



Research paper

Social anxiety is related to increased dwell time on socially threatening faces

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ABSTRACT

Background: Identification of reliable targets for therapeutic interventions is essential for developing evidence-based therapies. Threat-related attention bias has been implicated in the etiology and maintenance of social anxiety disorder. Extant response-time-based threat bias measures have demonstrated limited reliability and internal consistency. Here, we examined gaze patterns of socially anxious and nonanxious participants in relation to social threatening and neutral stimuli using an eye-tracking task, comprised of multiple threat and neutral stimuli, presented for an extended time-period. We tested the psychometric properties of this task with the hope to provide a solid stepping-stone for future treatment development.

Methods: Eye gaze was tracked while participants freely viewed 60 different matrices comprised of eight disgusted and eight neutral facial expressions, presented for 6000 ms each. Gaze patterns on threat and neutral areas of interest (AOIs) of participants with SAD, high socially anxious students and nonanxious students were compared. Internal consistency and test–retest reliability were evaluated.

Results: Participants did not differ on first-fixation variables. However, overall, socially anxious students and participants with SAD dwelled significantly longer on threat faces compared with nonanxious participants, with no difference between the anxious groups. Groups did not differ in overall dwell time on neutral faces. Internal consistency of total dwell time on threat and neutral AOIs was high and one-week test–retest reliability was acceptable.

Limitations: Only disgusted facial expressions were used. Relative small sample size.

Conclusion: Social anxiety is associated with increased dwell time on socially threatening stimuli, presenting a potential target for therapeutic intervention.

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1. Introduction

Threat-related attention bias is implicated in the etiology and maintenance of social anxiety disorder (SAD; Clark and Wells (1995) and Rapee and Heimberg (1997)), and has been identified as a target for therapeutic intervention in the form of attention bias modification treatment (ABMT; for reviews, see Bar-Haim (2010), Hakamata et al. (2010), Heeren et al. (2015) and Van Bockstaele et al. (2014)). Most of the evidence for biased attention in social anxiety comes from studies employing cognitive tasks that rely on reaction time (RT) data (for reviews, see Bar-Haim et al. (2007), Beard et al. (2012), Cisler et al. (2009) and Cisler and Koster (2010)). One drawback of RT-based tasks is the distal relation between the behavioral output (i.e., key presses) and the examined attentional processes, potentially giving rise to

confounding elements such as motor preparation and response execution (Armstrong and Olatunji (2012)). In addition, because RT measures capture only one instance in time, at the very end of a complex cognitive-behavioral process, they do not reflect the dynamic nature of online attention allocation (e.g., Bar-Haim (2010), Bar-Haim et al. (2007), Shechner et al. (2013) and Yiend (2010)). These shortcomings of RT-based measures point to the need to find new and improved paradigms to assess and subsequently modify attentional biases in anxious individuals (Van Bockstaele et al., 2014).

Recently, studies using eye-tracking methodology attempted to overcome some of the above-noted limitations. For example, in a typical free viewing task participants are requested to observe arrays of neutral and threat stimuli without specific requirements or instructions while their gaze is being continuously recorded. Previous free viewing studies found evidence for greater attention to threat in socially anxious (SA) relative to nonanxious participants reflected in the more frequent and faster first fixations on threat, longer dwell time on threat first fixations, as well as total

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dwell time on socially threatening stimuli (for reviews, see [Armstrong and Olatunji \(2012\)](#) and [Richards et al. \(2014\)](#)). However, most of these studies utilized small stimulus set sizes made of only 2–4 stimuli, with usually only one stimulus of an emotional valence. The generalizability and ecological validity of such stimuli displays has been called into question by [Richards et al. \(2014\)](#), who recommended use of more complex visual displays with various competing threatening and non-threatening stimuli presented at once, thereby increasing resemblance of these displays to real-world situations. In addition, most free viewing studies have examined data pertaining to first fixations, or to fixations occurring within the first 500 ms of stimuli presentation (e.g., [Bradley et al. \(2000\)](#), [Garner et al. \(2006\)](#) and [Stevens et al. \(2011\)](#)). The three studies that examined gaze patterns across longer presentation periods provide initial evidence for increased total dwell time on socially threatening stimuli among socially anxious individuals ([Buckner et al., 2010](#); [Schofield et al., 2012](#); [Wieser et al., 2009](#)). However, the set sizes used in these three studies were small, ranging only 1–4 stimuli.

Here we recorded eye-tracking data during a free-viewing task using complex stimuli comprised of eight socially threatening faces and eight neutral faces, presented for an extended time period of 6000 ms. We measured overall dwell time on threat and neutral stimuli throughout this extended period, and also measured first-fixation variables: latency to first fixations, location of first fixations, and dwell time of first fixations. We tested a sample of high and low SA undergraduate students, as well as a sample of treatment seeking patients with SAD. Internal consistency of the task was evaluated, as well as one-week test–retest reliability. We predicted that: (a) relative to nonanxious participants, socially anxious participants would exhibit greater total dwell time on threatening faces, but not on neutral faces; and (b) relative to nonanxious participants the latency to first fixations of socially anxious participants would be shorter, first fixations would be more frequently located on threat faces relative to neutral faces, and would be longer. We hoped that reliable group differences on these measures would present a viable target for future intervention for SAD.

