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# In Clue to Addiction, Brain Injury Halts Smoking

**By BENEDICT CAREY**

Scientists studying stroke patients are reporting today that an injury to a specific part of the brain, near the ear, can instantly and permanently break a smoking habit. People with the injury who stopped smoking found that their bodies, as one man put it, “forgot the urge to smoke.”

The finding, which appears in the journal Science, is based on a small study. But experts say it is likely to alter the course of addiction research, pointing researchers toward new ideas for treatment.

While no one is suggesting brain injury as a solution for addiction, the finding suggests that therapies might focus on the insula, a prune-size region under the frontal lobes that is thought to register gut feelings and is apparently a critical part of the network that sustains addictive behavior.

Previous research on addicts focused on regions of the cortex involved in thinking and decision making. But while those regions are involved in maintaining habits, the new study suggests that they are not as central as the insula is.

The study did not examine dependence on alcohol, cocaine or other substances. Yet smoking is at least as hard to quit as any other habit, and it probably involves the same brain circuits, experts said. Most smokers who manage to quit do so only after repeated attempts, and the craving for cigarettes usually lasts for years, if not a lifetime.

“This is the first time we’ve shown anything like this, that damage to a specific brain area could remove the problem of addiction entirely,” said Dr. Nora Volkow, director of the National Institute on Drug Abuse, which financed the study, along with the National Institute of Neurological Disorders and Stroke. “It’s absolutely mind-boggling.”

Others cautioned that scientists still knew little about the widely distributed neural networks involved in sustaining habits.

“One has to be careful not to extrapolate too much based on brain injuries to what’s going on in all addictive behavior, in healthy brains,” said Dr. Martin Paulus, a psychiatric researcher at the University of California, San Diego, and the San Diego V.A. Medical Center. Still, Dr. Paulus said, the study “opens up a whole new way to think about addiction.”

The researchers, from the University of Iowa and the University of Southern California, examined 32 former smokers, all of whom had suffered a brain injury. The men and women were lucid enough to answer a battery of questions about their habits, and to rate how hard it was to quit and the strength of their subsequent urges to smoke.

They all had smoked at least five cigarettes a day for two years or more, and 16 of them said they had quit with ease, losing their cravings entirely.

The researchers performed M.R.I. scans on all of the patients' brains to specify the location and extent of each injury.

They found that the 16 who had quit easily were far more likely to have an injury to their insula than to any other area. The researchers found no association between a diminished urge to smoke and injuries to other regions of the brain, including tissue surrounding the insula.

"There's a whole neural circuit critical to maintaining addiction, but if you knock out this one area, it appears to wipe out the behavior," said Dr. Antoine Bechara, a senior author of the new paper, who is a neuroscientist at the Brain and Creativity Institute at U.S.C. His co-authors were Dr. Hanna Damasio, also of U.S.C., and Nasir Naqvi and David Rudrauf of the University of Iowa.

The patients' desire to eat, by contrast, was intact. This suggests, the authors wrote, that the insula is critical for behaviors whose bodily effects become pleasurable because they are learned, like cigarette smoking.

The insula, for years a wallflower of brain anatomy, has emerged as a region of interest based in part on recent work by Dr. Antonio Damasio, a neurologist and director of the Brain and Creativity Institute. The insula has widely distributed connections, both in the thinking cortex above, and down below in subcortical areas, like the brain stem, that maintain heart rate, blood pressure and body temperature, the body's primal survival systems.

Based on his studies and others', Dr. Damasio argues that the insula, in effect, maps these signals from the body's physical plant, and integrates them so the conscious brain can interpret them as a coherent emotion.

The system works from the bottom up. First, the body senses cues in the outside world, and responds. The heart rate might elevate at the sight of a stranger's angry face, for example; other muscles might relax in response to a pleasant whiff of smoke.

All of this happens instantaneously and unconsciously, Dr. Damasio said — until the insula integrates the information and makes it readable to the conscious regions of the brain.

"In a sense it's not surprising that the insula is an important part of this circuit maintaining addiction, because we realized some years ago that it was going to be a critical platform for emotions," Dr. Damasio said in a telephone interview. "It is on this platform that we first anticipate pain and pleasure, not just smoking but eating chocolate, drinking a glass of wine, all of it."

This explains why cravings are so physical, and so hard to shake, he said: they have taken hold in the visceral reaches of the body well before they are even conscious.

Other researchers have found that the insula is activated in unpleasant circumstances, like a bad smell or the anticipation of a painful shock, or even in shoppers when they see a price that seems too high. Damage to the insula is associated with slight impairment of some social function.

While antismoking treatments based on the new findings are still a long way off, the authors suggest that

therapies that replicate some of the physical sensations of the habit, like inhalers, could be useful.

And at least two previous studies suggest that people can reduce the sensation of pain by learning to modulate the activity in an area of their brain.

In experiments, healthy volunteers watched real-time M.R.I. images of a cortical region linked strongly to pain sensation and learned to moderate that neural activity, reducing the pain they felt from a heated instrument pressed to their palms. The same kind of technique could be tried with addicts watching images of their insulas.

“The question is, Can you learn to deactivate the insula?” Dr. Volkow said. “Now, everybody’s going to be looking at the insula.”