Neural Circuitry of the Anticipation of and Reactivity to Aversive and Ambiguous Stimuli

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ABSTRACT
Aversive anticipation is an important adaptive mechanism allowing humans to detect and subsequently prepare behaviorally, physiologically, and psychologically for potentially threatening or dangerous situations. A plethora of neuroimaging studies have investigated the structures comprising the neural circuitry involved in anticipating aversive stimuli, but few have investigated the circuitry involved in anticipating aversive stimuli. This study employed event-related functional magnetic resonance imaging (fMRI) while 36 healthy participants viewed pictures presented by one of three warning symbols: an "X" predicted an aversive picture, a question mark predicted either an aversive or a neutral picture, and a circle predicted a neutral picture. Whole-brain gradient echo, echo-planar imaging (EPI) was used, and blood oxygen level dependent (BOLD) data were collected sagittally (3.0 mm slices) on a 3-Tesla magnet. General linear modeling procedures were utilized to deconvolve the MRI signal response to the warning stimuli into the response to the anticipated aversive and neutral stimuli. Greater activation for anticipation of aversive than neutral pictures was seen in the amygdala, medial ACC, dorsal ACC, several prefrontal sectors, inferior frontal gyrus, paracingulate, hippocampus, and cerebellum compared to prominent and parietal regions, thalamus, and visual cortex. Activation to the aversive reactivity consistently fell between that of aversive anticipation and neutral anticipation for these key areas. Although there are discernible differences, there is considerable overlap in the circuitry engaged in both the anticipation of and reactivity to aversive stimuli, which are associated with threat detection, neutral affective impact, visual processing, and motor programming. Consistent with previous research on pain, it is possible anticipation of an aversive event activates the neural circuitry involved in reacting to aversive stimuli.

INTRODUCTION
Aversive anticipation is an adaptive mechanism that aids us in the recognition of potentially threatening or aversive events and signals both physical and psychological changes that prepare us to deal with the impending threat. Aversive anticipation is adaptive in normal people; it becomes excessive and injurious in people with mood disorders, particularly anxiety disorders. A large body of neuroimaging research has identified key neural systems recruited when needing to anticipate aversive stimuli, which include, but are not limited to, the ACC, right dorsolateral PFC, medial PFC, ventrolateral PFC, insula, and amygdala. These key regions have been implicated in responsive (contextual) conflict related to unpleasant affect and threat processing: emotion regulation, response inhibition, autonomic function, and detection of motivationally salient events. Many of the psychological processes implicated in the anticipation of aversive stimuli are also present during the anticipation of aversive stimuli. Processes include threat perception and detection, selection of unpleasant affect, affective regulation, autonomic changes, behavioral withdrawal from the aversively motivated context, and an activation of key brain networks involved in threat detection and processing. One previous study in our lab (Foster & MO 225) demonstrated that although there is considerable overlap in the circuitry underlying the anticipation of and reactivity to aversive stimuli, the neural processes involved in anticipating aversive stimuli also differ between that of aversive anticipation and neutral anticipation for these key areas. These processes include threat perception and detection, elicitation of unpleasant affect, affective regulation, autonomic changes, behavioral withdrawal from the aversively motivated context, and an activation of key brain networks involved in threat detection and processing.