Medical Xpress

A good night's sleep with the flip of a switch?

April 30 2007

The flip of a switch could become all it takes to get a good night's sleep, according to a study released Monday. Researchers at the University of Wisconsin-Madison have found a way to stimulate the slow waves typical of deep sleep by sending a harmless magnetic signal through the skulls of sleeping volunteers.

Sleep remains one of the big mysteries in biology. All animals sleep, and people who are deprived of sleep suffer physically, emotionally and intellectually. But nobody knows how sleep restores the brain.

Now, Giulio Tononi, a professor of psychiatry at the University of Wisconsin-Madison School of Medicine and Public Health, has discovered how to stimulate brain waves that characterize the deepest stage of sleep. The discovery could open a new window into the role of sleep in keeping humans healthy, happy and able to learn. The study was published in the April 30 edition of the *Proceedings of the National Academy of Sciences*.

The brain function in question, called slow wave activity, is critical to the restoration of mood and the ability to learn, think and remember, Tononi says.

During slow wave activity, which occupies about 80 percent of sleeping hours, waves of electrical activity wash across the brain, roughly once a second, 1,000 times a night. In a paper being published this week in the Early Edition of the scientific journal PNAS, Tononi and colleagues, including Marcello Massimini, also of the UW-Madison School of

Medicine and Public Health, described the use of transcranial magnetic stimulation (TMS) to initiate slow waves in sleeping volunteers. The researchers recorded brain electrical activity with an electroencephalograph (EEG).

A TMS instrument sends a harmless magnetic signal through the scalp and skull and into the brain, where it activates electrical impulses. In response to each burst of magnetism, the subjects' brains immediately produced slow waves typical of deep sleep, Tononi says. "With a single pulse, we were able to induce a wave that looks identical to the waves the brain makes normally during sleep."

The researchers have learned to locate the TMS device above a specific part of the brain, where it causes slow waves that travel throughout the brain. "We don't know why, but this is a very good place to evoke big waves that clearly travel through every part of the brain," Tononi says.

Scientists' interest in slow waves stems from a growing appreciation of their role in sleep, Tononi says. "We have reasons to think the slow waves are not just something that happens, but that they may be important" in sleep's restorative powers. For example, a sleep-deprived person has larger and more numerous slow waves once asleep. And as sleep proceeds, Tononi adds, the slow waves weaken, which may signal that the need for sleep is partially satisfied.

Creating slow waves on demand could someday lead to treatments for insomnia, where slow waves may be reduced. Theoretically, it could also lead to a magnetically stimulated "power nap," which might confer the benefit of eight hours sleep in just a few hours.

Before that happens, however, Tononi must go further and prove that artificial slow waves have restorative benefits to the brain. Such an experiment would ask whether sleep with TMS leads to greater brain restoration than an equal amount of sleep without TMS.

Although an electronic power-napper sounds like a product whose time has come, Tononi is chasing a larger quarry: learning why sleep is necessary in the first place. If all animals sleep, he says, it must play a critical role in survival, but that role remains elusive.

Based on the fact that sleep seems to "consolidate" memories, many neuroscientists believe that sleeping lets us rehearse the day's events.

Tononi agrees that sleep improves memory, but he thinks this happens through a different process, one that involves a reduction in brain overload. During sleep, he suggests, the synapses (connections between nerve cells) that were formed by the day's learning can relax a little.

While awake, we "observe and learn much more than you think," he observes. "Tons of things are leaving traces, changing the synapses, mainly by making them stronger. It is wonderful that you can have all these synaptic traces in the brain, but they come at a price. Synapses require proteins, fats, space and energy. At the end of a waking day, you have all these traces of memories left behind.

"During the slow waves, all the connections, step by step, are becoming a little weaker," Tononi adds. "By morning, the total connection strength is back to the way it was the morning before. The trick is to downscale all the connections by the same percentage, so the ones that were stronger are still stronger. That way you don't lose the memory."

Without this type of weakening, he says, we "would not be able to learn new things" because our brains would lack sufficient available energy, space and nutrients.

Although the explanation is still a hypothesis, Tononi hopes that the ability to artificially stimulate slow waves will allow him and other researchers to test the notion that sleep restores the brain by damping connectivity between neurons.

Slow waves, he suspects, "Clear out the noise to make sure your brain does not become too much of an energy hog, a space hog. By morning, you have a brain that is energy efficient, space efficient and ready to learn again."

Source: University of Wisconsin-Madison

Citation: A good night's sleep with the flip of a switch? (2007, April 30) retrieved 10 April 2024 from https://medicalxpress.com/news/2007-04-good-night-flip.html