Study shows bats adjust the gape of their mouth to zoom field of view of biosonar

May 11 2015, by Bob Yirka

Big eared townsend bat (Corynorhinus townsendii) Credit: Public Domain

A team of researchers with Tel Aviv University has found that at least one kind of bat (the Bodenheimer's pipistrelle) is able to zoom in on information it receives from its biosonar, by adjusting the degree to which it stretches its mouth open. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes the experiments

they conducted with bats and how it is that mouth stretching is able to help the bats.

As most everyone knows, bats find their way around using echolocation—they emit a wide variety of different sounds and then listen to the sounds as they are bounced back. They do it very nearly constantly while flying around, emitting different length sounds, all of which are just fractions of a second. In this new effort the researchers discovered that bats also have a way of refining the process by adjusting the gape of their mouth.

To learn more about how bats make necessary adjustments when flying around things that are close as opposed to those that are farther away, the team set up a experiment that consisted of high-speed cameras, ultrasonic microphones, and a closed environment that included a tunnel to a pond to allow the bats to drink. The team filmed the bats as they approached the tunnel that led to the pond, knowing they would have to make an adjustment of some sort. That adjustment turned out to be opening their mouths wider—sometimes four times as wide (because the mouth adjustments occurred so rapidly, the team wound up using a neural network to match mouth gape size to different points in time). The tighter the quarters, the team found, the wider the bats opened their mouths—a wider mouth created a narrower sound beam, they suggested.

To make sure the bats were not responding in ways unique to the artificial environment, the team also recorded wild bats flying through a natural tunnel—they found the same response. The researchers note that many animals have been observed changing where they focus, or have lenses in their eyes to adjust for depth, but this is the first known instance of an animal with an ability to change its entire field of view.

More information: Bats adjust their mouth gape to zoom their biosonar field of view, Pavel Kounitsky, DOI:

10.1073/pnas.1422843112

Abstract

Active sensing, where sensory acquisition is actively modulated, is an inherent component of almost all sensory systems. Echolocating bats are a prime example of active sensing. They can rapidly adjust many of their biosonar parameters to optimize sensory acquisition. They dynamically adjust pulse design, pulse duration, and pulse rate within dozens of milliseconds according to the sensory information that is required for the task that they are performing. The least studied and least understood degree of freedom in echolocation is emission beamforming—the ability to change the shape of the sonar sound beam in a functional way. Such an ability could have a great impact on the bat's control over its sensory perception. On the one hand, the bat could direct more energy into a narrow sector to zoom its biosonar field of view, and on the other hand, it could widen the beam to increase the space that it senses. We show that freely behaving bats constantly control their biosonar field of view in natural situations by rapidly adjusting their emitter aperture—the mouth gape. The bats dramatically narrowed the beam when entering a confined space, and they dramatically widened it within dozens of milliseconds when flying toward open space. Hence, mouth-emitting bats dynamically adjust their mouth gape to optimize the area that they sense with their echolocation system.