Researchers map sound, response and reward anticipation in mouse brain

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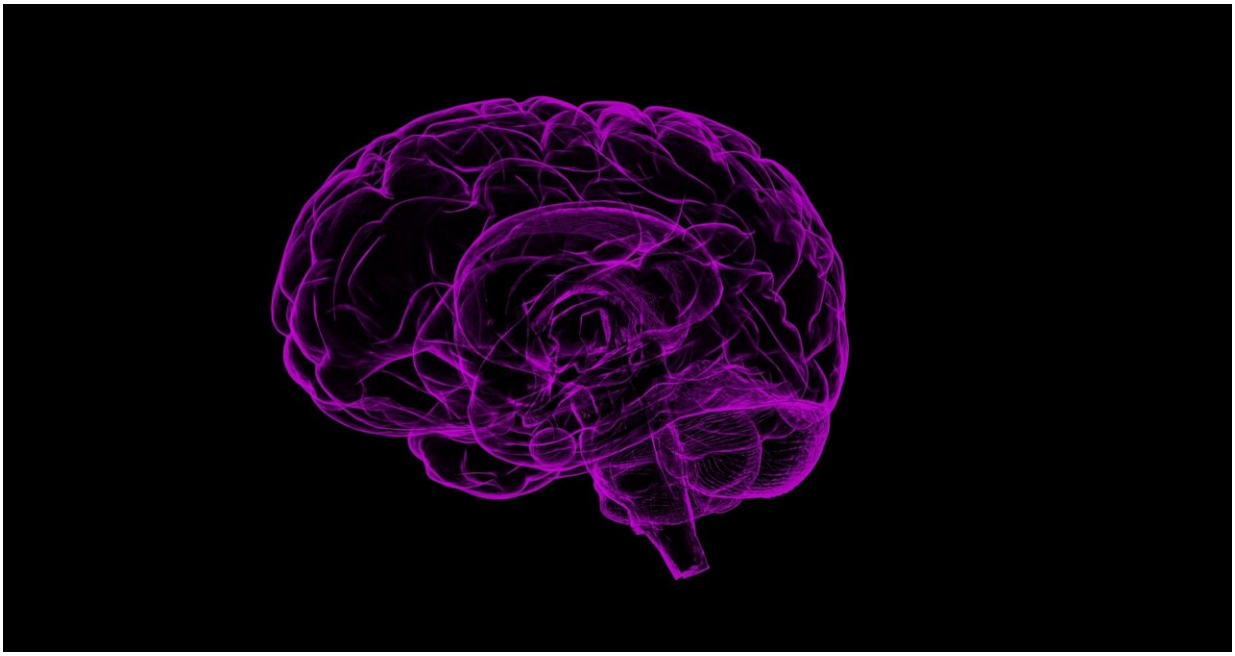

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University of Oregon neuroscientists report that two areas of the mouse brain combine representations of what is heard and anticipated, guiding behavior that leads mice to the best reward.

Researchers have known that signals go from the ears to the brain stem, the thalamus and auditory cortex and then onward. What was not known is how these signals about sounds are used by other brain areas to make

decisions and drive behavior.

In a series of studies using mice, researchers in lab of Santiago Jaramillo, a professor of biology and member of the Institute of Neuroscience, identified the posterior tail of the dorsal striatum as a key player. In an April 2018 paper in *Nature Communications*, Jaramillo and colleagues found evidence that neurons in this region provide a stable representation of sounds during auditory tasks.

Follow-up studies published in the *Journal of Neuroscience*, have sought to further understand what is happening in the mouse brain's auditory sensory system, Jaramillo said.

In January, his lab reported that the dorsal posterior striatum receives signals from two parallel pathways, one from the auditory thalamus and other from the auditory cortex. The second study, published online March 5, looked more closely at how signals are integrated.

"Signals from both pathways tell you the frequency of sounds very well," Jaramillo said. "This explains why if you shut down the auditory cortex you still get the signals you need from the auditory thalamus. In our second study, we investigated the integration of sound, action and reward . We knew that the activity of neurons in these brain regions represents sounds, but what about actions and expectations about reward?"

It turns out that the integration of reward response, or the expectation of a learned reward, is enhanced in the posterior striatum, the researchers found by using electrophysiological recordings in simple two-choice scenarios.

Initially 11 adult male mice, over 100 trials, heard brief bursts of high- and low-frequency sounds. As a reward, one or two drops of water awaited the mice if they moved right or left based on a sound's

frequency. At that point, researchers changed the reward-sound association to see if the programmed anticipation in the mice could be reprogrammed and influence a change in directional behavior.

Over time, the enhanced response in the posterior dorsal striatum emerged as the mice adapted their movements to seek the bigger reward. The new study suggests that the involved auditory neurons build representations about sounds, actions and reward expectation.

"You can tell from the firing of neurons which action the mouse expects will yield the best reward," Jaramillo said.

Research in Jaramillo's lab aims to understand how the brain learns to make better decisions. Brain regions and circuitry are similar in humans, he noted, but whether sound signals are reaching the posterior striatum from two pathways isn't known.

Eventually, Jaramillo said, his research could provide avenues for therapeutic strategies, potentially including specialized devices to treat human auditory disorders or damages associated with strokes or injuries.

"What we do in the lab is foundational science," he said. "We are trying to understand how the healthy brain works, so future research can use this knowledge to develop better diagnoses and therapies."

More information: Lan Guo et al, Choice-selective neurons in the auditory cortex and its striatal target encode reward expectation, *The Journal of Neuroscience* (2019). DOI: 10.1523/JNEUROSCI.2585-18.2019

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