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Fear activation and distraction during the emotional processing of claustrophobic fear

Michael J. Telch[a,*], David P. Valentiner[b], Doron Ilai[a], Paula R. Young[a], Mark B. Powers[a], Jasper A.J. Smits[c]

[a] *Laboratory for the Study of Anxiety Disorders, Department of Psychology, University of Texas at Austin, 1 University Station A8000, Austin, TX 79712 0187, USA*
[b] *Northern Illinois University, Dekalb, IL 60115, USA*
[c] *Southern Methodist University, Dallas, TX 75205, USA*

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Abstract

We tested several hypotheses derived from the emotional processing theory of fear reduction by manipulating claustrophobic participants' focus of attention during in vivo exposure. Sixty participants displaying marked claustrophobic fear were randomized to one of four exposure conditions. Each participant received a total of 30-min of self-guided exposure 2-weeks after pretreatment testing. One group attended to threatening words and images during exposure (TW) and was compared to a control group that attended to neutral words and images (NW). A third group performed a demanding cognitive load task—a modified Seashore Rhythm Test during exposure (SR) and was compared to an exposure only (EO) control group. Contrary to prediction, the threat word manipulation was not associated with lower levels of fear following treatment. Consistent with prediction, the distraction manipulation resulted in less fear reduction at post-treatment. Treatment process analyses revealed that the negative effects of distraction on treatment outcome manifested early as slower between-trial habituation. These results and their relevance to emotional processing theory are discussed.

*Corresponding author. Tel.: +1-512-475-8488; fax: +1-702-995-9347.
E-mail address: telch@austin.utexas.edu (M.J. Telch).

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1. Fear activation and distraction during the emotional processing of claustrophobic fear

Evidence accumulated over several decades and numerous domains of situationally bound fear has demonstrated the potency of exposure-based methods in the treatment of phobic disorders (Barlow, 1988; Marks, 1987; Rachman & Wilson, 1980). Nevertheless, considerable debate still exists regarding the mechanisms governing the reduction of pathological fear. Rachman (1980) proposed a theoretical account of fear reduction based on emotional processing. He defined emotional processing as the decline of emotional disturbance to the extent that other experiences and behaviors proceed without disruption, and as a process that was dependent upon direct experiencing of the emotional disturbance. In a revised account of emotional processing theory, Foa and Kozak (1986) proposed that fear activation is dependent upon a close match between the information presented and elements in the fear structure. Particularly salient to this process is information about feared stimuli, fearful responses, and the meaning associated with those responses. Through generalization of activation, information matching a part of the memory network activates other parts of the fear structure, particularly in cohesive networks representative of specific phobias.

In support of this view of fear activation, individuals trained to process response information as well as stimulus information experienced more physiological arousal during imagery (Lang, 1985). Zander and McNally (1988), however, found that individuals with panic disorder were equally fearful and physiologically reactive to scripts containing stimulus information alone, stimulus and response information, or stimulus, response, and meaning information. Thus, evidence that fear activation depends upon attention to specific stimulus, response, or meaning information is equivocal. Further, the provision of response and meaning information has not been linked to greater fear reduction.

Both Rachman's original account of emotional processing theory (Rachman, 1980) and the Foa and Kozak (1986) revised account proposed that more complete initial fear activation is related to greater fear reduction. Support for this hypothesis has been mixed. For instance, while findings from several studies (Borkovec & Sides, 1979; Kozak, Foa, & Stekette, 1988; Lang, Melamed, & Hart, 1970; Watson, Gaind, & Marks, 1972) suggested that those displaying higher fear activation responded more favorably to imaginal and in vivo exposure, more recent studies have shown that greater fear activation during in vivo exposure was not related to treatment outcome (Kamphuis & Telch, 2000) or was associated with a poorer outcome (Telch, Valentiner, Ilai, & Young, 2000).

