

## BACKGROUND

- Episodic memories are organized by temporal and spatial context KAHANA, 1996, MILLER ET AL., 2013
- The MTL has been implicated in spatial representations and retrieval of contextual information EICHENBAUM ET AL., 2012, MOSER ET AL., 2008
- Hippocampal theta oscillations have been implicated in spatial navigation EKSTROM ET AL., 2005
- Spatial information is reinstated in the MTL during recall MILLER ET AL., 2013

### What is the neural signature of spatial context retrieval in the MTL?

- Spectral correlates of successful spatial retrieval?
- Timing of reinstatement in sub-regions?
- Communication between sub-regions?

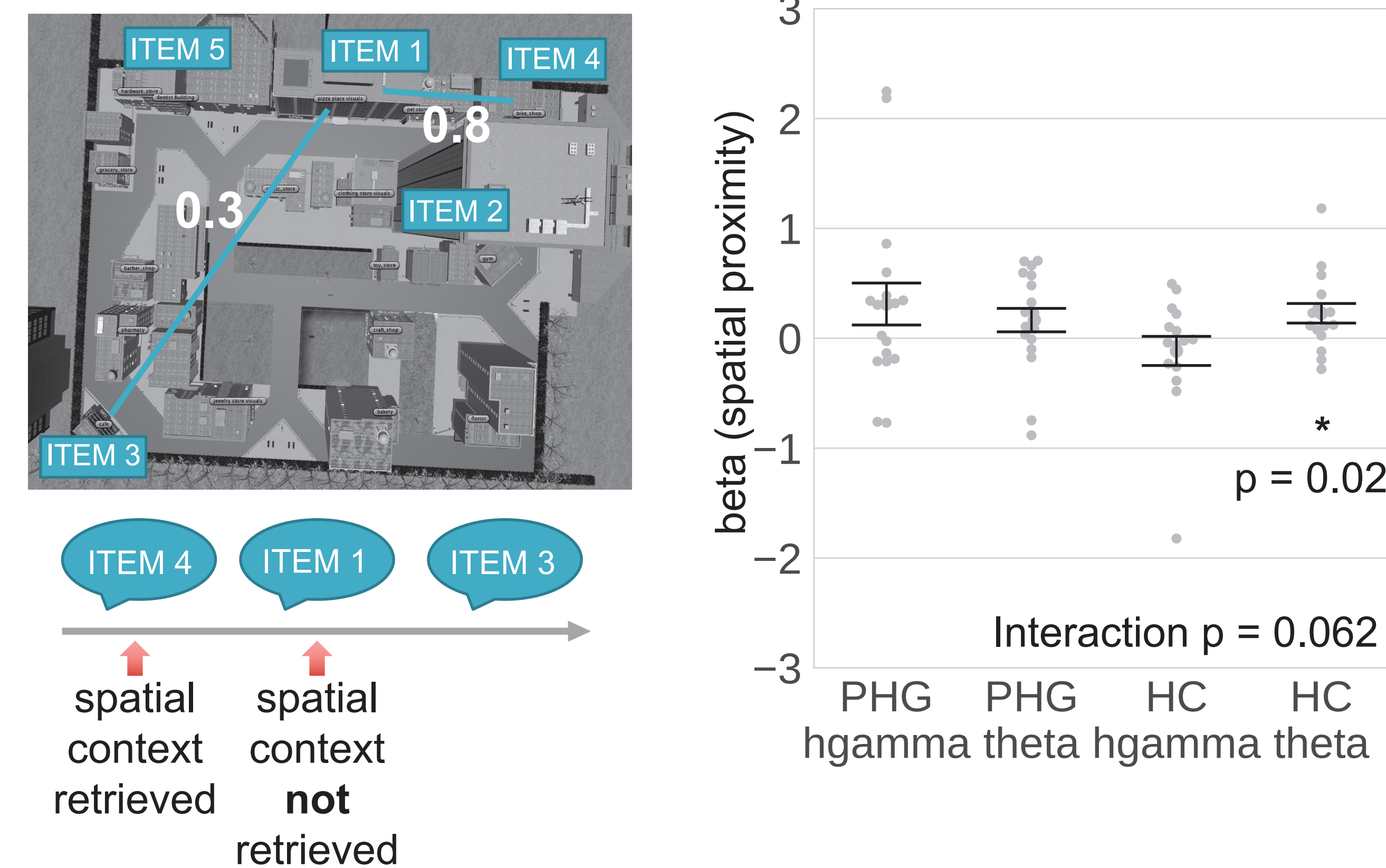
## METHODS



- Spatial free recall task with encoding phase in a virtual town
- Intracranial EEG data from 23 patients with medication-resistant epilepsy implanted with subdural strip and depth electrodes
- Bipolar referencing scheme
- Morlet wavelet convolution, log-transform, z-score
- ROIs: hippocampus (HC) and parahippocampal gyrus (PHG)
- FOIs: theta (3-8Hz), high gamma (70-100Hz)

