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What Pot Really Does to the Teen Brain

How much should we worry?

* By [Claudia Wallis](https://www.scientificamerican.com/author/claudia-wallis/) on December 1, 2017

American parents have been warning teenagers about the dangers of marijuana for about 100 years. Teenagers have been ignoring them for just as long. As I write this, a couple of kids are smoking weed in the woods just yards from my office window and about a block and a half from the local high school. They started in around 9 A.M., just in time for class.

Exaggerating the perils of cannabis—the risks of brain damage, addiction, psychosis—has not helped. Any whiff of *Reefer Madness* hyperbole is perfectly calibrated to trigger an adolescent's instinctive skepticism for whatever an adult suggests. And the unvarnished facts are scary enough.

We know that being high impairs attention, memory and learning. Some of today's stronger varieties can make you physically ill and delusional. But whether marijuana can cause lasting damage to the brain is less clear.

A slew of studies in adults have found that nonusers beat chronic weed smokers on tests of attention, memory, motor skills and verbal abilities, but some of this might be the result of lingering traces of cannabis in the body of users or withdrawal effects from abstaining while taking part in a study. In one hopeful finding, a 2012 meta-analysis found that in 13 studies in which participants had laid off weed for 25 days or more, their performance on cognitive tests did not differ significantly from that of nonusers.

But scientists are less sanguine about teenage tokers. During adolescence the brain matures in several ways believed to make it more efficient and to strengthen executive functions such as emotional self-control. Various lines of research suggest that cannabis use could disrupt such processes.

For one thing, recent studies show that cannabinoids manufactured by our own nerve cells play a crucial role in wiring the brain, both prenatally and during adolescence. Throughout life they regulate appetite, sleep, emotion, memory and movement—which makes sense when you consider the effects of marijuana. There are “huge changes” in the concentration of these endocannabinoids during the teenage years, according to neurologist Yasmin Hurd of the Icahn School of Medicine at Mount Sinai, which is why she and others who study this system worry about the impact of casually dosing it with weed.

Brain-imaging studies reinforce this concern. A number of smallish studies have seen differences in the brains of habitual weed smokers, including altered connectivity between the hemispheres, inefficient cognitive processing in adolescent users, and a smaller amygdala and hippocampus—structures involved in emotional regulation and memory, respectively.

More evidence comes from research in animals. Rats given THC, the chemical that puts the high in marijuana, show persistent cognitive difficulties if exposed around the time of puberty—but not if they are exposed as adults.

But the case for permanent damage is not airtight. Studies in rats tend to use much higher doses of THC than even a committed pothead would absorb, and rodent adolescence is just a couple of weeks long—nothing like ours. With brain-imaging studies, the samples are small, and the causality is uncertain. It is particularly hard to untangle factors such as childhood poverty, abuse and neglect, which also make their mark on brain anatomy and which correlate with more substance abuse, notes Nora Volkow, director of the National Institute on Drug Abuse and lead author of a superb 2016 review of cannabis research in *JAMA Psychiatry*.

To really sort this out, we need to look at kids from childhood to early adulthood. The Adolescent Brain Cognitive Development study, now under way at the National Institutes of Health, should fill the gap. The 10-year project will follow 10,000 children from age nine or 10, soaking up information from brain scans, genetic and psychological tests, academic records and surveys. Among other things, it should help pin down the complex role marijuana seems to play in triggering schizophrenia in some people.

But even if it turns out that weed does not pose a direct danger for most teens, it's hardly benign. If, like those kids outside my window, you frequently show up high in class, you will likely miss the intellectual and social stimulation to which the adolescent brain is perfectly tuned. This is the period, Volkow notes, “for maximizing our capacity to navigate complex situations,” literally building brainpower. On average, adolescents who partake heavily wind up achieving less in life and are unhappier. And those are things a teenager might care about.

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