## Session 2pAB

# Animal Bioacoustics and Psychological and Physiological Acoustics: Cognition in the Acoustic Behavior of Animals II

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**Chair's Introduction—1:00**

### *Invited Papers*

**1:05**

**2pAB1. Measuring the "acoustic gaze" of echolocating bats, and using it to access internal processes in an active sensing system.** Kaushik Ghose and Cynthia Moss (NACS, Psych., ISR, Univ. Maryland, College Park, MD 20742, kghose@umd.edu)

The sonar beam of an echolocating bat spatially filters the information it receives from the environment. It is proposed that the sonar beam direction can serve as an index to the cognitive state of an echolocating bat. In this respect the sonar beam may be considered an analog to visual gaze. Gaze direction spatially restricts visual information, and has been used as an index to study cognitive states of visual animals. A method to measure the sonar beam direction of a flying echolocating bat is outlined. Laboratory studies show, when presented with a single target, the bat tightly locks its sonar beam to the target before starting the high repetition rate (buzz) phase of insect pursuit. While maneuvering through a small gap, echolocating bats inspect the edges of the gap before flying through it. When presented with two targets, the bat may probe both targets with the center of its beam before changing its flight path to attack one. These studies support the hypothesis that the sonar beam of the echolocating bat may be used as an index of overt, spatial attention, much like gaze direction in naturally behaving visual animals.

**1:25**

**2pAB2. Object representation in echolocating bats: Recognition of targets from different orientations.** Caroline M. DeLong, Rebecca Bragg, and James A. Simmons (Dept. of Neurosci., Brown Univ., Box 1953, Providence, RI 02912, Caroline_Delong@brown.edu)

Big brown bats (*Eptesicus fuscus*) can discriminate among objects using wideband FM sonar sounds. Bats could perceive and represent only the acoustic dimensions of echoes (e.g., delay, frequency, amplitude), or they could use those dimensions to reconstruct object features (e.g., distance, shape, size). To investigate this question, bats were presented with a two-alternative (left/right) forced-choice sonar discrimination task. The stimuli were a one-cylinder monopole target and a two-cylinder dipole target that was presented at all aspect angles. Acoustic dimensions of the dipole echoes change depending on aspect angle. If the bats represent only acoustic dimensions, they should have difficulty selecting the dipole. If the bats represent object features, they should be able to select the dipole independent of aspect angle. Bats can select the dipole over a wide range of aspect angles, suggesting that they construct object features from echo acoustic dimensions. The bats' error patterns may indicate the echo dimensions they use to construct object features. [Work supported by NIH and ONR.]

**1:45**

**2pAB3. Classification across the senses: Auditory-visual cognitive performance in a California sea lion (*Zalophus californianus*).** Kristy L. Lindemann, Colleen Reichmuth-Kastak, and Ronald J. Schusterman (UCSC, Long Marine Lab., 100 Schaffer Rd., Santa Cruz, CA 95060)

The model of stimulus equivalence describes how perceptually dissimilar stimuli can become interrelated to form useful categories both within and between the sensory modalities. A recent experiment expanded upon prior work with a California sea lion by examining stimulus classification across the auditory and visual modalities. Acoustic stimuli were associated with an exemplar from one of two pre-existing visual classes in a matching-to-sample paradigm. After direct training of these associations, the sea lion showed spontaneous transfer of the new auditory stimuli to the remaining members of the visual classes. The sea lion's performance on this cross-modal equivalence task was similar to that shown by human subjects in studies of emergent word learning and reading comprehension. Current research with the same animal further examines how stimulus classes can be expanded across modalities. Fast-mapping techniques are used to rapidly establish new auditory-visual relationships between acoustic cues and multiple arbitrary visual stimuli. Collectively, this research illustrates complex cross-modal performances in a highly experienced subject and provides insight into how animals organize information from multiple sensory modalities into meaningful representations.