The Attentional Blink Effect in Spider Phobia

by

Arash Farshid

A thesis submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the degree of
Master of Science

Auburn, Alabama
December 12, 2011

Keywords: specific phobia, attentional blink, selective attention

Approved by

F. Dudley McGlynn, Chair, Professor Emeritus of Psychology
Jeffrey S. Katz, Alumni Professor of Psychology
Alejandro A. Lazarte, Associate Professor of Psychology
Chris Correia, Associate Professor of Psychology

Abstract

Extant research suggests that individuals with spider phobia relative to non-anxious controls display a shorter attentional blink (AB) in response to spider-related target words. Common methodological limitations of such research have included the following: (1) target stimuli have not included affectively neutral words for comparison; (2) experimenters have failed to include an inter-stimulus interval; (3) initial screening measures have not properly disguised the purpose of the experiment; (4) sub-clinical spider phobia samples have been used; and (5) target words have not been matched in frequency of use to the distracter words. Accordingly, the present study addressed each of these limitations. Individuals with spider phobia (DSM-IV: 300.29) did indeed exhibit a reduced AB duration; however, the magnitude of the effect was considerably smaller relative to previous findings. The results highlight the sensitivity of the AB to the aforementioned limitations.

Table of Contents

List of Figures

I. Introduction

The direction of anxiety disorders research has increasingly turned to information-processing paradigms to elucidate the cognitive basis of anxiety. A central principle derived from these paradigms has emphasized that the manner in which emotional information is processed plays a key role in the etiology, maintenance, and treatment of anxiety disorders (Eysenck, 1992). Accordingly, anxiety is thought to be associated with the selective processing of information related to threat, producing cognitive biases in memory, attention, and interpretation.

The examination of attentional biases in the anxiety disorders has received considerable attention. One of the most commonly used methods has been the emotional Stroop task (Mathews & MacLeod, 1985). In this task, participants are presented with both neutral and threat-related words, and are asked to rapidly name the color of each while ignoring its semantic content. Threat-related words are matched to the psychopathological condition of the anxious participants. Increased response latencies among anxious individuals (relative to non-anxious controls) for naming the colors of threat-related words compared to neutral words is said to reflect a misappropriation of information-processing resources toward processing the implications of the words at the expense of the color-naming task (Logan, 1980; Mathews & MacLeod, 1994). A major limitation of the Stroop task is its equivocal interpretation. Although it is apparent that color information is being processed inefficiently, it is unclear as to what information is receiving preferential processing. Specifically, insufficient attention for color-naming does not necessarily require that attention be placed instead to the processing of word content. Case in point, diverting attention away from the stimulus item altogether would also hinder such color-naming performance (Lavy & van den Hout, 1994). For this reason, caution should be taken when interpreting the results from the emotional Stroop task.

Another noteworthy paradigm in attentional bias research is the attentional probe task first developed by MacLeod, Mathews, and Tata (1986). Participants were presented with emotionally threatening and affectively neutral word pairs, in which one word appeared above another for 500 ms in the center of a computer screen; the upper word had to be read aloud as soon as it appeared. Once the words disappeared from view, participants were asked to press a hand-held button whenever a small dot briefly appeared in the location of one of the vacated words. Compared to non-anxious controls, anxious participants were faster to detect the dot probe when it replaced a threat-related word than when it replaced a neutral word. Subsequent research has yielded similar results in some anxiety-related contexts (Fox, 1993; MacLeod & Mathews, 1988) but not in others (Horenstein & Segui, 1997; Wenzel & Holt, 1999).

The rapid serial visual presentation (RSVP) paradigm has also been used in studies of attention. In the dual-task RSVP procedure, a stream of up to 20 stimuli is presented in rapid succession typically at the same spatial location on a computer screen. Participants are required to identify two targets (T1 and T2) embedded in the stimulus series, in which the second target (also referred to as the probe) is presented after the first at variable positions in the stream (Broadbent & Broadbent, 1987; Raymond, Shapiro, & Arnell, 1992). Perception of the second target has been shown to be impaired when it is presented 180-450 ms after the first target, a phenomenon known as the attentional blink (AB; Raymond et al., 1992). This effect was initially demonstrated with words (Broadbent & Broadbent, 1987) and subsequently with letters (Raymond et al., 1992; Shapiro, Raymond, & Arnell, 1994) and pictures (e.g., Boucart, de Visme, & Wagemans, 2000).

The application of the RSVP paradigm has since been generalized to studying attentional bias among anxious participants. For example, Arend and Botella (2002) found that emotional T1 words diminished the AB effect in the presence of neutral T2 words among high-trait anxious participants compared to low-trait anxious participants. A major limitation of the study, however, was that Arend and Botella, like others (e.g., Fox, Russo, & Georgiou, 2005), failed to use participants with a clinically-relevant anxiety disorder. One recent study which addressed this concern investigated attention to threat among high and low spider-fearful participants using the RSVP task (Cisler, Ries, & Widner, 2007). High and low spider-fearful participants were randomly assigned to either an experimental or control condition. In each condition, participants were presented with strings of 16-19 words per trial; T1 was spider-related and T2, which appeared on half the trials, was affectively neutral ("coat"). Participants assigned to the control condition were instructed to ignore T1 and simply report whether or not the probe word appeared. Participants assigned to the experimental condition were required to both identify T1 and report the presence or absence of T2. Compared to low spider-fearful participants, the duration of the AB was found to be reduced among high spider-fearful participants in response to spider-related T1 words. Taken together, the findings of these two studies suggest "that anxious individuals may require fewer attentional resources to process emotional stimuli, thereby allowing them to more rapidly process subsequent incoming stimuli" (Amir, Taylor, Bomyea, & Badour, 2009; p. 1082).

