

Wisconsin-Madison School of Medicine and Public Health: Sleep clears the brain's memory center for new learning

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MADISON, Wis. – A new study of sleep-deprived mice shows that the synapses in the brain's memory center, the hippocampus, are larger and stronger after a few hours spent awake exploring new objects.

The research led by Dr. Chiara Cirelli, of the Wisconsin Institute of Sleep and Consciousness (WISC), was published this week in the [Journal of Neurosciences](#).

Cirelli, professor of psychiatry, and colleagues at the University of Wisconsin-Madison School of Medicine and Public Health, examined how synapses in the hippocampus, a brain structure involved in learning, changed following sleep and sleep deprivation in mice.

Consistent with their [previous studies in the cortex](#), the researchers found that the synapses were larger, and therefore stronger, after the mice were kept awake by exploring novel objects for six to seven hours compared to after they slept for a similar time.

The researchers also found that the synapses were strongest when the mice were forced to stay awake and interact with many new stimuli, compared to mice that stayed awake on their own with few objects to explore. This is consistent with the hippocampus' role in learning; it also suggests that synaptic changes take place when learning occurs, not merely from being awake.

The results offer more support to the theory of “synaptic homeostasis hypothesis” (SHY) proposed by Cirelli and colleague Dr. Giulio Tononi about 15 years ago. This hypothesis holds that sleep is the price we pay for brains that are plastic and able to keep learning new things.

Thus, “weakening” synapses, Cirelli says, is necessary to reset the synapse strength.

“Sleep makes synapses leaner and more efficient, ready for new learning the next day,” she says. “This supports the theory that sleep may universally weaken synapses that are strengthened from learning, allowing for new learning to occur after waking.”