Mockingbird song decoded

June 4 2021

The mockingbird uses musical techniques like those of humans. Credit: MPI for Empirical Aesthetics

The North American mockingbird is famous for its ability to imitate the song of other birds. But it doesn't just mimic its kindred species, it

actually composes its own songs based on other birds' melodies. An interdisciplinary research team has now worked out how exactly the mockingbird constructs its imitations. The scientists determined that the birds follow similar musical rules as those found in human music, from Beethoven to Kendrick Lamar.

The song of the mockingbird is so complex that to investigate it required a joint effort of experts from very different fields. Neuroscientist Tina Roeske of the Max Planck Institute for Empirical Aesthetics, field biologist Dave Gammon of Elon University, and the music philosopher David Rothenberg of the New Jersey Institute of Technology combined their different approaches and areas of expertise to conduct this highly unusual study, the findings of which have just been published in the open-access journal *Frontiers in Psychology*.

Lead author Tina Roeske designed the algorithms used in testing the team's hypotheses. "When you listen for a while to a mockingbird," she explains, "you can hear that the bird isn't just randomly stringing together the melodies it imitates. Rather, it seems to sequence similar snippets of melody according to consistent rules. In order to examine this hunch scientifically, however, we had to use quantitative analyzes to test whether the data actually supported our hypotheses."

The results were unambiguous. The authors identified four compositional strategies that mockingbirds use in transitioning from one sound to the next: changing timbre, changing pitch, stretching the transition (lengthening it in time), and squeezing it (shortening it in time). The complex melodies they create are music to the ears not only of other birds but of humans as well. So, it should come as no surprise that (human) composers of varied musical styles use similar techniques in their work.

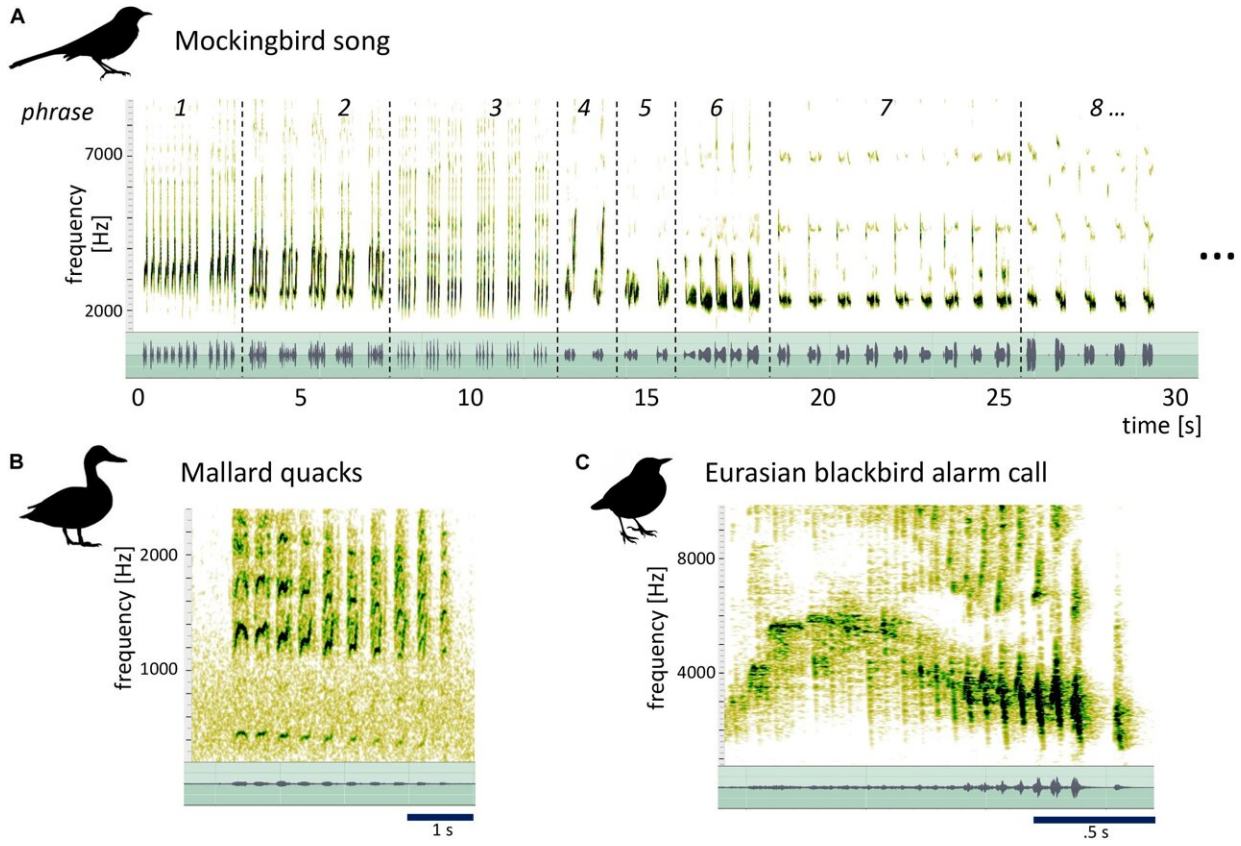

Figure 1. Spectrogram (top) and waveform (bottom, green) of mockingbird song, illustrating its hierarchical structure, and mallard and blackbird calls for comparison. (A) 14 s of male mockingbird song. Dotted lines mark phrase transitions. Both spectrogram and waveform illustrate the organization of Birdsong material in distinct phrases of repeated syllables (e.g., phrase 3) or syllable groups (e.g., phrase 1). (B) A series of mallard quacks (XC613266, recorded by Jack Berteau in the Vendée, France) and (C) a blackbird's alarm call (XC622587, recorded by Pierre Foulquier in Le Mans, France) that both contain a specific kind of acoustic morphing: one repeated note/syllable gradually slows down and descends in pitch (after an initial rise for the blackbird call). We argue here that the variegated morphing modes observed across mockingbirds' phrase transitions are distinct from these cases of stereotyped within-phrase morphing, less easily explained by muscular constraints, and surprisingly similar to certain strategies in music. The mallard quacks and the blackbird call in Figure 1 were obtained from the Xeno-Canto database. The mallard was recorded by Jack Berteau in the Vendée, France (recording XC613266) and the blackbird by Pierre Foulquier in Le Mans, France (recording XC622587).

As co-author David Rothenberg explains in a YouTube video, the Tuvan throat singing group Huun-Huur-Tu presents examples of timbre change, and pitch change can be heard in the famous opening of Beethoven's Fifth Symphony; the song "Show Yourself" from the Disney film "Frozen 2" itself shows the stretching of sound transitions; and if you listen very closely to Kendrick Lamar's song "Duckworth" from the album "Damn," you'll hear transitions being squeezed, or shortened.

More information: Tina C. Roeske et al, Mockingbird Morphing Music: Structured Transitions in a Complex Bird Song, *Frontiers in Psychology* (2021). DOI: 10.3389/fpsyg.2021.630115

Provided by Max Planck Society