Cope's gray treefrogs meet the cocktail party problem

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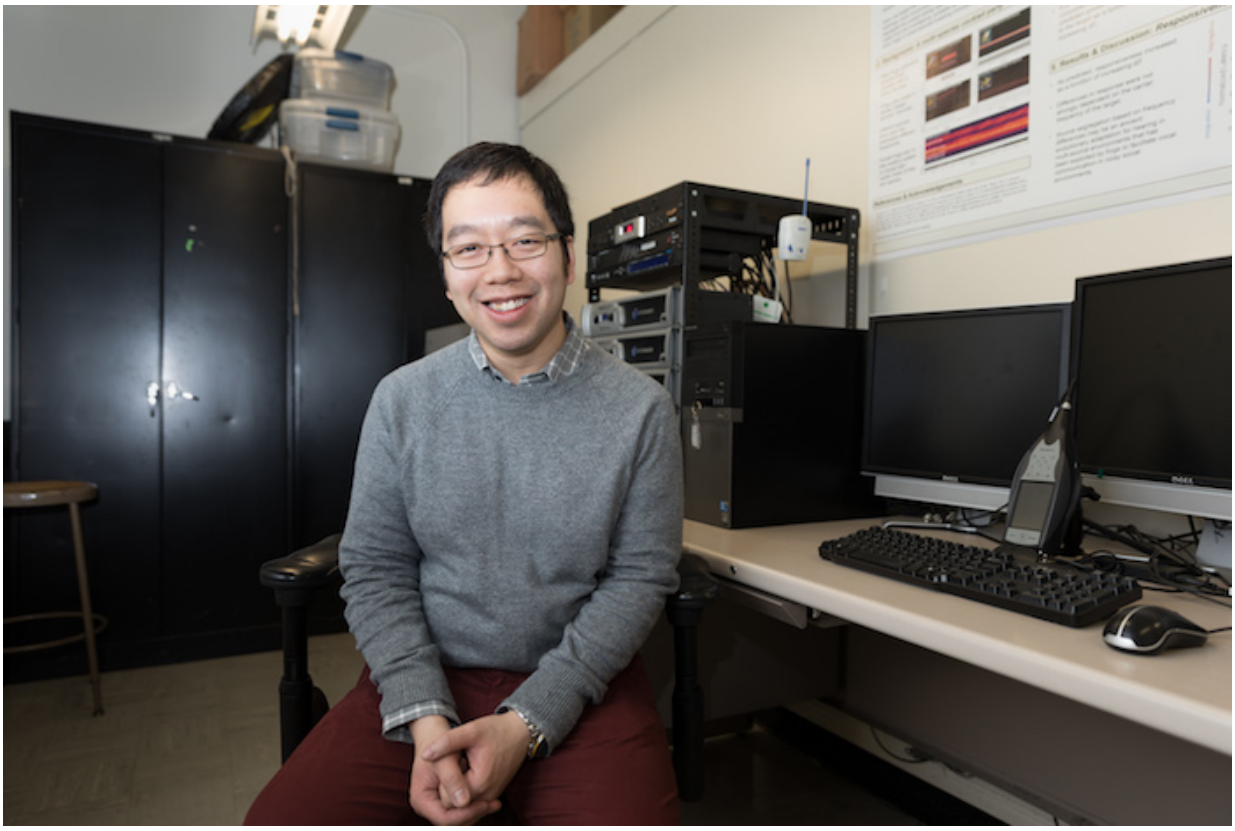
Credit: University of Minnesota

You've been there: Trying to carry on a conversation in a room so noisy that the background chatter threatens to drown out the words you hear. Yet somehow your auditory system is able to home in on the message being conveyed by the person you're talking with. The secret to rising above the noise—a dilemma known in the world of sound science as "the cocktail party problem"—turns out to lie in its ability to discern patterns in the background noise and selectively ignore such patterns, according

to a new study published in *Current Biology* earlier this month.

Listening to a deafening chorus of Cope's gray treefrogs on a spring evening, scientists have wondered: Do female frogs use a similar strategy to pick important messages about potential mates out of the cacophony? The chorus consists of the calls of countless individual male frogs, each of which is conveying information about which species it is and how fit it is—with faster, longer calls indicating fitter individuals. To ensure the best survival of their young, "the females have to be able to tell the appropriate species and be able to choose a high-quality male," says Norman Lee, a postdoctoral fellow in the Department of Ecology, Evolution, and Behavior. But how can they, when everyone is talking at the same time?

Working with associate professor Mark Bee and colleagues in EEB and the Department of Psychology, Lee has figured out what traits of the background noise of frog choruses allow females to tune out the hubbub and tune into the hubba-hubba—with implications not only for our understanding of frog ecology and evolution, but also for our ability to help humans hear.



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Lee knew from others' research that humans are able to hear certain sounds better in noisy settings when the background noise is "comodulated"—meaning that the various frequencies of sound it comprises vary in loudness together. Could the fact that the background noise is comodulated be a key to the frogs' success? To find out, he first built a model of the Cope's gray treefrog's ear and used it to determine how this species may process the background chorus. He then analyzed frog choruses and discovered that the chorus input indeed is comodulated.

"What we [still] didn't know is if animals could exploit these features for

improved decision-making," Lee says. To answer that question, he produced several artificial choruses made up of two noise bands centered on the call frequencies—one in which the sound was unmodulated, meaning that it didn't vary in sound intensity; one in which the two noise bands were modulated but not together; and one in which the two noise bands were comodulated. He then played each of those in the background while presenting females with a Cope's gray treefrog call and a call simulating another species. Indeed, the females were most likely to choose the right species' call when the background noise was comodulated. Similarly, he presented two Cope's gray treefrog calls, with one being longer and repeated at a higher call rate (and so, presumably representing a more fit mate and therefore a better evolutionary choice). He found, again, that females made the best choices when the background chorus was comodulated.

"Previous studies of animal communication have generally regarded noise as a relatively static feature of the animal's acoustic environment," says Bee. "What this new work shows is not only that noisy acoustic scenes are, in fact, dynamic, but also that they are dynamic in predictable ways that animals have evolved to exploit to avoid noise -induced errors in communication."

Because frogs' ears are configured differently than those of other vertebrates and so may process sound differently, the findings hold importance not only for understanding what it takes for frogs to successfully procreate, but also for humans: Knowledge of the differences, the researchers say, could potentially be used to design better hearing aids and speech recognition systems.

More information: Norman Lee et al, Frogs Exploit Statistical Regularities in Noisy Acoustic Scenes to Solve Cocktail-Party-like Problems, *Current Biology* (2017). DOI: 10.1016/j.cub.2017.01.031

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