Posterior Parietal Cortex Activation Predicts Working Memory Capacity for Faces

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AIM

We used fMRI to identify brain regions sensitive to load and individual differences in working memory capacity during a change detection task for faces.

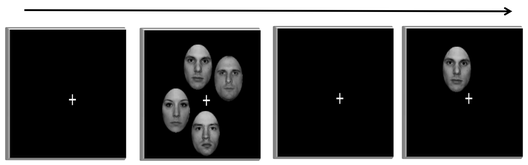
Introduction

- Faces play a key role in the complex socioemotional interactions characteristic of humans.
- The fusiform face area (FFA) and various prefrontal cortex areas may play a role in the encoding and storage of faces in visual working memory (Druzgal and D' Esposito, 2001; Druzgal and D' Esposito, 2003).
- Research using simple stimuli indicates that the intraparietal sulcus plays a role in visual working memory more generally (Xu & Chun, 2006).
- Little is known about the neural mechanism underlying individual variation in working memory storage capacity for faces.

Method

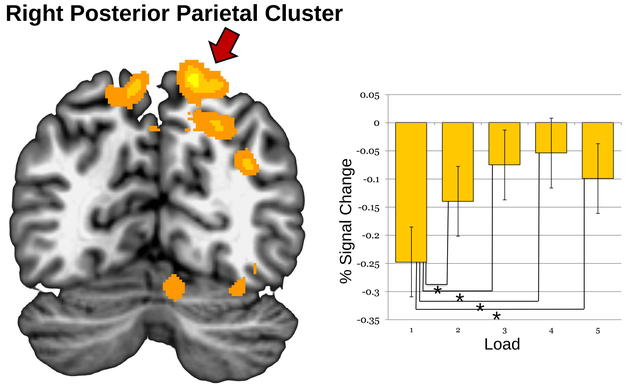
- 13 undergraduate students (9 F, 4 M)
- Participants completed a change detection task while fMRI data was collected.
- Face localizer task was used to functionally define FFA
- Participants were asked to report whether a single test face was present in a previous array of 1-5 neutral faces after a brief delay period.
- Working memory capacity was computed using Cowan's *k*
- Data was analyzed using AFNI .
- Standard pre-processing steps were applied, including slice time correction, motion correction, normalization, censoring of motion > 3mm, blur (4 mm) .
- A 14 s tent function with 8 tents beginning with the onset of the delay period was modeled and a mean of tents 3-6 was computed.
- A whole brain ANOVA using load as a single factor was computed.
- Results were cluster thresholded to produce a familywise p of .05.

Task Schematic

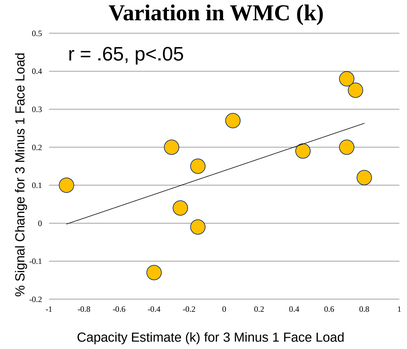


Posterior Parietal Cortex is Sensitive to Individual Differences in Working Memory Capacity (*k*)

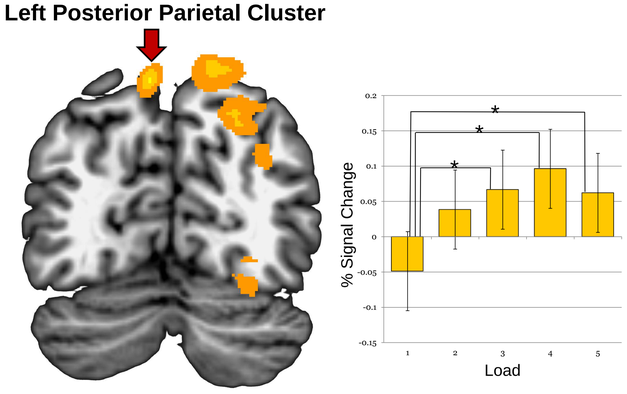
Right Posterior Parietal Cluster



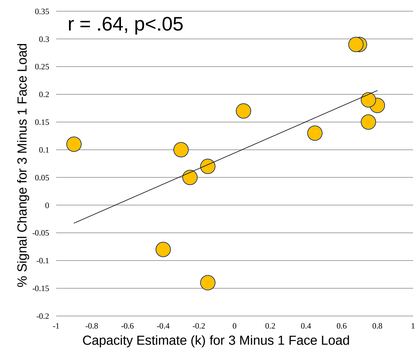
Activation in the R PPC Strongly Predicts Variation in WMC (k)



Left Posterior Parietal Cluster

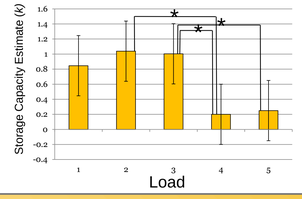


Activation in the L PPC Strongly Predicts Variation in WMC (k)



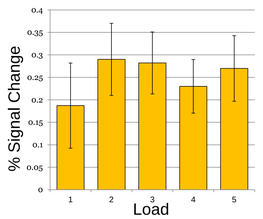
Note. All graphs use Tukey's HSD Statistical Significance Bars. An * indicates significance at .05 level, corrected for multiple comparisons using Tukey's HSD.