2. Methods

2.1. Participants

Participants in this study belonged to three groups: high and low socially anxious undergraduate students, and participants with clinically diagnosed SAD. Participants' self-reported social anxiety and depression scores (see Measures below) by group are presented in [Table 1](#).

Three hundred and fifty three undergraduate students were screened for social anxiety using the Liebowitz Social Anxiety Scale (LSAS; [Liebowitz \(1987\)](#)). Students with LSAS score ≥ 63 constituted the high SA group ($n=20$, 14 females, mean age=22.85 years, $SD=2.56$, range=20–30). Whereas LSAS score above 30 is considered the clinical cutoff on this scale, we set our cutoff score at 63 as this score was reported to yield no false positive identification of SAD among non-SAD individuals ([Mennin et al., 2002](#)). Thus, this cutoff score enabled the enrollment of participants that most closely resemble the clinical population of interest. The low SA group consisted of students with LSAS score ≤ 16 ($n=20$, 14 females, Mean age=22.05 years, $SD=1.76$, range=19–26), reflecting those who scored at the bottom of the sampling pool, reflecting minimal social anxiety. All student participants received course credit for participation.

The clinical group consisted of 20 treatment seeking patients diagnosed with SAD (12 females, mean age=35.15 years, $SD=9.67$,

Table 1

Psychopathological characteristics of the three groups.

Measure	High SA group		Low SA group		SAD group	
	M	SD	M	SD	M	SD
LSAS	76.40 ^a	17.13	17.30 ^b	12.91	74.20 ^a	17.56
PHQ-9	9.20 ^a	4.65	4.95 ^b	5.03	10.55 ^a	4.78

Note. Different superscripts signify differences between groups at $p < .001$. Same superscripts signify non-significant differences between groups at $p > .38$. SAD, social anxiety disorder; LSAS, Liebowitz Social Anxiety Scale; PHQ-9, Patient Health Questionnaire-9.

range=21–52). Primary and co-morbid diagnoses were ascertained using the Mini-International Neuropsychiatric Interview (see below, M.I.N.I.; [Sheehan et al. \(1998\)](#)) administered by a clinical psychologist trained to 85% reliability criterion with a senior psychologist. SAD diagnosis was further ascertained using the LSAS ([Liebowitz, 1987](#)), with a cutoff score of 50 and higher as an inclusion criterion. This cutoff score is considered to represent good identification for SAD with optimal balance between specificity and sensitivity ([Mennin et al., 2002](#); [Amir and Taylor, 2012](#)). Exclusion criteria for the clinical SAD group were: (a) age not between 18 and 60 years; (b) present or past psychotic episodes; (c) severe co-morbid depression with a high suicide risk; (d) co-morbid post-traumatic stress disorder (PTSD), obsessive-compulsive disorder (OCD), Tic disorder or Tourette's syndrome; (e) a neurologic condition (e.g., epilepsy, brain injury); (f) use of neuroleptic medication; and (g) drug or alcohol misuse, as defined by the MINI. Of the 20 participants with SAD included in the study, six also met criteria for a past or present depressive episode, one for dysthymia, ten for generalized anxiety disorder (GAD), two for panic disorder (PD), and four for agoraphobia. Five participants were using a stable dose of Selective Serotonin Reuptake Inhibitors (SSRIs).

The study protocol was approved by the local Institutional Review Board and participants provided written informed consent. We only invited participants that had normal or corrected-to-normal vision, excluding usage of multi-focal eyewear to prevent eye-tracking calibration difficulties. None of the participants had prior experience with eye-tracking procedures.

2.2. Measures

2.2.1. Social anxiety

Social anxiety was measured using the self-report version of the LSAS ([Liebowitz, 1987](#)). The LSAS lists 24 socially relevant situations. Each situation is rated on two scales ranging 0–3: level of fear and level of avoidance provoked by the described situation. Items are rated in relation to the passing week. The LSAS has strong psychometric properties, including high internal consistency, strong convergent and discriminative validity, and high test–retest reliability (e.g., [Baker et al. \(2002\)](#), [Fresco et al. \(2001\)](#) and [Heimberg et al. \(1999\)](#)).

2.2.2. Depression

Depression was measured using the Patient Health Questionnaire-9 (PHQ-9; [Kroenke et al. \(2001\)](#) and [Spitzer et al. \(1999\)](#)). The PHQ-9 is a 9-item self-report questionnaire evaluating symptoms of major depressive disorder according to the criteria of the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders, the DSM-IV ([American Psychiatric Association, 2000](#)). Each PHQ-9 item corresponds to one of the nine DSM-IV symptoms of depression, rated in relation to the previous two weeks. Responses include: “Not at all” (0), “Several days” (1), “More than half the days” (2), and “Nearly every day” (3). The

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