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Enhanced visuomotor processing of phobic images in blood-injury-injection fear

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ABSTRACT

Numerous studies have identified attentional biases and processing enhancements for fear-relevant stimuli in individuals with specific phobias. However, this has not been conclusively shown in blood-injury-injection (BII) phobia, which has rarely been investigated even though it has features distinct from all other specific phobias. The present study aims to fill that gap and compares the time-course of visuomotor processing of phobic stimuli (i.e., pictures of small injuries) in BII-fearful ($n = 19$) and non-anxious control participants ($n = 23$) by using a response priming paradigm. In BII-fearful participants, phobic stimuli produced larger priming effects and lower response times compared to neutral stimuli, whereas non-anxious control participants showed no such differences. Because these effects are fully present in the fastest responses, they indicate an enhancement in early visuomotor processing of injury pictures in BII-fearful participants. These results are comparable to the enhanced processing of phobic stimuli in other specific phobias (i.e., spider phobia).

1. Introduction

In recent years, numerous studies demonstrated that information processing of phobic stimuli is enhanced in individuals with animal phobias. For instance, motor responses are faster and visual search times are lower for phobic stimuli as compared to neutral ones (e.g., Lipp & Waters, 2007; Öhman, Flykt, & Esteves, 2001). Additionally, an involuntary orientation of attention toward phobic stimuli is frequently reported (Mogg & Bradley, 2006; Rinck & Becker, 2006, for reviews see Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1997). For instance, the studies by Mogg and Bradley (2006) and by Rinck and Becker (2006) suggest that phobic stimuli capture attention. While there is wide agreement about the existence of an attentional bias toward phobic stimuli, it is less clear what the exact attentional mechanisms are. Several studies suggest that an initial, involuntary orientation toward phobic images is followed by intentional avoidance (Derakshan, Eysenck, & Myers, 2007; Mogg & Bradley, 2006; Rinck & Becker, 2006), but many of the currently employed paradigms are not precise enough to distinguish between automatic capture of attention and rapid modulation by top-down processes. For example, Bardeen and Orcutt (2011) as well as Peers and Lawrence (2009) demonstrated that top-down mechanisms, such as attentional control, can influence the bottom-up orientation to threat stimuli within the first 100–200 ms of processing. Beside the interpretation that attention is drawn toward phobic or threat-relevant stimuli, there is also some evidence that the bias might result from disengagement difficulties *away* from those stimuli in fearful individuals (cf. Amir, Elias, Klumpp, & Przeworski, 2003; Fox, Russo, & Dutton, 2002; Gerdes, Alpers, & Pauli, 2008). Despite these open questions, all these studies agree that phobic or threat-relevant stimuli benefit from some form of processing enhancement over the time-course of the first half second of processing. In this paper, we are interested specifically in the enhanced ability of phobic stimuli to drive fast motor responses, such as keypress responses performed under time pressure.

Many studies show enhanced processing of fear-relevant material in a great variety of phobias and anxiety disorders, but few studies directly compared participants with different types of anxiety disorders. Öhman et al. (2001) asked non-anxious control, spider phobic, and snake phobic participants in a visual search task to search for pictures of spiders or snakes in grid-pattern arrays of flower and mushroom pictures, or vice versa. They found that fear-relevant pictures of spiders and snakes were found more quickly than neutral pictures by all three groups, with even faster responses to phobic stimuli in the two phobic groups (also cf. Teachman, Gregg, & Woody, 2001; Wenzel & Holt, 1999).

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However, Soares, Esteves, Lundquist, and Öhman (2009) reported that spider-fearful participants were specifically faster in detecting spiders compared to fear-relevant but non-phobic snakes and to neutral targets in a visual search task. In contrast, snake-fearful participants showed no differences in performance between snakes and fear-relevant but non-phobic spider pictures. We observed a similar asymmetry in a response priming study with spider-fearful, snake-fearful, and non-anxious control participants (Haberkamp, Schmidt, & Schmidt, 2013). Participants were presented with target images of spiders, snakes, flowers, or mushrooms, and had to decide as quickly as possible whether the target was an animal or non-animal by pressing one of two keys. Target images were preceded by prime images from the same four categories that could either prime the correct or incorrect response, thereby speeding or slowing responses to the target (*response priming effect*; Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003). In the group of spider-fearful participants, only spider pictures had a strong influence on motor responses, leading to fast response times and large priming effects. In contrast, in snake-fearful participants, enhanced processing of phobic material was less pronounced and extended not only to snake but also to spider images.

Such results suggest that information processing might differ in different types of specific phobias. Within the class of specific phobias, there is one type that especially differs from other specific phobias; that is blood-injury-injection (BII) phobia. In BII phobia, individuals experience an extreme and irrational fear of blood, injuries, or of receiving an injection or an invasive medical procedure (Öst, 1992). The prevalence rate is approximately 3.5% (Bienvenu & Eaton, 1998), and women are affected twice as often as men (Hamm, 2006). This phobia lends itself to investigation due to three reasons: (1) BII phobia has distinct features that distinguish it from all other specific phobias (e.g., experience of nausea and fainting in phobic situations; experiencing not only fear but also disgust,[1] e.g., Koch, O'Neill, Sawchuk, & Connolly, 2002; Schienle, Schäfer, Walter, Stark, & Vaitl, 2005); (2) few studies have investigated the speed of information processing in individuals with BII phobia compared to the large number of studies focusing on animal and social phobia; (3) those studies that did produced mixed results. Thus, it remains unclear whether BII-fearful individuals exhibit enhanced information processing and a bias similar to that in other phobias.

