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Memory 'brainwaves' look the same in sleep and wakefulness

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Identical brain mechanisms are responsible for triggering memory in both sleep and wakefulness, new research at the University of Birmingham has shown.

The study sheds new light on the processes used by the brain to

'reactivate' memories during sleep, consolidating them so they can be retrieved later.

Although the importance of sleep in stabilising memories is a well-established concept, the neural mechanisms underlying this are still poorly understood.

In this study, published in *Cell Reports*, scientists have been able to show for the first time in humans that distinctive neural patterns in the brain which are triggered when remembering specific memories while awake, reappear during subsequent sleep.

The findings provide further evidence of the beneficial effects of sleep on memory formation.

Gaining a more sophisticated understanding of these mechanisms also enhances our understanding of how memories are formed. This could ultimately help scientists unravel the foundations of memory disorders such as Alzheimer's and lead to the development of memory boosting interventions.

Working in partnership with researchers at the Donders Institute, in Holland, the team used a technique called Targeted Memory Reactivation, which is known to enhance memory. In the experiment, previously learned information—in this case foreign vocabulary—is played back to a person while asleep.

Using electroencephalography, the brain signals of the study participants were recorded while learning and remembering the foreign vocabulary before sleep.

Subsequently, the researchers recorded the distinct neural pathways activated as the sleeping volunteers' brains reacted to hearing the words

they had learned.

Comparing neural signals fired by the brain in each state, the researchers were able to show clear similarities in brain activity.

Dr. Thomas Schreiner, of the University of Birmingham's School of Psychology, who led the research, says: "Although sleep and wakefulness might seem to have little in common, this study shows that brain activity in each of these states might be more similar than we previously thought. The neural activity we recorded provides further evidence for how important sleep is to memory and, ultimately, for our well-being."

"If we can better understand how memory really works, this could lead to new approaches for the treatment of memory disorders, such as Alzheimer's disease."

Dr. Tobias Staudigl, of the Donders Institute, is co-lead author of the study. He said: "Understanding how memories are reactivated in different states also provides insight into how these memories could be altered—which might for example be interesting in therapeutic settings."

The team are planning a follow-on study, devising ways to investigate spontaneous memory activation during sleep. Using advanced machine learning techniques, the researchers can record and interpret neural patterns in the brain, identifying where memories are activated without the need for an external prompt.

More information: Schreiner et al (2018). 'Theta phase coordinated memory reactivation reoccurs in a slow-oscillatory rhythm during NREM sleep', *Cell Reports*.