A comprehensive look at phobic fear in inhibition of return: Phobia-related spiders as cues and targets

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Background and objectives: The so called inhibition of return (IOR) effect refers to a bias against returning attention to a location which was previously investigated. Because emotionally salient material has the capacity to capture and hold attention it has been suggested that this material may disrupt this otherwise impressively stable phenomenon.

Methods: 40 students participated in the experiment. Black and white schematic drawings of a spider, a butterfly or a cross were used as cues. A black dot, a spider, a butterfly or a cross were used as targets. Participants were required to press a key whenever the target picture appeared. Subsequently, they rated the pictures on valence and arousal.

Results: Results showed that the IOR effect remained stable and did not diminish with either fear-related cues or fear-related targets. This data adds strong arguments for the stability of IOR.

Limitations: The spider fearful participants were not diagnosed patients. They still meet the criteria for spider fear but follow-up studies should pursue the same question with a specific focus on participants’ levels of anxiety.

Conclusions: This study is a contribution to the debate on how emotions affect or do not affect attentional processes such as the IOR. IOR appears to be a robust phenomenon and the emotional valence of neither the cue nor the emotional valence of the target can override it.

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1. Introduction

Our attentional system is tuned to quickly detect novel stimuli. In this logic, search strategies are adaptive if they do not repeat locations which were already searched over and over again. Inhibition of return (IOR) refers to a delay in responding to a target which appears in the same location of a preceding cue (Posner & Cohen, 1984). In a typical IOR experiment, two boxes appear on the left and right of a fixation cross. One trial starts with a cue appearing in one of the boxes for a short time. After a specific time, the cue is followed by a target which can appear in the cued or uncued location and participants have to respond. This time from the presentation of the cue, to the presentation of the target is considered as stimulus-onset asynchrony (SOA). IOR involves two components: either a facilitation effect for short SOAs (100–300 ms) or an inhibitory after-effect for longer SOAs (300–3000 ms). Hence, it takes individuals more time to respond to a target appearing at a cued rather than at an uncued location. This paradigm was originally introduced by Posner and Cohen (1984), and has been widely used to investigate general attentional processes. IOR has been found in tasks using manual responses and sometimes with eye-movements towards the target. As a spatial cueing task it can be tested in different forms (i.e., detection, localization, or discrimination tasks). IOR with neutral stimuli (dots or other geometric shapes) has been shown to be a quite stable phenomenon and it is thought to facilitate search in many perceptual modalities, including auditory attention (Mondor, Breau, & Milliken, 1998) and visual search (Klein, 2000). It is well known that IOR can be influenced by stimulus properties such as shape (Riggio, Patteri, & Umiti, 2004) and color (Law, Pratt, & Abrams, 1995). A small but increasing number of studies has employed this paradigm to investigate attentional biases in anxious individuals or other subgroups.

The classical understanding of the IOR effect implies that individuals would inhibit the return of their attention to a location which was previously attended, regardless of stimulus valence.
However, other theoretical considerations suggest a modulation of the IOR effect in trait anxious individuals with various emotional stimuli (e.g., words: Pérez-Dueñas, Acosta, & Lupiánez, 2009; Waters, Nitz, Craske, & Johnson, 2007; faces: Fox, Russo, & Dutton, 2002; Park, Van Bavel, Vasey, & Thayer, 2012). Others consider it to be a robust perceptual phenomenon which cannot be easily modulated by cue valence (Lange, Heuer, Reinecke, Becker, & Rinck, 2008; Stoyanova, Pratt, & Anderson, 2007; Taylor & Therrrien, 2005; Weaver, Aronsen, & Lauwereyns, 2012). The question whether this inhibitory effect is influenced by the emotionality of the stimuli still remains ambiguous. Because there are contradictory findings (modulation and non-modulation of IOR from threat-related cues) it should be considered whether these studies may have documented different processes.

Hypervigilance toward threat is generally thought to be adaptive (Mineka & Ohman, 2002). However, a strong line of research shows that exaggerated fear can be maladaptive and play a crucial role in the maintenance and etiology of anxiety (Hofmann, Alpers, & Paull, 2009). The allocation of attention to threatening cues is a robust phenomenon in anxious individuals and it increases the severity of anxious episodes (for a review see: Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). A lot of the research focused on the issue of attentional biases in anxiety. For instance, the hypervigilance – avoidance pattern in anxiety disorders suggests a superiority in threat processing, i.e., threatening stimuli quickly capture the attention and this subsequently leads to avoidance behavior (Mogg, Bradley, de Bono, & Painter, 1997). While other lines of research document difficulties in disengaging attention from threatening stimuli (Fox, Russo, Bowles, & Dutton, 2001; Gerdes, Alpers, & Paulli, 2008; Gerdes, Paulli, & Alpers, 2009). These models are generally tested with modifications of spatial cueing or visual search tasks.

