

Introduction

Memory suppression is an active process that voluntarily prevents the intrusion of undesirable memories into one's conscious awareness. However, the process may trigger ironic effects, meaning such suppressed memories become more accessible to the conscious mind. Cognitive load is one of the factors contributing to ironic effects. The influence of directed remembering and suppression of emotionally valenced memories under cognitive load in anxiety are sparse in the literature, to our knowledge. We, therefore, measured whether the directed remembering/recall or suppression of emotionally valenced memories impact an independent visual working memory task (imposing a cognitive load) in healthy young adults with dispositional/subclinical anxiety and its association with resting state functional connectivity (rsfc).

Methods

1. We employed **three separate experiments**- a) quantitative behavioural experiment of "item-method-directed forgetting" (as shown in figure 1); b) recognition task to ensure task compliance with remember and suppression instructions provided in experiment a) ; c) functional magnetic resonance imaging experiment involving seed to voxel rsfc.

2. A composite metric- Balance Integration Scores (BIS) was calculated for each emotion and task instruction to measure task efficiency in item-method directed forgetting task. Higher BIS scores reflect better task efficiency.

$$BIS = zscore_{accuracy} - zscore_{RT} \quad (1)$$

3. Sensitivity measure was calculated for the recognition task after averaging across all three emotions for each task instruction.

4. To measure the **interaction** between BIS and fear affect (measured using National Institutes of Health toolbox) towards explaining the rsfc, we performed multiple linear regression analysis after controlling for the nuisance covariates – age and gender (n=47; females = 14; age-range= 19-27 years).

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 (X_3 * X_4) + \epsilon \quad (2)$$

where

y = rsfc between seed and voxel; β_0 = intercept; X1 = age; X2 = gender; X3 = BIS; X4 = fear affect scores; X3 * X4 = interaction term between BIS and fear affect scores; $\beta_1 - \beta_3$ = parameter estimates and ϵ = residual.

