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Combining Attention Bias Pretraining with Exposure Therapy for Individuals with a Fear of Spiders

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COMBINING ATTENTION BIAS PRETRAINING WITH EXPOSURE THERAPY FOR INDIVIDUALS WITH A FEAR OF SPIDERS

by

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ABSTRACT

COMBINING ATTENTION BIAS PRETRAINING WITH EXPOSURE THERAPY FOR INDIVIDUALS WITH A FEAR OF SPIDERS
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The exposure therapy literature supports the notion that facilitated attentional focus on threat is necessary for a reduction in fear symptoms. A newer, computer-based cognitive training program for anxiety conditions that manipulates patterns of attentional allocation called attention bias modification has also demonstrated efficacy in the reduction of anxiety symptoms. Interestingly, this form of treatment promotes the opposite pattern of attentional processing (i.e., disengagement from threat stimuli). Taken together, it appears that the optimal pattern of attentional allocation during exposure needed to facilitate the reduction of anxiety symptoms remains unclear. Furthermore, the effect of combining attention bias modification with exposure therapy has yet to be established in the literature. Research that directly examines the role of attention in the process of exposure therapy may have the benefit of increasing our understanding of this underlying mechanism and improving this form of treatment. To this end, participants of the current study were randomly assigned to receive a computer-based treatment program that either trained attention towards or away from spider-threat stimuli or a placebo program that was not expected to alter patterns of attentional processing. In addition, all participants completed a single session of exposure therapy. Group differences were examined in terms of subjective fear and anxiety symptoms, behavioral and physiological indices of fear and avoidance, and patterns of attentional processing. Results indicated that there is some evidence attention was trained in the expected directions, although that the adjunctive attention pre-training program did not yield differential impact on the exposure therapy procedure. There is also evidence that individuals in all groups increased in attentional engagement towards spider images suggesting the possibility that exposure may have overridden the effects of attention training. Explanations for the observed null findings will be discussed and suggestions for future research will be presented.

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Introduction

This dissertation sought to examine the effects of combining attention bias modification with exposure therapy among individuals with a fear of spiders. The paper presented a comprehensive review of the literature in order to build a case for the importance of learning more about the role of attentional processes in exposure therapy. To this end, we reviewed the literature on the underlying mechanisms behind exposure therapy and attention bias modification. Additionally, existing research concerning the combination of these two approaches (i.e., exposure therapy and attention bias modification) was reviewed. Next, a detailed plan for the current study was presented given that the ultimate goal of this type of work is to improve the practice of exposure therapy by addressing a key component of the process (i.e., attention). Lastly, the paper detailed the main study findings, and will conclude with suggestions for future investigations.

Exposure Therapy and Fear Reduction Theories

Exposure Therapy. Much of the anxiety disorders treatment literature supports the efficacy of exposure therapy for anxiety disorders (for a meta-analysis see Wolitzky-Taylor, Horowitz, Powers, & Telch, 2008) qualifying it as an empirically supported intervention (Chambless & Ollendick, 2001). Literature is also accumulating regarding the mechanisms of exposure therapy. Several theories have emerged that attempt to explain these mechanisms such as habituation theory (Groves & Thompson, 1970) and emotional processing theory (Foa & Kozak, 1986). These theories have laid the groundwork for further exploration into the specific components that may be involved in fear reduction.

Emotional Processing Theory

Definition and Background. Foa and Kozak (1986) define emotional processing as a change in the fear network that results in anxiety reduction. A fear network is a mental representation in memory of fear-related stimuli, responses, and the meaning of the stimuli and responses. These various information nodes form associative connections. According to emotional processing theory (EPT), the fear structure must be activated, and disconfirmation of threatening information must be processed (encoded) and incorporated into the network in order for change to occur.

In order for the fear structure to become active, information observed from the environment must match information nodes that are represented in the fear structure (Lang, 1977). In order for disconfirmation of threat to occur, one must have a corrective experience, which is indicated by a decreased fear response (i.e., within or between-session habituation) (Foa & Kozak, 1986). This is accomplished by exposure to the feared stimulus as this corrective experience weakens the associations of the fear network, and as originally proposed by Foa and Kozak (1986), replaces the old fear network with a new non-fear network. Specifically, confrontation with the feared stimulus and the resulting habituation serve to disconfirm fears that the anxiety experienced will last forever or become physically or psychologically unmanageable, as well as the fears of suffering harm from the feared situation itself.

Research supports the effectiveness of exposure therapy in reducing anxiety-related fear and avoidance (Kozak, Foa, & Steketee, 1988). Specifically, exposure-based therapy has been shown to greatly improve symptoms of anxiety conditions such as panic disorder (70-80% remission; Barlow et al., 1989), social anxiety disorder (75% responded; Heimberg et al., 1990), specific phobias (65% remission; Ost, 1989), post-traumatic stress disorder (40% remission, Foa, Rothbaum, Riggs, & Murdock, 1991), and obsessive-compulsive disorder (83% responded; Foa, 1996). In particular, some investigators argue that key indicators of emotional processing (i.e., fear activation and habituation; Foa & Kozak, 1986) appear to account for these effects.

***Fear activation*.** Early researchers discovered that fear activation seems to be a necessary component for reducing anxiety with respect to a feared object (Lang, Melamed, & Hart, 1970). Foa and Kozak (1986) address the role of information processing when they explain that attention directed towards a feared object activates the fear network. Subsequent emotional processing and incorporation of new, incompatible information weakens this fear structure and reduces the need for "preparatory physiology" (e.g., increased blood pressure). This notion was later revisited when researchers suggested that attentional focus towards threat may be a prerequisite to activating and modifying fear structures as this form of sensory processing is necessary to incorporate corrective information into the fear structure (Foa & McNally, 1996).

Exposure therapy effectiveness has been shown to be associated with heart rate response and fear habituation as measured by approach toward the feared object and subjective fear ratings (Lang et al., 1970). Borkovec and Grayson (1980) likewise noted the importance of greater fear activation during exposure therapy while the feared stimulus is initially presented. Similarly, Kozak and colleagues (1988) found an association between increased heart rate activity and reduced fear and avoidance post-treatment for individuals with obsessive-compulsive disorder. Later, Foa, Riggs, Massie, and Yarczower (1995) found that increased fear activation as indicated by greater subjective anxiety ratings and more intense facial fear expressions was associated with greater treatment improvement among those with post-traumatic stress disorder. Therefore, early evidence supports the notion that increased physiological responding in the presence of a stimulus is important for the treatment of fear responses.

Habituation. According to early fear reduction theories, habituation (i.e., the decrease in fear after repeated presentations of a stimulus) is a necessary process in exposure therapy (Foa & Chambless, 1978). Furthermore, habituation has been found to occur both within and between sessions, meaning within the duration of a single exposure and across different exposure sessions. Several investigations have examined the relationship between within and between-session habituation and outcome post-treatment. The majority of evidence appears to support the importance of between-session habituation (Kozak et al., 1988; Foa et al., 1983). Evidence concerning within-session habituation has been less clear with some studies noting the benefits (Foa & Chambless, 1978; Grayson, Foa, & Steketee, 1982; Foa et al., 1983), and others failing to find support for its association with long-term symptom improvement (Kozak et al., 1988; van Minnen, 2002). As suggested by Craske (2008), these differences arise perhaps due to some authors' reliance on habituation as indicated by decreased physiological symptoms which may not be a reliable indicator of long-term fear reduction.

Regardless of findings related to within vs. between-session habitation, it appears that attention is necessary for this process. In particular, habituation has an effect on cognitions by providing evidence against maladaptive beliefs; notably, that anxiety will only increase in the presence of the feared stimulus or that anxiety itself can become dangerous (Foa & McNally, 1996). Therefore, attention serves to facilitate the disconfirmation of threat that occurs during exposure tasks. Essentially, attention allows for the observation of discrepancies between the original fear network and the corrective experience of the stimulus information, responses to the stimulus, and the meanings associated with stimuli and fear responses. Without attention to the feared stimulus, these elements of the fear network cannot be challenged.

Inhibitory Learning Theory. Inhibitory learning theory arose from basic animal research and produced findings that were later incorporated into a revised version of Foa and Kozak's (1986) original theory (Foa, Huppert, & Cahill, 2006). Specifically, evidence from both animal and human literature regarding extinction in fear-conditioning indicate that fear is not unlearned (Hermans, Craske, Mineka, & Lovibond, 2006). In other words, associations between the conditioned stimulus and the unconditioned stimulus learned during fear conditioning persist despite extinction. Inhibitory learning occurs when the original association between the conditioned stimulus and the unconditioned stimulus is not erased, but rather a new association (conditioned stimulus and no unconditioned stimulus) is learned (Bouton, 2002). In this vein, extinction training (i.e., exposure therapy) does not destroy the old association, but instead a new association is formed and the old one remains.

Phenomena resulting from the retention of the original association in memory (such as renewal, reinstatement, and recovery) are associated with relapse (see Bouton & King, 1983; Rescorla & Heth, 1975; and Bouton, 1993). These findings led several researchers to propose that extinction is more sensitive to context shifts than the original excitatory learning (Bouton, 1997; Rosas, 2006). In particular, when there is ambiguous information concerning the meaning of a given fear cue, attentional resources are allocated to the context and the information is encoded into memory along with contextual information (Bouton, 1997). Rosas (2006) further stated that once a context is associated with ambiguous information, new information presented in that context becomes context-dependent. Thus, one resolves the contradiction between an old fear association and a new, non-threatening association by paying attention to the context, and processing the information as context-specific.

In line with Bouton's previous work, Foa and McNally (1996) revised EPT's (Foa & Kozak, 1986) stance that a new structure is created and instead proposed that the new, non-fear structure competes with the old one through the development of new associations. The acquisition of new inhibitory links should occur in the context in which the pathological fear network was once activated. Clinically, this information suggests that a goal for therapists is to increase the accessibility of these inhibitory associations in the old context in which fear structures were activated.

In Craske and Mytowski's (2006) review of the literature related to investigating extinction and exposure therapy, authors encouraged the field to move away from an emphasis on fear reduction. This unique and divergent point was further elaborated by Craske and colleagues (2008) when they proposed that fear toleration would yield greater benefit over fear reduction in exposure therapy. In particular, authors argue against relying on the previously mentioned indices of corrective learning according to EPT (Foa & Kozak, 1986) (i.e., fear activation, and within and between-session habituation), and instead emphasize toleration of distress in the context of exposure-based learning of new inhibitory associations.

A more recent review concerning inhibitory learning added further evidence in support of its role in exposure therapy (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Cognitive and behavioral strategies included were expectancy violation (i.e., designing exposures in order to maximize the discrepancies between expectancy and outcome), deepened extinction (i.e., presenting multiple fear cues after each has been used separately during exposure work or pairing a previously extinguished cue with a novel conditioned stimulus), reinforced extinction (i.e., occasionally pairing the conditioned stimulus and unconditioned stimulus during extinction training), variable practice (i.e., exposure to different stimuli as opposed to waiting for habituation to one stimulus before moving on to the next, or varying the duration of exposures), and using multiple contexts in which to conduct exposure therapy. The authors also listed other strategies such as attentional focus (i.e., maintaining attention on the exposure stimulus and the non-occurrence of the unconditioned stimulus) and affect labeling (i.e., describing one's emotional experience during the exposure procedure). Authors concluded that these types of procedures promote extinction learning (i.e., they strengthen the new memory so that it can compete with the old, fear-inducing memory).

The Role of Attentional Processing

The role of attention should be considered within the context of existing theoretically-supported mechanisms of fear reduction such as those mentioned previously. In review, attention is thought to play a role early on in the fear response and is associated with fear activation (Foa & Kozak, 1986). Specifically, attentional focus on threat is needed to both gain access to the fear structure during initial processing as well as during the process of acquiring new, inhibitory associations. Activation of the fear network enables the fear structure to be accessible for the encoding of new information. If this activation of the structure fails to occur via behavioral or cognitive avoidance, an individual will not be able to have a corrective experience via extinction training.

Along these lines, in order for the process of habituation to occur one must confront the feared object or situation. Therefore, it follows that the presentation of a stimulus would involve some degree of attentional processing. Given the previously discussed research, it appears that there is great support for the therapeutic benefits of facilitated attentional focus on threat with regard to behavioral therapy for anxiety.

Despite research developments regarding the importance of attention in anxiety interventions, the role of underlying attentional processes in exposure therapy has not been fully explored. Furthermore, the theories that set the foundation for behavior therapy do not thoroughly explain how critical this component is in fear reduction. Much more work is needed in this area to gain a more complete picture of this process. Therefore, it would benefit the field to move in the direction of addressing this gap in the literature.

Focused Attention Versus Distraction in Exposure Therapy

There is currently debate in the literature regarding the pattern of attentional processing and its effect on exposure to a feared stimulus, specifically regarding focused attention versus distraction. This question directly relates to potential mechanisms of exposure therapy. Again, EPT (Foa & Kozak, 1986) puts forward strong predictions regarding the impact of distraction on fear reduction. Specifically, that cognitive avoidance (distraction) should impede fear activation and long-term habituation. Accordingly, distraction may decrease fear in the short-term during an exposure task, but inadequate activation of the fear structure and deficient processing of disconfirmatory information should result in greater levels of fear in the long-term and ultimately a maintenance of anxiety symptoms. In other words, by utilizing distraction strategies, an individual is essentially not receiving the exposure treatment and thus fails to benefit from the corrective information. Hence, post-treatment, one would expect to observe a fear response in the same manner as an individual who has not received exposure treatment.

Despite these predictions, there is some experimental evidence in favor of distraction strategies. To begin, in one study, individuals with snake and spider phobia completed three exposure conditions in a counterbalanced order in order to examine the effects of distraction on fear levels (Craske, Street, Jayaraman & Barlow, 1991). For the focused condition, participants were instructed to think about the characteristics of either a snake or spider and their own physical reactions to the stimulus. For the distraction condition, participants listened to audio-taped passages followed by multiple-choice questions. A natural focus group was included with no additional instructions during the exposure, and a baseline condition was included for comparison. In each condition, participants stood in the presence of the snake or spider and were instructed to press a button each time that a light flashed behind the feared stimulus in order to ensure that visual attention was maintained.

Results indicated that focusing attention on physical sensations of fear and characteristics of the feared object resulted in increased subjective anxiety levels from beginning to end during the exposure task and increased fear ratings upon completion of the exposure. In contrast, individuals in the distraction condition reported less subjective fear supporting the researchers' hypothesis that distraction mimics the phobic individual's natural tendency to distract in an attempt to reduce anxiety. In terms of physiological responding, heart rate measurements revealed no differences between groups. Taken together, these findings appear to support the hypothesis that use of distracting as opposed to focusing strategies results in less subjective fear.

Craske and colleagues' (1991) investigation may be limited based on several noteworthy weaknesses. Importantly, fear reduction was not assessed pre to post-treatment as each participant completed each condition in a counterbalanced order. This greatly limits the potential to examine the effects of focused attention versus distraction outside of the immediate exposure experience. Also limiting, attentional focus was measured via self-report questions; therefore, a more direct manipulation of attention may be needed to draw stronger conclusions. Another potential methodological flaw concerns the use of a flashing light to aid participants in maintaining visual attention on the object. Although the researchers were more interested in verbal and cognitive attention, this may present a potential confound in the sense that visual attention was left intact which still allows for a certain degree of processing.

In a similar investigation, results revealed that participants with spider phobia who engaged in stimulus irrelevant (i.e., distracting) as opposed to stimulus relevant (i.e., threat-focused) conversations reported greater reductions in subjective anxiety both within and between sessions (Johnstone & Page, 2004). Likewise, individuals in the distraction condition evidenced lower subjective anxiety ratings that decreased more rapidly over the course of the exposure. Again, from the standpoint of EPT (Foa & Kozak, 1986), the data from Johnstone and Page's (2004) investigation appear to provide evidence that conflict with the notion that distraction hinders long-term fear reduction. The improvements of the distracted group were also found on self-report measures of spider fear and self-efficacy.

In addition, those who engaged in stimulus-irrelevant conversations during the exposure task completed an increased number of steps on the behavioral approach task. This finding reveals that distraction results in a clinically meaningful decrease in avoidance. Authors suggest that this enhanced performance may perhaps be due to the sense of greater self-efficacy and perceived control experienced among those in the distraction condition. This has important implications for the benefits of this strategy as opposed to a more traditional threat-focused approach during exposure work that would be supported by emotional processing models of fear reduction.

Oliver and Page (2008) attempted to extend these findings among individuals with blood-injection-injury phobia while at the same time further breaking down the conditions into internal versus external focusing and distraction. The authors believed that this adjustment could more adequately capture the influence of focusing attention on internal reactions to the phobic object versus the phobic object itself (which may be perceived as another form of distraction). Accordingly, individuals were assigned to one of five conditions: 1) exposure + internal focus (e.g., sensation of heart beating fast), 2) exposure + external focus (e.g., describing the stimuli in detail), 3) exposure + internal distraction (e.g., how feet feel in shoes), 4) exposure + external distraction (e.g., future plans), and 5) exposure only. During the exposure tasks that involved viewing phobia-relevant images on a computer screen, participants were required to maintain visual attention by responding to probes on the screen.

Investigators found that participants in all conditions improved from pre to post-treatment in terms of self-report measurements of fear. With respect to within and between session habituation, researchers noted that with the exception of the first exposure trial (during which there were no group differences), participants in the exposure + external distraction condition reported less subjective fear. Regarding perceived control, those in the distraction group reported greater increases at follow-up; however, this difference was not observed immediately post-treatment. In addition, results of the behavioral approach task revealed that individuals in the distraction condition completed more steps than those in the focusing condition both post-treatment and at follow-up.

The authors propose that these findings are consistent with an affective control model (Barlow, 1988), which assumes that distraction promotes fear reduction and increased perceived control. More importantly, distraction again facilitated approach behavior towards the feared stimulus, thus demonstrating a clinically meaningful reduction in anxiety (Oliver & Page, 2008). Again, the effects of distraction appear to benefit individuals with respect to the habituation process despite the predictions made by EPT (Foa & Kozak, 1986). Importantly, however, the methods used by Oliver and Page (2008) to maintain visual attention on threat continue to allow for some degree of threat-related processing. This critical methodological shortcoming of both Johnstone and Page (2004) and Oliver and Page (2008) may greatly limit the generalizability of these results under more naturalistic visual processing circumstances.

Regarding evidence against distraction, Kamphuis and Telch's (2000) findings appear to support Foa and Kozak's (1986) EPT. Researchers assigned claustrophobic individuals to one of four conditions: 1) exposure + threat reappraisal (i.e., focusing attention on perceived threat associated with exposure task and its disconfirmation), 2) exposure + cognitive load (i.e., listening to strings of numbers and responding based on task instructions, 3) exposure + threat reappraisal and cognitive load, and 4) exposure only (Kamphuis & Telch, 2000). Investigators found that threat reappraisal facilitated fear reduction and cognitive load (distraction) inhibited fear reduction between trials. No within-session differences were observed. In addition, those in the threat reappraisal group demonstrated the most fear reduction and the lowest return of fear on the behavioral approach task. Those in the cognitive load condition demonstrated reduced fear reduction from pre to post-treatment on the behavioral approach task in terms of subjective fear and heart rate response, as well as a greater return of fear.

Taken together, in order to benefit most from an exposure, results of this study indicate that attention should be maintained on the fear stimulus in order to sustain fear processing. Authors also reason that this maintenance of attention will help promote between-session habituation to the feared stimulus. Thus, there appears to be a direct link between the focus of attentional allocation and key components of emotional processing. Researchers noted that the cognitive load task utilized in this study "severely taxes information processing resources", suggesting that with this type of potent distraction manipulation, emotional processing may be more strongly impeded.

Building on Kamphius and Telch's (2000) previous work, Telch and colleagues (2004) designed another investigation that aimed to test the predictions of Foa and Kozak's (1986) EPT. Claustrophobic individuals were assigned to one of four conditions during exposure tasks that took place in a claustrophobia chamber: 1) attend to relevant threat words presented auditorily (repeat and form mental image), 2) attend to neutral words, 3) cognitive load (presented with tone pairs and instructed to identify as same of different) and 4) exposure only (Kamphuis & Telch, 2000). No differences were observed among groups in terms of fear activation during treatment; although, interestingly, increased fear activation was associated with reduced fear reduction. In terms of between-session habituation, those in the cognitive load condition demonstrated less reduction in subjective fear. Those in the cognitive load condition also demonstrated reduced clinical improvement from pre to post-treatment in terms of peak fear levels and heart rate response during the behavioral approach task.

Taken together, this form of cognitive distraction appears to hinder fear processing when compared with focusing attention on threat. Again, increased demand on the information processing system diminishes the amount of attention available for emotional processing to occur. Of note, the other conditions do involve some degree of attentional distraction in the sense that participants were simultaneously performing tasks while in the claustrophobia chamber. Consequently, this may be another case where it is a matter of degree in terms of processing interference that can inhibit the mechanisms of fear reduction proposed by EPT (Foa & Kozak, 1986).

Ultimately, it is important to establish the parameters in which attentional manipulations are effective in promoting fear reduction. Extant studies have made considerable progress in this regard; however, mixed findings due to methodological differences (see Rodriguez & Craske,

1993) such as inadequate definitions of distraction or inconsistent targets of distraction obscure this issue. Although there exists evidence to suggest the benefits of using distraction strategies during exposure therapy (e.g., Johnstone & Page, 2004; Oliver & Page, 2008), the vast majority of the literature supports the opposite, and is in line with Foa and Kozak's (1986) EPT. In particular, the evidence indicates that some degree of attention is necessary to activate the fear structure and for processing of incompatible information.