Foa and Kozak (1986) suggested that distraction (overt or covert) is likely to interfere with both fear activation and modification of the fear structure. Empirical examination of the role of distraction is warranted not only for conceptual reasons, but because cognitive and covert distraction is commonly used strategy to cope with the experience of fear (Craske, Street, & Barlow, 1989). Borkovec and Grayson

(1980) made a similar observation when they distinguished between exposure and functional exposure, and suggested that the mere presentation of a feared stimulus does not guarantee functional exposure.

Evidence supporting the deleterious effects of distraction on fear reduction during exposure comes from several domains of pathological fear including obsessive-compulsive disorder (Grayson, Foa, & Stekette, 1982), agoraphobia (Craske et al., 1989), small animal phobia (Craske, Street, Jayaraman, & Barlow, 1991; Rodriguez & Craske, 1993; Sartory, Rachman, & Grey, 1982); and claustrophobia (Kamphuis & Telch, 2000). It is unclear, however, whether distraction during exposure impedes fear reduction through interference with fear activation or interference with modification of the fear structure (Rodriguez & Craske, 1993).

The current study examined the role of fear activation and distraction during exposure to phobic threats. First, we hypothesized that claustrophobics who focused on threat words during exposure would display (a) greater fear activation during treatment, (b) greater between-trial habituation during treatment, and (c) greater overall fear reduction at post-treatment, relative to those assigned to either a neutral word focus condition or a no focus exposure only condition. Second, we hypothesized that participants who were engaged in the demanding cognitive load task during exposure would display (a) less fear activation during treatment, (b) less between-trial habituation during treatment, and (c) less overall fear change at post-treatment, relative to those in the exposure only condition.

2. Method

2.1. Participants

Severely claustrophobic college students from a large southwestern university ($N = 60$) took part in the experiment. Participants were selected from a large subject pool ($N = 2650$) of introductory psychology students through a two stage screening procedure. The final sample was predominantly female (83%) and Caucasian (96%). Participants ranged in age from 18 to 51 (mean age = 18.9; SD = 2.7). Students received partial course credit for their participation in the experiment.

2.2. Design

Participants were randomly assigned to one of four 30-min exposure conditions: (a) Threat words, (b) neutral words, (c) Seashore Rhythm Test, and (d) exposure only control. Outcome assessments consisted of self-report questionnaires and subjective, behavioral, and psychophysiological responses during two consecutive behavioral approach tests were conducted at pre- and post-treatment. Treatment process data consisting of subjective ratings of peak fear,

suffocation and entrapment concerns were collected during each exposure trial (see below).

2.3. Procedure

2.3.1. Screening

A two-step process was used to select participants. First, potential participants ($N = 3104$) were identified by their responses to two screening questions asking respondents to rate on a Likert scale their fear of enclosed places in general and their fear of entering and remaining in a dark narrow corridor for several minutes. Respondents ($N = 205$) reporting moderate or severe fear to both items were invited for further testing. Of those eligible for further testing, 117 students (57%) agreed to participate in a subsequent screening session. During this session, students were administered a more detailed claustrophobia history questionnaire and several paper-and-pencil measures. After completing these, two consecutive behavioral approach tests (BAT) were administered (see below). Students who were able to complete either of the two BATs with a SUDS rating of less than 50 on a 100-point scale, were deemed insufficiently phobic and excluded. Of the 117 students tested, 55 (47%) met these exclusion criteria. Of the remaining 62 eligible participants, 60 agreed to participate and were randomly assigned to one of the four experimental conditions.

