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Sounds During Sleep Aid Memory, Study Finds

By PAM BELLUCK

Science has never given much credence to claims that you can learn Chinese or French by having the instruction CDs play while you sleep. If any learning happens that way, most scientists say, the language lesson is probably waking the sleeper up, not causing nouns and verbs to seep into a sound-asleep mind.

But a new study about a different kind of audio approach during sleep gives insight into how the sleeping brain works, and may eventually come in handy to people studying a language, cramming for a test or memorizing lines in a play.

Scientists at Northwestern University reported that playing specific sounds while people slept helped them remember more of what they had learned before they fell sleep, to the point where memories of individual facts were enhanced.

In a study published online Thursday by the journal Science, researchers taught people to move 50 pictures to their correct locations on a computer screen. Each picture was accompanied by a related sound, like a meow for a cat and whirring for a helicopter.

Then, 12 subjects took a nap, during which 25 of the sounds were played along with white noise. When they awoke, none realized that the sounds had been played or could guess which ones had been used. Yet almost all remembered more precisely the computer locations of the pictures associated with the 25 sounds that had been played while they slept, doing less well placing the other 25 pictures.

“We were able to cue people to specific information they had learned,” said Ken A. Paller, a cognitive neuroscientist at Northwestern and co-author of the study. “The thinking is that during sleep, memory consolidation is going on and that rehearsal is a good way to strengthen memories.

“We showed that you can get information in during sleep using the auditory system and that you can cue that rehearsal by providing sounds specific to each episode of learning.”

The study adds a dimension to a theory that sleep allows the brain to process and consolidate memories.

A 2007 study found that people who were given whiffs of rose scent as they learned a task remembered the task better when they also inhaled rose scent while sleeping. But the new research suggests that individual memories can be explicitly singled out for strengthening.

“We haven’t before been able to manipulate very specific memories,” said Matthew P. Walker, a

neuroscientist at the University of California, Berkeley, who was not involved in the study.

“If you can experimentally amplify the memory-reinforcing process by forcing those sounds back into the brain while we’re asleep,” Dr. Walker said, it “may actually give us some clues as to what that mechanism is.”

Robert Stickgold, a cognitive neuroscientist at Harvard also not involved in the study, noted that the researchers did not play literal phrases recapping the memory, like “the cat is in the lower left,” but instead sound cues associated with a picture and a spatial task. The sounds made sense, too — the meow did not accompany the picture of dynamite, for example.

“It’s not really that you reminded them of what they needed to know,” Dr. Stickgold said, “but rather you reminded them of a larger memory that they needed to know.”

Not every scientist who studies sleep was impressed.

Robert P. Vertes, a neuroscience professor at Florida Atlantic University, said the results showed “such a minor effect that it’s not significant,” adding that the effect was even less significant because other study subjects who remained awake showed similarly better recall with sound cues.

The authors said more research was needed, but added that while awake people would be expected to do better with sound cues, the study was significant because it suggested that people could be coached during sleep.

Sara C. Mednick, an assistant professor of psychiatry at the University of California, San Diego, who was not involved in the study, was intrigued that the sleeping subjects appeared to show slight electrical shifts in their brain waves shortly after cues were played, suggesting that the brain replayed “prior experiences.”

The authors said they were interested in how long memory-enhancement was retained after waking and whether “this kind of thing will show up with overnight sleep,” said John D. Rudoy, a co-author and doctoral student at Northwestern.

The subjects napped 90 minutes or less, long enough to experience slow-wave or deep sleep but not REM sleep. Some scientists believe that in slow-wave sleep the brain reinforces factual memories, while in REM sleep the brain sorts and organizes memories.

The authors and other experts said the study’s primary contribution was helping to understand the brain’s memory-making process and reinforcing, as Dr. Walker put it, “how important it is to get a good eight hours.”

But Dr. Paller said he was exploring whether auditory cues could help reinforce cognitive behavioral therapy for people with depression or anxiety. And in other areas, he said, the method probably could not teach information, but reinforce something already learned.

“One of our speculations is that SAT scores could be improved,” he said.

It might help “a football player trying to learn a playbook,” Dr. Paller added. “Even remembering people’s names.”