

# What birds' rhythms tell us about how we form speech and movement

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Male zebra finches (right) have more pronounced ability for singing, and learning rhythm, than their female mates (left). Credit: Tufts University

If you have ever been moved by the beat of a drum or enchanted by a song, or if you have meandered through YouTube to watch animals from

elephants to dancing cockatoos swaying and bopping to music, you might suspect that there is an instinctive and primal connection to musical rhythms that humans share with many animals. In a study published in the *Proceedings of the National Academy of Sciences*, a collaborative team of Tufts University biologists and psychologists looked at how birds perceive songs and found that, like humans, zebra finches can recognize songs by their rhythmic patterns, even when played at very different tempos.

Given the growing evidence that rhythmic timing problems are associated with a number of childhood language disorders, including dyslexia, stuttering, and developmental language disorders (formerly known as specific language impairment), having an animal model of human rhythmic processing could be helpful in understanding how it is linked to vocal communication in the brain, according to the researchers. A recent published study by the authors explored using [zebra finches](#) as models for understanding stuttering in humans

The discovery could also provide insights into movement disorders. "Rhythm perception in humans involves complex neural connections between the parts of our brain that perceive sounds and the parts that control movement," said Andrew Rouse, corresponding author of the study, who recently earned his Masters in Psychology at Tufts. "It's one reason why rhythm is such a strong stimulus in the desire to dance, but it also suggests that [movement disorders](#) like Parkinson's disease and speech disorders such as stuttering could have links to the same auditory-motor networks in the brain."

"It is important to note that musical rhythms can facilitate more natural movement in patients with Parkinson's disease," added Mimi Kao, assistant professor of biology at Tufts and co-author of the study. "An animal model that can process rhythm patterns could help us understand why that happens."

Current evidence suggests that rats, which are biologically more closely related to humans and used as models for many human diseases, don't seem to have flexibility in rhythm perception. They might recognize a sequence of notes, but only at one tempo. Yet the researchers found that zebra finches can recognize songs more by [rhythmic patterns](#) than specific time intervals. They can recognize the pattern of the beat whether it is played fast or slow. The researchers suggest that this is because the zebra finches, and not rats, have special brain circuitry for learning and processing complex sound sequences and may actually be a better model system than rats for studying the neurobiology of human rhythm processing.

The study authors suggest that the ability to learn patterned vocalizations could be linked to rhythm perception, and there are varied levels of ability to do so across species. For example, birds that can learn new vocalizations throughout life ('open-ended learners') should outperform those whose song learning is limited to their youth ('closed-ended learners') when discerning rhythms. Some birds, like canaries, vary in their vocal learning abilities seasonally, and others, like finches, may have one gender with more pronounced vocal learning capabilities than their mates. They too, would differ in their ability to learn new rhythm patterns.

Other species predicted by the authors to be better performers at rhythm detection are Alston's singing mice, marmosets, and Japanese macaques, which engage in call and response vocalizations with others of their species; vocally flexible harbor seals; and bats that alter the timing of their vocalizations to produce regularly spaced clicks for echolocation.

Birds with particularly strong capabilities in learning vocalizations, including those that can mimic a wide range of sounds and human speech—like parrots, ravens and cockatoos—may have very well-developed [brain regions](#) that link auditory and motor neural networks

and identify not just rhythms but also complex and varying beat sequences. Many [birds](#) that don't have a singing repertoire, like pigeons, perform poorly when learning rhythm sequences.

"Zebra finches and possibly other species with flexible rhythm perception and specialized auditory-motor forebrain regions will allow fine-grained, circuit-level measurements and manipulations to give us clues to the neural architecture of speech and regulated movement in humans," said Tufts psychology Professor Aniruddh Patel, also a co-author of the study.

**More information:** Andrew A. Rouse et al, Vocal learning and flexible rhythm pattern perception are linked: Evidence from songbirds, *Proceedings of the National Academy of Sciences* (2021). [DOI: 10.1073/pnas.2026130118](#)

Provided by Tufts University

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