Learning while we sleep and dream

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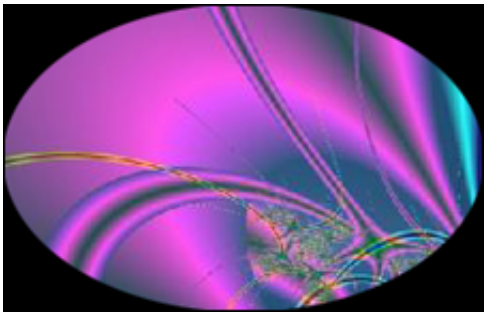

Images dubbed "Faberge eggs" from their obvious likeness to the colorful art form were used by Matthew Walker and colleagues to test the learning skills of people who were challenged to find a hidden connection. A good night's sleep was the key to success. (Image courtesy Matthew Walker)

Suppose you have a lot of information and you want to put it together so it makes sense. Here's a suggestion from psychologists at Harvard Medical School — sleep on it.

Seriously. Several research teams have found that sleep strengthens learning; it can help you to remember facts. A few years ago, Matthew Walker and his Harvard colleagues found that a good night's sleep can enhance movement skills, things like playing a piece of music, riding a bike, or throwing a ball the way you want.

"But remembering lots of facts is not the only or even the main function of memory," says Walker, a sleep expert who works at Harvard-affiliated Beth Israel Deaconess Medical Center. "The key to solving

problems and generating new ideas involves how those facts are put together into a bigger picture, one we've not seen before."

Walker suspected that big-picture work, too, is best done on the back of sleep, at least one purpose of which is to consolidate information. He got together with Jeffrey Ellenbogen, a sleep neurologist at Brigham and Women's Hospital, and other colleagues to test the idea.

The experimenters created a number of test pictures that 56 young male and female subjects would not likely be familiar with, oval images of colorful abstract patterns. These quickly became known to the researchers and test takers as "Fabergé eggs."

Participants, ages 18 to 30 years, were first shown a combination of five pairs of the eggs. The shapes were given ratings, and the subjects had to learn which shape rated higher and so should be chosen over another shape. For example, shape A should be chosen over B, B should be chosen over C, shape C over D, etc. What they were not told is that a hidden connection linked all five pairs together. They fit together a certain way on an imaginary chain.

The subjects were told they would be tested on their memory of the individual items at a later time, but the hidden organization or hierarchy was still not mentioned. Then they separated into three groups, one was tested after 20 minutes, the second after 12 hours, and the third had 24 hours to mull the patterns and their relationships. Half of those in the 12-hour group slept before the test, the other half did not.

Walker and Ellenbogen call the test results "striking." Those who got a good night's sleep performed best, those in the 20-minute group did the worst.

Knowledge expands with sleep

The 20-minute group showed no evidence of getting the big picture, A over B, B over C, C over D, etc. They failed to recognize this pattern when asked about, say, the connections between B and D. “Those who processed the information offline [while sleeping] were able to make leaps of inferential judgment just by letting their brain have time to unconsciously mull things over,” Walker says.

“Our results strongly imply that sleep is actively engaged in the cognitive processing of our memories,” Ellenbogen adds. “Knowledge appears to expand both over time and with sleep.”

“Perhaps this is the major role of sleep,” Walker boldly suggests.

If so, “sleeping on it,” instead of cramming during an all-nighter, should help not just students preparing for a final exam but everyone dealing with near-overloads of critical information. That brings up the possibility of training yourself to be a sleep learner. Could you, for example, train yourself to meditate for a short time at anytime to get the benefit of going offline, without waiting to obtain a good night’s sleep?

“We are interested in pursuing meditation as a ‘different brain state’ that might be used to process information,” Walker answers. He mentions other studies at Harvard on daydreaming, which show that it may not be just idle rumination but practical information processing.

Walker says he likes the idea of meditation as a state “when different kinds of information cocktails are being mixed in the brain, another way of brewing new generalizations and ideas. If this is true, it opens the exciting possibility of manipulating brain states to help us solve problems and learn.”

In the meantime, however, all you have to do to get such a thing done is rest your head on the pillow and let your brain do it for you.

The role of dreaming

Also in the meantime, Walker and his team will be trying to answer key questions raised so far. For example, there's the basic question of what exactly goes on in the brain when it mixes facts together in new ways?

The search for answers focuses around a surprisingly small s-shaped area deep in the brain, called the hippocampus. Most neurologists consider this the storehouse for new facts. Walker believes that, during sleep, the hippocampus carries on a conversation with the main thinking and organizing part of the brain, the so-called cortex that sits over the top and front of human brains.

During the give and take of such "therapy sessions," Walker imagines that the hippocampus lets go of new facts that then splash into the oceans of memories in the cortex. "The new information ripples through the old, swims in the sea of our past life experiences," he says poetically. "This process builds new links, new networks of connections that lead to new ideas, new big pictures we've never seen before."

Walker admits that there's some "arm-waving" involved in that kind of talk, but studying the "how" of the hippocampus should lead to a better understanding of "how much." Specifically, how many fact "eggs" can you put into the brain carton in one night and still come up with a new thought recipe?

Eventually, such research will lead to brain scans that attempt to capture images of the brain when and where new memories are made, and into reasons why they are not made. How do memories fade with age? Why do many fail in conditions like Alzheimer's disease?

Dreaming probably plays a role in all of this. Other research has shown that memories seem to be consolidated both during dreamless sleep at

the beginning of the night and during dreams that usually occur later. How does this tie in with the conversations between hippocampus and cortex? One idea is that new memories move out of the hippocampus and into the cortex during dreamless sleep earlier in the night. When new and old memories meet, they mix in bizarre and novel ways we call dreams.

“Is this the basis of creativity, the cauldron from which those lights-on-in-your-head happenings trigger big, new ideas? Walker asks. “These are exciting speculations to sleep on.”

Source: By William J. Cromie, Harvard University