

Marijuana use dampens brain's response to reward over time, study finds

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A dried flower bud of the Cannabis plant. Credit: Public Domain

Most people would get a little 'rush' out of the idea that they're about to win some money. In fact, if you could look into their brain at that very moment, you'd see lots of activity in the part of the brain that responds

to rewards.

But for people who've been using [marijuana](#), that rush just isn't as big - and gets smaller over time, a new study finds.

And that dampened, blunted response may actually open marijuana users up to more risk of becoming addicted to that drug or others.

The new results come from the first long-term study of young marijuana users that tracked [brain](#) responses to rewards over time. It was performed at the University of Michigan Medical School.

Published in *JAMA Psychiatry*, it shows measurable changes in the brain's [reward](#) system with marijuana use - even when other factors like alcohol use and cigarette smoking were taken into account.

"What we saw was that over time, marijuana use was associated with a lower response to a monetary reward," says senior author and U-M neuroscientist Mary Heitzeg, Ph.D. "This means that something that would be rewarding to most people was no longer rewarding to them, suggesting but not proving that their [reward system](#) has been 'hijacked' by the drug, and that they need the drug to feel reward—or that their emotional response has been dampened."

Watching the reward centers

The study involved 108 people in their early 20s - the prime age for marijuana use. All were taking part in a larger study of substance use, and all had brain scans at three points over four years. Three-quarters were men, and nearly all were white.

While their brain was being scanned in a functional MRI scanner, they played a game that asked them to click a button when they saw a target

on a screen in front of them. Before each round, they were told they might win 20 cents, or \$5 - or that they might lose that amount, have no reward or loss.

The researchers were most interested at what happened in the reward centers of the volunteers' brains - the area called the [nucleus accumbens](#). And the moment they cared most about was that moment of anticipation, when the volunteers knew they might win some money, and were anticipating performing the simple task that it would take to win.

In that moment of anticipating a reward, the cells of the nucleus accumbens usually swing into action, pumping out a 'pleasure chemical' called dopamine. The bigger the response, the more pleasure or thrill a person feels - and the more likely they'll be to repeat the behavior later.

But the more marijuana use a volunteer reported, the smaller the response in their nucleus accumbens over time, the researchers found.

While the researchers didn't also look at the volunteers' responses to marijuana-related cues, other research has shown that the brains of people who use a high-inducing drug repeatedly often respond more strongly when they're shown cues related to that drug. The increased response means the drug has become associated in their brains with positive, rewarding feelings. And that can make it harder to stop seeking out the drug and using it.

If this is true with marijuana users, says first author Meghan Martz, doctoral student in developmental psychology at U-M, "It may be that the brain can drive marijuana use, and that the use of marijuana can also affect the brain. We're still unable to disentangle the cause and effect in the brain's reward system, but studies like this can help that understanding."

Change over time

Regardless, the new findings show that there is change in the reward system over time with marijuana use. Heitzeg and her colleagues also showed recently in a paper in *Developmental Cognitive Neuroscience* that marijuana use impacts emotional functioning.

The new data on response to potentially winning money may also be further evidence that long-term marijuana use dampens a person's emotional response - something scientists call anhedonia.

"We are all born with an innate drive to engage in behaviors that feel rewarding and give us pleasure," says co-author Elisa Trucco, Ph.D., psychologist at the Center for Children and Families at Florida International University. "We now have convincing evidence that regular marijuana use impacts the brain's natural response to these rewards. In the long run, this is likely to put these individuals at risk for addiction."

Marijuana's reputation as a "safe" drug, and one that an increasing number of states are legalizing for small-scale recreational use, means that many young people are trying it - as many as a third of college-age people report using it in the past year.

But Heitzeg says that her team's findings, and work by other addiction researchers, has shown that it can cause effects including problems with emotional functioning, academic problems, and even structural brain changes. And, the earlier in life someone tries marijuana, the faster their transition to becoming dependent on the drug, or other substances.

"Some people may believe that marijuana is not addictive or that it's 'better' than other drugs that can cause dependence," says Heitzeg, who is an assistant professor of psychiatry at the U-M Medical School and member of the U-M Addiction Research Center. "But this study

provides evidence that it's affecting the brain in a way that may make it more difficult to stop using it. It changes your brain in a way that may change your behavior, and where you get your sense of reward from."

She is among the neuroscientists and psychologists leading a nationwide study called ABCD, for Adolescent Brain Cognitive Development. That study will track thousands of today's pre-teens nationwide over 10 years, looking at many aspects of their health and functioning, including brain development via [brain scans](#). Since some of the teens in the study are likely to use marijuana, the study will provide a better chance of seeing what happens over time.

Provided by University of Michigan Health System

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