Eye movement assessment in individuals with social phobia: Differential usefulness for varying presentation times?

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ABSTRACT

Visual dot probe tasks are used to examine attentional biases towards threat faces in social phobia. Based on eye movement assessments, short presentation times of stimuli have been proposed to investigate initial attentional processes. However, it remains unclear if eye movements contribute to anxiety related biases as measured in dot probe tasks when presentation times below 200 ms are used. In this study the electrooculogram (EOG) was recorded in a sample of 17 participants with social phobia and 13 controls performing a visual dot probe task in two presentation time conditions. In the 175 ms condition, half of the participants moved their eyes in only 10% of the trials. Significantly more participants moved their eyes in the 600 ms condition and individuals with social phobia directed their gaze more often to the threat faces than to the neutral faces. Eye movement measures were not related to reaction time measures but the number of initial eye movements towards threatening faces correlated with measures of social anxiety. For dot probe paradigms, the additional use of eye movement measures seems to be particularly appropriate for longer presentation times. The dissociation between attentional bias scores as measured with reaction time versus eye movement measures and their relation to different presentation times underlines the need for both measures when conducting visual probe studies.

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1. Introduction

Individuals with anxiety disorders supposedly process threat-related stimuli preferentially, compared to neutral or positive cues. This processing bias is thought to contribute to the etiology and/or maintenance of pathological anxiety (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJendoorn, 2007). In social phobia, this bias has regularly been investigated with the visual dot probe task with pictorial or verbal stimuli (Bögels & Mansell, 2004). When using faces as stimuli, a face with an emotional (e.g., angry) expression and a face with a neutral expression are presented simultaneously side by side on the screen. Immediately following their presentation, a probe replaces one of the two stimuli. Participants have to respond as quickly and as accurately as possible, either indicating the mere appearance of the probe on the right or the left side, or responding to other stimulus features, e.g., an arrow pointing up or down (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). Trials in which the probe replaces the emotional face are called congruent trials, whereas trials in which the probe replaces the non-emotional face are called incongruent trials. Results of studies using this methodology, however, are mixed, possibly due to methodological differences. For example, some studies used two faces, some studies paired faces with household objects. Also, the choice of presentation times for facial stimuli varies substantially. In most studies faces were presented for 500 ms, but in some studies shorter or longer presentation times were used.

Eye movement research suggests that during 500 ms presentation time, more than one shift in gaze may occur with the first saccadic eye movement starting at about 150–200 ms after stimulus onset (Kowler, 1995). Consequently, responding to the probe after presentation of the faces for 500 ms may not reflect the initial, i.e. the very first attentional shift as represented by the first saccade. To overcome this problem, some authors suggest to use presentation times of about 150–200 ms to map the first saccadic eye movements in visual dot probe tasks (Broomfield & Turpin, 2005; Cooper & Langton, 2006; Weierich, Treat, & Hollingworth, 2008). In addition to mere measures of reaction time, eye movement recordings offer the possibility to investigate overt shifts in attention, which represent shifts in gaze to a target stimulus. As

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processing of visual targets is usually determined by covert and overt shifts in visual attention, covering both aspects might be important for revealing disorder specific information processes.

1.1. Evidence for initial attentional bias with presentation times less than 200 ms

Studies using short presentation visual dot probe tasks generally support the notion of an initial attentional bias towards threat when comparing RTs to threatening versus neutral face pairs. However, only few studies investigated participants with clinically relevant social anxiety. With a presentation time of 100 ms, participants with elevated state anxiety responded faster to probes replacing threat words than probes replacing neutral words (Mogg, Bradley, DeBono, & Painter, 1997). With the same timing, Cooper and Langton (2006) investigated a sample of healthy students in a task with angry–neutral and happy–neutral face pairs. The authors found an attentional bias for the relatively threatening stimulus, i.e. the angry face in the angry–neutral and the neutral face in the happy–neutral pairings. With a presentation time of 200 ms, Mogg, Holmes, Garner, and Bradley (2008) examined anxious and nonanxious individuals using the Posner cueing task. In the cueing task, the observer has to detect a target that might appear in one of two locations. The probability of the target appearing at that location is given by a precue on the onset of each trial. In valid cue trials, when the target appears in the cued location, accuracy and speed to detect the target are typically higher than in the trials where the target appeared at the uncued location (invalid trials). When the effect of response slowing of threat cues on bias scores was taken into account, anxious individuals responded relatively faster to probes replacing threatening faces compared to those replacing neutral ones. Finally, using a visual dot probe task with a presentation time of 175 ms, Stevens, Rist, and Gerlach (2009) found an attentional bias for threat faces in individuals with social phobia compared with healthy controls, but not with a presentation time of 600 ms.

