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Attention training for reducing spider fear in spider-fearful individuals

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ABSTRACT

Cognitive theorists propose that attentional biases for threatening information play an important role in the development and maintenance of anxiety disorders. If attentional biases for threat figure in the maintenance of anxiety, then the experimental reduction of the bias for threat (attention training) should reduce anxiety. We randomly assigned 41 spider-fearful individuals to receive either attention training (n = 20) or control procedures (n = 21). We used a modified dot-probe discrimination paradigm with photographs of spiders and cows to train attention. Training reduced attentional bias for spiders, but only temporarily. Although both groups declined in spider fear and avoidance, reduction in attentional bias did not produce significantly greater symptom reduction in the training group than in the control group. However, reduction in attentional bias predicted reduction in self-reported fear for the training group. The reduction in attentional bias for threat may have been insufficiently robust to produce symptom reduction greater than that produced by exposure to a live spider and spider photographs alone. Alternatively, attention training may be an unsuitable intervention for spider fear.

1. Background

Cognitive theorists propose that attentional biases for threatening information play an important role in the development and maintenance of anxiety disorders (Beck & Clark, 1997). Using a variety of methods, researchers have consistently found attentional biases for threatening information among individuals with anxiety disorders (for reviews Harvey, Watkins, Mansell, & Shafran, 2004; Williams, Mathews, & MacLeod, 1996). If attentional biases for threat maintain anxiety, then the experimental reduction of the bias for threatening information (attention training) should reduce anxiety. Recently, investigators have begun to study attention training by modifying the dot-probe paradigm.

MacLeod, Mathews, and Tata (1986) developed this paradigm to measure attentional biases for threat among anxiety disorder patients. Participants view two stimuli (a threat-related word/photograph and a neutral word/photograph) presented in two areas of a computer screen. Immediately thereafter, a probe replaces one of the stimuli. Participants respond to the probe as quickly as possible. An attentional bias for threat-related stimuli occurs when participants are faster to respond to the probe when it replaces a threat stimulus than when it replaces a nonthreat stimulus, thereby implying that the participant's attention is directed to the location occupied by the threat stimulus. The dot-probe discrimination task is a variant of the dot-probe paradigm. It requires participants to identify the nature of the probe (e.g., the symbol: or ..; the letter E or F) as quickly and accurately as possible.

In attention training, the dot-probe paradigm is fixed so that the probe nearly always replaces either the threat-related or neutral stimulus. When participants complete this modified dot-probe, they learn that they can increase the speed of response if they attend to the stimulus that best predicts the location of the probe.

MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002) were the first investigators to modify the dot-probe paradigm to produce an attentional bias for either negative or neutral words in healthy individuals. They found that those participants trained to attend to negative material, when compared to participants trained to attend to neutral material, reported greater increases in negative mood and anxiety after completing a stressful anagram task. That is, the training procedure produced an attentional bias for negative material that rendered participants vulnerable to responding anxiously to a subsequent laboratory stressor.

More recent work has demonstrated that attention training with the modified dot-probe paradigm can reduce attentional bias for threat as well as symptoms of anxiety among students (Mathews & MacLeod, 2002; See, MacLeod, & Bridle, 2009), and people with social anxiety (Amir, Weber, Beard, Bomyea, & Taylor, 2008; Amir et al., 2009; Li, Tan, Qian, & Liu, 2008; Schmidt, Richey, Buckner, & Timpano, 2009), generalized anxiety disorder (Amir, Beard, Burns, & Bomyea, 2009), and sub-clinical obsessive–compulsive disorder (Najmi & Amir, 2010).

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In our experiment, we adapted procedures of MacLeod et al. (2002) and Mathews and MacLeod (2002, experiment 8) to examine the effect of attention training on levels of spider-related anxiety in spider-fearful individuals. Spider-fearful individuals have consistently demonstrated attentional biases for spider-related information on reaction time and eye-tracking measures of attention (Kindt & Brosschot, 1997; Mogg & Bradley, 2006; Pflugshaupt et al., 2005; Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005). These biases for threat also decline following successful treatment (van den Hout, Tenney, Hyugens, & de Jong, 1997). Although no one has attempted to modify pre-existing attentional biases for spiders in spider-fearful individuals, Harris and Menzies (1998) used the modified dot-probe paradigm to induce a bias either toward or away from spider-related words in non-fearful participants. In this case, induction of a bias in both directions was successful although the induction of a bias toward spider-related words did not increase spider fear. However, training was perhaps too brief (40 dot-probe trials) to produce a robust change in attentional bias.

