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Animals learn to fine-tune their sniffs

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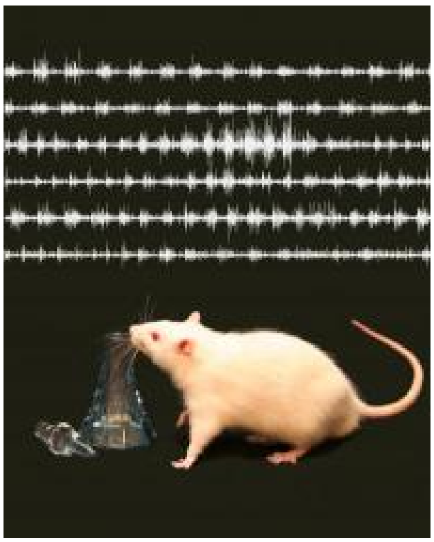

Animals learn to fine tune their ability to smell in order to better detect predators and find food, research on rats at the University of Chicago Shows. Credit: Reprinted with permission: Leslie Kay, et al. The *Journal of Neuroscience* 2012.

Animals use their noses to focus their sense of smell, much the same way that humans focus their eyes, new research at the University of Chicago shows.

A research team studying rats found that animals adjust their sense of smell through sniffing techniques that bring scents to receptors in different parts of the nose. The sniffing patterns changed according to what kind of substance the rats were attempting to detect.

The sense of smell is particularly important for many animals, as they need it to detect predators and to search out food. "Dogs, for instance, are quite dependent on their sense of smell," said study author Leslie Kay, associate professor of psychology and director of the Institute for Mind & Biology at the University of Chicago.

"But there are many chemicals in the smells they detect, so detecting the one that might be from a predator or an explosive, for instance, is a complex process."

Kay was joined in writing the paper by Daniel Rojas-Líbano, a postdoctoral scholar at the University of Chile in Santiago, who received his PhD from UChicago in 2011. Rojas-Líbano, who did the work as a doctoral scholar, was the first author on the publication. Their results are published in an article, "Interplay Between Sniffing and Odorant Properties in the Rat," in the current issue of the *Journal of Neuroscience*.

Scholars have hypothesized that animals may be able to focus sniffing, just as humans focus their sight to detect a target, like the face of a friend, in a crowd. Humans are also known to be able to adjust their ability to detect specific odors with practice when cooking or sampling wine, for instance.

Kay and Rojas-Libano drew from two ideas proposed by other scholars to test whether animals can focus their sniffs.

In one set of findings, researchers had shown that the nose can act like a gas chromatograph (a device that separates chemicals in complex blends like flower scents), absorbing substances for different times depending on how readily they interact with the water-based mucus on the sensory receptors in the nose. Odorants that have high "sorption values" are easily absorbed into the mucus, while odors that do not absorb easily into water have lower sorption values.

The other finding crucial to the current work was the discovery that changes in the airflow rates of scents entering the nose can change which odors the nose readily detects. Different parts of the nose have different airflows, and classes of receptors suited to detecting specific odors. Researchers had speculated that animals might be able to change airflow to target specific odors in a blend of chemicals, like focusing on smelling a particular scent in a perfume.

But until the publication of the paper by Kay and Rojas-Líbano, no one had been able to test the ideas that arose from those earlier findings.

"Daniel devised an excellent experiment to test these hypotheses," Kay explained.

Rojas-Líbano trained rats to detect a specific odor by rewarding them with a sugar pellet when they had detected a target odor and responded correctly. Electrodes attached to the rats' diaphragm muscles measured the rate at which they were taking in air. He then tested the animals with many mixtures of two chemicals to see if they could pick out those containing the target scent.

The rats were successful in making the distinctions, regardless of which type of odor they were seeking. But the rats learned to look for a highly absorbent odor much more quickly than the rats learning to detect a less absorbent odor.

The rats also inhaled differently, depending on which type of odor they were detecting. The animals inhaled for a longer time when they were learning to detect the low-absorbing odor, and then reduced flow rates once they had learned to detect the odor, researchers determined.

"What was happening was that the air was moving through the nose at a slower rate and targeting those parts of the nasal epithelium that are further along in the pathway—those more likely to pick up the low-absorbent odors," Kay said.

For highly absorbent odors, the animals inhaled more quickly because the parts of the nasal cavity that are sensitive to those smells are closer to the start of the nose's air pathway.

"I think one of the most interesting aspects of these experiments is the finding of the difference in difficulty the rats displayed to detect different targets from the same set of mixtures," Rojas-Líbano said. "This shows that there is more to olfaction than just receptor types and combinations. If detection was solely based on chemical-receptor interactions (as people seem to assume quite often), performance levels should have been more similar between the groups of rats. The physical properties of the odors matter a lot, and so does the type of sniff that an individual uses to smell the odors."

Provided by University of Chicago