MedicalXpress

University of Maryland researchers unlock mystery of a third olfactory system

August 29 2007

Researchers at the University of Maryland School of Medicine have found a “nose within the nose,” a unique olfactory system within the noses of mice that is able to “smell” hormones involved in regulating water and salt balance in the body. This research may lead to new insights into the complex system of “chemical communication” between individuals. The findings are published in the *Proceedings of the National Academy of Sciences* online early edition the week of August 27-31, 2007.

“The sense of smell provides an important way for humans and animals to interact with their environment, as well as with other members of their species,” says Steven Munger, Ph.D., associate professor of anatomy and neurobiology at the University of Maryland School of Medicine and lead author on the paper. “It allows animals to detect food and determine that food’s quality, it provides social information like sexual status about other animals, and it can warn an animal when a predator is present. Because of the great similarities between humans and animals when it comes to the sense of smell, the more we learn about the building blocks of the system, the more we will learn about how odors affect our lives.”

The noses of mice and most other mammals contain both a main and accessory olfactory system. These two systems work together to detect general odors, including food odors, as well as pheromones, which carry important social information between members of the same species. However, previous work had suggested that a third group of olfactory cells in the nose, named “GC-D neurons” for their expression of the

molecule GC-D, might play a unique role in sensing the odor environment.

To investigate these novel cells in the nose, Dr. Munger, graduate student Renee Cockerham, and their colleagues engineered a line of mice in which GC-D neurons were specifically labeled, making them easier to identify and characterize. In some mice, the GC-D gene was also "knocked out" completely, allowing the cells to be turned off. They then asked what odors might activate GC-D cells by exposing them to various compounds present in mouse urine.

"Urine contains a rich mixture of social signals for animals, including odors that communicate information about sex, dominance and genetic identity," says Dr. Munger. "We found that GC-D neurons responded to peptide hormones, such as uroguanylin and guanylin, found in the urine. These hormones are known to be involved in regulating fluid and salt balance in the body. Additionally, we found that the GC-D molecule itself is required for the neurons to respond to those hormones, which means that, in the absence of GC-D, these animals are 'blind' to these odors."

"This is evidence of an entirely different olfactory system mixed in with the main system in mice," says Dr. Munger. "It carries a very specific type of odor information that may communicate hormonal states between individuals. It's basically a 'nose within the nose.'"

According to Dr. Munger, animals may be able to detect the metabolic state of other animals by using this olfactory subsystem. "This system may tell a mouse that his brother needs a drink and that they must look for water or that another mouse has just had a big meal so food must be nearby," he says. "Throughout human evolution and for most wild animals today, food and water are scarce resources that need to be detected. This olfactory system is a mechanism by which these types of

communication can occur."

The GC-D system is unlikely to be functional in humans because of a disruption in a necessary gene. "Even though this specific system may not be functional in humans, it is clear that a number of other ones involved in chemical communication between individuals are present and working," says Dr. Munger. "Having a better understanding of the complexity of chemical communication across all mammals will give us important insights into how humans use their sense of smell. Odors not only enrich the experience of tasting wine, for example, but enrich our interactions with each other."

Source: University of Maryland Medical Center