2.3.2. Behavioral approach tests

Upon completing informed consent procedures, and several self-report questionnaires (see below), participants were fitted with an ambulatory heart-rate monitor. Next, participants were asked to look inside the BAT-1 chamber for 5 s. The chamber consisted of a long, dark, narrow observation corridor measuring $11.40\,\text{m} \times 0.57\,\text{m} \times 2.29\,\text{m}$. At the entrance of the corridor was a single unlocked door with a $5\,\text{cm} \times 7.5$-cm rectangle painted with glow in the dark paint. At the other end was a small dimly lit night-light. After viewing the inside of the chamber for 5 s, participants completed a pre-exposure questionnaire assessing the participant's anticipated fear, performance, and likelihood of panic. Each of these phobic appraisal dimensions were assessed using Likert scales. They were then provided the following instructions:

> I am now going to open the door of the chamber. You are to walk into the chamber and remain there for as long as you can. While you are in the chamber, it is important that you stay at the back wall. I will signal to you when the trial is over by opening the door. It is important that you understand that you can leave the chamber at any time if you get too uncomfortable. If you begin to leave the chamber before I open the door, you must exit immediately, even if upon approaching the door you start to feel more comfortable. The door of the chamber will remain unlocked at all times in the event that you want to come out. Do you have any questions?"

Length of time in the chamber were monitored. Maximum time spent in the chamber was limited to 2 min, though participants were not made aware of the 2-min limit. After 2-min, the experimenter opened the door and instructed the participant to exit. Upon exiting, the participant completed ratings of peak fear.

2.4. Treatment conditions

2.4.1. Exposure only condition (EO) and procedures common to all treatment conditions

Eligible participants returned two weeks later to begin treatment. Participants in each of the four conditions received a total of 30 min of self-guided in vivo exposure to the same claustrophobia chamber used to conduct the pre-treatment BAT. Participants were provided instructions similar to those given during the baseline assessment with additional instructions specific to their treatment condition. A general treatment rationale was provided emphasizing the fear-reducing effects of direct confrontation with the feared situation. Additional treatment rationales specific to treatment condition were also provided (see below). For each trial, participants were instructed to enter the chamber and remain inside for as long as possible up to a maximum of 5 min. Unlike assessment trials, which required the participant to stand at the back of the chamber, participants were informed that they were free to go anywhere in the chamber and move about at will. However, they were encouraged to venture further away from the entrance as their fear diminished. Participants were also informed that they were free to exit the chamber at any time if they became too uncomfortable.

Prior to the start of each treatment trial, participants completed ratings of anticipated fear, panic likelihood, danger, and self-efficacy for the upcoming excursion. Upon exiting the chamber, participants completed ratings of fear, panic, and anxiety symptom severity. The interval between treatment trials was approximately 3 min. The duration of each excursion trial was recorded by the experimenter along with a running total of exposure duration. Treatment proceeded in this fashion until each participant's total duration of exposure reached 30-min. This resulted in equivalent durations of exposure for all participants.

2.5. Threat word condition (TW)

Participants assigned to the threat word condition were instructed to attend to claustrophobic-relevant threat words (e.g., suffocate) during the entire duration of each treatment trial. Each of 15 threat words (e.g., suffocate, trapped, dark) was presented by a female voice every 10 s through headphones attached to a Sony Walkman. Participants were instructed to repeat aloud each word, and then form a mental image connecting them to the threat word. For example, for the word "suffocate", participants were instructed to

imagine running out of air in the chamber. To increase adherence to the experimental instructions, participants were informed that they would be queried about their images and tested on the words at the conclusion of the experiment.

2.6. Neutral word condition (NW)

This condition was identical to the threat word condition described above with the exception that 15 neutral words (i.e., banana) were repeatedly presented in place of the claustrophobic threat words. Neutral words and threat words were matched on number of syllables and word frequency.

2.7. Seashore rhythm test condition (SRT)

Participants in this experimental condition took part in a modified administration of the Seashore Rhythm Test (SRT; Halstead, 1947) during each exposure trial. This test was chosen for several reasons. First, the SRT requires continuous heavy demand on participants' information processing, thus providing a more stringent test of the effects of distraction on fear reduction. Second, performance on the SRT is well within the capacity of normal college students, thus reducing the likelihood that participants would give up on the task prematurely due to frustration generated by poor performance.