In this vein, several issues deserve further investigation. First, ways to improve the methodology in such research is needed. More importantly, investigations that employ a pre-exposure therapy manipulation of attentional processes should be considered, particularly regarding attention focused towards and away from threat in combination with exposure work. The majority of experiments thus far have used these manipulations concurrently with exposure to a feared stimulus. Perhaps, stronger conclusions may be drawn from a more strategic and controlled manipulation of attentional allocation that carries through exposure therapy with a feared object. Moreover, targeting of early visual attention as opposed to later, or higher-level processing may yield a different pattern of findings.

Attention Bias Modification and its Theoretical Foundations

Attention Bias Theory. Information processing models of anxiety propose that biased processing plays a role in the etiology and maintenance of anxiety pathology (Beck & Clark, 1997). Specifically, anxiety biases processing in 3 stages: 1) initial registration of the threat stimulus (i.e., orienting), 2) activation of a primal threat mode, and 3) the secondary activation of more elaborative and reflective modes of thinking. According to Beck and Clark's (1997) model, the primal mode is activated during the early stages of processing among anxious individuals and includes cognitive, affective, behavioral, and physiological responses with the purpose of maximizing safety and minimizing danger. It is during these early stages of processing that attentional resources are captured and devoted towards responding to a potential threat at the expense of more a constructive pattern of responses.

In particular, investigations examining the nature of this cognitive bias have revealed that anxious individuals appear to have difficulty with attentional disengagement as opposed to engagement or biased orienting towards threat (Fox, Russo, Bowles, & Dutton, 2001). Disengagement has been defined as one's ability to switch attention away from a threat stimulus and towards another stimulus (Cisler & Koster, 2010). A series of experiments used an exogenous cueing paradigm whereby anxious participants demonstrated slower reaction times to detect a target on invalid trials after a threat-related (lexical or pictorial) cue when compared with non-anxious participants (Fox et al., 2001). The authors suggested that it is this tendency to maintain attentional resources on threat that serves to perpetuate as well as elevate anxiety. Therefore, regarding mechanisms of attentional bias (AB) in anxiety, disengagement of threat is a key component of visual attention that is impaired.

In line with previous findings, Amir, Elias, Klumpp, and Przeworski (2003) found that individuals with social phobia demonstrated longer response times than non-anxious controls following the presentation of invalidly cued targets on a probe detection task. This indicates that they were slower to disengage attention from social threat stimuli and reorient their attention to the location of the target. Difficulty with disengagement has also been noted using eye-tracking technology whereby anxious participants demonstrated longer durations to detect a probe after viewing an emotional face (Schofield, Johnson, Inhoff, & Coles, 2012). Therefore, it appears that anxious individuals have difficulty shifting attention once allocated towards threat, and this pattern can be noted using various AB measurement techniques.

Considering the results from the aforementioned empirical studies, it appears that AB may be a causal maintenance factor in a number of anxiety disorders. This is supported by cognitive-behavioral theory as well, which proposed that individuals with social phobia are quick to engage attention towards threat, and have subsequent difficulty disengaging attention (Rapee & Heimberg, 1997). Indeed, according to one meta-analysis, data from numerous investigations indicates that AB towards threat is a robust phenomenon among anxious individuals, and is not found among non-anxious individuals (Bar-Haim et al., 2007). Taken together, there is strong theoretical support for the role of AB in the etiology and maintenance of anxiety.

Attention Bias Modification. In line with growing interest, there has been expansion in the area of computer-based treatment that aims to modify the direction of attentional allocation. A relatively new form of clinical intervention called attention bias modification (ABM) has shown growing promise for treating various anxiety conditions. Currently, the dot-probe task is a widely used computerized cognitive paradigm to measure and manipulate patterns of AB. In the original task, two words, one neutral and one threatening, are presented on the screen (one on top of the other) and are then replaced by a probe (MacLeod, Mathews, & Tata, 1986). The participant is instructed to respond with a key press indicating the location of the probe. Individuals that respond faster to the location of a probe that replaces a threat stimulus are said to demonstrate an AB towards threat.

When this task is used for treatment purposes, the contingency between the probe and non-threat stimuli are manipulated such that attention is directed away from threat stimuli. Specifically, it is believed that ABM programs train attentional disengagement (Amir, Weber, Beard, Bomyea, & Taylor, 2008). In other words, repeated trials enhance this ability to disengage attention from threat after the initial orienting takes place. According to the previously mentioned mechanisms underlying anxiety that are supported by cognitive theory, this type of intervention should correct this impaired (biased) attentional process and lead to improvements in anxiety symptoms.

Amir and colleagues (2008) tested the effectiveness of such a program using a single session of ABM among individuals with social anxiety and found that compared to a placebo control training program, those who were trained to disengage their attention from social-threat stimuli (i.e., disgust faces) demonstrated reduced social anxiety on self-report measures as well as in response to a social challenge. Therefore, directly manipulating this component of the attentional process using a brief cognitive intervention can impact anxiety symptoms.

Amir and colleagues' (2008) study was replicated in a randomized control trial using an extended duration (8 session) protocol among individuals diagnosed with social phobia (Amir, Beard, Taylor et al., 2009). Specifically, researchers determined that compared with individuals that received the placebo-controlled training program, individuals in the active ABM group that trained attentional disengagement from threatening faces demonstrated a greater reduction in AB towards threat. Additionally, investigators noted improvements as indicated by reduced self-reported social anxiety and better performance on a speech task as rated by independent observers. Importantly, authors noted that change in anxiety as a result of a change in AB mediated speech performance. Altogether, facilitated attentional disengagement appears to promote symptom improvement among the social anxious.

Investigations that have employed ABM to train attentional disengagement have also noted improvement with generalized anxiety (Amir, Beard, Burns, & Bomyea, 2009) and obsessive-compulsive symptoms (Najmi & Amir, 2010). In particular, individuals with generalized anxiety disorder received 8 sessions of either ABM or a control program (Amir, Beard, Burns, et al., 2009). Those in the ABM group demonstrated a significant reduction in AB and those in the control group did not. In addition, individuals who were trained to disengage attention from threatening faces reported significant reductions in anxiety from pre to post-treatment. Furthermore, more individuals in the ABM group no longer met diagnostic criteria for generalized anxiety disorder (50% compared to 13% in the control condition). In summary, results of this randomized, controlled study indicate that training attentional disengagement supports symptom reduction with generalized anxiety as well.

Among individuals with subclinical levels of obsessive-compulsive symptoms, Najmi and Amir (2010) tested the effectiveness of a single-session of ABM when compared with a control training program. Again, training attentional disengagement from threat (in this case, contamination-related words) was found to effectively reduce the magnitude of AB whereas the control program did not. Researchers also discovered that AB change mediated the relationship between ABM and the number of steps completed on a behavioral approach task. Analysis of fear ratings during the task did not reveal significant differences between groups. The authors proposed that this may be due to the differences between the number of steps completed, as those in the ABM group completed more and perhaps experienced increased stress. These findings together demonstrate a connection between the modification of attentional allocation via training attention away from threat, and the causal reduction of avoidance during a behavioral challenge.

In summary, biased attentional processing is characteristic of individuals with elevated anxiety symptoms. Difficulty disengaging attention in particular has shown to be a key component of this disordered processing style. It appears that this biased pattern of attentional processing is amenable to cognitive training. Growing evidence suggests that computerized programs that directly manipulate attention away from threat are effective in reducing both self-reported anxiety as well as behavioral indices of fear.

Importantly, AB has also been shown to be a moderator of treatment outcome in ABM among individuals with social anxiety disorder (Amir, Taylor, & Donohue, 2011). Specifically, those who demonstrated a greater magnitude of AB towards threat pre-ABM treatment reported greater reductions in social anxiety according to clinician ratings. The authors suggest this is in line with the notion that if AB towards threat is the problem and ABM is the way to fix it, those with greater AB would benefit most from ABM. Similarly, among socially anxious individuals that received behavior therapy, those that were slower to disengage attention during an AB assessment task administered pre-treatment demonstrated greater improvements according to clinician ratings (Niles, Mesri, Burklund, Lieberman, & Craske, 2013). This link between patterns of AB and symptom improvement further supports the theoretical importance of understanding the role of attention in fear reduction.

Regarding mechanisms of ABM, in a study that trained attention towards and away from social threat among individuals with social anxiety, attentional control increased in both groups compared to control and anxiety reduction in response to a social stressor occurred in both (Klumpp & Amir, 2010). Authors stated that training attention toward threat and seeing anxiety reduction is counter to what cognitive theory would predict. Importantly, these results demonstrate that increasing attentional control by modifying AB produces anxiety reduction. Therefore, there is evidence pointing in seemingly opposite directions (i.e., directing attention towards or away from threat may be beneficial via a common cognitive mechanism). Certainly, the majority of ABM research supports improving the ability to disengage attention.

The Current Status of ABM. The theoretical foundations as well as empirical evidence behind ABM indicate that biased patterns of attention play a role in the etiology and maintenance of fear and anxiety and can hinder treatment improvement. Evidence is accumulating that strongly support the efficacy of this novel treatment approach among a variety of anxiety conditions. In a recent meta-analysis, Hakamata and colleagues (2010) examined 12 randomized-controlled trials in which investigators tested ABM against a placebo dot-probe training program among clinical and non-clinical populations. The authors found that ABM resulted in significantly greater anxiety reduction when compared with placebo training with an effect size of Hedge's d (d) = 0.61. There was a significant trend (.0502) towards a moderating effect of AB change on anxiety level. Taken together, the literature strongly supports this novel treatment approach, and it appears the efficacy of ABM relates to reducing the magnitude of AB towards threat.

According to Bar-Haim's (2010) review, ABM produces similar effect sizes when compared with standard treatments such as cognitive-behavioral therapy (CBT) and selective serotonin reuptake inhibitors (SSRIs) when tested with clinical samples (see Amir, Beard, Burns, et al., 2009; Schmidt, Richey, Buckner, & Timpano, 2009). Furthermore, ABM does not require the presence of a highly-trained therapist and is highly cost-effective and accessible.

Of note, ABM procedures have come under scrutiny by some in the research community. For example, in Emmelkamp's (2012) review, the author argued that several ABM investigations could not be replicated among a clinically anxious as opposed to an analogue sample. An important paper addressing this point noted that in one of the key investigations in question (i.e., Carlbring et al., 2012), researchers were not successful in modifying AB patterns (Clarke, Notebaert, & MacLeod, 2014). This, the authors argue, is critically important, as failure to modify this causal mechanism is directly related to change in anxiety. The authors noted that these findings are thus still theoretically consistent with the notion that AB change produces a reduction in anxiety. In other words, if there is no change in AB, one cannot expect a reduction in symptoms. According to ABM theory, it is only when AB is successfully directed away from threat that there can be a change in anxiety.

In Clarke and colleagues' (2014) review, they referenced 29 studies measuring both change in AB patterns and emotional vulnerability. Of these studies, 26 follow this pattern of changes in emotional symptoms following a change in AB, and none reported change in emotional symptoms if there was no change in AB. Again, the majority of evidence with only minor exceptions indicates that when you are able to successfully modify attentional allocation, this change results in anxiety symptom reduction.

In review, empirical findings support the benefits of training attentional disengagement from threat (for examples, see previously discussed ABM research findings). This evidence has been established among clinical (e.g., Amir, Beard, Burns, et al., 2009; Amir, Beard, Taylor, et al., 2009) and subclinical (e.g., Amir et al., 2008; Bar-Haim, Morag, & Glickman 2011) anxiety populations alike. These changes are not only identifiable immediately post-treatment, but are maintained at follow-up as well (e.g., Amir, Beard, Burns, et al., 2009). Thus, it is important to consider the presence of effective manipulation of attentional disengagement from a theoretical standpoint, as this is a key impairment according to AB theory that influences anxiety reduction. Indeed, this is an exciting time for AB research, as these cognitive training methods continue to gain support in the area of anxiety disorders.

Limitations of Existing Work and Future Possibilities. Importantly, it has been stated in the AB literature that results obtained in the laboratory setting may not translate to real-world settings (MacLeod, Koster, & Fox 2009). For instance, using more behavioral approaches as opposed to relying on self-report measures of anxiety would enhance the generalizability of findings in terms of fear reduction post ABM. It is important to determine whether or not AB training-related symptom improvement extends to relevant anxiety-provoking situations. Therefore, researchers that employ behavioral assessment of fear reduction will methodologically strengthen these types of AB investigations.

Additionally, MacLeod and colleagues (2009) note the limitations of relying on dot-probe tasks for both the measurement and modification of AB. This methodological shortcoming presents a problem in terms of how well ABM can generalize to a more naturalistic environment. Currently, other AB assessment paradigms exist such as exogenous cueing that can be used in place of dot-probe assessment and training tasks (e.g., Van Brockstaele, 2011). Using both tasks is one method of strategically controlling for effects that may be due to the use of a shared paradigm. Likewise, Macleod and colleagues' (2009) review argued for a more broad approach that utilizes multiple methods of AB training and assessment as a range of stimuli could more successfully capture a variety of everyday situations. To summarize, future research should explore other methods to measure improvement in symptoms in more sensitive and ecologically valid ways as well as cognitive change because this is key to the process of treatment generalization.

Of note, attention training towards spider threat has been found to effectively reduce AB (Reese, McNally, Najmi, & Amir, 2010), although it did not produce significantly greater fear reduction when compared with a control training program. A similar investigation during which researchers trained attention either towards or away from spider images also successfully manipulated attention in the expected directions, but failed to observe changes in avoidance behavior or physiological arousal (Luo et al., 2015). More importantly, investigators were able to successfully manipulate attentional focus among this population. Given the paucity of ABM research that uses a specific phobic population, more investigation into the effects of ABM on fear reduction is warranted. It may be possible that ABM cannot reduce symptoms of specific phobia directly; however this form of intervention can have a lasting effect on patterns of attentional processing.

Altogether, there is growing empirical evidence in support of the mechanisms behind ABM. Importantly, it appears that this approach to modifying cognitive biases is effective to the extent that the modification of AB in fact occurs. As noted, there are some methodological limitations and shortcomings of previous research. For instance, ABM investigations may be improved by taking into consideration methods of outcome measurement, AB assessment and modification paradigms, as well as the population sampled (i.e., generalized anxiety concerns versus more specific fears). Additionally, there has been a call to the field of anxiety disorders to investigate the potential benefits of using a treatment approach that combines ABM with standard forms of treatment such as behavior therapy.

Combining Attention Bias Modification and Exposure Therapy. Regarding future research that combines ABM and CBT, it is important to take into consideration the underlying processes involved in fear reduction. ABM works by directly modifying patterns of attentional allocation, particularly, disengaging attention from threat. The role of attention during exposure therapy is less clear. To review, there is mixed evidence concerning attentional focus versus distraction in exposure therapy. More certain is the idea that some degree of cognitive processing factors into the confrontation with a feared stimulus and the anxiety response. Again, this premise is largely supported by the propositions of Foa and Kozak’s (1986) EPT. Fortunately, efforts are emerging to investigate the potential effects of combining these two treatment modalities.

Combining Attention Bias Modification and Exposure Therapy in the Literature. Researchers hypothesized that perhaps combining CBT and ABM may bolster the effects of treatment (Taylor & Amir, 2010). Thus far, few attempts have been made to integrate ABM with behavior therapy and the populations studied and the methodology employed has varied widely. For instance, Amir and Taylor (2012) found that 12 sessions of ABM plus computer-delivered CBT that included exposure modules resulted in symptom improvement for generalized anxiety disorder. There was no control group included in this study for comparison. Results indicated that the magnitude of AB towards threat was reduced, and that this decrease in AB was associated with a decrease in worry. Therefore, efforts to reduce attention towards threat may also be beneficial when combined with CBT.

Another study combined ABM and CBT in a community-based residential treatment program for anxiety that included medication management (Riemann et al., 2013). Specifically, children and adolescents were randomly assigned to complete either adjunctive attention training or placebo training programs. Although significant improvements occurred in both groups, those that received the adjunctive ABM program demonstrated additional improvement in anxiety symptoms at post-treatment. This was evidenced by a reduction in anxiety symptoms via self-report measurements. These two studies combined, provide preliminary support in favor of combining exposure therapy and ABM.

Other evidence in the literature provides weaker, yet encouraging support in favor if this approach. For example, investigators in a recent study combined attention training towards positive stimuli with a single session of exposure therapy for children with specific phobias

(Waters et al., 2014). Each participant viewed 160 trials containing pairs of faces with happy and angry facial expressions presented side-by-side. Individuals that were assigned to the active version of the training program responded to a probe that only replaced happy faces, while those in the placebo condition responded equally to both happy and angry faces as there was no contingency between probe and facial valence. The exposure component lasted a maximum of three hours and consisted of psychoeducation and graduated in-vivo exposure exercises.

Results of this study indicated that those who received the adjunctive ABM towards positive faces demonstrated a significant reduction in danger expectancy ratings. In addition, post-treatment vigilance towards happy faces was predictive of lower phobic severity at follow-up. There were no significant differences in terms of change in diagnostic status, or phobic, anxiety, and depression symptom severity. The authors suggested that perhaps a greater dose of ABM may produce more robust changes with respect to changes in the main clinical outcome measures. Further, researchers did not observe overall pre-treatment AB towards threat among participants, and suggested that this pattern made it less likely that they would observe a significant reduction in the magnitude of AB towards threat. Therefore, one cannot expect to find the typical association between improved attentional disengagement from threat, and a reduction in anxiety symptoms.

A similar study combined ABM towards happy faces and CBT for children (Britton et al., 2013). Results indicated that there was no pre-treatment AB towards threat among anxious individuals. Again, ABM is designed to alter this initial pattern of processing. Therefore, in the absence of clear difficulties with disengagement from threat, this manipulation may fail to produce changes on clinical symptom measures. In this investigation, active and placebo groups both demonstrated reductions in anxiety and symptoms on clinician administered and self-report measures. Of note, those in the active ABM condition did observe a faster treatment response. In summary, this research does not provide clear support in favor of using ABM towards positive stimuli as an adjunctive treatment.

Another group of researchers randomized anxious children into one of three conditions: CBT alone, CBT + ABM, or CBT + ABM placebo (Shechner at al., 2014). The CBT procedure consisted of 16 50-minute sessions that involved psychoeducation, cognitive-restructuring, and exposure therapy. Participants in the ABM conditions completed dot-probe tasks when they came for therapy appointments that presented images of disgust and neutral facial expressions. Analyses revealed significant reductions in the average number of anxiety symptoms in both the active and placebo ABM conditions. Additionally, significant reductions in symptom severity were observed across all 3 groups, with a larger effect demonstrated in the ABM groups compared with the CBT-alone group. Both ABM groups improved with respect to diagnostic status when compared with CBT alone. Lastly, only the active ABM + CBT group demonstrated significant reductions on parent-reported measures of anxiety.

To summarize, both ABM groups demonstrated greater reductions in anxiety symptoms according to clinician-administered measures. The authors offered several reasons for this observation including the potential enhancement of attentional control and flexibility as well as exposure to aversive stimuli via the threatening faces. Importantly, AB towards threat decreased significantly in all groups indicating that CBT alone can significantly alter AB perhaps creating a floor effect in the current study. Taken together, the benefits of training attention away from threat, specifically, in this sample were unclear.

In a study that combined group treatment for social phobia with ABM, investigators did not observe any group differences (Rapee et al., 2013). Specifically, individuals underwent 12 weekly 2-hour sessions that included standard CBT components such as cognitive restructuring and exposure therapy, as well as “attentional training” that involved explicit instruction to shift attention away from threat and towards the task at hand. A word-based dot-probe task was used for the active and placebo ABM procedure and was to be completed on a weekly basis at home. Importantly, the investigators provided a rationale for these two methods of targeting attention related to top-town and bottom-up processing. Results indicated that there were no differences between groups post-treatment in terms of diagnostic status, or self-reported and clinician ratings of social anxiety. Likewise, no group differences were observed for the social threat tasks.

The authors offered a number of limitations that may explain these null findings. Most importantly, AB was not successfully modified by the ABM procedure. As previously discussed, failing to alter patterns of attentional processing prevents one from expecting a change in anxiety symptoms. In addition, the investigators of the study reported that none of the participants completed all of the training sessions, and that more than half of the participants failed to complete over half of the training sessions. Thus, compliance with the at-home training was quite poor. Along these lines, ABM is traditionally delivered in a controlled laboratory setting and a home environment presents more opportunity for distraction. Together, these factors may have influenced the potency of the ABM procedures.

Moreover, Rapee and colleagues (2013) presented the mechanisms behind the attentional manipulations explicitly, which may have influenced task performance. Lastly, the inclusion of “attentional training” (i.e., instruction to make conscious attentional shifts) during the exposure procedure in combination with other forms of attentional manipulation may have altered the patterns of findings in this investigation. All together, there were several noteworthy limitations of this study that may account for the lack of support for a combined approach. All of these limitations should be considered in future research to improve the likelihood of successful intervention.

Kuckertz and colleagues (2014) tested the effectiveness of an adjunctive ABM procedure among individuals with PTSD in a community setting. All participants received standard treatment for PTSD (either prolonged exposure or cognitive processing therapy) and group-based treatment. Participants in the active and placebo conditions completed ABM training daily for a period of 2 weeks. Results indicated that there were no differences between groups in terms of AB change post-treatment. Regarding the clinical outcome measures, PTSD and depression symptoms decreased in both groups, and these decreases were larger in the active ABM group. These findings provide some preliminary support in favor of using ABM in conjunction with CBT; however, it appears that improving attentional disengagement alone did not account for these effects.

