How the brain consolidates memories during sleep

October 5 2016

Complex data need to be discussed: Nikolai Axmacher in conversation with postdoc Hui Zhang. Credit: RUB, Damian Gorczany

Researchers in the group of Prof Dr Nikolai Axmacher at the Ruhr-Universität Bochum (RUB) have studied which brain processes consolidate memories during sleep. They found clear parallels to

findings from experimental animal studies. The RUB's science magazine Rubin reports on the work of the Bochum neuropsychologists.

Study with epilepsy patients

Axmacher recorded the brain activity of epilepsy patients who had had electrodes implanted in their brains for medical reasons. The researcher had analyzed EEG data from 13 patients that he had recorded at his former workplace, the Bonn University Hospital.

While the researchers recorded the EEG, the patients first viewed a series of landscape images; then they slept. Later the scientists tested which of the images the test subjects had memorized and which not.

Making nerve cells receptive

Postdoctoral researcher Hui Zhang analyzed the data. The preliminary result: During sleep, the same brain activation patterns occurred as when viewing the landscape photos. This reactivation was particularly related to so-called ripple oscillations in the brain.

Ripples are a specific kind of brain activity. A group of interconnected nerve cells sends out signals at high frequency for a short period of time. In the EEG they appear as a characteristic wave form. One theory is: After a ripple event, a brain area is more receptive for long-term storage of reactivated information.

This was also shown by the current analysis of the patient data. After a ripple there was stronger reactivation than during a comparable time period before a ripple.

Mechanism for learning in sleep

"Individual stimuli, in our case landscape images, are reactivated during sleep, and the ripples seem to actively maintain this reactivation," explains Nikolai Axmacher. However, the researchers found this enhancement mechanism only for the reactivation of those images that were recalled during the final test.

In other words: "When a ripple enhances the reactivation, the image is recalled later," says Axmacher. "We are thus apparently dealing with a mechanism for learning in sleep."

Provided by Ruhr-Universitaet-Bochum