Place memory areas track predictions across views in immersive, real-world scenes

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Background

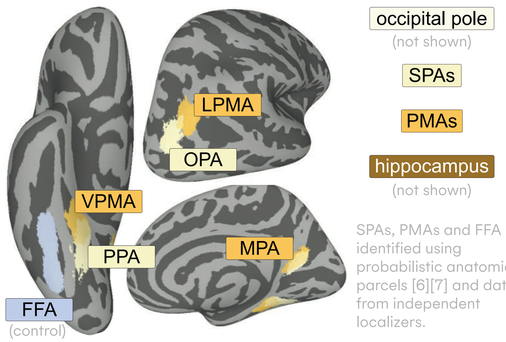
- We see the world with a limited field of view, but need to operate in 360° space.
- One way to support rapid perception in 360° space is to predict upcoming scene views.
- Visual prediction occurs across saccades [1][2], but how the brain supports this process across views in real-world scenes is unclear.

Question: Which brain regions represent upcoming scene views in immersive, real-world places? →

Hypothesis: The hippocampus and place memory areas (**PMAs**) [3] will convey memory-based predictions of upcoming scene views to scene perception areas (**SPAs**) [4][5].

Methods

Regions of interest



occipital pole (not shown)
SPAs
PMAs
hippocampus (not shown)

SPAs, PMAs and FFA identified using probabilistic anatomical parcels [6][7] and data from independent localizers.

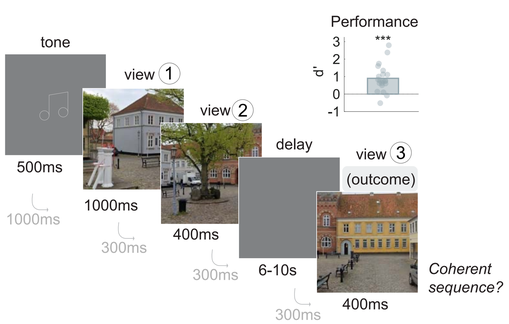
Study Phase (VR)

Participants (N=21) learned an immersive, real-world scene in head-mounted VR.

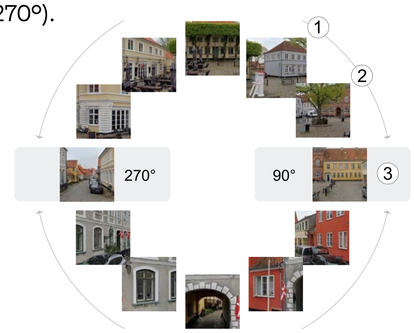
20s for 4 rounds

Main Task (fMRI)

On each trial, participants saw a sequence of three 30° views drawn from the studied scene.



Sequences ended on 'outcome' views at opposite poles of the scene (90° and 270°).

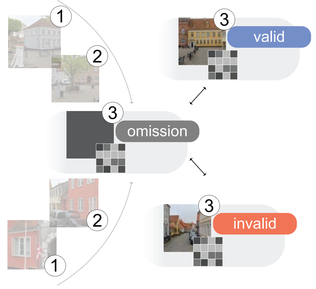


Trial conditions

Results

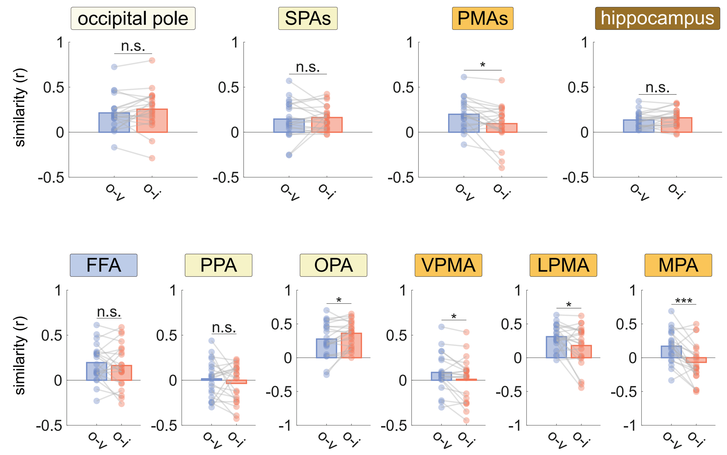
Place memory areas represent predictions of upcoming scene views

