Running head: ATTENTIONAL BIAS MODIFICATION

On the Costs and Benefits of Directing Attention towards or away from Threat-Related Stimuli: A Classical Conditioning Experiment

Bram Van Bockstaele[a], Bruno Verschuere[a], Jan De Houwer[a], and Geert Crombez[a]

[a]Ghent University

IN PRESS:

BEHAVIOUR RESEARCH AND THERAPY

Corresponding author:

Bram Van Bockstaele

Department of Experimental Clinical and Health Psychology

Faculty of Psychology and Educational Sciences

Ghent University

Henri Dunantlaan 2

B-9000 Ghent, Belgium

Email: Bram.Vanbockstaele@UGent.be

Phone: 0032 9 264 63 97

Fax: 0032 9 264 64 89

Abstract

In attentional bias modification programs, individuals are trained to attend away from threat in order to reduce emotional reactivity to stressful situations. However, attending towards threat is considered to be a prerequisite for fear reduction in other models of anxiety. We compared both views by manipulating attention towards or away from an acquired signal of threat. The strength of extinction and reacquisition was assessed with threat and US expectancy ratings. We found more extinction in the attend towards threat group, compared to both the attend away from threat group and a control group in which attention was not manipulated. The results are in line with the Emotional Processing Theory and cognitive accounts of classical conditioning.

Keywords: Attention, Extinction, Reacquisition, Attentional Bias, Fear, Anxiety, Attentional Training

On the Costs and Benefits of Directing Attention towards or away from Threat-Related Stimuli: A Classical Conditioning Experiment

A wealth of research has demonstrated that anxiety and fear are associated with selective attention for fear-relevant stimuli (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). It has been argued that an attentional bias for threatening stimuli is not merely a by-product of anxiety, but that it also contributes to the development and/or maintenance of anxiety (Williams, Watts, MacLeod, & Mathews, 1997). According to these authors, biases in the allocation of attention underlie individual differences in emotional vulnerability. Hence, it has been proposed that experimentally induced changes in attentional bias should lead to changes in emotional vulnerability. A study by MacLeod, Rutherford, Campbell, Ebsworthy and Holker (2002) supported this idea. Using a dot probe paradigm, they trained participants to attend either towards or away from negative information. Results indicated that participants who were trained to attend towards negative information reported more stress during a subsequent stress task than those who were trained to attend away from negative information. These results have been extended to (sub)clinical populations. Amir, Weber, Beard, Bomyea and Taylor (2008) and Schmidt, Richey, Buckner and Timpano (2009) reported evidence that an attentional avoidance training programme reduced self reported anxiety in socially anxious participants. Similar results have been obtained in patients with a generalized anxiety disorder (Amir, Beard, Burns, & Bomyea, 2009; Hazen, Vasey, & Schmidt, 2008).

Promising as these results are, they are also provocative. The idea that directing attention away from threatening information is beneficial is at odds with other accounts of fear and anxiety. First, according to the Emotional Processing Theory (EPT) of exposure therapy (Foa & Kozak, 1986), fear is the result of the activation of a fear structure. Fear reduction is achieved through the incorporation of information that is incompatible with the information stored in the fear structure. According to the EPT, the fear structure can only be activated and changed when the individual attends to the threatening stimulus. One may thus expect that fear reduction will be hampered when attention is directed away from the feared stimulus. Second, it is well established that learning requires attention (e.g., Mitchell, De Houwer, & Lovibond, 2009; Wagner, 1981). For instance, Dawson (1970) showed that learning decreased by adding an attention-consuming secondary task to a classical conditioning paradigm. Considering extinction as the learning of a new CS-noUS relationship (Bouton, 2002), the strength of extinction can also be expected to be dependent upon the availability of attentional resources.

In the present study, attention was manipulated towards or away from a signal of threat in an emotional adaptation of the exogenous cueing task (Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2005). In this task, participants are required to respond to a target stimulus that is presented at the same (valid) or opposite (invalid) location of a preceding cue. During acquisition, one cue (CS+, reinforced Conditioned Stimulus) was occasionally paired with an aversive white noise burst (US, Unconditioned Stimulus). Another cue (CS-, nonreinforced Conditioned Stimulus) was never paired with the US. In the subsequent extinction & attention manipulation phase, the CS+ was no longer followed by the US. Of particular relevance in this phase was the manipulation of attention. Attention was manipulated either towards the CS+ (attend towards threat group) or away from the CS+ (attend away from threat group) by presenting more valid CS+ trials in the attend towards threat group and more invalid

CS+ trials in the attend away from threat group. In the control group, we did not manipulate attention.

We assessed the effects of this attention manipulation on extinction using self-report ratings of differential conditioning. According to models of exposure and conditioning, extinction should be most pronounced in participants who attend towards the CS+. According to the attentional bias modification literature, extinction should be most pronounced in participants who attend away from the CS+. During reacquisition, the CS+ was again paired with the US in order to investigate the further effects of the attentional manipulation.