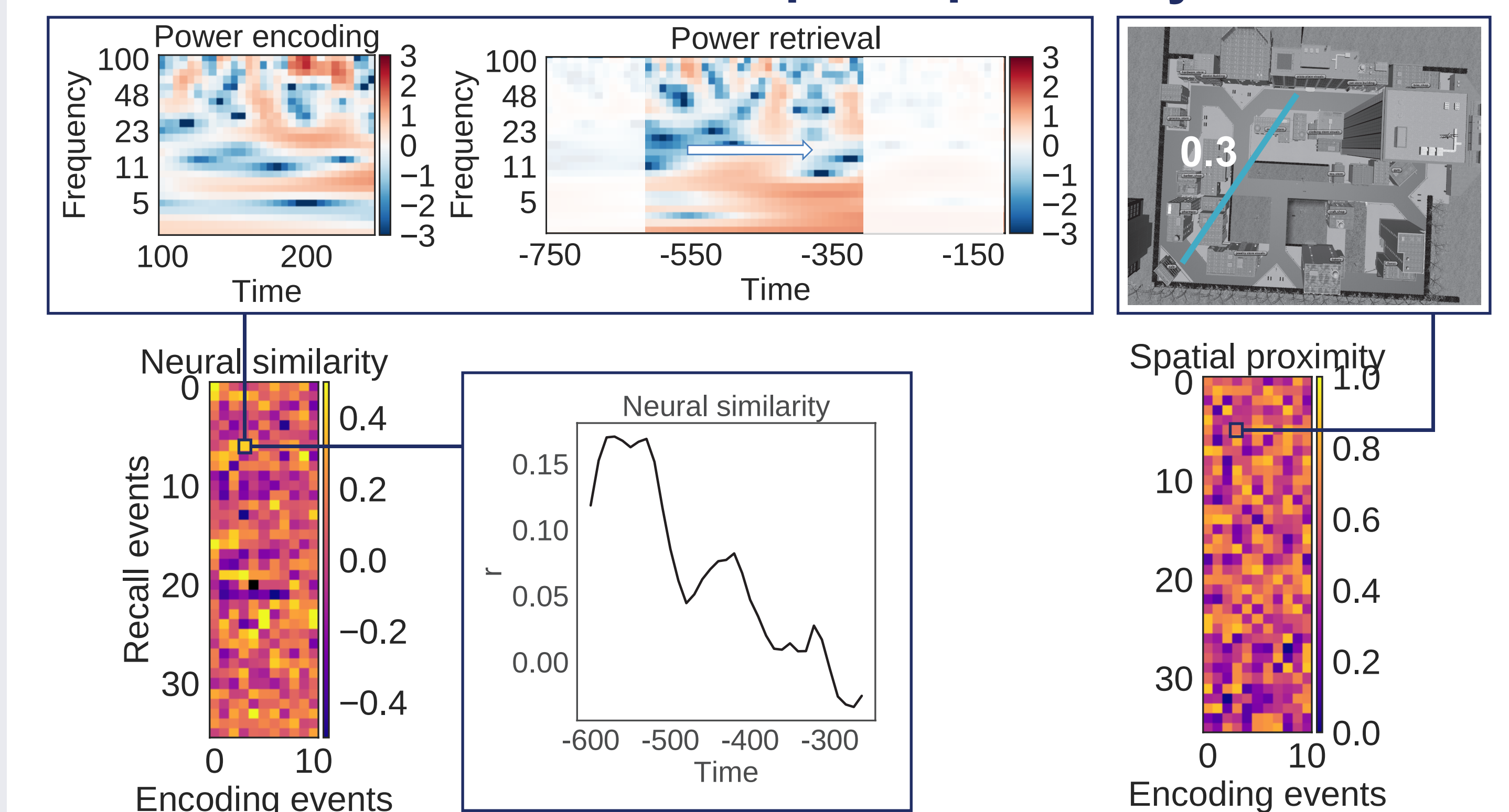


### Spectral power during recall as a function of spatial proximity

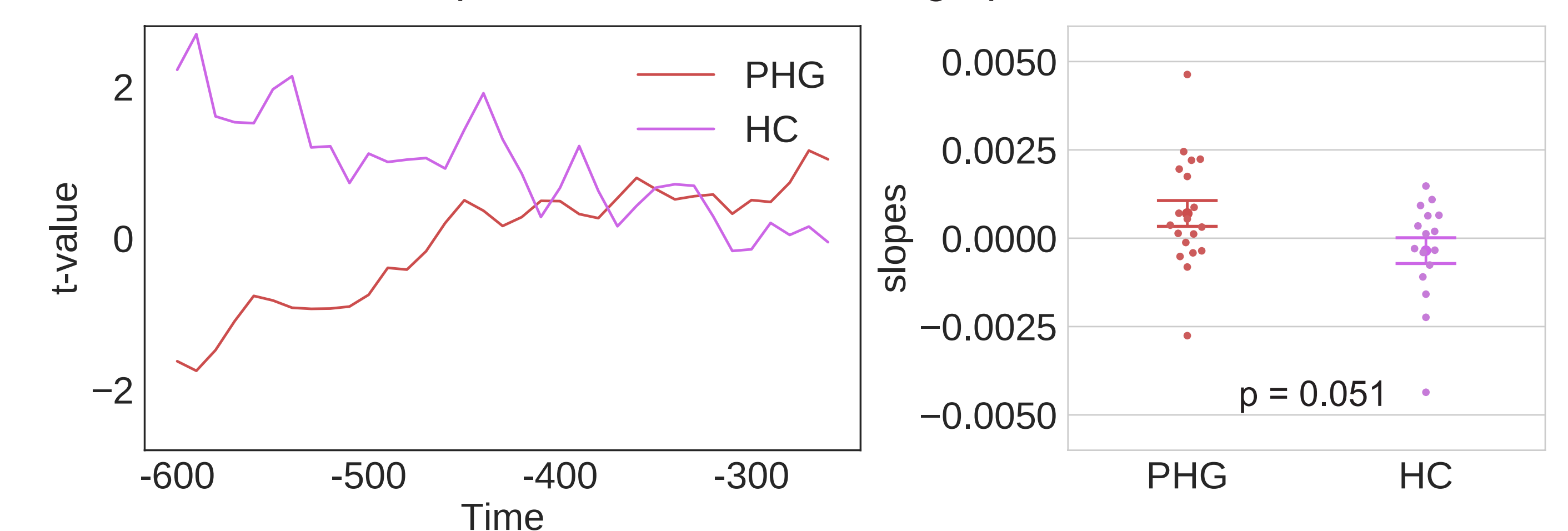


## ANALYSES & RESULTS

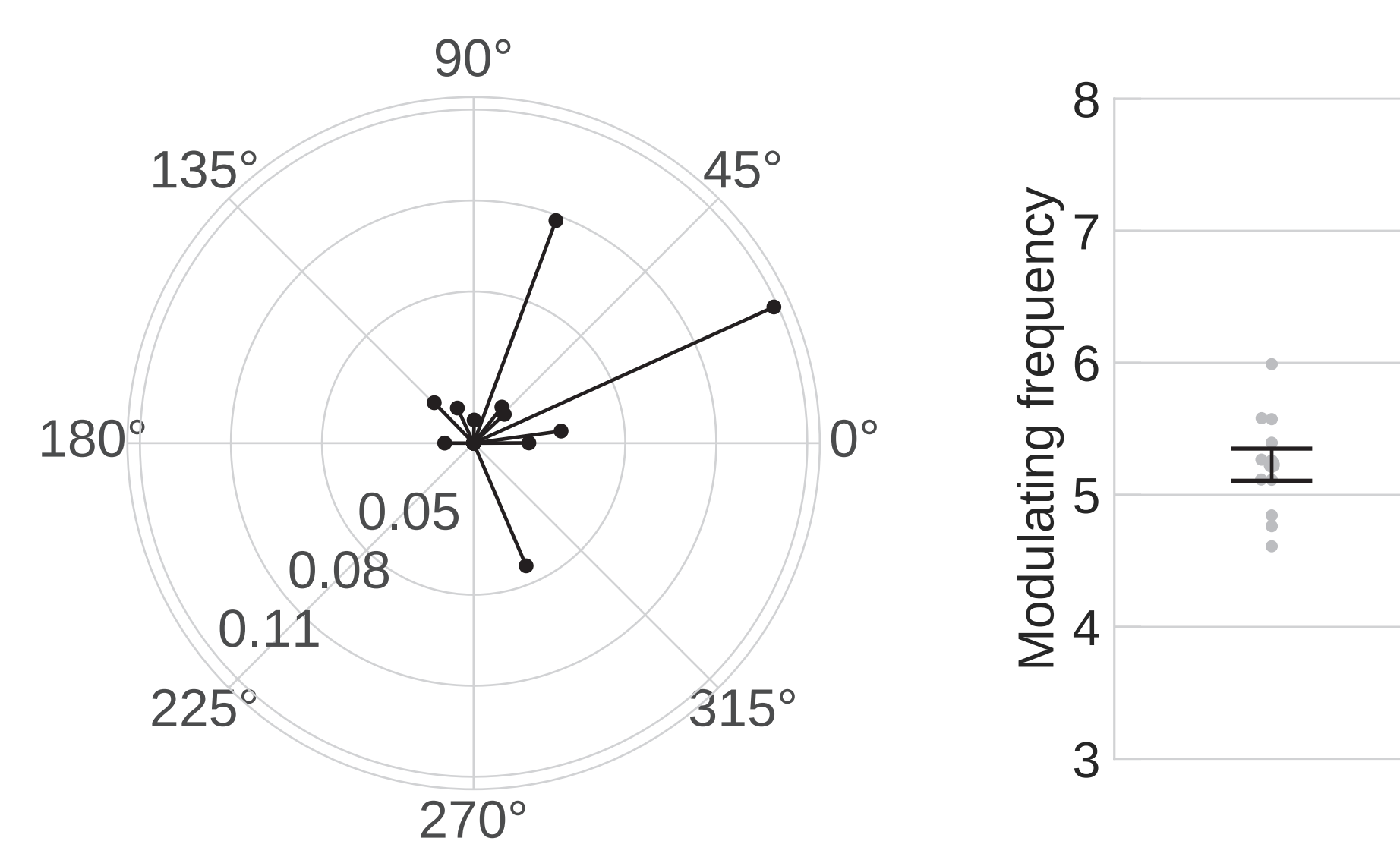
### Encoding-retrieval similarity as a function of spatial proximity



### Spatial information leading up to recall



### Theta-phase to gamma-amplitude coupling between HC and PHG during recall



Modulated frequency 86 Hz, p = 0.047, avg. preferred phase = 13°

- Cross frequency coupling measured as the consistency of phase values of the high frequency power envelope and the low frequency filtered signal COHEN ET AL., 2008
- Significance determined using a permutation procedure based on shifting the two phase time series

$$SI = \frac{1}{n} \times \sum_{t=1}^n e^{i[\phi_{lt} - \phi_{ut}]}$$

Synchronization index (SI)

## SUMMARY & CONCLUSIONS

- Retrieval of spatial context information is accompanied by an increase in hippocampal theta power
- Distinct temporal profiles of spatial context reinstatement in HC and PHG: Spatial information numerically increases in the PHG and decreases in the HC leading up to recall
- Theta-gamma coupling as a potential mechanism for inter-regional information transfer during recall

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