PRESS RELEASE

New insights into human memory

Researchers from Bonn and Freiburg decipher how the brain follows an internal rhythm

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Bonn, Freiburg, August 11 – A research team from the University Hospital Bonn (UKB), the University of Bonn, and the Medical Center – University of Freiburg has gained new insights into the brain processes involved in encoding and retrieving new memory content. The study is based on measurements of individual nerve cells in people with epilepsy and shows how they follow an internal rhythm. The work has now been published in the journal Nature Communications.

"Similar to members of an orchestra who follow a common beat, the activity of nerve cells appears to be linked to electrical oscillations in the brain, occurring one to ten times per second. The cells prefer to fire at specific times within these brain waves, a phenomenon known as theta-phase locking," says first author and postdoctoral researcher at the University of Bonn, Dr. Tim Guth, who recently joined the Cognitive and Translational Neuroscience group at the UKB from the Medical Center – University of Freiburg.

The research team led by Tim Guth and Lukas Kunz found that the interaction between nerve cells and brain waves is active in both the learning and remembering of new information – specifically in the medial temporal lobe, a central area for human memory. However, in the study on spatial memory, the strength of theta-phase locking of nerve cells during memory formation was independent of whether the test subjects were later able to correctly recall the memory content. "This suggests that theta-phase locking is a general phenomenon of the human memory system, but does not alone determine successful recall," says corresponding author Prof. Dr. Lukas Kunz, head of the Cognitive and Translational Neuroscience working group at the Clinic for Epileptology at the UKB and member of the Transdisciplinary Research Area (TRA) "Life & Health" at the University of Bonn.

Interaction of nerve cells and electrical signals

While most nerve cells always fired at the same oscillation time, some nerve cells interestingly changed their preferred timing between learning and remembering. "This supports the theory that our brain can separate learning and retrieval processes within a brain wave, similar to members of an orchestra who start playing at different times in a piece of music," says Guth. The study provides new insights into how nerve cells and electrical

signals in the brain interact while new memories are formed. Prof. Kunz concludes: "A better understanding of these processes could help us in the long term to better understand memory disorders and treat them more effectively. “

The research team was able to observe the interaction between nerve cells and brain waves during the memory process in the study by exploiting a special feature of epilepsy therapy. Patients with particularly difficult-to-treat epilepsy have electrodes implanted in their brains for diagnostic purposes. The aim is to determine the exact origin of the epileptic seizures in order to achieve better surgical results. However, these implanted electrodes can also be used to record human brain activity at the level of individual cells. The researchers used measurements taken at the Medical Center – University of Freiburg and would like to thank all patients who participated in this study.

Participating institutions and funding:
In addition to the University Hospital Bonn (UKB), the University of Bonn, and the Medical Center – University of Freiburg, the Columbia University (New York, USA) was also involved. The research was funded by the Federal Ministry of Research, Technology and Space (BMFTR), the US National Institutes of Health (NIH), the US National Science Foundation (NSF), the German Research Foundation (DFG), and the return program of the Ministry of Culture and Science of the State of North Rhine-Westphalia.

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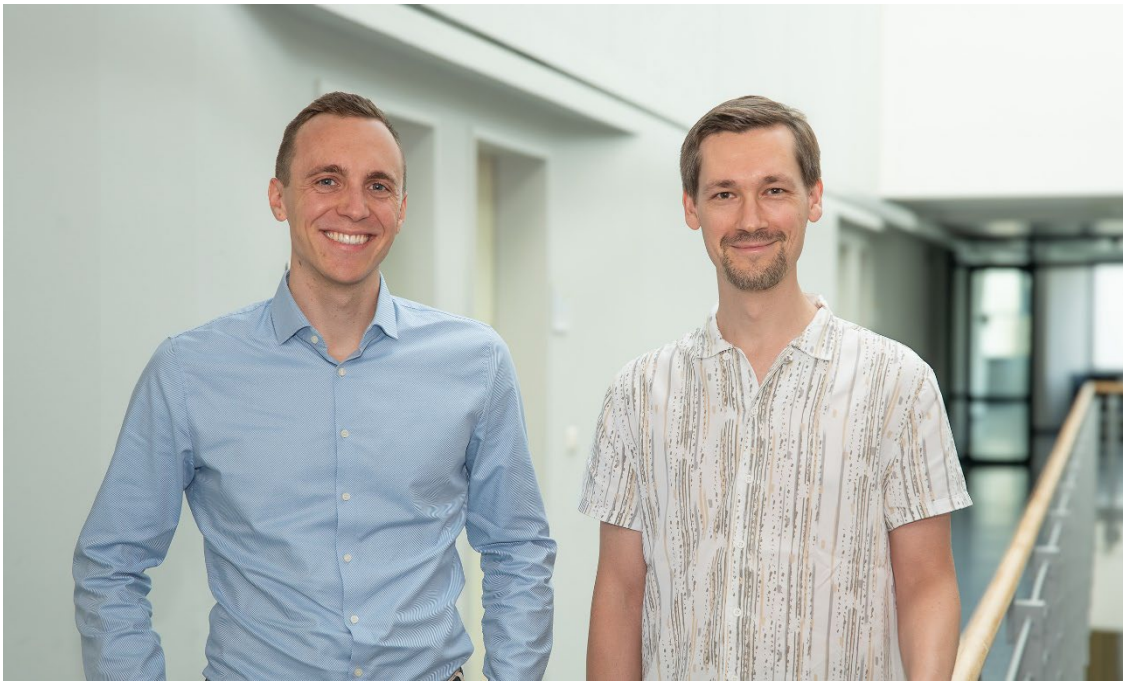

Caption: New insights into human memory:
(from left) Dr. Tim Guth and Prof. Lukas Kunz are deciphering how the brain follows an internal rhythm.

Image credit: University Hospital Bonn (UKB) / Rolf Müller

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About Bonn University Hospital: The UKB treats around 500,000 patients per year, employs approximately 9,500 people, and has a balance sheet total of €1.8 billion. In addition to 3,500 medical and dental students, 550 people are trained in numerous healthcare professions each year. The UKB ranks first among university hospitals (UK) in North Rhine-Westphalia in the Focus clinic list, had over €100 million in third-party funding for research in 2023, and has the second-highest case mix index (case severity) in Germany. The F.A.Z. Institute has awarded the UKB first place among university hospitals in the category "Germany's Training Champions 2024."