Method

Participants

Sixty-nine students (50 women, mean age = 20.17, *SD* = 3.84) were rewarded with course credits or 4 Euro for their participation. No selection criteria were applied.[1] All participants gave their informed consent.

Apparatus and Materials

The experiment was programmed using the INQUISIT Millisecond 2.0 (2007) software package. The program was run on a Dell Optiplex GX520 desktop computer with a 100Hz 19-inch colour monitor. The US was a 250 ms white noise burst presented through Sennheiser HD-497 headphones at approximately 92 dB.

Exogenous Cueing Task

All stimuli were presented against a black background. Each trial (Figure 1) started with the presentation of a white fixation cross, flanked by two white rectangles (5° high by 6°30’ wide) for 1000 ms. The distance between the centre of the rectangles and the fixation cross was 12°. Cues and targets were presented at the centre of the white rectangles. Cues consisted of two coloured (green or pink) rectangles of the same size as the white rectangles and were presented for 200 ms. The CS+ or CS- status of the colours was counterbalanced across participants. Targets were black squares (about 1° by 1°) that appeared 20 ms after cue offset and remained on the screen until a response was given. Participants were instructed to press the “a” or the “p” key on a standard AZERTY keyboard as fast as possible when the target appeared on the left or the right respectively.

Self Report Measures

Participants’ experiences during the experiment were assessed through a number of computer-controlled self report items to which participants responded by clicking with the mouse on a 9-point Likert scale. Participants reported to what the extent the CS+ (CS-) was experienced as positive/negative (CS valence: 1: “very positive” through 9: “very negative”), to what extent the CS+ (CS-) was arousing (CS arousal: 1: “calm, relaxed” through 9: “very excited”), to what extent the CS+ (CS-) was threatening (CS threat: 1: “not threatening at all” through 9: “very threatening”), and to what extent the US was expected after the CS+ (CS-) (CS-US expectancy: 1: “not at all” through 9: “very much”). Participants also reported to what extent the US was experienced as positive/negative (US valence: 1: “very positive” through 9: “very negative”) and to what extent they experienced the US as threatening (US threat: 1: “not threatening at all” through 9: “very threatening”).

Procedure

The experiment was conducted in a dimly lit room, with participants seated at approximately 60 cm from the computer screen. The experiment started with the presentation of three US-only trials to acquaint participants with the white noise.

Participants were informed that on most trials, a cue would precede the presentation of a target stimulus, either at the same or at the opposite location. They were instructed to respond as fast and as accurately as possible to the location of the target with the index fingers of both hands. To prevent responding to the cue instead of the target, catch trials were included, in which no target appeared following the cue. Participants were instructed not to respond on these trials and to wait for the next trial to begin. Furthermore, to encourage participants to focus on the fixation cross, digit trials were included. On these trials, the fixation cross was very briefly (100 ms) replaced by a digit ranging from 1 to 3. Participants were asked to identify the digit they had seen and were asked to guess if they had not seen anything. Trials were presented in a random order.

Practice phase. This phase consisted of 12 trials (4 CS+, 4 CS-, 2 catch, and 2 digit trials). Half of the CS+ and CS- trials were valid and half were invalid. No USs were presented and an error message appeared on incorrect responses.

Baseline phase. This phase consisted of 75 trials (16 valid CS+, 16 invalid CS+, 16 valid CS-, 16 invalid CS-, 8 catch, and 3 digit trials). No USs were presented. After this block, valence, arousal and threat value of both CSs were assessed.

Acquisition phase. The acquisition phase consisted of two separate but identical blocks, each consisting of 50% valid and 50% invalid CS+ and CS- trials for a total of 79 trials (36 CS+, 36 CS-, 4 catch, and 3 digit trials). Participants were instructed to put on the headphones and not to remove them. They were informed that on some trials, one of the two cues would be paired with the US. The US was presented simultaneously with the CS+ on 12 of the CS+ trials (6 valid and 6 invalid). In order to facilitate the detection of the contingency between the CS+ and the US, the first two trials were – as an exception on the randomised trial order – reinforced CS+ trials. After each acquisition block, the US expectancy, valence, arousal and threat value of both CSs were assessed, as were the valence and threat value of the US.

Extinction & attentional manipulation phase. This phase consisted of three blocks. In all three blocks, an extinction procedure was implemented in which the CS+ was no longer followed by the US. Participants were not informed about the absence of the US. Each block consisted of 59 trials (28 CS+, 28 CS-, 2 catch, and 1 digit trial). The manipulation of attention also took place in this phase. Participants were randomly assigned to one of three attentional manipulation groups. In the *control group,* 14 CS+ trials were valid and 14 were invalid. In the *attend towards threat group,* 24 CS+ trials were valid and only 4 CS+ trials were invalid. In the *attend away from threat group,* only 4 CS+ trials were valid, and 24 CS+ trials were invalid. In all three groups, 14 CS- trials were valid and 14 were invalid. Participants were not informed about this manipulation. After each block, we again assessed the US expectancy, valence, arousal and threat value of both CSs.