Although Cisler et al. (2007) were able to address some of the methodological weaknesses of the previous literature, their study was not without its own limitations. First, T1 stimuli did not include both spider-related and affectively neutral words. By using only spider-related words, it could not be determined whether the differences observed between high and low spider-fearful participants were due to differential processing of threat or more global differences in attentional capture (i.e., when attention is diverted away from a primary goal by an irrelevant stimulus). Second, a between-subjects design was used rather than a within-subjects design with respect to participation in the experimental and control conditions, thus precluding a comparison between the AB durations of the two conditions for each individual. Third, the design did not include an inter-stimulus interval, which has been demonstrated to be necessary for the AB effect to occur (Shapiro, Arnell, & Raymond, 1997). Fourth, participants in their study may have been unintentionally made aware of the general purpose of the experiment, given that the nature of the questionnaires administered prior to the RSVP task all related to a phobia of some kind. Fifth, a sub-clinical spider phobia sample was used, thus limiting the degree to which the results can be generalized to a clinical population. The last and most glaring limitation was that the target words were not matched in frequency of use to the distracter words, as had been originally claimed. Although the target and distracter words did not significantly differ from one another with respect to word length ($F(1, 33) = 0.001$, $p = 0.97$) and syllable number ($F(1, 33) = 0.023$, $p = 0.88$), the two word lists did significantly differ in frequency of use, $F(1, 30) = 5.246$, $p < 0.03$. Collectively, these limitations constrain the degree of confidence that can be placed in the obtained results.

Accordingly, the present study addressed each of these concerns by making the following modifications to the Cisler et al. (2007) experiment: (1) T1 included both spider-related and affectively neutral words; (2) a within-subjects design was employed such that each participant underwent both the experimental and control condition; (3) an inter-stimulus interval was used that is standard in the literature; (4) to help disguise the purpose of the experiment, a phobia-irrelevant questionnaire was administered prior to the RSVP task; (5) the Anxiety Disorders

Interview Schedule for the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (ADIS-IV; Brown, DiNardo, & Barlow, 1994) was conducted at the end of the experiment to reveal whether a participant's complaints corresponded to the diagnostic criteria for specific phobia, animal type; and (6) an entirely different distracter word list was generated such that these words were matched to the target words not only in syllable and length but in frequency of use as well. If high spider-fearful participants continue to display a shorter AB duration than low spider-fearful participants with the inclusion of these modifications, then the results would implicate the robustness of the effect. However, if the modifications presented here cease to produce a reduction in AB duration among high spider-fearful participants compared to low spider-fearful participants, then no longer will the results support the original conclusion that high spider-fearful individuals process threat-relevant stimuli more efficiently than low spider-fearful individuals in the context of the RSVP paradigm, as previously argued by Cisler et al.

II. Method

Participants

Thirty-six participants (M_{age} = 20.4 years, SD_{age} = 1.5 years) were recruited from a total of 76 self-selected undergraduate students seeking to earn extra credit for a psychology course. Twelve participants (9 females) were diagnostically identified as spider phobic and twenty-four (16 females) were non-anxious controls (NAC).

Measures

The Fear Survey Schedule-II (FSS-II; Wolpe & Lang, 1964) lists 51 feared objects and situations; respondents are asked to rate their fear of each item on a scale between 0 (“none”) and 6 (“terror”). Of interest was the item labeled, “Spiders.”

The I_7 Impulsiveness Questionnaire (Eysenck, Pearson, Easting, & Allsopp, 1985) comprises 54 yes-no questions characteristic of impulsive behavior, 19 of which were chosen for participants to answer as a way to help disguise the purpose of the experiment. Consequently, participant scores were ignored.

The Spider Questionnaire (SPQ; Klorman, Weerts, Hastings, Melamed, & Lang, 1974) comprises 31 true-false items about fear of spiders. Estimates of internal consistency (Kuder-Richardson Formula 20) for the SPQ have been consistently high, ranging from 0.83 to 0.89 (Klorman et al., 1974).

The Target Word Anxiety Ratings Scale (TWARS) is a questionnaire listing each target word used in the RSVP task. For each item, participants are asked to rate the degree to which they find the stimulus word to be anxiety-provoking based on a Likert-based scale, ranging from

1 (Not at all) to 7 (Very much). The TWARS was generated to assess the intended effect of the target word type manipulation.

The ADIS-IV (Brown et al., 1994) is a structured interview regularly used for the research and clinical diagnosis of anxiety disorders. The interview format is one in a series of other interview formats that first appeared in the original ADIS (DiNardo, O'Brien, Barlow, Waddell, & Blanchard, 1983). The interview format has yielded strong diagnostic reliabilities, particularly for principle diagnoses of simple phobia ($\kappa = .82$; DiNardo, Moras, Barlow, Rapee, & Brown, 1993).

Apparatus

Experimental events were produced using E-Prime computer software. Stimuli were presented on a 17-inch computer monitor and were displayed against a grey background in bolded lowercase Times New Roman, font size 60. Target words were displayed in white and all other words (distracters and probe) appeared in black. Responses were given on a computer keyboard.

Design and Stimuli

Participants completing the RSVP task were administered both the control and experimental conditions. The order of the two conditions was counterbalanced such that half of all participants were administered the control condition first and the other half were administered the experimental condition first.

Stimuli consisted of 24 target words (12 spider-related and 12 affectively neutral; see Appendix), 23 affectively neutral distracter words, and the probe word, "coat." Spider-related target words and the probe word were borrowed from Cisler et al. (2007), whereas affectively neutral target and distracter words were generated using the English Lexicon Project database

(ELP; Balota et al., 2007) before being piloted for appropriate valence. The target and distracter words were matched in length, syllable, and frequency of use (Kučera & Francis, 1967), as were the spider-related and affectively neutral target words. The matching process was performed in a systematic fashion such that the first word of the first list was matched along the aforementioned dimensions to the first word of the second list, the second word of the first list was matched to the second word of the second list, and so forth. Given that the distracter word list had one less word than the target word list, two of the target words could only be matched to a single distracter word; all other target words were matched to two distracter words.

