The Role of Prefrontal Cortex and Amygdala Dynamics in Emotion Regulation

Brianna Schuyler

Under the supervision of Andrew Alexander

At the University of Wisconsin-Madison

2012

The ability to regulate one's emotions in response to an emotional challenge is vital for maintaining well-being, and deficits in this ability are often associated with various forms of psychopathology. An understanding of the brain mechanisms involved in the regulation of emotion is critical for the formulation of treatments for affective disorders characterized by this dysregulation, and the cultivation of mental states and traits associated with optimized regulation. In this work, we have employed a number of analytic tools to examine properties of a cortico-subcortical circuit that is well-known to be involved in the regulation emotion. We investigated the ways in which dynamics within and between the prefrontal cortex and the amygdala contribute to various aspects of regulatory ability, namely arousal to negative stimuli, state and trait measures of affect, and behavioral responses to social stimuli.

In the first study, we tested the reliability of Dynamic Causal Modeling, a method to infer the causal relationship between regions using functional magnetic resonance imaging (fMRI) data. Upon confirmation of reliability of the method, we employed it in the second study to investigate the properties of the emotion regulatory network involving ventrolateral prefrontal cortex (vlPFC) and the amygdala. In accordance with a number of studies in animals, we found that the connection from vlPFC to amygdala was inhibitory. Further, the inhibition showed trend-level correlations with self-reported arousal to negative stimuli, along with trait affective measures related to regulatory ability.

In the third study, we focused on the temporal dynamics of amygdalar response to negative stimuli. We divided the amygdala response to negative images into an initial reactivity period and a recovery period. We found that initial reactivity in the amygdala did not predict trait affect measures. However, slower amygdala recovery predicted greater trait neuroticism--which has been associated with deficits in the ability to regulate emotion--and less likability of novel social stimuli.

Overall, the results presented in this dissertation highlight the importance of connectivity between brain regions in the ability to regulate emotion, and the importance of considering the temporal dynamics of brain activity to understanding the neural substrates of affective style.