PROGRESSION FROM FEATURE-SPECIFIC BRAIN ACTIVITY TO HIPPOCAMPAL BINDING DURING EPISODIC ENCODING

Poster #: A65

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BACKGROUND

- Episodic encoding relies on the integration of disparate features — e.g., people, objects, places, sounds — into a representation that can be subsequently recalled as a coherent event.
- Much research has demonstrated that brain regions such as left inferior frontal gyrus (IFG) and hippocampus (Hipp) support episodic encoding — increased activity predicts subsequent memory of objects and event associations e.g.,[1].
- However, less is known about how brain dynamics support the complex encoding of *multi-feature events*.
- Here, we tested how the brain simultaneously and *uniquely* encodes episodic features, and the temporal processes that support their *integration*.

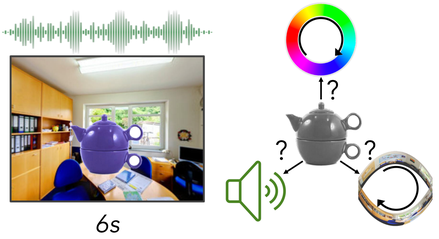
METHODS

- 27 participants **learned trial-unique objects** presented with 3 associated features [2]:

Color (360° space)

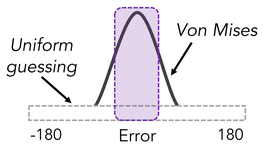
Scene location (360° space)

Sound (negative vs. neutral)

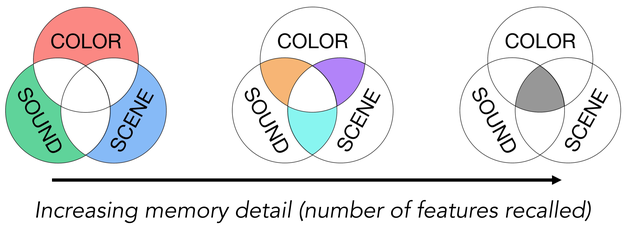


- In a later **memory test**, participants reconstructed the features of each object, cued in grayscale.

Color and Scene memory = 75% likelihood within von Mises distribution



Sound memory = correct and high confidence

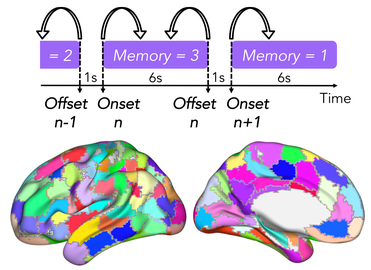


Increasing memory detail (number of features recalled)

- Each **encoding trial** was labelled according to the number (0,1,2,3) *and* type of features later successfully recalled (e.g., scene-only, color & scene, sound & color).

FMRI MODELS

- **β** estimates per encoding trial by modeling the **onset** *or* **offset**
- Mean **β**s from 204 ROIs (cortex [3] + MTL) per trial
- Linear mixed effect models (LMMs) →