Extinction test phase. This phase consisted of 71 trials (32 CS+, 32 CS-, 4 catch, and 3 digit trials). In all three groups, half of the CS+ and CS- trials were valid and half were invalid. No USs were presented. After the test block, the US expectancy, valence, arousal and threat value of both CSs were assessed.

Reacquisition phase. This phase consisted of 51 trials (24 CS+, 24 CS-, 2 catch, and 1 digit trial), with 12 valid and 12 invalid CS+ and CS- trials. The US was presented on 8 CS+ trials. The phase started with the presentation of two reinforced CS+ trials. Participants were not informed about the reoccurrence of the US. After the reacquisition block, we assessed US expectancy, valence, arousal and threat value of both CSs, and the valence and threat value of the US.

Results

For reasons of simplification, we averaged the scores of both acquisition blocks and the scores of the three extinction & attentional manipulation blocks for all dependent variables.

Manipulation Check

The US was rated as highly negative (acquisition: *M* = 7.97, *SD* = 1.23; reacquisition: *M* = 7.70, *SD* = 1.70) and threatening (acquisition: *M* = 6.76, *SD* = 1.68; reacquisition: *M* = 6.77, *SD* = 2.11).

Attention Manipulation: Reaction Time Data

Reaction times (RTs) were analyzed to examine whether we were successful in (1) replicating the acquisition and extinction of an attentional bias (Koster et al., 2005) and (2) manipulating attention in the attention manipulation phase.

Preparation of reaction time data. Following previous research (Koster et al., 2005), we excluded (1) one participant because he responded on 30% of the catch trials (group mean = 5.8%, *SD* = 6.25), (2) one participant because of poor performance on digit trials (participant's mean = 22% correct, group mean = 96% correct, *SD* = 10.13), (3) all trials on which a US was presented, (4) trials with errors, and (5) responses faster than 150 ms, slower than 1000 ms, or deviating more than three standard deviations from the individual mean.

Cue Validity Indices (CVIs) were computed for each experimental phase and cue type (CS+ or CS-) by subtracting the mean RT on valid trials from the mean RT on invalid trials (see Table 1). An attentional bias for threatening stimuli is present when the CVI for the CS+ is larger than the CVI for the CS-. Four separate 2 (Experiment Phase) x 2 (CS-Type: CS+ versus CS-) x 3 (Attention Group: control, attend towards threat or attend away from threat) repeated measures ANOVAs were conducted on the CVIs to investigate acquisition effects (by comparing the baseline and acquisition phase), attentional manipulation effects (by comparing the acquisition and the extinction & attentional manipulation phase), extinction effects (by comparing the acquisition and extinction test phase), and reacquisition effects (by comparing the extinction test and reacquisition phase).

Acquisition effects. A 2 (Experiment Phase: *baseline* versus *acquisition*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA only revealed a significant interaction between experiment phase and CS-type, $F(1, 64) = 14.64$, $p < .001$. Follow-up paired samples t-tests showed that CVI for the CS+ did not differ from the CVI for the CS- during the baseline phase, $t(66) = 1.22$, $p = .23$. This difference was significant during acquisition, $t(66) = 3.75$, $p < .001$, indicating an attentional bias towards the CS+. No other effects reached significance, all Fs < 1.81, all ps > .17.

Attentional manipulation effects. A 2 (Experiment Phase: *acquisition* versus *extinction & attentional manipulation*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA revealed significant main effects of attention group, $F(2, 64) = 11.52$, $p < .001$, and of CS-type, $F(1, 64) = 20.47$, $p < .001$, and a significant interaction between experiment phase and attention group, $F(2, 64) = 25.58$, $p < .001$. There were no group differences between the CVI for the CS+ and the CVI for the CS- in the acquisition phase. During the extinction & attentional manipulation phase, the attend threat group allocated more attention to both cues (the CS+ as well as the CS-) compared to the control group, $F(1, 43) = 20.89$, $p < .001$, which attended more to both cues than the attend away from threat group, $F(1, 42) = 9.24$, $p < .005$. No other effects were significant.

Extinction effects. A 2 (Experiment Phase: *acquisition* versus *extinction test*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA revealed a marginally significant main effect of CS-type, $F(1, 64) = 3.39$, $p = .07$, which was subsumed under an interaction between CS-type and experiment phase, $F(1, 64) = 5.07$, $p < .05$. This interaction shows that the attentional bias towards the CS+ had disappeared in the extinction test phase, $t(66) < 1$, $p = .85$. No other effects reached significance, all *F*s < 1. The lack of a significant interaction between experiment phase and attention group indicates that our attentional manipulation effects on the reaction time data were somewhat short-lived and did not extend to the subsequent phase.