1.2. Eye movement measures in dot probe research in social anxiety

Most studies which employ dot probe methodology and eye movement measures in anxiety research present facial stimuli for 500 ms or longer. Eye movements are assessed either via recording the electrooculogram (EOG) or relying on eye tracking equipment. Compared to neutral and happy faces, anxious individuals (500 ms presentation time; Bradley, Mogg, & Millar, 2000) were more likely to initially look at threatening faces compared with nonanxious controls. However, eye movements occurred in only 30% of the trials across all participants. Under social evaluative conditions, socially anxious individuals orient their gaze faster to and disengage it slower from emotional faces relative to neutral ones when presented for 1500 ms (Garner, Mogg, & Bradley, 2006). The authors suggest that this finding supports vigilance–avoidance patterns of stimulus processing with rapid initial orienting towards emotional faces followed by later disengagement of attention. In a further study, Mogg, Garner, and Bradley (2007) found a bias in initial gaze direction for anxious individuals towards negative faces presented for 500 ms, irrespective of whether the face depicted angry or fearful emotions.

There are only few studies in anxiety research which employ the dot probe methodology with short presentation times (<200 ms) and simultaneously assess eye movements. Hence, direct tests of whether eye movement measures are useful in assessing early attentional shifts or if eye movements are even relevant in dot probe tasks with such short presentation times are still missing. In their analysis of covert and overt attention in trait anxiety,

Broomfield and Turpin (2005) presented threat and non-threat words in a visual probe task for either 100 or 500 ms. The cue-target interval between offset of the stimuli was also fixed at 100 or 500 ms for a first, and at 500 ms for a second experiment. The EOG was recorded to register eye movements. In summary, only few trials contained eye movements (5.4% of the trials in experiment one, 19.6% in experiment two). This result was unexpected as there was a subgroup of individuals which was explicitly instructed not to move their eyes, but there was no statistically significant difference between the instructed and the non-instructed group with respect to RT bias scores. However, in an additional analysis, a bias of initial eye movements towards threat words, compared with nonanxious controls, occurred only in participants with high trait anxiety who received no instructions whether to move their eyes. Unfortunately, interpreting these results in the context of other visual probe studies is hampered by the two following issues: Firstly, since the authors used word material, they presented the stimuli in a visual angle of only 1.6°, whereas the visual angle in visual probe studies with faces usually ranges from 7 to 10° (Mogg et al., 2007). Secondly, most studies did not instruct participants not to use their eyes. Although Broomfield and Turpin (2005) found only marginal differences in the overall number of eye movements, a bias of initial orientation towards threat was only present in uninstructed eye movers.

1.3. Aims of the present study

The present study examined possible biases in eye movements in a traditional visual dot probe paradigm, examining the processing of angry versus neutral face stimuli in individuals with social phobia and in healthy controls. Concerning eye movements, we used a 175 ms presentation time condition to assess the first saccade after stimulus onset, which was expected to be more often directed to angry versus neutral faces in participants with social phobia compared to healthy controls (Cooper & Langton, 2006; Kowler, 1995). To compare results in the 175 ms condition with shifts in gaze direction during later attentional processing, we used a longer presentation time of 600 ms in addition. This condition allows a comparison with earlier studies using presentation times >500 ms (Bradley et al., 2000).

2. Method

2.1. Recruitment

Participants were recruited by advertisements and newspaper articles looking for people with and without fear of social situations. Those responding completed a short screening interview conducted by phone and were invited to an approximately 2-h diagnostic session conducted with the German version of the Structured Clinical Interview for the DSM IV (SCID I, Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). All participants also returned questionnaires, which they had received by mail and had completed at home. The SCID was conducted by an experienced clinical psychologist (SS). For their participation, control participants received 20 €. For individuals with social phobia, free participation in cognitive behavioural group therapy was offered. Exclusion criteria were current or past drug or alcohol abuse or dependence, use of psychoactive medication and current or past psychotic episodes. All participants gave written informed consent after they had learned about the experiment. This study was approved by the joint ethics committee of the General Medical Council Westfalen-Lippe and the Faculty of Medicine of the Westfalian Wilhelms-University, Münster, Germany.