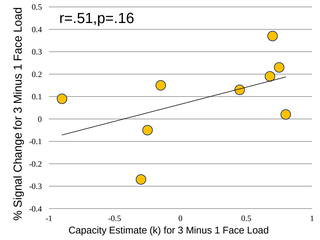
Storage Capacity (Cowan's *k*) Saturates ~ Load of 3



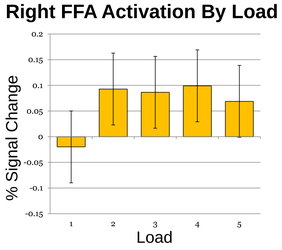
FFA Shows Trend Toward Sensitivity to Load, May Trend Toward Sensitivity to Individual Differences in Working Memory Capacity (*k*)

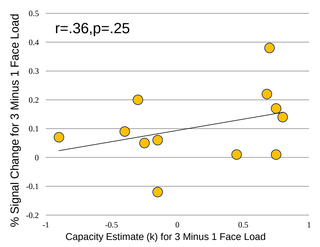
Left FFA Activation By Load



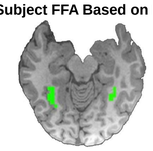


Right FFA Activation By Load





Single Subject FFA Based on Localizer

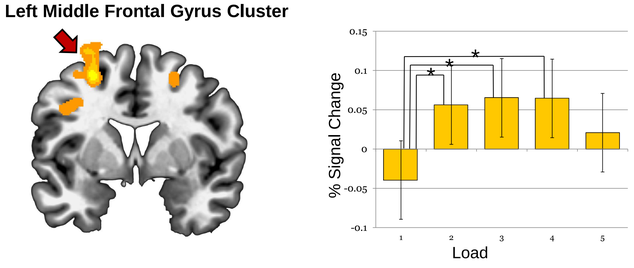


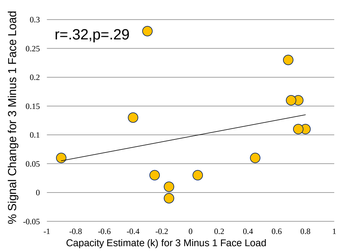
ANOVAs for FFA Activation with Load as a Single Factor

L FFA	F(4,32) = 1.6, p = .19
R FFA	F(4,44) = 2.4, p = .064

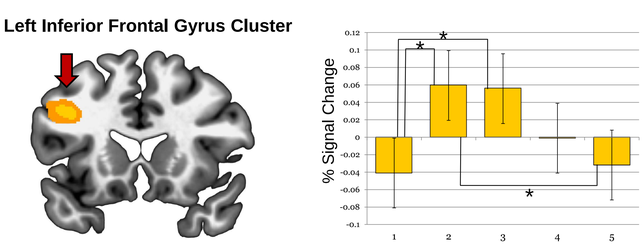
Prefrontal Cortical Areas Are Sensitive to Load, May Trend Toward Sensitivity to Individual Differences in Working Memory Capacity (*k*)

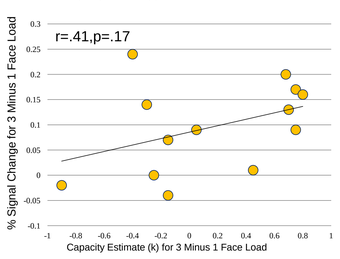
Left Middle Frontal Gyrus Cluster





Left Inferior Frontal Gyrus Cluster





Conclusions

- Individuals with greater working memory capacity for faces at higher loads had greater activation in posterior parietal cortical areas at higher loads. The posterior parietal cortex may play a role in allowing the storage of multiple complex objects, like faces.
- Many areas thought to be important for the storage of simple visual stimuli, such as dorsolateral prefrontal cortex and the intraparietal sulcus, show load sensitivity during visual working memory for faces. This suggests that similar mechanisms underlie the storage of faces and non-face stimuli in WM.
- The FFA showed a slight trend toward sensitivity to load and individual differences in working memory capacity, although this may be due to the FFA's role in encoding – rather than storing – faces (Druzgal and D' Esposito, 2003).
- Because the contents of WM help to guide attention and action, these observations set the stage for understanding the neurocognitive mechanisms that underlie the disordered behaviors characteristic of individuals with mood and anxiety disorders (e.g., Social Phobia).

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