The SRT procedures were as follows: On each self-directed exposure trial, participants were presented a series of auditory tone pattern pairs through headphones. Each tone pattern was presented for 1.5 s with 1 s separating the two items of the pair. For each pair of tone patterns, the participant was instructed to say aloud the word "*same*" if he or she perceived the pair to be identical and "*different*" if he or she perceived the pair to differ. Participants' verbal responses were recorded through a portable tape recorder worn by the participant. The next pair of tone patterns was presented 7 s following the presentation of the second item of the preceding pair. A total of 240 tone pattern pairs consisting of 30 different SRT tone pattern pairs (15 identical, 15 different) were randomly presented to the participant during their 30-min of self-directed exposure. At the end of each treatment trial, the experimenter depressed the stop buttons of the participant's tape player and tape recorder. At the start of the next trial, the recorder and player were reactivated.

2.8. Assessments

2.8.1. Outcome measures

Peak fear: Immediately upon exiting the BAT chamber, participants rated their peak fear while in the chamber. Fear level was measured on a Likert scale ranging from 0 (No fear) to 100 (Very Severe). These data were collected at the two

pre-treatment BATs and the post-treatment BAT (immediately following the 30-min of exposure).

2.8.2. Heart-rate reactivity

Participant's heart rate was monitored using the UNIQ Heartwatch Model 8799, Computer Instruments Corporation. This ambulatory heart-rate monitor consists of an electrode belt worn around the chest that transmits heart-rate signals to a wrist receiver that depicts and stores the participant's heart-rate data. The unit also has a built-in event marker to record when participants entered and exited the BAT chamber. Heart rate was sampled every 15 s during a 5-min resting period and averaged to produce a single baseline HR index. Heart-rate data were also recorded every 15 s during the BATs and averaged to produce a single performance HR index. HR reactivity was calculated as the difference between participants' performance HR during the BAT and their resting HR, with negative numbers recoded as zero.

2.8.3. Clinical status

A categorical classification of clinically significant change (pre- to post-treatment) was derived using the analytic strategy recommended by Jacobson and Truax (1986). This classification requires that a participant achieve a level of improvement from their pre-treatment level that is both statistically reliable *and* clinically meaningful (i.e., post-treatment scores move into the normal range). Participants were classified as achieving clinically significant change at post-treatment if they met the following three conditions: (a) the participant remained in the test chamber for the entire 2 min at post-treatment; (b) the participant reported a post-treatment SUDS level less than 36.9 which is closer to the ideal mean of "0" than to the observed pre-treatment mean of 63.8; and (c) the participant showed a clinically significant reduction from pre- to post-treatment, using the Jacobson and Traux's (1991) Reliable Change Index (RCI).

2.9. Treatment process measures

Immediately following each treatment trial, participants rated their peak fear, beginning fear, and ending fear on a Likert scale ranging from 0 (no fear) to 100 (extreme fear). Heart rate was sampled every 15 s during each of the 5-min treatment trials and averaged to produce an overall performance HR index for each trial. HR reactivity for each treatment trial was then calculated by subtracting their resting HR from their performance HR for each trial with negative numbers recoded as zero.

3. Statistical analyses

To confirm that the randomization procedure resulted in equivalent experimental groups, we examined group differences in pre-treatment levels of subjective fear and

heart-rate reactivity using one-way ANOVAs. No significant differences were observed for subjective fear or HR at pre-treatment.

3.1. Treatment outcome

Planned contrasts (TW vs. NW and EO) were performed on residualized fear change scores to test the hypothesis that compared to the NW and EO groups, the TW group would show greater fear reduction at post-treatment. A similar strategy was used to test the hypothesis that the SR group would show less fear reduction at post-treatment than the EO group.

We also examined clinically significant change across exposure conditions. A χ^2 test comparing the TW group to the NW and EO groups was used as a further test of the hypothesis that providing threat-relevant information during exposure would facilitate fear reduction. Similarly, a χ^2 test comparing the SR group to the EO group was used as a further test of the hypothesis that providing a demanding distracter task during exposure would have a deleterious effect on fear reduction.

