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# We've finally seen how the sleeping brain stores memories



**Rest well to remember**

Elke Meitzel/Millennium Images, UK

By **Jessica Hamzelou**

AT LAST, we've seen how the brain stores memories when we sleep. By scanning slumbering people, researchers have watched how the "trace" of a memory moves from one region of the brain to another.

"The initial memory trace kind of disappears, and at the same time, another emerges," says Shahab Vahdat at Stanford University in California. It is the first time memories have been observed being filed away in humans during sleep, he says.

Vahdat and his colleagues did this by finding people who were able to fall asleep in the confined, noisy space of an fMRI scanner, which is no easy undertaking. "We screened more than 50 people in a mock scanner, and only 13 made it through to the study," says Vahdat.

The team then taught this group of volunteers to press a set of keys in a specific sequence – in the same way that a pianist might learn to play a tune. It took each person between about 10 and 20 minutes to master a sequence involving five presses. "They had to learn to play it as quickly and as accurately as possible," says Vahdat.

Once they had learned the sequence, each volunteer put on a cap of EEG electrodes to monitor the electrical activity of their brain, and entered an fMRI scanner – which detects which regions of the brain are active.

The team saw a specific pattern of brain activity while the volunteers performed the key-pressing task. Once they had stopped, this pattern kept replaying, as if each person was subconsciously revising what they had learned.

The volunteers were then asked to go to sleep, while the team monitored each of them for two-and-a-half hours. At first, the pattern of brain activity continued to replay in the outer region of the brain called the cortex, which is involved in higher thought.

When the volunteers entered non-REM sleep – known as the stage when we have relatively mundane dreams – the pattern started to fade in the cortex, but a similar pattern of activity started in the putamen, a region deep within the brain (*eLife*, doi.org/cdsz). “The memory trace evolved during sleep,” says Vahdat.

His team thinks that movement-related memories are transferred to deeper brain regions for long-term storage. This chimes with the hypothesis that the brain’s cortex must free up space so that it can continue to learn new information, says Christoph Nissen at University Psychiatric Services in Bern, Switzerland.

Non-REM sleep happens within a few hours of dozing off, says Vahdat. If you’re hoping for some night-time learning, it’s important to make sure that those first few hours are uninterrupted, he says.

Nissen hopes a better understanding of how memories are consolidated during sleep could lead to treatments for people with insomnia and similar sleep disorders. Such individuals tend to be treated with drugs that send them to sleep, but Nissen has found that this sleep doesn’t seem to be as good at consolidating memories as natural sleep.

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