

# Probing Question: How do songbirds learn to sing?

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"Poor Sam Peabody, Peabody, Peabody!"

"Please, please, pleased to meetcha!"

"Who cooks for you?"

If you hear these phrases while walking through the woods, chances are there are a white-throated sparrow, chestnut-sided warbler and barred owl nearby.

Songbirds -- and the amusing gimmicks (called mnemonics) invented to remember their songs and calls -- have long delighted human listeners.

While it may seem they're singing for human pleasure, there is a serious purpose behind their warbling, said Alexay Kozhevnikov, assistant professor of physics and psychology at Penn State.

In most songbird species, only the males sing, and they learn to do so from their fathers, explained Kozhevnikov. "If a bird doesn't hear the tutor, it will sing, but its song will be nothing like the song of an adult bird. It will be poorly structured and lack the wealth of acoustic structure."

In a bird's world, a sloppy song can have serious consequences, Kozhevnikov said. "It means he'll have a very tough time mating," he noted. "One major reason songbirds sing is to attract females who choose their mates on the basis of song quality."

"If a bird doesn't sing an attractive song, his genes are going to be out of the genetic pool of the population," explained Kozhevnikov. Nature, it seems, is selecting for beautiful music, or at least what sounds beautiful to female songbirds.

"There is some research that has tried to find out which aspects of the song are most attractive to females," he added. "For certain bird species, it's the song's tempo precision or the bird's ability to repeatedly and precisely hit the same rhythm. It's not really clear why. Some speculate this might be an indication that the singer is fit and in great shape. There are a lot of questions about that."

Kozhevnikov's own research focuses on what happens in a bird's brain when it sings. By studying zebra finches and Bengalese finches -- both common pet birds -- he hopes to learn more about the relationship between the brain's neural circuits and the learning process. "The hope," he said, "is that the principles of such an organization might be general and what we learn about studying the birds might be applicable to humans."

Only a handful of animals can, like humans, listen to a sound and reproduce it. Birds, bats, whales and dolphins are all "vocal learners." Songbirds learn to sing in ways similar to how babies learn to talk, Kozhevnikov said, and a young songbird learning to sing can even sound like a babbling infant. Some songbird species master several sounds and learn to vary their order, as humans change the order of words to construct different sentences.

Using a tiny, lightweight device that doesn't hamper the birds from hopping in their cages as they sing, he has measured the electrical signals of individual neurons firing in one of the bird's brain areas responsible for singing, an area known as the high vocal center, and found their ability to repeatedly hit the same rhythm to be within a millisecond, or

one-thousandth of a second.

"Their biological clock turns out to be very precise," said Kozhevnikov. "By themselves, neurons are not very precise things, yet Mother Nature has made this extremely exact clock out of neurons. From an engineering/neuroscience point of view, it's a marvel. It's, I believe, the most precise sequence in nature found to date."

While a bird's brain structure is not similar to a human's, in other words, there is a lot of sophisticated engineering going on in that tiny head.

"Brain size may not be the right way to judge intelligence," Kozhevnikov suggested. "A song is a sequence of some actions. In terms of the ability to learn those sequences, the brains of the birds show some amazing capabilities."

Source: By Lisa Duchene, Research Penn State

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