



Temporal estimation of threatening stimuli in social anxiety disorder: Investigation of the effects of state anxiety and fearfulness



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ABSTRACT

Background and objectives: Prior studies suggest that particularly negative emotional events tend to be experienced as temporally dilated. Perceptual characteristics of the threat cue (averted or directed angry face), state as well as individual anxiety levels have been shown to contribute to the temporal distortions, but the interplay between these factors is not well understood. The present study investigated the relative contributions of these factors in a first study using clinical sample with social anxiety disorder (SAD) and healthy controls (HC).

Methods: Participants performed a temporal bisection task (TBT) before and after a stress provocation phase, which served to induce state anxiety. During the TBT task, angry and neutral faces with averted vs. direct gaze were presented for the length of 600, 800, 1000, 1200, 1400, 1600 ms, and judged regarding their similarity to the standard durations.

Results: A temporal overestimation effect for angry vs. neutral facial expressions was evident in both the HC and the SAD groups. An effect of experimentally induced state anxiety was evident solely in the SAD group, reflected in an overall increased temporal overestimation of angry vs. neutral expressions following the mood manipulation.

Limitations: The clinical sample may represent a high-functioning group, as the study was conducted on college students. Replication in more heterogeneous SAD samples is needed in order to draw further conclusions.

Conclusions: These results may be relevant for the understanding of the etiology and maintenance of SAD and potentially for the development of novel intervention methods.

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1. Introduction

A great amount of empirical evidence suggests that very quick, preferential processing of threatening signals is a part of an innate functional repertoire of a healthy human brain (Öhman, 2009; Tamietto & de Gelder, 2010). When faced with sudden danger, this may translate to a crucial temporal advantage to prepare for and execute a behavioral response. Interestingly, the internal “speeding up” is reflected not only in the quick and efficient processing, but also has effects on our subjective perception of time. Anecdotal reports and accumulating empirical evidence suggests

that time appears dilated or “slowed down” during acute life-threatening experiences (Dirnberger et al., 2012; Doi & Shinohara, 2009). This temporal dilation when faced with sudden threat may mirror an adaptive response related to the automatic activation of fear-response circuitry (Öhman, 2009), which allows for a quick processing and fast behavioral response to the impending threat.

1.1. Distortions of time perception related to emotion

The attempts to investigate the effects of emotion on time perception have been probed with various experimental approaches, such as the time bisection task (TBT). In this well-established paradigm, the participants are first trained to discriminate between standard long (e.g. 1600 ms) and short (e.g. 600 ms) durations using geometric forms. During the actual task, the participants rate comparison durations regarding their similarity to the short or to the long standard durations. The affective

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significance of comparison durations can then be systematically manipulated by employing emotionally laden visual stimuli in order to investigate emotion effects on time perception. Affective faces depicting threat (anger, fear, disgust), represent highly salient information which is reflected in the quick, automatic processing (Jusyte & Schönenberg, 2013) and the potential to evoke arousal (Dimberg & Thunberg, 2000; Esteves, Dimberg, & Öhman, 1994) as well as a neural response in the fear circuitry (Brooks et al., 2012). Hence, facial expressions signaling threat have often been employed in TBT paradigms and shown to be overestimated in their durations compared to happy or neutral faces (Doi & Shinohara, 2009; Droit-Volet, Brunot, & Niedenthal, 2004; Gil, Niedenthal, & Droit-Volet, 2007; Tipples, 2008, 2011; Young & Cordes, 2012); similar effects have also been reported for non-facial threatening stimuli (Gil & Droit-Volet, 2012a; Grommet et al., 2011; Lambrechts, Mella, Pouthas, & Noulhiane, 2011).

1.2. The role of stimulus characteristics

Threat potency may also be increased by subtle manipulations of the facial stimulus, such as frontal or averted head position or even the eye gaze. In accordance with the assumption that frontal angry faces signal immediate, impending threat directed towards the viewer, evidence shows that they tend to be perceived more intensely, elicit more anxiousness and a greater amygdala response than averted angry faces (Hess, Adams, & Kleck, 2007; N'Diaye, Sander, & Vuilleumier, 2009). Fearful faces on the other hand, which are assumed to signal environmental threat, elicit the greatest perceived intensity when the gaze/head position is averted from the viewer (Hess et al., 2007; N'Diaye et al., 2009). Interestingly, there is evidence that individual differences in (social) anxiety is associated with a higher sensitivity to the effects of gaze direction in angry as well as fearful expressions (Fox, Mathews, Calder, & Yiend, 2007; Roelofs et al., 2010; Wieser, Pauli, Alpers, & Mühlberger, 2009). In accordance with these findings, one previous study has investigated the effects of gaze direction on temporal processing of affective stimuli, indicating that temporal overestimation of angry faces was impacted by gaze direction (Doi & Shinohara, 2009). The authors showed that angry faces with a direct gaze produced significantly more temporal overestimation compared to angry faces with an averted gaze.

