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Bonn Lecture Series in Neuroscience

From virtual reality to reality: How neurons make memories and maps

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Life & Brain, Seminar Room, Ground Floor

All animals move through space. What are the sensory and biophysical mechanisms that generate and remember mental maps of space? How do these maps contribute to behavior? While tremendous progress has been made, these questions have not been fully resolved, partly because it is difficult to precisely measure, let alone manipulate, the wide range of sensory and motor variables that change when subjects move in space. Hence, we have developed a noninvasive, immersive and multisensory virtual reality system where precisely controlled stimuli determine the surrounding virtual space, and nonspecific stimuli are spatially uninformative. We simultaneously measured rats' behavioral performance and the activities of thousands of neurons from the hippocampal circuit while rats performed complex tasks, including the Virtual Morris Water Maze task. We also developed computational techniques to decipher the emergent neural dynamics. This integrative, experiment-theory approach provided many surprising results which I will describe.

Selected Publications

Acharya L, Aghajan Z, Moore J, Vuong C, **Mehta MR**. (2015) Causal Influence of Visual Cues on Hippocampal Directional Selectivity. *Cell*, 164: 197-207.

Mehta MR. (2015) From Synaptic Plasticity to Spatial Maps and Sequence Learning. *Hippocampus*, 25: 756-762.

Aghajan ZM, Acharya L, Moore JJ, Cushman JD, Vuong C, **Mehta MR**. (2014) Impaired spatial selectivity and intact phase precession in two-dimensional virtual reality. *Nature Neuroscience*, 18: 121-128.

Cushman JD, Aharoni DB, Willers B, Ravassard P, Kees A, Vuong C, Popeney B, Arisaka K, **Mehta MR**. (2013) Multisensory control of multimodal behavior: Do the legs know what the tongue is doing? *PLoS ONE*, 8(11): e80465.

Ravassard P, Kees A, Willers B, Ho D, Aharoni D, Cushman J, Aghajan ZM, **Mehta MR**. (2013) Multisensory control of hippocampal spatiotemporal selectivity. *Science*, 340: 1342-1346.

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