Reacquisition effects. A 2 (Experiment Phase: *extinction test* versus *reacquisition*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA revealed a marginally significant main effect of CS-type, $F(1, 64) = 3.46$, $p = .07$, which was subsumed under a significant interaction between CS-type and experiment phase, $F(1, 64) = 4.55$, $p < .05$. This interaction illustrates that, during reacquisition, the CVI for the CS+ was larger than the CVI for the CS-, $t(66) = 2.75$, $p < .01$. No other effects reached significance, all *F*s < 2.49, all *p*s > .09.

CS-US Expectancy (see Figure 2)

Acquisition effects. A 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA on the acquisition expectancy ratings revealed a significant main effect of CS-type, $F(1, 64) = 753.48$, $p < .001$, indicating that participants had a higher expectation of the US after the CS+. The main effect of attention group also proved significant, $F(2, 64) = 3.71$, $p < .05$. Follow-up comparisons between groups showed that participants in the attend towards threat group had an overall higher expectancy of the US, both compared to the attend away from threat group, $t(43) = 2.40$, $p < .05$, and the control group, $t(43) = 2.67$, $p < .05$.

Extinction effects. A 2 (Experiment Phase: *acquisition* versus *extinction & attentional manipulation*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA was conducted to investigate differential levels of extinction between groups. The crucial three-way interaction between experiment phase, CS-type and attention group proved significant, $F(2, 64) = 5.48$, $p < .01$. A follow-up 2 (Experiment Phase) x 3 (Attention Group) repeated measures ANOVA on the CS- scores revealed no significant effects, all *F*s < 2.55, all *p*s > .11. A similar analysis on the CS+ scores revealed a significant main effect of experiment phase, $F(1, 64) = 225.04$, $p < .001$, and a significant interaction between experiment phase and attention group, $F(2, 64) = 7.02$, $p < .005$. Follow-up comparisons between the three groups showed that the decrease in US expectancy was stronger in the attend towards threat group, both compared to the control group, $F(1, 43) = 5.26$, $p < .05$, and the attend away from threat group, $F(1, 43) = 12.96$, $p < .005$. There was no significant difference in US expectancy decrease between the control group and the attend away from threat group, $F(1, 42) = 2.30$, $p = .14$.

A 2 (Experiment Phase: *acquisition* versus *extinction test*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA again revealed a significant three-way interaction between experiment phase, CS-type and attention group, $F(2, 64) = 3.68$, $p < .05$. A follow-up 2 (Experiment Phase) x 3 (Attention Group) repeated measures ANOVA on the CS- scores revealed no significant effects, all *F*s < 1. A similar analysis on the CS+ scores revealed a significant main effect of experiment phase, $F(1, 64) =$

415.05, $p < .001$, and a significant interaction between experiment phase and attention group, $F(2, 64) = 6.56$, $p < .005$. Again, follow-up comparisons between the three groups showed that the decrease in US expectancy was stronger in the attend towards threat group, both compared to the control group, $F(1, 43) = 6.81$, $p < .05$, and the attend away from threat group, $F(1, 43) = 10.56$, $p < .005$. There was no significant difference in US expectancy decrease between the control group and the attend away from threat group, $F(1, 42) = 1.35$, $p = .25$.

Reacquisition effects. A 2 (Experiment Phase: *extinction test* versus *reacquisition*) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA revealed a marginally significant interaction between experiment phase, CS-type and attention group, $F(2, 64) = 3.08$, $p = .05$. A follow-up 2 (Experiment Phase) x 3 (Attention Group) repeated measures ANOVA on the CS- scores revealed no significant effects, all Fs < 1.05, all ps > .35. A similar analysis on the CS+ scores revealed a significant main effect of experiment phase, $F(1, 64) = 224.74$, $p < .001$, and a significant interaction between experiment phase and attention group, $F(2, 64) = 6.82$, $p < .005$. Follow-up comparisons between the three groups showed that the increase in US expectancy was stronger in the attend towards threat group, both compared to the control group, $F(1, 43) = 7.56$, $p < .01$, and the attend away from threat group, $F(1, 43) = 10.19$, $p < .005$. There was no significant difference in US expectancy increase between the control group and the attend away from threat group, $F(1, 42) < 1$.

CS Characteristics

For all three variables (arousal, valence and threat), a 5 (Experiment Phase) x 2 (CS-Type) x 3 (Attention Group) repeated measures ANOVA revealed an interaction between experiment phase and CS-type, all Fs(4, 61) > 35.68, all ps < .001. These interactions all demonstrated the expected time course of acquisition, extinction, and reacquisition. None of the expected three-way interactions reached significance, all *F*s (8, 122) < 1.27, all *p*s > .26. However, the pattern of results for these self-report measures was in line with those of the UCS expectancy ratings. For illustrative reasons, Figure 3 shows the results of the threat ratings. Comparing the CS+ ratings from the acquisition phase with those from the extinction & attentional manipulation phase, the attend towards threat group showed marginally more extinction compared to both the attend away from threat group, $F(1, 43) = 2.78$, $p = .10$, and the control group, $F(1, 43) = 3.66$, $p = .06$. Comparing the CS+ ratings in the acquisition phase with those from the extinction test phase, the attend towards threat group showed more extinction compared to the control group, $F(1, 43) = 4.28$, $p < .05$. The attend towards threat group did not differ significantly from the attend away from threat group, $F(1, 43) = 1.09$, $p = .30$.

