Brain Structure & Behavioral Correlates of Anxiety in Affect-driven Modulation of Attention and Decision Making

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Abstract

- Visuospatial attention is crucial to navigate and reach optimal decisions in daily environments, which are also replete in salient affective information.
- As internal state, e.g., anxiety significantly shapes cognitive functions, this study elucidates the behaviour-brain axis in anxiety influencing environmental affect-driven biases of visual attention and executive function.

Background

Our attentional systems rely on the interaction between low-level visual features and goal-based factors, prioritising incoming visual stimuli. This limiting irrelevant stimuli representations helps improve salience of stimuli and benefits decision-making under anxiety (Barbot & Carrasco, 2018; Heilman et al., 2010). Understanding the brain basis of these interactions may help developing effective intervention strategies in anxiety.

In this study we explore,

- Relationship between regional grey matter volumes (rGMV) and gradient of visuospatial attention in high trait anxious individuals.
- Relationship between rGMV and an index of decision-making pertaining to hypothetical rewards vs punishments.

Methods

- Sub-clinical individuals (n=39; Age = 23.5 ± 3.9; Females = 16) filled State-Trait Anxiety Inventory (TA = 47.5 ± 4.7); performed a visual attention & Iowa Gambling Task (IGT).
- Objective metrics of cognitive functions were calculated from the attention task (negative inverse efficiency score, nIES) and IGT (Decision-making Task Net score).
- Subsequently, the individuals underwent one T1-weighted magnetic resonance imaging scan (MRI) for brain structure. Pre-processed MR images were fed into Voxel-Based and Surface-based morphometry analyses pipelines using Statistical Parametric Mapping, implemented on SPM12 + CAT12, run on MATLAB 2022a.

Experiment Design

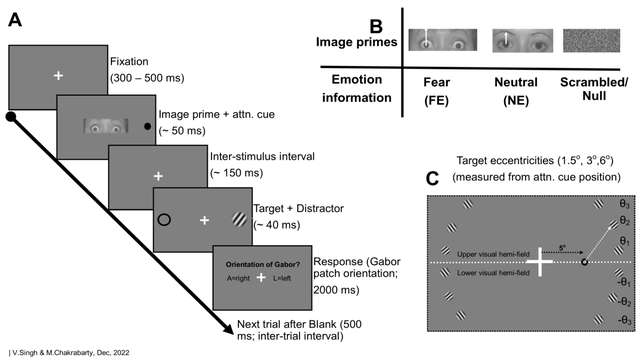


Fig1. Visuospatial attention task design.

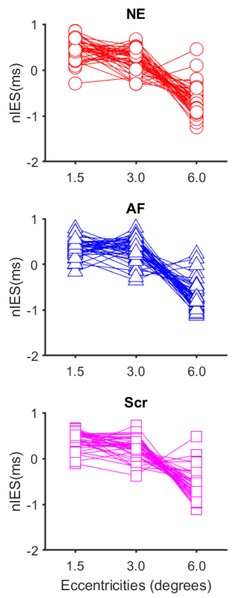


Fig2. Distribution of gradient of visuospatial attention across different Emotion types at 1.5°, 3.0° & 6.0° target eccentricities. Attentional gradients were calculated by taking the difference in nIES scores at 1.5° & 6.0°, averaged across three emotions

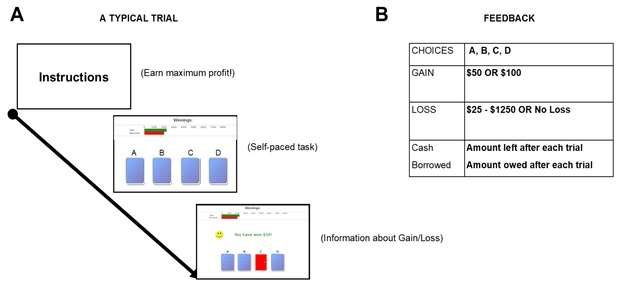
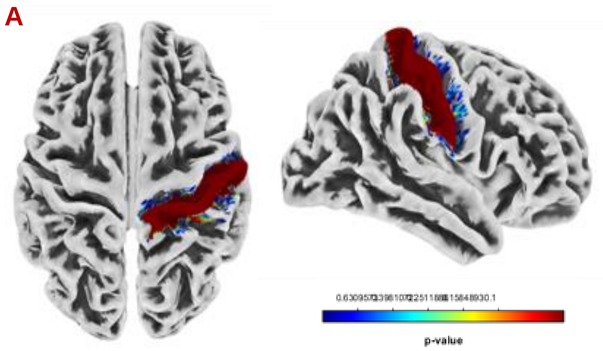