Let us look at the peculiarities of BII phobia in some more detail. First of all, up to 70% of BII phobics report a history of fainting due to a marked drop in blood pressure, heart rate, or both when confronted with their phobic stimuli (i.e., blood or injections) (Öst, 1992). In contrast, in other specific phobias (e.g., animal phobia), exposure typically triggers sympathetic reactions, for instance, panic-related symptoms like sweating, trembling, and an increased heart rate and blood-pressure (Antony, Brown, & Barlow, 1997). Furthermore, individuals with BII phobia frequently avoid medical procedures, which might lead to serious health implications (Öst, 1992). Therefore, Armstrong, Hemminger, and Olatunji (2013) argue that research should contribute to develop more effective treatments for BII-fearful individuals. According to these authors, one promising area is that of studying vigilance in BII-fearful individuals since the early attentional bias may contribute to the increased distress when they are confronted with a phobic stimulus (Weierich, Treat, & Hollingworth, 2008).

Even though an attentional bias favoring phobic stimuli is a core feature of other specific phobias, the evidence for such a bias in BII fear is equivocal. For example, Sawchuk et al. (1999) used a modified Stroop task to compare semantic information processing in BII phobic and non-phobic control participants. Ten medical (e.g., "injection"), 10 disgust (e.g., "vomit"), 10 negative (e.g., "lonely"), and 10 neutral words (e.g., "spoon") were randomly presented in black, blue, green, or red. The authors measured color-naming latencies in BII phobics and control participants for medical and disgust words and found no difference between the two groups. In particular, BII phobics were not slowed in naming the color of phobic words, indicating that their attention was not distracted by the phobic word. In line with these findings, Wenzel and Holt (1999) showed in a dot-probe task that individuals with BII phobia did not exhibit an attentional bias toward their phobic stimuli (i.e., the phobic group responded similarly fast to the probe regardless of whether it was presented at the location of a phobic or a neutral word). However, both studies are limited by the fact that they used lexical stimuli which might not be strong enough to elicit an attentional bias in BII-fearful participants (Armstrong et al., 2013). Additionally, the modified Stroop task has recently received some criticism, with some authors suggesting that the task is not suitable to measure information processing biases for emotional words (Algom, Chajut, & Lev, 2004; McKenna & Sharma, 2004; Weierich, Treat, & Hollingworth, 2008; for a critical review of the modified Stroop task in PTSD cf. Kimble, Frueh, & Marks, 2009; also see Bardeen & Orcutt, 2011).

The limitations of the modified Stroop task were overcome in a series of experiments that were conducted more recently by Buodo and colleagues. In their eye-tracking study, BII-fearful and control participants were shown phobic, positive emotional, and neutral pictures (Buodo, Sarlo, Codispoti, & Palomba, 2006). The authors measured free viewing times and event-related potentials (ERPs). The eye-tracking results revealed no clear pattern of visual avoidance in BII-fearful participants: Even though these participants spent less time looking at blood pictures when compared to control participants (between-groups comparison), they did not spend less time looking at blood pictures compared to the other picture categories (within-group comparison). Thus, phobic pictures were not specifically shunned by BII-fearful individuals. Additionally, the ERPs amplitudes of BII-fearful participants revealed neither an increase indicating an attentional bias toward the phobic stimuli nor a decrease indicating avoidance of the phobic stimuli. The authors concluded that BII-fearful individuals show no vigilance-avoidance pattern.

In a follow-up study, the authors measured magnetoencephalography (MEG) activity in BII-fearful and non-anxious control participants in response to phobic and non-phobic pictures (Buodo, Peyk, Junghöfer, Palomba, & Rockstroh, 2007). They found a higher activation in BII-fearful participants for the two picture categories of phobic and neutral stimuli, but not specifically for phobic pictures. Again, they interpreted these findings as evidence that phobic stimuli are not preferentially processed by BII-fearful individuals.

However, there is also evidence that BII phobia is associated with a vigilance-avoidance pattern. Tolin, Lohr, Lee, and Sawchuck (1999) used a viewing paradigm and showed that BII phobics avoided viewing injection images compared to non-anxious controls and spider phobics. Mogg, Bradley, Miles, and Dixon (2004) found the same effect for BII-fearful participants in a visual dot-probe task. In addition, the authors showed that an intentional avoidance was preceded by an initial vigilance for phobic stimuli. Finally, two studies by the group of Buodo and colleagues contradicted the group's earlier results. Buodo, Sarlo, and Munafò (2010) investigated the N2pc component of ERPs – which is assumed to reflect processes of spatial attention – in BII-fearful and non-anxious control participants and found an attentional bias followed by visual avoidance. Subsequent, Sarlo, Buodo, Devigili, Munafò,

[1] Note that fear and disgust also co-occur in animal phobias (e.g., Mulkens, de Jong, & Merckelbach, 1996). However, Sawchuk, Lohr, Lee, and Tolin (1999) suggest that disgust is the prominent emotion in BII phobia compared to fear.