Discussion

Attending away from threatening stimuli has been put forward as an effective tool to reduce fear. However, this idea is at odds with the EPT, which states that attention should be focussed on the feared stimulus in order to reduce fear. Furthermore, according to classical accounts of learning, attention is needed to detect the contingencies between a stimulus and its negative outcome. In this study, we manipulated participants' attention either towards or away from a signal of threat in an exogenous cueing paradigm, and we investigated the effects of this manipulation on extinction and reacquisition.

Our results regarding attentional bias towards a signal of threat replicate those of previous studies (Koster et al., 2005; Van Damme, Crombez, Hermans, Koster, & Eccleston, 2006). When stimuli become signals of threat, an attentional bias towards these signals emerges. When stimuli are no longer followed by aversive events, the attentional bias towards these stimuli extinguishes. Our results also extend these studies by showing that an attentional bias to signals of threat quickly reappears when the contingency between the stimulus and the aversive event is reinstalled.

Of particular importance in this study were the effects of our attentional manipulation. The results of the US-expectancy ratings indicate that manipulating participants to attend towards the CS+ facilitated extinction in comparison with the attend away from threat group and the control group, and are therefore in line with the EPT. This pattern of results is also consistent with cognitive accounts of conditioning, which state that contingency learning is dependent upon the availability of attentional resources (Dawson, 1970). Although most studies investigating the role of attentional processes in conditioning are limited to acquisition, it is reasonable to assume that attentional processes are also involved in extinction. To our knowledge, this study is one of the first to show that encouraging participants to focus attention on the CS+ increases extinction. The data regarding reacquisition are also in line with this interpretation. When participants have learnt to attend towards the CS+, changes in contingency between the CS and the US are picked up more easily, resulting in a swift reacquisition of US-expectancy.

Our study has some limitations. First, we found only strong effects of our attentional manipulation on the CS-US expectancy ratings but less so in the valence, arousal and threat ratings. It could be argued that our attentional manipulation affected mainly the cognitive awareness of the CS-US contingency, affecting the emotional components of the fear response only to a lesser extent. However, as the pattern of results was similar, our study might lack statistical power to reveal significant differences. Second, our attentional manipulation effect on the reaction times was short-lived and did not extend to phases beyond the attentional manipulation phase. This might be due to the limited number of training trials in our study compared to other studies using attentional retraining procedures (e.g., MacLeod et al., 2002). Third, we failed to find a differential effect of our attentional manipulation in the reaction time data for the CS+ and the CS-. Most likely, participants were influenced by the total ratio of valid and invalid trials irrespective of whether the cue was a CS+ or a CS-. Finally, we did not find any differences in US expectancy between the control group and the attend away from threat group. According to the EPT, extinction should be more pronounced in the control group because participants in this group were trained to attend more to the CS+ compared to participants in the attend away from threat group. Our attentional manipulation might have been too subtle to produce such differences.

These limitations notwithstanding, our results suggest that attending towards threatening information facilitates the detection of changes in contingencies, resulting in increased knowledge of important changes in the environment. These findings may prove clinically important. Fear and anxiety are often considered to be the result of learning (Craske, Hermans, & Vansteenwegen, 2006; Field, 2006). From a learning perspective, the disconfirmation of the expectancy that negative events will occur is crucial for fear reduction. Our results show that such disconfirmation is facilitated when attention is directed towards the threatening stimulus. This finding is particularly relevant for clinical problems in which patients have signals for upcoming negative events, or worse, catastrophes (Goubert, Francken, Crombez, Vansteenwegen, & Lysens, 2002; Rachman, 1994). In these situations, a disconfirmation of expectancies may prove suboptimal when attention is directed away from signals, and may be considered as cognitive avoidance (Borkovec & Grayson, 1980).

Acknowledgements

Preparation of this paper was supported by Grant BOF/GOA2006/001 of Ghent University. Bruno Verschuere is a postdoctoral fellow of the Scientific Research Foundation (FWO).

References

Amir, N., Weber, G., Beard, C., Bomyea, J., & Taylor, C. T. (2008). The effect of a single-session attention modification program on response to a public-speaking challenge in socially anxious individuals. *Journal of Abnormal Psychology, 117*, 860-868.

Amir, N., Beard, C., Burns, M., & Bomyea, J. (2009). Attention modification program in individuals with generalized anxiety disorder. *Journal of Abnormal Psychology, 118*, 28-33.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin, 133*, 1-24.

