



# Rapid visuomotor processing of phobic images in spider- and snake-fearful participants

Anke Haberkamp\*, Filipp Schmidt, Thomas Schmidt

University of Kaiserslautern, Germany



## ARTICLE INFO

### Article history:

Received 15 October 2012

Received in revised form 7 June 2013

Accepted 1 July 2013

Available online 7 August 2013

### PsycINFO classification:

2323

3215

### Keywords:

Phobia

Priming

Image processing

Amygdala

Perceptual learning

## ABSTRACT

This study investigates enhanced visuomotor processing of phobic compared to fear-relevant and neutral stimuli. We used a response priming design to measure rapid, automatic motor activation by natural images (spiders, snakes, mushrooms, and flowers) in spider-fearful, snake-fearful, and control participants. We found strong priming effects in all tasks and conditions; however, results showed marked differences between groups. Most importantly, in the group of spider-fearful individuals, spider pictures had a strong and specific influence on even the fastest motor responses: Phobic primes entailed the largest priming effects, and phobic targets accelerated responses, both effects indicating speeded response activation by phobic images. In snake-fearful participants, this processing enhancement for phobic material was less pronounced and extended to both snake and spider images. We conclude that spider phobia leads to enhanced processing capacity for phobic images. We argue that this is enabled by long-term perceptual learning processes.

© 2013 Elsevier B.V. All rights reserved.

## 1. Introduction

From an evolutionary point of view, it can be assumed that visual processing and rapid detection of potentially dangerous stimuli in the environment (e.g., perilous animals) are highly adaptive for all humans (cf. Öhman, Eriksson, Fredrikson, Hugdahl, & Olofsson, 1974; Öhman & Mineka, 2001). In addition, that ability should be further enhanced if the given stimulus (e.g., a spider) is interpreted as threatening by one individual (e.g., by a spider phobic) even if the same stimulus is taken as harmless by another non-anxious individual. Empirical evidence indicates that the processing of threatening objects is enhanced in the general population (Fox et al., 2000; Lipp & Waters, 2007; Öhman, Flykt, & Esteves, 2001; Williams, Moss, Bradshaw, & Mattingley, 2005; but see Tipples, Young, Quinlan, Brooks, & Ellis, 2002) and for phobic stimuli further pronounced in individuals with specific phobias (Lipp & Waters, 2007; Öhman et al., 2001; for other anxiety disorders, e.g. social anxiety, see Eastwood et al., 2005; Gilboa-Schechtman, Foa, & Amir, 1999). For instance, in the study by Öhman et al. (2001), non-anxious control participants, spider phobics, and snake phobics had to search for pictures of spiders or snakes in grid-pattern arrays of flower and mushroom pictures, and vice versa. Potentially threatening pictures of spiders

and snakes were found more quickly than neutral pictures by all three groups, with even faster responses to the phobic targets in the two phobic groups (i.e., spiders for spider-phobics and snakes for snake-phobics). Furthermore, search times for spider and snake targets but not for neutral targets (flowers and mushrooms) were largely unaffected by the number of distractors (which normally increase response times in serial search tasks), and that effect was further enhanced in phobic participants. These results suggest that detection of phobic pictures might be independent of the number of distractors, indicating an especially high degree of search efficiency (Treisman & Gelade, 1980).<sup>1</sup> Even though such a *pop out* effect was not consistently found in more recent studies (Yiend, 2010) the evidence points to an information processing advantage for threatening stimuli. This advantage seems to apply not only to the input end, but also to the output end of the processing system: Flykt, Lindeberg, and Derakshan (2012) showed in a similar search task that fear-relevant pictures increased the force with which a response was performed.

But what causes that advantage? Current studies report that the attention of individuals with specific phobias is automatically and involuntarily drawn towards the phobic stimuli. That effect is known as an attentional bias (Mogg & Bradley, 2006; Rinck & Becker, 2006; for reviews, see Mathews & MacLeod, 2005; Bar-Haim, Lamy, Pergamin,

\* Corresponding author at: University of Kaiserslautern, Faculty of Social Sciences, Experimental Psychology, Erwin-Schrödinger-Str. Geb. 57, D-67663 Kaiserslautern, Germany. Tel.: +49 631 205 3940; fax: +49 631 205 3910.