Researchers have yet to test whether one can attenuate pre-existing attentional biases in spider-fearful participants and whether any attenuation results in symptom reduction. We hypothesized that attention training designed to produce a bias toward nonthreatening pictorial stimuli will result in decreased levels of spider fear, and behavioral avoidance among spider-fearful individuals. We also hypothesized that degree of reduction in attentional bias for spiders will predict degree of reduction in spider fear, and behavioral avoidance among spider-fearful individuals.

Additionally, we examined whether participants learned to attend to neutral stimuli or to disengage attention from threatening stimuli. During the attention training, our participants saw pairs of cow and spider photographs (trained pairs). Subsequently, when we tested participants' attentional biases with the unmodified dot-probe discrimination task, participants saw trials with cows and spiders as well as birds and spiders (untrained pairs). By contrasting participants' reaction times for the trained pairs with the untrained pairs, we hoped to determine whether the learned bias results from attentional capture by the cow photographs or from attentional disengagement from the spider photographs. If participants show a reduction in bias for spiders for the trained stimulus pairs and not the untrained stimulus pairs after training, this would suggest that they are learning to attend to the cow photographs. Therefore, when that stimulus is absent, they do not exhibit the learned bias. If, however, participants show a reduction in bias for spiders for the trained and untrained pairs after training, this would suggest that the participants are learning to disengage from the spiders.

2. Method

2.1. Participants

Forty-four spider-fearful individuals (34 female; 38 White, 3 Asian, 3 Black) between the ages of 18 and 50 were recruited from the Boston area through craigslist.com. One-hundred and three individuals responded to our advertisements and those individuals who scored in the upper 25th percentile of the Spider Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974), according to the separate norms established for males and females were invited to participate. Two participants did not return after the first visit. One participant was excluded for failure to follow study instructions. These participants are not included in any further presentation of results. The remaining 41 participants were randomly assigned to training ($n = 20$) or control procedures ($n = 21$). Neither the experimenter nor the participant was aware of the experimental condition until the end of the experiment. Mean age of participants was 26.3 years. Training and control groups did not differ in age, self-reported spider fear, or behavioral avoidance at baseline (Table 1). Participants were paid $55 for participating.

Table 1
Baseline characteristics of the training and control groups.

	Training	Control	*t*	*p*
Age				
M	26.0	26.7	.28	.78
SD	7.48	8.73		
SPQ				
M	21.5	21.1	.29	.77
SD	4.53	4.30		
BAT score				
M	3.15	3.57	.99	.33
SD	1.27	1.43		

2.2. Apparatus

Stimuli were presented on a T42 IBM laptop with a 28.5 cm × 21.5 cm screen, and E-prime (Schneider, Eschman, & Zuccolotto, 2002) presented the computer tasks and recorded reaction times in milliseconds. Button-press responses to the dot-probe discrimination testing and attention training/control procedure were recorded on a serial response box, Model 200a, manufactured by Psychology Software Tools, Inc. Participants sat approximately 65 cm from the monitor for all computer tasks.

2.3. Measures

Spider Questionnaire (SPQ): The Spider Questionnaire is a 31-item questionnaire developed to assess fear of spiders (Klorman et al., 1974).

Visual analogue scale (VAS): Immediately before and after the training or control procedure, participants rated their feelings on 10 dimensions (relaxed, tense, happy, sad, awake, tired, calm, afraid, attentive, bored) by making an X on a 100 mm line ranging from 0 (not at all) to 100 (extremely).

2.4. Tasks

2.4.1. Behavioral Avoidance Test (BAT)

Participant's willingness to approach a caged, tarantula (Chilean Rose, *Grammastola rosea*) was measured. Participants were rated on a scale from 0 (not avoidant) to 5 (extremely avoidant). Those participants unwilling to enter the room with the spider received a score of 5. Participants only willing to enter the room briefly received a score of 4. Participants willing to stay in the room with the caged spider for 3 min received a score of 3. Participants willing to sit next to the spider's cage for 3 min received a score of 2. Participants willing to sit next to the open spider's cage for 3 min received a score of 1. Participants willing to touch the spider received a score of 0. Additionally, Subjective Units of Distress (SUDs) ratings of fear from 0 (no fear) to 100 (the most fear ever experienced) were obtained at each level of approach undertaken by the participant.