There were a total of 864 trials—648 for the experimental condition and 216 for the control condition, the latter representing a sufficient number to establish a baseline comparison for the condition of interest (i.e., experimental). Each trial consisted of 17-19 stimulus words. Distracter words comprised serial positions 1-5 of the stream. A target word appeared in one of the next three serial positions. Target words were displayed an equal number of times and were equally represented in serial positions 6-8. The probe word, which appeared on half the trials in each condition, was displayed an equal number of times in each of the nine positions following the target word (i.e., p1, p2, p3…p9). All other words in the stream were additional distracters. Each word was presented for 120 ms with an inter-stimulus interval of 15 ms. Figure 1 depicts an example trial.

Procedure

Participant selection. A total of 76 undergraduate students completed the FSS-II and the I_7 Impulsiveness Questionnaire. Those that rated their fear as 0 or 1 or as 5 or 6 on the FSS-II "spider" item proceeded with the rest of the experiment. All others were debriefed and thanked for their time.

Participants who had met criterion on the FSS-II were further screened after completion of the RSVP task. Participants were administered the SPQ, the TWARS, and were queried further by a graduate student using the specific phobia section of the ADIS-IV. The interviews continued until at least 12 participants were identified as spider phobic and whose scores were in the top 10 percent for the cohort on the SPQ and at least 12 participants were identified as NAC and whose scores were in the bottom 10 percent for the cohort on the SPQ.

RSVP task. Participants were seated at a computer terminal after condition-order assignment. Prior to each condition, participants underwent a practice session to facilitate task acclimation. All practice-session word stimuli were novel to those used in the experimental and control conditions.

Instructions for both conditions were given on the computer monitor. For the experimental condition, participants were instructed to perform two actions at the end of each trial: (1) type the word that had appeared in white, and (2) report whether or not they saw the word, "coat," by typing 'y' for yes and 'n' for no. For the control condition, participants were instructed to ignore the white word and simply report whether or not they saw the word, "coat," by typing 'y' for yes and 'n' for no. Each response was made in a separate message box that appeared at the end of each trial. Participants were further told that responses would not be recorded until the "Enter" key was pressed. Relatedly, participants were given unlimited time to provide their responses, resulting in a self-paced experiment.

III. Results

Demographics and Clinical Characteristics

Spider-phobic individuals and NAC did not significantly differ in age ($p > .05$). Mean age was 20.25 (*SD* = 1.53) for spider-phobic individuals and 20.54 (*SD* = 1.54) for NAC. The proportion of females was higher among spider-phobic individuals (75%) than among NAC (67%). This finding is consistent with previous research demonstrating a higher prevalence rate of spider phobia in women than in men (Fredrikson, Annas, Fischer, & Wik, 1996). Additionally, spider-phobic individuals endorsed more spider phobia-relevant symptoms on the SPQ than NAC, F (1, 34) = 159.99, $p < .001$. Mean SPQ score was 21.83 (*SD* = 4.69) for spider-phobic individuals and 4.67 (*SD* = 3.36) for NAC.

Target Word Type Validity

Figure 2 illustrates target word anxiety ratings as a function of anxiety status and target word type. The manipulation of target word type produced the intended differential effect between phobic individuals and NAC, which was confirmed by a 2 x 2 mixed design analysis of variance (ANOVA) with anxiety status (spider phobic, NAC) as a between-subject factor and target word type (spider-related, affectively neutral) as a within-subject factor. A main effect was found for target word type, $F(1, 34) = 131.89$, $p < .001$, as well as for anxiety status, $F(1, 34) = 7.06$, $p < .05$. Furthermore, the interaction between anxiety status and target word type was significant, $F(1, 34) = 25.08$, $p < .001$. A closer examination of this interaction revealed that phobic individuals rated the threat-related words as more anxiety-provoking than NAC, $F(1, 34)$

= 14.27, $p < .01$, whereas no significant difference was found between the two groups for affectively neutral words ($p > .05$).

Target Identification Rate

Target identification rate for the experimental condition was assessed as a function of anxiety status (spider phobic, NAC) and target word type (spider-related, affectively neutral), resulting in a 2 x 2 mixed design analysis of variance (ANOVA). Results revealed no significant effects (all $p > .1$). Accuracy rates for target identification performance ranged from 83% to 86.0%, a finding consistent with previous research using the RSVP paradigm (e.g., Amir, et al., 2009).

