Nicotine withdrawal affects the brain's cognitive systems, researchers find

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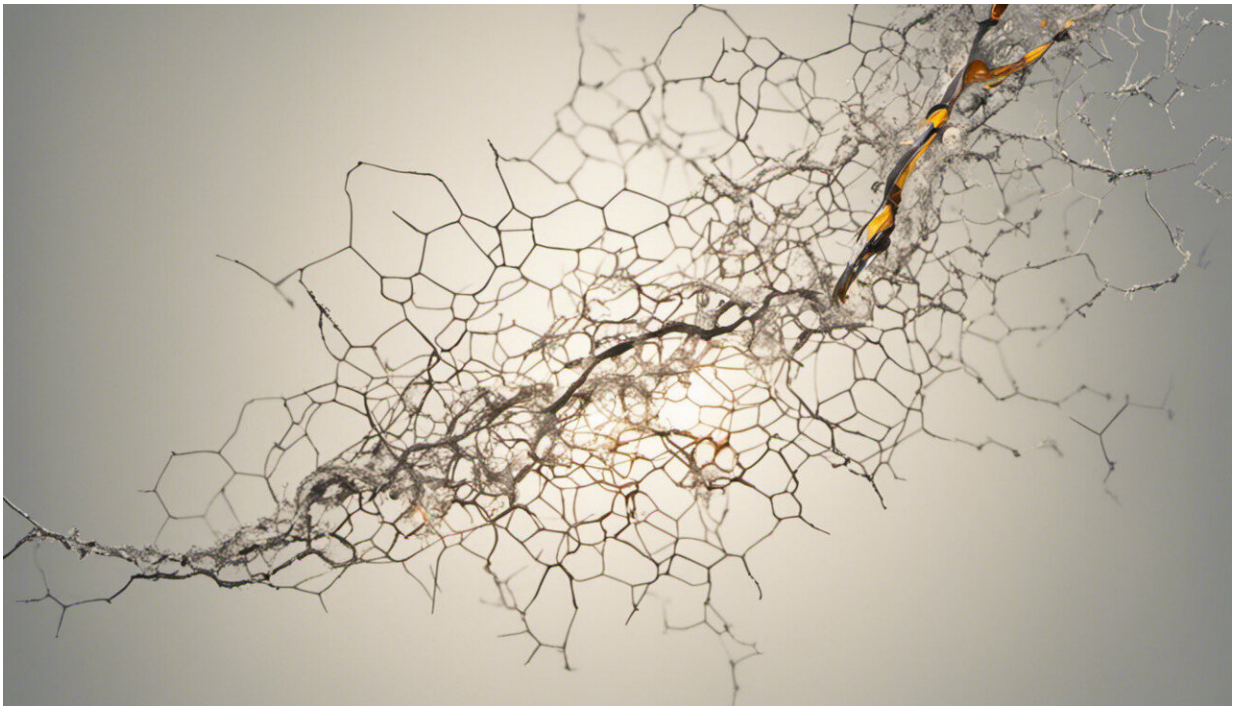

Credit: AI-generated image (disclaimer)

Most attempts to stop smoking are unsuccessful in the long term, even with smoking cessation methods such as nicotine replacement therapy. Penn State researchers are looking at how reward processing and working memory may determine why smokers choose to smoke again after trying to quit.

According Charles Geier, associate professor of human development and family studies and the Dr. Francis Keesler Graham Early Career Professor in Developmental Neuroscience, reward processes and working memory jointly contribute to value-based decision-making. "While previous studies have shown altered reward and working memory function are independently associated with nicotine exposure, little is known about the effects of nicotine or nicotine withdrawal on the joint function of these systems."

Geier, who is also a Social Science Research Institute co-funded faculty member, is interested in how reward processing interacts with cognitive control systems in the brain, such as working memory and inhibitory control. "We are particularly interested in smoking because nicotine has widespread effects on the brain, including effects on cognition and, importantly, one's sensitivity to both drug and non-drug awards," he said. "Knowing more about how these processes interact is important to better understand the decisions people make after exposure to nicotine, such as choosing whether or not to continue smoking after a quit attempt, and thus can help inform smoking cessation strategies."

In the study, the working memory of 18 daily smokers were tested on two separate occasions. In one session, participants were tested after normally smoking, and in another, participants were tested after at least 12 hours of smoking abstinence. In both sessions, participants completed a working memory task on a computer in which they were asked to focus on a fixation cross, but be aware of a flashing dot in their peripheral vision. After a short time, the fixation cross disappeared and the participants had to move their eyes to the remembered location of the dot. Geier and colleagues used eye tracking to assess precisely where the participants were looking and when they shifted their gaze.

In groups who had smoked regularly before testing and were being monetarily compensated for quickness and accuracy, researchers noticed

an improvement in working memory; this group more accurately remembered where the flashing dot appeared. Meanwhile, participants who had abstained from smoking showed no similar increases in accuracy when being monetarily compensated.

"Our results indicate that during a state of nicotine deprivation, participants failed to receive the same reward-related 'boost' to their working memory," said Geier. "We hope these results shed light on how rewards affect cognitive systems such as working memory, which is critical for our understanding of motivated decision making. These data also extend our fundamental understanding of smoking's effects on core affective and cognitive processes. A next step is to test participants on similar tasks within the functional MRI scanner to investigate the nature of motivated cognitive control at the neural circuit level."

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