

# Characterizing the Spatiotemporal Neural Representations of Perceived Similarity Using Implicit and Explicit Tasks.

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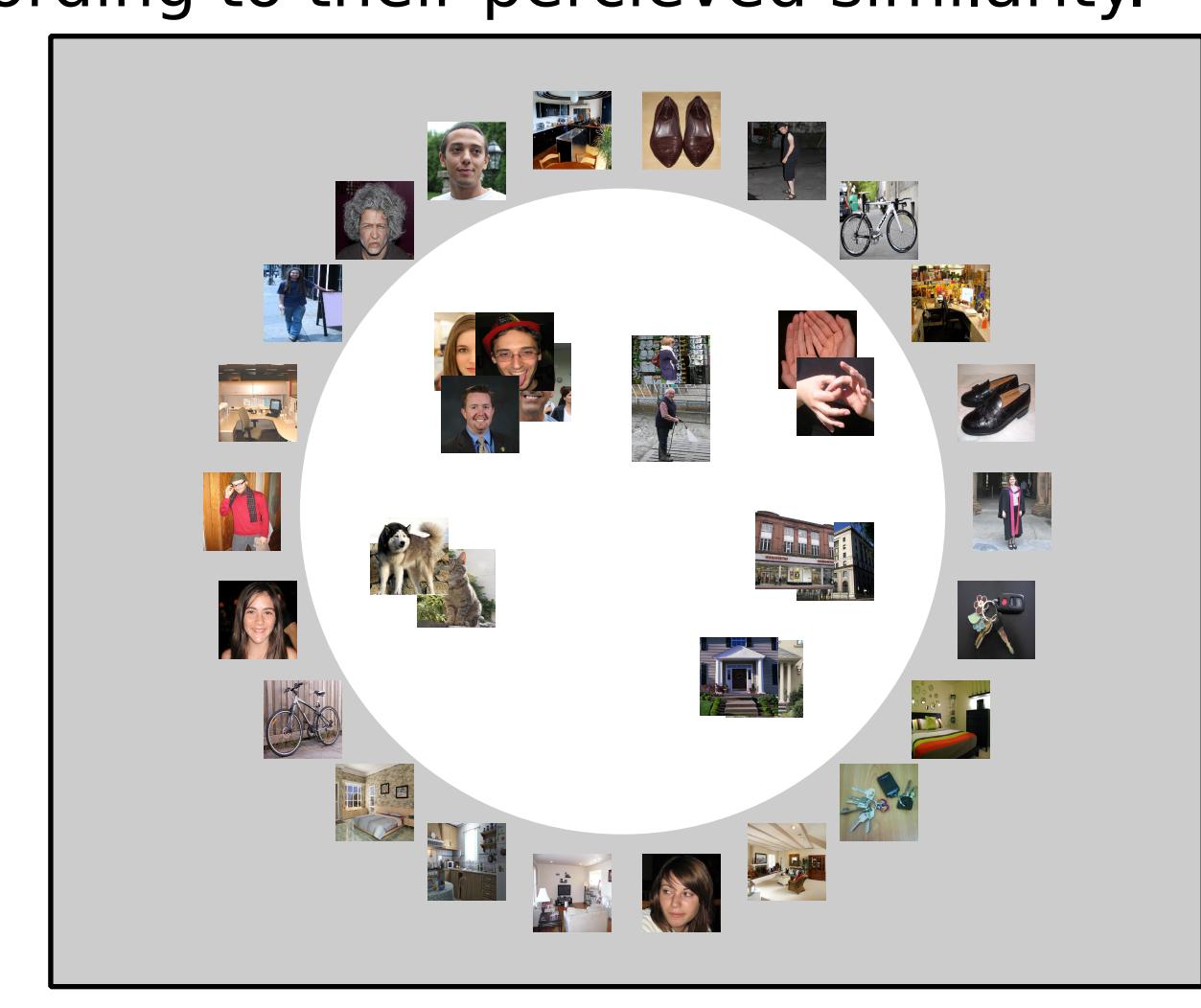
## Introduction

Perceived similarity judgments provide behavioral representations that strongly correlate with visual system activity through representational similarity analysis<sup>1,2</sup>. Many behavioral experiments using this paradigm utilize highly explicit, conscious judgements of similarity, such as the multiple arrangements (MA) task<sup>4</sup>, which has been instrumental in successfully relating explicit behavioral information about stimuli to representational geometries of brain activity patterns<sup>5,6,7,8</sup>. However, such explicit similarity judgments may not fully reflect representational geometries across the entire visual cortex<sup>9</sup>. Here, we aim to investigate how implicit and explicit similarity judgments capture complementary aspects of brain-behavior relations. By relating data from three tasks with varying levels of processing to recorded neural responses, we explore how they associate with the spatial (fMRI) and temporal (EEG) unfolding of object representations encoded in the ventral stream.

