The Temporal Dynamics of Facial Processing in Social Anxiety: Evidence from a Flankers Task

Jason S. Moser, Greg Hajcak & Robert F. Simons

Department of Psychology, University of Delaware

Abstract

Reaction time data suggest that socially anxious individuals preferentially allocate attention to negative faces. Given their excellent temporal resolution, event-related potentials (ERPs) may be an ideal tool to use in studying the time course of facilitated attention and perceptual processing of facial affect in this group. In the present study, we collected behavioral measures and stimulus- and response-related brain activity while socially anxious and control participants performed a face flankers task. Participants were presented with sets of three faces oriented horizontally in the center of a computer screen and were instructed to identify the emotion of the center face. Faces depicted either supportive or critical expressions. No group differences on behavioral measures. ERP results indicated that socially anxious individuals allocated more attentional resources on trials in which critical faces were the target as reflected in P300 magnitude. Socially anxious individuals also evidenced slower perceptual categorization of the face flanker stimuli as indexed by P300 latency. Last, response locked brain activity, as indexed by the magnitude of the correct-response negativity, suggested a lack of positive bias in socially anxious individuals. The results of the present study suggest that ERPs are a useful tool in elucidating the temporal dynamics of different information processing biases present in social phobia.

Introduction

-It has been proposed that anxious individuals are characterized by early attention to threatening cues (i.e., attentional bias) followed by an avoidance of the same information later in processing (Mogg & Bradley, 1998; Williams et al., 1997).

-Mogg et al. (2004) showed that socially phobic patients are characterized by an early, but not a late, negative attentional bias and suggested that this early attention to social threat is followed by an unstable pattern of attention to and avoidance of social information.

-Other studies examining relatively more controlled processes (i.e., interpretive biases) have shown a lack of positive bias in social phobia (Hirsch & Mathews, 2000).

-Despite the encouraging behavioral evidence described above, ERPs have yet to be used to study cognitive biases in social phobia.

-The P300 has been found to be significantly enhanced to fear-relevant information in PTSD patients (Attias et al., 1996) and panic patients (Pauli et al., 1997).

-The CRN is a fronto-centrally maximal response-locked ERP reflecting response monitoring ACC activity involved in signaling other frontal brain structures that increased cognitive control was needed (Barthalow et al., 2005). .

-Because the P300 reflects early attentional bias in anxious participants and the CRN indexes response related control processes that could capture later processing biases, we predicted that the P300 would be enhanced to critical faces in socially anxious subjects while the CRN would reflect a lack of positive bias in socially anxious subjects.

Methods

-21 high socially anxious and 21 low socially anxious students from introductory psychology courses were selected from the top and bottom of the Social Phobia Inventory (SPIN; Connor et al., 2000) distribution, respectively.

-30 pictures of models depicting critical and supportive facial expressions were taken from Perez-Lopez & Woody (2001) and edited to create supportive and critical congruent and incongruent face flanker stimuli (See Figure 1).

-Participants responded quickly and accurately to the emotion depicted by the center face, while ignoring the two flanking faces.

-Face flanker stimuli presented for 500 ms at random intervals between 1800 and 2400 ms; 576 total trials.

-EEG recorded from Fz, FCz, Cz, Pz, M1, and M2 using an ECI electrocap and tin disk electrodes, using a .1-100 Hz filter

-EEG recorded at 200 samples per second, using VPM software (Cook, 1998); EOG artifacts corrected by method developed by Gratton et al. (1983); Single-trial EEG was lowpass filtered at 20 Hz

-Only correct trials were analyzed for the current study.

-P300 was defined at the maximal site (Pz) as peak activity in a 300-700ms window post-stimulus (using a 75 ms pre-stimulus average as baseline)

-CRN was defined at the maximal site (FCz) as difference between most negative peak in 0 and 100 ms post response window and most positive peak starting at negative peak working back to 50 ms pre – stimulus (using the average activity in the 150 ms to 50 ms pre-response window as baseline)

-ERPs statistically evaluated using SPSS (Version 12.0) General Linear Model software with Greenhouse-Geisser corrected p-values

Figure 1. Examples of critical congruent and incongruent face flanker stimuli.