2.4.2. Dot-probe discrimination task

Dot-probe discrimination testing consisted of 96 trials delivered in one block. Each trial began with a fixation asterisk displayed in the center of the computer monitor for 1000 ms. Following the disappearance of the asterisk, two photographs appeared just above and below center screen. Five-hundred milliseconds later, the photographs disappeared and a probe (the letter E or F) appeared in one of the locations previously occupied by the photographs. The participant's task was to identify the letter by pushing the corresponding button (E or F) on a serial response box as quickly and as accurately as possible. The probe remained on the screen until a response was detected. The inter-trial interval was 500 ms. Each pair of photographs consisted of a spider photograph and nonthreatening photograph (cow or bird). At the baseline assessment, all trials consisted of spider–cow pairs. Participants saw 6 unique spider–cow pairs. Each spider–cow pair was presented 16 times with the cow and spider photographs appearing equally often in the top and bottom positions and the probe appearing equally often behind the cow and spider photographs. At the remaining assessments, participants saw 6 novel spider–cow pairs, and 6 novel spider–bird pairs randomly intermixed. Each spider–cow pair and spider–bird pair was presented 8 times, with the nonthreatening (cow or bird) and spider photographs appearing equally often in the top and bottom positions and the probe appearing equally often behind the nonthreatening (cow or bird) and spider photographs. The first 10 trials were excluded from each testing block to eliminate practice effects.

2.4.3. Attention training

Attention training consisted of the dot-probe discrimination task described above, modified to facilitate an attentional bias away from threatening material. In this case, the probe always replaced the cow photograph. Photographs used in dot-probe testing at baseline were used for the attentional training. Again, the cow and spider photographs appeared equally often in the top and bottom positions. Participants completed 768 trials delivered in 8 blocks. They were allowed to take as long of a break as desired between each block.

2.4.4. Control procedure

The control procedure was identical to the attention training except the probe appeared equally in the location previously occupied by the cow and spider photographs.

2.5. Stimuli

Thirty-six photographs (18 spiders, 12 cows, 6 birds) were used in the dot-probe testing and attention training/control procedure. All photographs were obtained on the Internet. Prior to initiating the study, we asked 15 independent raters to assess all photographs on 5 dimensions: threat, arousal, amusement, positivity and complexity. Raters scored each photograph on each dimension on a Likert scale from 0 (not at all) to 6 (extremely).

Contrast analyses were conducted to test for differences on each dimension between the spider, cow, and bird photographs used in the dot-probe discrimination testing and attention training/control procedure. As expected, the spider photographs were significantly more threatening than the cow photographs $t(33) = 20.33$, $p < .001$, $d = 7.08$ and the bird photographs $t(33) = 17.56$, $p < .001$, $d = 6.60$. The spider photographs were significantly less positive than the cow photographs $t(33) = 15.57$, $p < .001$, $d = 5.43$ which were also significantly less positive than the bird photographs $t(33) = 6.87$, $p < .001$, $d = 2.39$. Spider photographs were significantly more arousing than the bird photographs $t(33) = 13.22$, $p < .001$, $d = 4.61$, which were significantly more arousing than the cow photographs $t(33) = 3.35$, $p = .002$, $d = 1.17$. The cow and bird photographs were equally amusing and significantly more amusing than the spider photographs $t(33) = 15.97$, $p < .001$, $d = 5.56$. The spider photographs were not significantly more complex than the bird photographs but were significantly more complex than the cow photographs $t(33) = 5.93$, $p < .001$, $d = 2.07$.

2.6. Procedure

All participants visited the lab four times. At the first visit, participants provided informed consent before completing the SPQ, BAT, and the dot-probe discrimination task. Participants returned 1–5 days later to complete the attentional training or control procedures and dot-probe testing. Prior to and immediately following the training/control procedure, participants completed the visual analogue scales to assess for changes in mood, anxiety, and alertness. Participants returned for the third and fourth visits 1-day and 1-week after the training/control procedures, respectively. At these visits, participants repeated the SPQ, BAT, and dot-probe testing to assess for changes in self-reported fear, fear in the presence of a spider, avoidance, and attentional bias.

