The Impact of Emotional Stimuli on Attention Networks

The Cognitive Neuropsychology Lab

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Objective

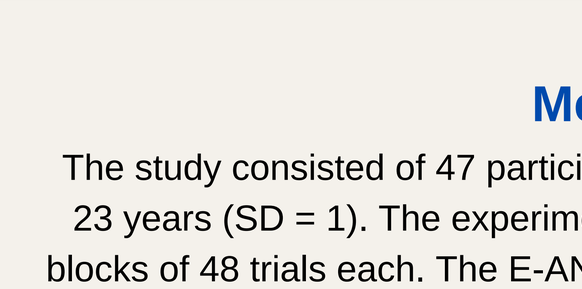
Our study examines the effect of different emotional categories- specificaly happiness, saddness, fear, peacefulness and neutral on attentional networks. We hypothesized that negative emotional valence would interfere with the functioning of attention networks, while positive valence would facilitate attention compared to neutral stimuli. Furthermore, we expected that specific emotional categories would differentially affect the distinct components of the attention system, including alerting, orienting, and executive control.

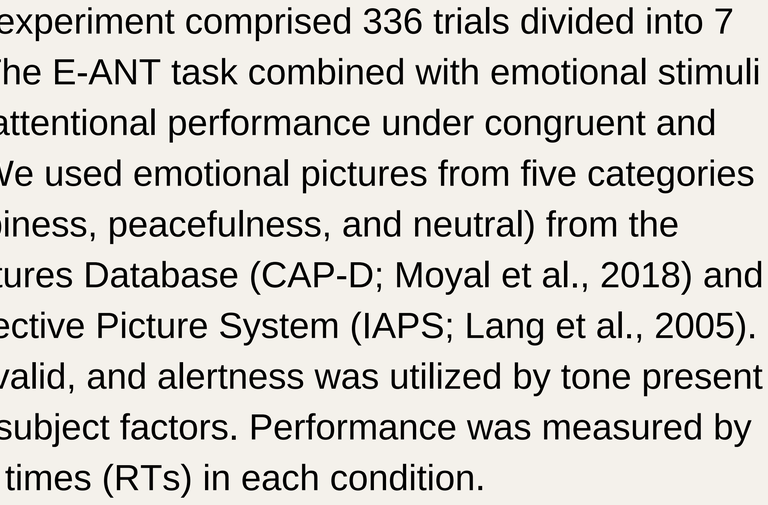
Introduction

Attention is a complex system with three networks: alerting (staying ready), orienting (directing focus), and executive control (managing distractions) (Posner & Petersen, 1990; Fan et al., 2002). Prior research demonstrate an interference effect of negative cues on attention (Okon-Singer, Tzelgov and Henik, 2007) or facilitating effect on happiness (Weidner et al., 2022). The Emotional Attention Network Test (E-ANT) allows researchers to measure how emotional cues affect each of the three attention networks (Boncompagni & Casagrande, 2019; Cohen et al., 2011). However, we still don't fully understand how different emotional categories affect each attention network, which limits our knowledge of emotion-attention interactions and their importance for disorders involving attention and emotional problems.

Method

The study consisted of 47 participants (41 females) with a mean age of 23 years (SD = 1). The experiment comprised 336 trials divided into 7 blocks of 48 trials each. The E-ANT task combined with emotional stimuli was used to measure attentional performance under congruent and incongruent conditions. We used emotional pictures from five categories (sadness, fear, happiness, peacefulness, and neutral) from the Categorized Affective Pictures Database (CAP-D; Moyal et al., 2018) and from the International Affective Picture System (IAPS; Lang et al., 2005). The cues were valid or invalid, and alertness was utilized by tone present or tone absent as within-subject factors. Performance was measured by reaction times (RTs) in each condition.





results

Mean RTs of correct responses were analyzed using repeated measures ANOVA with congruity, validity, alertness, valance, and emotional category as within-subject factors. Significant main effects were found for congruity ($F(1,46) = 527.08$, $p < .001$, $\eta p^2 = .92$), validity ($F(1,46) = 28.56$, $p < .001$, $\eta p^2 = .38$), and emotional category ($F(4,184) = 3.60$, $p < .008$, $\eta p^2 = .07$). A significant three-way interaction was found between alertness, validity, and emotional category ($F(4,184) = 3.70$, $p < .006$, $\eta p^2 = .07$). Post-hoc analyses revealed that fear-related stimuli showed stronger interference effects in invalid cue conditions without alertness tone ($t(14588) = 2.20$, $p < .028$). Peacefulness-related stimuli demonstrated facilitation effects with faster RTs (M = 601ms) compared to fear stimuli (M = 611ms).

