



# Psychophysiological responses to eye contact in adolescents with social anxiety disorder



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## ABSTRACT

We investigated whether eye contact is aversive and negatively arousing for adolescents with social anxiety disorder (SAD). Participants were 17 adolescents with clinically diagnosed SAD and 17 age- and sex-matched controls. While participants viewed the stimuli, a real person with either direct gaze (eye contact), averted gaze, or closed eyes, we measured autonomic arousal (skin conductance responses) and electroencephalographic indices of approach–avoidance–motivation. Additionally, preferred viewing times, self-assessed arousal, valence, and situational self-awareness were measured. We found indications of enhanced autonomic and self-evaluated arousal, attenuated relative left-sided frontal cortical activity (associated with approach–motivation), and more negatively valenced self-evaluated feelings in adolescents with SAD compared to controls when viewing a face making eye contact. The behavioral measures and self-assessments were consistent with the physiological results. The results provide multifaceted evidence that eye contact with another person is an aversive and highly arousing situation for adolescents with SAD.

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## 1. Introduction

Social anxiety is commonly defined as feelings of uneasiness arising when an individual interacts with others and anticipates the possibility of being negatively evaluated. The criteria for a clinical form of social anxiety, social anxiety disorder (SAD), are met when anxiety related to social situations interferes significantly with the person's normal life (American Psychiatric Association, 2013). The lifetime prevalence of SAD is estimated to be 7–13% (Furmark, 2002) and it typically emerges between early and late adolescence, the mean age of onset being between 10 and 16 years (Wittchen & Fehm, 2001). Cognitive-behavioral models of social anxiety suggest that negative self-appraisals in social situations are essential in the development and maintenance of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997). It has been proposed that social anxiety is associated with approach–avoidance conflicts resulting, on one hand, from increased investment in peer relationships in adolescence and, on the other hand, from a fear of humiliation and embarrassment aroused by peer evaluation (Caouette & Guyer, 2014).

Eyes are considered to be the strongest fear-producing cue in situations containing social appraisal (Öhman, 1986). An eye contact is a prominent way to signal preparedness for social interaction. A direct gaze signals that one's attention is directed towards the other person and an averted gaze suggests that one's attention is directed to someplace else. Thus, a direct gaze may be a potential threat for people with social anxiety. A prominent clinical symptom of SAD is avoidance of eye contact as well as other safety behaviors in social situations (Greist, 1994).

Previous research has shown shortened viewing times of the eye region or reduced eye contact in participants with social anxiety in comparison to non-anxious participants (Daly, 1978; Farabee, Holcom, Ramsey, & Cole, 1993; Garner, Mogg, & Bradley, 2006; Moukheiber et al., 2010). However, some studies have not found differences in gazing behavior between participants with and without social anxiety (Hofmann, Gerlach, Wender, & Roth, 1997), and even longer fixation times to the eye region by socially anxious females compared to non-anxious counterparts have been reported (Wieser, Pauli, Alpers, & Mühlberger, 2009). These discrepancies have been partly explained with a hypervigilance-avoidance hypothesis proposing that anxious individuals initially attend to but subsequently avoid threatening stimuli (Wieser, Pauli, Weyers, Alpers, & Mühlberger, 2009). It is also noteworthy, that only two of the studies cited above investigated clinically diagnosed socially anxious participants (Moukheiber et al., 2010; Hofmann et al.,

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1997). Studies reporting physiological responses to eye contact in adults or adolescents with social anxiety are scarce. Wieser, Pauli, Alpers, et al. (2009) found more pronounced cardiac acceleration, an index of autonomic reactivity, in participants scoring high in social anxiety to direct vs. averted gaze, whereas this difference was reversed in the group with medium scores and it was non-existing in low socially anxious group. However, measurements of skin conductance responses, another measure of autonomic arousal shown to be sensitive to gaze direction in several studies (Helminen et al., 2011; Helminen, Kaasinen, & Hietanen, 2011; Hietanen, Leppänen, Peltola, Linna-aho, & Ruuhiala, 2008; Nichols & Champness, 1971; Pönkänen et al., 2011b; Myllyneva & Hietanen, 2015), did not indicate differences in responses to direct versus averted gaze in any of the groups.

