2:05

2pAB4. Echoic functional class formation by a bottlenose dolphin. David Kastak and Ronald Schusterman (UCSC Long Marine Lab., 100 Shaffer Rd., Santa Cruz, CA 95060)

A bottlenose dolphin was trained to perform separate two-choice simple discrimination tasks using echolocation and vision. The targets were air-filled shapes constructed from PVC pipe. Targets varied in length and width but not depth, and were separated into classes of letters and numbers. Target echoes were measured, and classes were set up so that they could not be grouped on the basis of perceptual similarities between class members. The subject showed successful learning set formation (win-stay, lose-shift) in visual and echoic discrimination reversals consisting of specific target pairings. The subject also successfully grouped targets into classes as shown by performance in a discrimination reversal procedure involving sets of targets rather than individual pairings. The subject was unable to group the same targets using vision instead of echolocation. No evidence of bimodal performance enhancement or immediate cross-modal transfer was shown. The results suggest that dolphins can arbitrarily classify dissimilar targets using echolocation, but that performance can be independent of visual information. Successful cross-modal class formation likely results from high levels of experience associating echoic and visual stimuli, therefore is more likely to be shown in the context of a conditional discrimination rather than a simple discrimination task. [Work supported by ONR.]

2:25

2pAB5. Rhythm perception and production by the bottlenose dolphin. Heidi E. Harley, Sara E. Crowell (Div. of Social Sci., New College of Florida, Sarasota, FL 34243, harley@ncf.edu), Wendi Fellner, Kim Odell, and Leslie Larsen-Plott (Walt Disney World Resort, Lake Buena Vista, FL 32830)

Rhythm is an important component of many natural communication systems, but it has rarely been the focus of laboratory studies of nonhuman species. Recent cognitive studies with a bottlenose dolphin confirm that a dolphin can discriminate among six different 14-kHz 4-s acoustic rhythms at 94% accuracy, and can transfer that discrimination across multiple frequency (93%) and tempo (16%–93%) shifts. In addition, a dolphin has learned to produce six different rhythms in an object-labeling paradigm. Original training required the dolphin to produce the rhythms using a pneumatic switch that led to the in-air projection of computer-generated tones. However, the dolphin spontaneously began to produce the rhythms vocally as well. To date, the dolphin has accurately labeled five objects with unique rhythms at 87% accuracy using the switch and at 83% accuracy using his own vocalizations. Confusions at the various tempos in the perception study and the variability of some characteristics and stability of others in the production study provide insight into how dolphins represent rhythm and have implications for natural communication in this species.

2:45–3:00 Break

3:00

2pAB6. What's in a voice? Cues used by dolphins in individual recognition of signature whistles. Laela S. Sayigh (Biological Sci., UNCW, Wilmington, NC 28403, sayighl@uncw.edu), Vincent M. Janik (Univ. of St. Andrews, UK), and Randall S. Wells (Chicago Zoological Society, c/o Mote Marine Lab, Sarasota, FL 34236)

Cues that bottlenose dolphins may use for individual recognition of signature whistles are (1) the individually distinctive frequency modulation patterns of whistles; and (2) voice cues caused by the anatomy of the vocal apparatus. Experiments were designed to determine whether dolphins use either or both of these cues in recognizing whistles. Temporarily held wild dolphins listened to whistles of a close relative and of a known conspecific of the same sex and similar age. To test the hypothesis that dolphins recognize the frequency modulation patterns of whistles, signature whistles were synthesized and all general voice features removed. In playbacks to 14 individuals, dolphins turned significantly more often towards the speaker if they heard the synthetic signature whistle of a close relative than that of another individual. To test the hypothesis that dolphins may also be using voice cues to recognize whistles, natural variant (nonsignature) whistles were played back, which are highly variable in contour. Preliminary analysis of seven playbacks showed no difference in responses to variant whistles of kin versus nonkin. Thus, the frequency modulation pattern of signature whistles alone provides information on the identity of the caller, and voice cues are likely not used by dolphins to identify individuals.

Contributed Papers

3:20

2pAB7. The big brown bat's perceptual dimension of target range. James A. Simmons (Dept. of Neurosci., Brown Univ., Providence, RI 02912, james_simmons@brown.edu)

Big brown bats determine the distance to targets from echo delay, but information actually is entered onto the bat's psychological delay scale from two sources. The first is the target-ranging system itself, from the time that elapses between single-spike neural responses evoked by the broadcast and similar responses evoked by echoes at different delays. These responses register the FM sweeps of broadcasts or echoes, and the associated system of neural delay lines and coincidence detectors cross correlates the spectrograms along the time axis. The second source is the echo spectrum, which relates to shape expressed as range profile. The target-ranging system extracts this by fanning out to encompass parallel representations of many possible notch frequencies and notch widths in echoes. Bats perceive delay separations of $5-30$ μs and have a resolution limit of about 2 μs, but interference amplifies small delay separations by transposing them into large changes in notch frequency, so only perception of intervals smaller than 5 μs is surprising. Experiments with phase-shifted echoes show that the psychological time scale can represent two different delays originating entirely in the time domain when they are at least as close together as 10 μs. [Work supported by NIH and ONR.]