Neuronal allocation mechanisms of recent and remote memories in the normal and pathological brain

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Neuronal allocation mechanisms of recent and remote memories in the normal and pathological brain

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The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords
Research Abstract

Associative memories are gradually stored and stabilized within the neocortical circuits during the course of systems-level memory consolidation. Recent studies have shown that an early

tagging of these neocortical circuits is crucial for the formation of enduring associative memories, via a time-dependent dialogue between the hippocampus and cortex. These intriguing findings raise many important questions. For example, which distinct neuronal populations in the neocortical network store the specific memories? Are the same neurons activated in recent and remote memory? What are the cellular plasticity mechanisms underlying memory formation and storage in the neocortex?

Recent findings suggest that a plastic change in intrinsic excitability, touching a distinct population of prefrontal cortex neurons might be involved in the encoding of an associative memory trace. Previous studies in the amygdala, hippocampus, and piriform cortex suggest that an increase in neuronal excitability plays a profound role in memory allocation and storage. As a corollary, it is hypothesized that changes in neuronal excitability (i.e. intrinsic plasticity) modulate the probability that a given neuron will be involved in storing a specific memory. We would therefore like to ask the question if intrinsic plasticity could be part of the tagging process, and if so, what is the time course of this form of plasticity? Moreover, can we establish a causal relationship between intrinsic plasticity and memory performance? Our hypothesis is that intrinsic plasticity in distinct neuronal populations could play a permissive role for the formation and subsequent storage of associative memories in the neocortex and/or could be part of the engram itself. To address this hypothesis, we need to understand the nature, dynamics, and role of this form of plasticity during memory consolidation, as well as the identity of the specific neuron types engaged in the formation of recent and remote memories. To achieve this we will employ a powerful combination of sophisticated behavioral paradigms, an innovative mouse model combines with viral targeting approaches and virally encoded tools and electrophysiological approaches. We believe that the answer to these questions will be crucial for increasing our understanding of memory formation and storage in the neocortex,

Based on the wealth of data arising from this work, we will then turn our attention to how these processes might be altered in disease. In particular we will focus on disorders of aging and to do this we will use an inducible model of Alzheimer’s disease (AD). This will enable us to examine, with temporal precision, the effect of our intervention of the intrinsic properties of neurons engaged in memory encoding. Finally, we will use viral based tools to attempt to correct the pathological changes observed in intrinsic neuronal properties in this AD mouse model and to determine their effect on behavioural readout. Through this innovative and multi-tiered approach, we hope to obtain an improved understanding of the cellular mechanisms involved in memory encoding and their pathophysiological changes in aging-based disease.

Lay Summary
Further information available at:

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