



Neuronal mechanisms of saccade-coordinated visuospatial memory recollection in the human brain

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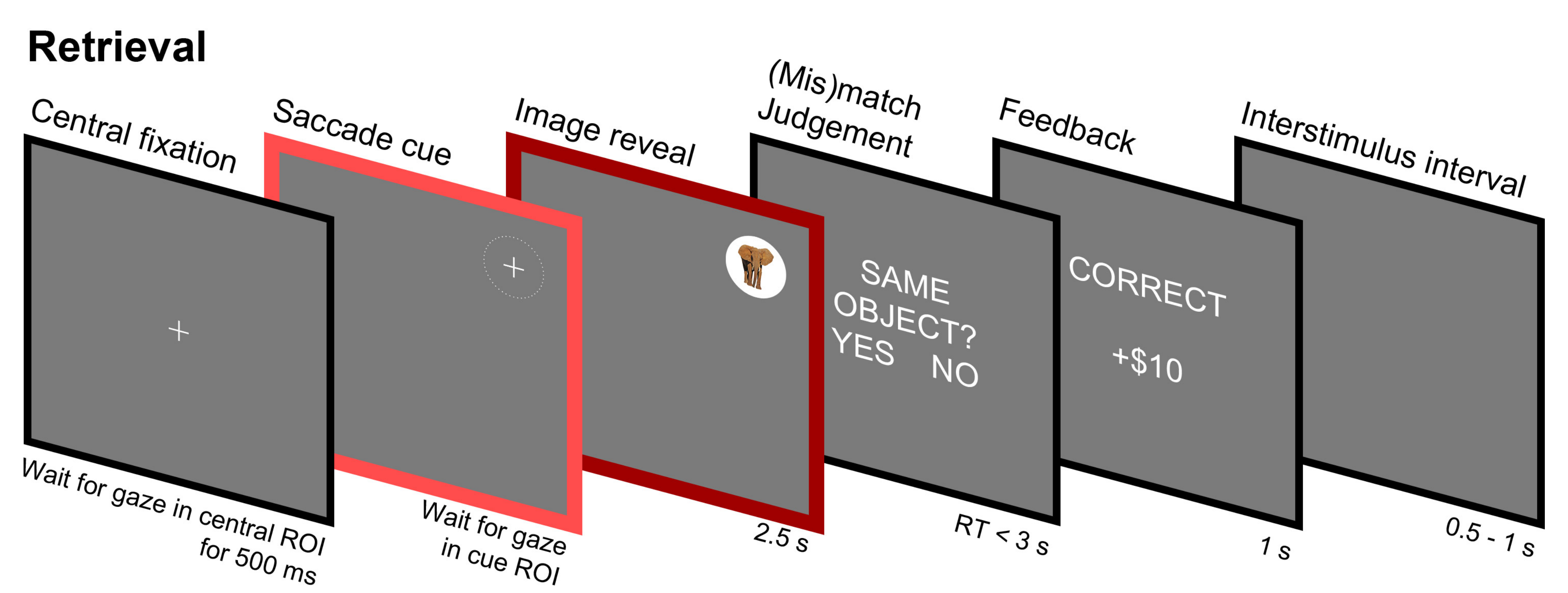
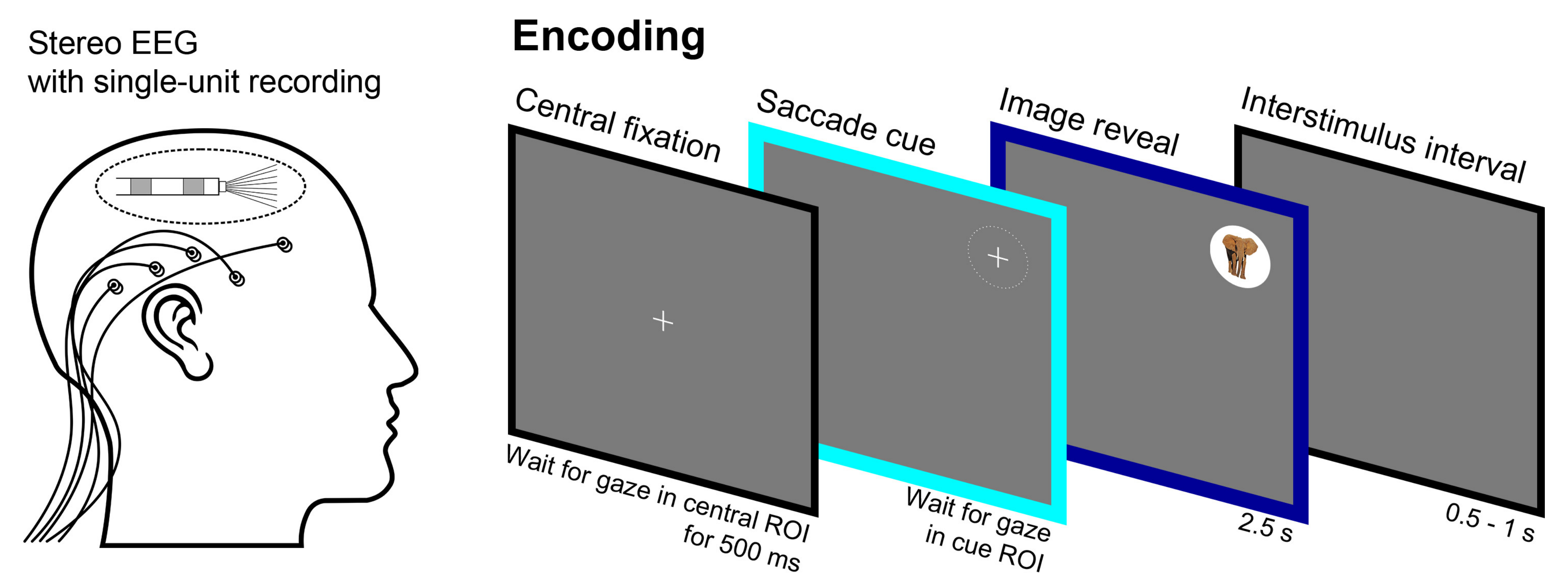


