Echoes to Action: The Bat Superior Colliculus

Timothy K. Horiuchi, Cynthia F. Moss, Melville Wohlgemuth & Ninad Kothari

The Horiuchi and Moss laboratories have long collaborated on behavioral, neurophysiological, and neural modeling of the echolocating bat. In recent work, we investigate the brain area known as the “superior colliculus” which is involved in orienting behavior (e.g., head and eye movements), but known to be involved in generating echolocation calls in the bat.

Vocalization Behavior:

Spatial perception by echolocation involves the dynamic interplay between auditory information processing and adaptive motor control (Griffin, 1958). An important component of this adaptive system is the timing of echolocation signals, which the bat adjusts, not only with respect to object distance, but also in the context of perceptual demands and planning. Specifically, the big brown bat, *Eptesicus fuscus*, produces stable groups of echolocation signals, flanked by longer pulse intervals, when it performs challenging bat in the context of perceptual demands and planning. Specifically, the big brown bat, *Eptesicus fuscus*, produces stable groups of echolocation signals, flanked by longer pulse intervals, when it performs challenging bat in the context of perceptual demands and planning. Specifically, the big brown bat, *Eptesicus fuscus*, produces stable groups of echolocation signals, flanked by longer pulse intervals, when it performs challenging bat in the context of perceptual demands and planning.

Neurophysiology:

The midbrain superior colliculus (SC) of the echolocating bat shows functional specializations to support acoustic orientation by sonar. Auditory neurons in the bat SC show 3-D spatial response profiles: Echo delay tuning is tagged to the azimuth and elevation of a sound source (Valentine and Moss, 1997).

A 4x4 silicon probe was implanted in the SC of the echolocating bat (right). Wireless recordings were transmitted (TBSI) from the SC of the free-flying echolocating bat as it oriented in a large room. Extracellular potentials were acquired with a Plexon system, and spikes were sorted off-line. Echo scenes were reconstructed using a model based on 3-D video position data of the bat, its head aim, and the location of objects in the room. The echo model was then used to characterize auditory spatial responses in single and multunit activity.

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