3. Results

3.1. Data reduction

Dot-probe discrimination testing: All trials with incorrect responses were excluded (3.26% of pre- and post-training trials). Trials with response latencies less than 200 ms or greater than 1000 ms were excluded (6.74% of correct pre- and post-training trials). Finally, trials with response latencies $\pm(2 \times \text{SD})$ from each participant's mean response latency were excluded (4.78% of remaining pre- and post-training trials). There were no significant differences between the training and the control group in the mean number of trials included at baseline, $t(39) = .174$, $p = .86$, or post-training, $t(39) = .112$, $p = .91$.

3.2. Analyses

3.2.1. Attentional bias

To assess for an attentional bias for spiders at baseline, we conducted a one-tailed paired-samples *t*-test comparing mean RT for trials in which the probe replaced the cow and mean RT for trials in which the probe replaced the spider. Participants were on average 9 ms faster at detecting the probe when it replaced the spider photograph than when it replaced the cow photograph. This difference fell short of statistical significance, $t(40) = 1.38$, $p = .089$, suggesting a trend toward attentional bias for spiders at baseline.

To assess whether a change in attentional bias occurred among the training group, we first computed an index of attentional bias for the spider photographs as:

$$\begin{aligned}\text{Spider Bias} = {} & \text{mean RT for trials in which the probe replaced the cow} \\ & - \text{mean RT for trials in which the probe replaced the spider.}\end{aligned}$$

We then conducted a 2(Group: training, control) × 2(Time: pre-training, post-training) mixed ANOVA with Group as a between subjects factor, Time as a repeated measures factor, and Spider Bias as the dependent variable. This was done first with the Spider Bias in the cow–spider trials and then repeated with the Spider Bias in the bird–spider trials. A significant Group × Time interaction emerged, $F(1, 39) = 6.01$, $p = .019$ for the cow–spider pairs. The main effects of Group and Time were nonsignificant. Follow-up analyses revealed that the groups did not significantly differ in degree of Spider Bias at pre-training, $t(39) = .033$, $p = .97$. Immediately post-training, the training group demonstrated a significantly lower Spider Bias than the control group, $t(39) = 2.80$, $p = .008$, $d = .90$. Moreover, one-tailed *t*-tests revealed that the pre- to post-training change in attentional bias was nonsignificant for the control group, $t(20) = 1.59$, $p = .064$, and significant for the training group, $t(19) = 1.85$, $p = .039$, $d = .63$.

A similar pattern of results emerged with the bird–spider pairs. Again, a significant Group × Time interaction emerged, $F(1, 39) = 6.87$, $p = .012$. The main effects of Group and Time were nonsignificant. Follow-up analyses revealed that the groups did not significantly differ in degree of Spider Bias at pre-training, $t(39) = .033$, $p = .97$. Immediately post-training, the training group demonstrated a significantly lower Spider Bias than the control group, $t(39) = 2.41$, $p = .021$, $d = .77$. Moreover, one-tailed t-tests revealed that the pre- to post-training change in attentional bias was nonsignificant for the control group, $t(20) = 1.33$, $p = .099$ and significant for the training group $t(19) = 2.36$, $p = .015$, $d = .60$.

To explore whether training effects persisted to 1-day post-training, we conducted a 2(Group: training, control) × 2(Time: pre-training, 1-day post-training) mixed ANOVA with Group as a between subjects factor, Time as a repeated measures factor, and Spider Bias as the dependent variable. Because results at post-training did not differ between the cow–spider pairs and bird–spider pairs, we collapsed our findings across both trial types. Results revealed a marginally significant Group × Time interaction, $F(1, 39) = 3.99$, $p = .053$, with no main effect of Group or Time. Similar to post-training, follow-up analyses revealed that the groups did not significantly differ in degree of Spider Bias at pre-training, $t(39) = .033$, $p = .97$. One-day post-training, the training group demonstrated a significantly lower Spider Bias than the control group, $t(39) = 2.30$, $p = .027$, $d = .74$. Moreover, one-tailed t-tests revealed that the pre- to 1-day post-training change in attentional bias was nonsignificant for the control group, $t(20) = 1.08$, $p = .147$, and significant for the training group, $t(19) = 1.77$, $p = .047$, $d = .44$.