Fig3. Iowa Gambling Task Design(PEBL)

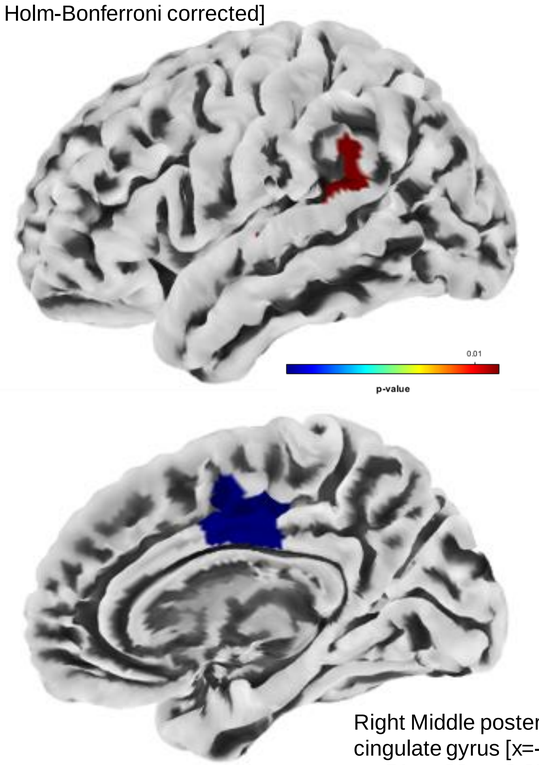
Results: Visuospatial Attention



Left Postcentral gyrus [x=-20, y=-46, z=56; p<0.05 FDR-corrected].

B

Left Supramarginal gyrus, [x=-46, y=-66, z=30; p<0.05 Holm-Bonferroni corrected]



Right Middle posterior cingulate gyrus [x=-5, y=-51, z=38; p<0.05 Holm-Bonferroni corrected]

Fig4. Gradient of visuospatial attention A) with rGMV. B) with cortical thickness, in moderate to severe trait anxious individuals. *SPMs overlayed on one subject-brain surface.*

Results: Decision-Making

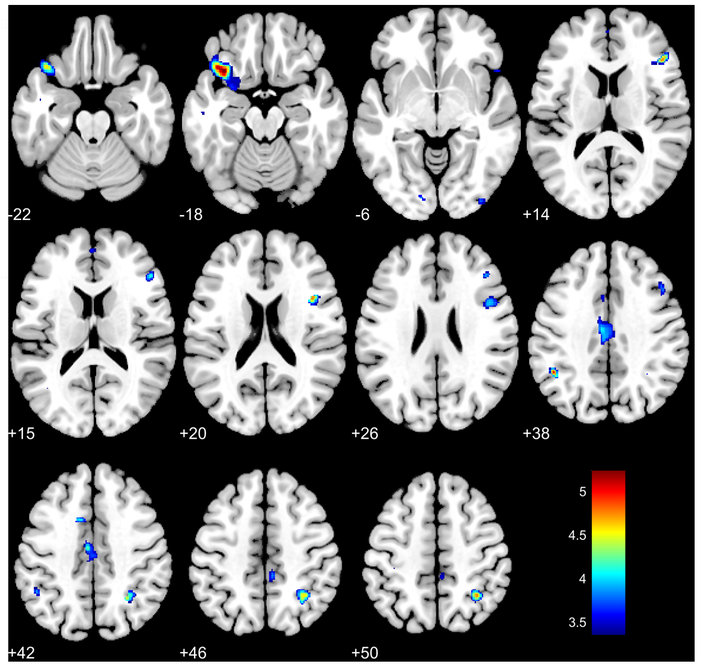


Fig5. Left posterior orbital gyrus [x=-34, y=20, z=-18; p<0.05 FWE-corrected. Ke = 879]. *SPMs overlayed on axial slices.*

CONCLUSION

In Moderate-Hight trait anxious individuals

1. Higher degrees of tunnel vision correlate with decreasing rGMV and cortical thickness in **left postcentral gyrus**, and **left supramarginal** and **right middle posterior cingulate gyrus** respectively.
2. Higher degrees of risk aversiveness in decision-making correlate with decreasing rGMV in **left posterior orbital gyrus.**

References:

1. Barbot, A. & Carrasco, M. Emotion and anxiety potentiate the way attention alters visual appearance. *Scientific Reports 2018 8:1* **8**, 1–10 (2018).
2. Heilman, R. M., Crişan, L. G., Houser, D., Miclea, M., & Miu, A. C. (2010). Emotion regulation and decision making under risk and uncertainty. *Emotion*, *10*(2), 257.

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