I INTRODUCTION

Disgust is classified as one of the six basic emotions by Darwin (1872). Disgust-inducing pictures have been shown to elicit activity in several brain regions, including the anterior cingulate cortex (ACC), orbitofrontal cortex (OFC), insula, and amygdala. What is not entirely clear is whether the same structures also activate during the anticipation of disgust, and whether controllability over exposure to disgust stimuli may modulate such activation.

The present event-related functional magnetic resonance imaging (fMRI) study enlisted healthy volunteers to identify the areas normally recruited in the anticipation of and response to disgust-inducing videos of actual disgusting scenes (e.g., vomiting, fecal matter). Previous research on disgust-inducing videos has been restricted to facial expressions of disgust (Wicker et al. 2003). We hypothesized that parts of the network of brain regions previously shown to be involved in viewing disgust-inducing pictures would also be involved in anticipation of disgust videos, in the same manner that anticipation of exposure to aversive pictures has been shown to activate the same network (Nitschke et al. 2006). We also predicted that parts of the same set of regions would show increased activation when presentation of the anticipated disgust video was uncontrolable. Uncontrollability was manipulated by giving subjects control over half of the trials to avoid viewing the videos.

METHODS

Participants

The 16 participants (6 females, mean age 25.06, range 19-48) were right-handed and neurologically healthy. Participants were absent of all clinical disorders as assessed by the Structured Clinical Interview for DSM-IV (First et al. 1996). Informed consent in accordance with rules set by the University of Wisconsin at Madison Human Studies Committee was obtained from all participants prior to the experiment.

Stimuli

The stimuli consisted of 3-5 disgust, fish, and snake videos (24 each). Each video was standardized for several psychological attributes (e.g., arousal, valence, disgust, fear) during pilot ratings prior to the study. Physical attributes such as brightness, contrast, scene complexity and movement of the stimuli were equalized. Videos were presented to participants in the scanner using Avotec goggles mounted on the head coil of a 3.0 Testa GE Sigma Scanner (TR=2 s).

Procedure

Experimental Paradigm

Participants were administered several anxiety and phobia questionnaires, followed by pilot trials during which they practiced the experimental task. Each trial began with an anticipation period signaled by a cue. A D preceded disgust videos, an F preceded fish videos, and a S preceded snake videos. Subjects were instructed at the onset of the study that they would be receiving these videos. Uncontrollability was indicated by the color of the anticipation cue. A blue cue indicated a controllable trial, and a yellow cue indicated an uncontrollable trial. When a subject had a controllable trial, presentation of the stimulus (RT) was fast enough to a red target square that followed the cue after a variable delay, they received a fixation cross rather than the video, and they received the video. A success rate of approximately 50% was achieved with online monitoring of RT by DMOS software. Similarly, half of the uncontrollable trials were followed by a video. Of the 72 total video trials, half were cued as uncontrollable and the other half controllable. Each trial ended with one Likert online rating about the nature of the stimulus valence, arousal, disgust, and fear -counterbalanced across condition.

RESULTS

Anticipation

Anticipation of disgust videos activated the dorsal ACC, left ACC, right anterior and bilateral mid insula more than anticipation of fish and snake videos (Figure 2, 3, 4).

Figure 2. Disgust Anticipation > Snake Anticipation ROI that distinguish activity to anticipation of a disgust cue as compared to snake in the left ACC in addition to the anterior and mid right insula. All differences are significant at p<0.005 (see Figure 8 for complementary video response data).

Figure 3. Disgust Anticipation > Fish Anticipation ROI that distinguish activity to anticipation of a disgust cue as compared to fish in the supragenual ACC, right anterior insula, and bilateral mid insula. All differences are significant at p<0.005.

DISCUSSION

1. Consistent with predictions, increased ACC activation was observed during the anticipation of disgust than fish videos (see Figure 2). Contrary to predictions, we did not observe greater insula activation in anticipation of disgust than fish videos. However, there was greater anterior and mid insula activation in anticipation of disgust than snake videos (Figure 2), as well as in response to disgust compared to fish videos (Figure 4) and snake videos (Figure 5), as previously reported (Kerr et al. 2006 5FN). Thus, anticipation of an aversive disgust video results in brain activity increases in areas activated by anticipation of an aversive video found in Nitschke et al. (2006). ACC and anterior/mid insula activations highlight the importance of these areas in the integration of affective and autonomic processes (Ochsner et al. 2004, Nitschke et al. 2006) as opposed to somatosensory processes more localized to posterior insula.

2. Consistent with predictions, activity in the left OFC during the anticipation of disgust videos was higher in uncontrollable than in controllable trials. Controllable tasks require motor responses ( insufficient response avoids video presentation) may attenuate anticipation-related activity in this area. Recent neuromaging research on cognitive reappraisal, another type of controllability, may also be relevant. Effective in decreasing negative emotions, cognitive reappraisal activates several prefrontal cortex (PFC) regions including the OFC, which in turn regulate the amygdala (Ochsner & Gross 2005). This type of reappraisal control may have been employed in our uncontrollable condition. Specifically, when participants were not given an option of avoiding the video by motor response (i.e., uncontrollable condition), they may have engaged in this reappraisal type of control. This would explain the increased activity in the OFC and the attenuation of activity in other areas (e.g., amygdala) expected to show activation.

REFERENCES


