Correlations between Emotion Regulation, Learning Performance, and Cortical Activity

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Introduction

While much has been made about the various concepts of emotional regulation in recent psychological literature, little published literature explores the possible relationships between emotional regulation and adult learning performance. Furthermore, there is no literature detailing research that quantitatively investigates the potential correlation between patterns of neural activity and varying degrees of individual emotion regulation.

This current study applies advanced pattern recognition and biomedical signal processing methods to explore the changes in cortical activity during the two types of visual learning task: a spatial reconstruction task as well as a verbal pseudo-vocabulary task. There are several different potential task-neuroactivation associations we are investigating.

Methodology

After reading and signing the informed consent form, 19 participants were presented with three questionnaires. The first is a general survey of personal demographics. The second questionnaire administered is the 20-item PANAS (Watson, D., Clark, L., & Tellegen, A 1988). The third questionnaire is the 36-item CERQ Adult (Garnefski, N., Kraaij, V., & Spinhoven, P. 2001).

After completion of the measures, the eight EEG surface electrodes were affixed to the participant's scalp, using the international 10-20 system in positions which correspond with sites FP1, FP2, F3, F4, C3, C4, CZ, and FZ. Data were taken continuously throughout the completion of the following learning tasks, which are counterbalanced to control for possible order effects.

The visual pseudo-vocabulary task asked the participant to learn new, "nonsense" labels for common objects such as "chair" and "ball." After training, the participant is asked to label the photos with the pseudo-vocabulary words. The outcome is the raw count of photos correctly labeled.

The other learning task asked the participant to reconstruct pictured structures with Wedgit manipulatives. Three different structures were attempted. The outcome is the total time of completion for each structure.

Preliminary Analysis and Results

We extracted signal features using the Wavelet and Fourier transforms. These features include the cumulative spectral power in ά, β, δ, θ, and γ frequency ranges, and means, median, and variance of wavelet coefficients in high and low levels of decomposed EEG signals using db3 mother wavelets to the fourth level (Najarian & Splinter, 2005). The test of statistical significance of the features was performed using ANOVA to determine the statistical significance of each of the extracted feature across post-study analysis groups. Early results demonstrate a significant difference in ά across high-low emotion regulation groups in the spatial task. Also, for both tasks, γ power increased with the level of task difficulty.

Preliminary analysis has not demonstrated a correlation between verbal task performance and the PANAS, and mixed, weak correlations between CERQ scores. There is a weak to moderate negative correlation between spatial learning and positive CERQ subscales (e.g. Acceptance $r = -.53$, $p < .05$). Correlational results between spatial performance and negative CERQ subscales were more mixed (e.g. Self-blame $r = -.28$, $p = .26$, Catastrophizing $r = .15$, $p = .55$).

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