Two nostrils better than one, study shows

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A human following a scent trail (right) employs a zigzag strategy similar to that used by a dog following a scent (left) . (Photos courtesy Noam Sobel lab, UC Berkeley)

University of California, Berkeley, graduate student Allen Liu last Friday donned coveralls, a blindfold, earplugs and gloves, then got down on all fours and sniffed out a 33-foot chocolate trail through the grass.

This was no fraternity initiation, but part of an experiment to find out whether mammals compare information coming from their two nostrils in order to aid scent-tracking performance, much like they compare information from their ears in order to locate a sound.

In a paper appearing this week in the advance online edition of *Nature Neuroscience*, UC Berkeley researchers report conclusive evidence from

these experiments that humans do indeed gain a performance advantage from cross-nostril comparisons. They also found that humans can scent-track, and that, with training, they can improve their accuracy significantly while nearly doubling their speed along the scent trail.

In one experiment, the authors found that while volunteers with one nostril blocked could still track a scent - in this experiment, essence of chocolate - volunteers with two open nostrils tracked a scent quicker and with fewer deviations from the trail.
"We were asking the question, 'Are two nostrils better than one?'" said lead author Jess Porter, a graduate student in biophysics at UC Berkeley. "The answer is yes."

Apparently, according to Porter and her colleagues, the mammalian brain compares smells between nostrils to tell where an odor is coming from in the same way that the brain compares the sounds entering a person's two ears to locate a source. Until now, many researchers thought this was unlikely because a mammal's nostrils, in a mouse, for example, are too close together to receive distinctly different smells.

"The human brain compares information from two 'noses' to turn smell information into spatial information," said Noam Sobel, associate professor of neuroscience and psychology and member of the program in biophysics at UC Berkeley.

Sobel hopes to use information from these experiments to design scent-tracking robots equipped with his eNose, an electronic nose that one day could detect odors such as that from an explosive mine.

To test Sobel and Porter's smell hypothesis, the UC Berkeley researchers soaked a 33-foot (10-meter) string in chocolate essence and laid it in the grass outside Barker Hall, located at the northwest corner of the UC Berkeley campus. They then garbed volunteers to block their senses of

sight, hearing and touch, eliminating all clues other than smell to guide them along the trail. Sniffing like bloodhounds, two-thirds of 32 subjects were able to follow the chocolate scent to the end of the trail within three attempts. All volunteers zigzagged along the trail in the same way that tracking dogs follow a scent.

The researchers then trained four of these volunteers to see if they could improve. All were able to double their speed along the track within just a few days and deviated much less from the scent trail than on their first attempts. The researchers measured subjects' sniffs and noticed that the faster the subjects moved along the trail, the more rapid their sniffing - just as with dogs, though not as fast as the six sniffs per second rate exhibited by dogs.

The big question, however, was whether two nostrils allow scent localization in the same way that a human's two ears and eyes help locate sounds and sights.

To further test this, the researchers devised an ingenious nasal "prism" that mixed scents from the outside world and then presented this to both nostrils, so that there was no difference between what the nostrils smelled. The four subjects were half as accurate at tracking smells under these conditions.

Independent measurements showed that a human's two nostrils sample odors from distinct areas separated by approximately 1.5 inches (3.5 centimeters), more than enough distance to distinguish the edge of a scent plume.

All of these experiments put the lie to a common assumption that humans are lousy smellers compared to all other mammals. While it's true that humans are predominantly visual creatures, Sobel said, their olfactory sense can be compared to that of dogs and other mammals.

"Our sense of smell is less keen partly because we put less demand on it," Porter said. "But if people practice sniffing smells, they can get really good at it."

Source: University of California - Berkeley