Memory and Alzheimer's: Towards a better comprehension of the dynamic mechanisms

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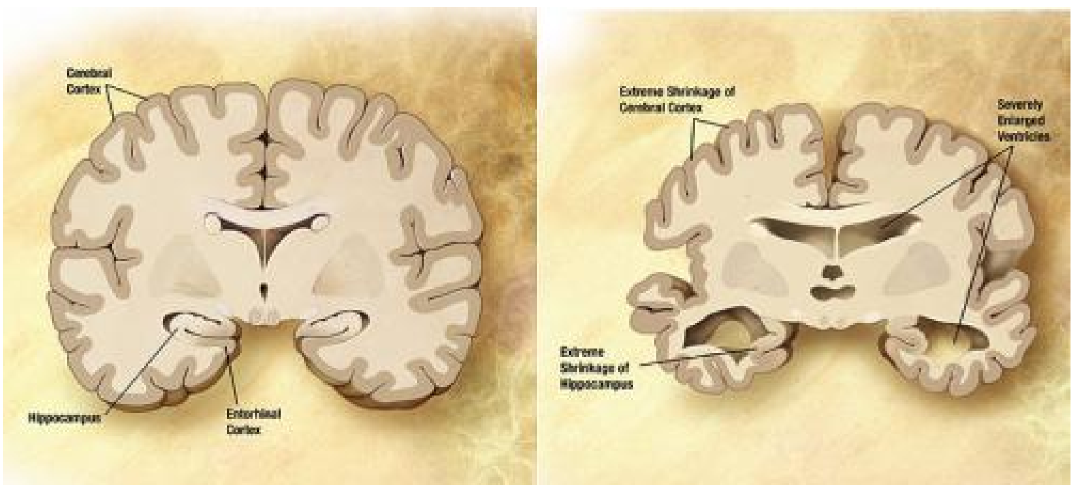

Diagram of the brain of a person with Alzheimer's Disease. Credit: Wikipedia/public domain.

A study just published in the prestigious *Nature Neuroscience* journal by, Sylvain Williams, PhD, and his team, of the Research Centre of the Douglas Mental Health University Institute and McGill University, opens the door towards better understanding of the neural circuitry and dynamic mechanisms controlling memory as well of the role of an essential element of the hippocampus – a sub-region named the subiculum.

In 2009, they developed a unique approach – namely, the in vitro preparation of a hippocampal formation. Now, the research team of Dr.

Williams has succeeded in demonstrating in mice that, contrary to what has been thought to be the case for a hundred years, the flow of activity linked to memory in the hippocampus is not unidirectional and that the subiculum is not simply the exit point of this flow.

At the heart of memory

Memories form the very core of our identity. Despite this, the creation and retrieval of memories are phenomena that are not yet well understood. The neural circuitry underlying learning and memory are studied primarily because of their fundamental role in memory and diseases affecting it, such as Alzheimer's. The work of Dr. Williams and his team in the last few years has been concerned with understanding the dynamics of this circuitry. While we can say that the processes of memory encoding and retrieval require the activation of hundreds of thousands of neurons in the hippocampus working together synchronously, we still know very little about the circuits – or "routes" – underlying these processes.

Understanding how neurons of the hippocampus behave will give powerful insights into the anomalies in neural circuitry involved in Alzheimer's disease and schizophrenia and will lead to more targeted interventions.

"It is only by identifying these circuits as well as their dynamic within the hippocampus that we will understand the mechanisms responsible for memory," says Dr. Williams. "Moreover, a better comprehension of the intricate dynamics of these circuits could be used to identify very early changes indicating the development, or future development, of Alzheimer's disease. Indeed, we have recent results that show that, in mouse models of Alzheimer's, these small alterations can appear long before memory loss."

This recent research was able to be undertaken thanks to optogenetics, a revolutionary technique which offers the unique capability to manipulate specific groups of neurons with light to better understand their role in neural circuits and brain rhythms.

The complete article (Reversal of theta rhythm flow through intact hippocampal circuits) is published on August 31in *Nature Neuroscience*.

More information: Reversal of theta rhythm flow through intact hippocampal circuits, *Nature Neuroscience*, DOI: 10.1038/nn.3803

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