INTRODUCTION

Anticipatory anxiety has been implicated as a major component and contributor to anxiety disorders in general (Barlow, 2002). Previous research has found that in anticipation of a threatening stimulus, various areas of the brain—amygdala, insula, and anterior cingulate cortex (ACC)—are activated in the amygdala and insula, and the prefrontal cortex (Damasio, 1994). Among emotional responses, autonomic markers like skin conductance response (SCR) are used to assess anxiety disorders. However, little research has been done investigating the relationships between brain areas and skin conductance response (SCR) elicited by emotional stimuli. The current research explores the link between brain areas activated in snake phobia and SCR in the anticipation of, and response to, aversive stimuli in both specific phobic and non-phobic controls.

Hypotheses

1) There will be group differences in key brain areas distinguishing snake phobics from non-phobics in the amygdala, the ACC, and during anticipation and response to aversive stimuli.
2) There will be group differences in SCR distinguishing snake phobics from non-phobics in controls, with phobics showing greater SCR to snake stimuli and non-phobics to disgust.
3) There will be correlations between brain activation and SCRs to aversion in both phobics and non-phobics.

METHODS

Participants

The 21 snake phobic participants (17 females, mean age 22.8 years, range 18-36) and 18 non-phobic participants (17 females, mean age 28.6 years, range 19-58) were right-handed and neurologically healthy. Participants were absent of all clinical disorders as assessed by the Structured Clinical Interview for the DSM-IV. Informed consent in accordance with those set by the University of Wisconsin at Madison Human Studies Committee was obtained from all participants prior to the experiment.

Stimuli

The video set consisted of a snake, a fish, and a snake video (24 each). Each video was standardized for several psychological attributes (e.g., arousal, valence, disgust, fear) during pilot rating sessions prior to the study. Physical attributes (e.g., scene complexity, movement, and duration) were standardized. Videos were equally rated as aversive and neutral. Visual images were presented to participants in the scanner using the Presentation software.

Procedure

Experimental Paradigm: Participants completed several anxiety and skin conductance questionnaires, followed by a mock scanner session during which the paradigm for the experimental task. Each trial began with an anticipation period signaled by a 5 sec red square. A 2.5 sec presentation of a stimulus video, a 1 sec fixation, followed by a trial. The intertrial interval was 5 sec.

Data Analysis

fMRI analysis procedures (artifact removal, head movement compensation and atlas transformation). The data were analyzed using a head-motion correction general linear model (GLM) fit to the gamma variate hemodynamic response function (HRF) (see Figure 2, 3, 4, and 5) for the analysis of the results. The data were then performed: Cluster extinctions were performed for each condition. The data for this controllability manipulation is presented to participants in the scanner using the Aventec Scanner (TR=2 sec).

RESULTS

Behavioral SCR

A group by stimulus ANOVA revealed main effects for period (F=22.81, p<0.001), and group by stimulus interaction (F=6.24, p<0.01). To further explore these effects we conducted group X stimulus ANOVAs separately for each period. For the anticipation period, a group by stimulus ANOVA was conducted to explore the group difference in SCR magnitude. A main effect of stimulus (F=7.97, p=0.006) and a group by stimulus interaction (F=3.68, p<0.036). Both the non-phobics and phobics showed greater SCR magnitude for snake videos anticipating neutral fish videos (p<0.001 and p<0.03, respectively; Fisher's LSD). For non-phobics, there were no significant differences in magnitude of anticipatory SCR for any of the stimuli.

Video Period: ANOVA revealed a main effect for stimulus (F=3.34, p<0.007), in the neutral stimulus (F=4.18, p<0.026). Phobic SCR magnitude was greater for both snake and disgust cues as compared to neutral fish cues (p<0.001 and p<0.015, respectively; Fisher's LSD). For non-phobics, there were no significant differences in magnitude of anticipatory SCR for any of the stimuli.

Video Period: ANOVA revealed a main effect for stimulus (F=4.18, p<0.026) and a group by stimulus interaction (F=1.1, p<0.01). To further explore these effects we conducted group X stimulus ANOVAs separately for each period. For the anticipation period, a group by stimulus ANOVA was conducted to explore the group difference in SCR magnitude. A main effect of stimulus (F=3.28, p=0.005) and a group by stimulus interaction (F=1.1, p<0.01). In the snake condition, phobics showed significantly greater activation when viewing the snake videos as compared to the non-phobics, with phobics showing greater ACC activation to snake videos as compared to both neutral and aversive disgust videos. All differences are significant at p<0.01.

Figure 4. ACC Activation Group Differences

In the snake condition, phobics showed significantly greater activation when viewing the snake videos as compared to the non-phobics, with phobics showing greater ACC activation to snake videos as compared to both neutral and aversive disgust videos. All differences are significant at p<0.01.

Figure 5. Insula Activation Group Differences

In the snake condition, phobics showed significantly greater activation to snake videos as compared to fish videos, and greater right insula activity in response to viewing disgust videos. However, phobics did show greater bilateral insula activation to disgust videos as compared to fish videos. Non-phobics showed greater activation to snake and fish videos as compared to disgust videos in the left insula only. All differences are significant at p<0.01.

Figure 6. SCR Predicts Greater Right Insula Activation During Anticipation of Disgust vs. Fish Videos

In the snake condition, SCR increases during anticipation of disgust (as compared to neutral stimuli) correlated positively with increases in right insula activity to disgust (photos r=5.4, non-phobics r=0.46).

Figure 7. SCR Predicts Greater Left Insula Activation During Viewing of Disgust vs. Fish Videos

In the snake condition, during viewing of the disgust videos, correlated positively with brain activation to the left insula (r=5.6). However, there was no significant association found for viewing of the disgust videos in the left insula for the non-phobics (r=ns).

DISCUSSION

1) Group differences in brain activation during anticipation and response to aversive stimuli were observed in the snake and ACC, but not amygdala. (Amygdala findings fell below our significance threshold p<0.005).

2) Group differences in SCR magnitude were also observed, with phobics showing greater SCRs to both snake and disgust stimuli, and non-phobics to disgust.

3) Significant correlations between brain activity and SCR were seen for disgust, but not a snake, stimulus in bilateral insula regions for both groups.

REFERENCES