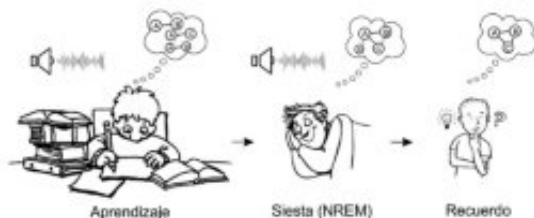


# Researchers identify neural mechanisms that strengthen or weaken memories during sleep

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In order to delve into this memory purging mechanism, researchers used an experimental technique to induce the memory activation artificially. Credit: Universidad de Barcelona

A study led by the University of Barcelona has identified the process in the brain which strengthens or weakens memories of daily events during sleep. According to the study published in the *Journal of Neuroscience*, the brain reactivates networks of interrelated memories during sleep, instead of doing so with isolated memories. Also, researchers show that in this memory reactivation process, the brain also promotes the forgetting of less important and less established information in the network of memories.

One of the most relevant questions in the field of [memory](#) is selecting experiences that are going to be remembered in the future. Scientific research studies have proved that during the sleeping process, the brain reactivates some of the encoded memories so that they are stored. In

order to delve into this memory purging mechanism, [researchers](#) used an experimental technique to induce the memory activation artificially.

This technique relates a sensory stimulation to a memory in order to induce its reactivation artificially during sleep. In the study, participants had to memorize fifteen locations –in a grid- of pairs of 147 identical cards with pictures of animals, means of transport or [musical instruments](#). In the first set, cards were in different positions inside the grid and the second set had one of the cards in a different place regarding the first one, while the other was in the same place. Therefore, the task made participants form two different sets of memory traces which shared a common element: the position of one of the cards in each pair. In addition, in the second set, card pairs were attached sounds related to the picture they had so that researchers could induce the memory activation for these positions showing sounds while participants were sleeping in the laboratory.

Therefore, while participants were sleeping, researchers showed half of the sound stimulus randomly selected (animal sounds, transport, or musical instruments) and reactivated memories of the positions of the cards that were related to each sound. However, when participants woke up, researchers evaluated the memory of the place of the first set of cards that had not been related to any sound but shared an element (they were related to each other) with those reactivated and those not reactivated during the sleeping process.

To manipulate the relation between the interrelated memories of the first set with those of the second set, researchers used two groups of participants. One group learnt both sets of cards consecutively (continuous group) so that both sets of cards were strongly related to each other. A second group learnt the second set of cards three hours after having learnt the first set (delay group). Therefore, both sets of memories were poorly related.

## Network reactivated memories

Results revealed that the continuous group remembered better the memories of the first set of [cards](#) that were related to those that had been reactivated during sleep. That is, those reactivated memories through sounds, in the second set, helped them remembering the location of the related pairs in the first set (same picture and position of the first card). "In the first group, memories were strongly interrelated, since they were encoded in a very close and similar context. This feature allows these memories to benefit from the reactivation of other elements in the network, since they represent solid and important information", says the supervisor of the study, Lluís Fuentemilla.

Moreover, researchers found the opposite effect in the second group of participants. Positions of each card in the first set, which were related to those reactivated during sleep, were not remembered as much as those related with the ones that had not been reactivated with sounds.

According to Javiera Oyarzún, first author of the article, "these results show for the first time that there is an active and selective mechanism to erase irrelevant or not frequent memories, which has been applied during sleep". Therefore, the reactivation of a specific memory, especially induced through sounds, has an impact on the memories of previously acquired similar experiences. In this case, memories with a strong relation benefited from the reactivation and were kept, while those that were less related to the reactivated memory were actively forgotten.

With this brain mechanism, the memory system would take the need of keeping information that can be useful in the future –according to the priority. "This strategy is highly adaptive, since it allows us to find patterns in the environment and predict what could happen if we find some situation which is similar to others we have already experienced. At the same time, it would prevent the memory of the information representing less frequent or inconsistent features from being kept in the

long run, avoiding interferences in the memory in the future", says Lluís Fuentemilla.

## Differences in electrophysiological activity

The study also analysed the brain electrophysiological activity of [participants](#) during memory reactivation and differences between the groups were detected. Records of both groups were placed in the theta activity during the reactivation process, but only the group with more forgetfulness recorded electrophysiological activity in the beta band. According to researchers, the fact that the same stimulation protocol during [sleep](#) causes different oscillating activity could point that the brain involves two different neural mechanisms for memory strengthening and weakening. "The activity in the beta band would point the launch of an additional regulating neural mechanism to weaken those irrelevant memories and therefore keep the network of memories stable and efficient" says Javiera Oyarzún.

**More information:** Javiera P. Oyarzún et al. Targeted Memory Reactivation during Sleep Adaptively Promotes the Strengthening or Weakening of Overlapping Memories, *The Journal of Neuroscience* (2017). [DOI: 10.1523/JNEUROSCI.3537-16.2017](https://doi.org/10.1523/JNEUROSCI.3537-16.2017)

Provided by University of Barcelona

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