Multi-unit activity in human MTL reflects retrieval of spatial and temporal context

Nora A Herweg[1], Lukas Kunz[3], Paul A Wanda[1], Armin Brandt[3], Michael R Sperling[2], Ashwini D Sharan[2], Andreas Schulze-Bonhage[3], Michael J Kahana[1]

1) Computational Memory Lab, University of Pennsylvania; 2) Thomas Jefferson University Hospital; 3) University Clinic Freiburg, Germany

Contact: nherweg@sas.upenn.edu PDF of poster available at http://memory.psych.upenn.edu/Posters

BACKGROUND

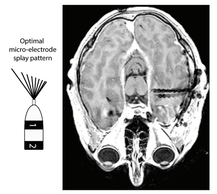
- The MTL is a core structure for episodic memory, our ability to remember events associated with a particular place and time
- Cell populations in the MTL are sensitive to place and time [1,2,3]
- Little is known about the activity of MTL neurons during the encoding and retrieval of spatial and temporal context

► What is the population response during encoding and retrieval of spatial and temporal context?

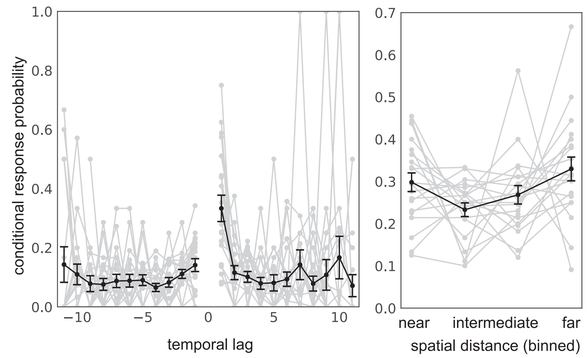
► How does it differ by MTL sub-region?

METHODS

- MTL micro-wire recordings from 19 patients undergoing clinical seizure monitoring (hippocampus, HC: 16 subjects, parahippocampal gyrus, PHG: 12 subjects, amygdala, AMY: 12 subjects)
- Subjects deliver objects to a series of target stores in a virtual town and subsequently recall those objects
- Recall transitions between items that were encoded in spatial or temporal proximity signal contextual retrieval
- We analyzed multi-unit firing rates as a function of contextual retrieval

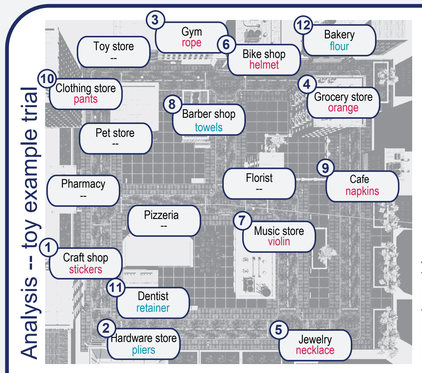


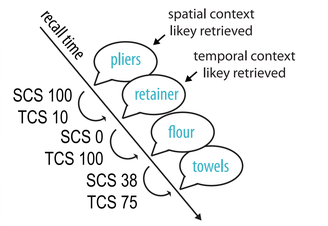
RECALL ORGANIZATION



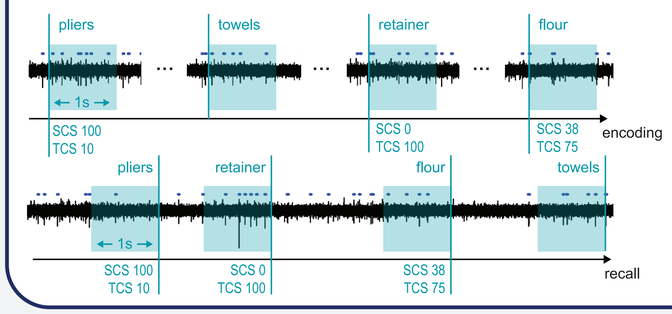
- Recalls are organized by their temporal and spatial study context [4,5], suggesting that retrieved context cues items encoded nearby
- Displayed are the conditional probabilities of transitioning from recall of item i to item j with a given temporal lag or spatial distance between these items during encoding

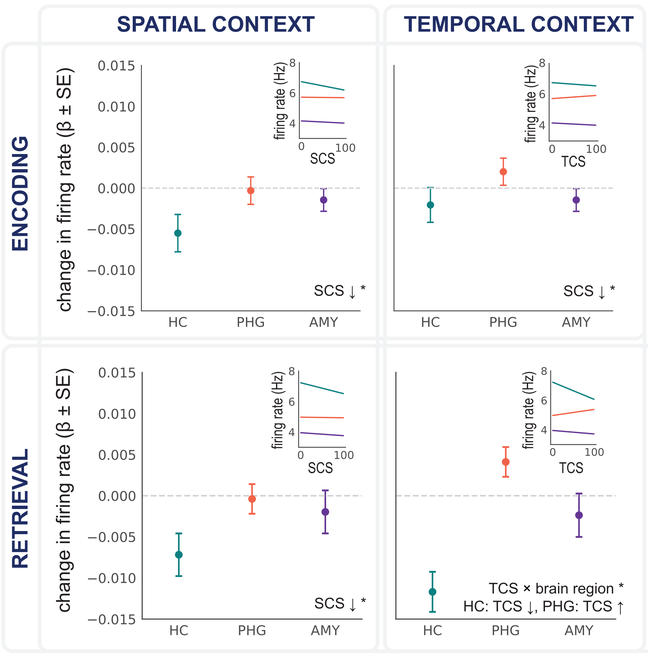
MULTI-UNIT ACTIVITY DURING ASSOCIATIVE ENCODING AND RETRIEVAL



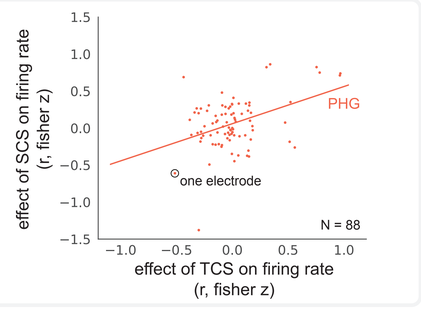


Analysis of MUA by spatial (SCS) and temporal (TCS) clustering scores, i.e. the percentile rank of spatial or temporal proximity (during encoding) between successive recalls, a measure of contextual memory





- Decrease in MUA during contextual encoding and retrieval
- Selective decrease in HC and increase in PHG during temporal context retrieval
- PHG electrodes that show increased MUA for temporal context retrieval also show increased MUA for spatial context retrieval



CONCLUSIONS

- Recall organization can reveal the neural signature of contextual memory encoding and retrieval
- Decreases in hippocampal population firing rates during contextual encoding and retrieval are in line with the idea of a sparse code in which few neurons fire for each memory [6]
- Increases in parahippocampal firing rates and the correlation between responses to temporal and spatial context retrieval may suggest that the firing of neurons in the PHG is less specific to individual memories

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