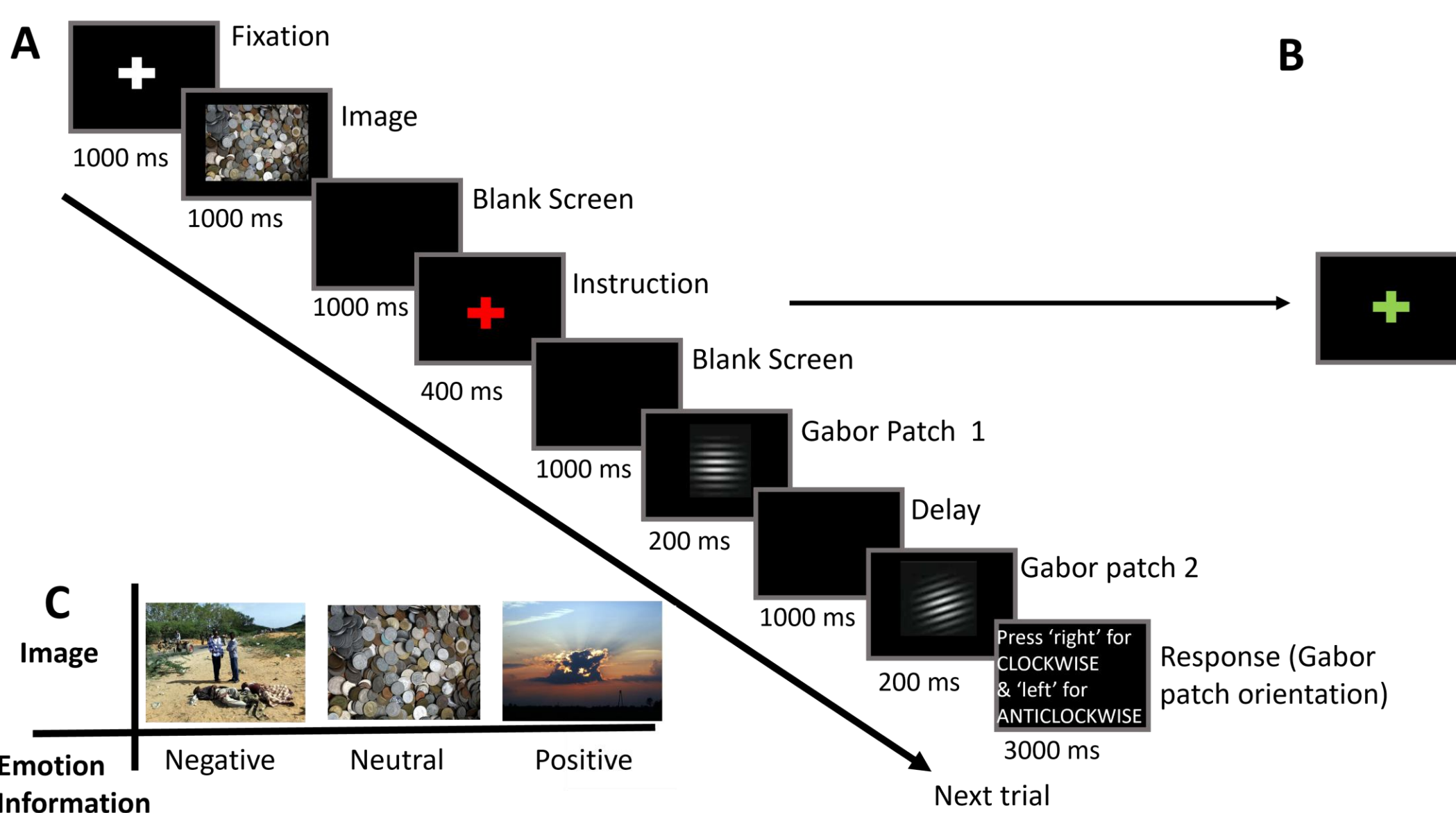


Figure1: Study design depicting recall (A) and suppress (B) condition

Results

A) No influence of task instruction and emotions observed on task efficiency **B) Higher sensitivity for recall condition reflects task compliance**