Probe Detection Accuracy

Consistent with previous research (Amir et al., 2009; Cisler et al., 2007), probe detection accuracy was calculated only for those trials in which T1 was identified correctly. Figure 3 illustrates mean probe detection accuracy when T1 is spider-related and affective neutral. Preliminary analyses revealed that condition order was neither significant as a main effect nor as an interaction with any other factor. As a result, condition order was collapsed across subjects in the analyses for probe detection accuracy. Relative to NAC, spider-phobic individuals in the experimental condition were significantly more accurate at detecting the probe at p2, p3, p4, and p5 when T1 was spider-related compared to affectively neutral. A few scattered differences in probe detection accuracy were found in the control condition between spider-phobic individuals and NAC as a function of target word type. These results for probe detection accuracy were supported by a series of analysis of variances (ANOVAs), beginning with a 2 x 2 x 9 x 2 mixed design ANOVA with anxiety status (spider-phobic, NAC) as a between-subject factor and target word type (spider-related, affectively neutral), probe position (p1-p9), and condition (experimental, control) as within-subject factors. Significant main effects were found for anxiety status, $F(1, 34) = 9.76$, $p < .005$, $\eta_p^2 = .22$; probe position, $F(8, 272) = 723.82$, $p < .001$, $\eta_p^2 = .96$; target word type, $F(1, 34) = 53.26$, $p < .001$, $\eta_p^2 = .61$; and condition, $F(1, 34) = 4361.05$, $p < .001$, $\eta_p^2 = .99$. These effects were modified by the interactions of probe position x anxiety status, $F(8, 272) = 6.06$, $p < .001$, $\eta_p^2 = .15$; target word type x anxiety status, $F(1, 34) = 14.37$, $p < .005$, $\eta_p^2 = .30$; condition x anxiety status, $F(1, 34) = 9.59$, $p < .005$, $\eta_p^2 = .22$; probe position x target word type, $F(8, 272) = 4.85$, $p < .001$, $\eta_p^2 = .13$; probe position x target word type x anxiety status, $F(8, 272) = 4.77$, $p < .001$, $\eta_p^2 = .12$; probe position x condition, $F(8, 272) = 505.31$, $p < .001$, $\eta_p^2 = .94$; probe position x condition x anxiety status, $F(8, 272) = 5.83$, $p < .001$, $\eta_p^2 = .15$; target word type x condition, $F(1, 34) = 6.78$, $p < .05$, $\eta_p^2 = .17$; target word type x condition x anxiety status, $F(1, 34) = 8.07$, $p < .01$, $\eta_p^2 = .19$; probe position x target word type x condition, $F(8, 272) = 4.56$, $p < .001$, $\eta_p^2 = .12$; and probe position x target word type x condition x anxiety status, $F(8, 272) = 3.98$, $p < .001$, $\eta_p^2 = .11$.

To interpret the four-way interaction, separate 2 (anxiety status: spider phobic, NAC) x 2 (target word type: spider-related, affectively neutral) x 9 (probe position: p1-p9) mixed design ANOVAs were conducted for each condition. For the control condition, significant main effects were found for probe position, $F(8, 272) = 33.64$, $p < .001$, $\eta_p^2 = .50$, as well as for target word type, $F(1, 34) = 7.54$, $p < .05$, $\eta_p^2 = .18$. These effects were modified by the interactions of probe position x anxiety status, $F(8, 272) = 3.61$, $p < .01$, $\eta_p^2 = .10$; probe position x target word type, $F(8, 272) = 2.40$, $p < .05$, $\eta_p^2 = .07$; and probe position x target word type x anxiety status, $F(8, 272) = 2.39$, $p < .05$, $\eta_p^2 = .07$. No other effects were significant (all $p > .05$). The three-way interaction was examined further by conducting separate 2 (target word type: spider-related, affectively neutral) x 9 (probe position: p1-p9) repeated measures ANOVAs for each anxiety status group. For NAC, a significant main effect was found for probe position, $F(8, 184) = 33.15$, $p < .001$, $\eta_p^2 = .59$, indicating that probe detection accuracy in the control condition increased as the temporal lag between the probe and T1 increased. No other effects were significant (both $p > .05$). For spider-phobic individuals, a significant main effect was found for probe position, $F(8, 88) = 11.86$, $p < .001$, $\eta_p^2 = .52$. This effect was modified by the interaction of probe position x target word type, $F(8, 88) = 4.27$, $p < .001$, $\eta_p^2 = .28$. The main effect for target word type was not significant ($p > .05$). A simple effects analysis found that spider-phobic individuals in the control condition were significantly more accurate at detecting the probe at p1 [$F(1, 88) = 11.5$, $p < .001$], p2 [$F(1, 88) = 4.59$, $p < .05$], and p3 [$F(1, 88) = 5.61$, $p < .05$] when T1 was spider-related compared to affectively neutral; probe detection accuracy was higher at p9 [$F(1, 88) = 9.28$, $p < .01$] when T1 was affectively neutral compared to spider-related. No other effects were significant (all $p > .05$).

A separate 2 (anxiety status: spider phobic, NAC) x 2 (target word type: spider-related, affectively neutral) x 9 (probe position: p1-p9) mixed design ANOVA was conducted for the experimental condition. Significant main effects were found for anxiety status, $F(1, 34) = 28.65$, $p < .001$, $\eta_p^2 = .46$; probe position, $F(8, 272) = 2035.48$, $p < .001$, $\eta_p^2 = .98$; and target word type, $F(1, 34) = 52.33$, $p < .001$, $\eta_p^2 = .61$. These effects were modified by the interactions of probe position x anxiety status, $F(8, 272) = 11.58$, $p < .001$, $\eta_p^2 = .25$; target word type x anxiety status, $F(1, 34) = 24.41$, $p < .001$, $\eta_p^2 = .42$; probe position x target word type, $F(8, 272) = 8.97$, $p < .001$, $\eta_p^2 = .21$; and probe position x target word type x anxiety status, $F(8, 272) = 8.08$, $p < .001$, $\eta_p^2 = .19$. The three-way interaction was examined further by conducting separate 2 (target word type: spider-related, affectively neutral) x 9 (probe position: p1-p9) repeated measures ANOVAs for each anxiety status group. For NAC, a significant main effect was found for probe position, $F(8, 184) = 1452.82$, $p < .001$, $\eta_p^2 = .98$, indicating that probe detection accuracy in the experimental condition increased as the temporal lag between the probe and T1 increased. No other effects were significant (both $p > .05$). For spider-phobic individuals, significant main effects were found for probe position, $F(8, 88) = 951.46$, $p < .001$, $\eta_p^2 = .99$, as well as for target word type, $F(1, 11) = 104.99$, $p < .001$, $\eta_p^2 = .91$. These effects were modified by the interaction of probe position x target word type, $F(8, 88) = 15.62$, $p < .001$, $\eta_p^2 = .59$. A simple effects analysis found that spider-phobic individuals in the experimental condition were significantly more accurate at detecting the probe at p2 [$F(1, 88) = 7.64$, $p < .01$], p3 [$F(1, 88) = 94.24$, $p < .001$], p4 [$F(1, 88) = 90.16$, $p < .001$], and p5 [$F(1, 88) = 6.16$, $p < .05$] when T1 was spider-related compared to affectively neutral. No other effects were significant (all $p > .05$).

