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

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BACKGROUND

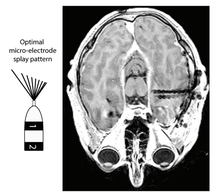
- The MTL is a core structure for episodic memory, our ability to remember events associated with a particular place and time
- Cell populations in the MTL are sensitive to place and time [1,2,3]
- Little is known about the activity of MTL neurons during the encoding and retrieval of spatial and temporal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

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

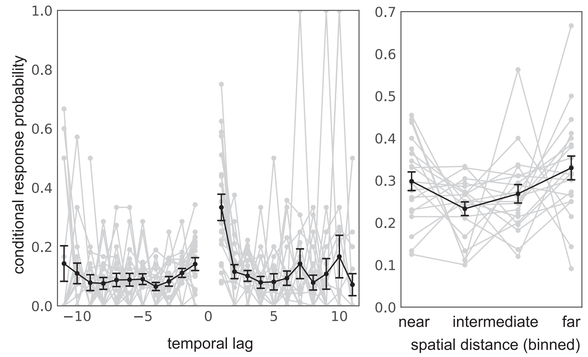
► How does it differ by MTL sub-region?

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

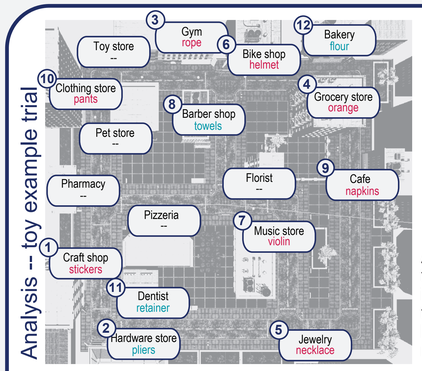


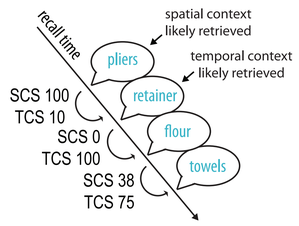
RECALL ORGANIZATION



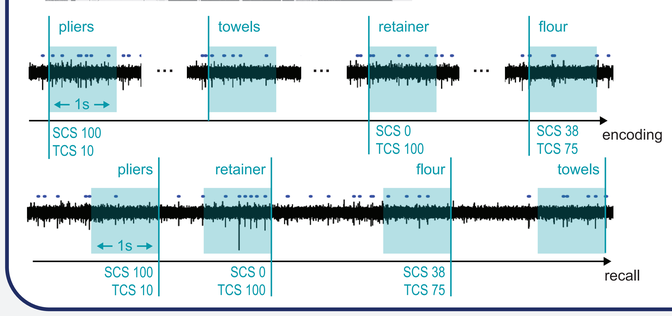
- Recalls are organized by their temporal and spatial study context [4,5], suggesting that retrieved context cues items encoded nearby
- Displayed are the conditional probabilities of transitioning from recall of item i to item j with a given temporal lag or spatial distance between these items during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

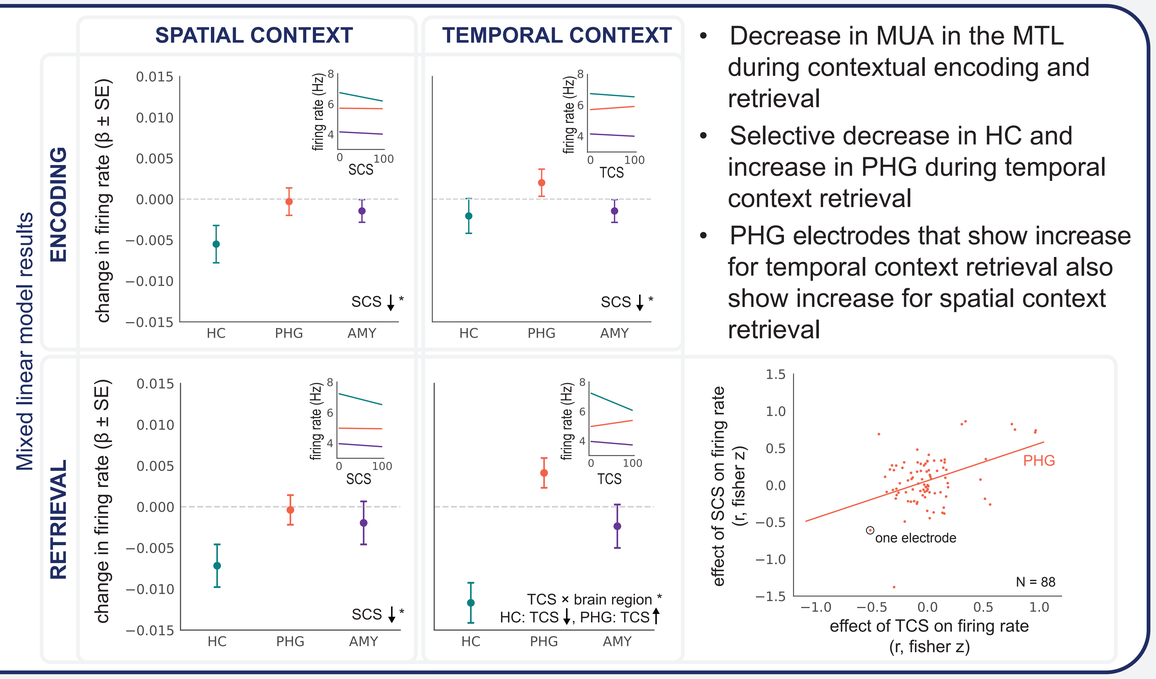
MULTI-UNIT ACTIVITY DURING ASSOCIATIVE ENCODING AND RETRIEVAL





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

CONCLUSIONS

- Recall organization reveals the neural signature of contextual memory encoding and retrieval
- Decreases in hippocampal population firing rates during contextual encoding and retrieval are in agreement 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 during temporal and spatial context retrieval suggest that the firing of neurons in the PHG is less specific to individual memories

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This work was supported by NIH grant MH061975 to MJK and by DFG grant HE 8302/1-1 to NAH.