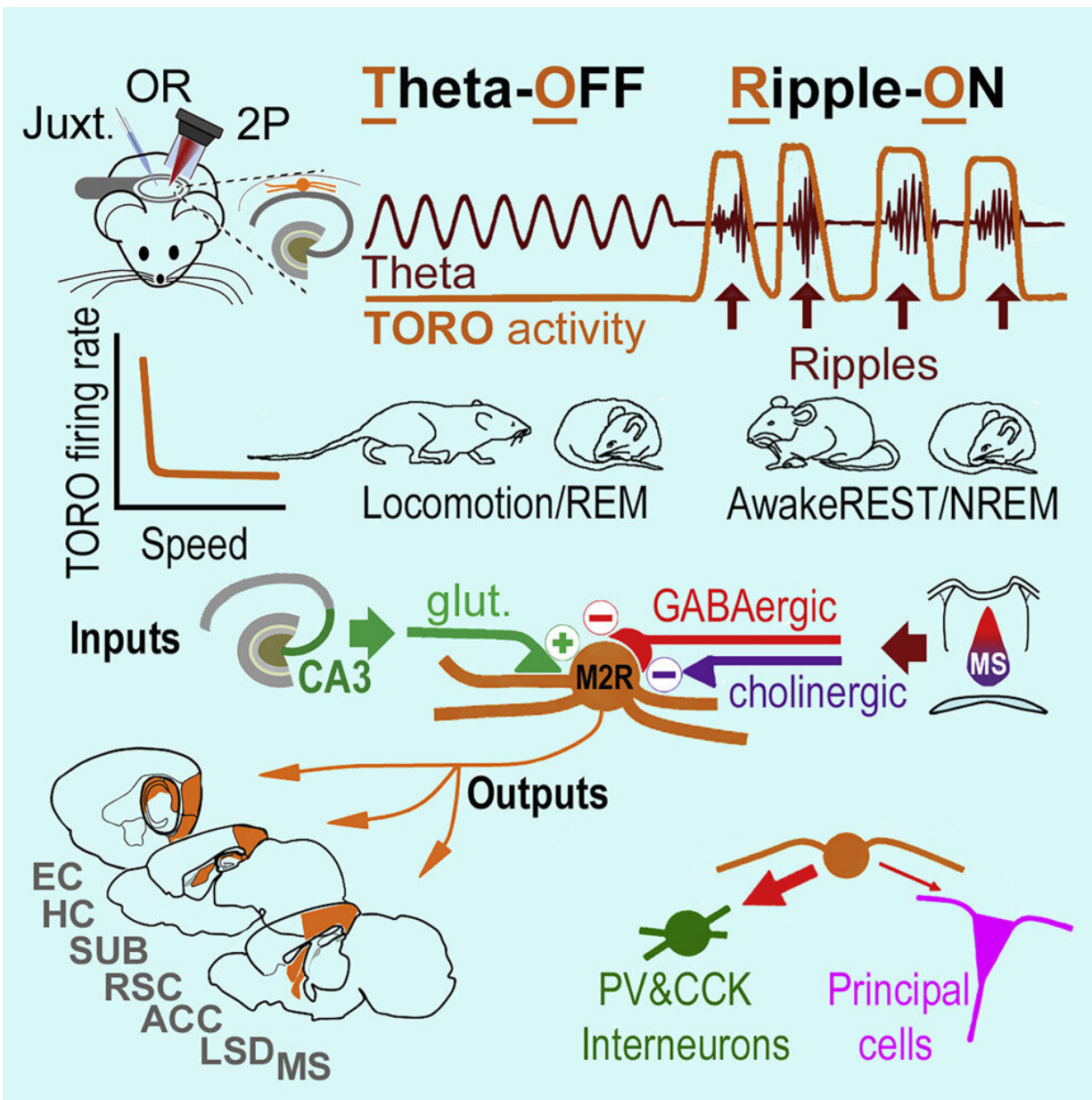


Newly discovered brain cell sheds light on the formation of memories

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Graphical abstract. Credit: *Neuron* (2022). DOI: 10.1016/j.neuron.2022.04.002

Researchers have long known that memory is represented by changes in the part of the brain called the hippocampus.

One of the well-established changes in the [hippocampus](#) that has been associated with memory is the presence of so-called sharp wave ripples (SWR). These are brief, high-frequency electrical events generated in the hippocampus, and they are believed to represent a major event occurring in the brain in the so-called [episodic memory](#). This type of memory refers to episodes that took place in the life of an individual, such as [childhood memories](#), recollection of the first date with a partner or memory of an old cell phone number.

However, what happens in the famous seahorse-shaped structures of the brain—the hippocampus—when SRWs are generated has not been well understood.

Now a new study sheds light on the existence of a neuron type in the mouse hippocampus that might be a key to better understanding of episodic memory.

Professor Marco Capogna and Assistant professor Wen-Hsien Hou from the Department of Biomedicine at Aarhus University have contributed to the discovery of the novel neuron that is associated with sharp wave ripples and memory. The study was recently published in the scientific journal *Neuron* in collaboration with Professor Ivan Soltesz' group at Stanford University.

Might be disrupted in dementia and Alzheimer's

The study reports the novel neuron type—or nerve cell—in the hippocampus, defines its functional role in the brain, discloses its connectivity with other [nerve cells](#) and [brain areas](#) and progresses the understanding of brain circuits underlying fast brain waves that are often associated with memory.

"We have found that this new type of neuron is maximally active during SWRs when the animal is awake—but quiet—or deeply asleep. In contrast, the neuron is not active at all when there is a slow, synchronized neuronal population activity called 'theta' that can occur when an animal is awake and moves or in a particular type of sleep when we usually dream," Professor Marco Capogna says.

Because of this dichotomic activity, this novel type of neuron is named theta off-ripples on (TORO).

The study is relevant for experts in the field of memory, hippocampus and neural circuits. However, it may also raise attention from anybody interested in how the brain works in memory process.

"How come, TORO-neurons are so sensitive to SWRs? The paper tries to answer this question by describing the functional connectivity of TORO-neurons with other neurons and brain areas, an approach called circuit mapping. We find that TOROs are activated by other types of neurons in the hippocampus, namely CA3 pyramidal-neurons and are inhibited by inputs coming from other brain areas, such as the septum," Marco Capogna says.

"Furthermore, the study finds that TOROs are inhibitory neurons that release the neurotransmitter GABA. They send their output locally—as most GABAergic neurons do—within the hippocampus, but also project and inhibit other brain areas outside the hippocampus, such as the septum and the cortex. In this way, TORO-neurons propagate the SWR

information broadly in the [brain](#) and signal that a memory event occurred," he explains.

The team has monitored the activity of the neuron by using electrophysiology—a technique that detects activity of the neurons by measuring voltage versus time, and by using imaging that detects activity by measuring changes in calcium signaling inside the neurons.

An important next step would be to demonstrate a [causal link](#) between the activity of TORO-nerve cells and memory. Furthermore, it will be interesting to document whether inhibition of TORO-neurons and sharp wave ripples occurs in dementia and Alzheimer's diseases causing [memory](#) loss.

More information: Gergely G. Szabo et al, Ripple-selective GABAergic projection cells in the hippocampus, *Neuron* (2022). [DOI: 10.1016/j.neuron.2022.04.002](#)

Provided by Aarhus University

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