Motivational intensity in the prefrontal cortex

ABSTRACT:

Background/Aim
The aim of this work was to investigate the motivational intensity model (MIM) using measures of brain activation. The MIM has been extensively explored using cardiovascular psychophysiology, however the activation of the prefrontal cortex has not been explored in this particular paradigm. The aim of this study was to investigate how cognitive demand in response to working memory load affected activation of the rostral prefrontal cortex (rPFC) under two conditions: (a) control (no reward) and (b) financial reward. It was hypothesised that the presence of reward would enhance rPFC activation but only when cognitive demand was high.

Methods
40 participants (20 males) volunteered for the mixed-design study where reward group served as a between-participants factor. Cognitive demand was varied by exposing participants to a working memory task (nback) at five levels of difficulty, e.g. 0-back, 1-back, 3-back, 5-back, 7-back. Demand was estimated to be easy (0-back, 1-back), hard (3-back, 5-back) or impossible (7-back). All participants were paid £10 for taking part in the study, but half of the participants were offered an additional monetary reward of £10 that was linked to their performance on the task. Blood oxygenation in the rPFC was captured using a functional near-infrared spectrography (fNIRS) device that covered the forehead region of the participant and monitored BA10.

Results
The results of the study indicated that blood oxygenation in the rPFC was generally higher in the presence of reward. It was also apparent that activation of the rPFC peaked at the 3-back task for participants in the control group, whereas this peak was observed at the 5-back for participants in the reward group.

Conclusions
The rPFC responded to both cognitive demand and the presence of a reward. This effect was consistent with the MIM where the level of effort invested into a task is influenced by the likelihood of success and the presence of an extrinsic reward.

Keywords
Motivation, Working memory, Prefrontal cortex, fNIRS

Published Work:

Ewing, K., Fairclough, S. H., & Gilleade, K. (2016). Evaluation of an adaptive game that uses EEG measures validated during the design process as inputs to a biocybernetic loop. *Frontiers in Human Neuroscience, 10*: 223. doi: 10.3389/fnhum.2016.00223

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