



Interpretative bias in spider phobia: Perception and information processing of ambiguous schematic stimuli[☆]



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ABSTRACT

This study investigates the interpretative bias in spider phobia with respect to rapid visuomotor processing. We compared perception, evaluation, and visuomotor processing of ambiguous schematic stimuli between spider-fearful and control participants. Stimuli were produced by gradually morphing schematic flowers into spiders. Participants rated these stimuli related to their perceptual appearance and to their feelings of valence, disgust, and arousal. Also, they responded to the same stimuli within a response priming paradigm that measures rapid motor activation. Spider-fearful individuals showed an interpretative bias (i.e., ambiguous stimuli were perceived as more similar to spiders) and rated spider-like stimuli as more unpleasant, disgusting, and arousing. However, we observed no differences between spider-fearful and control participants in priming effects for ambiguous stimuli. For non-ambiguous stimuli, we observed a similar enhancement for phobic pictures as has been reported previously for natural images. We discuss our findings with respect to the visual representation of morphed stimuli and to perceptual learning processes.

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1. Introduction

The fast detection and reaction to fear-relevant situations and stimuli in our environment is one of the most important and evolutionary significant tasks of the human visual and motor system. However, which situations and stimuli are regarded as fear-relevant is not at all universal. Different individuals strongly differ in their evaluations with respect to fear relevance. This is most evident when considering individuals with anxiety disorders such as social or specific phobias.

Indeed, individuals with specific phobias by definition suffer from a “marked fear or anxiety about a specific object or situation [...] which is out of proportion to the actual danger posed by the specific object or situation” (Diagnostic criteria for specific phobia, DSM-5, American Psychiatric Association, 2013, pp. 197). In other words, they evaluate specific situations (e.g., heights, plane rides) or stimuli

(e.g., spiders, snakes, dogs, or blood) as strongly threatening that are not necessarily regarded as such by other, non-anxious individuals. Additionally, a large number of studies has demonstrated that individuals with social anxiety disorder – that experience significant distress in social settings (DSM-5, American Psychiatric Association, 2013) – tend to interpret even typical social situations as potentially threatening (e.g., Amir, Foa, & Coles, 1998; de Jong, Merckelbach, Bögels, & Kindt, 1998; Mellings & Alden, 2000; Voncken, Bögels, & de Vries, 2003; Wells, Clark, & Ahmad, 1998; for a review see Heinrichs & Hofmann, 2001). However, this misinterpretation, or interpretative bias, is promoted by the fact that social situations are often ambiguous. So the question arises whether such bias is also present in individuals with specific phobias directed to situations or stimuli that are less inherently ambiguous?

This question can be evaluated by considering, for example, individuals with spider phobia. In contrast to other persons – which are encountered in social situations – spiders do not exhibit much behavior that might be (mis)interpreted by humans. Furthermore, the potential ambiguity of the fear-relevant stimuli can be further reduced by using static visual stimuli, as in previous studies on information processing in individuals with specific phobias (e.g., Haberkamp, Schmidt, & Schmidt, 2013; Öhman, Flykt, & Esteves, 2001). An observed interpretative bias in individuals with spider phobia for static visual stimuli cannot be based on a bias in the interpretation of (ambiguous) behavior but has to be based on a more fundamental bias in the interpretation of visual

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features of the stimuli.² Is there any evidence for such a fundamental bias in information processing in individuals with spider phobia?

Becker and Rinck (2004) presented spider-fearful participants and non-anxious control participants with a stream of scrambled pictures interspersed by short 14 ms presentations of photographs of spiders, beetles, or butterflies. Spider-fearful participants more often reported that they have seen a spider or a beetle – which was also rated as being aversive. Thus, spider-fearful participants seem to have a more liberal criterion when classifying perceptually similar animals as fear-relevant compared to non-anxious individuals. Kolassa et al. (2007) presented participants with spider phobia or social phobia, spider aficionados, or non-anxious control participants with schematic stimuli (i.e., line drawings) that morphed from flower into spider pictures in 7 steps. Again, participants with spider phobia more often reported that these ambiguous stimuli (i.e., those in-between flowers and spiders) resembled a spider compared to all other groups.

This fundamental bias in the perceptual interpretation of static visual information prompts the question whether information processing on the visuomotor level would also be different for ambiguous stimuli between spider-fearful participants and non-anxious participants. This cannot be taken for granted because, for example, dissociations between (slow) perception and (fast) motor responses have been reported frequently. For example, the effects of masked primes can be dramatically different in perception and visuomotor priming: invisible primes can produce strong priming effects (e.g., Kiesel, Kunde, Pohl, Berner, & Hoffmann, 2009; Vorberg, Mattler, Heinecke, Schmidt, & Schwarzbach, 2003).

With respect to non-ambiguous and natural fear-relevant stimuli, numerous studies demonstrated that information processing (i.e., detection and classification) is enhanced in the general population (Fox et al., 2000; Lipp & Waters, 2007; Öhman et al., 2001; Williams, Moss, Bradshaw, & Mattingley, 2005; but see Tipples, Young, Quinlan, Brooks, & Ellis, 2002). This effect is even more pronounced in individuals with specific phobias (e.g. Berdica, Gerdes, Pittig, & Alpers, 2014; Gerdes & Alpers, 2014; Haberkamp & Schmidt, 2014; Haberkamp et al., 2013; Lipp & Waters, 2007; Öhman et al., 2001; for a review see Yiend, 2010) and with other anxiety disorders (e.g., social anxiety, Eastwood et al., 2005; Gilboa-Schechtman, Foa, & Amir, 1999).

