of results suggests that the participants from the Re-engage group became more able to engage their attention to non-threatening stimuli.

3.4. Speech task

3.4.1. Visual analogue scales

We computed separate 4 (groups) × 3 (time: baseline, post-training, speech) ANOVAs with repeated measurement on the second factor for mood and anxiety analogue scales. Due to a leptokurtic distribution, a logarithmic transformation was used. For the mood scale, the ANOVA only revealed a main effect of time, $F(2,150) = 15.42$, $p < .001$, $\eta_p^2 = .17$. For the anxiety scale, although there were no significant group × time interaction, $F(6,150) = 1.01$, $p > .41$, $\eta_p^2 = .04$, the ANOVA revealed a main effect of Time, $F(2,150) = 57.56$, $p < .001$, $\eta_p^2 = .43$, qualified by a significant effect of group, $F(3,75) = 4.34$, $p < .01$, $\eta_p^2 = .14$. Follow-up paired *t-tests* revealed that, although there were no significant changes from baseline to post-training for all groups, all groups showed a significant increase in their level of self-reported anxiety from post-training to the stress phase (*ps* < .001). One-way ANOVAs revealed that although groups did not differ in their level of self-reported anxiety before training, $F(3,78) = .88$, $p > .45$, $\eta_p^2 = .03$, and after training, $F(3,78) = 1.06$, $p > .37$, $\eta_p^2 = .14$, there were a significant group difference at speech performance, $F(3,78) = 7.90$, $p < .001$, $\eta_p^2 = .24$. Post hoc comparisons, using the LSD procedure, revealed that the Disengage/Re-engage group (*M* = 328.10, *SD* = 101. 40) as well as the Disengage group (*M* = 300.27, *SD* = 75.95) reported less anxiety than the Re-engage (*M* = 403.11, *SD* = 79.96) and Control (*M* = 396.42, *SD* = 59.50) groups.

3.4.2. Behavioral change

We computed a one-way ANOVA on the total BASA scores. The ANOVA revealed a significant difference among groups, $F(3,78) = 7.843$, $p < .001$, $\eta_p^2 = .24$. Post hoc comparisons, using the LSD procedure, revealed that participants in the Disengage/Re-engage group and the Disengage group were significantly rated as less anxious during their speech performance than participants who were in the Re-engage and Control groups. This pattern of results is displayed in Fig. 1.

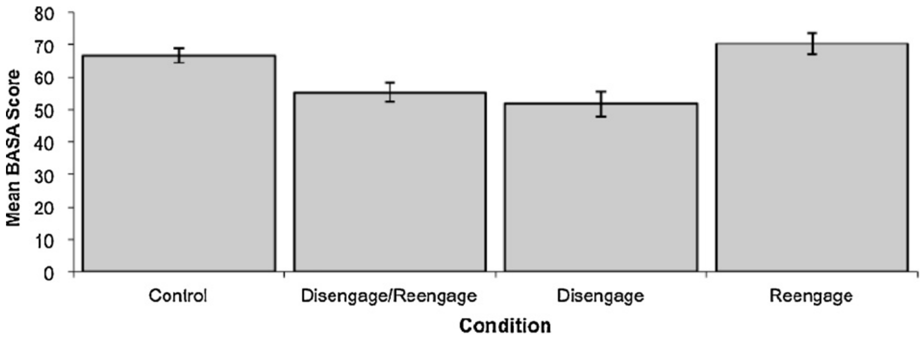

Fig. 1. Mean Score of the Behavioral Speech Anxiety Assessment as a Function of Condition. Errors bars represent standard error of the mean.

3.5. Mediational analyses

To examine whether the effects of attentional training task on behavioral measures were mediated by changes in the ability to disengage attention from social threat, we performed mediational analyses according to the procedure of MacKinnon, Fairchild, and Fritz (2007).This procedure tests the product of the coefficients for the effects of (a) the independent variable (contrast coded: Disengage group = +3, Disengage/Re-engage group = +1, Re-engage group = −3, control group = −1) to the mediator (change in reaction times for invalid threat trials from pre-treatment to post-treatment) (alpha), and (b) the mediator to the dependent variable when the independent variable is taken into account (beta). This procedure is a variation on the Sobel (1982) test that accounts for the non-normal distribution of the alpha–beta path through the construction of asymmetric confidence intervals (MacKinnon et al., 2007).

We examined whether the impact of treatment condition on the dependent variable (BASA score) was mediated by change in the ability to disengage from threat. Consistent with a statistically significant mediation, the 95% confidence interval of the indirect path (alpha–beta) did not contain zero (lower limit = .953, upper limit = 16.478). The same conclusion was supported by the results of the Sobel test, $Z = 2.183$, $p < .030$ (two-tailed).