Attentional Blink

For each target word type, the attentional blink (AB) length was assessed separately for NAC and spider-phobic individuals by comparing the probe detection accuracy between experimental and control conditions at each probe position (as per Raymond et al., 1992). NAC had an AB length of 5 probe positions (i.e., an AB duration of 675 ms) and spider-phobic individuals had an AB length of 4 probe positions (i.e., an AB duration of 540 ms) when T1 was spider-related, producing a difference in AB duration of 135 ms. The findings were confirmed by a series of paired-samples t-tests with Bonferroni adjustments. For NAC, significant between-condition differences were found at the following probe positions when T1 was spider-related: p1 [$t(23) = 15.42$, $p < .001$], p2 [$t(23) = 26.22$, $p < .001$], p3 [$t(23) = 29.34$, $p < .001$], p4 [$t(23) = 20.53$, $p < .001$], and p5 [$t(23) = 4.47$, $p < .001$]. For spider-phobic individuals, significant between-condition differences were found at the following probe positions when T1 was spider-related: p1 [$t(11) = 20.16$, $p < .001$], p2 [$t(11) = 35.04$, $p < .001$], p3 [$t(11) = 19.92$, $p < .001$], and p4 [$t(11) = 6.40$, $p < .001$]. Analyses of the other probe positions for each group revealed no significant differences ($p > .03$).

Both NAC and spider-phobic individuals had an AB length of 5 probe positions when T1 was affectively neutral, producing an equivalent AB duration (675 ms). This result was supported by a series of paired-samples t-tests with Bonferroni adjustments. For NAC, significant between-condition differences were found at the following probe positions when T1 was affectively neutral: p1 [$t(23) = 16.19$, $p<.001$], p2 [$t(23) = 38.96$, $p<.001$], p3 [$t(23) = 35.09$, $p<.001$], p4 [$t(23) = 13.98$, $p<.001$], and p5 [$t(23) = 8.13$, $p<.001$]. For spider-phobic individuals, significant between-condition differences were found at the following probe positions when T1 was affectively neutral: p1 [$t(11) = 15.69$, $p<.001$], p2 [$t(11) = 27.39$, $p<.001$], p3 [$t(11) = 22.45$, $p<.001$], p4 [$t(11) = 16.37$, $p<.001$], and p5 [$t(11) = 3.88$, $p<.001$]. Analyses of the other probe positions for each group revealed no significant differences ($p > .02$).

IV. Discussion

Relative to NAC, individuals with spider phobia displayed a shorter AB duration in response to spider-related target words by a difference of 135 ms, whereas no such differences were found between the two groups when target words were affectively neutral. Furthermore, spider-phobic individuals in the experimental condition were more accurate at detecting the probe when it was presented between 135 and 540 ms after a spider-related target word. No significant differences were found between spider-phobic individuals and NAC in recalling the target words, irrespective of target word type. This absence of an explicit memory bias among spider-phobic individuals for phobia-relevant stimuli is consistent with extant research (e.g., Cisler et al., 2007).

The primary goal of the present study was to assess whether the limitations of a representative study in the literature on attentional blink in spider phobia (Cisler et al., 2007) were significant enough to influence the validity of the results. Accordingly, the present study addressed these limitations by applying appropriate modifications to its design. Although the AB duration among spider-phobic individuals was reduced relative to NAC in response to spider-related target words, the magnitude of this difference was considerably smaller than what was previously reported by Cisler et al. (i.e., 135 ms vs. 240 ms). In the context of the RSVP paradigm, a net difference of 105 ms (calculated by subtracting 135 from 240) is significant given how brief the AB effect is overall. The results indicate that spider-phobic individuals do indeed exhibit a differential AB effect when processing threat-relevant stimuli, allowing them to more readily process subsequent stimuli presented in the same spatial location. However, the magnitude of this effect is much smaller than previously observed, thereby highlighting its sensitivity to the aforementioned limitations.

However, it should be acknowledged that the present study had a number of its own limitations. First, given the number of modifications made to the original methodology, it is unclear as to which modification(s) were responsible for the differences found with respect to the magnitude of the AB effect for spider-phobic individuals relative to NAC. Applying these modifications in a stepwise fashion would aid in addressing this issue. Second, stimuli consisted of words rather than pictures, which are more commonly encountered in the natural environment. As a result, the use of word stimuli decreased the ecological validity of the results. Third, target stimuli did not include phobia-irrelevant threat words. Thus, it was unclear as to whether the obtained results were due to differential processing of threat-relevant information or threat information in general. Fourth, many of the presentation parameters were borrowed from Cisler et al. (2007) for ease of comparison, even those that are not standard in the literature. For example, the stimulus duration of 120 ms was kept the same for this experiment despite the fact that stimulus onset asynchrony in an RSVP paradigm typically does not exceed 100 ms (Shapiro, Arnell, & Raymond, 1997). Such differences are likely to have a significant impact on the AB effect and probe detection accuracy as a whole. Consequently, future research should further examine the degree to which these variables affect the magnitude of the AB effect in the context of spider phobia.

What also must be highlighted is how the present results impact our conceptualization of the anxiety disorders as a whole. In particular, recent research examining the AB effect in the other anxiety disorders has yielded mixed results. For example, the effect has been observed for individuals with post-traumatic stress symptoms (Amir et al., 2009) and yet has not been found for some of the other anxiety disorders, such as social phobia (de Jong, Koster, van Wees, & Martens, 2009). What these results illustrate is that there may be greater heterogeneity in the attentional patterns among some of the anxiety disorders than originally believed. Such results potentially have significant implications for existing models of anxiety with respect to how it is thought to be maintained (viz., as a function of avoidance behavior). One of the most prominent models is Mowrer's two-factor theory. The theory proposes that anxiety stems from both classical and instrumental conditioning processes. Initially, neutral stimuli (e.g., a spider) are paired with innately fear-evoking stimuli. As a result of this association, these once neutral stimuli come to elicit conditioned fear responses (i.e., via classical conditioning). Environmental cues that evoke fear produce an *instrumental* response to terminate the fear (i.e., escape or avoidance), which in turn produces an outcome (i.e., anxiety reduction) that increases the likelihood that the escape/avoidance response will be made again.

