

Unsupervised Clustering on Task-Related Representations in PFC

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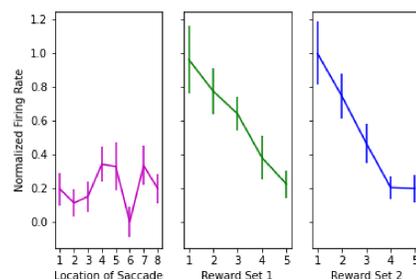
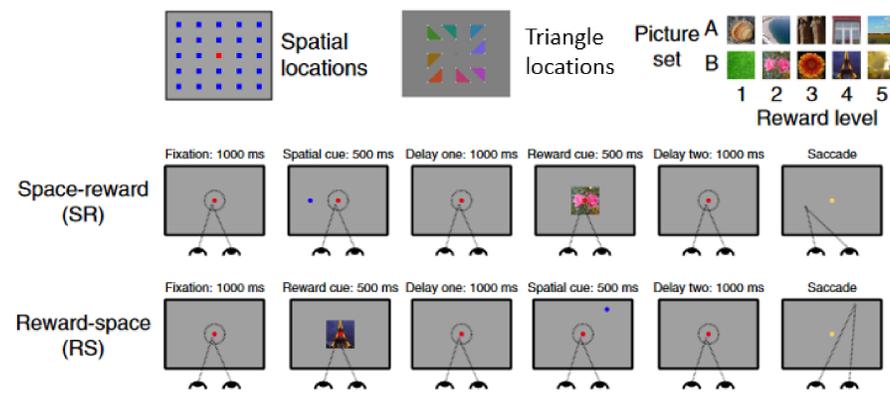
Introduction

- The **prefrontal cortex** (PFC) is known to encode information relevant to decisions, such as **reward** and **task structure**
- Single Neuron Responses** is the classical view of neuronal selectivity, where the activity of neurons scales with the magnitude of individual variables such as **reward**¹
- The alternative hypothesis is **Random Mixed Selectivity** (RMS) which explains the complexity of neuronal responses in the PFC. Here, neurons encode random mixtures of **reward** and **task structure**^{1 2}

Aims

- Use method of **Spectral Clustering** to probe how the **ACC, DLPFC, VLPFC, OFC** in **non-human primates** encode task-related variables

Method



- Performed spectral clustering on representational space of 18 dimensions. These dimensions are the 8 spatial locations and the 2x5 reward cues.
- Evaluated the performance of the algorithm using two metrics, adjusted rand index (ARI) and silhouette score

References

- ¹ Rigotti, M., Barak, O., Warden, M. *et al.* (2013) Nature
² Hirokawa, J., Vaughan, A., Masset, P. *et al.* (2019) Nature

1. Representational Space is Structured

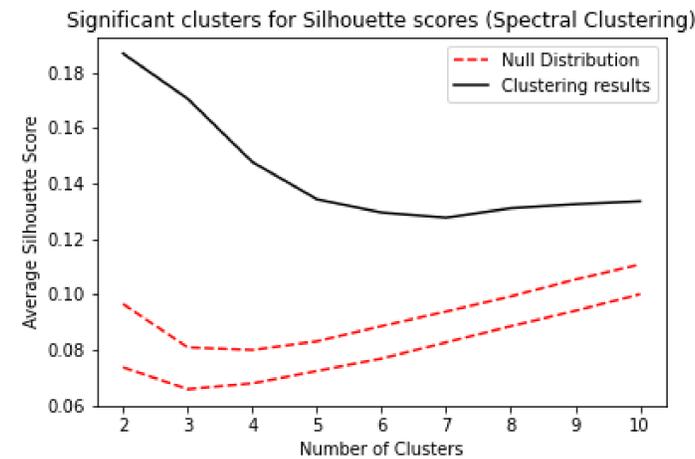


Fig 1: Comparison to null distribution in ACC using silhouette score as metric. To construct null distribution we shuffled trials and conducted 500 permutations.

