



# Response bias-related impairment of early subjective face discrimination in social anxiety disorders: An event-related potential study



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## ARTICLE INFO

### Article history:

Received 12 February 2016

Received in revised form 6 December 2016

Accepted 3 February 2017

Available online 5 February 2017

### Keywords:

Memory bias

N170

Response bias

Social anxiety disorder

Social evaluation

Social rejection

Social phobia

Expectancy bias

## ABSTRACT

Considerable research has shown that social anxiety disorder (SAD) is accompanied by various negative cognitive biases, such as social feedback expectancy bias, memory bias, and interpretation bias. However, whether the memory bias in individuals with SAD is actually a manifestation of response bias, and whether such response bias is associated with deficits in face discrimination, remains unclear. In the present study, we investigated response bias (i.e., a tendency to recognize more negative evaluations) to faces with positive (social acceptance) or negative (social rejection) social evaluations in individuals with SAD and healthy controls (HCs) using event-related potentials (ERPs). Behavioral results revealed significant group differences in response bias in the forced-choice recall task, but no difference in overall memory accuracy. ERP results demonstrated that HCs showed a larger N170 to faces that had rejected them as compared to those that had accepted them, but this effect was not evident in the SAD group. Further analysis showed that response bias was correlated with the  $\Delta$ N170 (rejected – accepted) amplitude. We concluded that the response bias in individuals with SAD is resulted from impairments in early discrimination of social faces, as reflected by the absent early N170 differentiation effect, which was associated with their combined negative biases.

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## 1. Introduction

A large body of research has demonstrated negative biases in social anxiety disorder (SAD) (Huppert, Foa, Furr, Filip, & Mathews, 2003; Lapsa, Cassin, & Rector, 2010; Stopa & Clark, 2000; Wilson & Rapee, 2005). According to the cognitive-behavioral model of social anxiety in Rapee and Heimberg (1997), people with social anxiety attend to negative social information to a greater extent than do individuals without social anxiety (Buckner, Maner, & Schmidt, 2010; Mogg & Bradley, 2002; Mogg, Philippot, & Bradley, 2004). For instance, anxious individuals may show memory bias, or preferential memory (i.e., higher memory accuracy), for negative social information (Coles & Heimberg, 2002). However, previous studies on the association between social anxiety and memory bias for negative information have shown inconsistent results

(Amir, Bower, Briks, & Freshman, 2003; Amir, Foa, & Coles, 2000; Cloitre, Cancienne, Heimberg, Holt, & Liebowitz, 1995; Foa, Gilboa-Schechtman, Amir, & Freshman, 2000; Perez-Lopez & Woody, 2001; Rapee, McCallum, Melville, Ravenscroft, & Rodney, 1994). For example, a study using a face recognition task with critical and accepting faces found that individuals with SAD recognized more critical faces than accepting faces, whereas controls showed the reverse pattern (Lundh & Ost, 1996). However, Coles and Heimberg (2005) demonstrated that the difference between individuals with SAD and control participants may reflect response bias (i.e., a person is more likely to respond as having been rejected), but not memory bias. In memory tasks and real-life situations, people make responses not only based on objective knowledge, but also partly based on intuition or guessing. Response bias reflects whether people's decision criteria are prone to being "liberal" or "conservative," and it is independent of memory accuracy (Snodgrass & Corwin, 1988).

According to the combined cognitive biases hypothesis (Hirsch, Clark, & Mathews, 2006), various negative cognitive biases may interactive with each other. Tasks with social acceptance versus

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rejection feedback provide an opportunity to investigate the potential interaction between different cognitive biases in social anxiety (Cabeleira et al., 2014; Cao, Gu, Bi, Zhu, & Wu, 2015). For example, Caouette et al. (2015) examined the relationship between expectancy biases and memory bias for social feedback in social anxiety, and found that participants with higher levels of social anxiety had more negative expectations about social evaluation, and this expectancy bias fully mediated the relationship between social anxiety and memory bias (Caouette et al., 2015). However, the memory bias in Caouette et al.'s (2015) study was actually response bias – that is, in the recall stage, the highly socially anxious individuals were more likely to recognize other people's faces as the ones who had rejected them.

The event-related potential (ERP) technique has been used to investigate the time course of memory bias and response bias (Wiese, Schweinberger, & Hansen, 2008; Windmann & Kutas, 2001; Wolff, Kemter, Schweinberger, & Wiese, 2014; Zhang, Kong, Hasan, Jackson, & Chen, 2015). One ERP study investigated response bias-related ERP effects by comparing a high- and a low-bias group (Windmann, Urbach, & Kutas, 2002). There was no group difference in memory accuracy or in the ERPs to items that were actually old versus new, but there was an amplitude difference in the ERPs over prefrontal sites around 300–500 ms post-stimulus based on their subjective judgment of whether an item was new or not. The N170, which is an ERP component that reflects face or expression coding (Bruce & Young, 1986; Luo, Feng, He, Wang, & Luo, 2010), has been frequently investigated in face recognition and memory tasks (Campanella, Quinet, Bruyer, Crommelinck, & Guerit, 2002; Itier & Taylor, 2002, 2004; Wiese, 2012). For example, a face memory study with own-/other-race and own-/other-age faces as materials showed a significant response type effect on N170 amplitude, with more negative N170 amplitudes for hits (responding “old”) as compared to correct rejections (responding “new”; Wiese, 2012). Therefore, the N170 could be regarded as a potential response bias-related component, and we expected it to reflect early judgments of “he/she doesn't like me” and “he/she likes me” as an index of the discriminative mechanism in a face (evaluator) memory task.

