

Air Pollution Stunts Cognition

Particulates in the air can cause impaired learning and depression in mice.

By Tia Ghose | July 6, 2011



Smoke stacks [ADIE REED](#) VIA FLICKR

Air pollution has already been implicated in a variety of human diseases, including asthma, heart disease, and stroke. Now, new data in mice suggests that the air-borne particulates we breathe in throughout our lives may also slow learning and cause depression, according to a study published Tuesday (July 5) in *Molecular Psychiatry*.

“This is a really important study and they did a really nice job,” said Staci Bilbo, a neuroimmunologist at Duke University, who was not involved in the research. “It really is one of the first to show a lifetime exposure effect” of [pollution].

Several studies have shown that normal particulate matter in the air can trigger inflammation that leads to respiratory and cardiovascular problems. Previous research has also linked unnaturally high doses of air pollution to short-term changes in brain function in animals. But relatively little was known about how normal levels of pollution affect the brain long-term.

Laura Fonken, a neuroscientist at Ohio State University, and her colleagues suspected that even moderate levels of air pollution may also harm the brain. The researchers concentrated particulate matter made up of automobile, power plant, and factory emissions from ambient air in Columbus, Ohio, and created a new mixture with levels of pollution similar to that seen in countries with high levels of pollution, such as China and India.

The researchers then exposed one group of male mice to the dirty air for 6 hours a day, five days a week, while providing another group with filtered air. After ten months, the mice went through a battery of tests, including a maze test that assessed learning and memory, and a forced swim test

that measured levels of despair. Mice that breathed the polluted air were slower to learn the maze's escape route and gave up swimming more quickly, a sign of depression.

When the group analyzed the brains of the mice, they found the hippocampus had fewer connections between neurons and high levels of cytokines and TNF-alpha, molecules known to cause inflammation.

"This suggests that there may be some mild, chronic, low-grade inflammation in the mice exposed to particulate matter," Fonken said. The researchers think the inflammation may be reducing the neuronal connections and in turn lowering the rats' cognitive abilities.

But the study focused exclusively on male mice, so it remains to be seen whether the same effects will hold true in female mice, as well as other species. "They didn't study females, which I was very disappointed to see, because we're half the population," said Stacy Bilbo, a neuroscientist at Duke University in Durham, N.C. who was not involved in the study. Females (both the mouse and human varieties) are also more prone to depression, she said.

Furthermore, significant differences between the nasal tracts and lungs of rodents versus humans may affect how the species respond to inhaled pollution, Bilbo added, and thus human studies are needed—and soon—to really understand how air pollution is affecting people. "I think that we really need to start to understand what it is that we're doing to ourselves."

L. Fonken, et. al, "Air pollution impairs cognition, provokes depressive-like behaviors and alters hippocampal cytokine expression and morphology," *Molecular Psychiatry*, <http://dx.doi.org/10.1038/mp.2011.76>, 2011.