1.3. Contributions of individual differences and state anxiety components

Some evidence suggests that the effects of emotion on time perception may also be influenced by individual and state differences in anxiety levels. The effects of anxiety are thought to be exerted through the effects of arousal (Bar-Haim, Kerem, Lamy, & Zakay, 2010), which has been shown to mediate the relationship between time dilation and emotional events (Gil & Droit-Volet, 2012a). Consequently, transient increases in state anxiety levels provoked by the situational characteristics as well as individual differences in fearfulness are thought to distort the processing of threatening cues (Bishop, 2007). In accordance with these assumptions, early studies that employed genuine anxiety-inducing contexts reported larger temporal overestimations (Langer, Wapner, & Werner, 1961; Watts & Sharrock, 1984). More recent findings employing the TBT paradigm have also demonstrated temporal overestimation following film-induced mood (Droit-Volet, Fayolle, & Gil, 2011) and during anticipation of an aversive cue in humans (Droit-Volet, Mermillod, Cocenas-Silva, & Gil, 2010) as well as animals (Meck, 1983).

However, only few studies to date have examined the contribution of individual differences in anxiety to threat-related

temporal distortions, yielding findings which indicate that particularly the anxious sensitivity toward certain types of threat-relevant cues, i.e., fearfulness, may contribute to an overestimation of threatening event durations (Bar-Haim et al., 2010; Buetti & Lleras, 2012; Sarason & Stoops, 1978; Tipples, 2008, 2011; Watts & Sharrock, 1984). For instance, one early study (Sarason & Stoops, 1978) investigated the relationship between test anxiety, performance and time passage, reporting that individuals with high test anxiety exhibited a poorer performance and a prolonged time perception. Similarly, a study (Watts & Sharrock, 1984) conducted on spider phobics reported dilated time estimations when confronted with a live spider. More recent studies that employed the TBT to investigate this issue also indicate that there may be a link between fearfulness and the magnitude of temporal distortions for threatening stimuli. For instance, Tipples (2011) demonstrated that individual levels of fearfulness, i.e., reactive sensitivity to threatening stimuli, but not trait anxiety, was associated with an increased temporal overestimation of angry faces. Most importantly, one recent study (Buetti & Lleras, 2012) extended these results to a population of subclinical spider-fearful individuals, who viewed fear-relevant (spiders) vs. negative, fear irrelevant (IAPS images) images as stimuli in a TBT task. The results indicated that the extent of the participants' fear of spiders was associated with an increased overestimation of the duration of spider images.

Unfortunately, no studies to date have investigated time perception using TBT in clinically anxious populations, i.e., individuals who exhibit increased fearfulness to specific types of stimuli, as is particularly the case in phobias. In social anxiety disorder (SAD), the patient's fears revolve around the scrutiny of social partners, which is reflected in abnormalities in the processing of social threat, most of all angry faces, indicating a hypersensitivity on a perceptual and neural level which extends to even the most basic, automatic processing levels (Staugaard, 2010). Thus, there are grounds to assume that SAD patients may be particularly prone to experience temporal dilations during distressing social interactions, which may add to the subjective averseness of the situation and perpetually increase fear. An investigation of temporal distortions of social threat in SAD is relevant as it adds to our understanding of the automatic mechanisms and their distortions exerted by fear-relevant situations. Furthermore, it is important to understand how transient changes in state anxiety may impact potential preexisting processing biases related to anxious psychopathology. Some evidence suggests that anxiety induction may modulate the processing advantage for threat, e.g., several studies reported that the bias to threatening faces is only present in SAD following a provocation, e.g., anticipation of a public speech (Garner, Mogg, & Bradley, 2006; Putman, Hermans, & van Honk, 2004; Sposari & Rapee, 2007). To understand how unconscious biases guide perception, cognition and behavior in real-time situations, it is necessary to examine both latent factors as well as alterations following a provocation of state anxiety symptoms.

1.4. Aims of the current study

In summary, the aims of the present study were threefold:

- 1) Investigation of the impact of individual levels of social anxiety on the temporal processing of emotional events in a population of individuals with clinically relevant SAD. Based on previous literature, we expected the impact of baseline levels of social anxiety to become evident in a greater temporal overestimation of threatening stimuli (i.e., more "long" responses for angry vs. neutral facial expressions) in SAD vs. HCs prior to the provocation.

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