Rapidly recognizing faces and determining whether one is being positively or negatively evaluated is critical in social interactions, but whether individuals with SAD can differentiate between faces that are positively or negatively evaluative remains unclear. Early face discrimination impairment, as reflected by the N170 component, has been reported in clinical patients, including those with schizophrenia (Ibanez et al., 2012; Maher, Mashhoon, Ekstrom, Lukas, & Chen, 2016) and bipolar disorder (Degabriele, Lagopoulos, & Malhi, 2011). In a categorization task of faces with positive and negative valence, control subjects showed an N170 valence effect, but the discrimination effect was reduced in schizophrenia patients (Ibanez et al., 2012). A previous study also demonstrated a selective impairment of fear identification in generalized social phobia (Garner, Baldwin, Bradley, & Mogg, 2009). More importantly, a recent study indicated that visuocortical steady-state visual evoked potentials (SSVEP) in individuals with high social anxiety cannot discriminate between social conditioning faces with negative or positive valence, whereas individuals with low social anxiety showed a discrimination effect (Ahrens, Mühlberger, Pauli, & Wieser, 2015). Accordingly, we expected to find an impairment among individuals with SAD when they differentiate between positively and negatively evaluative faces, which should be reflected as a reduced N170 effect.

Therefore, the first aim of present study was to examine whether individuals with SAD exhibit a response bias in social evaluation, and whether such bias is related to deficits in early face discrimination. We hypothesized that compared to healthy controls (HCs), individuals with SAD would show less positive expectation regarding social evaluation, with a response bias of being more likely to

**Table 1**  
Characteristics and Self-Report Measures of Participant Groups.

|                    | SAD group<br>(n = 21) | Healthy controls<br>(n = 23) | t-test<br>(df = 42) |
|--------------------|-----------------------|------------------------------|---------------------|
| Age in years (SD)  | 19.67 (1.02)          | 20.56 (0.99)                 | 0.311               |
| Gender (% females) | 65.2%                 | 66.7%                        |                     |
| IAS (SD)           | 51.14 (11.63)         | 30.61 (6.10)                 | 7.425***            |
| STAI               |                       |                              |                     |
| Trait anxiety (SD) | 49.95 (14.01)         | 33.70 (7.27)                 | 4.893***            |
| State anxiety (SD) | 47.81 (14.78)         | 30.61 (7.17)                 | 4.98***             |
| SES (SD)           | 23.86 (5.89)          | 32.78 (2.78)                 | 6.528***            |

Note. SAD = social anxiety disorder; IAS = Interaction Anxiousness Scale; SES = Self-Esteem Scale; STAI = Chinese version of Spielberger's Trait-Trait Anxiety Inventory.  
\*\*\*  $p < 0.001$ .

judge people as having rejected them as compared to HCs. Second, we expected to observe an abnormal early N170 differentiation effect (responding “rejected me” vs. responding “accepted me”) in SAD. Following the rationale of Windmann et al. (2002), which concerns the subjective vs. objective old/new ERP effect, we were particularly interested in ERP differences between the two groups for items considered as “rejected me” as opposed to “accepted me.” We believe this comparison would provide insight into the neural processes underlying the response criteria of social information for social anxiety.

## 2. Methods

### 2.1. Participants

Participants were 23 (15 female) right-handed adults who met the DSM-IV criteria for current SAD and 23 (15 female) demographically matched HCs. Both groups were with no history of any DSM-IV psychiatric disorders according to the diagnoses guided by the Chinese translation of the Structured Clinical Interview for DSM-IV (SCID-IV; Ruying, Yuanhui, & Bin, 1997). Participants were recruited from a public mental health clinic at Harbin Medical University (DaQing Campus). All participants provided written informed consent in accordance with the Harbin Medical University Review Board guidelines. The interviewers were two clinical psychology psychiatrists who received training for the administration of the SCID-IV. Inclusion criteria for the SAD group included (a) a primary diagnosis of SAD according to DSM-IV criteria, (b) age between 18 and 25, and (c) right handed. Exclusion criteria included (a) past or current diagnosis of schizophrenia and (b) history of neurological disorders. The detailed screening procedure and the diagnoses were the same as our previous work (Cao et al., 2015). Subjects' anxiety symptoms were assessed using the State-Trait Anxiety Inventory (STAI, Spielberger, 1983), and Interaction Anxiousness Scale (IAS, Leary & Kowalski, 1993). Demographic data and the self-reported measures of the final 44 participants in the two groups are presented in Table 1.

### 2.2. Procedure

#### 2.2.1. The preparation stage and cover story

Two to four days before the formal experimental procedure, we told participants that they would receive a social evaluation from 120 peer participants (half females). To prepare for the social evaluation, participants were asked to send their profiles including photos, major, interests, and so forth. The cover story was similar to the “Island Getaway task” (Kujawa, Arfer, Klein, & Proudfit, 2014) in that people need to vote to let someone stay (social acceptance) or leave (social rejection). Before the formal procedure, all participants were asked to look at 10 faked participant profiles and vote to accept or reject the person. Furthermore, they provided their

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