INTRODUCTION

- How the human medial temporal lobe (MTL), the major mnemonic structure, supports mnemonic prediction remains largely elusive.
- MTL concept cells represent individual concepts with high specificity¹, arguably constituting the building block of declarative memory². Concept cells also show anticipatory firing to predictable stimuli (e.g., sequences³).
- MTL also encodes eye position^{4,5} and object-space associations⁶.
- **When saccading to a previously explored location, do humans predictively reactive item memory, as indexed by the anticipatory firing of MTL concept cells?**

PARADIGM: GAZE-CONTINGENT VISUOSPATIAL MEMORY

- Individuals with epilepsy (N = 6, 1 female) implanted with Behnke-Fried electrodes
- Field potential and single-unit activities along with simultaneous eye-tracking
- A gaze-contingent paradigm ensures that any anticipatory firing can be attributed to memory retrieval, not peripheral vision or attention



Quartet	Task	Image	Location	Match
1	Encoding	Eiffel tower	↖	
1	Encoding	License plate	↘	
1	Encoding	Windmill	↙	
1	Encoding	Office chair	↗	
Self-paced				
1	Retrieval	Windmill	↙	TRUE
1	Retrieval	Office chair	↖	FALSE
1	Retrieval	License plate	↘	TRUE
1	Retrieval	Eiffel tower	↗	FALSE
Self-paced				
2	Encoding	Gavel	↘	

• 12 images (from the BOSS stimuli set) selected as stimuli from a screening session for each patient