In two recent studies, we investigated rapid information processing by using natural images of neutral, fear-relevant, and phobic stimuli (Haberkamp & Schmidt, 2014; Haberkamp et al., 2013). We found that spider-fearful participants responded faster to phobic target pictures of spiders compared to fear-relevant snakes or neutral flowers and mushrooms. Additionally, spider-fearful participants responded faster to spider targets compared to a non-anxious control group. Finally, spider primes elicited larger priming effects in the spider-fearful group compared to fear-relevant and neutral primes, and compared to the control group (Haberkamp et al., 2013). For blood-injury-injection-fearful participants, we observed the same data pattern although that phobia has features that clearly distinguish it from other specific phobias (e.g., experience of nausea and fainting in phobic situations). Fearful participants responded faster to target pictures of small injuries compared to neutral targets and compared to a non-anxious control group. Also, phobic primes elicited larger priming effects compared to neutral primes (Haberkamp & Schmidt, 2014).

We concluded that phobic natural images lead to rapid information processing in fearful individuals. Our findings are in line with other studies in the image processing literature showing that despite their visual complexity, the categorization of natural images is remarkably fast (e.g., Bacon-Macé, Kirchner, Fabre-Thorpe, & Thorpe, 2007; Schmidt & Schmidt, 2009). How can this rapid processing of natural images be explained?

VanRullen (2009) suggested a process of “hardwired” binding of features to which a person is frequently exposed as a result of perceptual learning. For example, if a person is frequently exposed to spiders, this might induce enhancements in the functional properties of the cortical arrays involved in spider detection and recognition. In individuals with spider phobia, these learning processes are presumably stronger because spiders have strong emotional significance and thus attract more attention (Haberkamp et al., 2013).

However, to investigate information processing for ambiguous stimuli, natural images pose problems that schematic pictures do not. Schematic pictures lend themselves much more easily to controlled variations in the level of ambiguity (e.g., by morphing stimuli between a schematic flower and spider, see below) because they are restricted to the variation of shape information. This ambiguity is much less restrained in the case of natural images where typically shape, color, and texture information are combined. Because of this combination the range of potential stimuli is much larger compared to schematic pictures. Consequently, there is a risk that differences in information processing are driven by shape, color, or texture information that is specific for the tested exemplars. At the same time, schematic stimuli should still contain the most relevant “hardwired” key (shape) features of the natural images (i.e., spider body and legs). As a consequence, information processing can be measured over this range of different ambiguity levels and compared for individuals with specific phobia and non-anxious controls. Finally, by using schematic stimuli, it is possible to compare information processing of phobic stimuli to that of stimuli which are perceptually very similar – in contrast to a comparison to the processing of very distinct natural images of butterflies, mushrooms, and flowers.

Here, we use stimuli that were designed to investigate “the role of the Gestalt of a spider as one of the fear-inducing properties that might induce fear in spider phobic subjects” (Kolassa et al., 2007; p. 2). Spiders are reduced to their key features and then morphed by a gradual shift of their contours into schematic flowers (Fig. 1, lower panel).³ The morphing manipulations by Kolassa, Musial, Kolassa, and Miltner (2006, 2007) allow us to investigate the influence of slight perceptual stimulus changes on rapid information processing and on measures of perceptual interpretation and emotional significance, and follow these influences over different levels of stimulus ambiguity. By using a response priming paradigm, we can tie in with our earlier results on phobic natural images (Haberkamp & Schmidt, 2014; Haberkamp et al., 2013). Also, our study is related to research on morphed emotional face stimuli in the general population (e.g., Duval, Moser, Huppert, & Simons, 2013; Haberman & Whitney, 2007; Schweinberger, Burton, & Kelly, 1999) as well as in clinical and subclinical samples (e.g., Averbek, Bobin, Evans, & Shergill, 2011; Heuer, Lange, Isaac, Rinck, & Becker, 2010; Joormann & Gotlib, 2006). To the best of our knowledge, the effect of ambiguous schematic stimuli in phobic participants was never before tested with respect to rapid information processing.

2. The present study

We use a response priming paradigm that taps into the earliest stages of observable behavior (Klotz & Neumann, 1999; Klotz & Wolff, 1995; Vorberg et al., 2003; also see Schmidt, Haberkamp, & Schmidt, 2011). The paradigm was successfully applied in recent studies on information processing in individuals with specific phobias (Haberkamp & Schmidt, 2014; Haberkamp et al., 2013). In response priming, participants have to classify target stimuli into different response categories (e.g., spider versus flower) by performing a speeded motor response. The target stimulus (e.g., spider) is preceded by a prime stimulus triggering either the same response as the target (consistent prime; e.g., spider) or the opposite response (inconsistent prime; e.g., flower). Consistent primes

² Note that individuals with social phobia did not show any interpretative bias in the judgment of ambiguous, static images of facial expressions (for a review see Staugaard, 2010).

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