# Familiarity signals in the human amygdala during recognition memory

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## Background

- Signals related to the familiarity of stimuli shown in recognition memory tasks are frequently observed in both the hippocampus (HF) and the amygdala (AM) in humans
- These cells are more common in HF (10%) vs Amygdala (7%), but otherwise their response appears similar between the two areas
- These signal can be observed in single-neuron recordings in human neurosurgical patients
- This work has led to the observation of memory selective (MS) cells, which respond preferentially to novel/familiar signals, as demonstrated in Fig.1

### Research Aim

- It is unclear what specifically the amygdala contributes to recognition memory. Our goal was to compare the properties of MS cells between AM and HF to identify potential roles for the amygdala in recognition memory.

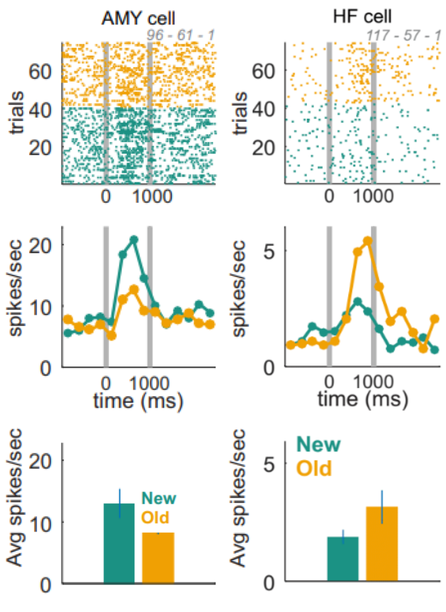



**Figure 1: Example memory selective cells in the amygdala and hippocampus**

## Task

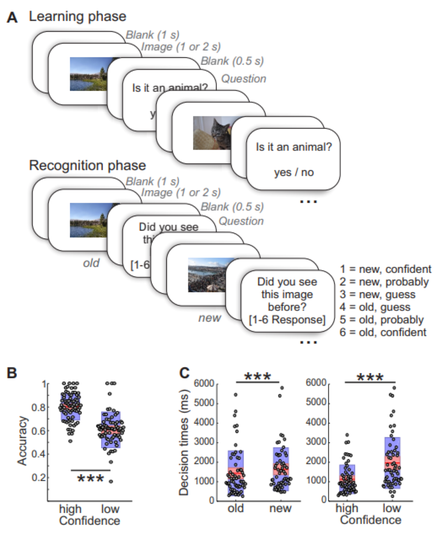



**Figure 2: Task design and behavior summary**

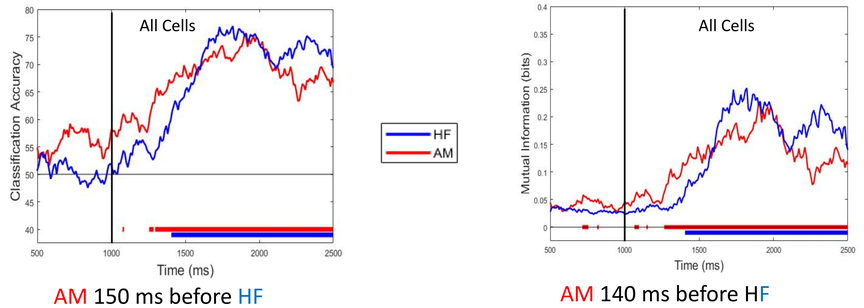
## Task Summary

- The recognition memory task (Fig. 2A) was performed by 48 participants with implanted microelectrodes for phase II epilepsy monitoring
- When subjects reported being highly confident, recognition accuracy was significantly larger than when they reported having low confidence (Fig. 2B)
- Decision times (relative to question onset until button press) were significantly slower for new compared to old stimuli (left) and low compared to high confidence trials (right). Statistics are paired Wilcoxon signed rank test. ***: p<0.001. (Fig. 2C)

## RESULTS

We used population decoding across all recorded MS cells (AM N = 75; HF N = 68) as a function of time to evaluate the first point of time at which MS cells signal the novelty/familiarity of stimuli. We used leave-one-out cross validation (SVM) and quantified performance with classification accuracy and mutual information. Permutation testing was used to determine significance. Key result: familiarity is decodable earlier in the amygdala compared to hippocampus.