Fear of spiders is reliably triggered by very specific cues (Gerdes, Uhl, & Alpers, 2009), therefore spider pictures as highly emotional/threatening cues may override the inhibited attention typically observed in IOR. In an earlier study, Lange et al. (2008) ran a series of IOR experiments with groups of spider fearful and socially anxious participants. They used angry faces and spiders as cues with the argument that no previous studies tested the IOR effect following biologically relevant cues. However, they manipulated only the emotionality of the cue, leaving the target neutral. They concluded that spiders and faces do not influence IOR even in their subclinical groups; suggesting that this effect is robust and resistant to emotional stimuli. However, they did not manipulate the emotional significance of the target.

In IOR tasks participants are required to respond to the target pictures, so it may be reasonable to expect that it is more suitable to manipulate the emotional valence of the target rather than just the cue. Some studies did not report a modulation of the IOR from the emotionality of the cue (Lange et al., 2008; Stoyanova et al., 2007) while others found a reduction of the IOR effect in specific subclinical groups, such as emotional faces in patients with low cardiac vagal tone (Park, Bavel, Vasey, & Thayer, 2012), in OCD-related objects in patients with obsessive and compulsive disorder (Harkin & Kessler, 2012), and sad faces in depression (Dai & Feng, 2009). So far, only few studies have manipulated the valence of the targets (Berdica, Gerdes, Pittig, & Alpers, 2014; Pérez-Dueñas, Acosta, & Lupiánez, 2013; Pérez-Dueñas et al., 2009; Rutherford & Raymond, 2010; Silver & Funes, 2016). Some of them report some emotion effects but do not have conclusive evidence that IOR cannot be malleable with fear-related targets.

Previously, we presented spiders and butterflies as targets in a spider fearful group (Berdica et al., 2014). When the dependent variable was assessed with eye-tracking (i.e., the first fixation to the target), there was a stable IOR effect but no modulation or reduction when the target was a spider. Our study differed from typical IOR procedures with respect to the assessment of manual reaction times: button presses followed the eye-movements. In this non-established measure we did not find the expected modulation of IOR.

Interestingly, in a recent study a reduction of IOR was observed for fearful faces as targets but only when these faces were made task-relevant (Silvert & Funes, 2016). In a series of experiments the authors tested under which conditions IOR is reduced with fearful faces used as targets. They concluded that the variation of the task affects the IOR effect such that the greater the target relevance, the more IOR was reduced. They did not, however, test this in an anxious group (i.e., socially anxious individuals). This leaves the question whether fear has an impact on the IOR still open.

Rutherford and Raymond (2010) used spiders, faces and objects as targets in an IOR study. They found a modulation of the IOR effect only when they had a block design with spider and angry face targets. This was not the case when targets were mixed and randomized. Nevertheless, in their study the authors did not recruit (spider)fearful participants, and thus once again, little can be said about the effect of the fear on this attentional bias. In a similar fashion, Pérez-Dueñas and colleagues used threatening words (2009) and faces (2013) as targets, and they observed a modulation of the IOR effect by the content of these stimuli. Group differences, though, were found only in the study where they used threatening words (Pérez-Dueñas et al., 2009) — high trait anxious individuals show a reduced IOR effect for negative words. Face targets in their other study modulated the IOR for the whole sample — showing no IOR effect for angry faces (Pérez-Dueñas et al., 2013).

Given the ambiguity of the existing results, the goal of this paper is to more closely examine whether the target’s emotionality matters in an IOR task. Previous research is rather inconsistent in the design, either by not recruiting (sub)clinical groups or by not using emotional targets. In order to fill this gap, in the present study we recorded manual reaction times during a typical IOR experiment — and we include both valenced cues and valenced targets. To better understand the well documented influence of emotion on spatial attention, it will be important to document where these influences are limited. To this end, we used a method similar to the one used by Lange et al. (2008). However, for the first time in an IOR experiment, rather than presenting only threatening cues, we additionally included threatening targets as well, in a group of spider fearful and non-fearful participants. The aim was to further extend existing findings and investigate whether the emotional valence of the target itself is relevant in spider fearful individuals and if its relevance affects the IOR effect. We hypothesized that spider fearful individuals will show a reduction of the IOR effect when spiders were presented as targets. The same reduction will be visible when spider cues appear, in comparison to butterfly cues. Additionally the IOR effect will remain stable for the non-fearful group across conditions.

2. Method

2.1. Participants

Forty high and low spider fearful participants from the University of Mannheim participated in the experiment in exchange for course credit. Based on the cut-off scores of the German version of the Fear of Spiders Questionnaire (Rinck et al., 2002) we assigned the ones scoring 0 to 6 to the non-fearful group (N = 20) and the ones scoring 15 or higher to the spider fearful group (N = 20). Participants had normal or corrected-to-normal vision. They were tested individually in a 1 h session. Exclusion criteria included any serious chronic diseases, substance abuse and use of psychotropic

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