Sleep deprivation can affect the endocannabinoid system, leading people to choose fattier, higher calorie foods, a new study shows. AH86/ISTOCKPHOTO

Why skimping on sleep makes your brain crave sweets

By **Eva Frederick** | Oct. 17, 2019 , 9:00 AM

It's a truism of the diet industry that getting too little sleep can make fatty, sweet foods more tempting. Now, researchers think they know why: Sleep loss influences the same smell-processing neural pathway that smoking marijuana does. "This is an exceptional study," says Christian Benedict, a neuroscientist at Uppsala University in Sweden who has worked on the effects of sleep loss on metabolism but was not involved with the new research.

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do nab id system, a complex network of neurotransmitters and receptors that, among other things, **is affected by marijuana**. Studies in mice have shown this system influences how the brain processes smells. And smell is a powerful driver of appetite—as illustrated by any gas station cinnamon roll shop.

Previously, though, no one had established clear links between sleep, the endocannabinoid system, smell, and appetite in humans. "We came in and said, 'OK, let's test this in humans. Let's put these things together,'" Kahnt says.

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To do so, he and his team asked 25 healthy volunteers to sleep for either 4 hours or 8 hours per night. Four weeks later, the volunteers repeated the experiment, but those who slept 4 hours during the first round slept 8 hours, and vice versa. The following evening, the volunteers provided blood samples. Sleep-deprived volunteers, as expected, had higher levels of 2-oleoylglycerol, a molecule that likely acts on endocannabinoid receptors. The sleep-deprived group didn't report feeling hungrier than their well-rested fellows, and when they were given a buffet of food, both groups consumed the same average amount of calories. However, people in the sleep-deprived group consistently chose foods that packed more energy per gram—for example, glazed doughnuts instead of blueberry muffins.

To test whether sleep was affecting the odor-processing parts of the brain, the researchers also took prebuffet MRI scans. While in the scanner, study participants smelled a variety of food and nonfood odors, including pot roast, cinnamon rolls, garlic, and fir trees.

The researchers examined scans of the piriform cortex, a pear-shaped region responsible for interpreting smells in the brain. In mice, it is peppered with endocannabinoid receptors. If increased endocannabinoid system molecules changed how the brain interpreted smell—and therefore a person's appetite—the researchers reasoned that the piriform cortex should show variations in smell-processing activity that lined up with volunteers' changes in food preferences.

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, th an ml took a different tack. Maybe, they reasoned, the sleep-related changes that led to high-calorie cravings took place somewhere else in the brain. When they looked at information flow between the insula, a region deep inside the brain that helps regulate food intake, and the piriform cortex, they found that volunteers with higher levels of 2-oleoylglycerol showed consistently less "chatter" between the two regions. Those changes, along with the changes in appetite, show a possible pathway for **how lack of sleep affects the olfactory system and food intake**, the researchers report this month in *eLife*.

Kahnt stresses that cause and effect in the two brain regions are unclear. "We don't know who is speaking and who is listening," he says. But the work solidifies the connection between sleep deprivation and sensory processes. "It also really underscores the role that the sense of smell has in guiding food choices," he says. Knowing more about how external factors can affect smell processing and appetite could lead to new approaches to treating obesity or eating disorders, he says.

Benedict says the well-designed project provides plenty of avenues for future research. However, he notes that variables aside from sleep duration could have affected the results. For example, the people who slept 8 hours went to bed at 11 p.m. and woke up at 7 a.m., whereas the 4-hour group slept from 1 a.m. to 5 a.m. "We know that [time of] awakening has some effect on the circadian rhythm," he says. Waking before dawn might throw your biological clock off compared with someone who woke up to sunshine.

Kahnt and his team hope to next look at how a person's sense of smell changes throughout the day, and how that might contribute to food intake. Another project will examine how the body's circadian rhythm is affected by extended fasting, in which a person limits their food intake to a short window of time each day. Kahnt wonders whether such changes exist, and if so, how they will whet the appetites of other researchers studying smell processing.

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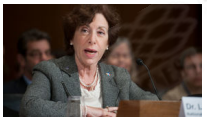

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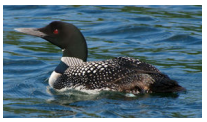

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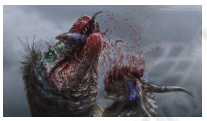

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