To explore whether the training effects persisted to 1-week post-training, we conducted a 2(Group: training, control) × 2(Time: pre-training, 1-week post-training) mixed ANOVA with Group as a between subjects factor, Time as a repeated measures factor, and Spider Bias as the dependent variable. Again, results revealed a marginally significant Group × Time interaction, $F(1, 39) = 3.57$, $p = .066$ with no main effect of Group or Time. Again, similar to post-training, follow-up analyses revealed that the groups did not significantly differ in degree of Spider Bias at pre-training, $t(39) = .033$, $p = .97$. One-week post-training, the training group demonstrated a significantly lower Spider Bias than the control group, $t(39) = 2.17$, $p = .036$, $d = .70$. In contrast to our previous findings, however, one-tailed t-tests revealed that the pre- to 1-week post-training change in attentional bias was significant for the control group, $t(20) = 1.78$, $p = .045$, $d = .39$, but not for the training group, $t(19) = .903$, $p = .189$. Examination of the mean Spider Bias scores reveals that the Spider Bias of the control group significantly increased from pre-training to 1-week post-training, whereas the Spider Bias of the training group was still reduced but not significantly so. Fig. 1 presents mean Spider Bias for each group at pre-training, post-training, 1-day post-training, and 1-week post-training.

3.2.2. Visual analogue scale

To assess for immediate changes in mood, anxiety and alertness as a result of the training or control procedures, we conducted a 2(Group: training, control) × 2(Time: pre-training, post-training) mixed ANOVA for each of the 10 dimensions of the VAS with Group as a between subjects factor, Time as a repeated measures factor and VAS score as the dependent variable. There were no significant Time × Group interactions for any of the 10 dimensions. All participants became significantly less relaxed ($F(1, 39) = 8.47$, $p = .006$, $d = .71$), more tense ($F(1, 39) = 10.18$, $p = .003$, $d = .73$), less happy ($F(1, 39) = 34.22$, $p < .001$, $d = 1.03$), less awake ($F(1, 39) = 28.67$, $p < .001$, $d = .90$), more tired ($F(1, 39) = 16.41$, $p < .001$, $d = .74$), less calm ($F(1, 39) = 5.42$, $p = .025$, $d = .49$), more afraid ($F(1, 39) = 7.09$, $p = .011$, $d = .50$), less attentive ($F(1, 39) = 31.50$, $p < .001$, $d = 1.29$), and more bored ($F(1, 39) = 81.96$, $p < .001$, $d = 2.28$) over the course of the training or control procedure. Participants experienced no significant changes in their level of sadness.

3.2.3. Change in self-reported spider fear, avoidance, and fear in the presence of a spider

To assess for changes in self-reported fear, we conducted a 2(Group: training, control) × 2(Time: pre-training, 1-day post-training/control procedure) ANOVA scores with Group as a between subjects factor, Time as a repeated measures factor and SPQ score as the dependent variable. This analysis was repeated with BAT score, as well as fear ratings during the BAT, as the dependent variables. To adjust for the fact that many participants approached the spider more closely on the BAT on each subsequent assessment and so may report higher maximum levels of fear overall, we analyzed the fear ratings at the Visit 3 and 4 BAT for the step on the baseline BAT at which the participant stopped. So, for example, if a participant stopped at level 5 at baseline, we examined their fear rating for level 5 at Visit 3 and 4.

Both the training and control groups declined in self-reported spider fear, avoidance, and fear during the BAT over the course of the experiment (SPQ: $F(1, 39) = 11.25$, $p = .002$, $d = .37$; BAT: $F(1, 39) = 29.03$, $p < .001$, $d = .42$; BAT fear: $F(1, 36) = 4.77$, $p < .036$, $d = .34$). There was no significant Group × Time interaction for any of these measures. Thus, although both groups experienced symptom improvement over the course of the experiment, the attention training was not associated with significantly greater improvement than that experienced by the control group. A similar pattern of results emerged at 1-week post-training. Both groups declined in self-reported spider fear, avoidance, and fear during the BAT over the course of the experiment (SPQ: $F(1, 39) = 9.31$, $p = .004$, $d = .44$; BAT: $F(1, 39) = 24.03$, $p < .001$, $d = .55$; BAT fear: $F(1, 37) = 14.78$, $p < .001$, $d = .55$). As before, there was no significant Group × Time interaction for any of these measures.