3.2. Treatment process

Planned contrasts (i.e., TW vs. NW and EO) were performed on initial HR and subjective fear (i.e., Trial 1 measures) adjusting for pre-treatment levels to test the hypothesis that the provision of threat words would result in higher levels of initial fear. Similarly, planned contrasts (i.e., SR vs. EO) were performed on initial HR and subjective fear (i.e., Trial 1 measures) adjusting for pre-treatment levels to test the hypothesis that distraction would result in lower levels of initial subjective fear.

An examination of the pattern of fear change across the 30 min of self-directed exposure treatment was accomplished by calculating six subjective fear indices corresponding to the first through sixth 5-min exposure time blocks. The subjective fear index for a given time block was defined as the average of all subjective fear ratings associated with that time block, weighted by the amount of time represented in that 5-min time block.

To investigate the relationship between fear activation during treatment and treatment outcome we regressed the residualized fear change score on subjective fear and HR reactivity independently.

In order to examine whether the respective manipulations (i.e., activation, distraction) were predictive of the rate of change in subjective fear across treatment blocks, we modeled peak fear using a multi-level, random regression procedure (HLM; Bryk & Raudenbush, 1992; Bryk, Raudenbush, & Congdon, 1996). In level one, fear was modeled as a function of trial. In this analysis, an estimate of the rate of decline of fear was computed for all individuals and hypotheses were tested regarding the populations of individual slopes (Level 1). The degree to which these level 1 slopes were influenced by the respective manipulation was then evaluated. More specifically, slopes

Table 1
Group means and standard deviations for the primary outcome measures at pre- and post-treatment

Measure	Exposure condition											
	Threat word (activation)			Neutral word control			Seashore rhythm (distraction)			Exposure only control		
	Pre1	Pre2	Post	Pre1	Pre2	Post	Pre1	Pre2	Post	Pre1	Pre2	Post
Peak fear												
Mean	74.7	63.3	26.7	69.3	65.3	23.3	69.3	63.3	31.3	67.3	63.3	13.3
SD	15.1	17.2	18.8	16.2	11.9	26.1	17.5	16.3	26.4	17.1	16.8	24.1
HR												
Mean	10.2	7.6	4.4	12.9	8.7	6.6	18.8	14.1	3.3	13.9	12.2	4.2
SD	7.8	6.7	5.7	7.8	5.8	5.8	8.8	12.4	5.5	7.0	11.0	5.4

Note: Pre1 = Pre-treatment BAT 1, Pre2 = Pre-treatment BAT 2. *N*'s for each group = 15.

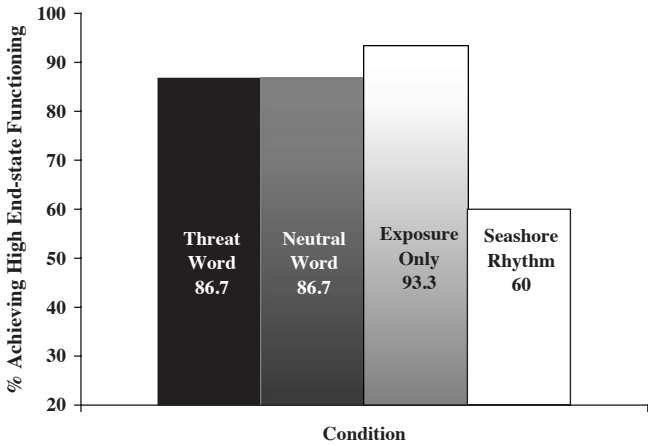

Fig. 1. Percentage of participants attaining clinically significant improvement for the four exposure conditions.

of the fear = *f*(time) function was modeled as the outcome variable of a "Level 2" regression of slopes on contrast 1 (TW vs. NW and EO) and pre-treatment fear to test whether the provision of threat words would facilitate fear change. Similarly, slopes of the fear = *f*(time) function was modeled as the outcome variable of a "Level 2" regression of slopes on contrast 2 (SR vs. EO) and pretreatment fear to test whether the high cognitive load condition would display a lower rate of fear decline during treatment relative to the exposure only condition.