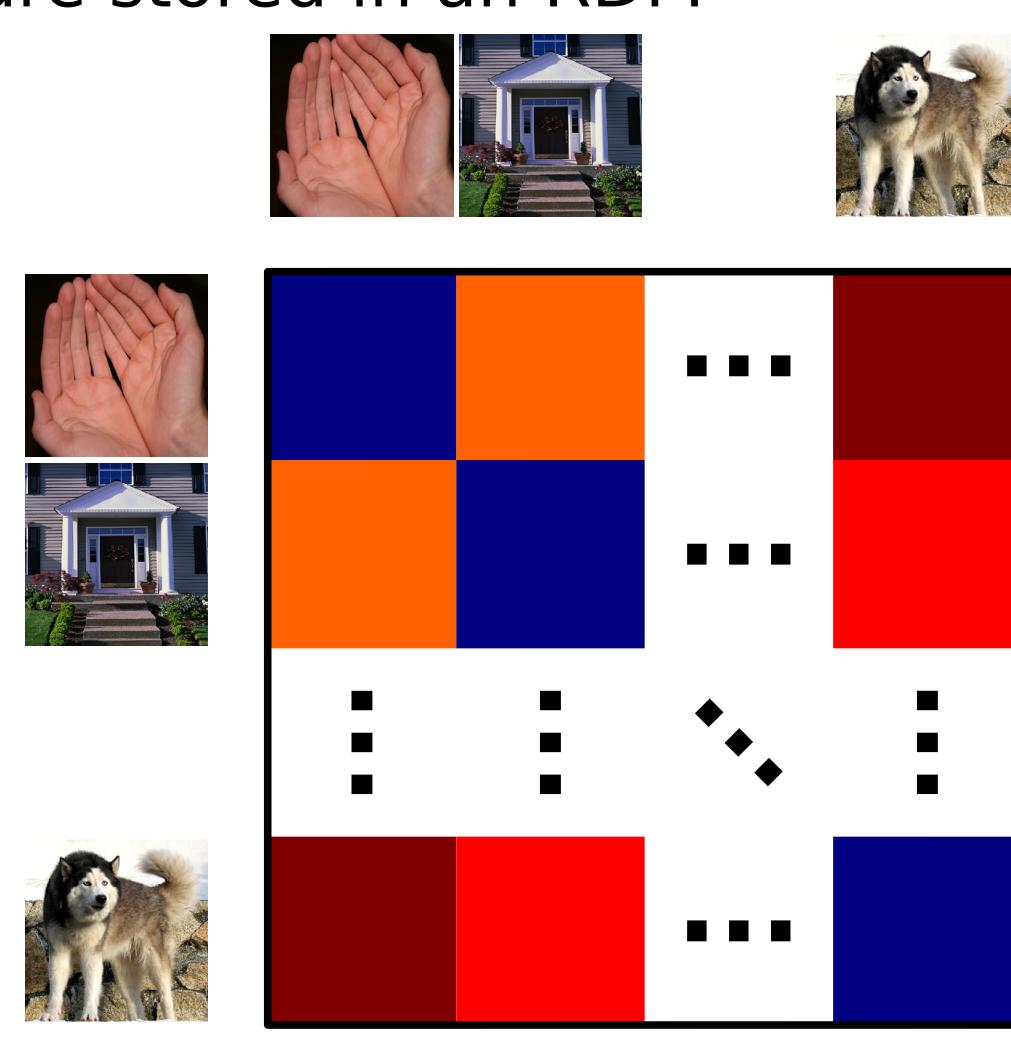
## Methods

### Explicit Similarity Judgements: The Multiple Arrangements Task

A) Participants arrange stimuli on a 2D arena according to their perceived similarity.

