Songbirds may hold the secret to how babies learn to speak

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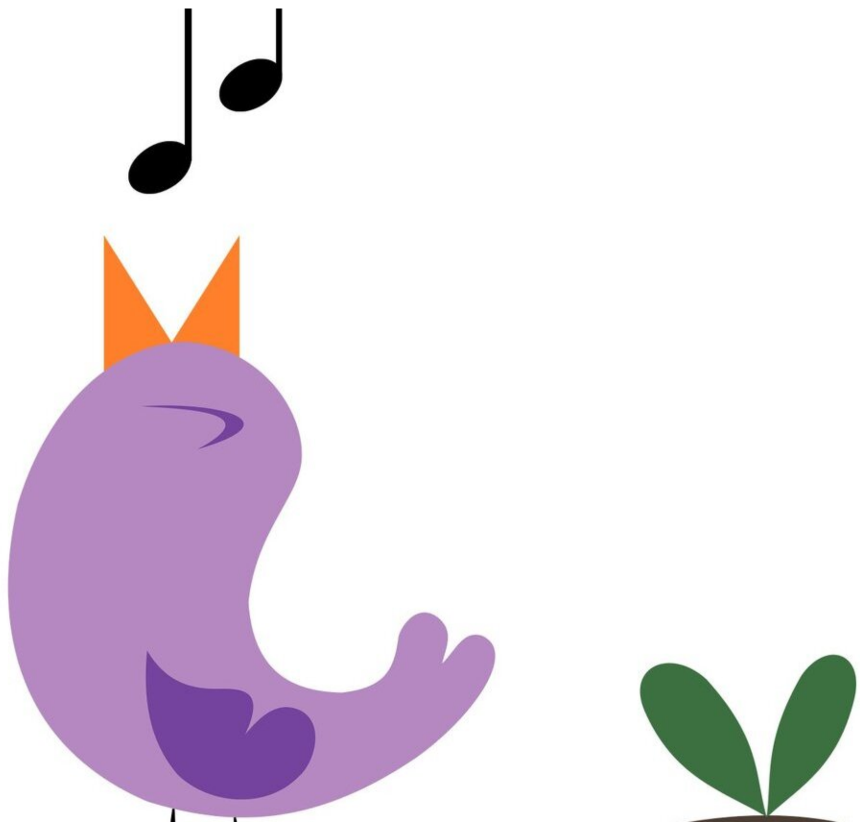

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The explanation for how people learn complex behaviors, such as speech, might be found in a new study of songbirds by scientists at the USC Dornsife College of Letters, Arts and Sciences.

"One hypothesis to explain speech development is that the sound of each word creates a memory, or template in the brain," says Sarah Bottjer, a professor of biological sciences and psychology at USC Dornsife College and an author of the study. "That template becomes the internal recording a baby uses, as its goal, to say the word."

When attempting to say a word, a baby's brain may compare the sound it utters to the brain's template of that word. The outcome of that evaluation may be relayed to neural circuits responsible for generating motor commands (mouth movement and breathing) to produce sound. When the sound is a match, the neural circuitry to make that sound is strengthened. When it's not, it's recognized as an error that corresponds with an attempt to correct the neural circuitry.

"Songbirds offer a powerful experimental model for studying the neural mechanisms that underlie motor skill learning since we can implant electrodes into their brains and record the activity of neurons in juveniles as they practice 'babbling' sounds. In this way, we can track changes in neural activity as learning progresses."

Bird brains offer key insights to learning

The study findings, published in the journal *eLife* on Dec. 19, reveal what happens in specific neural circuits when young zebra finches make vocal sounds.

Researchers recorded neurons in a distinct portion of their brains, a part of the cortex that is inter-connected with the basal ganglia, located within the center of the brain. Cortical-basal ganglia circuitry is key for learning motor skills, particularly those that become highly practiced habits. That's one of the reasons basal ganglia are related to conditions such as obsessive-compulsive disorder, addiction, and Tourette's syndrome.

The scientists found that when the birds produced sounds that mimicked the sounds that they had memorized, there was an increase in activity in some neurons within this cortico-basal ganglia circuit and a decrease in activity in others.

"The finding is exciting," says Bottjer, "because it provides a rare example of changes in neural activity that correspond with behavioral attempts to achieve a mental goal; in this case, to produce vocalizations that mimic the memory of a sound. The findings offer key insight into the brain's learning process."

Perhaps the way people learn a tennis serve, or how to make other precise skilled movements, can be explained by the same process. Bottjer says she plans to conduct more research to address that question.

More information: Jennifer M Achiro et al. Neural activity in cortico-basal ganglia circuits of juvenile songbirds encodes performance during goal-directed learning, *eLife* (2017). DOI: 10.7554/eLife.26973

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