# Neuronal- and systems-level understanding of spatial and episodic memory.

https://www.neurodegenerationresearch.eu/survey/neuronal-and-systems-level-understanding-of-spatial-and-episodic-memory/

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**Country**

United Kingdom

**Title of project or programme**

Neuronal- and systems-level understanding of spatial and episodic memory.

**Source of funding information**

MRC

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**Start date of award**

01/10/2011

**Total duration of award in years**

5.0

**The project/programme is most relevant to:**

Alzheimer's disease & other dementias|Neurodegenerative disease in general

**Keywords**
**Research Abstract**

Our memories are critical to who we are, and depend on the hippocampal formation (HF) and its interactions with other areas. Damage or dysfunction in this system in dementia, epilepsy, stroke, or posttraumatic stress disorder (PTSD) can cause debilitating mnemonic impairments. The precise neuronal and systems-neuroscience mechanisms supporting memory are unknown, leaving a gap between molecular and physiological knowledge of neurons and

synapses and behavioural, structural and electrophysiological measures in human health and disease. To bridge this gap, I propose a convergent series of behavioural, neuropsychological, functional neuroimaging and electrophysiological experiments in healthy volunteers, neurological patients and behaving rodents, integrated via computational modelling. I will use spatial memory as a model system, using similar tasks in humans and rodents, to begin to understand the neural mechanisms of episodic memory and how they fail in conditions such as dementia and PTSD. I aim to build a quantitative computational understanding of: i) The neuronal representations underlying memory for environmental spatial locations; ii) The dynamics of these representations, focussing on rhythmicity in the theta band; iii) How novelty affects the neuronal mechanisms of memory, including the creation of new representations; iv) How the mechanisms of spatial memory extend to episodic memory, including the effects of traumatic content or neurological damage. Proposed research includes: 1) Electrophysiological recording and 2-photon microscopic calcium imaging of the activity of place cells and grid cells in rodents navigating in open environments and in head-fixed virtual reality; 2) Testing my computational model of how place cells and grid cells represent environmental locations, and developing it to include the effects of novelty, development and reconsolidation; 3) Extending the model to human spatial memory and the effects upon it of novelty, neurological damage and Alzheimer?s dementia, using fMRI and studies in neurological patients; 4) Understanding the role of theta-band rhythmicity in neural computation and the coordination of processing across brain regions, using magnetoencephalography in healthy volunteers and intracranial recording in epilepsy patients; 5) Extending the model to include the role of the HF in episodic memory: using fMRI to whether the HF supports recall by providing: attractor dynamics for recall; conjunctive codes for binding together the disparate elements of an event; pre-existing contextual associations for the formation of new memories. 6) Understanding the interaction of the HF with the amygdala and sensory systems in supporting memory for context and content of traumatic /fearful memories, and how this fails in PTSD.

**Lay Summary**
**Further information available at:**

**Types:**
Investments > €500k

**Member States:**
United Kingdom

**Diseases:**
Alzheimer's disease & other dementias, Neurodegenerative disease in general

**Years:**
2016

**Database Categories:**
N/A

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