Borkovec, T. D., & Grayson, J. B. (1980). Consequence of increasing the functional impact of internal emotional stimuli. In K. Blankstein, P. Pliner & J. Policy (Eds.), *Advances in the study of communication and affect: Assessment and modification of emotional behavior* (pp. 117-137). New York: Plenum Press.

Bouton, M. E. (2002). Context, ambiguity and unlearning: Sources of relapse after behavioral extinction. *Biological Psychiatry, 52,* 976-986.

Craske, M. G., Hermans, D., & Vansteenwegen, D. (2006). *Fear and learning: From basic processes to clinical implications.* Washington D.C.: American Psychological Association.

Dawson, M. E. (1970). Cognition and conditioning: Effects of masking the CS-UCS contingency on human GSR classical conditioning. *Journal of Experimental Psychology, 85,* 389-396.

Field, A. P. (2006). Is conditioning a useful framework for understanding the development and treatment of phobias? *Clinical Psychology Review, 26,* 857-875.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin, 99*, 20-35.

Goubert, L., Francken, G., Crombez, G., Vansteenwegen, D., & Lysens, R. (2002). Exposure to physical movements in chronic back pain patients: No evidence for generalization across different movements. *Behaviour Research and Therapy, 40*, 415-429.

Hazen, R. A., Vasey, M. W., & Schmidt, N. B. (2009). Attentional retraining: A randomized clinical trial for pathological worry. *Journal of Psychiatric Research, 43*, 627-633.

Inquisit 2.0 [Computer software]. (2007). Seattle, WA: Millisecond Software.

Koster, E. H. W., Crombez, G., Van Damme, S., Verschuere, B., & De Houwer, J. (2005). Signals for threat modulate attentional capture and holding: Fear-conditioning and extinction during the exogenous cueing task. *Cognition and Emotion, 19*, 771-780.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*, 107-123.

Mitchell, C. J., De Houwer, J., & Lovibond, P. F. (2009). The propositional nature of human associative learning. *Behavioral and Brain Sciences, 32,* 182-246.

Rachman, S. (1994). The overprediction of fear: A review. *Behaviour Research and Therapy, 32*, 683-690.

Schmidt, N. B., Richey, J. A., Buckner, J. D., & Timpano, K. R. (2009). Attention training for generalized social anxiety disorder. *Journal of Abnormal Psychology, 118*, 5-14.

Van Damme, S., Crombez, G., Hermans, D., Koster, E. H. W., & Eccleston, C. (2006). The role of extinction and reinstatement in attentional bias to threat: A conditioning approach. *Behaviour Research and Therapy, 44*, 1555-1563.

Wagner, A. R. (1981). SOP: A model of automatic memory processing in animal behavior. In N. E. Spear & R. R. Miller (Eds.), *Information processing in animals: Conditioned inhibition* (pp. 223-266). Hillsdale, NJ: Lawrence Erlbaum Associates.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and the emotional disorders* (2nd ed.). New York: Wiley.

Footnotes

1. State and Trait Anxiety data of all participants are available upon request.

Figure caption

Figure 1. Schematic overview of the exogenous cueing paradigm.

Figure 2. US-expectancy ratings as a function of CS-type, attention group and experiment phase.

Figure 3. CS threat ratings as a function of CS-type, attention group and experiment phase.

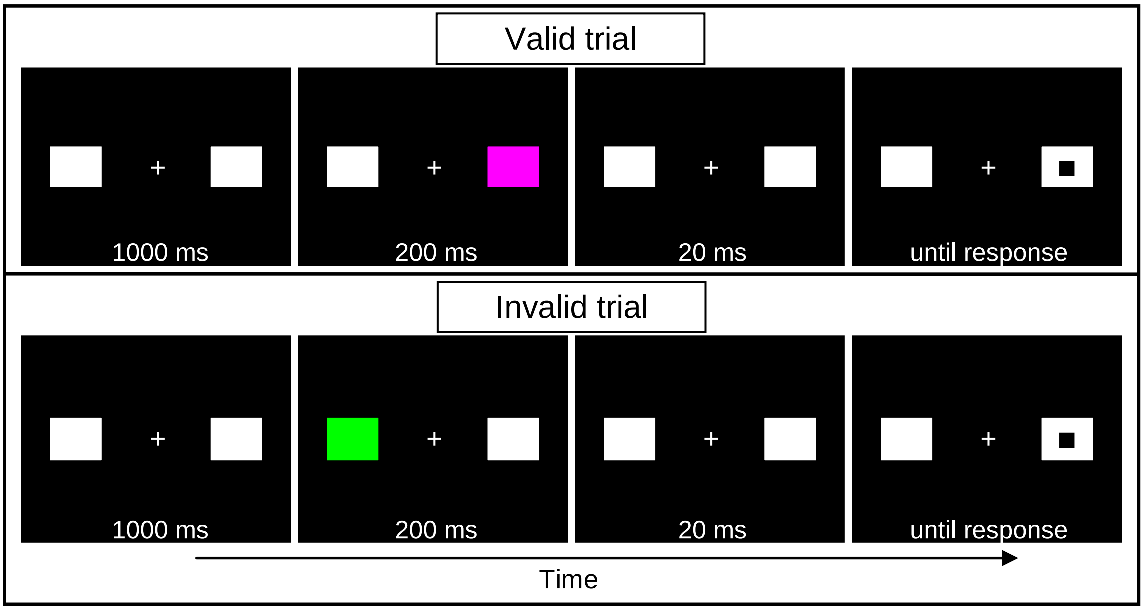
Valid trial
1000 ms
200 ms
20 ms
until response
Invalid trial
1000 ms
200 ms
20 ms
until response
Time

Figure 1.

