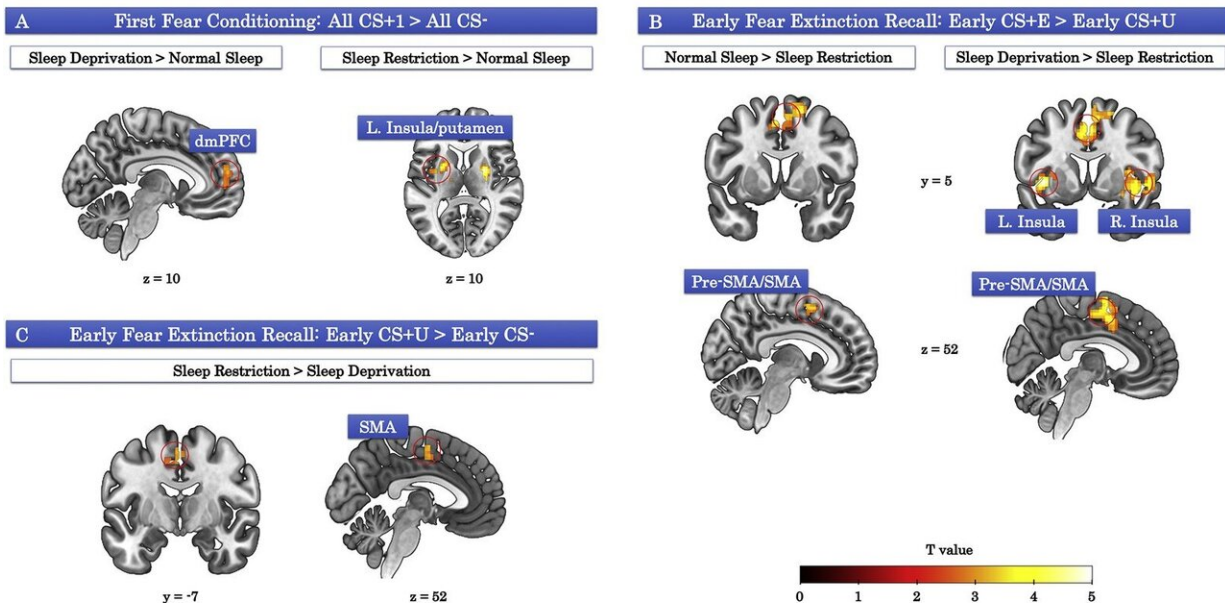


Sleep loss hijacks brain's activity during learning

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Contrast maps depicting differences between the normal sleep, sleep deprivation, and sleep restriction groups. Credit: Elsevier

Sleep is crucial for consolidating our memories, and sleep deprivation has long been known to interfere with learning and memory. Now a new study shows that getting only half a night's sleep—as many medical workers and military personnel often do—hijacks the brain's ability to unlearn fear-related memories. That might put people at greater risk of conditions such as anxiety or posttraumatic stress disorder.

The study appears in *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*.

"This study provides us with new insights into how [sleep](#) deprivation affects [brain](#) function to disrupt [fear extinction](#)," said Cameron Carter, MD, Editor of *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*.

The researchers, led by Anne Germain, Ph.D., at the University of Pittsburgh and Edward Pace-Schott, Ph.D., at Harvard Medical School and Massachusetts General Hospital, studied 150 healthy adults in the sleep laboratory. One third of subjects got normal sleep, one third were sleep restricted, so they slept only the first half the night, and one third were sleep deprived, so they got no sleep at all. In the morning, all the subjects underwent fear conditioning.

"Our team used a three-phase experimental model for the acquisition and overcoming of fearful memories while their brains were scanned using functional magnetic resonance imaging," said Dr. Pace-Schott. In the conditioning paradigm, subjects were presented with three colors, two of which were paired with a mild electric shock. Following this fear conditioning, the subjects underwent fear extinction, in which one of the colors was presented without any shocks to learn that it was now "safe." That evening, subjects were tested for their reactivity to the three colors, a measure of their fear extinction recall, or how well they had "unlearned" the threat.

Brain imaging recorded during the tasks showed activation in [brain areas](#) associated with emotional regulation, such as the prefrontal cortex, in people who got normal sleep. But the [brain activity](#) looked very different in people with restricted sleep, said Dr. Pace-Schott. "We found that among the three groups, those who had only gotten half a night's sleep showed the most activity in brain regions associated with fear and the

least activity in areas associated with control of emotion."

Surprisingly, people who got no sleep lacked the brain activation in fear-related areas during fear conditioning and extinction. During the extinction recall 12 hours later, their brain activity looked more similar to those with normal sleep, suggesting that a limited night of sleep may be worse than none at all.

The researchers hypothesize that sleeping only half the night results in a loss of rapid eye movement (REM) sleep, which has been shown to be important for memory consolidation and usually happens toward the end of a normal sleep period.

Dr. Carter said the study used "noninvasive brain imaging to give us a novel window into how sleep deprivation disrupts the normal fear [extinction](#) mechanisms and potentially increases vulnerability to posttraumatic stress symptoms."

"Medical workers and soldiers often have curtailed or interrupted sleep rather than missing an entire night's sleep," Dr. Pace-Schott said. "Our findings suggest that such partially sleep-deprived individuals might be especially vulnerable to [fear](#)-related conditions such as posttraumatic stress disorder."

More information: Jeehye Seo et al, Partial and Total Sleep Deprivation Interferes with Neural Correlates of Consolidation of Fear Extinction Memory, *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging* (2020). [DOI: 10.1016/j.bpsc.2020.09.013](https://doi.org/10.1016/j.bpsc.2020.09.013)

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