E-mail address: [haberkamp@sowi.uni-kl.de](mailto:haberkamp@sowi.uni-kl.de) (A. Haberkamp).

<sup>1</sup> That means that the efficiency of processing might be further boosted by secondary factors like emotional significance.

Bakermans-Kranenburg, & van Ijzendoorn, 2007): as a consequence of selective attention, threatening stimuli that are attended are processed faster than unattended ones.<sup>2</sup> Several studies indicate that the attentional bias has a time course where early attentional capture occurs within approximately the first half second of exposure (Asmundson & Stein, 1994; Bradley, Mogg, White, Groom, & de Bono, 1999; Mogg & Bradley, 2006; Rinck & Becker, 2006; but see also Gerdes, Alpers, & Pauli, 2008).

Taken together, there is strong evidence that (1) threatening stimuli are detected faster compared to emotionally neutral stimuli and (2) this early detection is accompanied by an early attentional bias. But what are the neurophysiological processes underlying accelerated processing? Currently, there are two different accounts which try to explain that phenomenon. First, a widespread assumption is that the human amygdala plays a crucial role in rapid, automatic, and non-conscious processing of threatening stimuli. According to this theory, two cortical pathways are involved when a feared stimulus is recognized: firstly, a slow and elaborate cortical pathway, and secondly, a subcortical route – the so-called ‘low road’ – which projects information directly from the thalamus to the amygdala via the pulvinar (LeDoux, 1995). In the latter case, it is assumed that the thalamic input reaches the amygdala more quickly and, therefore, might allow for rapid responses on the basis of limited stimulus information. This model is supported by recent work from different research teams (e.g., Anderson & Phelps, 2001; Morris, Öhman, & Dolan, 1999), even though some researchers challenge the role of the amygdala in rapid emotional processing (for a review, see Pessoa & Adolphs, 2010). Alternatively to the ‘low road’ hypothesis, specific phobias might lead to perceptual learning processes regarding phobic material (Kourtzi & DiCarlo, 2006; for a review, see Gilbert, Sigman, & Crist, 2001), which in turn might enable faster recognition and encoding of those stimuli (cf. Zeelenberg, Wagenmakers, & Rotteveel, 2006). Biased attention might facilitate such learning processes (for example, when a phobic person is in a state of constant vigilance), but it is also conceivable that perceptual learning in turn increases the ability of phobic stimuli to capture attention (for example, by providing a more salient bottom-up signal that draws attention involuntarily).

As has been repeatedly shown, the classification of natural images by means of speeded motor responses is very rapid (Kirchner & Thorpe, 2006; Thorpe, Fize, & Marlot, 1996). Note that the two accounts described above place different demands on the time-course of the visual processing during this classification. The amygdala account requires the ‘low road’ to (1) classify incoming stimuli according to their emotional relevance (at least on the basis of visual low-level features), (2) outpace the cortical object recognition route, and (3) exert modulatory control on that processing route before it finishes processing the object. In contrast, the perceptual learning account explains enhanced processing of fear-relevant images by long-term changes in the processing hierarchy. Thus, processing enhancement for fear-relevant images could conceivably be hardwired into those processing structures involved in the first sweep of information processing through that hierarchy (*feedforward sweep*; Lamme & Roelfsema, 2000; VanRullen & Thorpe, 2001). These structures are all visual areas along the ventral pathway (*V1, V2, V4, posterior inferior temporal cortex, and anterior inferotemporal cortex*; Thorpe & Fabre-Thorpe, 2001, 2003). In other words, even if the classification of natural images is already rapid, that of fear-relevant pictures should be further enhanced. A strong prediction of perceptual learning model is that any processing enhancement should be fully present in the earliest signs of visuomotor processing. Therefore, any demonstration of processing enhancements in the earliest motor output would be consistent with a perceptual-learning account and

would place strict time constraints on the ‘low road’ account, possibly strict enough to challenge its physiological plausibility.

