Bats adjust their 'field-of-view'

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A new study reveals that the way fruit bats use biosonar to 'see' their surroundings is significantly more advanced than first thought. The study, published September 13 in the online, open access journal *PLoS Biology*, examines Egyptian fruit bats (*Rousettus aegyptiacus*), which use echolocation to orient inside their caves and to find fruit hidden in the branches of trees. Their high-frequency clicks form a sonar beam that spreads across a fan-shaped area, and the returning echoes allow them to locate and identify objects in that region. As these bats were considered to have little control over their vocalizations, scientists have puzzled over how they are able to navigate through complex environments.

The research team, led by Nachum Ulanovsky of the Weizmann Institute in Israel and Cynthia Moss of the University of Maryland, reports that these bats adapt to environmental complexity using two tactics. First, they alter the width of their sonar beam, similar to the way humans can adjust their spotlight of attention in order to spot, for example, a friend

in a crowded room. Second, they modify the intensity of their emissions. "The work presented here reveals a new parameter under adaptive control in bat echolocation", says Ulanovsky.

Ulanovsky and his team trained five Egyptian fruit bats to locate and land on a mango-sized plastic sphere placed in various locations in a large, dark room equipped with an array of 20 microphones that recorded vocalizations. In one set of experiments, the researchers simulated an obstacle-filled forest by surrounding the sphere with two nets spread between four poles. To reach the target, the bats flew through a narrow corridor whose width and orientation varied from trial to trial.

In the obstacle-filled environment, the bats covered three times as much area with each pair of clicks as they did when the obstacles weren't there. The angle separating each two beams was also wider and the volume of the clicks louder, and these differences became more pronounced as they drew further into the corridor and therefore closer to their obstacles. This larger 'field of view' allowed the bats to track the sphere and the poles simultaneously, and avoid collisions while landing.

"This is the first report, in any sensory system, of an active increase in field-of-view in response to changes in environmental complexity," says Ulanovsky. Although these new findings may be unique to Egyptian fruit bats because of their rapid tongue movements, Ulanovsky explains that their results "suggest that active sensing of space by animals can be much more sophisticated than previously thought – and they call for a re-examination of current theories of spatial orientation and perception."

More information: Yovel Y, Falk B, Moss CF, Ulanovsky N (2011) Active Control of Acoustic Field-of-View in a Biosonar System. PLoS Biol 9(9): e1001150. doi:10.1371/journal.pbio.1001150