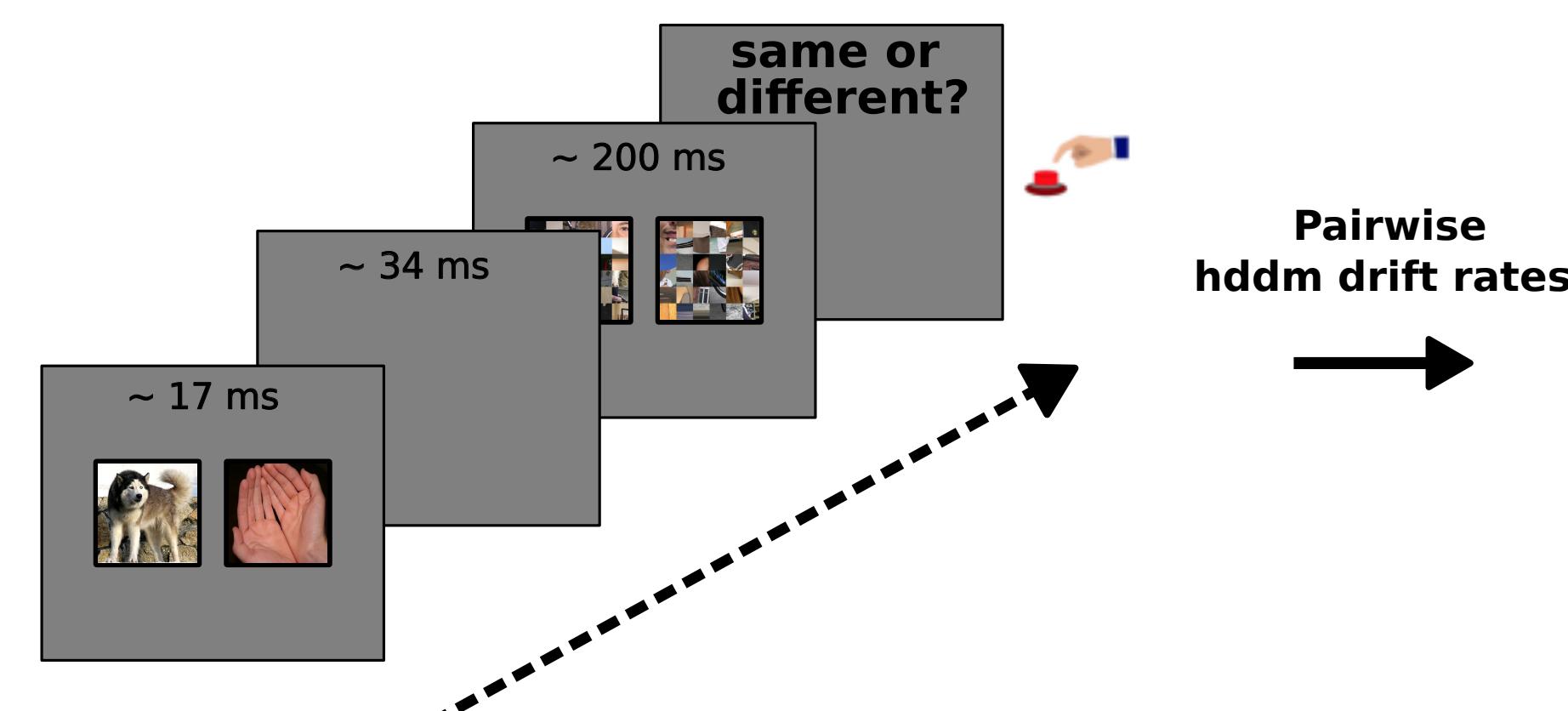


B) Pairwise Euclidean distances are stored in an RDM

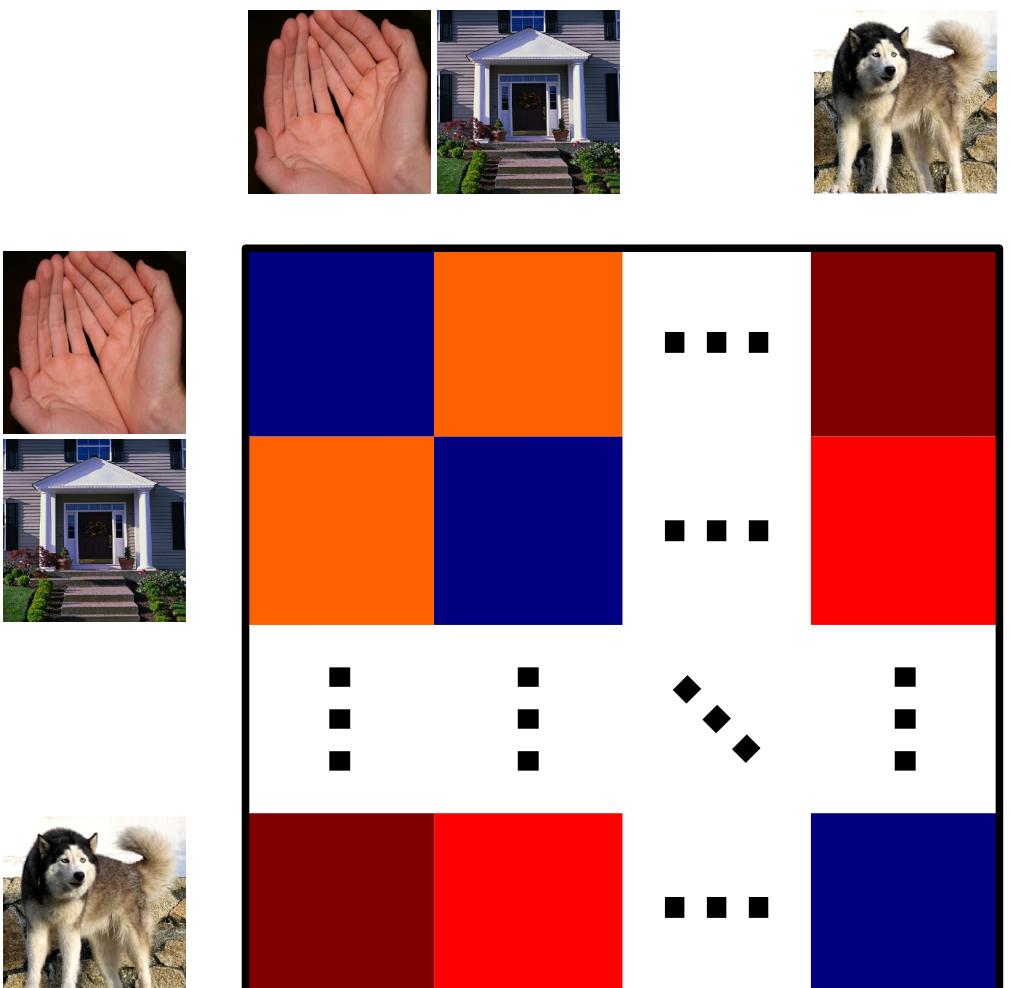


### Implicit pairwise similarity judgements: Discriminability task

A) Participants are rapidly presented with two images in sequence and asked to indicate whether or not they were the same image.

