School of – Psychology

COGNITIVE CONTROL - THE MODERATING EFFECT OF EMOTION

Kelly Dawson and Dinkar Sharma (kad37@kent.ac.uk)

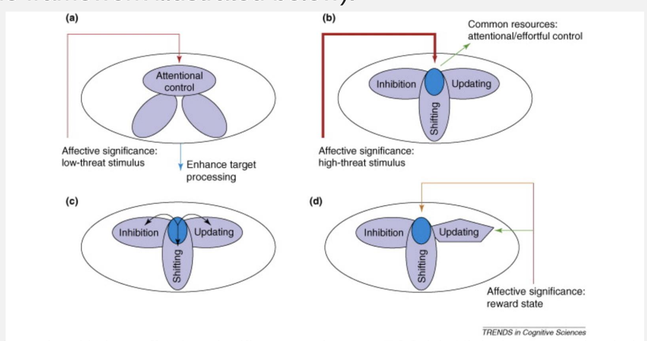
University of Kent

Introduction

Monitoring the current environment and task demands, inhibiting unhelpful behaviours and switching to helpful ones are three main elements of executive cognitive control (ECC). ECC and emotion are vital in shaping and maintaining appropriate, goal directed behaviour. However, there is no concrete understanding of how these aspects interact and share resources (e.g Cohen et al., 2001).

One example of the adaptive and fluid nature of ECC is the decrease in the Stroop effect (I-C) when the previous trial is incongruent (I) compared to when it is congruent (C). This effect has been named sequential modulation (SM).

Threat and reward have been shown to reduce SM (Pessoa, 2009). Pessoa proposed a Dual competition framework in which stimuli with affective significance and low threat facilitate SM. In contrast, highly threatening affective stimuli disrupt it (as shown by the framework illustrated below).



When threat level is low, affective significance enhances ECC (a). High-threat emotion-laden stimuli will typically recruit common-pool resources that allow their processing to be prioritised, which will detract from ECC (b). High threat will also trigger specific executive functions to handle the challenges to the organism (c). State-dependent affective significance, such as reward can, cause fine-tuning of ECC (represented by the change of shape) or rearrange (bright blue area and green arrow) the allocation of common-pool resources (d).

Pessoa (2009) proposed that both positive and negative visual stimuli could disrupt SM but only if they are biologically relevant. Negative, threat-based images have been shown exclusively to disrupt SM (e.g. Padmala et al, 2011). However, the effect that positive visual stimuli has on SM is still unclear.

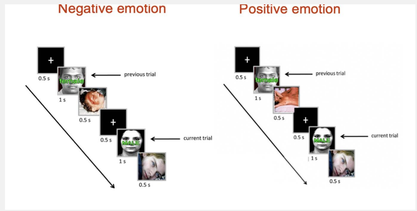
Aim: To replicate and extend the research of Padmala et al (2011). We used the same negative, threat-based images, neutral images, task and procedure. We added matched positive images from the international affective picture system (IAPS) in experiment 1 and images of baby faces (which have been shown to have attentional significance to human beings) in experiment 2.

Method

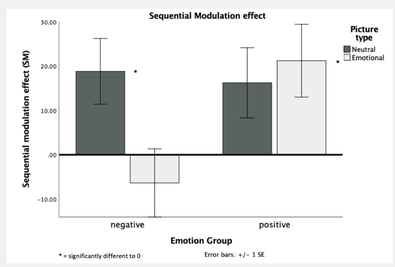
A Stroop like face-word task was employed to measure selective attention. This consisted of black and white images of females or males displaying neutral facial expressions superimposed with congruent (female face/female word or male face/male word) or incongruent (male face/female word or female face/male word) words in green font. These were interspersed with neutral/negative images or neutral/positive images.

Experiment 1

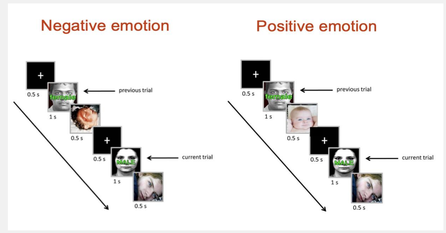
- Positive images included matched images from the international affective picture system (IAPS)
- Positive images were mainly depicting sexual scenes and reward-based images
- 66 participants (56 female, 10 male)



Picture Type	Mean arousal	Mean valence
Positive	6.16 ± 1.19	7.39 ±0.95
Negative	6.29 ± 0.64)	1.84 ±0.25
Neutral	3.62 ± 0.93)	5.16 ±0.1



The interaction between Emotion Group x Picture Type x Previous Congruency x Current Congruency was significant ($F(1,60) = 3.991$, MSE = 528.602, p=.02, $\eta_p^2 = .62$). Further analysis showed that in the negative group, negative threat/fear based images disrupted sequential modulation whereas neutral images did not ($F(1,33) = 5.593$, MSE = 399.082, $p \leq .05$, $\eta_p^2 = .15$). In the positive group, positive, erotic/reward based images did not disrupt sequential modulation effects when compared to neutral images ($F(1,27) = .534$, MSE = 686.905, p=.534, $\eta_p^2 = .19$).



Experiment 2

- Positive images included baby faces that were rated as positive prior to the study by university of Kent students.
- Positive images were mainly face and whole person shots.
- 57 participants (45 female, 12 male).

The interaction between Emotion Group x Picture Type x Previous Congruency x Current Congruency was not significant ($F(1,52) = .732$, MSE = 1396.203 p =.396, $\eta_p^2 = .014$). The Picture Type x Previous Congruency x Current Congruency interaction was significant ($F(1,52) = 5.520$, MSE = 10525.980 p =.02, $\eta_p^2 = .09$) Further analysis showed that emotional images disrupted the usual sequential modulation effects ($F(1,52) = 0.000$, MSE = .103, p =.998, $\eta_p^2 = .00$) whereas neutral images did not ($F(1,52) = 7.368$, MSE = 4195.535, p =.009, $\eta_p^2 = .12$).

Conclusions

Cognitive control is reduced by negative, threat-based images and images of baby faces. This suggests that when faced with a challenging task, threat and the survival of the species are significant enough to disrupt the usual recruitment of resources available under neutral conditions.

However, reward and sexual images did not affect SM. This could indicate that, although biologically relevant, sexual images were not relevant enough to detract from the resources required for ECC. One explanation could be the large number of female participants in this study. This could result in baby faces being more relevant biologically than erotic images/reward.

References

1. Pessoa, L. (2009). How do emotion and motivation direct executive control?. *Trends in cognitive sciences*, *13*(4), 160-166.
2. Padmala, S., Bauer, A., & Pessoa, L. (2011). Negative emotion impairs conflict-driven executive control. *Frontiers in psychology*, *2*, 192.
3. Botvinick, M. M., Braver, T. S., Barch, D. M., Carter, C. S., & Cohen, J. D. (2001). Conflict monitoring and cognitive control. *Psychological review*, *108*(3), 624.