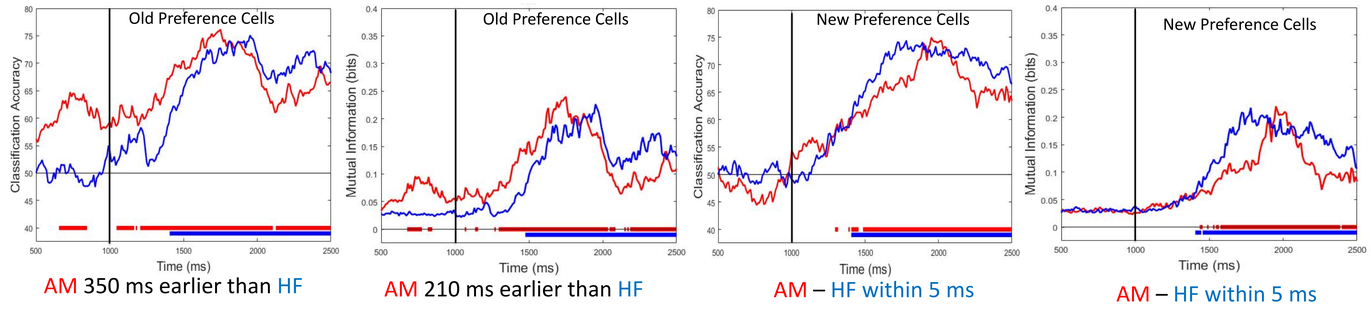
***Stimulus onset at t = 1000 ms***




AM 150 ms before HF

AM 140 ms before HF

**Figure 3: Latency difference between AM and HF. Familiarity was decodable ~150ms earlier in AM compared to HF (correct trials only, all confidence levels)**



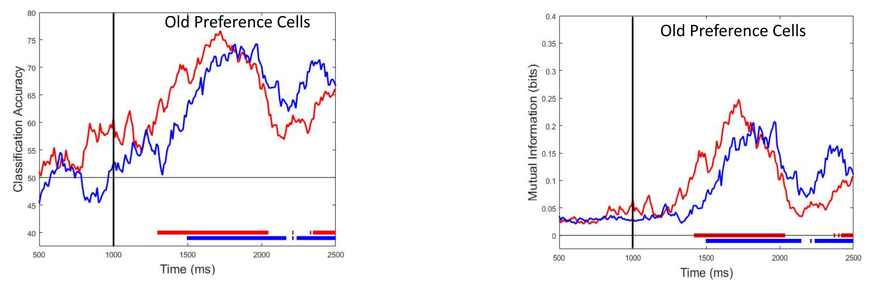

AM 350 ms earlier than HF

AM 210 ms earlier than HF

AM – HF within 5 ms

AM – HF within 5 ms

**Figure 4: Old preference AM cells maintain early latency in decoding accuracy and mutual information, as demonstrated in Fig, 3, whereas no such latency difference between AM and HF cells for new>old cells arises**




AM 200 ms before HF

AM 80 ms before HF

**Figure 5: Latency differences between AM and HF are also visible when only using high confidence trials.**

## DISCUSSION

- The early latency observed in both AM decoding is observed in old preference cells, but not new preference cells
- We hypothesized this might be due to confidence, however, we still see an early AM latency when using only high confidence trials
- We hypothesize that the amygdala might receive an earlier familiarity signal from perirhinal cortex, whereas the latter hippocampal familiarity signal is a reflection of recollection computed locally
- In the future we plan to delve deeper into the underlying mechanisms driving the responses of these cell types

## REFERENCES

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