Unimodal load selectively reduces recruitment of sensory cortices for working memory storage

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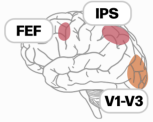
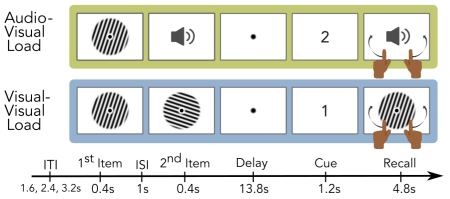
Background

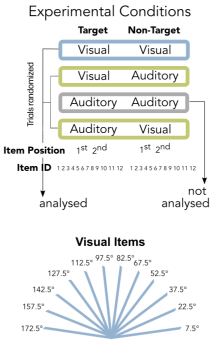
Previous research suggests that working memory storage relies on distributed representations[1] in **sensory areas**, where representations might be less robust[2,3], and **anterior cortices**, where representations could be protected from interference[4,5] but modulated by attentional priority[6].



How are resources allocated to accomplish the concurrent storage of multiple items?

Methods

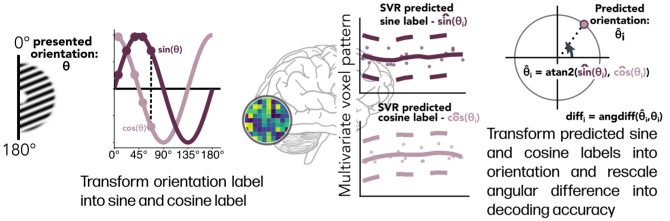




N = 81
3T MRI with multiband sequence | factor = 8
TR = 800ms | TE = 37ms | voxel size = 2mm³

fMRI analysis:

periodic support vector regression to reconstruct orientations from multivariate voxel pattern



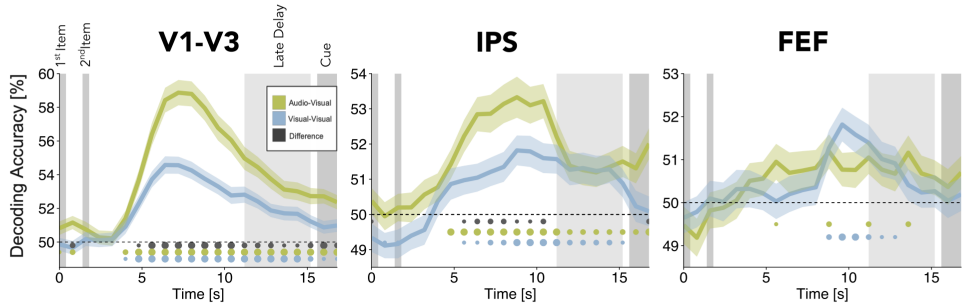
Transform orientation label into sine and cosine label

Transform predicted sine and cosine labels into orientation and rescale angular difference into decoding accuracy

Conclusion

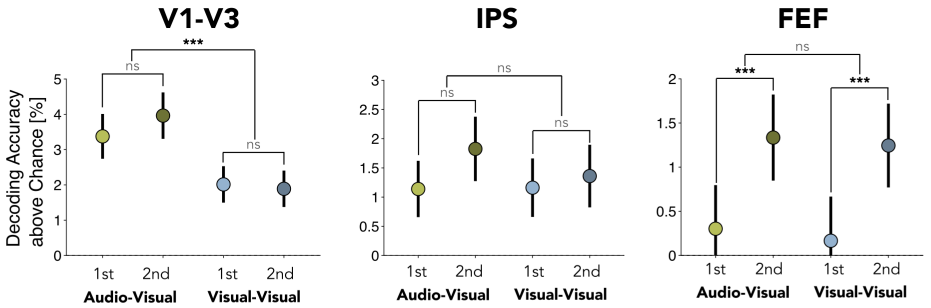
Our results suggest a division of labor between **visual cortices**, which are crucial for the representation of individual items and **anterior regions**, where more recent items are stored. All three regions contribute the maintenance of working memory contents and behavioural recall.

Results

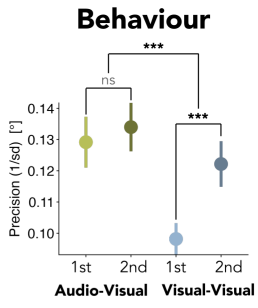


Decreased recall precision with unisensory load is accompanied by reduced decoding accuracy in visual cortex. However, there is no difference between load conditions in late delay decoding accuracy in the anterior regions, IPS and FEF.

Late Delay Order Decoding:

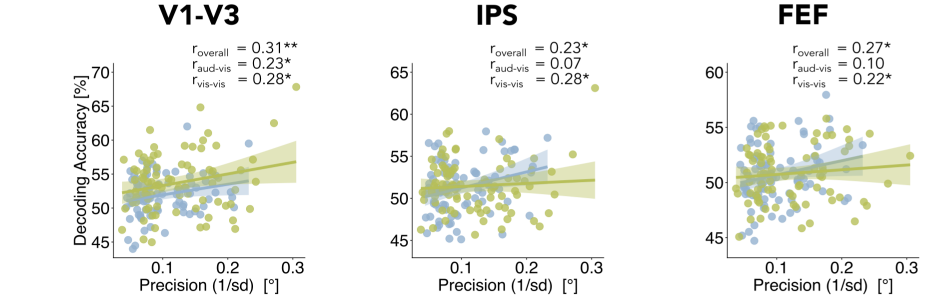


Sequential encoding of memory items results in separable neural representations in FEF, where more information about the second item can be decoded, irrespective of experimental condition.



Overall, the recall precision is higher when only the target is visual. Precision is higher for the second item when both items are visual.

Brain-Behaviour Correlation:



Brain-behaviour correlations show that all three ROIs contribute to recall precision. Decoding accuracy in V1-V3 is correlated with precision in all experimental conditions.

[1]Christophel et al. (2012) TiCS, 21(2),111-124 [2]Emrich et al (2013) J Neurosci, 33(15),6516-6523
[3]Bettencourt & Xu (2016), Nat Neurosci,19(1), 150-157 [4]Rademaker et al. (2019) Nat Neurosci, 22(8), 1336-1344
[5]Christophel et al (2018) Nat Neurosci, 21(4), 494-496 [6]Yu & Shim (2019) Cereb Cortex, 29(7), 3182-3192