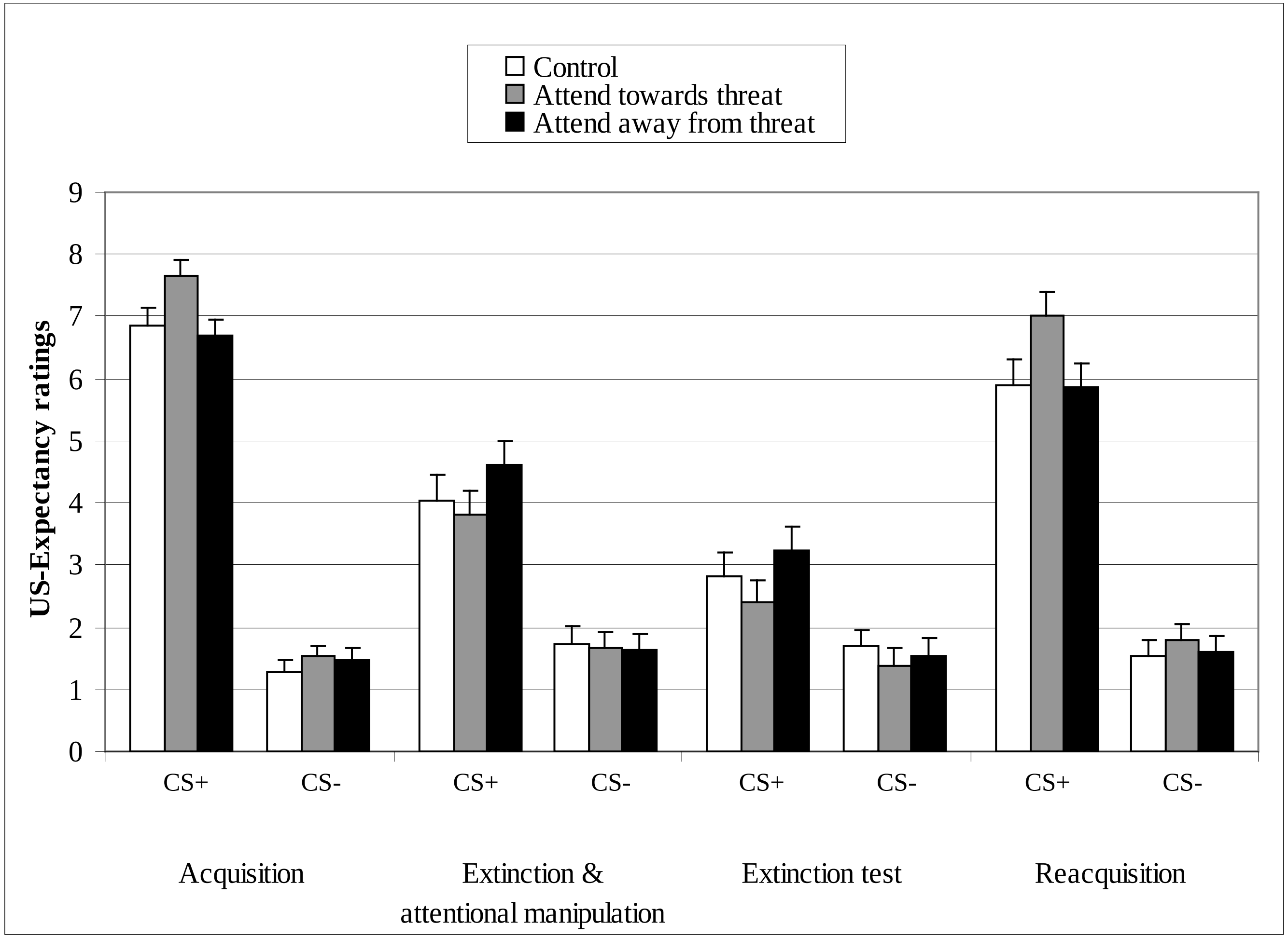
Control
Attend towards threat
Attend away from threat
US-Expectancy ratings
0
1
2
3
4
5
6
7
8
9
CS+
CS-
CS+
CS-
CS+
CS-
CS+
CS-
Acquisition
Extinction & attentional manipulation
Extinction test
Reacquisition

Figure 2.

