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Influence of perceptual cues and conceptual information on the activation and reduction of claustrophobic fear

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A R T I C L E I N F O

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A B S T R A C T

Background: Fear reactions in phobic patients can be activated by specific perceptual cues (C) or by conceptual fear-related information (I). An earlier study with spider phobic participants documented that perceptual stimuli are particularly potent to trigger fear responses. Because fear of spiders is activated by very circumscribed stimuli, we set out to investigate whether another phobia with more contextual fear-elicitation (i.e., a situational phobia) would yield similar patterns. Thus, we investigate the two paths of fear activation (cues vs. information) and fear reduction during exposure in claustrophobic patients.
Method: Forty-eight claustrophobic patients and 48 healthy control participants were randomly assigned to one of three virtual reality exposure conditions: C, I, or a combination of both (CI). Exposure lasted 5 min and was repeated 4 times. Self-report and physiological reactions were assessed.
Results: Claustrophobic patients experienced more initial self-reported fear when confronted with fear-relevant perceptual cues than conceptual information, when the perceptual cues were combined with conceptual information there was no significant enhancement. Furthermore, fear habituated more in the perceptual condition. For the physiological parameters, groups differed and in claustrophobic patients heart rate decreased differently in the conditions.
Limitations: Longer exposure duration and long-term effects of the manipulation were not investigated.
Conclusion: We found similar patterns in a situational phobia as compared to a specific-cue related phobia (animal type). Thus, once more this highlights the central role of visual cues in phobic fear and the potential of virtual reality for conducting exposure therapy.

The most comprehensive theoretical conceptualization of the mechanisms of exposure therapy to date is the emotional processing theory (EPT) by Foa and Kozak (1986). This theory suggests that fear memory, as first described by Lang (1971), can be viewed as a network comprising information about a reaction and a set of propositions about a stimulus (e.g., a spider), a response (e.g., heart racing) and their meaning (e.g., 'I will be poisoned'), which is stored in memory. Any modification of the fear memory requires its activation to be as whole as possible. Importantly, the fear network can be fully activated by inputs that match part of the structure, which are substantial enough to activate other parts of the structure (Craske et al., 2008).

Perceptual (fear-related cues) and conceptual (fear-related information) paths are assumed to modulate fear activation. The relative importance of perceptual fear-related cues and fear-related information on the initial activation of fear network has been investigated in one previous study with spider phobia patients (Peperkorn, Alpers, & Mühlberger, 2014). In this study we showed that specific visual cues or conceptual information activated the fear network through different entry routes and importantly, that they have different fear activating properties with the perceptual (visual in that case) path being more fear provoking than the informational route. The two routes of fear elicitation were directly manipulated by virtual reality (VR) to present the visual cues on the one hand and the independent information about the existence of a

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real fear-evoking stimulus (a spider for spider phobics) on the other hand. While the basic concepts may apply to very different phobias, there might also be some differences between phobias. One such difference might be the specificity of the perceptual cues that elicit the fear response. While for spider phobia these stimuli are very specific, for other phobias like claustrophobia or even social phobia the stimuli are of a more contextual nature as both are related to a situation and not a specific stimulus (Hofmann, Alpers, & Pauli, 2009; Loken, Hettema, Aggen, & Kendler, 2014). Furthermore, treatment differs between different phobias, too. For example, claustrophobia is a more difficult disorder to treat, e.g., it is associated with a slower fear reduction during exposure (Alpers & Sell, 2008; Botella, Villa, Banos, Perpina, & Garcia-Palacios, 1999; Craske et al., 2008; Öst, Alm, Brandberg, & Breitholtz, 2001).

We conducted an analogous approach as Peperkorn et al. (2014) with claustrophobic patients instead of spider phobic participants in order to investigate the effect in a situational phobia as opposed to a stimulus related phobia. While it has been shown that perceptual input (VR exposure) is effective in activating fear responses in claustrophobia-related situations and claustrophobic participants (Botella, Baños, Villa, Perpiñá, & García-Palacios, 2000; Mühlberger, Bülthoff, Wiedemann, & Pauli, 2007; Mühlberger, Wieser, & Pauli, 2008), the differential influence of perception and information on fear activation and fear reduction has not yet been investigated. With the use of VR, we investigated the potency of perceptual cues (C), conceptual information (I) and the combination of both (CI) to elicit fear and reduction of fear in the course of exposure. According to the results for spider phobia (Peperkorn et al., 2014), we expected perceptual cues, a virtual claustrophobic box with a closed door (C), to activate intense self-reported fear and physiological fear responses. We expected a longer lasting fear response in a third group who saw the closed box and who was also informed that the door of a real claustrophobic box that they were sitting in was also closed (CI). In contrast, presenting the participants a VR opened box yet informing them that they are actually sitting in a closed real claustrophobic box should yield an attenuated fear response compared to the two other groups.