Although there is clearly a paucity of research in this area, the results obtained thus far appear to be promising. Of note, the current literature related to combining ABM and exposure therapy presents mixed findings and investigations that vary widely in their approach. Based on the evidence, it is important moving forward to consider several factors including the dose and delivery of the two forms of treatment. There may be an optimal balance to be reached in terms of the number of sessions as well as the environmental conditions in which the treatment is delivered, particularly with respect to the ABM procedure. Future researchers should also carefully evaluate characteristics of the cognitive-behavioral treatment that ABM is paired with. In particular, any inclusion of an attentional manipulation may convolute the effects of ABM. Lastly, as with all AB research, it is critical to examine the presence of AB change from pre- to post in order to determine the association between this variable and treatment outcome.

Competing Evidence for the Benefits of using a Combined Approach. More systematic experimental research is needed to determine the effects of combining ABM and exposure therapy in order to reconcile the theoretically conflicting role of attention. These two approaches diverge with respect to attention, as exposure therapy seems to require attentional focus towards threat whereas the traditional ABM paradigm promotes more threat-avoidant attentional patterns. Investigations that systematically manipulate attention prior to exposure work may shed light on how to potentially improve this form of intervention by optimizing attentional focus.

The Current Study

The Importance of Understanding the Role of Attentional Processing in Exposure. Early on, the importance of the role of attention during exposure was noted in the literature. Borkovec and Grayson (1980) argued that mere exposure alone is not what defines a successful exposure; instead, variables that "facilitate the subject's awareness and/or processing" are what make exposures "functional" (p.118). Therefore, enhancing attentional focus towards threat could potentially have the effect of promoting fear processing during exposure therapy. Furthermore, training attention towards threat is more consistent with the principles of EPT (Foa & Kozak, 1986), which posit that confrontation with threat is essential for successful exposure therapy as this leads to activation of the underlying fear structure and processing of discrepant information. Taken together, a pre-exposure manipulation of attentional allocation *toward* threat in combination with exposure may mutually facilitate processing of the exposure stimulus and thus optimize threat processing related to one's fears (i.e., *Threat-focus Facilitation Hypothesis*).

Regarding the opposite point of view, the majority of the literature regarding attention training for anxiety disorders indicates that training attention away from threat is effective (e.g., Amir et al., 2008; Schmidt, Richey, Buckner, & Timpano, 2009; Amir, Beard, Burns, et al., 2009). The growing support of this method of intervention is quite intriguing when considering the opposite mechanisms (i.e., attentional focus on threat) supported by Foa and Kozak's (1986) EPT and the exposure therapy literature. The ABM findings also parallel other previously mentioned experimental data suggesting that distraction, or essentially training attention away from threat, can lead to improvements with respect to anxiety symptoms. In other words, perhaps some degree of distraction from threat in one's immediate environment allows the individual to exhibit greater approach behaviors towards the stimulus. This may then facilitate the process of learning that a feared outcome did not occur and that avoidance or extreme anxiety in such situations is unjustified. Therefore, in terms of combining ABM and exposure interventions, one can reasonably argue for a competing hypothesis where exposure can be more effective with the assistance of the threat-disengagement training (promoting attentional avoidance from threat rather than attentional focus on threat) by adding up the two established paradigms (i.e., *Additive Effects Hypothesis*).

We need a systematic investigation to examine how the therapeutic effect of exposure therapy can be further enhanced by incorporating the ABM paradigm. Based on existing theories and empirical data, each of these two competing hypotheses appear viable in predicting the results of the combined ABM + Exposure intervention. The Threat-focus Facilitation Hypothesis would predict that exposure may be enhanced further by facilitating threat confrontation during exposure via ABM focused on increasing attentional focus on threat. In contrast, the Additive Effects Hypothesis would argue that the well-established threat-disengagement ABM intervention would serve as the most effect adjunctive intervention to add to the therapeutic effects of exposure therapy.

Study Aims and Hypotheses. The primary aim of the current study was to test the two competing hypotheses (i.e., Threat-focus Facilitation Hypothesis vs. Additive Effects Hypothesis) in explaining the effects of combining attention bias pre-training with exposure therapy (EXP) for individuals with a fear of spiders. To achieve this aim, individuals were randomly assigned to one of three ABM computerized cognitive training programs: 1) attention training away from threat (ATA), attention training towards threat (ATT), or placebo control attention training (ATP). We examined which of the two competing hypotheses would be better supported by resulting data from this randomized experiment.

From the perspective of the Threat-focus Facilitation Hypothesis, it is expected that combining exposure therapy with attention training *towards* threat would facilitate the effects of EXP (which seems to require attentional focus on threat). Training attention towards threat stimuli prior to the exposure intervention may promote attentional focus on the threat during EXP, and thus enhance the potency of the exposure procedure. Therefore, the Threat-focus Facilitation Hypothesis would specifically state that ABM toward threat combined with exposure therapy (ATT + EXP) would be most effective, followed by attention training placebo plus exposure (ATP + EXP), and lastly attention training away from threat plus exposure (ATA + EXP). ATA + EXP would be predicted to be the least effective condition as the ATA intervention would attenuate the focus on threat, and thereby weaken the effects of the exposure procedure. These group differences were predicted in the following domains:

a) Subjective fear and anxiety symptoms. We predicted that we would observe differences between groups on the BAT measures including SUDS ratings and our cognitive outcome measures. In particular, we expected that individuals in the ATT + EXP condition would demonstrate greater reductions in fear and anxiety as measured by average and peak SUDS ratings and cognitive measures of spider fear, followed by ATP + EXP and ATA + EXP.

b) Behavioral indices of fear and avoidance. We predicted that we would observe differences between groups with respect to the average number of steps successfully completed on the BAT. Specifically, we expected that individuals in the ATT + EXP condition would complete more steps of the behavioral approach task.

c) Physiological symptoms. We expected that those in the ATT + EXP condition would demonstrate the greatest reduction in average and peak heart rate reactivity and average and peak breathing rate on the BAT post-treatment, followed ATP + EXP and ATA + EXP.

In contrast, the Additive Effects Hypothesis would state that ATA + EXP would more effectively reduce spider fear and avoidance. Although attentional disengagement training and exposure interventions require the opposite patterns of attentional processing, if the well-established ATA serves as an incrementally effective intervention even in the context of exposure therapy, the resulting effects of the combined interventions may likely be the additive sum of the two independent interventions. As evidenced by the ABM literature, ATA has been more consistently validated than ATT as ABM theory supports training attentional disengagement among anxious individuals (Fox et al., 2001). Furthermore, traditional ABM and EXP may be most beneficial considering the demonstrated therapeutic effects of both interventions as well as their combination (e.g., Amir & Taylor, 2012; Riemann et al., 2013). In line with this rationale, the Additive Effects Hypothesis would specifically state that the ATA + EXP condition will outperform the ATT + EXP condition, and that both ATA + EXP and ATT + EXP would outperform the ATP + EXP condition across the outcome domains described above. ATT is thought to have the benefit of increasing general attentional control and flexibility

(Klumpp & Amir, 2010), though this effect is expected to be modest compared to the active ATA program when combined with EXP. Thus, ATA + EXP and ATT + EXP were hypothesized to outperform ATP + EXP.

Taken together, the current study conducted an experimental randomized trial to test the two competing hypotheses to help understand how EXP can be effectively combined with an adjunctive ABM program by systematically varying the nature of attentional manipulation through ABM across conditions. Resulting data were expected to test which of the two hypotheses would be more reasonable in explaining the combined effects of ABM and EXP.

Hypothesis Related to Changes in Attentional Bias: We also hypothesized that all three conditions would decrease AB towards threat stimuli. The primary rationale behind this prediction was that the main treatment component (EXP) has been shown to decrease AB (Lavy, Van Den Hout, & Arntz, 1993), although it appears that successful implementation of EXP requires attentional focus on threat during the extinction trials. Therefore, we hypothesized that the ATA + EXP group would demonstrate the greatest reduction in attention towards threat (= improved disengagement from threat) as indicated by our AB indices, followed by ATP + EXP, and lastly ATT + EXP. This basis of this prediction came from the ABM literature, which demonstrates that ATA improves the ability to disengage attention from threat (= reduced attentional bias to threat; Fox et al., 2001). Therefore, both interventions combined may produce the greatest reduction in attentional bias to threat. CBT protocols including EXP components alone reduce AB towards threat (see Tobon, 2011 for a review), so we expected that our ATP + EXP condition will likewise demonstrate this pattern of reduced attentional bias (= improved attentional disengagement from threat). In contrast, the ATT + EXP group may demonstrate (1) the least amount of reduction in AB towards threat as the effects of ATT may interfere with the effects of EXP in reducing the difficulty with disengaging from threat, or (2) even an increase in attentional bias to threat (= increased difficulty disengaging attention from threat) as the effects of ATT may increase the attention toward threat while overriding the AB-reducing effect of EXP.

Method

Participants and Recruitment Procedure

66 participants with high levels of spider fear were recruited for the current study (22 in the ATT + EXP condition, 23 in the ATA + EXP condition, and 21 in ATP + EXP condition). For a complete graphical representation of participant flow, see Appendix A. Participants were included in the sample if the following inclusion criteria are met: (a) between the ages of 18 and 60, (b) demonstrated moderate levels of spider fear as indicated by a score of ≥ 15 on the Fear of Spiders Questionnaire (FSQ). Participants were excluded if any of the following exclusion criteria are met: (a) current or past schizophrenia, bipolar disorder, or organic mental disorder, (b) severe attentional problems, (c) known or possible allergies to latex, band aids, or Neosporin, and (d) known or possible allergies to spider or insect venom (e.g., bees, spiders).

Participants of the current study were recruited through several methods. First, participants were recruited through the University of Wisconsin-Milwaukee (UWM) Psychology Research Sign-up System (SONA) in one of three ways: (1) through the mass screening survey, (2) after endorsing the Spider Study question about spider fears, or (3) through the Spider Study page on SONA. The mass screening survey had its own separate consent form and included the items from the Fear of Spiders Questionnaire (FSQ). For those that endorsed high levels of fear on the Spider Study question, a laboratory staff member contacted them and provided the link the study's online consent form and the FSQ. Likewise, those that viewed the list of studies available on SONA and clicked on the Spider Study were routed to the online consent form and the FSQ.

Advertisements were also posted on Milwaukee-area Craigslist web pages. In addition, advertisements were posted on the Anxiety Disorders Laboratory (ADL) website that listed the details of the study and laboratory contact information. Lastly, flyers were posted on and around UWM's campus with information about the current study and laboratory contact information. If participants contacted the laboratory, a research staff member provided the link to the online consent form and FSQ.

If through any of these means individuals scored above the cutoff on the FSQ (i.e., total score $\geq$ 15), they were recruited for phase two of the screening process which involved a brief phone interview to assess inclusion and exclusion criteria. Specifically, the research staff member first obtained consent over the phone to participate in the pre-screening study procedure. Next, they provided the potential participant with a thorough outline of the study including information about the study design and procedures. Next, they conducted modules from the Mini International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998) including the Specific Phobia, Psychotic Disorder, Bipolar, and ADHD modules. Additionally, the research staff member asked questions regarding allergies and questions related to having experienced a traumatic brain injury or organic mental disorder. Individuals who met the study entry criteria were allowed to continue with the in-person study procedures, whereas those who did not meet the eligibility criteria discontinued the study processes. Following the phone screening, participants were informed as to whether or not they would be invited to the lab.

Individuals that were recruited from the community were compensated with a $10 gift card for participating in the study upon completion of the experiment. Undergraduate students in

UWM psychology courses obtained partial course credit as well as a $10 gift card for participating in the study upon completion of the experiment.

Measures

Demographic Information. The Anxiety Disorders Laboratory Demographic Survey was administered to collect basic demographic information.

Structured Diagnostic Interview. The Mini International Neuropsychiatric Interview is a brief structured interview that includes the main diagnostic categories of the DSM (M.I.N.I.; Sheehan et al., 1998). Trained interviewers follow a simple scoring algorithm to produce current diagnoses.

Spider Fear Symptoms. The Fear of Spiders Questionnaire (FSQ; Syzmanski & O'Donohue, 1995) is an 18-item self-report measure of an individual's fear of spiders and is able to discriminate those with spider phobia from those without spider phobia. In addition the FSQ loads onto two factors: fear of harm and avoidance/help seeking. The FSQ demonstrated adequate convergent validity with a behavioral avoidance test. This instrument also demonstrates good internal consistency ($\alpha = .92$).

Spider Phobia Questionnaire (SPQ; Watts, 1984). The SPQ is a 33 item self-report instrument that measures cognitive and behavioral reactions to spiders. Items include, for example, "do you get other people to get rid of spiders when you find them" and "can you spot a spider out of the corner of your eye". The SPQ's 3 factors (avoidance-coping, vigilance, and internal preoccupation) demonstrate adequate internal reliability ($\alpha = .77$, .78, and .81, respectively), can distinguish phobic from non-phobic individuals, and show sensitivity to the effects of treatment.

Depression Anxiety Stress Scale - 21 (DASS-21; Henry & Crawford, 2005). The DASS-21 measures the level of depression, anxiety, and stress symptoms via three subscales. All three subscales (i.e., depression, anxiety, and stress) have demonstrated good reliability (α = .91, .81, .89) and discriminant and divergent validity with other instruments that measure depression and anxiety.

Spider Phobia Beliefs Questionnaire (SBQ; Arntz, Lavy, Van den Berg, & Van Rijsoort, 1993). The SBQ assesses beliefs about a spider during a previous confrontation with a spider. The spider-related beliefs subscale comprising the first 42 items was used for the current study. It includes the following factors: harm (e.g., "the spider is dangerous"), hunter and prey (e.g., "the spider will drop from the ceiling on me"), unpredictability and speed (e.g., "the spider runs very fast"), territory (e.g., "the spider will crawl into my clothes"), and multiplication (e.g., "the spider is never alone, there are always more of them"). Internal consistency is good for the spider-related beliefs subscale of the SBQ (α = .94). The scale has good convergent validity with other spider phobia measures and can discriminate between spider phobic individuals and non-spider phobic individuals. The SBQ is also sensitive to treatment changes.

State Trait Anxiety Inventory (STAI; Spielberger, 1983). The STAI-State and Trait scales will be used to assess state and trait anxiety. The two scales have demonstrated adequate psychometric characteristics in terms of reliability and validity (Spielberger, Gorsuch, & Lushene, 1970; Spielberger & Vagg, 1984).

Positive And Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988). Five items from the original 20-item PANAS will be used to measure negative affect. Specifically, they will be administered five times during the experimental session to assess changes in levels of negative affect throughout the study procedure. Watson et al. (1998) reported adequate internal consistency for the negative affect scale with an alpha coefficient of .84 to .87. This mood dimension also has good convergent and discriminant correlations with other instruments.

Acceptance and Action Questionnaire - II (AAQ-II; Bond et al., 2011). The AAQ-II is a 10-item self-report measure of experiential avoidance or psychological inflexibility. Example items include "I am afraid of my feelings" and "worries get in the way of my success". The AAQ demonstrates adequate reliability (α = .78 - .88) and is associated with theoretically related variables such as depression, anxiety, and stress.

Attentional Control Scale (ACS; Derryberry & Reed, 2002). The ACS measures one's ability to focus and shift attention and to flexibly control thought. This 20-item scale includes items such as "it's very hard for me to concentrate on a difficult task when there are noises around" and "I can quickly switch from one task to another". The measure demonstrated good psychometric properties.

Anxiety Sensitivity Index - III (ASI-III; Taylor et al., 2007). The ASI-III measures the fear of anxiety-related sensations (e.g., rapid heartbeat, mind going blank). This 18-item scale is comprised of three subscales that each demonstrate good internal consistency reliability (physical concerns α = .79; cognitive concerns α = .84; social concerns α = .79). In addition, the ASI-III demonstrated good convergent, discriminant, and criterion-related validity.

Disgustingness Questionnaire (DQ; Armfield & Mattiske, 1996). The DQ contains 8 items and measures spider disgust. The scales' items include, for example, "even if I was hungry I would not eat food that a spider has touched" and "I think spiders are dirty or unclean animals". The DQ demonstrates good internal reliability (α = .83).

Cognitive Tasks. All pictures for the cognitive tasks were either taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1999) or the internet.

Prior to data collection for the main study, doctoral level graduate students rated all images for the current study included in the AB assessment tasks (i.e., exogenous cueing and eye-tracking), and the attention training program (i.e., dot-probe) along the following dimensions using a 1-9 scale: unpleasant—pleasant; unaroused—aroused; and unthreatened—threatened. The following were the obtained ratings by image category: 1) Neutral (pleasantness = 5.78, arousal = 1.42, threat = 1.27); 2) General Threat (pleasantness = 2.99, arousal = 5.10, threat = 5.13); 3) Spider Threat (pleasantness = 1.93, arousal = 6.76, threat = 6.68); and 4) Pleasant (pleasantness = 8.22, arousal = 2.52, threat = 1.30). These data from our pilot testing indicated that the images appear to perform as expected.

Exogenous Cueing Attention Bias Assessment Task. The exogenous cueing task (see Figure 1) was used to measure pre and post-treatment patterns of attentional allocation. This task was selected to provide an alternative method of assessment to a dot-probe attention bias measurement task as the attention training will be using the dot-probe paradigm. The task was modeled after Van Brockstaele's (2011) task which presented both threat and neutral pictures. For the current study, stimuli consisted of pictures of spiders and neutral objects as well as general threat images for comparison. A total of 18 pictures were used in the task (6 in each stimulus category). The task was created using E-prime software.

All stimuli in the exogenous cueing task were presented on a white background. Each trial began with a central fixation cross flanked by two empty boxes on either side of the screen. Next, a cue (image) appeared in the center of one of the boxes for 500ms. A mask (gap) then occured for a period of 50 ms during which both boxes were blank. This gap was followed by a probe (E or F) that appeared in either the same (valid trial), or opposite (invalid trial) box until the participant responded. Participants were instructed to press the corresponding E or F key as quickly and accurately as possible to move on to the next trial. The task presented a total of 156 trials, 12 of which were practice trials and the other 144 valid and invalid trials presented household images (e.g., a couch, a ceiling fan), general threat images (i.e., a shark, a forest fire) and spider pictures in a random, counterbalanced order.

Eye-tracking Picture Viewing Attention Bias Assessment Task. AB was assessed using eye-tracking technology and computer-based tasks. The eye-tracking task (see Figure 2) was created using SensoMotoric Instruments Experiment Center and IVIEW X software. This picture viewing task presented 10 trials containing 4 pictures of various categories for 30 seconds [i.e., spider, general threat (e.g. fire), neutral (e.g., chair), and positive (e.g., nature scene)] to which participants were instructed to view the images, naturally, as if reading from a magazine. The pictures representing each category were presented at the top right, bottom right, top left or bottom left side of the participant's visual field. During each trial, the subject's line of free gaze was recorded by the eye-tracking device, generating several indices that contributed to depicting the pattern of attentional processing (i.e., the number and location of fixation points, fixation duration).

Dot-Probe Attention Bias Modification Training Program. The AB pre-training (dot-probe) computer program (see Figure 3) presented pictorial stimuli using E-Prime software. Specifically, images of spiders and images of neutral household objects (e.g., chair, dresser) were displayed on a white background. The pairs of stimuli consisted of 10 spider images and 10 neutral images that were presented in a random counterbalanced order. There were a total of 480 trials divided into two 240 trial blocks. For each block, 192 trials consisted of spider-neutral pairs, and the remaining 48 trials consisted of neutral-neutral pairs to obscure the nature of the task. Images were presented for 500 ms following a centrally located fixation cross. Next, the probe (one or two asterisks) appeared on one side until the participant responded. Specifically, participants were instructed to identify the probe as quickly as possible by pressing the 1 or 2 key depending on the number of asterisks observed.

Given the specific study hypotheses, three separate attention training programs were created each using stimuli that were presented in a random, counterbalanced order. Participants were randomly assigned to one of these three conditions. The ATT program trained attention towards threat stimuli (i.e., pictures of spiders). In other words, the active trials presented probes in the location of the spider images. The ATA program trained attention away from threat (i.e., towards neutral pictures of household objects). In other words, the program presented probes in the location of the neutral images. Lastly, the ATP program was not designed to manipulate attentional allocation patterns (i.e., there is no contingency between the probe and threat or neutral stimuli). Therefore, for the ATP program, equal numbers of the active trials presented probes following both spider and neutral stimuli.

A brief eye-tracking assessment task was built into the ABM program and administered before and after the main trials. The task presented the same 10 pairs of spider and neutral images as the attention training trials described above. Each pair was presented for 5 seconds while participants simply viewed the images while eye-movements were recorded. This task was repeated after the main training (= 20 total trials).

