Temporal context as a posterior distribution over latent states

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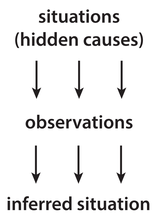
1 Introduction

Situation models and "schemas"

- Serve to organize thoughts and experiences as we encode them into memory
- The posterior-medial network (PM network) of brain regions might be involved in their construction and application

Central question: How do we infer what situation we are in?

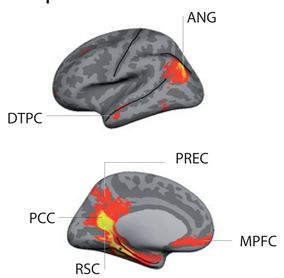
Using **Bayesian latent cause models?**



- Situations can be viewed as hidden causes that give rise to observable events
- We can use Bayesian inference to infer the current situation, as the **posterior probability distribution *P(situation | observations)***

Hypothesis: Brain regions implicated in situation modelling (the PM network) represent the posterior distribution over situations, as computed by Bayesian latent cause models.

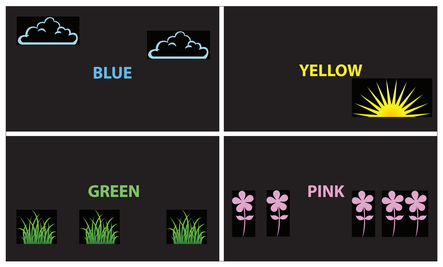
The posterior-medial network



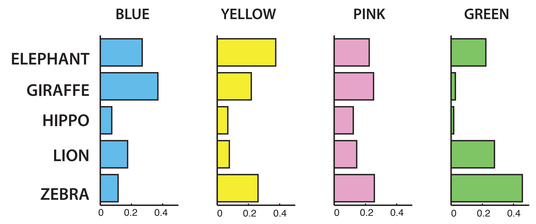
(Ranganath & Ritchey 2012)

2 "Animal Safari" posteriors task

The safari is divided into 4 "zones"

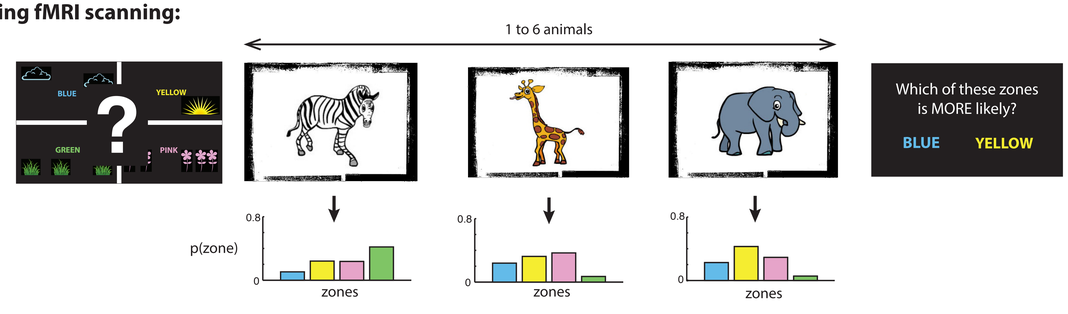


Animals appear in different zones with different probabilities:



Subjects are trained on these probabilities before scanning.

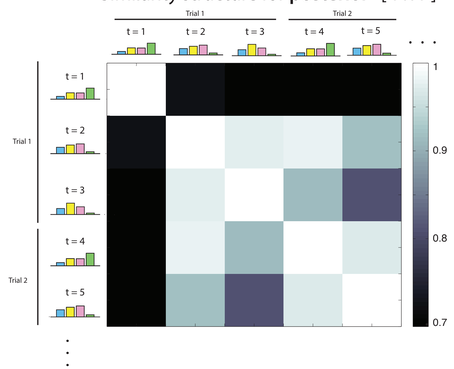
During fMRI scanning:



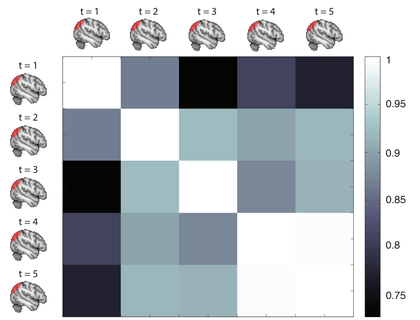
Subjects must continuously update their beliefs about the **posterior probability of each zone.**

3 Representational similarity analysis

Similarity structure for **posterior** [T x T]



Similarity structure for **ROI** [T x T]



Take correlation of these two matrices to obtain
the **representational similarity match of ROI and posterior**

We can also compute similarly compute the representational similarity for various **null models:**

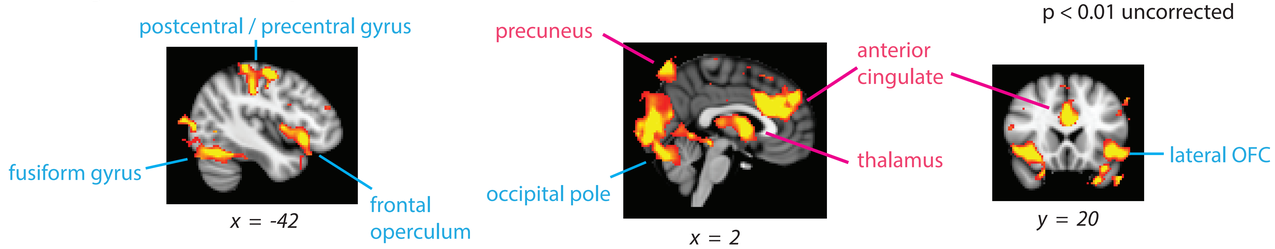
- **current animal** = indicator vector, e.g. [0 1 0 0] if lion at timestep t

4 Whole-brain searchlight

Preliminary results (n = 6)

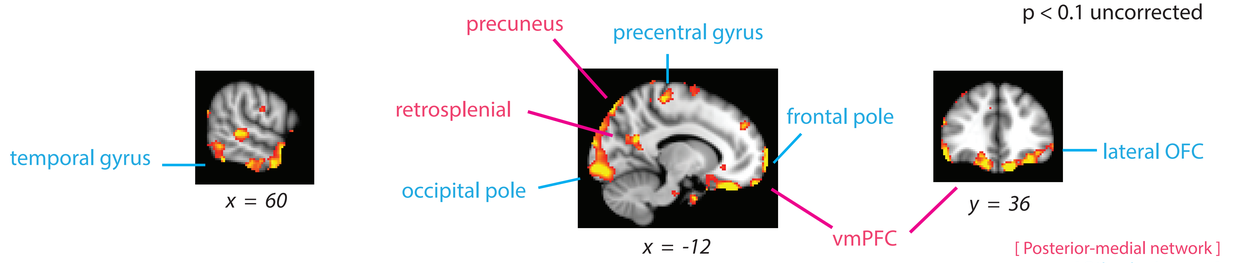
regions with match to posterior

p < 0.01 uncorrected



regions where (match to posterior) > (match to current animal)

p < 0.1 uncorrected



[Posterior-medial network]
[Other brain areas]

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