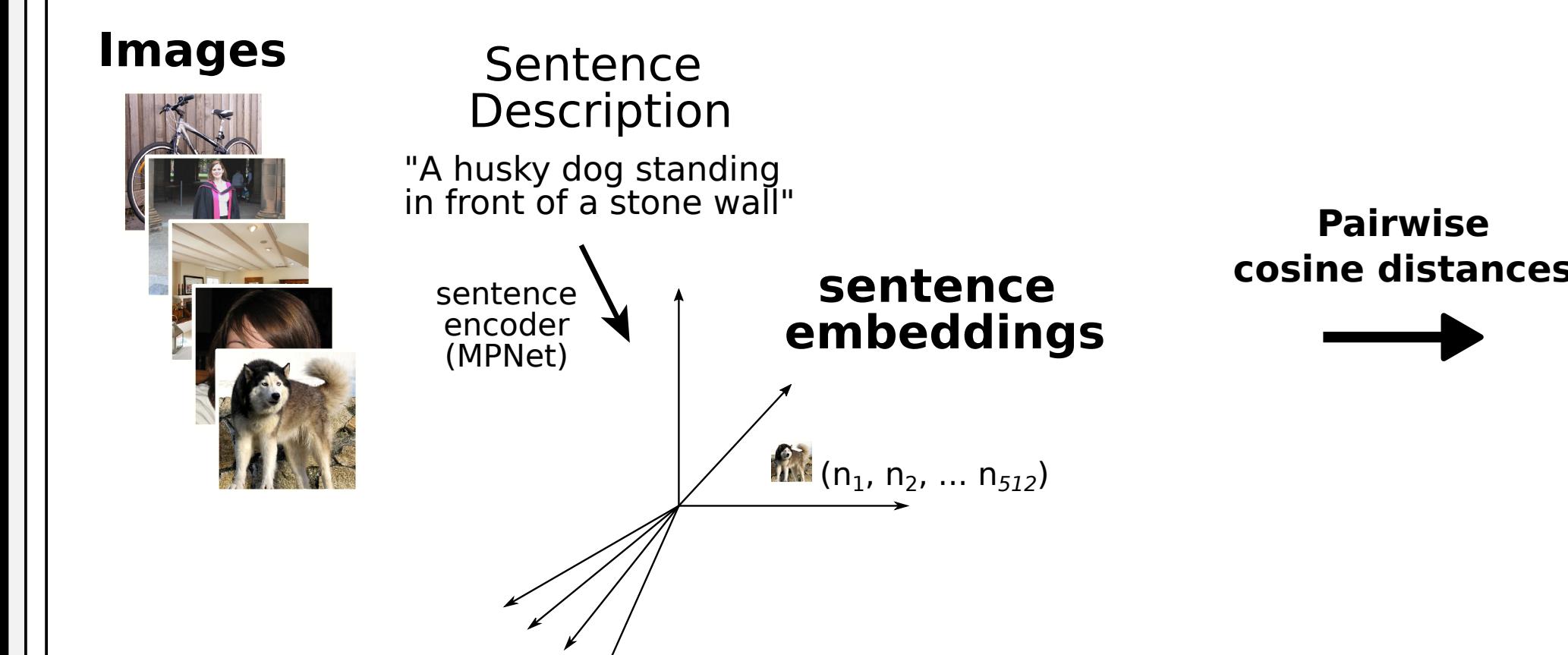


B) Pairwise hddm drift rates are stored in an RDM

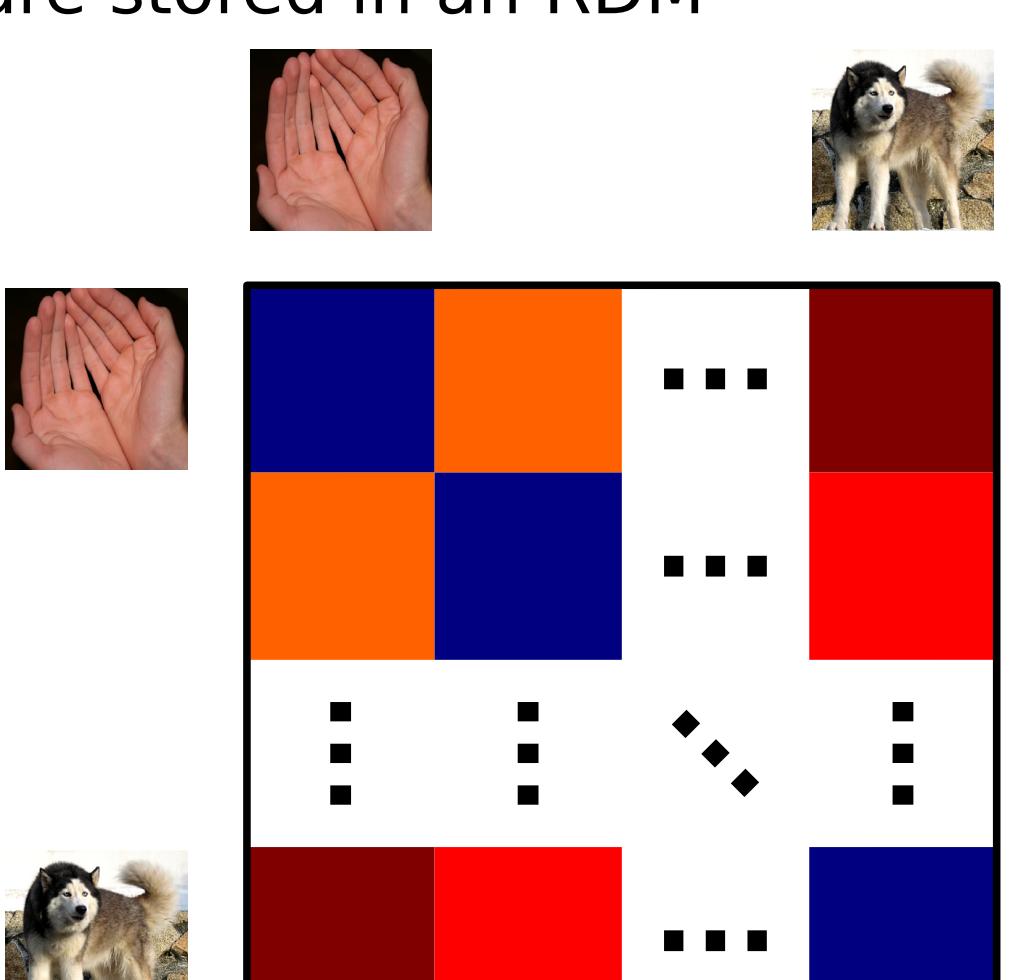


### Highly Explicit Stimulus Descriptions: The Image Captioning Task

A) Participants are shown a series of images and asked to describe each one in a sentence. Which was then projected in to latent space.