Exposure Therapy. The EXP hierarchy was modeled after Merluzzi, Taylor, Boltwood and Gotestam’s (1991) paradigm and consisted of 16 steps:

1. Look at pic of spider
2. Touch pic of spider
3. Stand 10 ft from spider in closed container
4. Stand 5 ft from spider in closed container
5. Stand 1 ft from spider and look down at spider in closed container
6. Place hand against container near spider

7. Hold spider in closed container 1 ft from face
8. Look down at spider in open container while experimenter keeps the spider in the container
9. Let spider crawl freely in the tray in front of you
10. Touch spider with small paintbrush
11. Touch spider with heavy gloved hand (5x)
12. Let spider walk on heavy gloved hand (with arm covered)
13. Let spider walk on latex gloved hand (with arm covered)
14. Let spider walk on latex gloved hand
15. Let spider walk on the bare hand (with arm covered)
16. Let spider walk on bare hand

The EXP session included participant modeling and providing a series of instructions in a graduated fashion that brought the participant in closer contact with a live tarantula. This is a standard method of providing EXP for individuals with specific fears in this line of research examining fear reduction processes (e.g., Öst, 1989; Rodriguez, Craske, Mineka, & Hladek, 1999; Mineka, Mystkowski, Hladek, & Rodriguez, 1999). Experimenters were instructed to provide support if appropriate.

Throughout the procedure, subjective units of distress (SUDS; Hope & Heimberg, 1993) (i.e., fear) ratings on a 0-100 scale were be obtained in order to gauge when it was appropriate to move to the next step in the treatment hierarchy (i.e., when SUDS ratings were ≤ 25). This method of communicating anxiety used the following as anchor points: 0 (no anxiety; calm and relaxed); 25 (mild anxiety; minimal distress, able to cope); 50 (moderate anxiety; nervous, noticeable physical symptoms of anxiety, trouble concentrating); 75 (severe anxiety; quite distressed, strong physical symptoms of anxiety, thoughts of escaping the situation); and 100 (extreme anxiety; worst fear or anxiety ever experienced, intense fear or panic).

The maximum time for completion if all tasks were completed was 1 hour. If a participant failed to complete all steps at the 1 hour time point, the session ended, and the participant was given any time needed for their SUDS to return to ≤ 25. This recovery period was included so that anxiety could return to manageable levels before the next activity.

Additionally, all participants were required to undergo at least 30 minutes of EXP work. If a participant completed the highest level before the 30 minutes elapsed, then the final level was repeated. Lower levels were repeated until SUDS ≤ 25 if 30 minutes duration had not been reached.

Participants were not required to complete a certain number of steps. In fact, we did not expect all participants to complete the entire hierarchy. This was perfectly acceptable for our purposes as the task was designed this way to ensure variability in performance.

Behavioral Approach Task. The behavioral approach task (BAT) hierarchy was modeled after Heading and colleagues' (2001) paradigm and consisted of 13 steps:

1. Open the door and the enter room and stay inside
2. Reach the table on which the container holding the live spider is placed
3. Look at the spider therein
4. Touch the container with your hand
5. Lift the container and hold it using both hands
6. Hold the container to your face and observe the details of the spider therein
7. Put the container on the table and open it without removing the lid completely
8. Remove the lid completely and look inside the container
9. Look closely at the spider in the open tray
10. Gently touch the spider with a paintbrush
11. Touch the spider with a fingertip
12. Put one hand on the tray with palm facing up and gently touch the spider with the other hand to move the spider onto the open hand
13. Hold the spider with both hands off the tray

The BAT was administered pre and post-treatment and consisted of an increasingly difficult series of steps (different than those used in the EXP session and slightly fewer in number) that brought the participant in closer contact with a live tarantula. Participants were asked willingness to complete each task. If there was ever a 2 minute delay to initiate a step, this was considered a step failure, and the task ended. Throughout the procedure, subjective fear ratings on a 0-100 scale were obtained to assess level of anxiety (i.e., before, during, and after each step).

These steps took place with the experimenter present to assess fear throughout the procedure and to assist if needed; however, the experimenter did not model the tasks or provide encouragement or praise. Participants were not required to complete a certain number of steps. In fact, we did not expect all participants to complete the entire hierarchy.

Heart-Rate and Breathing-Rate Recording. Heart rate (HR) and breathing rate (BR) were recorded simultaneously and continuously using a Zephyr monitoring belt. While the participant was simply wearing the chest belt, the raw electrocardiogram (ECG) signals were recorded remotely through the USB data receiver connected to a secure laboratory computer. Additionally, this system records HR and BR with good accuracy. Adding this index of physiological arousal added another facet to our measurement approach.

Overall and peak HR and BR were recorded at baseline (i.e., 2-minute base rate of HR and BR when the participant was not engaging in an anxiety-provoking task), during the first BAT, during the all EXP trials, and during the second BAT.

Cognitive Outcome Variables. Throughout the BAT task, in addition to collecting SUDS ratings, research staff asked about participants' perceived level of threat and chance of being bitten. Participants responded using a 0-100 scale similar to the SUDS scale which ranged from not threatened or low chance of being bitten, to high level of perceived threat or high likelihood of being bitten.

Along these lines, participants responded to the following metacognition questionnaire (Rowe & Craske, 2008) using a 0-100 scale in regards to their perceptions: (a) that his or her fear had decreased (0-100); (b) of the permanence of this reduction (0-100); (c) fearfulness if confronted with a spider outside of the experiment (0-100); and (d) fearfulness if asked to repeat the most recent task accomplished, in a few weeks (0-100). This metacognition questionnaire provided insight into potential cognitive change from the completion of the BAT pre-treatment to the completion of the BAT post-treatment and methodologically strengthened the current project.

Procedure

For a graphic representation of the study procedures see the complete study activities flow chart in Appendix B. Participants first underwent the informed consent procedure which included information about the study as well as information about tarantulas and study safety procedures. Next, participants completed the remainder of the structured diagnostic interview. Participants then completed the comprehensive assessment battery on the computer. After this, participants completed the computerized cognitive assessment tasks followed by the pre-treatment BAT.

Upon completion of the pre-treatment phase of the study, participants were randomized to one of the three treatment conditions. Next, participants completed the treatment portion of the experiment. First, participants completed the attention pre-training program to which they were previously randomly assigned. Next, the individuals completed the EXP component of the study. After the treatment phase of the study was complete, participants completed the post-treatment cognitive assessment and behavioral tasks.

Data Analytic Strategies

We first examined baseline group differences in sample characteristics (i.e., demographics, FSQ, SPQ, DASS-21, SBQ, STAI, PANAS, AAQ-II, ACS, ASI-III, DQ) by conducting chi-square tests and analyses of variance (ANOVA) on these demographic and clinical variables.

To test our hypotheses regarding differences in efficacy when combining attention pre-training with EXP with respect to subjective fear and anxiety symptoms (i.e., average and peak SUDS ratings and cognitive ratings on the BAT), we used a series of 3 (Group: ATT + EXP, ATA + EXP, ATP + EXP) X 2 (Time: pretreatment, post-treatment) repeated measures analyses of covariance (ANCOVAs). Therefore, we examined group differences at post-treatment while controlling for the baseline level of the dependent variables in each analysis. Significant interaction effects were followed up with post-hoc contrast analyses. Additionally, we controlled for relevant covariates in these analyses that may influence the results of our analyses (i.e., depression and anxiety symptoms using the DASS-21, level of state anxiety using the STAI-S, and current affective valence using the PANAS). In this way, we could explore the potential influence of various clinical and demographic features as covariates. This is important as these state and trait variables can potentially influence attentional processing [see Mathews and MacLeod (1994) for review].

Likewise, to test our hypotheses concerning differences between groups in terms of behavioral and physiological indices of fear and avoidance, we examined the impact of treatment on the number of steps completed and average and peak HR/BR during the BAT. Specifically, we conducted repeated measures ANCOVAs to compare the three groups while controlling for covariates. Any significant differences observed in terms of our dependent measures were followed up with post-hoc contrast analyses.

In terms of the exogenous task, two AB indices were computed. First, attentional engagement scores were computed by subtracting the reaction times on valid spider or general threat trials from valid neutral trials. This score reflected the speed at which the individual engaged attention towards either threat category cues relative to neutral cues. Higher attentional engagement scores indicate greater engagement towards threat. In contrast, attentional disengagement scores were computed by subtracting reaction times on invalid neutral trials from reaction times on invalid spider or general threat trials. Attentional disengagement reflects the speed at which the individual disengages attention from threat cues when compared with neutral cues. Higher scores of attentional disengagement indicate the individual has greater difficulty with disengaging attention from threat cues. Furthermore, negative attentional disengagement scores indicate greater attentional disengagement (i.e., attentional avoidance) from threat cues, relative to neutral cues.

We used these AB assessment indices to compare our groups using repeated measures ANCOVAS. In particular, we used a 3 (AB group) X 2 (Time: pre/post) repeated measures ANCOVA. Significant main effects were followed up with post-hoc contrast analyses. We also examined Pearson correlation coefficients to examine the association between AB indices and the severity of spider fear. In addition, we used correlation coefficients to examine whether or not change in AB is associated with change on our primary outcome measures (i.e., SUDS and cognitive ratings, BAT performance and HR/BR response).

Various components of AB (i.e., number and duration of fixations) were examined using eye-tracking technology. First, fixations are defined as location of eye gaze (X &Y eye position coordinates) within one degree of visual angle for a minimum duration of 100 ms. An area of interest (AOI) is defined as the area of the image on which eye fixations will be measured and analyzed. The images used were of 4 stimulus categories (i.e., spider threat, general threat, neutral, and pleasant), therefore, on each display, there were 4 areas of interest. On the computer monitor (22 inch), each image was a rectangular patch (width = 12 cm, height = 15 cm). Number of fixations was examined by totaling the number of fixations for each stimulus category within each 30 sec trial. Percentage fixation duration was examined by calculating the percentage of fixation duration on a given AOI taking into account other AOIs presented during the trial. This has the advantage of allowing for inspection of the proportion of time spent fixating on a specific stimulus category with respect to other stimulus categories. Total fixation duration was examined by computing the average duration of all fixations for each stimulus category within each trial. This more global measure of the length of fixations also yields information regarding the period of time spent fixating on a given stimulus category.

Results

Group Comparisons on Demographic and Basic Clinical Variables

The demographic and clinical characteristics of the three groups are listed in Tables 1 and 2, respectively. There were 22 individuals in the ATT + EXP group, 23 individuals in the ATA + EXP group, and 21 individuals in the ATP + EXP group. There were no significant differences observed among groups on demographic characteristics including age, gender, marital status, education and income. There was no group difference with respect to psychological treatment history. In terms of various clinical characteristics, there were no group differences at baseline on the following measures: FSQ (F = .342, p = .712), SPQ (F = .662, p = .519), SBQ (F = .038, p =.963), STQ (F = .741, p = .481), DQ (F = .778, p = .464), STAI (F = 1.621, p = .206), ASI-III (F = 1.506, p = .230), DASS-21 (F = 2.963, p = .059), ACS (F = .814, p = .448), and AAQ-II (F = 2.545, p = .087). There were also no group differences pertaining to DSM diagnoses. Altogether, the randomization was successful in creating three equivalent groups.

Correlations between Variables at Baseline

Pearson correlation coefficients were used to examine the association among various behavioral and clinical variables at baseline (see Table 5.1). Results indicated that there was a significant correlation between FSQ scores and performance on the BAT in terms of peak fear (r = .437, p = .001) and number of steps completed (r = -.267, p = .049). Specifically, greater spider fear was associated with higher peak SUDS ratings and fewer steps completed. The correlation between FSQ scores and peak HR during the BAT at baseline trended towards significance (r = .230, p = .092). Results also indicated that there was a significant correlation between the number of steps completed during the first BAT and the percentage (r = .370, p = .008) and total (r = .371, p = .007) duration of fixations on spider images at pre-treatment, as well as the number of fixations (r = .296, p = .035) on spider images at pre-treatment. This indicates that greater attentional vigilance is associated with an increased number of steps completed. In other words, those with greater AB towards spider images exhibited greater approach behavior during the BAT. These attentional vigilance indices also showed a negligible association with the FSQ or BAT peak fear.

Analyses Regarding Interventions

Manipulation of Attention Bias Using ABM Procedure

The brief eye-tracking assessment was included at the beginning and end of the attention training procedure as a manipulation check to examine whether the training programs produced change in AB in the intended directions (see Figures 4.1-4.9). Repeated measures analyses of variance were conducted using the AB indices: (a) fixation duration and number toward the neutral stimuli, (b) fixation duration and number toward the spider stimuli, and (c) difference scores in fixation indices between spider and neutral stimuli. In terms of percentage of fixation duration, there were Time X Group interactions for neutral images [F (1,61) = 4.222; p = .019], and for spider threat images [F (1,61) = 3.497; p = .037], but not when taking both spider and neutral image categories into account for comparison [F (1,61) = 1.822; p = .17]. There was a

Time X Group interaction for number of fixations on neutral images [*F* (1,61) = 6.149; *p* = .004], but no Time X Group interaction for spider images [*F* (1,61) = .016; *p* = .984], or when taking both image categories into account for comparison (i.e., spider-neutral) [*F* (1,61) = 1.983; *p* = .146]. There were Time X Group interactions for total fixation duration on both neutral [*F* (1,61) = 4.2; *p* = .02] and when taking spider and neutral images into account [*F* (1,61) = 3.392; *p* = .04], but not on total fixation duration on spider images [*F* (1,61) = 1.726; *p* = .187].

The observed pattern of interaction effects indicated that individuals who received the ATT program generally demonstrated greater attention towards spider threat stimuli in terms of both the number and duration of fixations (see Figures 4.1-4.9). Individuals who received the ATA program demonstrated less attention towards threat, or fewer fixations and shorter durations for spider images. Individuals who received the ATP program generally did not show a significant change in attention either towards or away from threat in terms of both the number and duration of fixations. In summary, these analyses provided some important evidence that our AB manipulation was successful as the pattern of attentional allocation during the training program was modified in the designed directions.

Group Comparisons on Exposure Therapy Task

No group differences were observed on the EXP task in terms of the number of steps completed [*F* (2,63) = .825, *p* = .443], total duration [*F* (2,63) = .987, *p* = .382], or peak SUDS levels [*F* (2,63) = 1.050, *p* = .356]. See Figures 5.1-5.3. Furthermore, there were no differences in terms of average [*F* (2,59) = 1.864, *p* = .164] and peak [*F* (2,59) = 1.201, *p* = .308] HR, or average [*F* (2,59) = .519, *p* = .598] and peak [*F* (2,59) = .502, *p* = .608] BR during the EXP task. See Figures 5.4-5.6. These results showed that the three groups experienced a quite similar EXP procedure.

Main Hypotheses – Threat-focus Facilitation vs. Additive Effects: Will ATT or ATA Experience the Greatest Reduction in Spider Fear or Avoidance?

To test the main hypotheses regarding which condition would experience the greatest reduction in fear and avoidance symptoms (ATT + EXP or ATA + EXP), repeated measures analyses of covariance were conducted using the following outcome variables in separate analyses: (a) SUDS ratings on the BAT, (b) cognitive ratings on the BAT (c) number of steps completed on the BAT, (d) physiological recordings measured during the BAT, and (e) state negative affect before and after the treatment procedure. Treatment group was entered as the between-subjects variable. The levels of general depression, anxiety, and stress, as well as state anxiety were entered as covariates in these analyses. See Table 3 for results summary.

BAT: Fear Ratings

Results indicated that there were no significant Time X Group interaction effects in terms of anticipatory fear [$F\ (2,61) = .735$ $p = .484$; $\eta_p^2 = .024$], peak fear ($F\ (2,60) = .326$; $p = .723$; $\eta_p^2 = .011$), and fear upon completion of the BAT ($F\ (2,60) = .360$ $p = .699$; $\eta_p^2 = .012$) (see Figures 6.1-6.3). There was only a main effect of Time for each of these three variables [$F\ (1,61) = 10.415$, $p = .002$; $\eta_p^2 = .146$]; [$F\ (1,60) = 10.113$, $p = .002$; $\eta_p^2 = .144$]; [$F\ (1,60) = 7.676$, $p = .007$; $\eta_p^2 = .113$] showing that individuals in each group improved with respect to self-reported indices of fear, but without a significant difference across groups.

BAT: Cognitive Ratings

Concerning the cognitive ratings, there were no significant Time X Group effects in terms of perceived level of threat / chance of being bitten during the BAT [$F\ (1,60) = .459$, $p = .634$; $\eta_p^2 = .015$] (see Figure 6.4). Perception of fear reduction upon BAT completion / perception of fear generalization outside of the experiment trended towards significance [$F\ (1,61) = 2.903$, p

= .062; η_p^2 = .087] (see Figure 6.5). In particular, the two AB training conditions (ATT and ATA) tended to outperform the ATP condition in improving the perception of fear reduction and generalization upon completing the BAT. There was not a main effect of Time for either variable [*F* (1,60) = .138 *p* = .712; η_p^2 = .002]; [*F* (1,61) = 1.709, *p* = .196; η_p^2 = .027].

BAT: Avoidance

Regarding behavioral avoidance, there were no significant Time X Group effects with respect to the number of steps completed on the BAT [*F (2,61)* = 1.171, *p* = .317; η_p^2 = .037] (see Figure 6.6). Overall, the study sample showed an increase of 2.14 steps from pre to post, however, the main effect of Time was not significant, indicating that neither group completed a significantly greater number of steps from pre to post-treatment on the BAT [*F* (1,61) = 1.377, *p* = .245; η_p^2 = .022].

BAT: Physiology

There were no Time X Group effects for both average HR [*F* (2,57) = 1.04, *p* = .360] and peak HR [*F* (2,57) = 1.896, *p* = .159] during the BAT. See Figures 6.7 and 6.8. There was also no main effect of Time for either average [*F* (1,57) = 1.848, *p* = .179] or peak [*F* (1,57) = 1.956, *p* = .167] HR. There were also no significant Time X Group effects for average [*F* (2,57) = .647, *p* = .528] and peak [*F* (2,57) = 1.273, *p* = .288] BR during the BAT. See Figures 6.9 and 6.10. No main effect of Time was observed for average [*F* (1,57) = .166, *p* = .685] or peak [*F* (1,57) = .379 *p* = .541] BR. Taken together, there were no significant differences between groups in terms of change in physiological arousal from pre to post-treatment.

State Negative Affect

In terms of state negative affect, there was no significant Time X Group interaction [*F (2,61)* = .335, *p* = .716; η_p^2 = .011] (see Figure 6.11); and no main effect for Time [*F (1,61)* =

.052, p = .821; η_p^2 = .001] indicating no differences between groups concerning self-reported state negative affect from pre to post-treatment.

Spider Fear

No Time X Group Interaction effect was observed on the FSQ from baseline to follow-up [F (2,53) = 1.057, p = .355; η_p^2 = .038]; however, there was a main effect for Time indicating a significant reduction in spider fear for all groups from pre to post-treatment (F (1,53) = 4.663, p = .035; η_p^2 = .081) (see Figure 7).

Attention Bias Hypothesis – ATA + EXP Will Experience Greatest Reduction in AB towards Threat

Repeated measures analyses of covariance (ANCOVA) were conducted to examine changes in AB from pre to post-treatment on the exogenous cueing task. AB indices were entered as the within-subjects variables and treatment group was entered as the between-subjects variable. Concerning attentional engagement towards general threat images, there was a Group X Time interaction [F (2,47) = 3.282, p = .046; η_p^2 = .123] (see Figure 8.1). A paired t-test (pre vs. post) comparison indicated that there were no significant pre-to-post differences in attentional engagement towards general threat for any of the three groups (ATT: t = .867, p = .399; ATA: t = -1.122, p = .279; ATP: t = -.243, p = .811). The overall pattern, however, showed a numeric trend that those in the ATA and ATP conditions demonstrated greater engagement towards general threat from pre to post-treatment and those in the ATT condition demonstrated a decrease in attentional engagement towards general threat.

Regarding attentional engagement towards spider images, there was no Group X Time interaction [F (2,47) = .186, p = .831; η_p^2 = .008] (see Figure 8.2). There were also no differences observed among the three groups on paired t-test comparisons (ATT: t = -1.155, p = .265; ATA:

t = -1.528, p = .147; ATP: t = -1.649, p = .116), though mean scores for engagement towards spider images increased for all groups possibly suggesting the overriding effects of the EXP procedure on attentional processing.

In terms of attentional disengagement from general threat images, there was no Group X Time interaction [$F(2,47)$ = .148, p = .862; η_p^2 = .006] (See Figure 8.3). There were also no differences observed on paired t-test comparisons for any of the groups (ATT: t = .946, p = .358; ATA: t = 1.738, p = .103; ATP: t = .840, p = .412), with mean scores showing a decrease in disengagement difficulty from general threat images for all groups.

With respect to attentional disengagement difficulty from spider images, there was no significant Group X Time interaction [$F(2,47)$ = .702, p = .501; η_p^2 = .029] (See Figure 8.4). Using a paired t-test analysis, results revealed that in terms of disengagement difficulty from spider images, the ATA group post-treatment mean scores were reduced from pre-treatment mean scores at a marginally significant level (t = 1.993, p = .065). This trend is in the direction of what would be expected given that the effect of ABM aims to improve the ability to disengage attention from threat.

Taken together, AB indices from the cueing task suggest the following about the pre-to-post AB change: 1) The three conditions showed a similar level of increase in engagement toward spider images. Therefore, the three different ABM pre-training interventions (i.e., ATT, ATA, vs. ATP) did not seem to differentially change how promptly individuals engage their attention toward spiders (vs. neutral images) in the context of the cueing task. However, overall increase in attentional engagement toward spider images might also reflect the possibility that confrontation with live spiders during EXP may have overridden the effect of pre-exposure ABM. 2) The three conditions showed a non-significant, but differential numeric trend in change of attentional disengagement difficulty from spider images. Once an individual engages attention toward a stimulus, the next step is to disengage from it when reorienting attention. Unlike the ATT and ATP conditions, individuals in the ATA condition showed a marginally significant trend of decrease in difficulty with disengaging attention from spiders. Thus it is possible that ATA resulted in less difficulty disengaging from spiders (because it trained disengagement from spider images), although it did not seem to affect the early engagement process differentially compared to the ATT or ATP. Therefore, some evidence exists in our data set which suggests the possibility that the impact of different types of ABM may have been yielded throughout the EXP procedure and observed at the post-exposure assessment.

