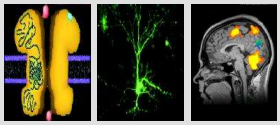

SENSORY ENCODING AND THE EMERGENCE OF MEMORY

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Session 1 **Factors influencing brain function: evolutionary, attention and stress perspectives**

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The utility of neural synchronization and synaptic plasticity for human episodic memory formation

Oscillations synchronize neural firing. Such synchronization allows a sending group of neurons to effectively drive their down-stream partners. If this happens within a critical time window, then the synaptic weights between the two neurons is changed, which is required for transforming a fleeting experience into a durable memory. While we often assume that these processes underly human episodic memory formation evidence for a direct role of such synchronizing mechanisms is scarce, and direct links with synaptic plasticity are missing. In this talk I will present recent work from human single unit studies where spiking neurons were recorded alongside local field potentials in the human medial temporal lobe during a memory task. We show how theta and gamma oscillations synchronize neurons locally and across regions. These results also show that these theta and gamma oscillations ensure co-firing of pairs of neurons in time windows that are critical for synaptic plasticity. I will also present behavioural studies where we manipulated the timing of neural assemblies via rhythmic auditory-visual stimulation. These studies show that the ability to form memories obeys exactly those timing rules that are predicted by well-known principles of synaptic plasticity. Computational models further support these results in showing that they are consistent with theta phase dependent plasticity and spike-timing dependent plasticity. In conclusion, I will revisit the utility of synaptic plasticity mechanisms observed in animal models for explaining episodic memory formation in humans.