

Scientists find that nicotine use increases compulsive alcohol consumption

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Credit: Vera Kratochvil/public domain

Why do smokers have a five to ten times greater risk of developing alcohol dependence than nonsmokers? Do smokers have a greater tendency toward addiction in general or does nicotine somehow reinforce alcohol consumption?

Now, a study led by scientists at The Scripps Research Institute (TSRI)

helps provide insight into these questions, showing that, in rat models, nicotine exposure actually promotes [alcohol](#) dependence.

"It's a vicious cycle," said TSRI biologist Oliver George, a senior author of the new study. "Nicotine makes individuals crave alcohol to 'reward' the brain and reduce stress."

In the study, published April 14, 2015, in *The Journal of Neuroscience*, the researchers also showed that the combination of nicotine and alcohol activated a unique group of neurons, giving positive reinforcement to continue alcohol and nicotine use.

In conducting the new research, the team first tested whether nicotine exposure could affect [alcohol-drinking](#) behavior in rat models. They started with two groups of male rats. Both groups were given access to alcohol to establish the baseline of how much they would drink. The rats drank a little bit, perhaps the equivalent of one or two beers for a human, but they stopped before showing signs of drunkenness.

After this baseline test, the researchers used alcohol vapor to induce [alcohol dependence](#) in one group of rats. Dependence developed in about two months. In subsequent tests where alcohol was freely available, these rats consumed the equivalent of a six-pack of beer and had [blood alcohol levels](#) close to three times the legal limit for humans.

The second group of rats were exposed to both nicotine and alcohol vapor. These rats developed alcohol dependence much faster—and they began drinking the equivalent of a six-pack in just three weeks. "We had never seen such a rapid escalation of alcohol drinking before," said George.

The researchers then offered the rats alcohol with the bitter compound quinine added to see if they could stop the rats from drinking. Most rats

decreased their [alcohol consumption](#) to avoid the bitter taste, but the nicotine-exposed [rats](#) just kept drinking. This indicated that their behavior was compulsive, much like alcoholism in humans.

Using further neurological studies, George and his colleagues tracked this compulsive behavior to the activation of "stress" and "reward" pathways in the brain.

Previous studies from George's lab had shown that nicotine activates certain "reward" neurons in the brain—giving positive reinforcement to keep smoking. At the same time, nicotine activates "stress" neurons in the brain, giving negative reinforcement. This stress can lead individuals to crave alcohol to both activate the reward system and calm the stress system.

The compulsive alcohol consumption and neurological pathways seen in the new study suggest that alcohol works with nicotine to further activate the brain's reward system and dampen the stress of [nicotine exposure](#).

This interaction may explain why it is difficult for smokers to quit drinking, and *vice versa*. Interestingly, the combination of neurons activated by [nicotine](#) and alcohol together is different from the neurons activated by each substance on its own.

"Now we can try to find compounds that will specifically inactivate those neurons," said George.

Provided by The Scripps Research Institute

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