Although Mowrer's theory does an excellent job of explaining avoidance behavior from a macro perspective, it does little to explain how anxiety is maintained at the micro level. In particular, what the model does not account for are the intervening processes that would be presumed to mediate the dual-step (classical-instrumental) relationship in Mowrer's theory. Given the possible differences in attentional patterns among the anxiety disorders, these mediators may in fact be different both across and within different types of anxiety disorders. Presently, much is unknown about these mediators. By continuing to investigate how anxiety is maintained through observances of attentional bias, it may very well aid in elucidating the nature and heterogeneity of these mediators and thus allow clinicians to develop more efficient, customizable forms of treatment for anxiety.

References

Amir, N., Taylor, C. T., Bomyea, J. A., & Badour, C. L. (2009). Temporal allocation of attention toward threat in individuals with posttraumatic stress symptoms. *Journal of Anxiety Disorders, 23*, 1080-1085.

Arend, I., & Botella, J. (2002). Emotional stimuli reduce the attentional blink in sub-clinical anxious subjects. *Psicothema, 14*, 209-214.

Balota, D. A., Yap, M. J., Cortese, M. J., Hutchison, K. A., Kessler, B., Loftis, B., … Treiman, R. (2007). *Behavior Research Methods, 39*, 445-459.

Boucart, M., de Visme, P., & Wagemans, J. (2000). Effect of benzodiazepine on temporal integration in object perception. *Psychopharmacology, 152*, 249-255.

Broadbent, D. E., & Broadbent, M. H. P. (1987). From detection to identification: Response to multiple targets in rapid serial visual presentation. *Perception & Psychophysics, 42*, 105-113.

Brown, T. A., DiNardo, P. A., & Barlow, D. H. (1994). *Anxiety disorders interview schedule for DSM-IV (ADIS-IV)*. Albany, NY: Graywind.

Cisler, J. M., Ries, B. J., & Widner, R. L. (2007). Examining information processing biases in spider phobia using the rapid serial visual presentation paradigm. *Journal of Anxiety Disorders, 21*, 977-990.

de Jong, P. J., Koster, E. H., van Wees, R., & Martens, S. (2009). Emotional facial expressions and the attentional blink: Attenuated blink for angry and happy faces irrespective of social anxiety. *Cognition and Emotion, 23*, 1640-1652.

DiNardo, P. A., Moras, K., Barlow, D. H., Rapee, R. M., & Brown, T. A. (1993). Reliability of the DSM-III-R anxiety disorder categories: Using the Anxiety Disorders Interview Schedule-Revised (ADIS-R). *Archives of General Psychiatry, 50*, 251-256.

DiNardo, P. A., O'Brien, G. T., Barlow, D. H., Waddell, M. T., & Blanchard, E. B. (1983). Reliability of the DSM-III anxiety disorder categories using a new structured interview. *Archives of General Psychiatry, 40*, 1070-1074.

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Eysenck, S. B., Pearson, P. R., Easting, G., & Allsopp, J. F. (1985). Age norms for impulsiveness, venturesomeness, and empathy in adult. *Personality and Individual Differences, 6*, 613-619.

Fox, E. (1993). Attentional bias in anxiety: Selective or not? *Behaviour Research and Therapy, 31*, 487-493.

Fox, E., Russo, R., & Georgiou, G. A. (2005). Anxiety modulates the degree of attentive resources required to process emotional faces. *Cognitive, Affective & Behavioral Neuroscience, 5*(4), 396-404.

Fredrikson, M., Annas, P., Fischer, H., & Wik, G. (1996). Gender and age differences in the prevalence of specific fears and phobias. *Behavior Research and Therapy, 34*, 33-39.

Horenstein, M., & Segui, J. (1997). Chronometrics of attentional processes in anxiety disorders. *Psychopathology, 30*, 25-35.

Klorman, R., Weerts, T. C., Hastings, J. C., Melamed, B. G., & Lang, P. J. (1974). Psychometric description of some specific-fear questionnaires. *Behavior Therapy, 5*, 401-409.

Kučera, H., & Francis, W. (1967). *Computational analysis of present-day American English*. Providence, RI: Brown University Press.

Lavy, E. H., & van den Hout, M. A. (1994). Cognitive avoidance and attentional bias: Causal relationships. *Cognitive Therapy and Research, 18*, 179-191.

Logan, G. D. (1980). Attention and automaticity in Stroop and priming tasks: Theory and data. *Cognitive Psychology*, *12*, 523-553.

MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 40*(A), 653-670.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 96*, 15-20.

Mathews, A., & MacLeod, C. (1985). Selective processing of threat cues in anxiety states. *Behaviour Research and Therapy, 23*, 563-569.

Mathews, A., & MacLeod, C. (1994). Cognitive approaches to emotion and emotional disorders. *Annual Review of Psychology*, *45*, 25-50.

Raymond, J. E., Shapiro, K. L., & Arnell, K. M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink? *Journal of Experimental Psychology: Human Perception and Performance, 18*, 849-860.

Shapiro, K. L., Arnell, K. M., & Raymond, J. E. (1997). The attentional blink. *Trends in Cognitive Sciences, 1*, 291-296.

Shapiro, K. L., Raymond, J. E., & Arnell, K. M. (1994). Attention to visual pattern information produces the attentional blink in RSVP. *Journal of Experimental Psychology: Human Perception and Performance, 20*, 357-371.

