

Where memory is encoded and retrieved

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Are the same regions and even the same cells of the brain area called hippocampus involved in encoding and retrieving memories or are different areas of this structure engaged? This question has kept neuroscientists busy for a long time. Researchers at the Mercator Research Group "Structure of Memory" at RUB have now found out that the same brain cells exhibit activity in both processes.

They have published their results in the journal *Hippocampus*.

Hippocampus: the key to memory

In the course of their project, Dr Nozomu Nakamura and Prof Dr Magdalena Sauvage from the work group "Functional Architecture of Memory" (FAM) focused on the brain region hippocampus. This seahorse-like structure plays a crucial role in the formation of long-term memories and later in retrieving of memory contents. This has been demonstrated in patients with amnesia or in elderly people in which cases damage to this structure correlates to severe memory deficits.

Encoding and retrieving memories

For their studies with rats, researchers adapted a standardised word-based memory test for humans, using however scents instead of words. The researchers hid small treats in sand-filled cups. In addition, each cup also contained a different scent, such as thyme or coriander which could be smelled by the rats when searching for the treats. Each training unit consisted of three phases. During the learning phase, researchers

presented several scents to the animals. A pause followed, and subsequently a recognition phase. In the latter, the animals were presented the scents from the learning phase as well as other smells. The animals demonstrated that they recognised a scent from the learning phase by running to the back wall of their cage, where they were rewarded with food for the correct response. If, on the other hand, they recognised that a scent had not been presented during the learning phase, they demonstrated it by digging in the sand with their front paws.

New findings at a cellular level

Using molecular imaging, researchers subsequently identified the regions and the cells of the hippocampus in which activity during encoding and retrieval was predictive of accurate memory performance. To this end, they detected mRNAs from different activity markers closely tied to memory function. The results showed that those cells were exclusively located in the rats' upper region of the hippocampus, which in humans corresponds to the posterior part of the hippocampus. Moreover, they could show that the same cells were engaged during the encoding and the retrieval of the [memory](#). "The debate whether the same or different [hippocampus](#) regions are involved in both processes is a long-standing one," says Prof Dr Magdalena Sauvage. "The unique aspect of our approach is that we were able to analyse each single cell and, consequently, brought compelling evidence that the same [cells](#) are engaged during the formation and the retrieval of memories."

More information: "Encoding and reactivation patterns predictive of successful memory performance are topographically organized along the longitudinal axis of the hippocampus," *Hippocampus*, [DOI: 10.1002/hipo.22491](#)

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