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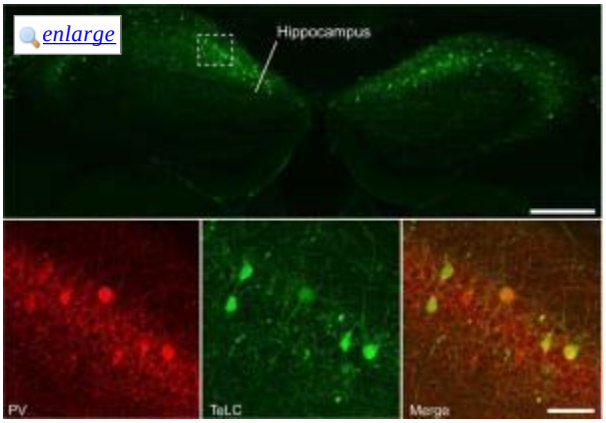
Learn to the Rhythm: Nerve Cells Acting as Metronomes Are Necessary for Certain Memory Processes

ScienceDaily (Feb. 24, 2011) — Usually, we associate rhythms with dance and music. But they also play an important role in the brain. When billions of neurons communicate with each other, certain rhythmic activity patterns arise. The proper metre in this interplay is provided by nerve cells that do not excite other cells, but inhibit their activity instead.



Metronomes in the brain of a mouse: fast reacting, inhibitory nerve cells in the hippocampus ("PV", red) could specifically switched off ("TeLC", green), as can be seen in the merged picture in the lower right. This resulted in an impaired working memory, while the spatial reference memory remained intact. (Credit: M. Bartos, University of Freiburg)

One type of these inhibiting cells acts in a particularly fast and efficient way and is therefore thought to be crucial for memory formation and information processing in neuronal networks. Scientists from Freiburg and the UK were able to specifically switch off this cell type and to observe the consequences for memory formation. Surprisingly, they found that working memory is highly dependent on fast inhibitory cells, whereas spatial reference memory can operate without these neuronal metronomes.

In the journal *Nature Neuroscience*, Marlene Bartos from the Institute for Physiology I and the Bernstein Center of the University of Freiburg and her colleagues Peer Wulff from the University of Aberdeen and William Wisden from the Imperial College London describe how they were able to specifically switch off these fast inhibiting "interneurons" in the hippocampus of mice. This part of the brain is central to the formation of spatial memories. When the interneurons' output was switched off, the mice behaved completely normal.

Only when the scientists presented the animals with an orientation task that required a functional working memory, impairments became obvious. The mice had to learn to reach a goal within a Y-shaped maze. Animals with deactivated interneurons made significantly more mistakes than their peers from the untreated control group, turning more often into the wrong arm of the maze although they had been there before. This indicated that the working memory was affected by the missing fast inhibitory cells. Remarkably, the spatial reference memory, which had been formed during several days of training, showed no such decrease in performance.

Up to now, impairment of the working memory, common in schizophrenia, had been attributed to dysfunctional inhibitory neurons in the prefrontal cortex. The new results by Bartos, Wisden and Wulff show that this disease can be partly traced back to a change in the function of fast inhibitory cells in the

hippocampus.

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1. Andrew J Murray, Jonas-Frederic Sauer, Gernot Riedel, Christina McClure, Laura Ansel, Lesley Cheyne, Marlene Bartos, William Wisden, Peer Wulff. **Parvalbumin-positive CA1 interneurons are required for spatial working but not for reference memory**. *Nature Neuroscience*, 2011; DOI: 10.1038/nn.2751

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