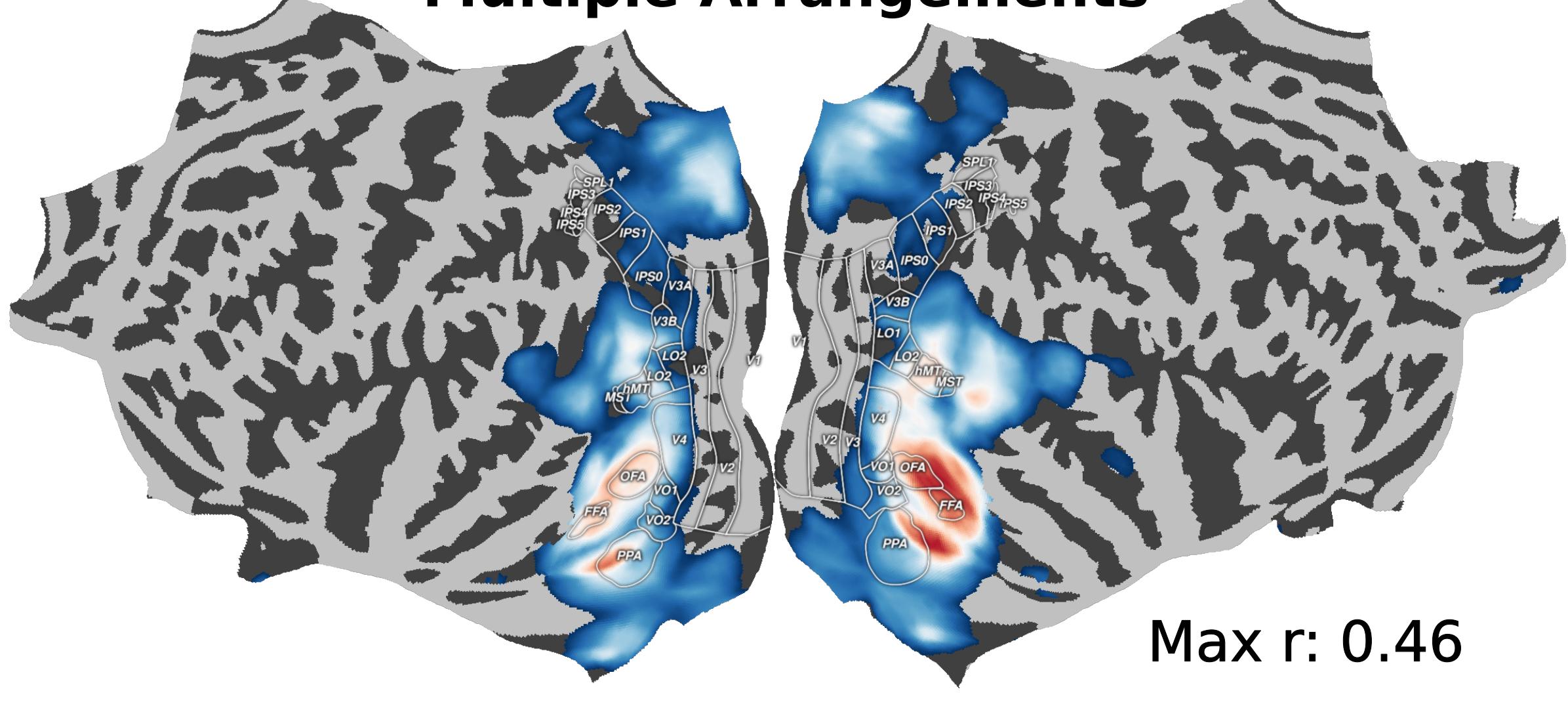


B) All pairwise cosine distances are stored in an RDM



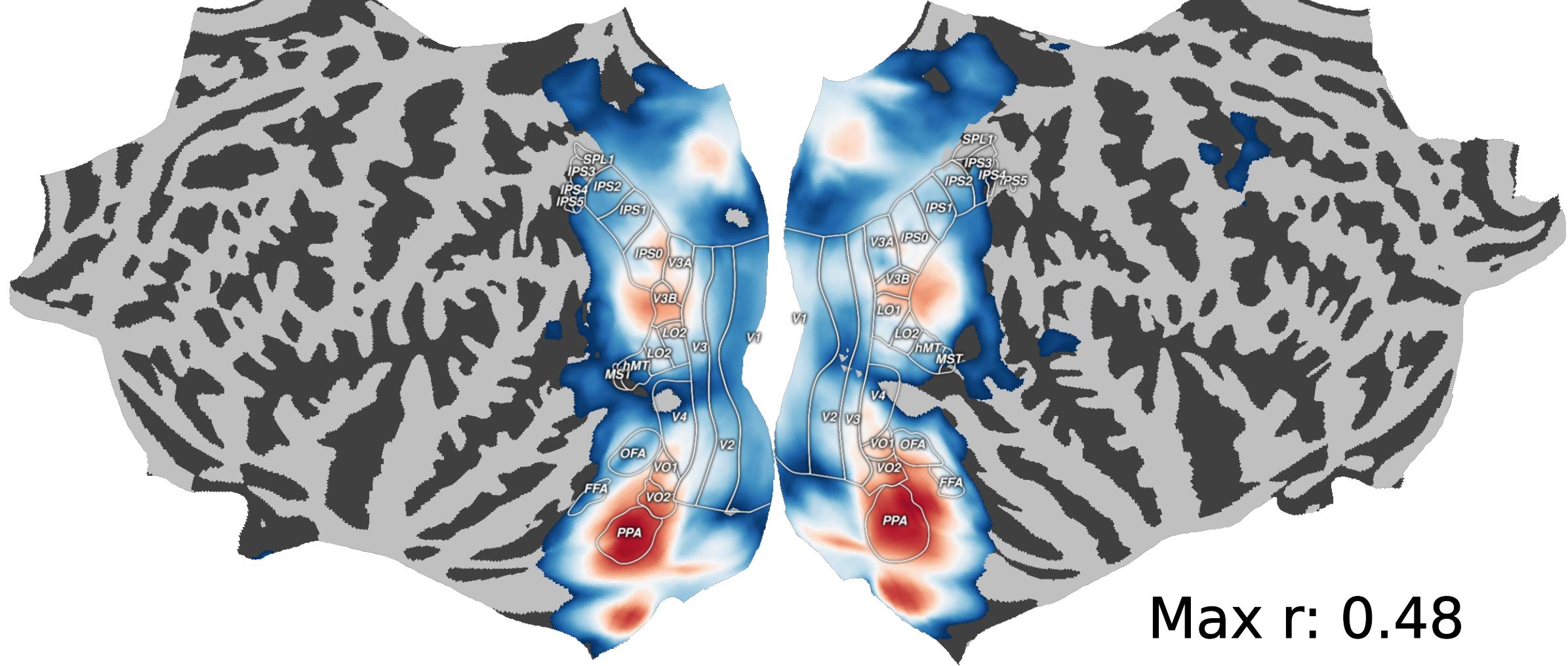
## Results

### fMRI Searchlight Mapping Multiple Arrangements



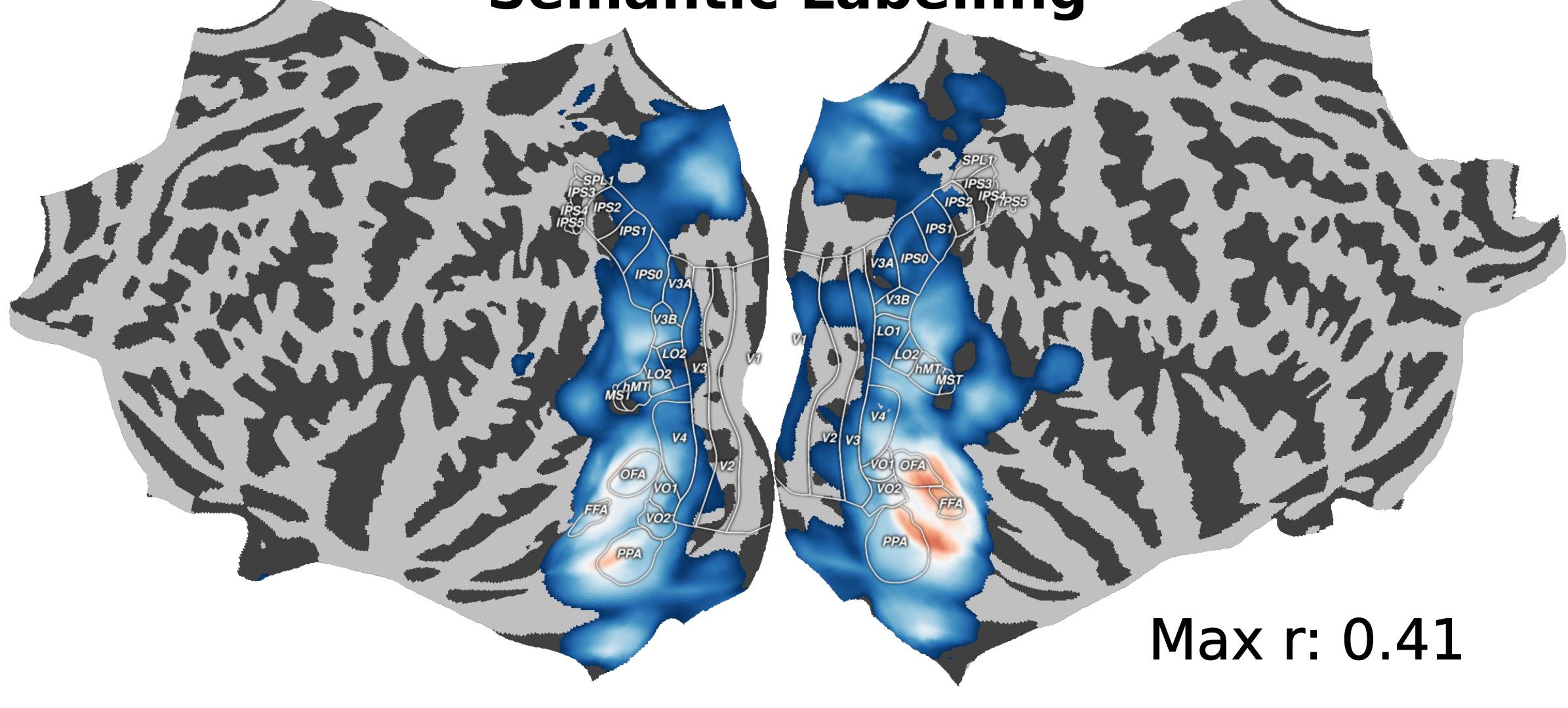
Max r: 0.46

### Discriminability Task



Max r: 0.48

### Semantic Labelling

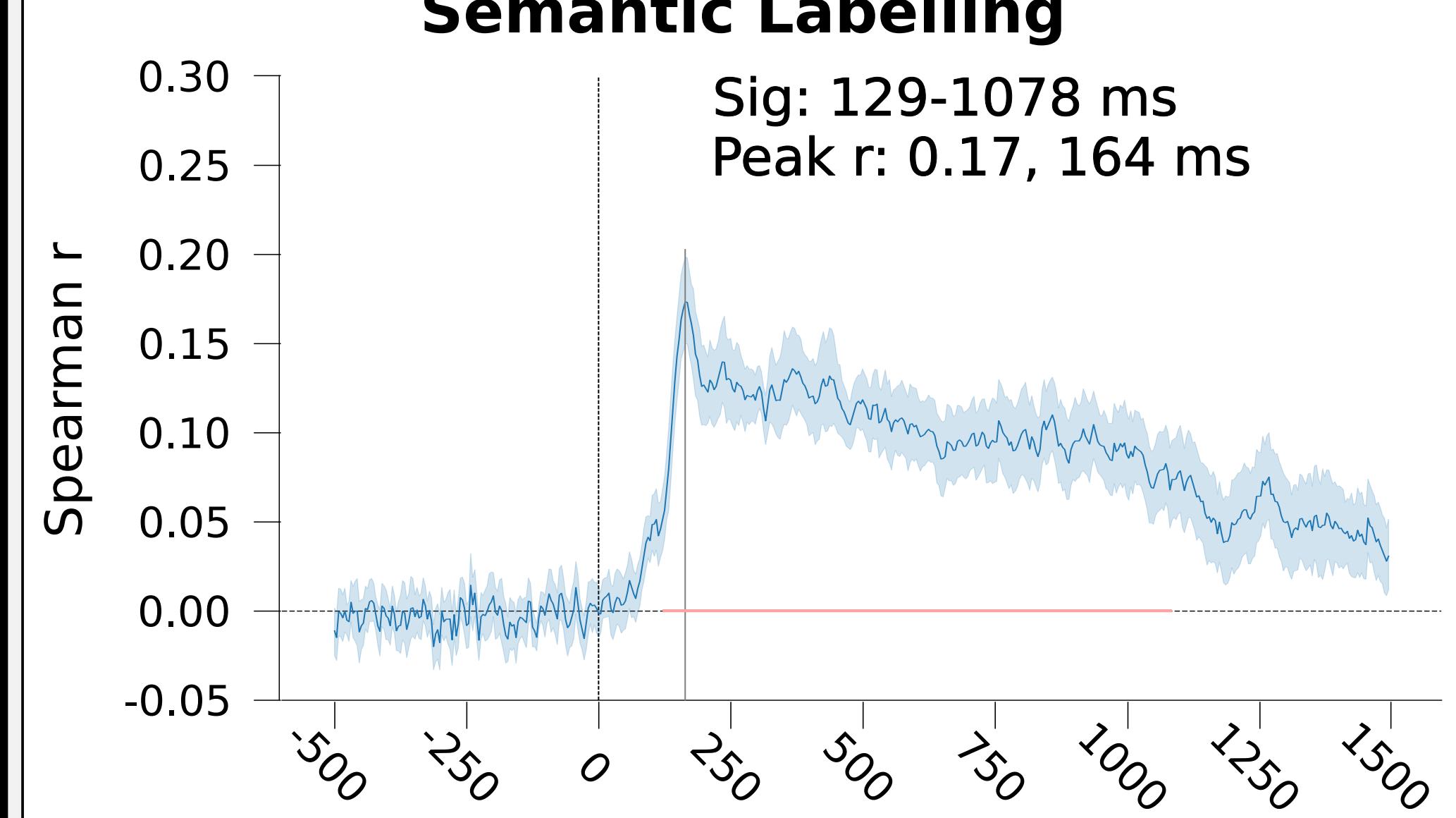


Max r: 0.41

Spearman R Coefficient  