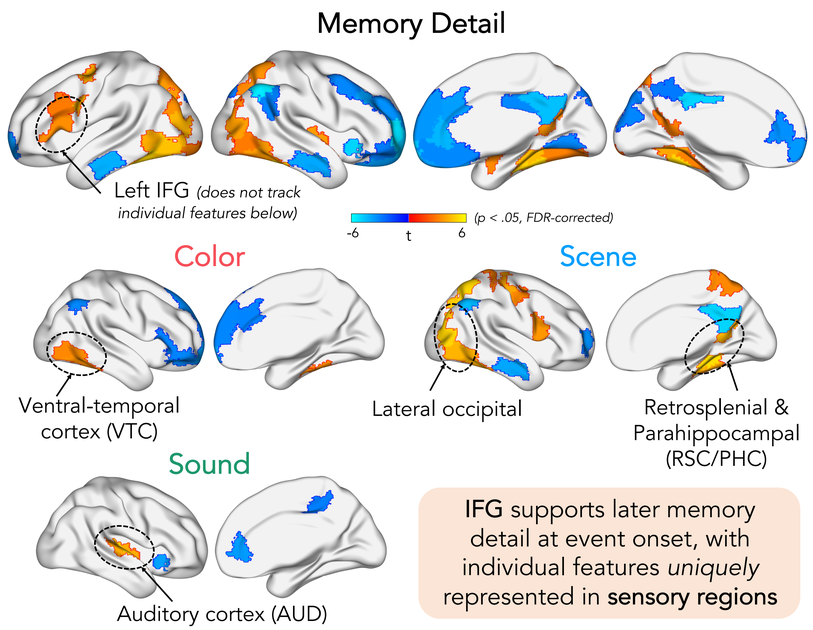


ROI **β** *~ 1 +* ***Memory Detail*** *+ (1 + Memory Detail | Subject)*

ROI **β** *~ 1 +* ***Color*** *+* ***Scene*** *+* ***Sound*** *+ (1 + Color + Scene + Sound | Subject)*

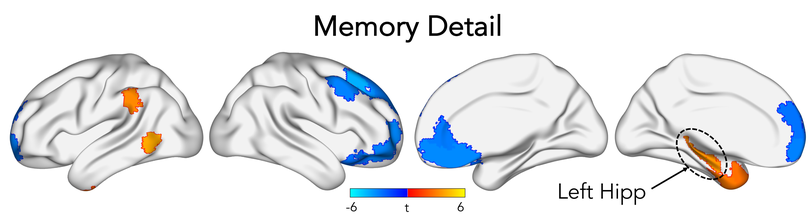
Memory Detail *= 0,1,2,3* ***Color*** */* ***Scene*** */* ***Sound*** *= 0,1*

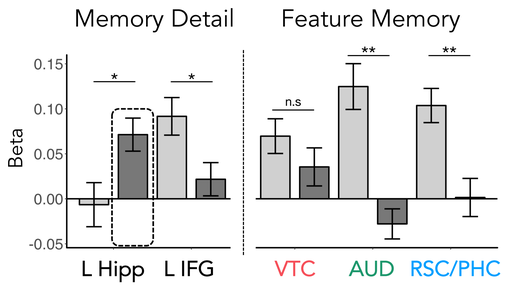
FEATURE ENCODING AT EVENT ONSET



IFG supports later memory detail at event onset, with individual features *uniquely* represented in **sensory regions**

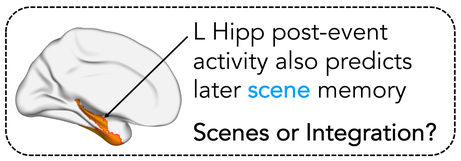
END-OF-EVENT ENCODING ACTIVITY





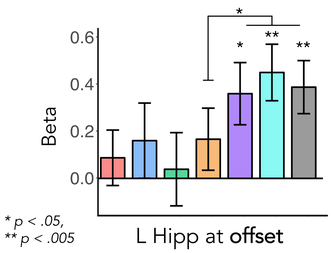
Increased left **Hipp** activity at the offset of an event tracks the number of details later remembered

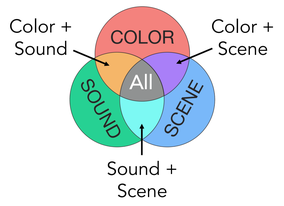
HIPPOCAMPAL SPATIAL INTEGRATION



LMM predicting ***offset*** *activity with all feature combinations (baseline = none recalled)*

Feature combinations later remembered





Hipp activity at event offset is increased when features are integrated with scene information in memory

SUMMARY

- Successful encoding of multi-feature episodes is associated with temporally evolving patterns of neural activity.
- Individual features are uniquely tracked by sensory regions early on during encoding.
- Early IFG activity tracks the amount of episodic detail later recalled, perhaps providing a conceptual organizational framework for the event.
- In contrast, a complementary end-of-event hippocampal signal may integrate the just-viewed event features into a spatially coherent representation.

REFERENCES

For further details, see:

Cooper & Ritchey (2020) Progression from feature-specific brain activity to hippocampal binding during episodic encoding. J Neurosci, 40(8), 1701-1709

[1] Horner et al. (2015) Evidence for holistic episodic recollection via hippocampal pattern completion. Nat Comms, 6:7462

[2] Cooper & Ritchey (2019) Cortico-hippocampal network connections support the multi-dimensional quality of episodic memory. eLife, 8:e45591

[3] Schaefer et al. (2018) Local-Global Parcellation of the Human Cerebral Cortex from Intrinsic Functional Connectivity MRI. Cerebral Cortex, 28, 3095-3114

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