We also examined whether the impact of treatment condition variable (contrast coded: Disengage group = −3, Disengage/Re-engage group = +1, Re-engage group = +3, control group = −1) on the dependent variable (BASA score) was mediated by change in the ability to attend to non-threat cues. Inconsistent with a statistically significant mediation, the 95% confidence interval of the indirect path (alpha–beta) contain zero (lower limit = −1.89, upper limit = 5.95). The same conclusion was supported by the results of the Sobel test, $Z = .999$, $p = .32$ (two-tailed).

These findings are consistent with the hypothesis that the affect of attention training on behavioral anxiety during a social stressor is mediated by a decrease in the difficulty of disengaging attention for threatening social stimuli.

4. Discussion

The primary purpose of this study was to investigate the critical processes in attention training for social phobia. At this end, participants were randomized to either attention training to disengage from threat, engage towards non-threat, both disengage from threat and engage towards non-threat, or a control training. Consistent with the disengagement hypothesis, training benefits were observed only for participants trained to *disengage attention from threat cues* and those trained to *disengage from threat cues and re-engage to non-threat cues*. Specifically, during the speech task, participants from these two conditions reported less anxiety and exhibited fewer behavioral indices of anxiety relative to participants in the control condition and those only trained to attend to non-threat cues.

Nevertheless, as such, these observations cannot support the conclusion that this change in symptoms can confidently be attributed to selective attentional processing elicited by the training. As argued by MacLeod, Koster, and Fox (2009), the successful induction of the target cognitive change must be confirmed by demonstrating predicted performance changes on a cognitive task reliably measuring the cognitive process of interest. Secondly, they also suggest that, in order to strengthen the conclusion that symptom change results from cognitive change elicited by the training, it is desirable to demonstrate that the magnitude of assessed symptom change is related to the magnitude of observed cognitive change across individuals.

To address the first requirement, in the present case, as compared to participants in the two other conditions, those trained to *disengage from threat and re-engage to neutral stimuli* as well as those trained to *only disengage from threat* exhibited, after training, a greater reduction in latency for identifying probes during invalid threat trials. Congruently, as compared to participants in the three other conditions, those trained to engage their attention to non-threat showed, after training, shorter latencies to identify probes during valid non-threat trials. As mentioned above, previous work (e.g., Amir et al., 2003) showed that reaction times for invalid social threat is related to the capacity to disengage attention from socially threatening stimuli while reaction times for valid non-threat cues is related to the capacity to engage attention towards non-socially threatening stimuli. We may therefore conclude that all three manipulations worked regarding change in attentional bias. The processing bias was thus modified by the experimental manipulation as intended.

Furthermore, the present study included an independent measure of attention bias which is a spatial cueing task with words rather than a dot-probe task with faces and demonstrated that changes in attention generalized to a different measure of attention bias and to a different type of stimulus. This observation suggests that the experimental procedure exerts a general impact on the selective processing of the categories of information from which the present training stimuli were drawn.

We conducted meditational analyses to address the second recommendation of MacLeod et al. (2009) to evaluate the mediation of attentional change on the impact of attention training on symptom change. They revealed that attention training has an indirect effect on behavioral performance during speech through decreased difficulty to disengage attention from social threatening stimuli. These observations support the conclusion that the behavioral change observed in this study can confidently be attributed to the selective attentional processing elicited by the training.

At a fundamental level, this finding converges with previous studies suggesting that attention training procedures can affect vulnerability to anxiety (e.g., Amir et al., 2008; MacLeod et al., 2002). It replicates observations of an effect of attention training on behavioral performance during a speech task (Amir et al., 2008; Heeren et al., submitted for publication). Furthermore, the current work expands the literature by suggesting that the critical process of attention training in social phobia is the training of attentional disengagement from threat.

In relation to the cognitive models of social phobia, the present data support the notion that selective attention to threatening social stimuli plays a causal role in the maintenance of this disorder (Clark, 1999; Clark & Wells, 1995; Rapee & Heimberg, 1997). The present findings clearly bolster the argument that the difficulty in disengaging attention from threat is causally involved in the maintenance of the disorder (e.g., Amir et al., 2003). Furthermore, Fox et al. (2001) propose that the ability to disengage from threat cues may serve as a protective factor from anxiety reactivity, whereas an inability to effectively disengage from threat may serve to maintain or increase anxiety. They postulate that the tendency to dwell on threat cues may contribute to maladaptive rumination. According to Buckner, Maner, and Schmidt (2010), in the case of social anxiety, it may be that the difficulty in disengaging attention from social threat increases the tendency of socially anxious individuals to engage in maladaptive rumination, which may in turn activate memories of prior experiences of negative evaluation. Furthermore, it may also be that the difficulty in disengaging attention from threat results in constant anxiety by creating a vicious cycle in which anxiety is increased as the individual dwells on the social threat. Consistent with these notions, the present data revealed that training socially anxious individuals to improve their ability to disengage from social threat cues clearly led to a significant reduction in anxiety. As a consequence, one cannot exclude that this change occurs through a reduction in maladaptive rumination and in memories of prior experiences of negative evaluation. It may also be that attention training is efficient because it disrupts the vicious cycle in which anxiety is increased as the individual dwells on threat cues. In accordance to this latter proposal, Heeren et al. (submitted for publication) have observed that attention training led to a decrease of sympathetic physiological activation during situation in which the individual dwells on a threat (i.e., speech task). Future experiments are clearly needed to evaluate the possibility that attention training is efficient because it disrupts the vicious cycle mentioned above.