Wenzel, A., & Holt, C. S. (1999). Dot probe performance in two specific phobias. *The British Journal of Clinical Psychology, 38*, 407-410.

Wolpe, J., & Lang, P. J. (1964). A Fear Survey Schedule for use in behaviour therapy. *Behaviour Research and Therapy, 1*, 27-30.

Appendix A

Target Words

Spider-related	*Affectively Neutral*
Crawly	Diagrams
Creepy	Daybed
Spider	Tokens
Arachnid	Doctoral
Fang	Twig
Bite	Knit
Legs	Flow
Cobweb	Hanger
Web	Ion
Venom	Plaza
Disgust	Inflate
Insect	Heater

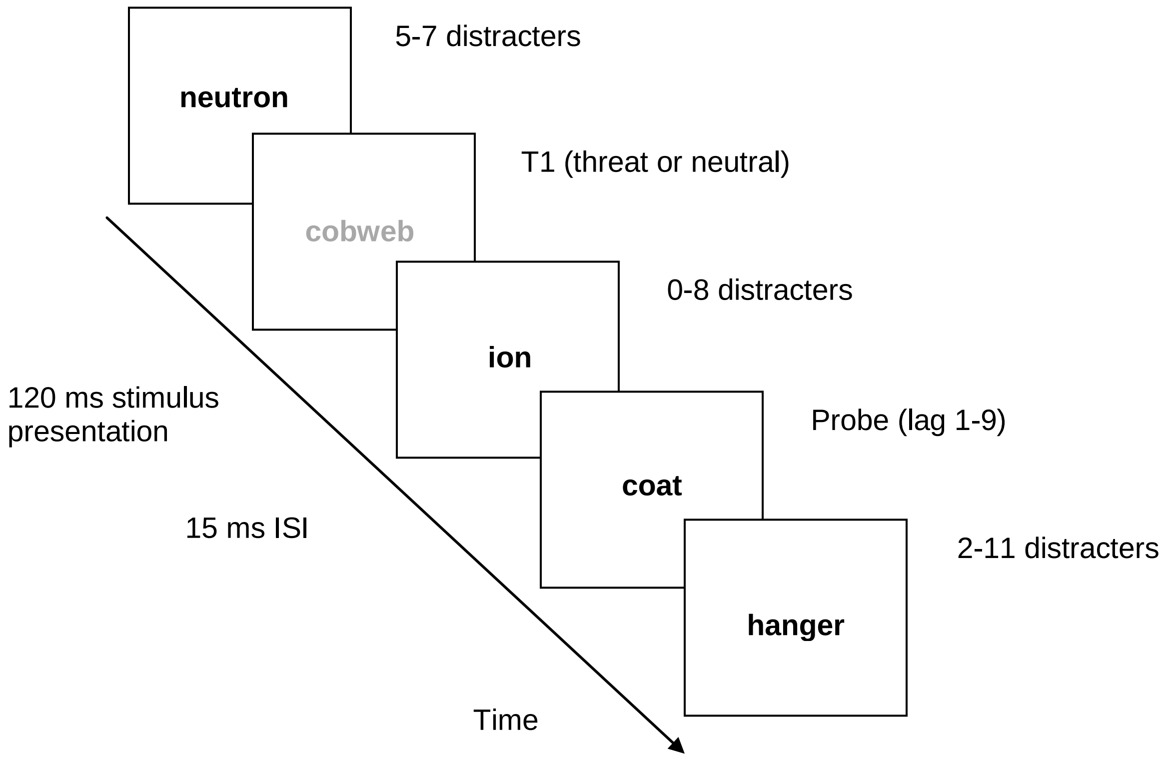

Figure 1. Participants were presented with strings of 17-19 words per trial, in which a target (T1; either spider-related or affectively neutral) and a probe ("coat"), which appeared on half the trials, are embedded in the stimulus series. All other words in the stream were distracters. Participants underwent two conditions. In the experimental condition, participants were asked to identify T1 and report whether or not the probe word appeared. In the control condition, participants were instructed to ignore T1 and report the presence or absence of the probe word. Each word was presented for 120 ms with an inter-stimulus interval (ISI) of 15 ms.