1. Method

1.1. Participants

Forty-eight claustrophobic patients (40 females, 8 males; age: 19–64 years, $M = 38.67$, $SD = 15.58$) and 48 healthy control participants (40 females, 8 males; age: 18–65 years, $M = 34.96$, $SD = 15.12$), matched for age (+/−2 years, $t(94) = 1.18$, $p = .24$) and gender, completed the study. Participants were recruited by advertisements in newspapers, via internet and among patients seeking help at the university outpatient center. Eighty-five persons who reported claustrophobic symptoms in the screening were assessed using the Structured Clinical Interview for DSM-IV axis I disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1996; German: Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). Exclusion criterion was any further Axis I diagnosis beside claustrophobia. The control group also completed the SCID-I and only persons without any diagnosis were admitted to the study. Physiological data of 10 claustrophobic patients and 6 control participants could not be analyzed due to technical failures. All participants received a compensation of 24 €. Written informed consent was obtained from all participants involved in this study at the beginning of the experiment. The participants were randomly assigned to one of the three experimental conditions (C, I, CI) with the computer software Research Randomizer (Urbaniak & Plous, 2011).

Claustrophobic patients reported significantly higher claustrophobic fear (Claustrophobia Questionnaire [CLQ]; Radomsky, Rachman, Thordarson, McIsaac, & Teachman, 2001) and a significantly higher anxiety sensitivity (Anxiety Sensitivity Index [ASI]; Reiss, Peterson, Gursky, & McNally, 1986; German: Alpers & Pauli, 2001) compared to the control group (see Table 1 and Table A.1), as well as body-related fears (Body Sensation Questionnaire [BSQ]; Chambless, Caputo, Bright, & Gallagher, 1984; German: *Fragebogen zu körperbezogenen Ängsten, Kognitionen und Vermeidung*; Ehlers, Margraf, & Chambless, 1993) and trait anxiety (State Trait Anxiety Inventory [STAI-t]; Spielberger, Gorsuch, & Lushene, 1970; German: Laux, Glanzmann, Schaffner, & Spielberger, 1981).

Comparing pre-exposure and post-exposure, the data of the *CLQ, ASI* and *BSQ* revealed no significant change in the claustrophobic or control group (see Table 1). Comparing the condition C, I and CI, the data of the STAI-t, CLQ, and ASI showed no significant differences in both groups. Only for the BSQ in the control group a p-value below .05 was found, which is based on a difference between condition I and CI (see Table A.1 in the appendix for descriptive). Since no hypothesis regarding differences between conditions in these variables has been made and several tests for different variables have been conducted, this difference should be handled with caution. However, to account for possible influences of this difference between conditions, an additional ANOVA with the BSQ as covariate was computed, that confirmed the results presented in the result section.

1.2. Fear induction

During the experiment, participants were seated on a chair inside a claustrophobic box according to the descriptions by Öst, Johansson, and Jerremalm (1982), and Richter, Hamm, Pané-Farré, Gerlach, Gloster, Wittchen et al. (2012). However our box was 1 m × 1 m x 1.8 m and we installed small cameras and dim lights in order to be able to monitor the participants during the experiment (see Fig. 1). To induce fear reactions to specific perceptual (mainly visual) cues (C), a virtual wooden box with closed doors was presented in a virtual laboratory room via a HMD (Head-Mounted Display, while the participants were informed that the door of the real wooden box, which they were sitting in, stayed open. In the conceptual information group (I), fear was induced by informing the participants that the real box door was closed while they could see that the VR door stayed opened. In the combination group (CI), both doors (VR and real) were closed. It is important to note that in the information condition, the provided information was fear related, but the perceptional input (VR) was clearly not fear related (open door) and vice versa. Furthermore, participants were not able to see if the real wooden box was opened or not, because they wore the HMD.

To ensure the credibility of the information given, we videotaped the trials and gave the participants the information that they can watch the video after the experiment. No participant had doubt about the correctness of the information given.

1.3. Technical equipment

A virtual environment (see Fig. 2) was run on the STEAM-engine (Valve Corporation; Bellevue, Washington, USA). The virtual environment was rendered using a standard Windows PC and displayed on a HMD (eMagin Z800 3DVisor; Bellevue, Washington, USA). The experiment was controlled by the in-house built CyberSession Virtual Reality Interface (http://www.cybersession.info). A Polhemus™ 3 space Fastrak position tracking system (Polhemus; Colchester, USA) was used to measure the head position. It was attached to headphones (Sennheiser HD 215, Sennheiser Electronic, Germany), over which participants received instructions and information about the surrounding environment.