

UW-Madison School of Medicine and Public Health: Are you dreaming? Activity in the brain's "hot zone" predicts dreams during sleep

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MADISON, Wis. — Neuroscientists can now tell when you are dreaming, which areas of the brain are involved, and what they may contribute to the content of your dreams.

A new study from the Wisconsin Institute of Sleep and Consciousness (WISC), out today in *Nature Neuroscience*, overturns some current ideas about dreams and identifies a "hot zone" in the back of the brain where high-frequency electrical activity shows when the brain is actively dreaming.

It shows that both dreams and dreamless sleep occur in both Rapid Eye Movement (REM) sleep and non-REM sleep. Also, the contents of those dreams – whether they involved faces or speech, for example – were tied to higher activity in the parts of the brain in charge of those actions during wakefulness.

"This study has managed to identify the brain regions that are involved in dreaming," says one of the study's lead authors, Dr. Francesca Siclari, of the University of Lausanne and the WISC lab. "We've also been able to identify the brain areas that correspond to specific dream contents (like faces, spatial setting,

movement and speech) during well-established sleep.” The other lead authors are Dr. Benjamin Baird and Dr. Lampros Perogamvros.

Giulio Tononi, professor of psychiatry and the study’s senior author, says the study also shows that dreams may be a valuable model for studying consciousness.

“Dreams are forms of consciousness that occur during sleep. In the course of a night’s sleep, consciousness varies considerably: it can either be absent or present in the form of thoughts, images or dreams,” says Tononi, who directs WISC and is an international expert on consciousness.

“An important aspect of this study is that we were able to compare what changes in the brain when we are conscious, that is, when we are dreaming, compared when we are unconscious, during the same behavioral state of sleep. In this way we could zoom in on the brain regions that truly matter for consciousness and avoid confounding factors having to do with being awake rather than asleep or anesthetized.”

To do the three experiments in the study, a total of 46 volunteers slept at the WISC laboratory wearing nets covered with 256 electrodes that covered their scalps and part of their faces. The electrodes created a high-density electroencephalography (HD-EEG) report of electrical activity in their brains. In all three experiments, the sleepers were awakened by a tone, and asked to report whether they were dreaming or not.

The first experiment showed that in both REM and NREM sleep, sleepers reported dreams when the ‘posterior hot zone’ of their brains was activated, regardless of what the rest of the cortex is doing. This explains why dreaming can occur in different sleep stages, Siclari says, because dreaming depend on this brain region being active and not on the sleep stage.

In the second experiment, the sleepers reported the content of their dreams: the proportion of sensory content versus more thinking content, for examples, or whether the dreams involved faces or hearing speech.

Those who reported dreaming had EEG readings that showed high-frequency activity in the brain regions associated during wake with the content of their dreams. For example, dreams associated with hearing speech triggered activity in Wernicke’s areas on the left side of the cerebral cortex, which is involved in

language perception and understanding. Previous studies, she says, were only able to show this in the falling-asleep period, the transition between sleep and wakefulness.

“This suggests that dreams recruit the same brain regions as experiences in wakefulness for specific contents,” Siclari says. “This also indicates that dreams are experiences that truly occur during wakefulness, and that they are not ‘inventions’ or ‘confabulations’ that we make up while we wake up.”

The final experiment tested whether researchers could accurately predict – based on the EEG readings – whether the sleepers would report a dream or not when they awakened. Researchers were able to predict the presence of dreaming 92 percent of the time and the absence of dreaming 81 percent of the time.

“This is the first time someone has shown that absent or forgotten dream experiences also carry a distinct EEG signature, which should encourage us to take reports of dream experiences at face value,” Siclari says.

Other Wisconsin members of the study team are Joshua LaRocque, Brady Riedner, Melanie Boly and Bradley Postle.