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Smelling the light: 'What if we make the nose act like a retina?'

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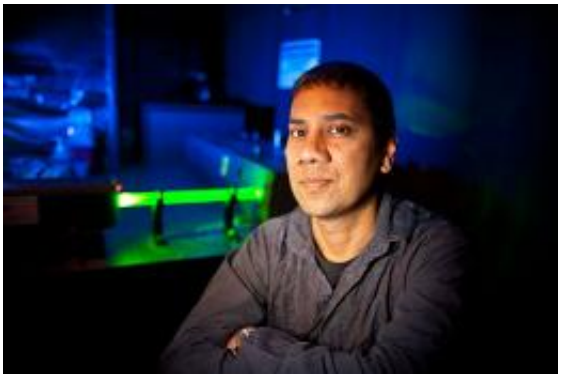

Professor Venkatesh N. Murthy and his colleagues at Harvard and Cold Spring Harbor Laboratory used light to study smell, applying the infant field of optogenetics to the question of how cells in the brain differentiate between odors. “In order to tease apart how the brain perceives differences in odors, it seemed most reasonable to look at the patterns of activation in the brain,” Murthy said. Photo: Justin Ide

(PhysOrg.com) -- Harvard University neurobiologists have created mice that can "smell" light, providing a potent new tool that could help researchers better understand the neural basis of olfaction.

The work, described this week in the journal *Nature Neuroscience*, has implications for the future study of smell and of complex perception systems that do not lend themselves to easy study with traditional methods.

"It makes intuitive sense to use odors to study smell," says Venkatesh N. Murthy, professor of molecular and cellular biology at Harvard. "However, odors are so chemically complex that it is extremely difficult to isolate the neural circuits underlying smell that way."

Murthy and his colleagues at Harvard and Cold Spring Harbor Laboratory used light instead, applying the infant field of optogenetics to the question of how cells in the brain differentiate between odors.

Optogenetic techniques integrate light-reactive proteins into systems that usually sense inputs other than light. Murthy and his colleagues integrated these proteins, called channelrhodopsins, into the olfactory systems of mice, creating animals in which smell pathways were activated not by odors, but rather by light.

"In order to tease apart how the brain perceives differences in odors, it seemed most reasonable to look at the patterns of activation in the brain," Murthy says. "But it is hard to trace these patterns using olfactory stimuli, since odors are very diverse and often quite subtle. So we asked: What if we make the nose act like a retina?"

With the optogenetically engineered animal, the scientists were able to characterize the patterns of activation in the olfactory bulb, the brain region that receives information directly from the nose. Because light input can easily be controlled, they were able to design a series of experiments stimulating specific sensory neurons in the nose and looking at the patterns of activation downstream in the olfactory bulb.

"The first question was how the processing is organized, and how similar inputs are processed by adjacent cells in the brain," Murthy says.

But it turns out that the spatial organization of olfactory information in the brain does not fully explain our ability to sense odors. The temporal

organization of olfactory information sheds additional light on how we perceive odors. In addition to characterizing the spatial organization of the olfactory bulb, the new study shows how the timing of the "sniff" plays a large part in how odors are perceived. The paper has implications not only for future study of the olfactory system, but more generally for teasing out the underlying neural circuits of other systems.

More information: www.nature.com/neuro/index.html

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