Mice have biological clock for smell

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'I smell a rat!' Researchers have found that the sense of smelling in mice is affected by a biological clock devoted entirely to olfaction -- smelling stuff, like sleeping and waking, is on a daily cycle. Credit: Washington University in St. Louis

Biologists at Washington University in St. Louis have discovered a large biological clock in the smelling center of mice brains and have revealed that the sense of smell for mice is stronger at night, peaking in evening hours and waning during day light hours.

A team led by Erik Herzog, Ph.D., Washington University associate professor of Biology in Arts & Sciences, discovered the clock in the olfactory bulb, the brain center that aids the mouse in detecting odors.

The olfaction biological clock is hundreds of times larger than the known biological clock called the suprachiasmatic nucleus (SCN),

located at the base of the brain right on top of where the optic nerves cross each other. Cells in both the SCN and the olfactory bulb keep 24-hour time and are normally highly sychronized to each other and environmental cycles of day-night.

"It's been a question for some time whether the SCN functions as the only biological clock," said Herzog. "One wouldn't think that the ability to smell would cycle, but that's what we show.

" I think now that the SCN is like the atomic clock, important for keeping central time, and then there are all of these peripheral clocks - for timing tasks like sleep-wake, vigilance, digestion, olfaction, hearing, touch and vision, though not all yet found. It may be that the peripheral clocks are like individual wristwatches that we must periodically reset."

Perhaps most surprising is the observation that the olfactory bulb clock can run independent of daily rhythms in sleep-wake or the SCN, making it the Big Ben of the mammalian circadian rhythm world.

"It seems to be one of those biological clocks that can keep running itself for a long time, even without the SCN," Herzog said.

Results were published in the Nov. 22, 2006, issue of the *Journal of Neuroscience*.

Herzog and collaborators Daniel Granados-Fuentes, Ph.D., Washington University postdoctoral researcher, and undergraduate student researcher Alan Tseng, put a little cedar oil on a Q-tip and allowed mice to sniff it for five minutes.

"We then preserved their brains and counted the number of olfactory bulb cells that had been activated by the odorant," Herzog said. "The gene cFOS is a marker for cells that were activated by the stimulus. We

recorded the expression of that gene. All of the data came from in vivo measurements."

They saw more of those cells light up in the olfactory bulb at night than in the day.

"The olfactory bulb might be more sensitive at night when the creatures are active than when they are resting in the day," Herzog speculated. "This might help them find food or mates when they are hungry for food or for love."

Do the results suggest that women should splash on the Estee Lauder during the night so that men can notice all the more and shun the bottle during the day?

"There are anecdotes in the literature about humans liking certain perfumes more during the evening than the morning, and there is some evidence that we also have daily rhythms in olfaction," Herzog said.

Herzog said that it is rare to find someone missing their SCN, so it's tricky to study the human olfactory clock by itself. For this reason, his lab plans to study olfactory behavior in mice.

"We can say that this (olfactory bulb) clock has a functional consequence, and now we're setting up to do olfactory behavior," he said. "We'll ask the mice to tell us when they can smell odors of different concentrations, and we hope to learn more about how and how much the clock modulates their sense of smell, and which cells and genes are needed."

The olfactory bulb biological clock study opens up many questions, a key one of which is: Why are there multiple clocks?

"This idea of multiple biological clocks is new," Herzog said. "We might need now to consider ourselves a clock shop. It appears that disrupting the coordination between these clocks is bad for our health, like in jet lag or shift work."

Source: Washington University in St. Louis