3.2.4. Relationship between degree of reduction in attentional bias for spiders and symptom reduction

To obtain an index representing the degree of change in spider bias, we computed the following:

$$\text{Pre-training Spider Bias} - \text{Post-training Spider Bias}$$

Positive scores on this index indicated a reduction in attentional bias for spiders. We then correlated this index with the amount of change in SPQ score, BAT score, and BAT fear, 1-day post-training for the training and control groups separately. As expected, no significant correlations emerged for the control group. Degree of reduction in spider bias between pre- and post-training was significantly correlated with reduction in self-reported fear on the SPQ from pre- to post-training for the training group, $r(18) = .55$, $p = .01$. Degree of reduction in spider bias between pre- and post-training was not significantly correlated with reduction in avoidance, or fear during the BAT from pre- to post-training for the training group.

To explore durability of this relationship, we next correlated the degree of reduction in attentional bias for spiders from pre-training to 1-day post-training with the amount of change in SPQ score, BAT score, and BAT fear, from pre-training to 1-week post-training for the training and control groups separately. In this case, degree of reduction in spider bias between pre- and 1-day post-training was significantly negatively correlated with reduction in avoidance from pre- to 1-week post-training for the control group, $r(19) = -.49$, $p = .03$. No other correlations were significant for the control group. For the training group, degree of reduction in spider bias between pre- and 1-day post-training was again significantly correlated with reduction in self-reported fear on the SPQ from pre- to 1-week post-training, $r(18) = .54$, $p = .01$. As before, degree of reduction in spider bias between pre- and 1-day post-training was not significantly correlated with reduction in avoidance or fear during the BAT from pre- to 1-week post-training for the training group.

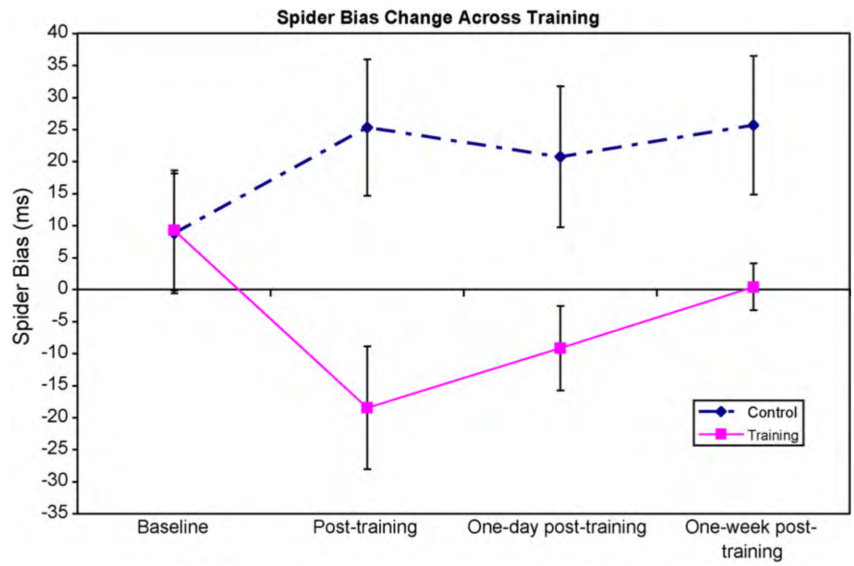

Fig. 1. Mean attentional bias for spiders for the training and control groups over the course of the experiment. Error bars signify the standard error of the mean.

4. Discussion

Results show that attentional biases for spiders in spider-fearful individuals can, indeed, be experimentally reduced. Moreover, this reduction was sustained 1-day post-training. That modification of attention generalized to the bird-spider pairs, suggests that the attention training procedure may be training individuals to disengage attention from spiders rather than to attend to cows. Although attentional capture and disengagement cannot be conclusively teased apart with the probe discrimination paradigm, it is unlikely that participants learned to attend to cows and then applied this rule to birds. It is more likely that the participants learned to disengage attention from the spider and so applied this rule to the spiders in the spider–bird pair.