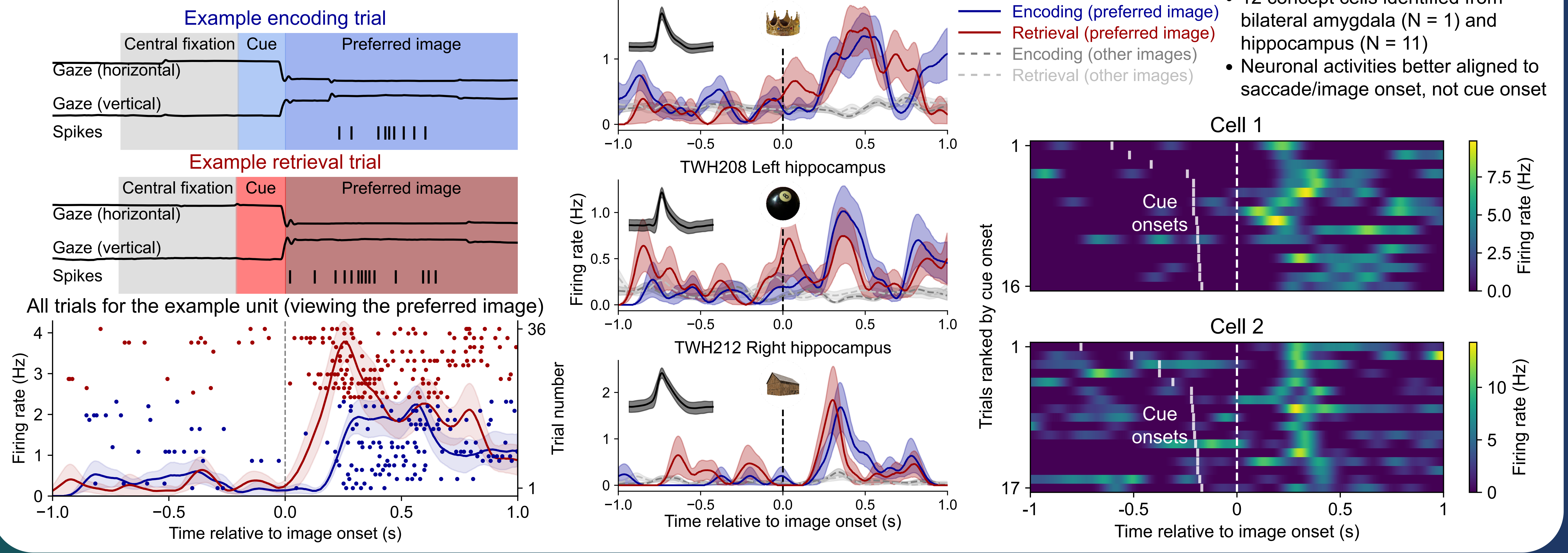
• Each mini-block consists of the encoding and retrieval of 4 images (a quartet)

