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Scientists find sight-impaired mice may help vision research

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Jennifer Hoy, a doctoral student, and Cristopher Niell, a professor of biology and member of the University of Oregon's Institute of Neuroscience, have found that the poor vision of mice might provide scientists with a good way to study the vision-brain network. Credit: University of Oregon

Mice may have poor vision when compared to humans, but how their visual system works when they go after prey may provide insights on how human brains make decisions based on visual cues, say University of Oregon researchers.

Most studies that have probed the brain circuitry connected to natural visual behaviors in mice have focused on fear response—avoiding becoming prey. Mice are color blind, and their visual acuity is more than 100 times worse than a human's, suggesting that their vision is so poor that they could never provide insight into the visual functions of higher order mammals such as humans.

An approach developed at the UO, however, may help extend the use of mice as a model for studying vision. In a study published online Oct. 20 ahead of print in the journal *Current Biology*, UO researchers demonstrated that mice actually use their eyesight to catch prey—in their experiments, a cricket.

"I had learned about owls producing prey capture behavior and how it's related to development and plasticity," said Jennifer Hoy, a postdoctoral researcher in in the UO's Institute of Neuroscience. " I thought, 'wow, wouldn't it be nice if we could access the brain circuitry the way we can for mice.' Then I wondered if we could get mice to produce the same behavior."

To pursue that idea, Hoy placed a cricket in a mouse's habitat, a small box with plain white sides where the cricket was quickly caught and eaten. The next step was to determine which senses the mouse used to locate and approach its prey.

In a series of experiments, Hoy's four-member research team showed that a mouse is dramatically more successful at following and catching a cricket when it is able to see it. When placed in a lighted arena, nearly all of the mice tested (96 percent) became successful in rapidly and reliably capturing a cricket.

When researchers put earplugs in a mouse's ears, the cricket was captured just as easily as when a mouse could hear, but if a mouse was placed in the dark, the time it took to locate the cricket took almost four times longer.

The researchers next found that if vision and hearing were blocked at the same time, then approach accuracy and capture rates fell much more dramatically than when just one sensory input was blocked. This suggests, they said, that auditory cues may aid prey capture in the absence of vision, but that vision serves as the dominant cue that enables rapid and accurate approaches from a distance.

As a final test of the role of vision and to estimate what features of visual stimuli drove accurate approach behavior, crickets were placed behind a clear barrier of plexiglass that eliminated all non-visual cues. Under these conditions, the mice made accurate approaches towards their prey only in the light and made contact with the plexiglass just in front of the crickets.

Using this approach, the researchers were able to quantify the mouse's behavior, allowing them to measure parameters of the mouse's vision, such as the size and distance over which they see, as well as the accuracy in aiming toward the cricket.

The results provide convincing evidence that the mouse relies on its vision during the hunt, said Hoy and co-author Cristopher Niell, a professor of biology and member of the UO's Institute of Neuroscience.

"In a lot of ways, this justifies the work people are doing with the mouse, Niell said. "The mouse is easy to study because we can look and see how neurons work in ways that we can't in primates and humans.

In future experiments, Niell and Hoy want to examine visual system function during prey capture to study how visual areas encode and transform the information they receives from the eyes. In addition to the visual cortex, they are interested in the more primitive part of the brain, the superior colliculus, which is responsible for instinctive reactions towards lights, movement and sounds.

There is much that is unknown about how the eyes, visual cortex and superior colliculus interact with each other during behavior, Niell said. "If I throw you a Frisbee and your reach out to catch it, how did you do that?"

Niell and Hoy plan to monitor and manipulate mouse neurons as they pursue clues to that interaction in follow-up studies.

The research eventually could have implications in some human conditions, Hoy said. The inability to suppress distracting sensory stimuli during tasks, for example, has been implicated in attention deficit hyperactivity disorder. Hoy says she wants to find out how a human brain is able to focus on a single object and how this ability develops as people mature.

"There's this developmental phenomenon where if a child is focused on a task they are easily distracted by activity in their periphery, whereas with an adult that's much less true," Hoy said. "That process undergoes development as we mature, and that development is important for us to focus as an adult. I don't think anyone fully understands how that process works, and that's what I find interesting."

More information: Jennifer L. Hoy et al, Vision Drives Accurate Approach Behavior during Prey Capture in Laboratory Mice, *Current Biology* (2016). DOI: 10.1016/j.cub.2016.09.009

Provided by University of Oregon

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