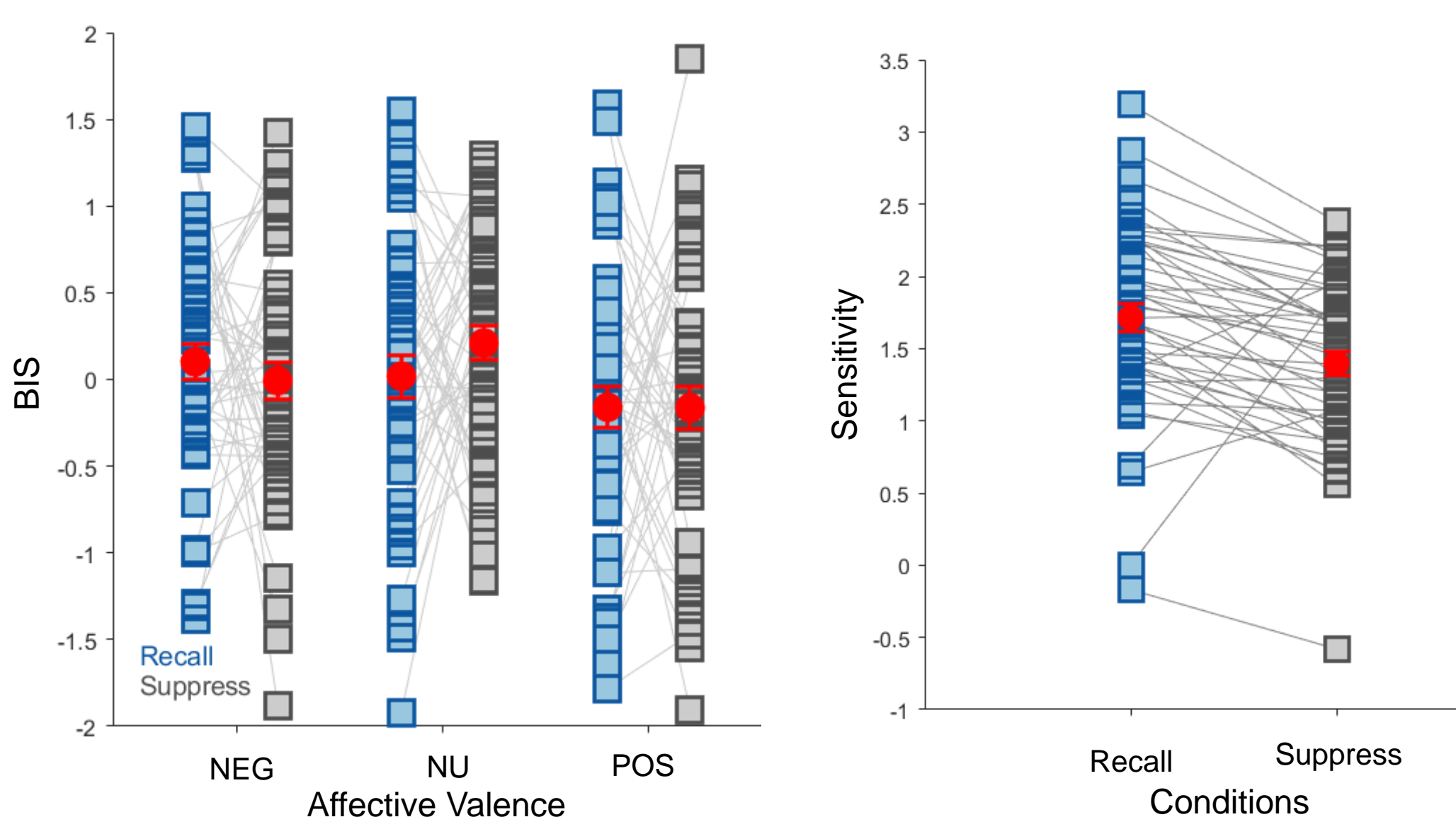
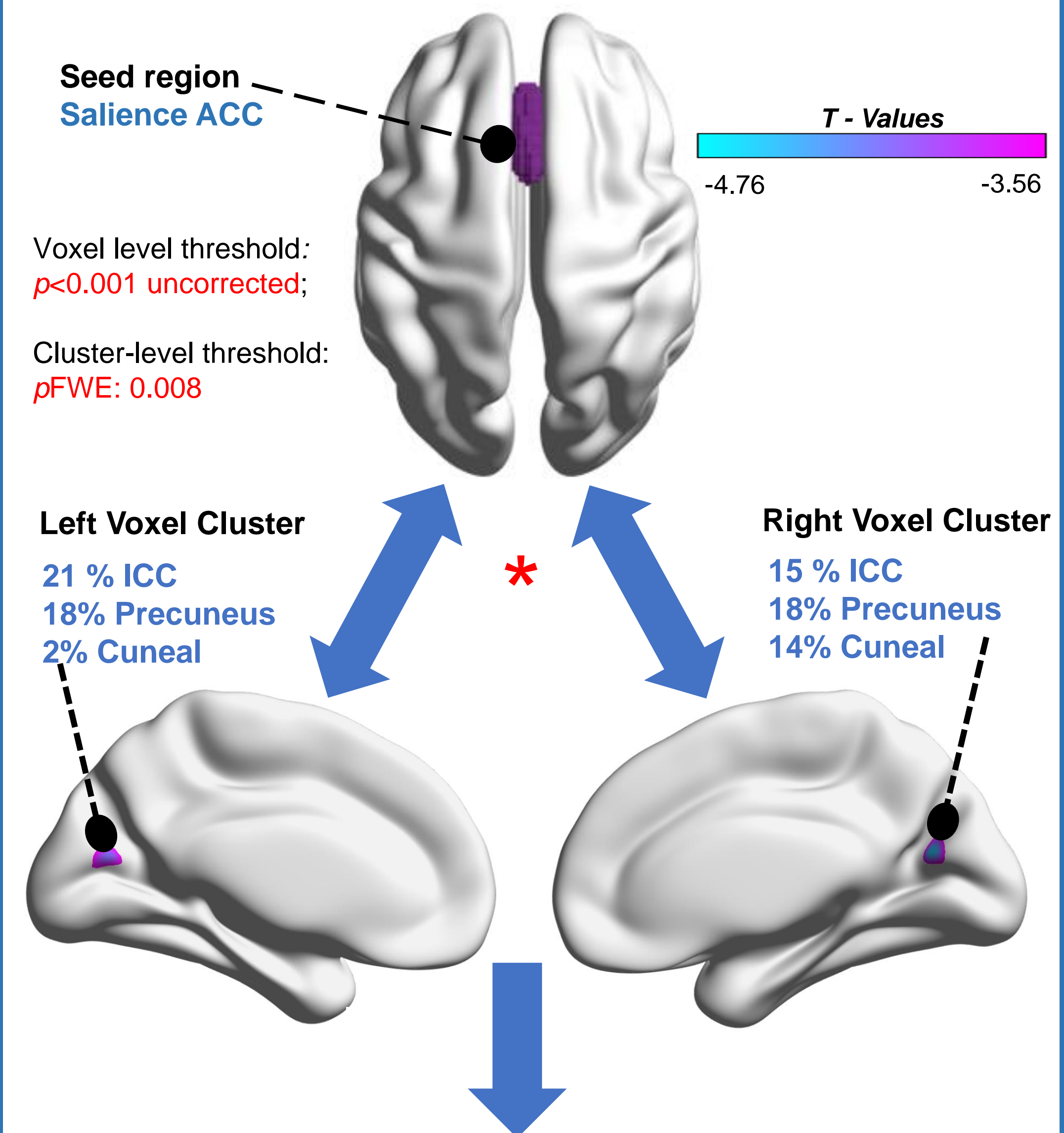


Figure2: BIS scores for each task instruction – recall & suppress for each emotion with means & std error of the mean marked in red

Figure3: Sensitivity across three emotions for recall and suppress condition with means & std error of the mean marked in red