Concerning the 30 sec eye-tracking picture viewing task, 2 (Time: Pre vs. Post) X 3 (Group: ATT, ATA, vs. ATP) X 4 (Emotional valence: Spider, General threat, Neutral, vs Pleasant) repeated measures ANCOVAs were conducted. Results indicated that there were no significant Time X Group X Emotional Valence interactions in terms of percentage of fixation duration [F (2,59) = .633; p = .703] and number of fixations [F (2,59) = .798; p = .573]. See Figures 9.1 and 9.5.

When looking at only the attentional indices for the spider images, the Time X Group interaction was not significant for percentage duration [F (2,57) = *1.4; p* = .255] or for number of fixations [F (2,57) = .596; p = .554] (see Figures (9.2, and 9.6).

For exploratory purposes, when the data were visually inspected in terms of their numeric change, individuals in the ATT + EXP condition showed an increase in the number and percentage duration of fixations toward spider images, whereas those in the ATA condition remained about the same, or saw a slight decrease in the number and percentage duration of fixations towards spider threat images. Those in the ATP + EXP condition saw a slight increase in the number and percentage duration of fixations toward the spider images.

In summary, there is a preliminary trend in terms of change in attentional allocation, as measured in a more naturalistic viewing situation. Although there were no significant group differences during the picture viewing task, the numeric pattern of pre-to-post change suggests the possibility that the increase of AB was greater in ATT, relative to ATA, as predicted. Indeed, the ATT condition showed the opposite pattern (i.e., an increase in attention towards spider images), which was not observed in the ATA group. This pattern is consistent with the expectation that ATT would show the least amount of reduction in AB towards spider images or increased attentional engagement towards spider images. Importantly, caution should be used when interpreting these data due to the following conditions: (1) the baseline scores for each group were different for unknown reasons, so the pattern of change could simply reflect "regression toward the mean", and (2) the differences in AB change were only at a non-significant trend or numeric level.

In terms of total fixation duration (= total length of all fixations on the target image), a similar pattern emerged; however there was no significant Group X Time X Emotional Valence [F (2,59) = .855; p = .529] or Time X Group interaction [F (2,57) = 1.389; p = .258]. See Figures 9.3 and 9.4.

Correlations among Change Scores

Pearson correlation coefficients were used to examine the association between changes in AB and various clinical variables from pre to post-treatment (see Table 5b) for the entire study sample. Results indicate that reductions in spider fear from pre to post are positively correlated with decreases in peak fear during the BAT (r = .411, p = .002). There were no significant correlations between changes in attentional indices and changes in behavioral and physiological measures during the BAT.

Discussion

The purpose of this investigation was to explore the role of attentional processing during exposure by examining the effects of AB pre-training when combined with EXP. Interestingly, these two interventions propose opposing positions regarding the role of attention. Specifically, ABM is designed to improve the ability to disengage attention from threat, whereas EXP requires the attentional focus on threat. Furthermore, even less is known about the effects of a pre-exposure manipulation of attention prior to exposure with a feared object. Indeed, recent research has revealed the potential benefits of using a combined approach of ABM to enhance the effects of CBT to treat anxiety problems (Amir & Taylor, 2012; Riemann et al., 2013). The present study examined the effects of training attention either towards threat, which is in in line with EPT and the goals of EXP (Foa & Kozak, 1986), or away from threat, which would support attentional disengagement, the key factor behind ABM effectiveness (Fox et al., 2001), in comparison with a placebo attention control condition. Accordingly, the project tested two competing hypotheses: The Threat-focus Facilitation Hypothesis (i.e., the effect of EXP may be further improved by threat-engagement ABM by enhancing threat confrontation) vs. the Additive Effects Hypothesis (i.e., the effect of EXP may be further improved by adding threat-disengagement ABM as an additional established intervention).

In total, findings from the current study demonstrate that all three groups (i.e., ATT + EXP, ATA + EXP, and ATP + EXP) improved significantly from pre to post-treatment with respect to many of our outcome variables. It is worth noting the effect of our EXP procedure in improving fear and avoidance related to spider fears. However, our main hypothesis that either the ATT, or conversely, the ATA condition would show greatest improvement in fear and avoidance symptoms was not supported. Specifically, it appears that the adjunctive ABM program did not yield differential impact on EXP. This was demonstrated through analyses of primary outcome indices on the BAT including anticipatory fear, peak fear, and fear upon completion of the task. Additionally, both the ATT and the ATA group failed to outperform the other (or the ATP group) with respect to avoidance behavior as indicated by the number of steps completed on the BAT. Further, cognitive ratings during the BAT related to perceived threat and perceived fear reduction did not differ among the groups. There were also no differential effects of ABM group regarding state negative affect, physiological arousal, or self-reported spider fear from pre to post-treatment.

Our AB hypothesis stated that participants would experience the greatest amount of reduction in AB towards threat in the ATA + EXP, followed by the ATP + EXP, and the ATT + EXP condition was partially supported. There is some preliminary evidence that the nonsignificant but numeric pattern of change in AB was in the expected direction regarding AB training effects. Specifically, the ATA + EXP and ATP + EXP groups demonstrated a greater ability to disengage attention from threat and the ATT + EXP group demonstrated greater disengagement difficulty, or an increase in AB towards threat. Although not statistically significant, this trend indicates a directional response of the ABM pre-training procedure.

There are several possible explanations for the observed null findings in the current study. First, it may have been the case that the manipulation of AB was unsuccessful. According to the results of our brief eye-tracking assessment, those in the ATT condition demonstrated greater attention towards spider threat stimuli as indicated by higher frequency and duration of fixations (i.e., increased attentional engagement toward spider threat). In addition, those in the

ATA group showed an opposite pattern of processing whereby there were fewer and shorter durations of fixations on spider images (i.e., increased attentional disengagement from spider threat). The ATP group demonstrated a frequency and duration of fixations in between these two groups as researchers would expect given the equal number of towards and away training trials during the ABM procedure. Considering this pattern of change in AB, it is unlikely that the current null findings stemmed from a complete absence of ABM effects, which would merely suggest a manipulation failure. Furthermore, these results are consistent with successful attempts to train attention both towards and away from spiders in past research conducted by Van Bockstaele and colleagues (2011). Nevertheless, given the overall trend level findings in AB indices, we cannot exclude the possibility that the ABM was not sufficiently potent to have a strong impact on the EXP procedure.

The second possibility for the observed null findings is that the effects of ABM might not persist throughout the EXP procedure. Our data suggest that the pattern of AB was successfully modified through training (as indexed by the change in eye-tracking indices assessed at the beginning and end of the ABM training), but one might argue that the effects of ABM could have faded out too quickly to have a persistent impact on the clinical outcomes. However, careful inspection of the AB data suggest that this is unlikely the cause of the null findings. Specifically, findings from the exogenous cueing task indicated that in terms of disengagement difficulty from spider images, those in the ATT group demonstrated more difficulty disengaging from spider threat images, and those in the ATA group demonstrated less difficulty disengaging attention from spider threat images. This pattern of change was not statistically significant, however, and only ATA’s mean scores of disengagement difficulty reduced at a marginally significant level. Furthermore, there is some evidence that hints that ABM had lasting effects as indicated by the 30 second picture viewing task AB patterns, which was collected after completing the EXP procedure. In particular, regarding spider images, the ATT group evidenced an increase in the frequency and duration of fixations and those in the ATA group did not. Although this pattern was not statistically significant, this differential trend in change suggests the possibility that ABM could produce a change in the pattern of AB that cannot be completely eliminated even after undergoing a potent EXP session involving a live tarantula.

Similarly, despite a successful change in AB, EXP may have overridden the effects of the ABM procedure. Exposure therapy is a highly potent therapeutic intervention for anxiety problems. In the current study, participants interacted with a live tarantula for up to one hour. Given the relatively short duration needed to produce change among clinically phobic individuals with a fear of spiders (see Ost, Ferebee, & Furmark, 1997), this duration provided enough contact to produce significant changes. Although we obtained some preliminary evidence that the numeric patterns of AB were modified in the expected directions and carried throughout the EXP procedure, the dose or potency of the ABM effects might have been suboptimal to yield a significant impact on the EXP procedure.

Interestingly, on the exogenous cueing task, individuals in the ATA group demonstrated both an increase in engagement towards spider threat, as well as improved ability to disengage attention from threat. With both indices showing greater attention towards threat after disengagement training, this indicates seemingly contradictory findings. Contrarily, although not statistically significant, these findings highlight the independent processes that take place during engagement and disengagement of attention. Regarding the attentional system, engagement occurs only after disengagement of attention from a previous location (Posner and Petersen, 1990). In other words, one must first disengage attention from the current stimulus before reengaging attention to a new spatial location. Therefore, the interpretation of these results with respect to anxiety-related attentional bias towards threat reflects the consideration of the multi-faceted nature of attentional processes.

In terms of the implications for current study findings, we unsurprisingly confirmed that EXP is effective in reducing fear and avoidance. The results of our procedure provided some preliminary evidence that ABM may change patterns of attentional processing with spider-related content, although the effects of a single session of ABM did not appear to exert influence on the effects of EXP as all groups performed similarly. In particular, it does not appear that threat-focus facilitation or threat-disengagement of ABM produced any meaningful difference in EXP outcome. For ABM to add incremental improvement over EXP alone for specific fears, critical improvements may need to be made to the existing paradigm.

It has been speculated that ABM and EXP operate at two different stages or work through different processes to improve symptoms of emotional disorders (Taylor & Amir, 2010). For instance, ABM may target early-stage information processing according to Beck and Clark's (1997) model of attentional processing. In other words, ABM may have an influence on the less effortful, more automatized, and more stimulus-driven early-stage attentional processes (Taylor & Amir, 2010). On the other hand, Taylor and Amir (2010) hypothesize that confrontation with threat during exposure work is believed to involve more effortful, intentional, and regulatory attentional processes. Therefore, this late-stage effort of strategic processing may serve in a more emotion regulation capacity. Thus, attentional disengagement intended in the ABM paradigm, and attentional engagement intended in the exposure intervention may not interfere with each other in the combined intervention context. Consideration of time-varying nature of attentional processing may guide us to explain how we can reconcile the effectiveness of each intervention.

Although the benefits for a combined approach were not observed in the current investigation, consideration of these two different systems (i.e., early, stimulus-driven vs. late-stage, schema-driven) and their aggregate effects in future research may allow for the formation of a more potent treatment package for the treatment of anxiety-related problems. In particular, future research should test the effectiveness of ABM adjunctive training among populations with more generalized anxiety-related problems that appear to show higher responsivity to the effects of ABM as opposed to specific fears which have not produced consistent evidence of responsiveness to ABM (see MacLeod & Mathews, 2012 for review).

It is possible that if these interventions work independently in terms of stage of attentional processing, the combined effect could be more robust as opposed to one intervention's effects reducing the potency of the other. We did not observe this; however, this may be due to the limited potency of the ABM procedure. If researchers can find a way to optimize ABM for specific phobias, it may still be possible to use ABM as an adjunctive intervention. Recent research pertaining to the advancement of ABM more generally has indeed found that a number of elements can improve outcomes including: a) providing explicit instructions regarding the direction of attentional manipulation, b) setting goals for performance and providing feedback, and c) adapting the level of challenge based on previous accuracy and rate of learning during the task (Amir, Kuckertz, & Strege, 2016).

Although not mentioned previously, one may argue that the effects of ABM and EXP may produce cancellation (as opposed to additive) effects pertaining to the combination of ATA (= disengaging attention from threat) with EXP (= confronting a feared object). Considering this notion, ATA did not appear to cancel out the effects of EXP (i.e., there was no interference with EXP as all groups evidenced equivalent outcomes). If there had been a cancellation effect, we would have observed poorer outcomes for the ATA group compared with the ATT or ATP group. Likewise, there was no evidence of facilitation by the ATT training. All groups demonstrated similar reductions in our primary outcome measures. Although it is still possible that this lack of interference or facilitation effects was due to the limited potency of ABM in our study, overall findings indicate that the pre-training ABM program did not affect EXP in a significant way.

Results from aforementioned studies signal that specific phobias may be somewhat resistant to the effects of ABM (Reese et al., 2010; Van Bockstaele et al., 2011; Luo et al., 2015). Primarily, these investigators were successful in manipulating AB in the intended direction, yet they failed to produce reliable decreases in fear symptoms. Van Bockstaele and colleagues (2011) failed to find differences between active and placebo training groups after successful attentional manipulation. They hypothesized that their null findings resulted from a distinction they made between anxiety-based disorders such as GAD and fear-based disorders such as phobias, explaining that ABM can more effectively reduce the former. As mentioned previously, numerous investigations have noted improvements including reduced social anxiety, generalized anxiety, and obsessive-compulsive symptoms (Amir et al., 2009; Amir, Beard, Burns, & Bomyea, 2009; Najmi & Amir, 2010). Considerably less support exists for improving symptoms of specific fears using ABM. The current study is consonant with the extant literature by offering some evidence of successful manipulation of AB, yet a lack of difference between outcomes for individuals who received active versus placebo attention training.

Reese and colleagues' (2010) research demonstrated equivalent outcomes for both active disengagement training from spider images and placebo training at post-treatment. Importantly, they noted that at 1-week follow-up, AB towards spiders among those who received disengagement training increased, revealing an issue with durability. Authors suggested using a distributed approach of ABM (i.e., dividing training blocks into multiple sessions) for stimulus-driven anxiety problems such as spider fears. The present investigation did not employ a multi-session approach of ABM. Although single-session paradigms have yielded improvement among other populations (Amir et al., 2008; Najmi & Amir, 2010), given our population of individuals with specific fears, the potency of the current ABM may not have been sufficient.

Luo and colleagues (2015) were the first group of researchers to observe behavioral change following successful manipulation of AB among a population with specific fears. They attribute this success to the use of pairing snake images with positive as opposed to neutral stimuli. Researchers also noted that the stimulus categories varied, similar to what might occur naturally in a real-world setting. The current study followed the more standard paradigm of pairing spider images with neutral images. Future research may examine whether the following modifications to the current procedure would produce more beneficial outcomes: a) using positive-valence images during the training procedure, or b) using neutral images, but from varied stimulus categories as opposed to exclusively household objects. Again, due to our population of individuals with specific fears that may be more resistant to the effects of ABM, researchers may be able to produce more robust changes in AB and fear symptoms by intensifying the ABM procedure.

Although not directly tied to study hypotheses, performance during the EXP task was examined to determine group equivalence. Overall, there were no significant group differences in terms of fear ratings and performance. Interestingly, in terms of physiological arousal during EXP, one may anticipate some group differences considering the independent effects of the ABM and EXP procedures. In particular, an argument could be made for the reduction in arousal for either the ATT or the ATA conditions. Although not statistically significant, our results indicated that the ATA group always had the lowest levels of physiological arousal, indicating that they did not become as anxious during the EXP procedure. It may have been the case that pre-attentional disengagement training prevented them from fully confronting the live spider. ABM researchers to date would interpret this as a beneficial outcome given the intended effects of ABM. Indeed, previous research among snake-fearful individuals who received attentional disengagement training (versus attention training towards snake images) evidenced lower physiological arousal when approached by a live snake (Luo et al., 2015). Overall, findings from the current investigation replicate this effect and indicate that a trend of reduced arousal among individuals in the ATA group did not interfere with our main outcome measures.

The findings from the current study have produced lines of questioning that warrant future research. One suggestion is to utilize a modified ABM task for the treatment of specific fears. This design may take the form of either multiple EXP and ABM sessions, or an increased duration of pre-training to achieve the desired response. It would be of interest to learn if ABM works in a way that can reduce the duration of EXP (without adding a significantly longer pre-training portion that is even more time intensive and thus prohibitive) or make the procedure more palatable. Using suggestions from previous research, modifying the current paradigm in terms of task stimuli and instruction may allow the more subtle changes in AB observed in the current study to strengthen, leading to greater improvements in fear reduction. Additionally, developing a way to measure attentional focus during EXP without interfering with the intervention may yield additional information concerning the effects of ABM as a pre-exposure manipulation. For example, a wearable eye-tracker that records overt processing during EXP may allow for observation of AB patterns during EXP. Along these lines, more research is needed to continue exploring the question of precisely how much attentional focus is ideal during EXP. Further inquiry into this line of investigation may produce more effective recommendations for behavior therapists using this mode of treatment. These issues are important to further explore as the current null findings may simply be due to an insufficient potency of our ABM procedure.

There are several noteworthy limitations of the current study that deserve mention. One limitation of the current study is the use of a non-clinical sample. A sample comprised of diagnosed spider phobic individuals may have yielded a different pattern of response during the behavioral and computerized cognitive tasks. In this vein, previous research indicates that ABM is most effective when there is evidence for vigilance at baseline (Amir, Taylor, & Donohue, 2011). In the present study, initial AB towards threat was not particularly robust (see Figures 8 and 9 for examples in the cueing and eye-tracking data). Therefore, in future research, investigators may include a control group to compare various baseline levels of AB. An additional limitation of the investigation is the relatively small dose of ABM. As mentioned previously, EXP is a particularly potent intervention for specific fears, and the effects of this mode of treatment could outweigh the effects of the attentional manipulation, particularly if it is at a sub-therapeutic dose.

Further, a possible ceiling effect of the behavioral hierarchies constructed for the BAT or EXP procedure is another potential limitation to consider. Perhaps a greater number of steps or a shorter max duration of the tasks could produce more variability in responding. Additionally, the present investigation took place in an artificial laboratory setting. Unlike a typical therapeutic setting, the EXP procedure in the current study was highly prescribed to ensure consistency across participants. The rigorous procedures employed involving timing, interaction with the therapist, etc. are no doubt more rigorous.

Conclusion

Given the state of the literature concerning the role of attention in EXP, it was important to further investigate the potential effects of experimentally manipulating attentional allocation when combined with EXP. In summary, all groups experienced a reduction in symptoms on primary outcome measures that was not dependent on AB pre-training condition. We found some preliminary evidence that ABM can change AB with specific fears. Further, preliminary findings indicate that this manipulation in attention will persist throughout a behavioral intervention without interference. Due to the potential need for modifications that intensify the ABM procedure with this population, the utility of ABM as an adjunctive intervention and the optimal amount of attentional training remains to be determined. Future research should seek to clarify the issue of dosage proposed in the current study, as well as continue to examine the factors surrounding attentional focus during EXP.

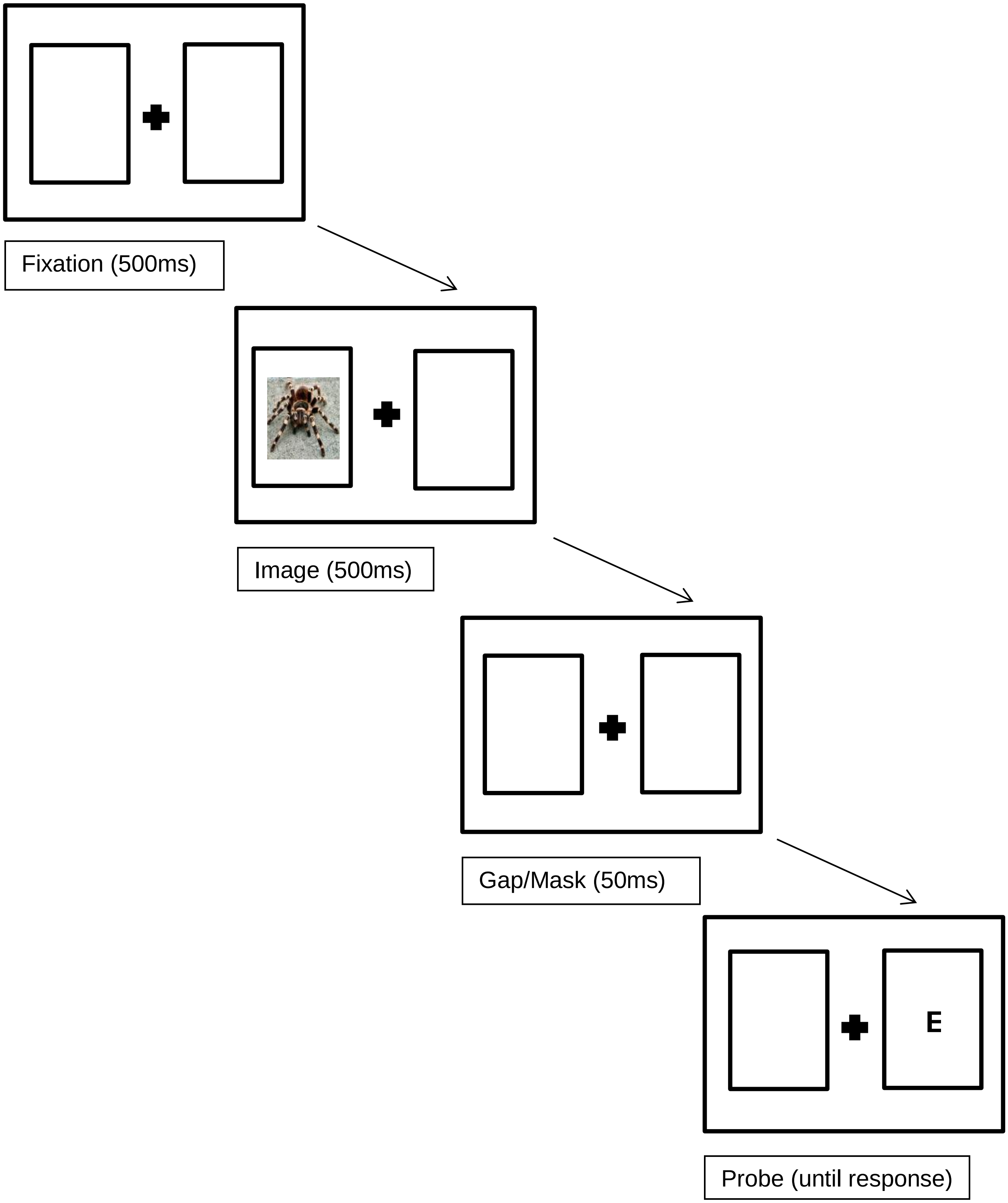


Figure 1. Procedure of the Exogenous Cueing Task. This figure illustrates the following sequence: First, a fixation cue is presented for 500ms. Next, either a spider or a neutral image is presented for 500ms. Then a brief mask conceals the image. Lastly, a probe (letter E or F) is presented until the participant responds as quickly as possible. The above is an example of an invalid trial.