4. Results

4.1. Treatment outcome

Means and standard deviations of subjective fear and heart-rate reactivity at the pre-treatment assessment and at the post-treatment assessment for the four exposure conditions are reported in Table 1. Contrary to expectation, the TW condition did not show greater reduction in fear or HR reactivity at post-treatment than the NW and EO conditions. Consistent with prediction, the SR condition showed less fear reduction than the EO condition, $F(1,56) = 4.20$, $p < 0.05$. However, no differential change was observed for HR reactivity.

Fig. 1 presents the percentage of participants in each of the exposure conditions who attained clinically significant improvement at post-treatment. The TW group did not differ significantly from the NW and EO groups in the proportion of participants who achieved clinically significant change at post-treatment (86.7% vs. 86.7% and 93.3%, respectively). However, a lower proportion of individuals in the SR condition (60%) meet criteria for clinically significant change than in the EO condition (93.3%; $X^2(1) = 3.97$, $p < 0.05$].

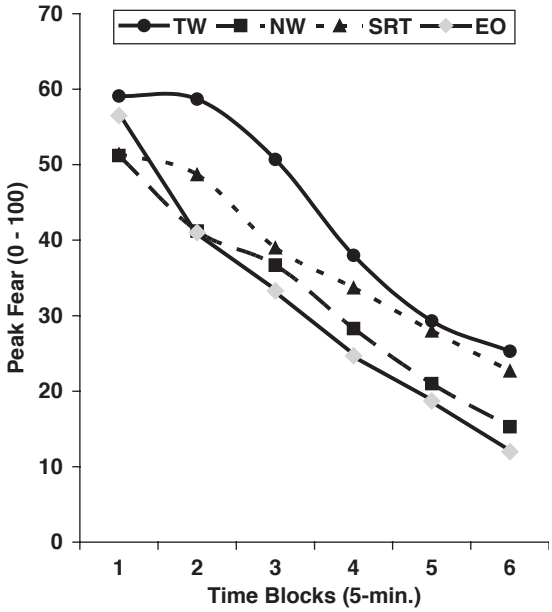

Fig. 2. Decay lines of maximum subjective fear during treatment for the threat word and neutral word exposure, seashore rhythm test (distraction) and exposure-only control exposure conditions.

4.2. Treatment process

4.2.1. Fear activation

Contrary to prediction, the TW condition did not show greater subjective or HR fear activation than the NW and EO conditions. The observed power of the contrast was 0.72. Planned contrasts comparing the SR to the EO group on initial subjective fear and HR reactivity were also not significant. Contrary to expectation, higher subjective fear activation during treatment was associated with less fear reduction at post-treatment $F(1,59) = 7.15$, $p < 0.05$. However, no significant relationship was observed between HR reactivity during treatment and level of fear change at post-treatment.

4.2.2. Between-trial habituation during treatment

Change in mean ratings of subjective fear across the 6 trials for the four conditions are presented in Fig. 2. Contrary to expectation, the planned contrast comparing the TW to the NW and EO groups on subjective fear was not significant. As predicted, the SR group showed less subjective fear change than the EO group, even after controlling for pre-treatment fear, $t(176) = 2.26$, $p < 0.05$.