The goal of the current study was to determine whether accelerated processing of fear-relevant images is detectable at the earliest stages of observable behavior. We used a *response priming paradigm* (Klotz & Neumann, 1999; Klotz & Wolff, 1995; Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003; also cf. Schmidt, Haberkamp, & Schmidt, 2011), which has not been applied in research on specific phobias before. In response priming, participants have to classify a target stimulus (e.g., a shape or color stimulus or a natural image of an animal) into two response categories (e.g., spider or snake) by performing a speeded motor response. The target stimulus (e.g., a spider) is preceded by a prime stimulus triggering either the same response as the target (*consistent prime*; e.g., another spider) or the opposite response (*inconsistent prime*; e.g., a snake).<sup>3</sup> If the prime is consistent, it speeds responses to the target; if it is inconsistent, it slows responses. This *response priming effect* increases with increasing stimulus-onset asynchrony (SOA) between prime and target for SOAs approximately up to 100 ms (Vorberg et al., 2003) and is defined as response time differences between consistent and inconsistent trials. While response compatibility paradigms have been used before to study processing advantages for fear-relevant material, response priming has special properties that have not yet been demonstrated for other paradigms. Firstly, many studies have confirmed that primes directly initiate the specific motor responses assigned to them; an effect clearly discernible in the time-course of lateralized readiness potentials and overt pointing movements (e.g., Leuthold & Kopp, 1998; Schmidt, 2002). Therefore, response priming effects are directly related to the visuomotor processes triggered by visual stimuli, and are sensitive to differences in visuomotor processing. Secondly, behavioral and electrophysiological evidence links response priming to visuomotor feedforward processing, because the earliest output of the motor system is controlled exclusively by the prime but is independent of all properties of the target. This was established for goal-directed pointing responses (Schmidt, Niehaus, & Nagel, 2006; Schmidt & Schmidt, 2009) as well as lateralized readiness potentials (Vath & Schmidt, 2007), just as expected from a simple feedforward system that processes prime and target in strict sequence. As far as we know, response priming effects are confined to two-choice responses, possibly because the underlying mechanism depends on a winner-takes-all process involving mutual inhibition of response alternatives (see Vorberg et al., 2003, for a model).<sup>4</sup>

We hypothesized that spider-fearful and snake-fearful participants will show enhanced visuomotor processing of spider or snake images, respectively; (1) in comparison to the visuomotor processing of the neutral pictures of mushrooms and flowers, and (2) compared to the visuomotor processing of spiders and snakes in the non-anxious control group. We expected similar results for the two types of phobia (Åhs et al., 2009; Soares & Öhman, 1993). Based on our previous research on response priming, we predicted that enhanced processing of phobic primes will lead to larger response priming effects compared to neutral targets. Because the perceptual learning account predicts that processing enhancements for fear-relevant stimuli should be apparent even in the fastest motor responses, we are especially interested in the earliest deciles of the response time distribution.

### 1.1. The present study

The experiment was designed as follows. Three groups of participants took part in the study; one group of spider-fearful participants

<sup>2</sup> Note that the attentional bias may also base on the participants' expectancy about the appearance of their phobic object/animal (Devue, Belopolsky, & Theeuwes, 2011) or other characteristics of visual perception, for instance, sudden appearance of objects (cf. Cole & Kuhn, 2009, 2010).

<sup>3</sup> Note that we excluded trials in which by accident primes and targets consisted of the exact same picture (e.g. the same spider picture) to avoid *identity* or *repetition priming*, respectively.

<sup>4</sup> Note that “response priming” is the proper name of the paradigm, named so because of the ability of the prime to trigger a motor response. There is no assumption that effects are exclusively motoric, as opposed to visual, semantic, or other priming processes.

Download English Version:

<https://daneshyari.com/en/article/10453768>

Download Persian Version:

<https://daneshyari.com/article/10453768>

[Daneshyari.com](https://daneshyari.com)