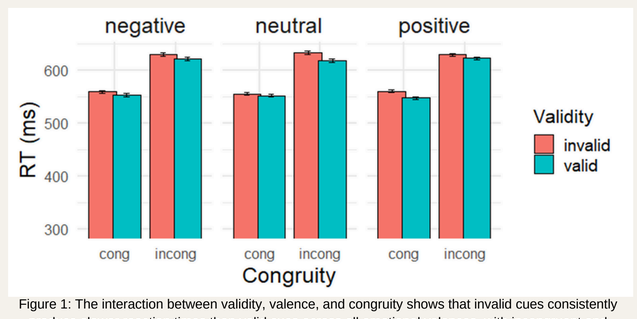


Figure 1: The interaction between validity, valence, and congruity shows that invalid cues consistently produce slower reaction times than valid cues across all emotional valences, with incongruent and invalid conditions producing the slowest reaction times compared to congruent conditions across all valences.

Figure 2: The interaction between validity and tone in fear and peacefulness categories reveals opposing patterns - in fear conditions, invalid cues with no-tone produce slower reaction times than with tone, while valid cues show the reverse pattern; peacefulness demonstrates the opposite interaction effect with faster responses to no-tone in invalid conditions and slower responses to no-tone in valid conditions.

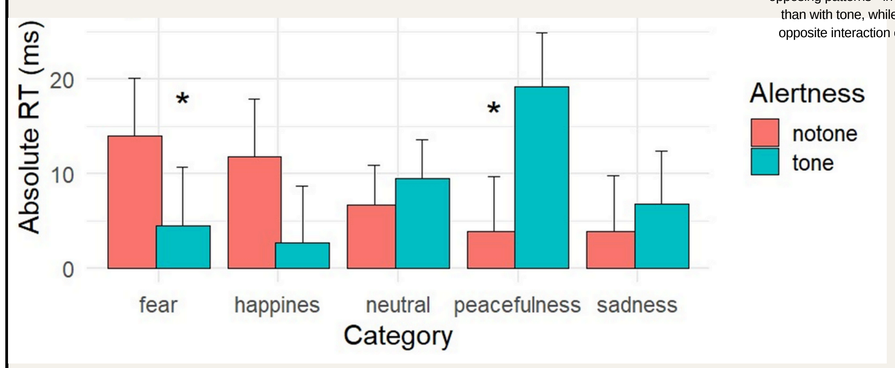


Figure 3: The interaction between tone and no-tone conditions across different emotional categories demonstrates significant and opposite effects for fear and peacefulness, with fear showing slower reaction times in no-tone conditions compared to tone conditions, while peacefulness exhibits the reverse pattern with faster responses during no-tone trials.

Discussion

Our findings support the hypothesis regarding the variable influence of different emotions on attention networks, demonstrating that the type of emotion, beyond its valence, plays a crucial role in shaping attentional processes. The results reveal an intriguing pattern of differential processing between peacefulness and fear, particularly evident in reaction times under no-tone conditions. Fear-related stimuli showed heightened sensitivity and interference effects, suggesting cognitive fixation on threatening stimuli as part of an evolutionary adaptive mechanism. In contrast, peacefulness-related stimuli enhanced reaction times, indicating that calm emotional states facilitate attentional efficiency. The three-way interaction between emotional category, alertness, and cue validity confirms that emotional influences on attention are context-dependent, with fear producing interference in challenging conditions while peacefulness consistently facilitates performance across conditions.

Referance

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