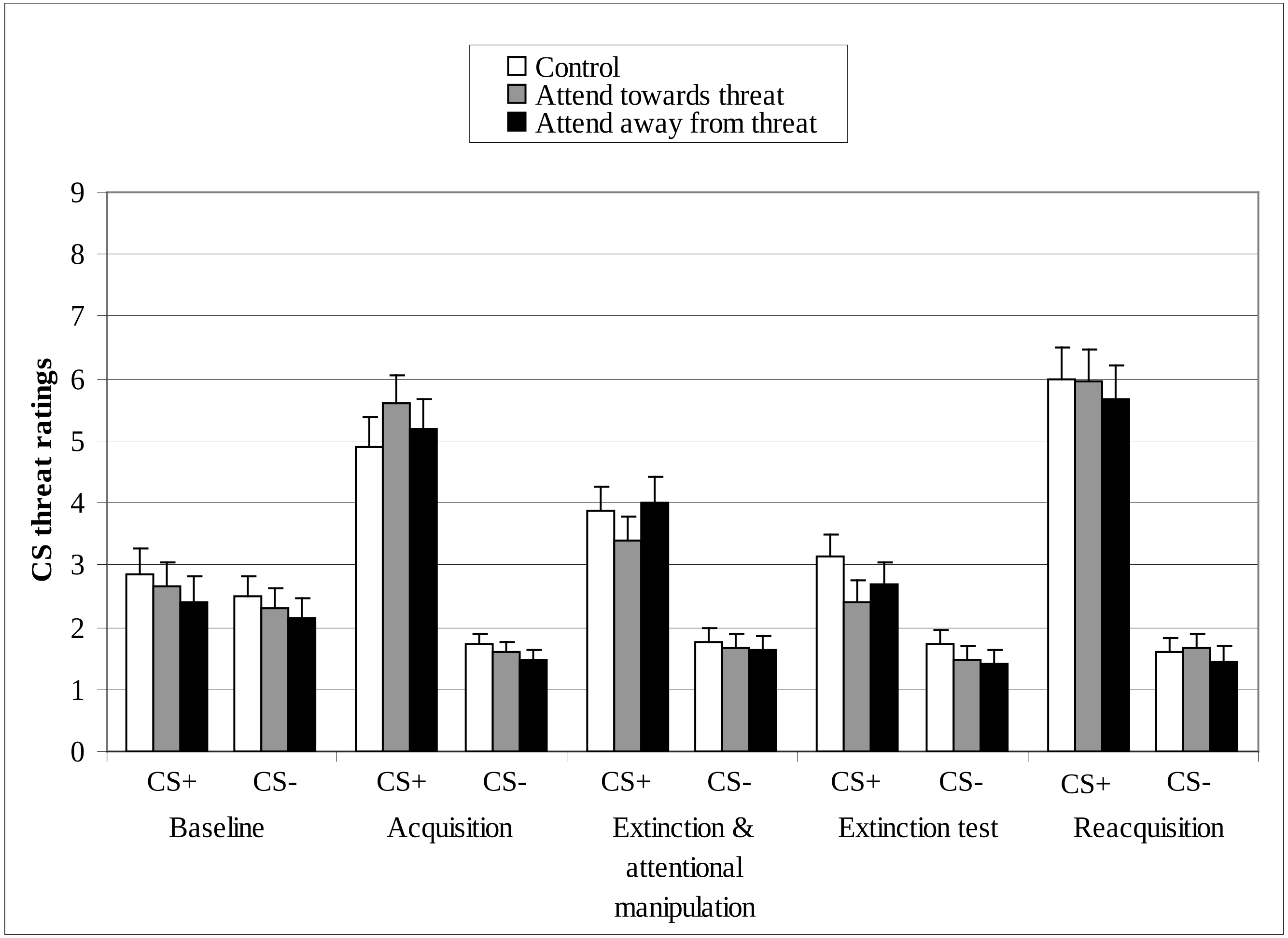
Control
Attend towards threat
Attend away from threat
CS threat ratings
0
1
2
3
4
5
6
7
8
9
CS+
CS-
Baseline
CS+
CS-
Acquisition
CS+
CS-
Extinction & attentional manipulation
CS+
CS-
Extinction test
CS+
CS-
Reacquisition

Figure 3.

Table 1

Cue Validity Indices (ms) as a Function of CS-Type, Training Group and Experiment Phase

	Control group				Attend *towards* threat group				Attend *away from* threat group			
	CS-		CS+		CS-		CS+		CS-		CS+	
Experiment Phase	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Baseline	21	18	15	23	28	24	25	27	22	18	18	14
Acquisition	14	17	27	16	19	24	30	27	14	22	22	23
Extinction & Attentional Manipulation	15	16	23	12	42	27	50	33	-4	26	6	29
Extinction Test	27	30	18	28	30	19	32	30	17	31	21	30
Reacquisition	7	26	28	28	26	24	34	35	12	37	19	46