Neuroscientist probes sleep's role in learning and memory

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Credit: University of Massachusetts Amherst

Does "sleeping on it" help us make better decisions? Are sleep disorders just a natural part of aging? How important are naps, anyhow? Rebecca Spencer, Professor in the Department of Psychological and Brain Sciences and director of the UMass Amherst Sleep Monitoring Lab is finding answers to these questions.

"There are so many sleep myths out there, and so few have scientific support," says Spencer. That's starting to change, as researchers rush to solve the mysteries of sleep and to decipher its complex relationship to mood, learning, memory, and aging.

"People are talking about sleep a lot more now," says Spencer. "Doctors have realized that they need to ask patients about sleep, but they don't have the answers. So they send them for a sleep study. Well, everyone has some level of sleep disorder—we just don't know enough about how to delineate them."

That's where Spencer's work comes in. Right now she's focused on two populations that may seem disconnected but have a surprising amount in common, sleep-wise: preschoolers and the elderly. "Sleep changes developmentally, and sleep changes with aging; memory changes developmentally, and memory changes with aging. There's a strong connection there. Before our studies, nobody had looked at whether sleep and memory are related in older adults and kids," says Spencer.

Sleep studies conducted at UMass Amherst show that daytime naps improve memory recall in preschoolers. Credit: University of Massachusetts Amherst

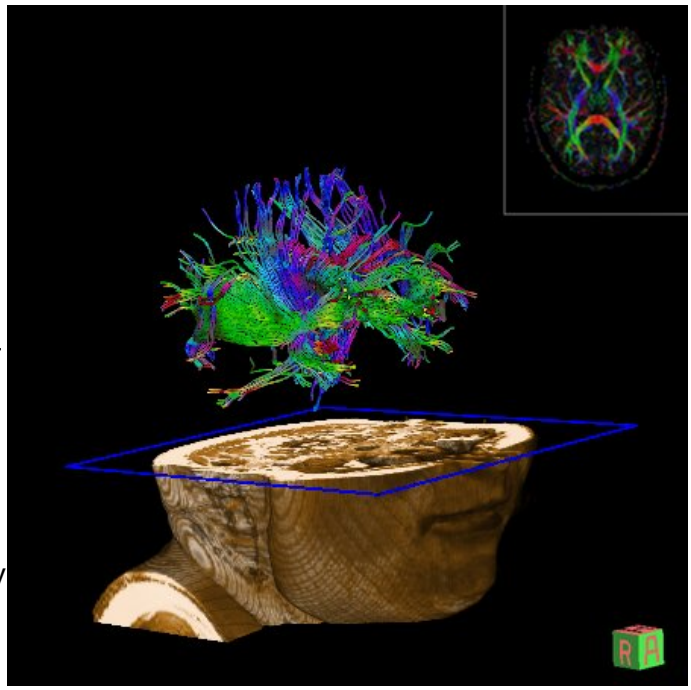
The answers may provide not only medical but legislative guidance. Preschools are under pressure to reduce naps to make more time for active learning. In Massachusetts, laws mandate just a 45-minute "rest period"—a decision that was "based on nothing in particular," says Spencer. Her research, funded by grants from the National Institutes of Health and the National Science Foundation, indicates that preschoolers who nap remember 100% of what they learned before they napped; without a nap, they lose 12% of that recollection. Spencer hopes her data, the first of its kind, will help set national accreditation policies and American Academy of Pediatrics recommendations.

Kids aren't the only ones affected. The occurrence of sleep disorders is notoriously high in aging populations, who are often concurrently plagued by memory loss. "Is it possible that as the brain degrades the need to process more frequently is

reduced?" asks Spencer. "Are we sleeping less because we're learning less?" To find out, Spencer is making use of a five-year, $2.6 million grant from the National Institutes of Health to study how memories are encoded in the brain before sleep and how those memories are changed by sleep and wakefulness.

This is the type of work conducted in the University's Sleep Monitoring Lab in the Institute for Applied Life Sciences. Using an MRI, Spencer and her research team study younger and older adults while learning a task, and then again while their subjects recall the information after either napping or staying awake. "We can study how memory changes when we literally see how the brain activity changes with sleep after learning and see how that changes with aging," she explains. "It could be that older adults use different parts of the brain to learn which changes how the memory can be transformed by sleep."

Understanding the effect that sleep has on the brain is critical to our ability to treat pervasive neurological conditions ranging from ADHD to Alzheimer's and Parkinson's, says Spencer. "There's a connection between neurodegenerative diseases and sleep deficit. For instance, we know that occurrence of REM sleep disorder is high in patients with Parkinson's. But we don't know how much is cause and how much is effect."



Spencer's team uses an MRI to observe brain function on tasks performed with and without the benefit of sleep.

In other words, the answer is far more complicated than just getting more sleep. "So far, sleep-related treatments in Alzheimer's take a hammer approach—just get them to sleep more regardless of how," says Spencer. That's proved largely unsuccessful, which is why her research takes a targeted approach. "It's not about total sleep, it's about specific aspects of sleep that need to be improved."

To discover those aspects, Spencer's studies look first at healthy older adults. "If we find that a certain aspect of sleep function is preserved in healthy aging, we can then target that aspect to improve that function," says Spencer. "For example, slow wave sleep—a form of deep sleep that occurs early in the night—is related to positive mood in healthy older adults. This would be a reason to target slow wave sleep in individuals with Alzheimer's who are exhibiting mood deficits, which is common in Alzheimer's disease," she says.

In the upcoming years of her grant, Spencer plans to apply her ideas to individuals with Alzheimer's

disease in the hope of creating data-driven interventions that produce more effective results. "Are structured naps a way to process memories?" she asks. "Personal monitoring devices may play a role in creating nap interventions that help individuals deepen sleep."

"We can come up with generalities every time we get a finding, but we will always be interested in parameters that define sleep function. Sleep has a lot of potential, with a wide expanse of unanswered questions," says Spencer. "This is a project with no end, frankly," she says.

Provided by University of Massachusetts Amherst