Abstract

This thesis investigates the neurophysiological and neuronal mechanisms underlying the processing of different types of stress stimuli, focusing on the brain and body's differential responses to highly affective negative stimuli, processed more automatically versus context-dependent negative stimuli, likely requiring greater cognitive control. Using a multimodal approach that integrates fMRI, heart rate (HR), and respiratory patterns, this study explores the complex interplay between emotional and cognitive processes in response to negative, stress-inducing stimuli. The stimuli were naturalistic visual-text media content, representing daily stressors contributing to chronic ecological stress.

Stress research has evolved from Cannon's foundational "fight or flight" response and Selye's General Adaptation Syndrome to modern perspectives emphasising psychological factors and cognitive appraisal in stress processing. Contemporary studies highlight the importance of brain regions such as the amygdala, prefrontal cortex, anterior cingulate cortex, and insula in emotion regulation, threat detection, and interoceptive awareness, linking psychological factors closely with neurobiological mechanisms in stress responses.

Unexpectedly, the study's neuroimaging results showed significant activation in the posterior cingulate cortex, angular gyrus, fusiform gyrus, and visual association cortices rather than the anticipated amygdala and prefrontal cortex. These results suggest that participants processed the stressors more cognitively than emotionally, underscoring the critical roles of cognitive appraisal and visual processing in stress perception. Physiological measures did not differ significantly across stimulus types, prompting questions about the roles of individual differences, emotion regulation strategies, and the ecological validity of laboratory-based stressors.

These findings challenge traditional views prioritising the amygdala and prefrontal cortex in stress responses. They highlight the importance of cognitive evaluation, sensory processing, and individual differences in stress research. The implications of this work extend to developing a more comprehensive model of the stress process, which could lead to the development of personalized stress management strategies and psychological interventions in the future. The study's limitations, including the controlled laboratory setting and uniform physiological responses, suggest that future research should focus on more ecologically valid methodologies and a deeper exploration of the interactions between brain regions and physiological systems during stress.

Keywords: stress, ecological validity, heart rate, respiratory rate, fMRI, cognitive control, posterior cingulate cortex, visual association cortex