

Why it's so hard to diet

June 25 2014, by Jacqueline Mitchell

We tried low-fat diets. We tried high-protein and low-carb. Each diet had its pros and cons. By now, many Americans are coming to the inescapable conclusion that there's only one way to lose weight: eat less. Why is that so much easier said than done?

That's what Emmanuel N. Pothos, associate professor of pharmacology and experimental therapeutics and neuroscience in the School of Medicine's Department of Integrative Physiology and Pathobiology, and his colleagues are trying to understand. Pothos' research focuses on the [reward system](#) in the brain that motivates us to seek out food. He also studies what happens when that system goes haywire and what—if anything—can restore it.

When a normal animal eats a meal, the brain's food reward system releases dopamine, one of a group of chemicals called neurotransmitters that relay signals between brain cells. Dopamine produces a pleasurable sensation that lets the animal know it has satisfied a primal need.

Starvation, however, will alter this reward system's otherwise tidy feedback loop. When an animal is having a hard time finding enough food—during a drought, for example—the brain doesn't want it to feel satisfied after just one meal. The brain wants to compel the animal to keep looking, to keep eating, all day if it can.

That's exactly what Pothos and other researchers have seen in the lab. Underweight animals' brains release less dopamine than normal weight animals' do. Less dopamine means a blunted feeling of satisfaction,

leaving even a recently fed animal scrounging for more.

The surprise came when Pothos looked at what was going on in overweight animals.

Overweight and underweight animals both have "exactly the same deficit in the brain—a significant lack of dopamine released in the site that mediates reward," says Pothos.

Even though the overweight animals have plenty of stored fat, the brain's dopamine system does not seem to get the message. They'll keep eating until their brains release enough dopamine to make them feel satisfied.

Brain imaging studies with living human subjects by other researchers indicate something similar is likely going on in people. Just like overweight mice, overweight people tend to have a reduced number of [dopamine receptors](#) in their brains, indicating deficient dopamine release, says Pothos. And after their bodies' daily calorie requirements have been met, they still want to eat.

"Even though they are mirror opposites, the undernourished and the obese share two things—an increased motivation to eat and a deficient brain dopamine system," Pothos says.

Why should that be? A number of factors can knock the reward system off kilter. There's some genetic predisposition; some animals are born with lower dopamine levels than others. Also, the reward systems of all babies, regardless of their DNA, are heavily influenced by the environment they encounter in the womb. Gaining weight and losing weight alter the system, too, as can certain diseases, including addiction.

And once the reward system gets out of whack, it's hard to set right. "It seems it is a chronic, behavior-defining pattern," says Pothos. "It's very

difficult for the overweight animal or human patient to overcome."

The situation, however, is not hopeless. As often is the case in weight management research, exercise may offer a solution—but not just because it can burn off calories. Pothos says there's early evidence that regular exercise, in addition to all its other benefits, can help reset the dopamine reward system. So the best diet advice is not just "eat less." It's "eat less and exercise more."

"I'm convinced physical exercise is beneficial, and so is any intervention that restores [dopamine](#) neurotransmission in the brain without side effects," Pothos says. "The big challenge that I'm still trying to understand is what prevents us from doing it. What is in our biology that prevents us from following good advice on weight loss? That's what we're trying to understand."

Provided by Tufts University

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