Episodic memory

Episodic memory is the memory of autobiographical events (times, places, associated emotions, and other contextual who, what, when, where, why knowledge) that can be explicitly stated or conjured. It is the collection of past personal experiences that occurred at a particular time and place. For example, if one remembers the party on their 6th birthday, this is an episodic memory. They allow an individual to figuratively travel back in time to remember the event that took place at that particular time and place.

Neuroimaging studies of episodic memory retrieval routinely observe the engagement of specific cortical regions beyond the medial temporal lobe. Of these, medial parietal cortex (MPC) is of particular interest given its distinct functional characteristics during different types of retrieval tasks. Specifically, while recognition and autobiographical recall tasks are both used to probe episodic retrieval, these paradigms consistently drive distinct spatial patterns of response within MPC. However, other studies have emphasized alternate MPC functional dissociations in terms of brain network connectivity profiles or stimulus category selectivity. As the unique contributions of MPC to episodic memory remain unclear, adjudicating between these different accounts can provide better consensus regarding MPC function. Therefore, we used a precision neuroimaging dataset (7T fMRI) to examine how MPC regions are differentially engaged during recognition memory and how these task-related dissociations may also reflect distinct connectivity and stimulus category functional profiles. We observed interleaved, though spatially distinct, subregions of MPC where responses were sensitive to either recognition decisions or the semantic representation of stimuli. In addition, this dissociation was further accentuated by these functional subregions displaying distinct profiles of connectivity with the hippocampus during task and rest. Finally, we show that recent observations of dissociable person and place selectivity within MPC reflect category specific responses from within identified semantic regions that are sensitive to mnemonic demands. Together, by examining precision functional mapping within individuals, these data suggest previously distinct observations of functional dissociation within the MPC conform to a common principle of organization throughout hippocampal-neocortical memory systems.Significance Statement Medial parietal cortex (MPC) is ubiquitously implicated in studies of human episodic memory retrieval. Interestingly, distinct subregions of the MPC are engaged depending on the type of retrieval task being performed. Other types of functional dissociation have also been reported for MPC, focusing on brain network organization or stimulus selectivity. To reconcile these different functional views, we leveraged a precision neuroimaging dataset where participants performed thousands of recognition memory trials. We observed distinct MPC subregions supporting either recognition decisions or their semantic content, which recapitulated distinct patterns of hippocampal connectivity and visual category selectivity within MPC. These findings promote a common principle of functional organization that is shared amongst brain regions supporting episodic memory and advances our understanding of MPC [1)]

Berto et al. measured memory-sensitive oscillations using intracranial electroencephalography recordings from the temporal cortex of patients performing an episodic memory task. When these patients subsequently underwent resection, they employed transcriptomics on the temporal cortex to link gene expression with brain oscillations and identified genes correlated with oscillatory signatures of memory formation across six frequency bands. A co-expression analysis isolated oscillatory signature-specific modules associated with neuropsychiatric disorders and ion channel activity, with

highly correlated genes exhibiting strong connectivity within these modules. Using single-nucleus transcriptomics, they further revealed that these modules are enriched for specific classes of both excitatory and inhibitory neurons, and immunohistochemistry confirmed the expression of highly correlated genes. This unprecedented dataset of the patient-specific brain oscillations coupled to genomics unlocks new insights into the genetic mechanisms that support memory encoding [2)]

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Koslov SR, Kable JW, Foster BL. Dissociable contributions of the medial parietal cortex to recognition memory. J Neurosci. 2024 Mar 25:e2220232024. doi: 10.1523/JNEUROSCI.2220-23.2024. Epub ahead of print. PMID: 38527809.
2)
Berto S, Fontenot MR, Seger S, Ayhan F, Caglayan E, Kulkarni A, Douglas C, Tamminga CA, Lega BC, Konopka G. Gene-expression correlates of the oscillatory signatures supporting human episodic memory encoding. Nat Neurosci. 2021 Mar 8. doi: 10.1038/s41593-021-00803-x. Epub ahead of print. PMID: 33686299.