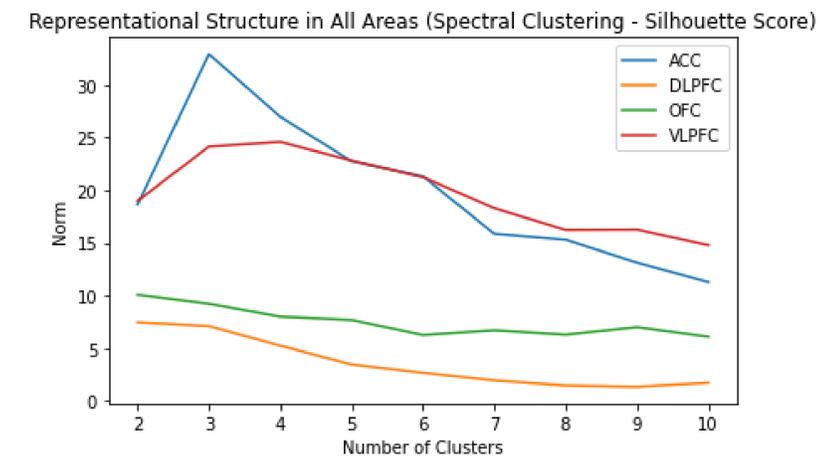


Fig 2: Distances to Null Distribution for all areas normalized by the width of the null distribution. ACC and VLPFC have more structure in their coding of task variables.

2. Dissociation of Areas

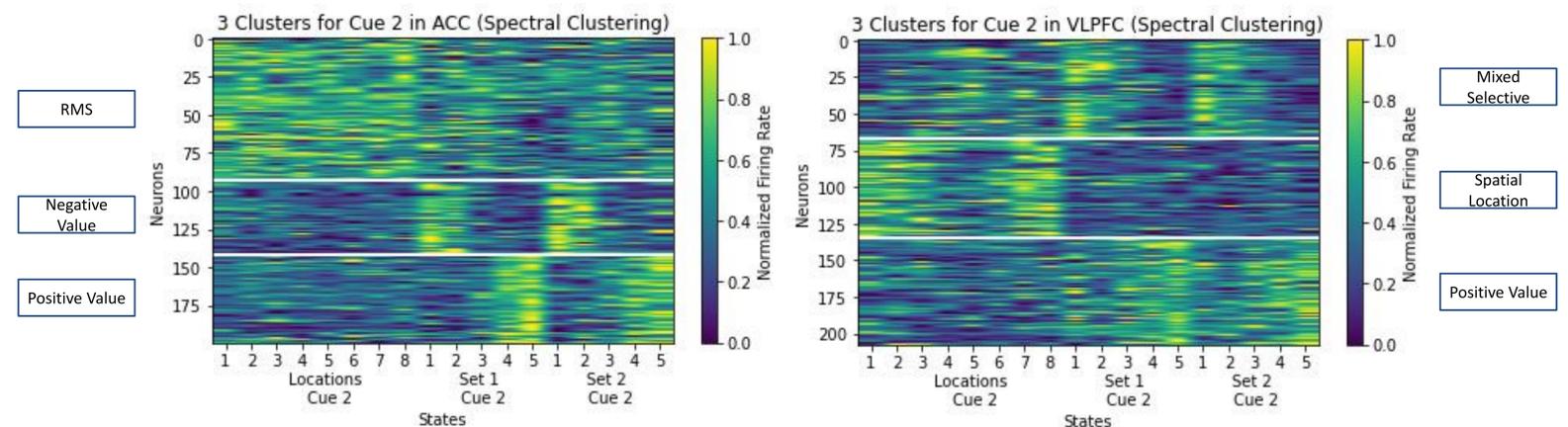


Fig 4 and 5: Clustering output for the two more structured areas. ACC has strong value coding whereas VLPFC encodes spatial location as well as value coding. There is also evidence of single neuron, random mixed selective and mixed selective populations of neurons (to be confirmed with future statistics).

Conclusions

- The algorithm pulls out single neuron, RMS and mixed selective populations of neurons within the PFC (to be confirmed with statistics)
- Differences between areas in coding of task variables, with **value coding** in the ACC and **spatial coding** in the VLPFC