Figure 2. Example Screenshot from the Eye-tracking Picture Viewing Task. The task presents a set of images from four different stimulus categories (i.e., general threat, spider, pleasant, and neutral) in a counterbalanced order. The participant views the stimuli for 30 seconds in a naturalistic manner while eye movements are recorded.

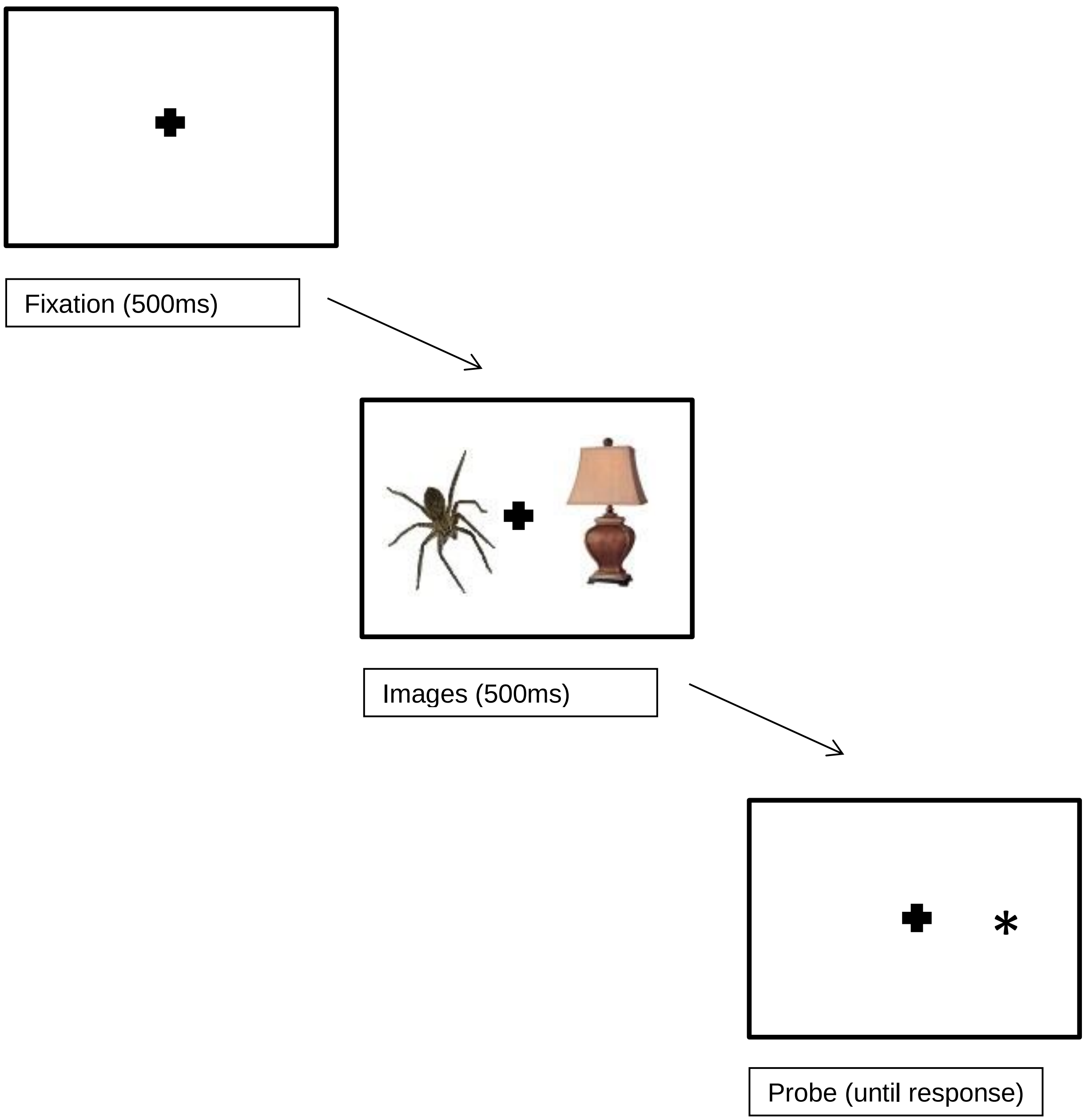


Figure 3. Procedure of the Dot-Probe Attention Pre-training Program. This figure illustrates the following sequence: First, a fixation cross in presented in the center of the screen for 500ms. Next, spider-neutral or neutral-neutral image pairs are presented on either side of the screen for 500ms. Lastly, a probe (asterisk) appears on either side depending on condition until the participant responds as quickly as possible. The example above is the training condition designed to disengage attention away from threat.

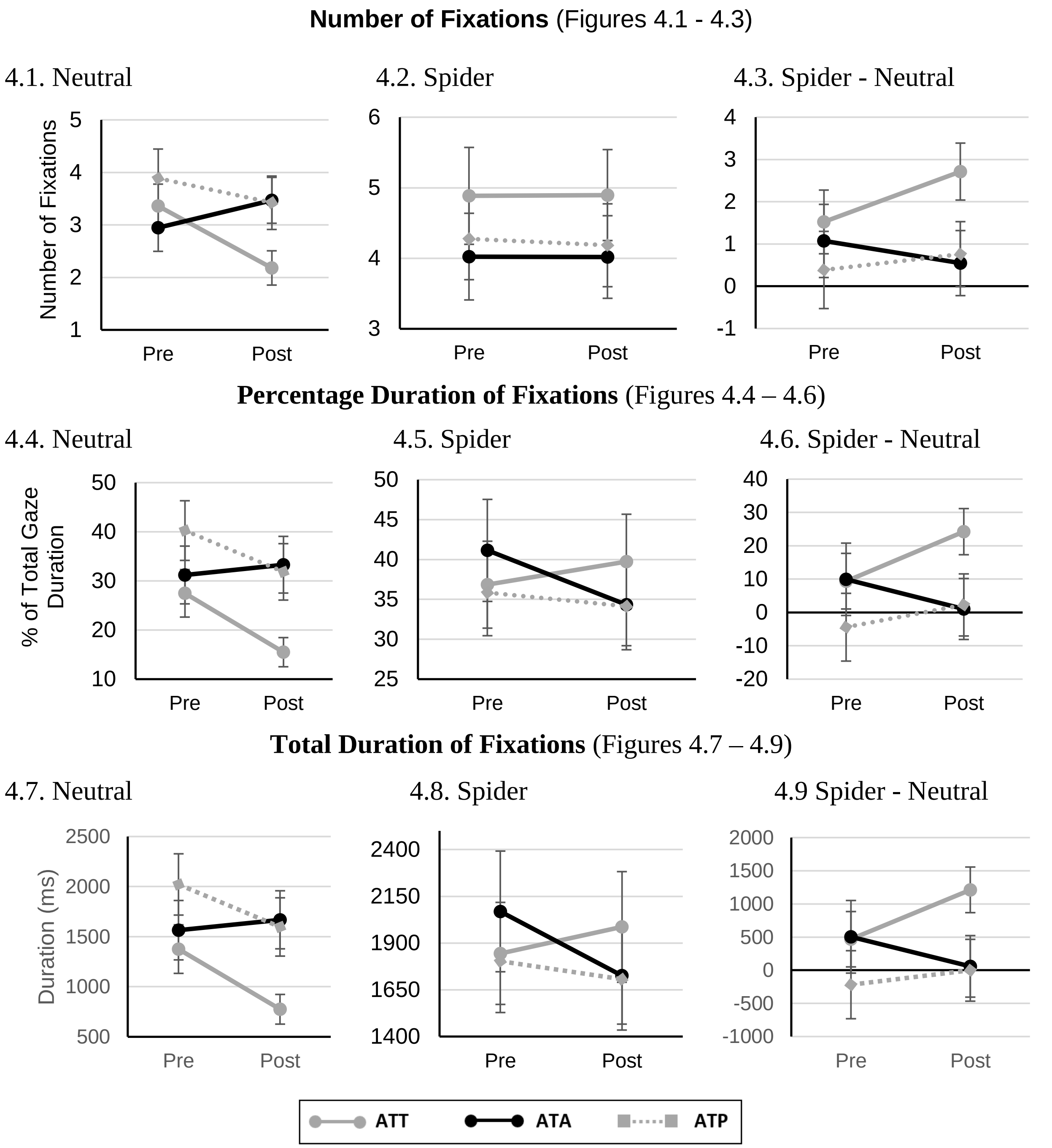


Figure 4. Eye-tracking Manipulation Check Results. These graphs depict data that were collected at the beginning and end of the attention training procedure. Change in attention was examined by assessing eye-movement, which was indexed by (1) the number of fixations, (2) percentage duration of fixations (%), and (3) total duration of fixations (in milliseconds) on the neutral images and spider images. The difference scores between the spider and neutral images were also computed for these indices.

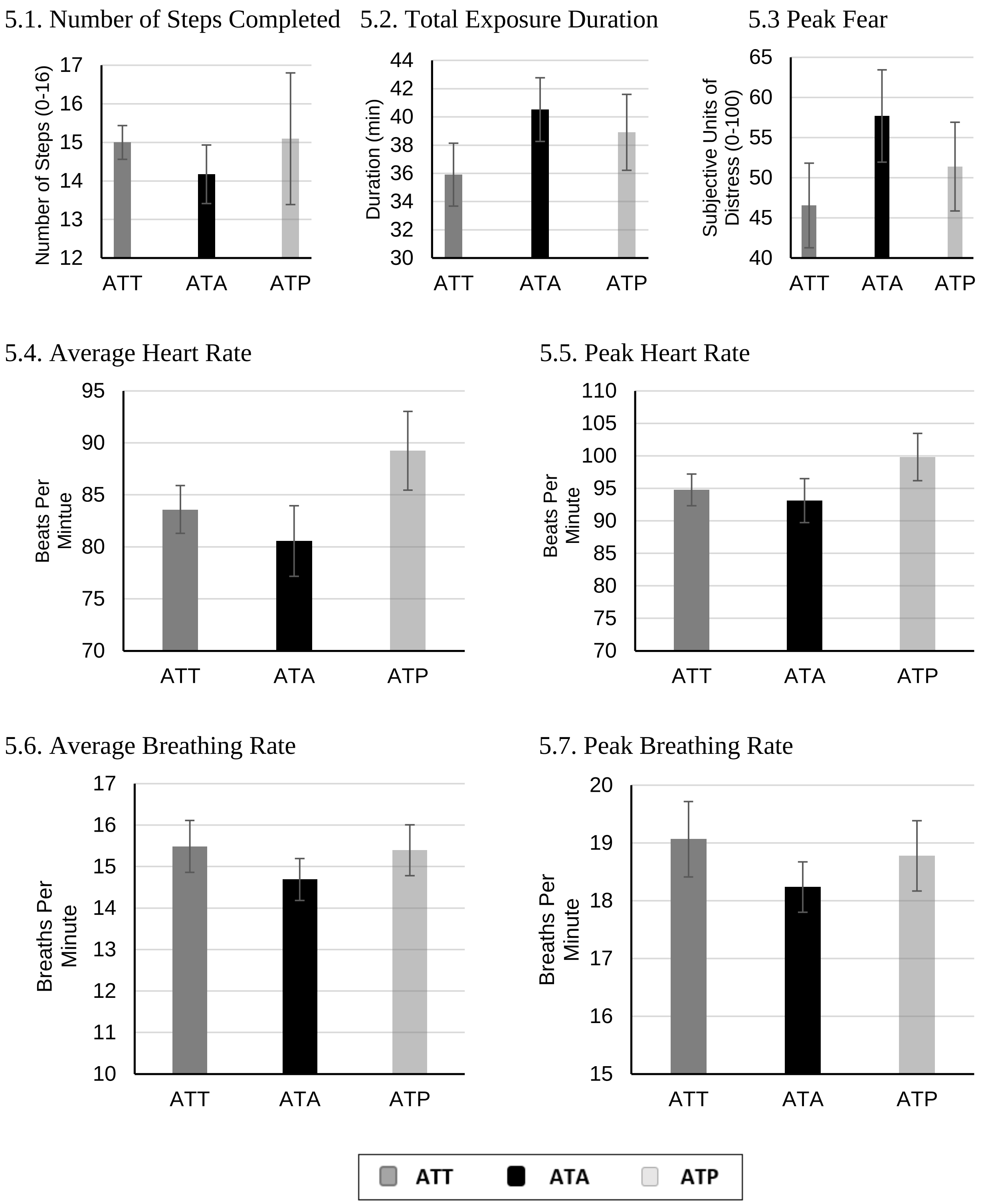


Figure 5. Exposure Task Results. The above graphs depict all of the data derived from the single-session exposure procedure. This includes behavioral approach (5.1), session length (5.2), subjective anxiety reporting (5.3), and psychophysiological recordings (5.4 – 5.7).

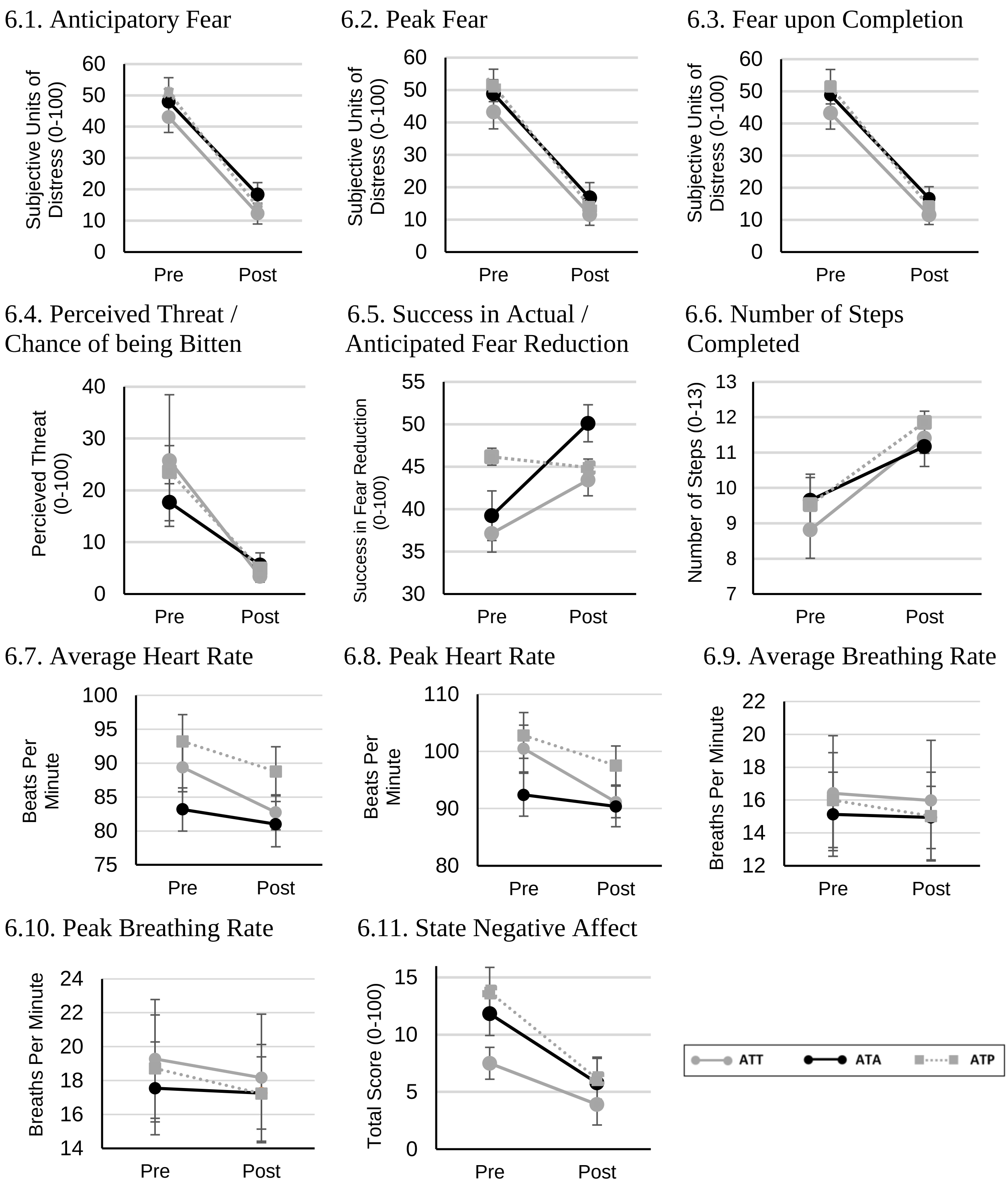


Figure 6. Behavioral Approach Test Results. The behavioral approach test was administered before and after the intervention (combining exposure therapy and attention bias modification). Outcomes measured multiple domains including experienced fear (6.1 - 6.3), perceived threat (6.4), success in actual/anticipated fear reduction (6.5) behavioral approach (6.6), psychophysiological measurement (6.7-6.10), and negative affect (6.11).

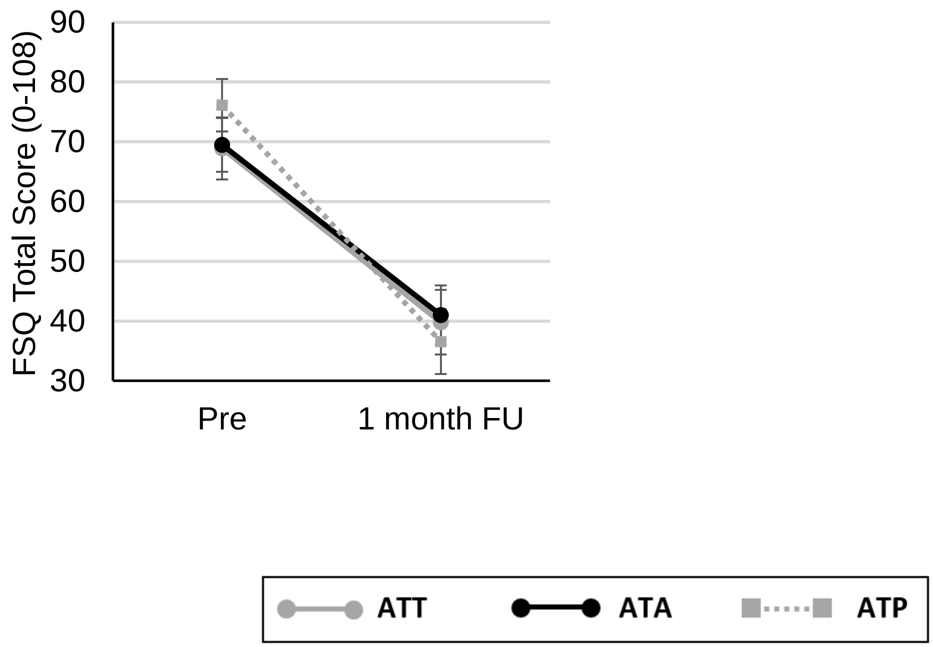


Figure 7. Fear of Spiders Questionnaire Results. The Fear of Spiders Questionnaire was administered at the beginning of the experimental session and 1-month follow-up. The above graph represents change in scores among study completers (n=59).