Compare pattern similarity for matching predicted outcomes (MVPA)

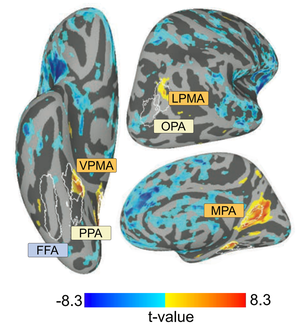


paired t-test: *p < .05, **p < .01, ***p < .001; n.s., not significant

o_v o_i *r*(omission, valid)
o_v o_i *r*(omission, invalid)



Group searchlight for prediction representations

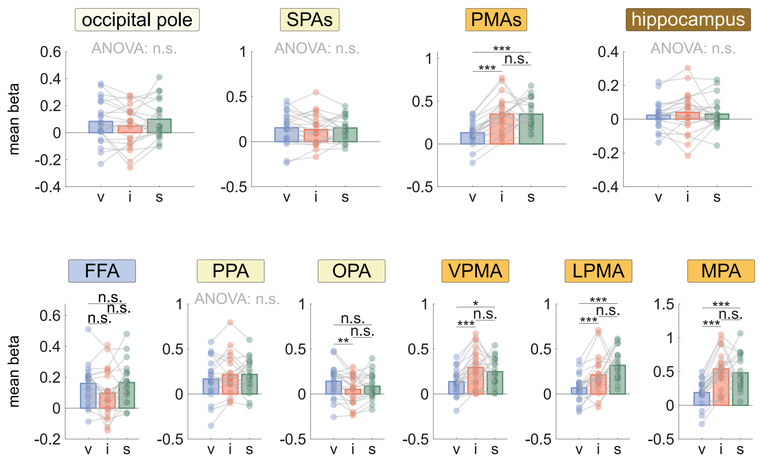


Searchlight group map shows t-value indicating r(omission,valid) −r(omission,invalid), uncorrected p < .05.

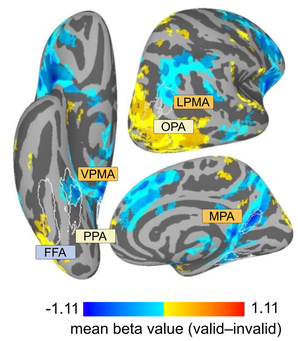
Place memory areas track prediction errors across scene views

Compare univariate response across valid, invalid, and scrambled conditions

One-way repeated measures ANOVA per ROI; significant main effects followed up with Bonferroni-corrected paired t-tests; *p < .05, **p < .01, ***p < .001; n.s., not significant



Group univariate maps for prediction error signal

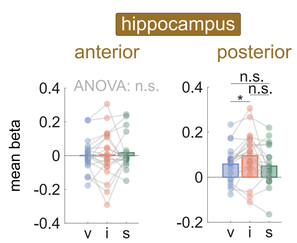


Group contrast map (valid < invalid), p<.05, uncorrected. Cool colors indicate valid < invalid.

Next Steps

Question: Where do predictions of upcoming scene views originate in the brain?

Hippocampus was divided at its midpoint along the long axis. Univariate responses in the anterior and posterior regions were compared across valid, invalid, and scrambled conditions.



Conclusions

- PMAs represent predictions of upcoming scene views and track errors in those predictions.
- OPA distinguishes between predicted and unpredicted views.
- Together, these results suggest that the PMAs and SPAs work in concert to supply predictions of upcoming views in immersive, real-world places.

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