• 50% chance of having a pair of images swapped

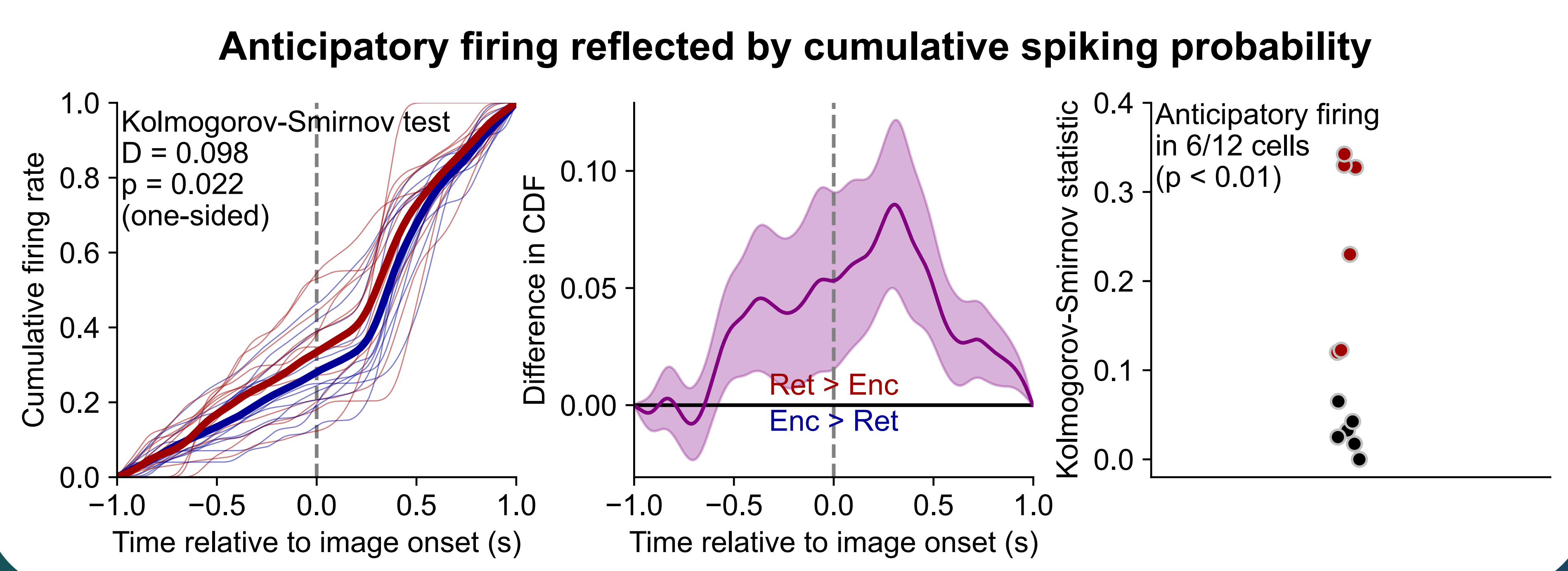
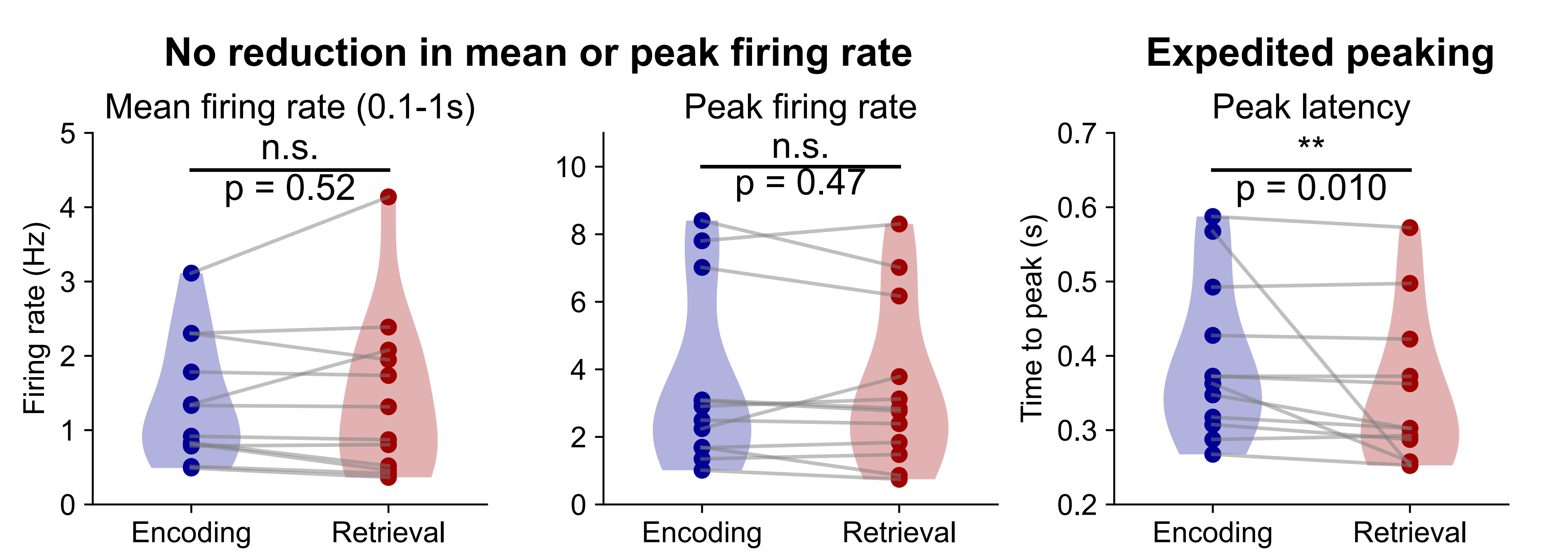
• Visuospatial association is necessary for the task

• Behavior (mean ± SD): Accuracy = 89 ± 5%, RT = 0.84 ± 0.34 sec

IDENTIFICATION OF CONCEPT CELLS



GROUP-LEVEL ANALYSES



CONCLUSIONS AND DISCUSSIONS

- Validates the feasibility and usefulness of the gaze-contingent paradigm in probing visuospatial memory
- Evidence for anticipatory firing in visuospatial memory
 - MTL retrieves image identity based on spatial cue provided by the reinstatement of gaze position (presumably via pattern completion)
 - Anticipatory firing may be a generic neural correlate of prediction generation in the MTL
 - May underlie functional enhancement of memory retrieval underlying eye movement reinstatement⁷ or REM
- Anticipatory firing is aligned to saccade but not cue onset
 - Saccadic motor signal (corollary discharge) may act as a temporal cue to coordinate memory retrieval
- No evidence of predictive suppression
 - Concept cells more likely represent predictions than error
- Supports our previous finding that visually-selective cells are not modulated by saccades⁸.

FUTURE DIRECTIONS

- Expanding analyses to non-concept cells by applying time-resolved dimensionality reduction techniques
 - Identify saccade-modulated and eye position cells and how they jointly with concept cells shape visuospatial prediction
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