

## Press Release

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### **Memory can be manipulated using auditory stimuli during sleep**

Numerous evidence has shown that sleep may play a key role in processing memories we learn during the day to improve our waking performance. Intriguingly, it has been shown that this memory processing can be manipulated during sleep by re-presenting stimuli such as sounds or odors that were given during the original learning of that memory. These ‘conditioned stimuli’ may therefore reactivate the memory during sleep affecting the memory processing. However, it is unclear why memories are sometimes enhanced by this technique and other times impaired. Further, whether memories can be manipulated during non-rapid eye movement (NREM) or rapid eye movement (REM) sleep needs further testing, especially in non-human species.

This research study, led by Masanori Sakaguchi of International Institute for Integrative Sleep Medicine (WPI-IIIS), University of Tsukuba, aimed to further our knowledge of how memories associated with fear could be manipulated during sleep. A simple training protocol was used where mice were given a mild electric foot shock paired with a sound. By repeating the pairing of the shock and sound, mice eventually associated the sound alone, with receiving the unpleasant sensation. Mice were then allowed to sleep where they were split into groups with the sound being replayed during either NREM sleep, REM sleep, or not at all. The next day mice were placed into a new environment and the sound was played again without the foot shock. The researchers identified that mice who previously received the sound during NREM sleep showed less freezing than either of the other two groups. The lack of anticipation of the foot shock shown by the decreased freezing response suggested that their memory of associating the sound with the foot shock was impaired.

This research confirms previous findings showing that using auditory stimuli only seems to have an effect when replayed specifically during NREM sleep. Further, it has previously been shown, using different learning conditions to the current one, that stimuli during NREM sleep can enhance fear memory. Therefore whether the memories are enhanced or impaired is very dependent upon how the memories are originally learnt. This finding could prove critical when applying this technique to relieve pathological fear memories such as those acquired in post-traumatic stress.

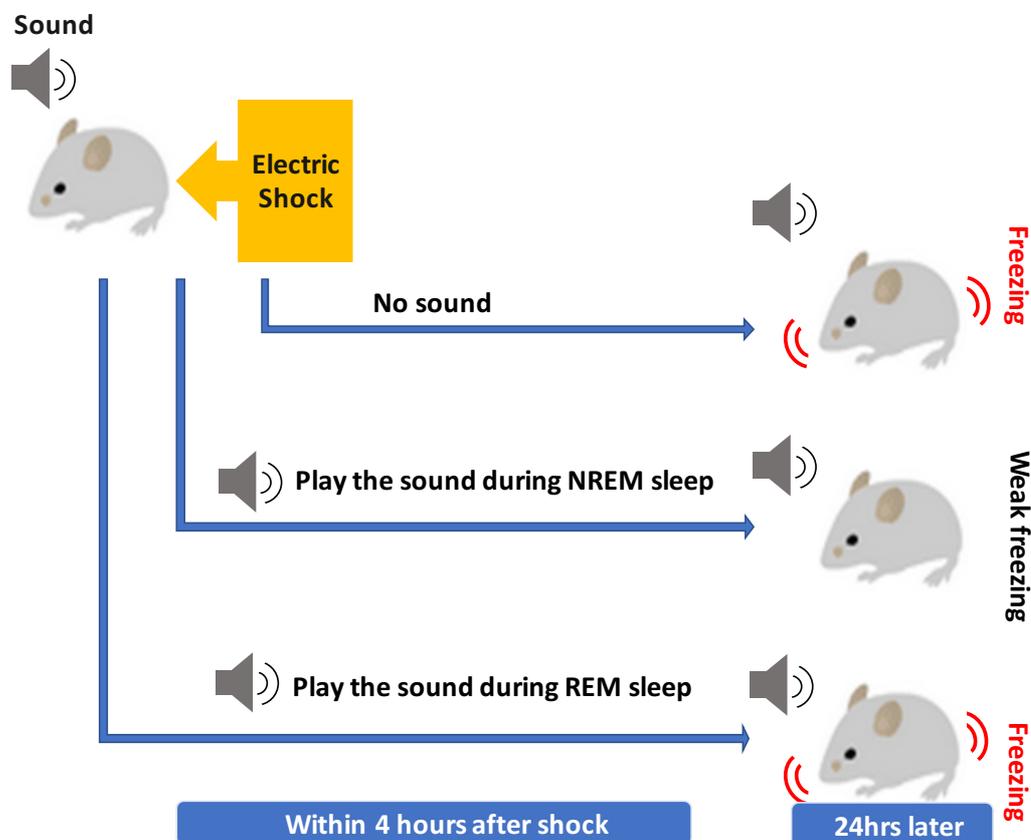


Figure | Mice established a fear memory by associating a sound with receiving a foot shock. This sound was then re-played during either NREM sleep, REM sleep or not at all. If mice had the sound replayed during NREM sleep they showed significantly weaker freezing than the other two groups and therefore an impairment of that memory. ■

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**Bibliographic information**

Purple R *et al.* (2017) Auditory conditioned stimulus presentation during NREM sleep impairs fear memory in mice. *Scientific Reports* 2017; doi:10.1038/srep46247.

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