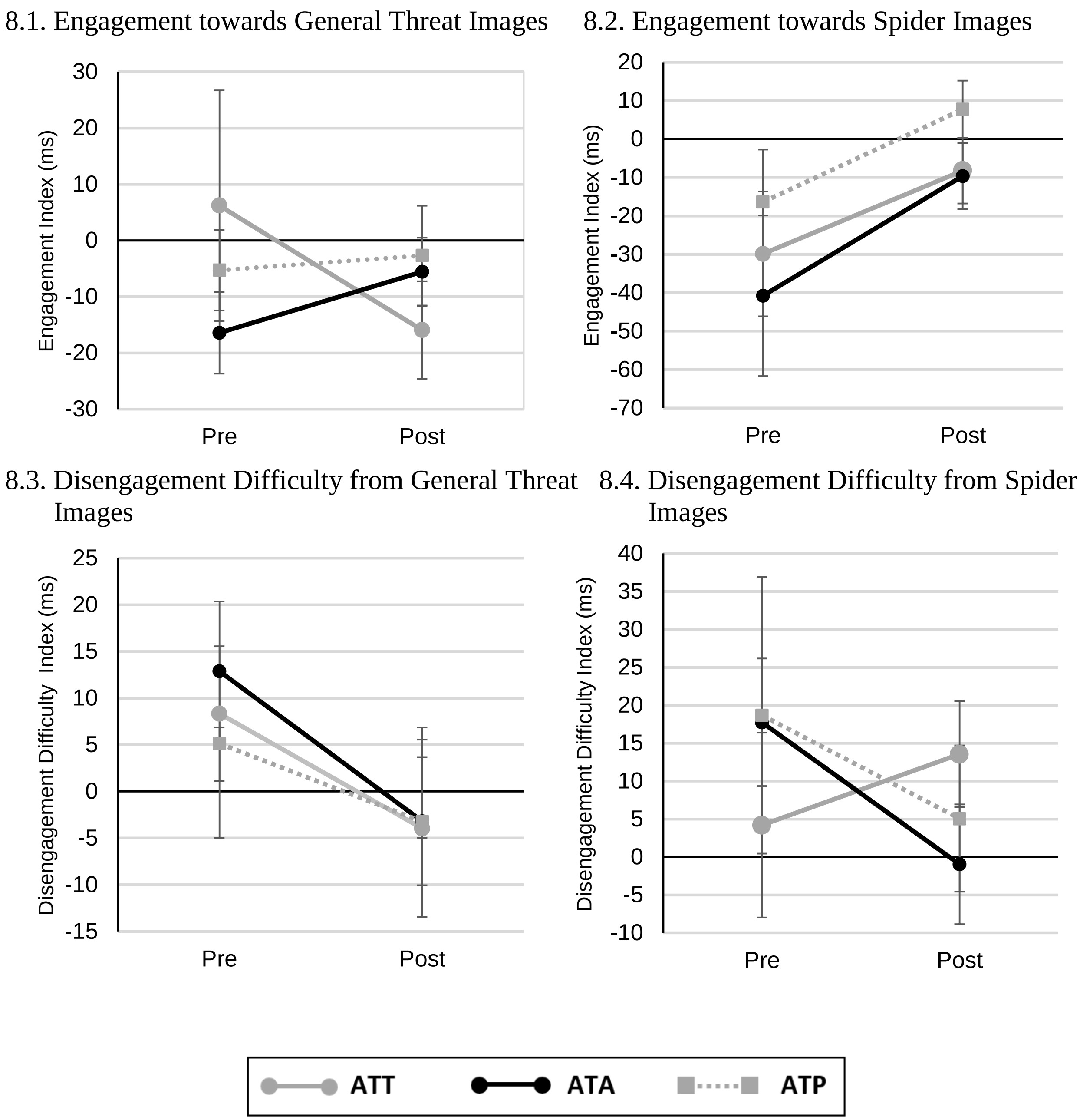
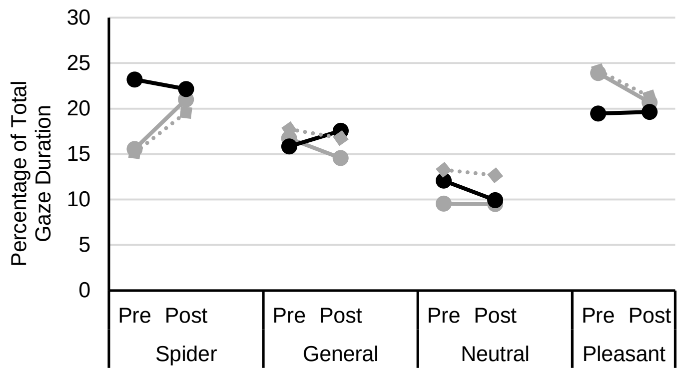


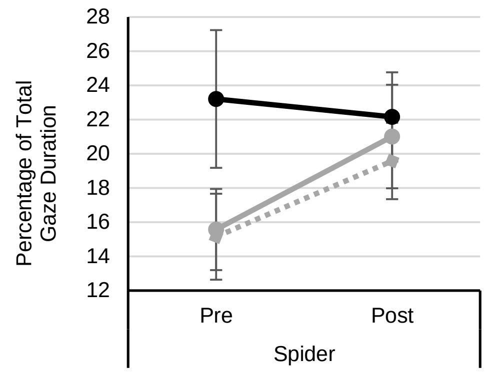
Figure 8. Exogenous Cueing Task Results. The exogenous cueing task was administered before and after the intervention (combining exposure therapy and attention bias modification). Engagement scores were calculated by subtracting reaction times on valid threat cues from reaction times on valid neutral cues. Scores less than zero equal less engagement and scores greater than zero equal more engagement. Disengagement scores were calculated by subtracting reaction times on invalid neutral cues from reaction times on invalid threat cues. Scores less than zero equal less difficulty disengaging and scores greater than zero equal more difficulty disengaging.

Percentage Duration of Fixations

9.1 All Image Categories

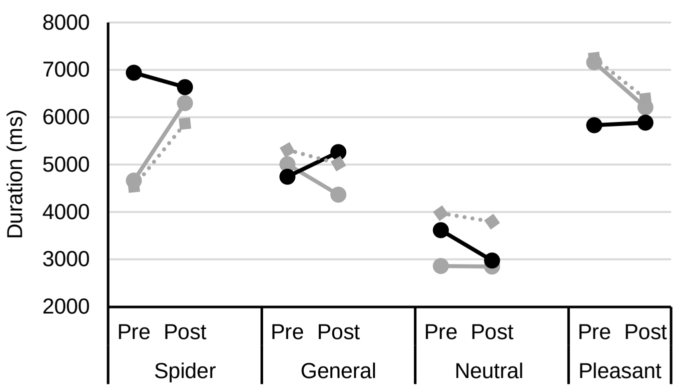


9.2 Spider Images

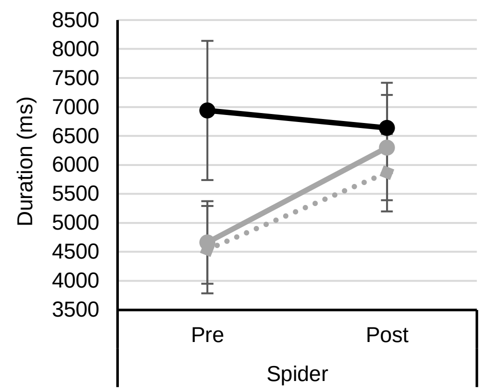


Total Duration of Fixations

9.3 All Image Categories

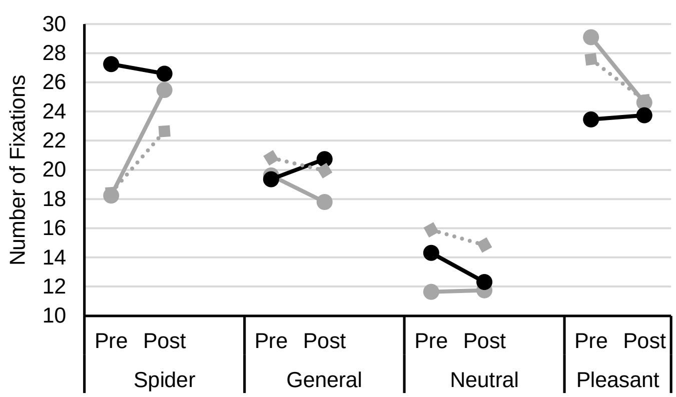


9.4 Spider Images

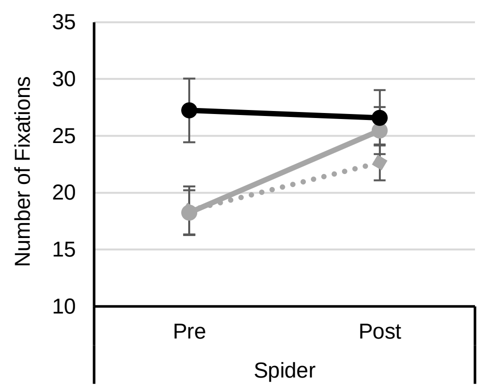


Number of Fixations

9.5 All Image Categories



9.6 Spider Images



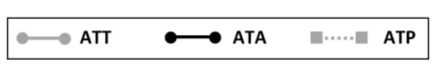


Figure 9. 30 Second Picture Viewing Task Results. The above graphs present eye-movement data for each of the four stimulus categories as well as separate graphs detailing the spider category only data. Three separate attentional indices were calculated: Percentage and total duration of fixations (9.1-9.2; 9.3-9.4) and number of fixations (9.5-9.6).

Table 1. Basic Demographic Characteristics (N=66)

	ATT (n=22)	ATA (n=23)	ATP (n=21)	*F* or Chi-squared	*p*
	Mean (SD)	Mean (SD)	Mean (SD)		
Age	22.32 (7.44)	20.26 (3.19)	21.33 (5.01)	F (2,63) = .794	.456
Marital Status					
Never Married	91% (n=20)	91.3% (n=21)	100% (n=21)	X^2 (4) = 3.947	.413
Married	4.5% (n=1)	8.7% (n=2)	0% (n=0)		
Widowed	0% (n=0)	0% (n=0)	0% (n=0)		
Divorced / Annulled	4.5% (n=1)	0% (n=0)	0% (n=0)		
Gender					
Male	18.2% (n=4),	21.7% (n=5)	23.8% (n=5)	X^2 (2) = .209	.901
Female	81.8% (n=18)	78.3% (n=18)	76.2% (n=16)		
Education					
High School Diploma	45.5% (n=10)	30.4% (n=7)	28.6% (n=6)	X^2 (6) = 4.388	.624
Some College	45.5% (n=10)	60.9% (n=14)	66.7% (n=14)		
Bachelor's Degree	4.5% (n=1)	8.7% (n=2)	4.7% (n=1)		
Doctoral or Professional Degree	4.5% (n=1)	0% (n=0)	0% (n=0)		
Income					
< 10,000	36.4% (n=8)	43.5% (n=10)	52.4% (n=11)	X^2 (10) = 6.658	.757
10,000 - 20,000	13.6% (n=3)	8.7% (n=2)	9.5% (n=2)		
21,000 - 30,000	22.7% (n=5)	17.4% (n=4)	14.3% (n=3)		
31.000 - 50,000	9.1% (n=2)	8.7% (n=2)	14.3% (n=3)		
51,000 - 100,000	9.1% (n=2)	21.7% (n=5)	4.7% (n=1)		
> 100,000	9.1% (n=2)	0% (n=0)	4.7% (n=1)		

Note. ATT = Attention Training Towards + Exposure Therapy; ATA = Attention Training Away + Exposure Therapy; ATP = Attention Training Placebo + Exposure Therapy.

Table 2. Basic Clinical Characteristics (N=66)

	ATT (n=22) Mean (SD)	ATA (n=23) Mean (SD)	ATP (n=21) Mean (SD)	*F* or Fisher's Exact Test	*p*
Therapy					
Past Tx	31.8% (n=7)	8.8% (n=2)	14.3% (n=3)		.159
Current Tx	9.1% (n=2)	4.3% (n=1)	4.8% (n=1)		.838
Trait Anxiety and Depression					
STAI-T	30.27 (11.715)	31.83 (12.202)	36.76 (15.336)	*F* (2,63) = 1.426	.248
DASS-A	2.41 (3.541)	3 (3.503)	4.43 (4.226)	*F* (2,63) = 1.633	.204
DASS-D	2.86 (3.454)	2.70 (4.279)	4.67(5.642)	*F* (2,63) = 1.255	.292
DSM Diagnoses					
Spider Phobia	13.6% (n=3)	21.7% (n=5)	23.8% (n=5)		.738
Major Depressive Disorder	9.1% (n=2)	0% (n=0)	0% (n=0)		
Panic Disorder	9.1% (n=2)	8.7% (n=2)	9.5% (n=2)		
Social Anxiety Disorder	4.5% (n=1)	4.3% (n=1)	33.3% (n=7)		
Hypochondriasis	0% (n=0)	0% (n=0)	0% (n=0)		
Obsessive-Compulsive Disorder	0% (n=0)	4.3% (n=1)	14.3% (n=3)		
Post-traumatic Stress Disorder	0% (n=0)	4.3% (n=1)	4.8% (n=1)		
Alcohol Use Disorder	0% (n=0)	0% (n=0)	0% (n=0)		
Substance Use Disorder	0% (n=0)	0% (n=0)	0% (n=0)		
Anorexia Nervosa	0% (n=0)	0% (n=0)	0% (n=0)		
Bulimia Nervosa	0% (n=0)	0% (n=0)	4.8% (n=1)		
Body Dysmorphic Disorder	0% (n=0)	0% (n=0)	0% (n=0)		
Generalized Anxiety Disorder	0% (n=0)	4.3% (n=1)	4.8% (n=1)		
Bipolar Disorder	0% (n=0)	0% (n=0)	0% (n=0)		
Psychotic Disorder	0% (n=0)	0% (n=0)	0% (n=0)		
Attention-Deficit/Hyperactivity Disorder	4.5% (n=1)	0% (n=0)	4.8% (n=1)		
FSQ	67.09 (23.94)	71.7 (21.1)	72.1 (21.67)	*F* (2,63) = .342	.712
SPQ	15.05 (6.42)	16.52 (7.66)	17.43 (6.38)	*F* (2,63) = .662	.519
SBQ	42.62 (22.33)	44.21 (18.42)	43.28 (17.24)	*F* (2,63) = .038	.963
STQ	29.91 (12.84)	29.48 (15.08)	25 (11.02)	*F* (2,63) = .741	.481
DQ	35.45 (7.31)	36.48 (8.49)	33.57 (7.5)	*F* (2,63) = .778	.464
STAI	60.41 (16.82)	64.48 (18.68)	71 (22.52)	*F* (2,63) = 1.621	.206
ASI-III	32.14 (10.4)	32.7 (11.93)	38.1 (14.68)	*F* (2,63) = 1.506	.230
DASS-21	9.45 (8.77)	10.35 (10)	16.76 (13.1)	*F* (2,63) = 2.963	.059
ACS	42.18 (5.65)	39.3 (9.1)	40 (8.34)	*F* (2,63) = .814	.448
AAQ-II	24.36 (10.66)	26 (12.44)	32.24 (12.96)	*F* (2,63) = 2.545	.087

Basic Clinical Characteristics (N=66) (Continued)

Note. ATT = Attention Training Towards + Exposure Therapy; ATA = Attention Training Away + Exposure Therapy; ATP = Attention Training Placebo + Exposure Therapy. STAI = State - Trait Anxiety Inventory; DASS-21 = Depression Anxiety Stress Scale - 21; FSQ = Fear of Spiders Questionnaire; SPQ = Spider Phobia Questionnaire; SBQ = Spider Beliefs Scale; STQ = Spider Thoughts Questionnaire; DQ = Disgust Questionnaire; ASI-3 = Anxiety Sensitivity Index - 3; ACS = Attentional Control Scale; AAQ-II = Acceptance and Action Questionnaire - II.

Table 3. Group Differences in BAT Outcomes at Pre and Post-treatment (N=66)

	ATT (n=22) Mean (SD)	ATA (n=23) Mean (SD)	ATP (n=21) Mean (SD)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
BAT: Fear							
Anticipatory							
Pre	43.07 (23.14)	47.94 (19.65)	51.08 (20.93)	F (2,63) = .777	F (2,61) = .320	F (1,61) = 10.415	F (2,61) = .735
Post	12.29 (15.59)	18.3 (18.51)	14.3 (11.03)	p = .464	p = .728, η_p^2 = .010	p = .002, η_p^2 = .146	p = .484, η_p^2 = .024
Peak							
Pre	43.23 (24.62)	48.86 (20.17)	51.44 (22.93)	F (2,62) = .743	F (2,60) = .423	F (1,60) = 10.113	F (2,60) = .326
Post	11.58 (15.46)	16.7 (19.43)	14.09 (10.8)	p = .480	p = .657, η_p^2 = .014	p = .002, η_p^2 = .144	p = .723, η_p^2 = .011
After							
Pre	39.2 (23.47)	46.1 (20.4)	44.44 (22.86)	F (2,62) = .917	F (2,60) = .508	F (1,60) = 7.676	F (2,60) = .360
Post	9.73 (14.34)	14.08 (17.83)	11.72 (14.77)	p = .405	p = .605, η_p^2 = .017	p = .007, η_p^2 = .113	p = .699, η_p^2 = .012
BAT: Cognitive							
Perceived threat / Chance of being bitten							
Pre	5.74 (59.55)	17.7 (16.71)	23.58 (23.1)	F (2,62) = .259	F (2,60) = .181	F (1,60) = .138	F (2,60) = .459
Post	3.42 (5.43)	5.6 (10.22)	4.83 (4.99)	p = .773	p = .835, η_p^2 = .006	p = .712, η_p^2 = .002	p = .634, η_p^2 = .015
Perceived fear reduction / Fear generalization							
Pre	37.15 (10.32)	39.23 (14.05)	46.17 (15.99)	F (2,62) = 2.573	F (2,61) = 1.254	F (1,61) = 1.709	F (2,61) = 2.903
Post	43.43 (8.69)	50.11 (10.48)	44.9 (12.72)	p = .084	p = .293, η_p^2 = .039	p = .196, η_p^2 = .027	p = .062, η_p^2= .087
BAT: Avoidance							
Number of steps							
Pre	8.82 (3.78)	9.65 (3.53)	9.52 (3.53)	F (2,63) = .342	F (2,61) = .461	F (1,61) = 1.377	F (2,61) = 1.171
Post	11.41 (2.04)	11.17 (2.72)	11.86 (1.42)	p = .712	p = .633, η_p^2 = .015	p = .245, η_p^2 = .022	p = .317, η_p^2 = .037

Group Differences in BAT Outcomes Cont.

	ATT (n=22)	ATA (n=23)	ATP (n=21)	[a]*F* Test *p*	ME Group	ME Time	Time X Group
	Mean (SD)	Mean (SD)	Mean (SD)				
BAT: Physiology							
HR Peak	100.51 (19.18)	92.42 (16.41)	102.8 (18.31)				
Pre	91.15 (12.94)	90.38 (15.59)	97.53 (15.69)	F (2,59) = 1.797	F (5,57) = 2.040	F (1,57) = 1.956	F (2,57) = 1.896
Post				p = .175	p = .139, $\eta_p{}^2$=067	p = .167, $\eta_p{}^2$= .033	p = .159, $\eta_p{}^2$= .159
HR Average	89.38 (16.88)	83.17 (13.92)	93.21 (18.13)				
Pre	82.74 (12.13)	81 (14.59)	88.79 (16.54)	F (2,59) = 1.872	F (2,57) = 2.537	F (1,57) = 1.848	F (2,57) = 1.040
Post				p = .163	p = .088, $\eta_p{}^2$= .082	p = .179, $\eta_p{}^2$= .031	p = .360, $\eta_p{}^2$= .035
BR Peak	19.27 (3.5)	17.55 (2.74)	18.72 (3.16)				
Pre	18.17 (3.74)	17.26 (2.13)	17.22 (2.9)	F (2,59) = 1.558	F (2,57) = 1.169	F (1,57) = .379	F (2,57) = 1.273
Post				p = .219	p = .318, $\eta_p{}^2$= .039	p = .541, $\eta_p{}^2$= .007	p = .288, $\eta_p{}^2$= .043
BR Average	16.42 (3.5)	15.13 (2.56)	15.99 (2.89)				
Pre	15.97 (3.68)	14.94 (1.89)	15.02 (2.67)	F (2,59) = .945	F (2,57) = .940	F (1,57) = .166	F (2,57) = .647
Post				p = .394	p = .397, $\eta_p{}^2$= .032	p = .685, $\eta_p{}^2$= .003	p = .528, $\eta_p{}^2$= .022
State Affect							
Pre	7.5 (6.54)	11.83 (9.09)	13.71 (9.92)	F (2,63) = 2.959	F(2,61) = .966	F (1,61) = .052	F (2,61) = .335
Post	3.9 (8.43)	5.78 (10.8)	6.14 (8.15)	p = .059	p = .386, $\eta_p{}^2$= .031	p = .821, $\eta_p{}^2$= .001	p = .716 $\eta_p{}^2$= .011

Note. ATT = Attention Training Towards + Exposure Therapy; ATA = Attention Training Away + Exposure Therapy; ATP = Attention Training Placebo + Exposure Therapy; BAT = Behavioral Approach Test; HR = Heart Rate; BR = Breathing Rate.
[a] = One-way ANCOVA baseline

Table 4. Attention Bias Indices on Exogenous Cueing Task (N=66)

	ATT (n=17)	ATA (n=16)	ATP (n=19)	[b] *F* Test	*p*
	Mean (SD)	Mean (SD)	Mean (SD)		
Attentional Engagement towards General Threat Images					
Pre	6.19 (84.56)	-10.9 (32.25)	-5.29 (31.28)		
Post	-15.94 (35.82)	-6.57 (25.18)	-2.69 (38.59)	F (2,50) = 2.097	.133
Attentional Engagement towards Spider Images					
Pre	-29.88 (66.95)	-20.69 (95.54)	-16.37 (59.30)		
Post	-8.23 (35.29)	-6.91 (33.99)	7.72 (32.60)	F (2,50) = .138	.871
Attentional Disengagement Difficulty from General Threat Images					
Pre	8.34 (29.79)	10.99 (28.92)	5.13 (29.7)		
Post	-3.96 (39.16)	-1 (29.96)	-3.22 (29.13)	F (2,50) = .092	.912
Attentional Disengagement Difficulty from Spider Images					
Pre	4.2 (50.16)	10.23 (40.1)	18.69 (79.46)		
Post	13.54 (28.76)	-.45 (30.39)	5.06 (42.04)	F (2,50) = .381	.685

Note. ATT = Attention Training Towards + Exposure Therapy; ATA = Attention Training Away + Exposure Therapy; ATP = Attention Training Placebo + Exposure Therapy.
[b] = Repeated Measures ANCOVA

Table 5. Correlations

5a. Correlations Among Self-Report Measures and Various Behavioral, Cognitive, and Physiological Indices from the BAT, Exogenous Cueing, and 30 sec Picture Viewing Tasks at Baseline

Baseline Scores

	DASS-21	FSQ	BAT Peak Fear	BAT # Steps	Disengagement Difficulty	% Duration Fixations	Total Duration Fixations	# Fixations	Peak HR
DASS-21	-----								
FSQ	.133	-----							
BAT Peak Fear	.110	.437**	-----						
BAT # Steps	-.003	-.267*	.183	-----					
Disengagement Difficulty	-.143	.134	-.114	-.027	-----				
% Duration Fixations	-.039	-.081	-.152	.370**	.176	-----			
Total Duration Fixations	-.039	-.083	-.152	.371**	.176	1.000**	-----		
# Fixations	.011	-.026	-.108	.296*	.232	. 901**	.899**	-----	
Peak HR	-.195	.230	.041	-.174	-.076	-.223	-.224	-.219	-----

*p<.05, **p<.01

5b. Correlations Among Self-Report Measures and Various Behavioral, Cognitive, and Physiological Indices from the BAT, Exogenous Cueing, and 30 sec Picture Viewing Tasks from Pre to Post

Change Scores

	FSQ	BAT Peak Fear	BAT # Steps	Disengagement Difficulty	% Duration Fixations	Total Duration Fixations	# Fixations	Peak HR
FSQ	-----							
BAT Peak Fear	.411**	-----						
BAT # Steps	.078	-.204	-----					
Disengagement Difficulty	-.034	-.271	.081	-----				
% Duration Fixations	-.113	.006	-.098	.011	-----			
Total Duration Fixations	-.114	.005	-.098	.011	1.000**	-----		
# Fixations	-.118	.027	-.132	.010	. 930**	.930**	-----	
Peak HR	-.015	.047	.025	-.139	-.261	-.260	-.251	-----

*p<.05, **p<.01

Note. BAT = Behavioral Approach Test; DASS-21 = Depression Anxiety Stress Scale - 21; FSQ = Fear of Spider Questionnaire; BAT Peak Fear = Self-reported peak fear during BAT; BAT # Steps = Number of steps completed during BAT; Disengagement Difficulty = Attentional disengagement difficulty from spider images during exogenous cueing task; % Duration of Fixations = Percentage duration of fixations on spider images during 30 second photo viewing task; Total Duration of Fixations = total duration of fixations on spider images during 30 second picture viewing task; # of Fixations = Number of fixations on spider images during 30 sec picture viewing task; Peak HR = peak heart rate during BAT.