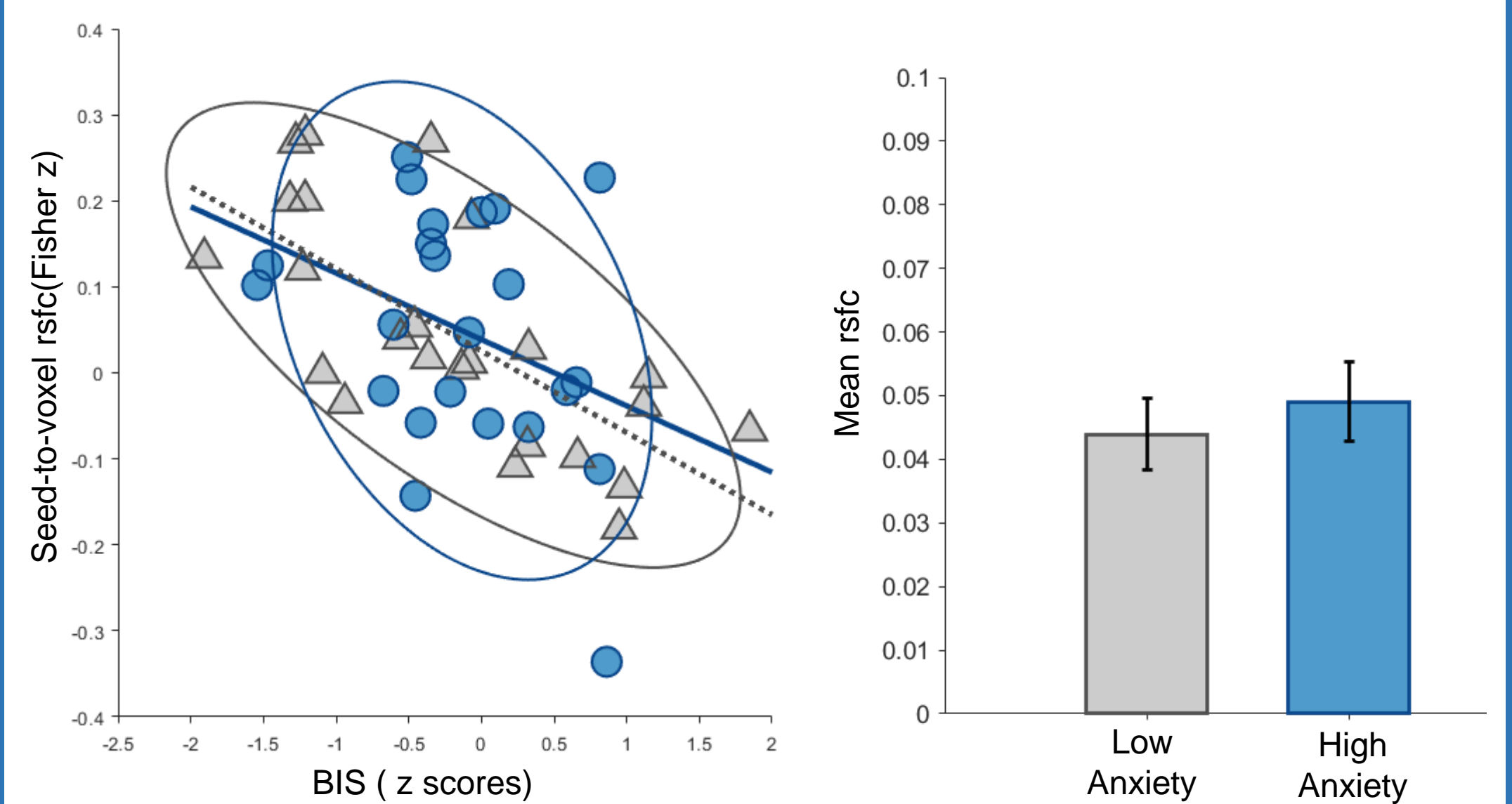
Results

C) Subclinical Anxiety moderates rsfc b/n seed Anterior Cingulate Cortex (ACC) & cluster - Intracalcarine Cortex (ICC) and (Pre)Cuneus linked with Suppressing Positive Memories



* Trend of the relationship
Seed to voxel rsfc vs. BIS

Mean rsfc
Low vs. High anxiety group



Low FA (Pearson's r : -0.70, p : 0.00016, Slope: -0.10)

High FA (Pearson's r : -0.35, p : 0.10344, Slope: -0.08)

Conclusions

1. The functional connectivity (rsfc) between the seed region in the salience ACC and the cluster containing ICC and (Pre)Cuneus transitions from a positive to a negative relationship with increasing task efficiency,
2. The shift in connectivity is further influenced by individual anxiety levels with significant effect observed only in low anxious group.
3. The transition may suggest that the anterior cingulate cortex, involved in cognitive control and emotional regulation, downregulates the intracalcarine cortex (visual processing and memory retrieval) and precuneus (mental imagery and episodic memory) which may help prevent emotionally charged memories from entering conscious awareness thereby reducing the burden on working memory and improving task performance.