At a clinical level, the present data are consistent with recent developments in cognitive bias modification (e.g., Browning, Holmes, & Harmer, 2010; Hakamata et al., 2010) demonstrating that the attention bias for threatening stimuli can be changed and that this change is related to cognitive and behavioral benefits. More precisely, the current double-blind randomized experiment adds to a small but growing empirical literature revealing the efficacy of computerized attention training procedure in reducing clinical symptoms in individuals who suffers from social phobia (Amir et al., 2009; Schmidt et al., 2009). Specifically, the present experiment represents an attempt to better understand the mechanisms underlying this procedure. Indeed, results showed that, in a single-session design, disengagement from threat is more important than allocation to non-threat. However, it is possible that for larger dose treatments involving attention training, training socially anxious individuals to attend to non-threat would become important after these participants can disengage from threat. Future studies should further investigate this question.

Regarding implications for treatments, present findings suggest that clients may benefit from clinical intervention specifically targeting the ability to disengage attention from threat-related stimuli. At this end, computerized training may be delivered, such as the disengagement training used in the present paper. Likewise, as suggested by Wadlinger and Isaacowitz (2011), meditative interventions, such as mindfulness training, may be also used. Indeed, a consensus emerges to suggest that mindfulness training might promote effective emotion regulation through the improvement of the ability to disengage attention from threat-related cues and thoughts (e.g., Chiesa & Serretti, 2010; Heeren & Philippot, 2011; Heeren, Van Broeck, & Philippot, 2009).

The present study has limitations. First, the sample size is small, which provides limited power to conduct statistical analysis. Second, we used a single-session design and did not collect follow-up data. As such, one cannot determine whether group differences were long-lasting or simply a transient effect. Third, there was no significant group × time interaction for the self-reported measure of anxiety. Although no significant difference among groups before and just after the manipulation were observed, post hoc tests, however, revealed that the Disengage/Re-engage as well as the Disengage group reported significantly less anxiety than the Re-engage and Control groups at speech performance. Such lack of interaction does not fit with previous findings showing strong effects of attention training on self-reported measures. One cannot exclude the small sample size as an explanation. An alternative explanation might be that the present visual analogue scales were not sufficiently discriminative. Future studies should use reliable measures of self-reported anxiety (e.g., STAI-state). Fourth, we used a spatial cueing task as a measure of attention bias. Mogg, Holmes, Garner, and Bradley (2008) have argued that the spatial cueing task may not provide unambiguous evidence for delayed disengagement, as there may be a confound between delayed disengagement and a generic slow-down effect caused by the presence of threat. Although this limits the conclusions that can be drawn from this task, Cisler and Olatunji (2010) recently found that the difficulty in disengaging in the spatial cueing task remained in anxious individuals when statistically controlling for the generic response slowing, suggesting that this task confound does not explain difficulties in disengagement. Fifth, participants from the Disengage group and the Re-engage group do not have to attend to the threat value of the stimulus in order to perform the task. Indeed, these two conditions are more similar to a Posner spatial cueing task than a dot-probe task. Therefore, one cannot exclude that participants from these two conditions just learned to attend to either the opposite or same location as the cue. As a consequence, it might be that these two conditions require different processes of change than those involved in the usual dot-probe training. The present data should thus be interpreted with caution. Future studies should further investigate this question. For instance, researchers may include eye-tracker techniques during the training to better understand what participants effectively do during these two conditions. Sixth, although both speech raters have at least three years of CBT training, they were not trained to use the BASA. Although one may assume that someone trained in CBT is qualified to rate anxiety, it would be preferable to ensure that raters were trained to use the BASA. However, the impact of this weakness is limited by the high-standardization of the BASA (i.e., including self-report items for each of the 18 categories, good psychometric properties, and high inter-rater reliability). This same suggestion applies to how the clinicians were trained to use the MINI. Finally, given recent evidence that anxious individuals, regardless of their type of anxiety, appear to demonstrate attentional biases towards threat (e.g., Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007), future experiments should examine whether the effects observed in the current study generalize to individuals with other anxiety disorders.

In conclusion, present findings show that training individuals with social phobia to disengage from threat reduces social anxiety during a speech performance. Furthermore, it appears that this effect is particularly related to an improvement in the ability to disengage attention from threat.

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