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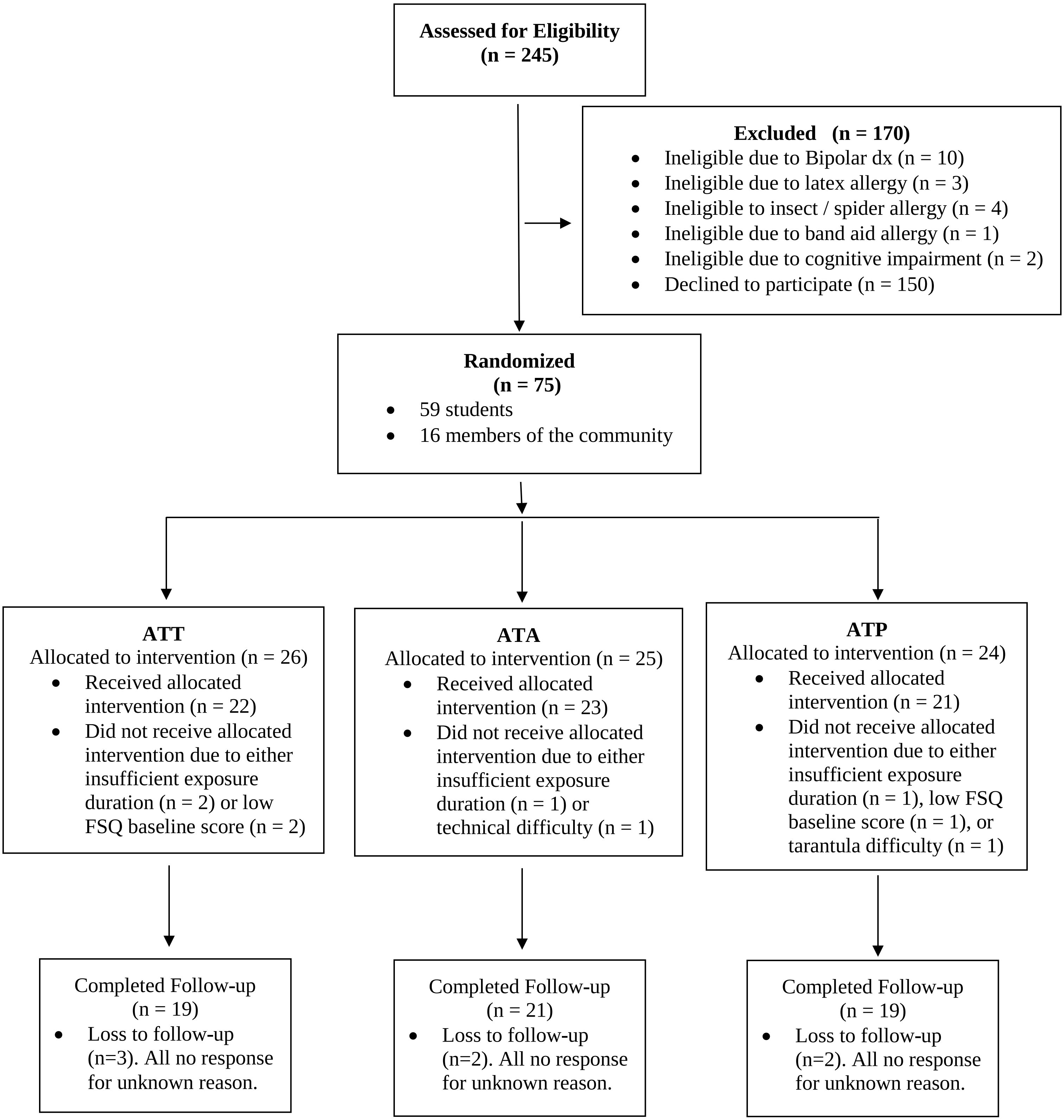
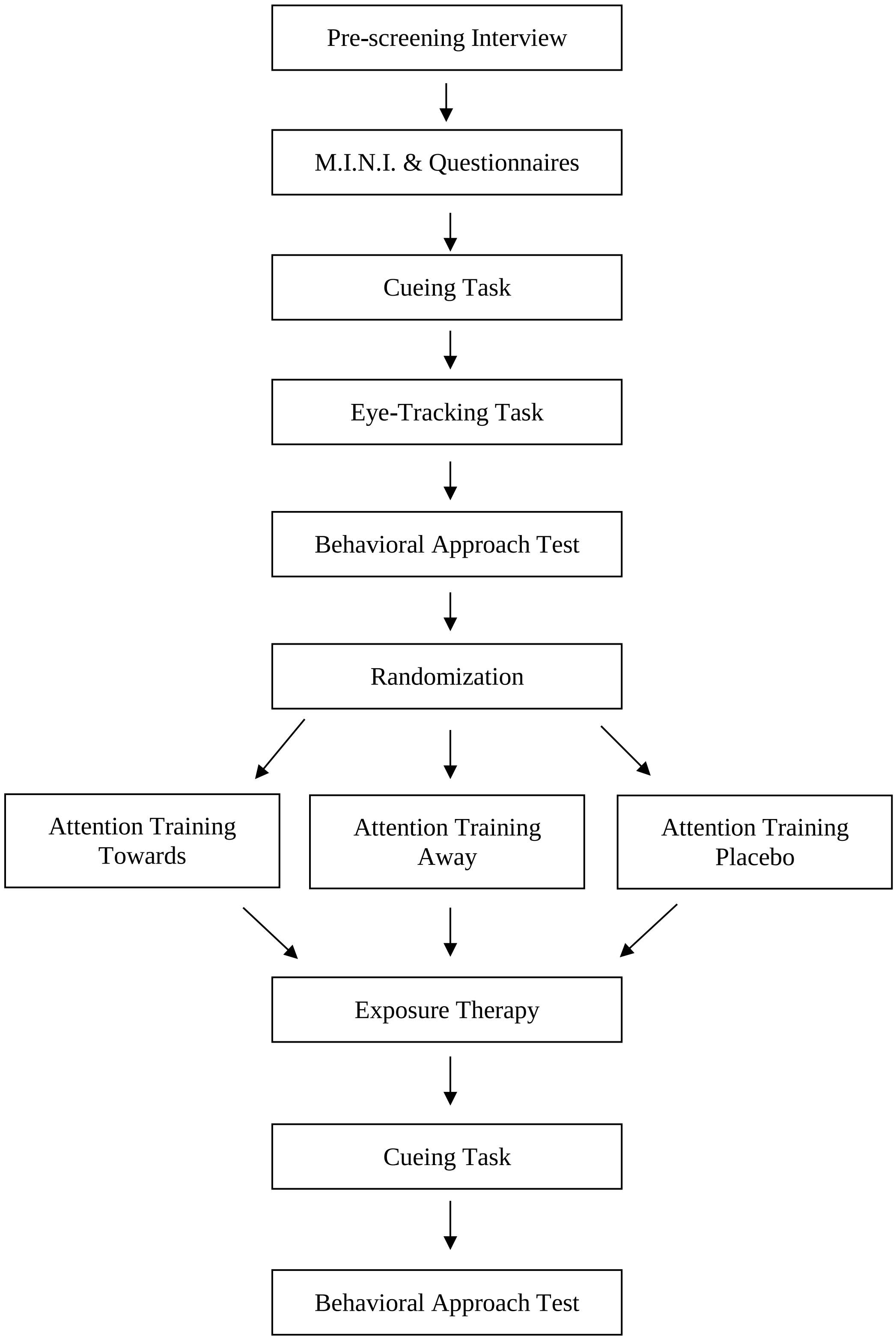
Appendix A:

Participant Flow Chart



Appendix B:

Complete Study Activities Flow Chart



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EDUCATION

Doctorate (Clinical Psychology, Neuroscience Minor)
The University of Wisconsin-Milwaukee, Milwaukee, WI
Dissertation Title: "Combining Attention Bias Pre-training with Exposure
Therapy for Individuals with a Fear of Spiders"
Advisor: Han-Joo Lee, Ph.D.
Expected Date of Completion: August 2017

Master of Science (Psychology) **2013**
The University of Wisconsin-Milwaukee, Milwaukee, WI
Thesis Title: "Subgrouping Individuals with Generalized Social Phobia:
A Classification Based on the Pattern of Attentional Bias"
Advisor: Han-Joo Lee, Ph.D.

Bachelor of Science (Psychology) **2008**
The University of Georgia, Athens, GA
Minor: Child and Family Development

CLINICAL ACTIVITIES

Pre-Doctoral Psychology Intern **08/08 – Present**
OCD Residential Treatment Center, Rogers Memorial Hospital, Oconomowoc, WI
Supervisors: Bradley C. Riemann, Ph.D., Rachel C. Leonard, Ph.D. & Chad Wetterneck, Ph.D.

Student Therapist **09/15 – 05/16**
Women's Resource Center, Women Veteran's Health Program
The Clement J. Zablocki VA Medical Center, Milwaukee, WI
Supervisor: Carol L. Goulet, Ph.D.

Student Supervisor **09/15 – 05/16**
Anxiety Disorders Specialty Team, University of Wisconsin-Milwaukee
Supervisor: Christopher R. Martell, Ph.D., ABPP

Student Therapist **08/12 – Present**
Psychology Clinic, University of Wisconsin-Milwaukee
Supervisors: Shawn P. Cahill, Ph.D., Robyn C. Ridley, Ph.D., & Christopher R. Martell, Ph.D., ABPP

Assistant to the Clinic Director **05/13 – 08/15**
Psychology Clinic, University of Wisconsin-Milwaukee
Supervisor: Christopher R. Martell, Ph.D., ABPP

Student Supervisor **09/14 – 05/15**
Integrative Behavioral Couples Therapy Team, University of Wisconsin-Milwaukee
Supervisor: Christopher R. Martell, Ph.D., ABPP

Student Therapist **08/13 – 05/14**
OCD Residential Treatment Center, Rogers Memorial Hospital, Oconomowoc, WI
Supervisors: Bradley T. Boivin, Psy.D. and Bradley C. Riemann, Ph.D.

Practicum in Assessment Student **08/10 – 06/12**
University of Wisconsin-Milwaukee
Supervisors: Bonnie Klein-Tasman, Ph.D. and Han-Joo Lee, Ph.D.

Volunteer **05/08 – 11/08**
Peer Support Adult Mental Health Day Program, Advantage Behavioral Health Systems, Athens, GA
Supervisor: Carolyn Campbell, M.Ed.

RESEARCH ACTIVITIES

Student Principal Investigator **06/15 – Present**
Anxiety Disorders Laboratory, University of Wisconsin-Milwaukee
Supervisor: Han-Joo Lee, Ph.D.
Project: Combining Attention Bias Pretraining with Exposure Therapy for Individuals with a Fear of Spiders

Study Coordinator & Independent Evaluator **06/11 – 09/14**
Anxiety Disorders Laboratory & Behavior Therapy and Research Laboratory, University of Wisconsin-Milwaukee
Supervisors: Han-Joo Lee, Ph.D. and Douglas W. Woods, Ph.D.
Projects: Developing Effective Response Inhibition Training for Symptom Relief in Tourette Syndrome

Study Coordinator & Independent Evaluator **06/11 – 06/14**
Anxiety Disorders Laboratory, University of Wisconsin-Milwaukee
Supervisor: Han-Joo Lee, Ph.D.
Project: Examining Inhibitory Control Processes in OCD and its Spectrum Conditions

Student Principal Investigator **10/11 – 06/12**
Anxiety Disorders Laboratory, University of Wisconsin-Milwaukee
Supervisor: Han-Joo Lee, Ph.D.
Project: The Effects of Internal and External Rumination on Attention Bias Among Individuals with Social Phobia

Study Coordinator **08/10 – 06/11**
Anxiety Disorders Laboratory, University of Wisconsin-Milwaukee
Supervisor: Han-Joo Lee, Ph.D.
Project: Testing the Effectiveness of Computerized Sustained Attentional Regulation Training Among Individuals with Social Phobia

Research Assistant **01/08 – 05/09, 01/10 – 04/10**
Institute for Behavioral Research, University of Georgia, Athens, Georgia
Supervisor: Steven R. H. Beach, Ph.D.
Projects: Program for Strong African American Marriages, Program for Strong African American Families, The Impact of Perceived Discrimination and Social Support on Gay Male Couples, Attributions for Percieived Discriminatory Events as Predictors of Social Anxiety in Gay Men

Research Interviewer **05/09 – 12/09**
Women's Mental Health Program, Emory University School of Medicine, Atlanta, Georgia
Supervisor: Bettina T. Knight, RN, CCRC
Projects: Perinatal Stress and Gene Influences: Pathways to Infant Vulnerability, Bipolar Disorder in Pregnancy and the Postpartum Period: Predictors of Morbidity

Research Assistant & Co-Investigator **08/07– 08/08**
Optimal Functioning Laboratory, University of Georgia, Athens, Georgia
Supervisor: Michael H. Kernis, Ph.D.
Projects: Secure versus Fragile High Self-esteem as a Predictor of Verbal Defensiveness, Authenticity and Self-Infiltration

Research Assistant **01/06 – 05/06**
Social Psychology Laboratory, University of Georgia, Athens, Georgia
Supervisor: Leonard L. Martin, Ph.D.
Project: The Effects of Mindfulness Meditation on Subliminal Priming

PEER-REVIEWED PUBLICATIONS

1. Capriotti, M.R., Espil, F.M., Johnson, R.A., **Turkel, J.E.,** & Woods, D.W. (2017). Comparing Fixed-Amount and Progressive-Amount DRO Schedules for Tic Suppression in Youth with Chronic Tic Disorders. *Journal of Applied Behavior Analysis, 50(1)*, 106-120.
2. Capriotti, M.R., Piacentini, J.C., Himle, M.B., Ricketts, E.J., Espil, F.M., Lee, H.-J. **Turkel, J.E.,** & Woods, D.W. (2015). Assessing Environmental Consequences of Ticcing in Youth with Chronic Tic Disorders: The Tic Accommodation and Reactions Scale. *Children's Health Care,* 44*(3*), 205-220.
3. Lee, H. –J., Goetz, A.R., **Turkel, J.E.**, & Siwiec, S.G. (2015). Computerized Attention Retraining for Individuals with Elevated Health Anxiety. *Anxiety, Stress & Coping: An International Journal*. *28(2*), 226-237.
4. Capriotti, M.R., Brandt, B.C., **Turkel, J.E.**, Lee, H.-J., & Woods, D.W. (2014). Negative Reinforcement and Premonitory urges in Tourette Syndrome: An Experimental Evaluation. *Behavior Modification. 38(2)*, 276-296.

5. Goetz, A.R., Lee, H.-J., Cougle, J.R., & **Turkel, J.E.** (2013). Disgust propensity and sensitivity: Differential relationships to obsessive-compulsive symptoms and behavioral approach task performance. *Journal of Obsessive-Compulsive and Related Disorders, 2(4),* 412-419.
6. Lee, H.-J., Franklin, S.A., **Turkel, J.E.**, Goetz, A.R., & Woods, D.W. (2012). Facilitated Attentional Disengagement from Hair-Related Cues among Individuals Diagnosed with Trichotillomania: An Investigation based on the Exogenous Cueing Paradigm. *Journal of Obsessive-Compulsive and Related Disorders,1(1*), 8-15.
7. Lee, H.-J., & **Turkel, J.E.** (2012). Elevated Affective Lability and Poor Response Inhibition: An Investigation Based on Emotional and Non-Emotional Go/No-Go Tasks. *Journal of Experimental Psychopathology, 3(5), 7*50-767.
8. Lee, H.-J., **Turkel, J.E.,** Cotter, S.P., Milliken, J.M., Cougle, J.R., Lesnick, A.M. & Goetz, A.R. (2012). Attentional Bias toward Personally-Relevant Heath-Threat Words. *Anxiety, Stress, and Coping, 26(5*), 493- 507.

BOOK CHAPTERS

1. Martell, C.R. & **Turkel, J.E.** (in press). Behavioral Activation for Depression. In A.E. Wenzel (Ed.). *The SAGE Encyclopedia of Abnormal and Clinical Psychology.* Thousand Oaks, CA: SAGE Publications.
2. Lee, H.-J., & **Turkel, J.E.** (2013). Treatment of Anxiety and Comorbid Cluster A Personality Disorders. In E.A. Storch & D. McKay (Eds.), *Handbook of Treating Variants and Complications in Anxiety Disorders.* (223-242). New York: Springer.

CONFERENCE SYMPOSIA

1. McGuire, J. F.,Wilhelm, S., Capriotti, M.R., Brandt, B.C., **Turkel, J.E.,** Lee, H.-J., Woods, D.W., Specht, M.W., Nicotra, C.M., Kelly, L., Walkup, J.T., Ricketts, E.J., Conelea, C., Grados, M., Ostrander, R., Conelea, C., Walther, M.R., Freeman, J., Garcia; J. Sapyta; M. Khanna; J. March; M. E. Franklin; J. F. McGuire; C. Hanks; A. Lewin, A.M., Storch, E.A., Murphy, T.K. (2013). *Updates in the Phenomenology of Tourette Disorder: New Directions for Treatment.* Symposium presented at the Association for Behavioral and Cognitive Therapies Conference, Nashville, TN.

EDITORIAL ACTIVITIES

2013 Ad-hoc Reviewer, Anxiety, Stress & Coping

TEACHING EXPERIENCES

Teaching Assistant **01/16 –05/16**
The University of Wisconsin-Milwaukee, Department of Psychology
Psychology 101: Introduction to Psychology & Psychology 454: Psychopharmacology

Teaching Assistant **08/15 – 12/15**
The University of Wisconsin-Milwaukee, Department of Psychology
Psychology 260: Child Psychology

Teaching Assistant **01/12 – 05/13**
The University of Wisconsin-Milwaukee, Department of Psychology
Psychology 205: Principles of Personality

Guest Lecturer
The University of Wisconsin-Milwaukee, Department of Psychology **03/13**
Psychology 205: Principles of Personality

Teaching Assistant **8/12 – 12/12**
The University of Wisconsin-Milwaukee, Department of Psychology
Psychology 412: Psychopathology

AWARDS AND HONORS

2014	UWM Graduate Student Travel Award ($400)
2014	UWM Department of Psychology Summer Research Fellowship ($3,178)
2013	UWM Graduate Student Travel Award ($400)
2013	UWM Graduate Student Travel Award ($100)
2012	UWM Graduate Student Travel Award ($400)
2012	UWM Graduate Student Travel Award ($500)
2008	William T. James Award for the Outstanding Senior Major in Psychology, University of Georgia
2004-2008	Helping Outstanding Pupils Educationally (HOPE) Full Tuition Academic Scholarship, University of Georgia

PROFESSIONAL AFFILIATIONS

Association for Behavioral and Cognitive Therapies (ABCT)
Anxiety and Depression Association of America (ADAA)