	Socially Anxious	Controls
Percent Correct (overall)	89.91 (5.74)	92.19 (5.34)
Critical Congruent RT	551.69 (73.74)	568.26 (102.65)
Critical Incongruent RT	554.44 (73.25)	574.02 (102.50)
Supportive Congruent RT	534.92 (81.98)	541.65 (94.62)
Supportive Incongruent RT	542.64 (79.38)	547.18 (88.71)
Critical Face P300 latency	582.75 (64.20)	553.95 (70.85)
Supportive Face P300 latency	553.70 (67.80)	503.35 (57.95)

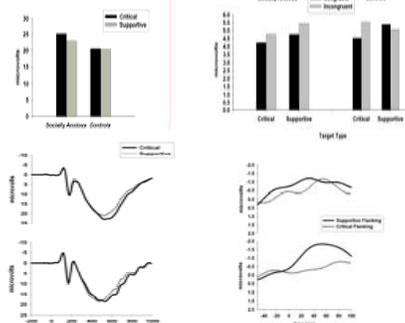Table 1. Descriptive statistics for behavioral measures and P300 latency

Results

Figure 2. (Top Panel) P300 magnitudes for critical and supportive face trials

(Bottom Panel) Stimulus –locked ERPs for critical and supportive face trials at Pz for socially anxious (top) and controls (bottom).

Figure 3. (Top Panel) CRN magnitudes for congruent and incongruent critical and supportive face trials

(Bottom Panel) Response –locked ERPs displaying flanker interference effect on critical and supportive flanking face trials at FCz for socially anxious (top) and controls (bottom).

-No group differences on any behavioral measure.

-P300 was enhanced for critical face trials in both groups ($F(1,40)=7.35$, $p<.01$).

-P300 demonstrated interaction between valence and group ($F(1,40)=6.29$, $p<.05$).

-Socially anxious students evidenced larger P300s to critical faces than supportive faces ($t(20)=4.05$, $p<.001$).

-Control participants showed no difference in P300s to critical and supportive faces ($t(20)<1$).

-P300 latency demonstrated overall group effect ($F(1,40)=4.67$, $p<.05$) such that socially anxious participants were slower to categorize facial stimuli.

-CRN enhanced for incongruent stimuli ($F(1,40)=5.84$, $p<.05$)

-CRN demonstrated interaction between valence, congruency, and group ($F(1,40)=4.69$, $p<.05$).

-Socially anxious students did not evidence a significant valence X congruency effect ($F(1,20)<1$).

-Controls evidenced a significant valence X congruency effect ($F(1,20)=4.78$, $p<.05$) such that CRN flanker interference effect was larger for supportive flanking faces.

Discussion

-In the absence of reliable RT differences, we found enhanced P300s to critical facial expressions in the socially anxious group that suggests the P300 might be a more sensitive measure of cognitive bias in social phobia.

-The enhanced P300 to critical facial expressions in the socially anxious group is consistent with current theory (Williams et al., 1997) and RT data (Mogg et al., 2004) suggesting a relatively early negative attentional bias during stimulus processing in social anxiety.

-We also found that socially anxious individuals were characterized by longer P300 latencies to both critical and supportive facial stimuli, suggesting that socially anxious individuals take longer to successfully categorize facial affect.

-The CRN flanker interference effect was enhanced for supportive flanking faces in the control group, suggesting that socially anxious subjects lacked a positive bias at response monitoring stages of information processing.

-Although there is no evidence for a 'lack of positive attentional bias', per se, in social phobia, other methodologies such as self-report (Brown et al., 1998) and 'interpretation bias' RT studies (Hirsch & Mathews, 2000) have suggested that socially anxious individuals lack a positive bias.

-Overall, the findings of the current study suggest that social phobia is characterized by multiple abnormalities in the processing of facial affect that unfold over time, and that future research should consider the utility of ERPs in teasing apart abnormalities in stimulus- and response – related information processing.

Selected References

-Attias et al. (1996). Event-related potentials in post-traumatic stress disorder of combat origin. *Biological Psychiatry, 40*, 373–381.
-Barthalow et al. (2005). Strategic control and medial front negativity: Beyond errors and response conflict. *Psychophysiology, 42*, 33-42.
-Connor et al. (2000). Psychometric properties of the Social Phobia Inventory (SPIN): New self-rating scale. *British Journal of Psychiatry,176*, 379-386.
-Cook, E.W., III (1998). *VPM reference manual.* Birmingham, Alabama: Author.
-Hirsch & Mathews (2000). Impaired positive inferential bias in social phobia. *Journal of Abnormal Psychology, 109*, 705–712.
-Mogg et al. (2004). Selective attention to angry faces in clinical social phobia. *Journal of Abnormal Psychology, 113*, 160-165.
-Williams et al. (1997). *Cognitive psychology and emotional disorders* (2nd ed.). Chichester, England: Wiley.