That we are training individuals to avoid spiders appears to be at odds with the aim of traditional behavior therapy: reduce avoidance and encourage exposure to the feared stimulus. However, spider-fearful individuals have a vigilance–avoidance pattern of attention such that relative to non-fearful individuals they initially locate spiders faster, but subsequently divert their attention from the spider (Mogg & Bradley, 2006; Pflugshaupt et al., 2005). This early vigilance may serve to heighten anxiety whereas the later avoidance maintains the fear. Attentional training may be a means of modifying the initial vigilant response, whereas traditional exposure therapy targets the later avoidance. In this way, the two treatment strategies could be complementary rather than contradictory. Also, photographs of spiders have relatively low absolute threat value, and so attentional avoidance of such mild threats may be adaptive. Low-trait anxious individuals have demonstrated this pattern of attentional avoidance of mild threats (Bradley, Mogg, Falla, and Hamilton (1998); Mackintosh & Mathews, 2003; MacLeod et al., 1986), which may serve as a means of regulating mood (Mogg & Bradley, 1998).

It is curious that the control group demonstrated a significant increase in their attentional bias for spiders 1-week post-training. That this occurred in the context of declines in self-reported fear and avoidance is also puzzling. The reason for this pattern is unclear. One possibility is that participants with pre-existing attentional biases, who undergo the control procedure, gain further practice attending to spiders. That is, the repetitive, brief presentation of the spider photographs during the control procedure provides further experience for them to exercise and thus strengthen their pre-existing bias. Yet the behavioral tests provide traditional exposure to their feared animal, thereby reducing self-reported fear and avoidance.

Reduction in attentional bias did not reduce symptoms more in the training group than in the control group. Both groups showed significant declines in self-reported fear, avoidance, and fear in the presence of a spider. This is perhaps not surprising given that both the treatment and the control groups were exposed to a live tarantula and many photographs of spiders, and exposure is integral to traditional behavior therapy for spider phobia. However, that the degree of reduction in attentional bias for spiders in the training group correlated with the degree of reduction in self-reported fear suggests that the attentional training may have exerted some influence over symptom reduction. It is possible that reduction in attentional bias for threat was insufficiently robust to produce symptom reduction greater than that produced by exposure to a live spider and spider photographs alone.

It could also be, however, that attention training is not an effective intervention for spider fear. The benefits of attention training have been most apparent for anxiety problems that are far less stimulus-bound than spider phobia. GAD and generalized social phobia are characterized by repetitive, distressing cognition at least as much as by fear of specific, discrete stimuli. By contrast, most spider-fearful people remain untroubled by their fear unless they encounter their feared object. Hence, it remains to be seen whether reducing attentional biases for threat in stimulus-driven anxiety disorders results in symptomatic improvements as it does in disorders characterized by ruminative cognition. Although the results of our study were therapeutically disappointing, they may point to potential boundary conditions for attention training. Either attention training is unsuitable for stimulus-driven phobias or training must be strengthened.

We recruited high-fearful individuals rather than clinically phobic individuals for this study. Thus, caution in generalizing these findings to a clinical population is warranted. Nevertheless, 18 of our 41 participants scored in the 95th percentile on the SPQ, thereby implying clinically severe levels of fear.

In future studies researchers should attempt to enhance the strength and durability of the training. Our data suggest that a small rebound in spider bias occurred by 1-week post-training for the training group. Phobic individuals have shown more efficient and durable reductions in fear after distributed rather than massed exposure to a phobic stimulus in traditional exposure therapy (Ramsay, Barends, Breuker, & Kruseman, 1966; Rowe & Craske, 1998). Therefore, it would be useful to test whether the training may be more powerful when administered in a distributed manner. Consolidation of gains in reduction of spider fear might also occur if participants received D-cycloserine prior to attentional training (McNally, 2007). Although this drug possesses no anxiolytic properties, it enhances exposure therapy for acrophobia (Ressler et al., 2004).

It would also be interesting to examine the effects of explicit instruction on attention training. Thus far, researchers have not informed participants of the contingency between the probe and the neutral stimuli during the training. At the conclusion of the present study, we asked participants in the training condition whether they noticed any pattern during the training. Data were missing for 3 participants. Of the remaining 17 participants, eight could correctly identify that the letter always replaced the cow photographs. Nine participants reported not noticing any pattern. Both groups experienced an approximately 35 ms mean reduction in Spider Bias across the training suggesting that awareness is not necessary for the training to be effective but it remains to be seen whether direct instruction could enhance the effect of training.

Although effective treatments for specific phobias exist, the implementation of these treatments requires a trained clinician. If a computer-administered treatment was effective it could perhaps be used to augment traditional behavior therapies and thereby reduce the number of sessions required for treatment. Also, if effective, the procedure lends itself to use through the Internet which would allow individuals to experience a reduction in fear without the assistance of trained clinician.

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