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Emotion affects prefrontal cortex activity during cognitive task performance: A change blindness functional near-infrared spectroscopy study.

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Introduction

Research is increasingly demonstrating that emotional processes interact with our cognitions and that the prefrontal cortex (PFC) is heavily involved during such tasks. Higher naturalistic negative mood is related to reduced PFC activity during working memory tasks (Aoki et al., 2011). In addition increases in PFC activity have been observed when attending to visual art of positive valence (Kreplin & Fairclough, 2013). How emotion influences attentional processes and what the underlying role of the PFC is during attentional tasks warrants investigation. This study aimed to investigate if changes in PFC activity were evident during a change detection flicker task (e.g. Rensink, O'Regan, & Clark, 1997) following induction of positive, negative as well as neutral affect. The Positive and Negative Affect Scale (Watson, Clark, & Tellegan) was employed to collect self-reported emotional affect. The study also sought to examine if there were any behavioural improvements in visual attention following induction of positive affect.

Method



- Eleven participants completed three blocks of trials with 3 tasks in each block.
- 20 images (positive, neutral or negative; taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008) were presented in a random order for 5 seconds each.
- Following this 'scene viewing' stage participants completed 24 change detection trials (see figure 1). All trials were presented in a random order.
- Finally participants completed the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegan, 1988).
- PFC activity was recorded using continuous wave functional near-infrared spectroscopy.

Results and Discussion

- Two one-way repeated measures ANOVAs were conducted to check that our affective stimuli were successfully inducing mood states in participants.
- **Positive Affect:** Participants reported higher positive mood scores after viewing positive stimuli compared to neutral stimuli (31.1 vs. 19.6; $F(1, 10) = 15.744$, $p < 0.01$).
- **Negative Affect:** Participants reported higher negative mood scores after viewing negative stimuli compared to neutral stimuli (21.5 vs. 12.2; $F(1, 10) = 18.044$, $p < 0.01$).
- Two one-way repeated measures ANOVAs were completed to investigate the effects of emotion on attentional task performance and PFC activity.
- **Task performance:** Participants were no quicker to detect changes in the attentional task between positive, neutral and negative emotion groups ($p = 0.198$).
- **PFC blood oxygenation:** There was a significant increase in PFC blood oxygenation during the change detection task under positive emotion task conditions compared to neutral emotion (0.51 vs. 0.18; $F(1, 10) = 9.121$, $p < 0.05$).
- There were no changes in change detection task performance during different emotion conditions.
- However, increases in PFC blood oxygenation were observed during the change detection task under conditions of positive affect.
- This suggests an increased recruitment of the PFC during attentional tasks under positive mood conditions relative to neutral and builds upon research demonstrating increased PFC activity when viewing positively valenced visual art (Kreplin, & Fairclough, 2013).

Figure 1: Trial layout in the change detection task.

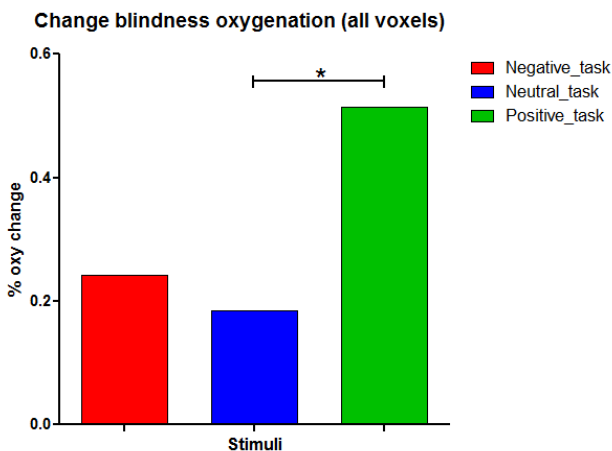


Figure 2: PFC oxygenation change (%) during positive, neutral and negative emotion conduction during change detection task.

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