Previous research has thus provided some evidence suggesting that seeing another person's direct gaze may be an aversive and arousing stimulus for individuals suffering from social anxiety. In the present study, we aimed at providing further evidence for the aversive and arousing nature of direct gaze for socially anxious individuals and, more specifically, we aimed to investigate whether this is reflected in the psychophysiological measurements of cortical and autonomic nervous system activity. Electroencephalographic (EEG) studies have associated approach–avoidance–motivation to asymmetries in the frontal alpha activity (8–13 Hz). Stronger left-sided vs. right-sided frontal activity has been associated with activations of the approach–motivation system, whereas stronger right-sided vs. left sided activity has been associated with the activation of the avoidance–motivation system (Davidson, 2004; Harmon-Jones, 2003; Van Honk & Schutter, 2006). Now there is experimental evidence showing that, in healthy adults, seeing a face with a direct vs. averted gaze results in more pronounced left-sided, approach-related frontal EEG activity in the perceiver's brain (Hietanen et al., 2008; Pönkänen et al., 2011b). Interestingly, stronger relative left-sided activity to direct vs. closed eyes has been observed also in typically developing children, but not in children with autism spectrum disorder (Kylliäinen et al., 2012). Although there are no previous studies measuring asymmetries in the frontal alpha activity of people suffering from social anxiety in response to perceiving a face with different gaze directions, individuals with social anxiety have been shown to exhibit elevations in right-sided, avoidance-related frontal EEG activity during resting state measurements under social stress (Davidson, Marshall, Tomarken, & Henriques, 2000). However, the findings concerning frontal alpha asymmetry in anxiety disorders are not totally consistent (for a review, see Thibodeau, Jorgensen, & Kim, 2006). One possible reason for these inconsistencies may be that passive resting state measurements are not optimal to capture state or trait relevant EEG-asymmetries and that emotionally and motivationally relevant situations should be employed instead (e.g., Coan, Allen, & McKnight, 2006; Wacker, Chavanon, & Stemmler, 2010).

In earlier studies from our laboratory, we have shown that viewing a face of a real live person, physically present in the experimental situation, elicits differential physiological and self-assessed responses compared to viewing a picture of a face (Hietanen et al., 2008; Pönkänen, Peltola et al., 2011; Pönkänen, Alhoniemi, Leppänen, & Hietanen, 2011). For example, pronounced left-sided, approach-related frontal EEG activity and enhanced skin conductance responses to direct versus averted gaze were observed in response to live faces, but not when the faces of the same persons were shown in a pictorial format. The differences were suggested to be due to mentalizing processes, following from being looked at by another person (Hietanen et al., 2008; Myllyneva & Hietanen, 2015; Pönkänen, Peltola et al., 2011). Being looked at by another individual is likely to elicit feelings of being evaluated. These feelings are, in turn, associated to public self-awareness (Buss, 1980). Our previous studies have shown, indeed, that self-assessed pub-

lic self-awareness is higher when being looked at by a real person versus not being looked at (Hietanen et al., 2008; Pönkänen et al., 2011b; Myllyneva & Hietanen, 2015). Cognitive theories of SAD postulate that heightened public self-awareness plays a central role in social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997) and this is supported by empirical evidence (Hope & Heimberg, 1988; George & Stopa, 2008). Against these previous findings, we reasoned that the use of live social stimuli with a potential for interaction is especially important when investigating participants with social anxiety suffering from fear of negative evaluation and criticism from other people. Several other researchers working in the field of social cognition and social neuroscience have also raised similar concerns regarding the ecological validity of facial stimuli presented in pictorial or video format (Risko, Laidlaw, Freeth, Foulsham, & Kingstone, 2012; Schilbach et al., 2013; Teufel et al., 2012). In the above mentioned studies investigating socially anxious individuals' gazing of the eye region, only three had participants viewing real persons instead of pictures or videos (Daly, 1978; Farabee et al., 1993; Hofmann et al., 1997), and yet the difference between using real persons vs. pictures or videos as stimuli can be considerable on gazing behavior (Laidlaw, Foulsham, Kuhn, & Kingstone, 2011).

In the present study, we investigated autonomic arousal and approach–avoidance related brain activity in response to a face with different gaze directions in adolescents with clinically diagnosed SAD vs. age and sex matched controls. We showed the participants a live face with either direct gaze, averted gaze, or closed eyes through a liquid crystal window, and simultaneously recorded skin conductance responses (SCR) and electroencephalographic (EEG) cortical activity. We hypothesized that all participants would show heightened sympathetic activity and, thus, larger SCRs to direct gaze compared to averted gaze or closed eyes. Because anxiety and fear are related to heightened autonomic activation (Kreibig, 2010), we expected that this pronounced sympathetic activation to direct gaze would be more salient in the SAD group than in the control group. Secondly, we hypothesized that participants in the SAD group would show less relative left-sided frontal cortical activity specifically when observing a face with a direct gaze compared to participants in the control group. In the second part of the experiment, the participants controlled the presentation of the stimuli (a face with a direct or averted gaze) themselves, and in addition to the psychophysiological responses, we measured the viewing time of the facial stimuli. We expected shorter self-controlled viewing times for direct gaze in the SAD group than in the control group. Finally, the participants were also asked to assess their subjective arousal, valence, and situational self-awareness when viewing a face with a direct or averted gaze. We expected that participants in the SAD group would show higher ratings of self-assessed arousal, lower ratings of affective valence (pleasantness), and higher levels of self-assessed public self-awareness for direct gaze compared to participants in the control group.

## 2. Methods

### 2.1. Participants

The participants were seventeen adolescents with SAD (mean age 15.2 years, std 1.52, range 13–17) and seventeen age- and gender-matched controls (mean age 15.3 years, std 1.53, range 13–17). Both groups consisted of 4 males and 13 females. The control group was composed in such a way that each socially anxious participant had a gender-matched counterpart differing less than six months in age. Adolescents with SAD were recruited from the Department of Adolescent Psychiatry, Tampere University Hospi-

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