 $P < 0.05$ , FDR corrected

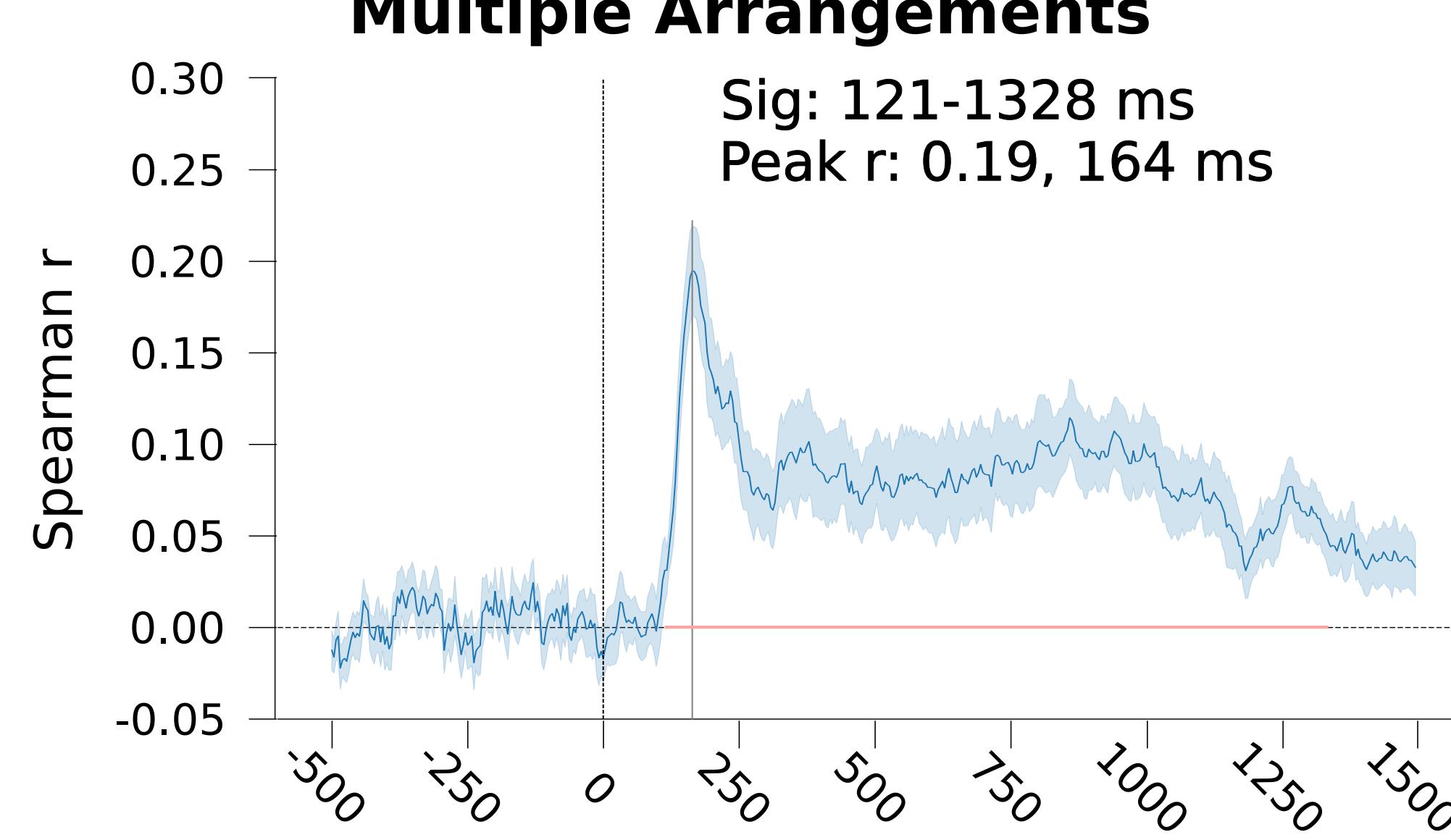
### EEG Temporal Dynamics

#### Multiple Arrangements



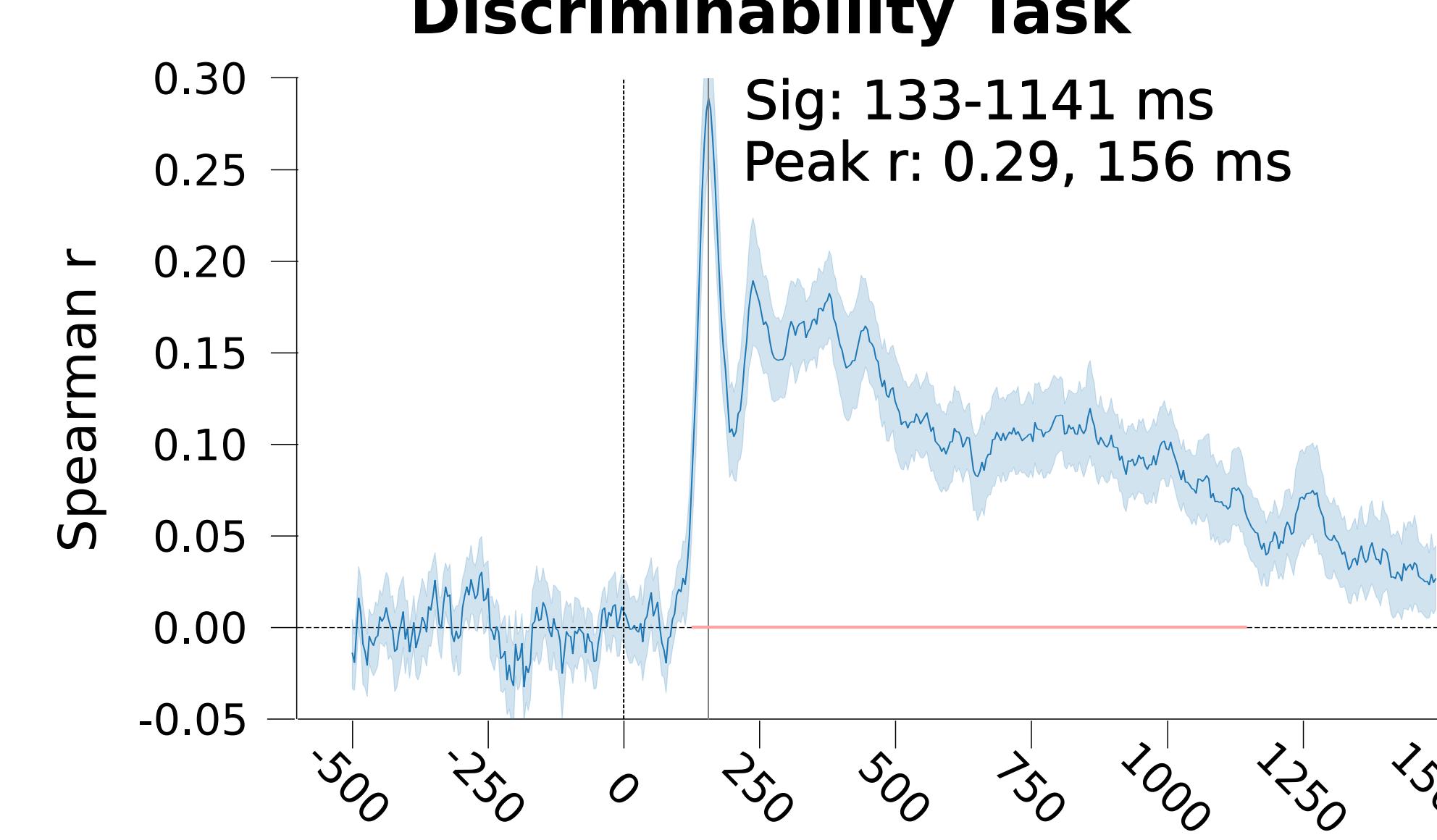
#### Semantic Labelling

Sig: 129-1078 ms  
Peak r: 0.17, 164 ms



#### Multiple Arrangements

Sig: 121-1328 ms  
Peak r: 0.19, 164 ms



#### Discriminability Task

Sig: 133-1141 ms  
Peak r: 0.29, 156 ms

## Discussion

Implicit tasks, in which conscious decisions about similarity are absent, is a strong behavioural predictor of the neural representational geometry of the visual cortex in both space and time. Compared with explicit similarity judgements, this implicit task is able to explain representational geometries along the visual ventral stream in both more posterior regions and high-level anterior regions. Combining behavioural experiments that capture complementary features underlying similarity judgements can provide a more comprehensive spatiotemporal map of neural object representations than either could alone, and provide novel insights about behaviourally relevant brain representational similarities at different stages of information processing along the visual ventral stream.

## References

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