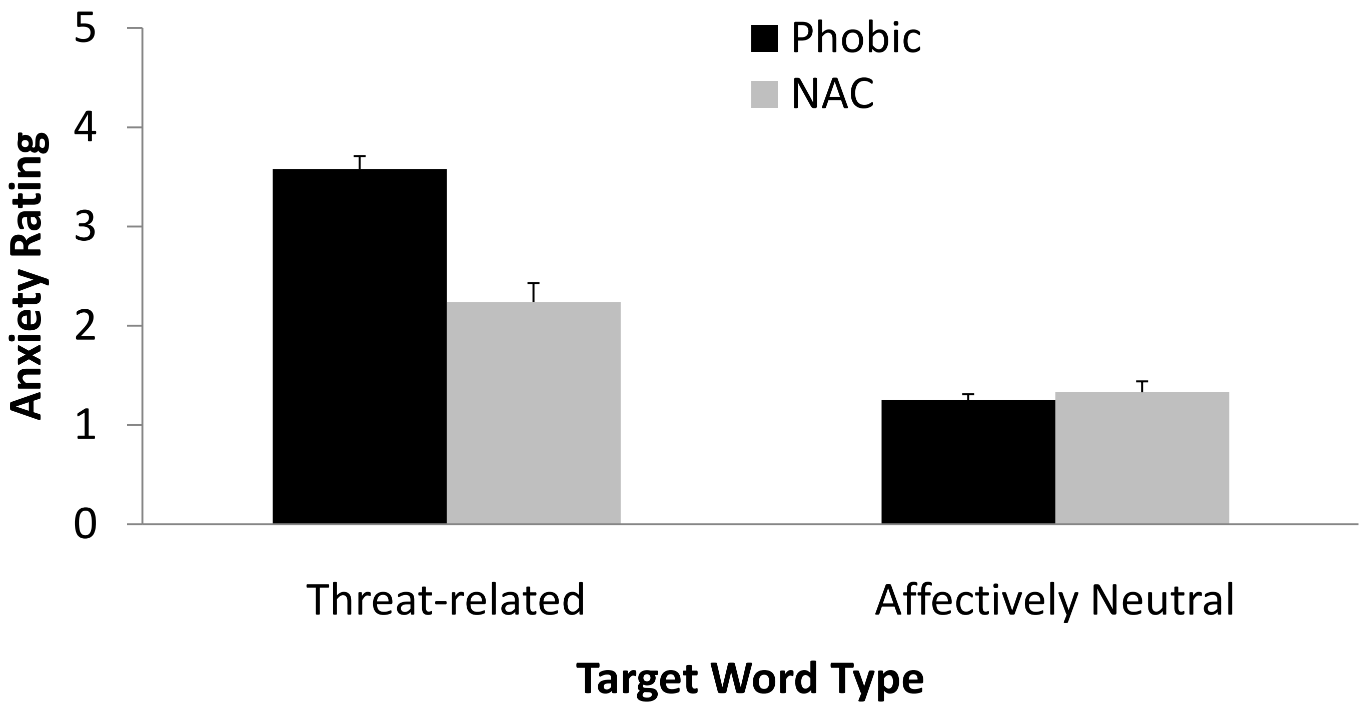

Figure 2. Mean (+1 SEM) target word anxiety ratings as a function of anxiety status and target word type. Anxiety ratings were based on a Likert-type scale, ranging from 1 (Not at all) to 7 (Very much).

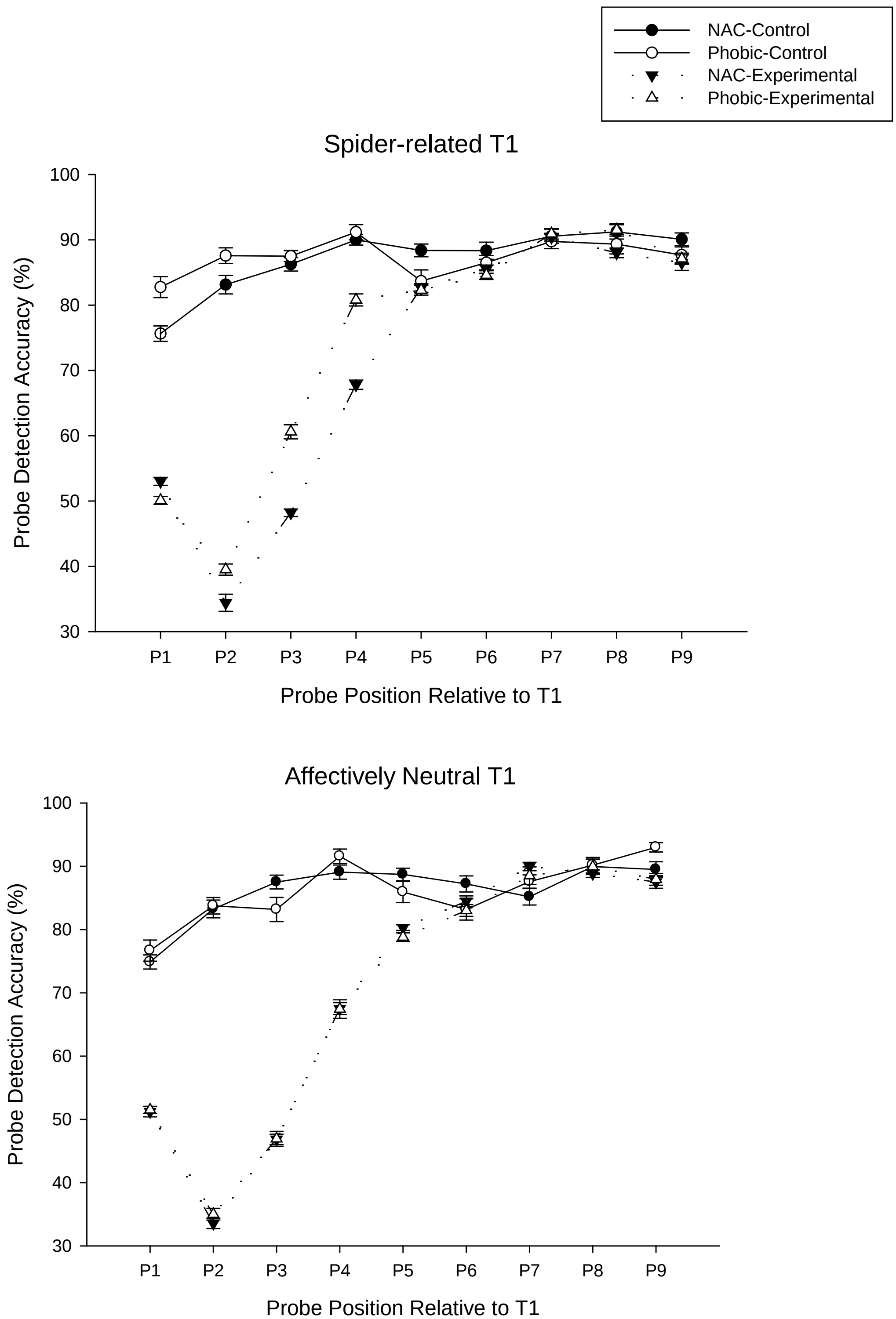

Figure 3. Mean probe detection accuracy (+/- 1 SEM) as a function of probe position, anxiety status, and condition when T1 is spider-related (top panel) and affectively neutral (bottom panel).