5. Discussion

This study examined the effects of fear activation and distraction during in vivo exposure as a way of further testing specific predictions from the emotional processing theory of fear reduction (Foa & Kozak, 1986). Our approach was to manipulate several parameters of exposure in order to examine the effects on fear reduction while controlling for the total duration of exposure. Our attempt to increase initial fear activation by having participants focus on threat-relevant words and images during exposure was not successful in eliciting greater fear activation during treatment, nor was it associated with greater fear reduction at post-treatment. Our finding of a negative relationship between level of fear activation during treatment and treatment outcome is at odds with early studies showing a positive relationship between higher initial fear activation and greater fear reduction (Borkovec & Sides, 1979; Kozak et al., 1988; Lang et al., 1970; Watson et al., 1972) but is quite consistent with the findings from two recent studies in our laboratory showing that greater initial fear activation was not associated with a more favorable response to treatment (Telch, Valentiner, Ilai, Petruzzi, & Hehmsoth, 2000; Kamphuis & Telch, 2000). One possibility is that our claustrophobia chamber is sufficiently threatening to participants so that once inside, sufficient activation of the fear structure is almost guaranteed. Thus, further attempts to enhance fear activation, although successful, will not lead to enhanced emotional processing or more favorable treatment outcome.

Consistent with our previous work (Kamphuis & Telch, 2000), results showed that phobics who engage in a demanding cognitive load task during exposure fared significantly worse at post-treatment relative to the three other exposure conditions.

These findings are consistent with predictions from emotional processing theory (Foa & Kozak, 1986; Rachman, 1980) and results from studies demonstrating the deleterious role of distraction on fear reduction (e.g., Craske et al., 1991). Results from the present study help to resolve the mixed findings reported on the effects of distraction on fear reduction during exposure (Rodriguez & Craske, 1993). Our findings suggest that it is not distraction per se that interferes with fear reduction but the extent to which the distracter task makes attentional resources less available for cognitive processing during exposure. Support for this position in the present study comes from the finding that having participants focus on non-threat related words and images (i.e., neutral word condition) did not show a significant disruptive effect on fear reduction.

Our treatment process analyses shed some light on the mechanisms underlying the disruptive effects of cognitive load on fear reduction. Based on findings from the current study and those reported elsewhere (Kamphuis & Telch, 2000), it appears that distraction exerts its detrimental effects on fear reduction through an attenuation of between-trial habituation as opposed to a dampening of fear activation. Several pathways may be implicated in the observed distraction-induced attenuation of between-trial habituation. One possibility is that distraction during exposure limits the cognitive resources necessary for attending to threat disconfirming information. In addition, distraction may constrain the higher order processing of threat disconfirming information (i.e., the reappraisal of stimulus or response information as non-threatening).

Several limitations of the study deserve comment. First, although we employed a stringent two-stage screening procedure to ensure that our research participants display marked phobicity, most did not meet DSM-IV criteria for specific phobia. Upon closer examination, our research participants meet all DSM-IV criteria with the exception of Criterion E (i.e., the person must experiences significant interference in social, academic or work functioning or experiences marked distress about having the phobia). Although we have no reason to believe that this clinical status variable limits the generalizability of our findings,[1] the issue remains an empirical one and awaits replication with a treatment-seeking clinical sample.

Our pre- and post-treatment assessments made use of the same claustrophobic chamber used during treatment, thus precluding a determination of whether treatment gains generalized to other claustrophobic situations. However, other studies in our laboratory using the same treatment chamber have found evidence for treatment generalization to a non-treated test chamber (Kamphuis & Telch, 2000; Sloan & Telch, 2001; Telch et al., 2000). In addition, the results may have differed if the exposure had been continuous rather than intermittent, if it had continued over a longer period, and if escape during exposure had been further discouraged (Marks, 1987).

[1] In a first attempt to investigate this issue, Powers, Smits, and Telch (2004) reported that diagnostic threshold (i.e., whether claustrophobic participants met DSM-IV criterion E) was unrelated to treatment outcome.

Our assessment was limited to post-treatment effects only and therefore does not address the important issue of durability. It is possible that the disruptive effects of cognitive load on fear reduction dissipate over time and that phobics continue to improve following treatment. Alternatively, it is possible that limiting attentional resources during exposure treatment will result in greater return of fear at follow-up. Preliminary support for the latter was reported by Kamphuis and Telch (2000), however, the follow-up was relatively brief (i.e., 2 weeks) and hence future studies with longer follow-up are needed.

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