AUGUST 11 2005

Range resolution by an echolocating bottlenosed dolphin (*Tursiops truncatus*) FREE

A. Earl Murchison

J. Acoust. Soc. Am. 60, S5 (1976)
https://doi.org/10.1121/1.2003440

10:20

B5. Representation of target range in the sonar receivers of echolocating bats. James A. Simmons and W. A. Lavender (Department of Psychology and Program in Neural Sciences, Division of Biological and Biomedical Sciences, Washington University, St. Louis, MO 63130)

Echolocating bats can discriminate the range (echo arrival time) of simulated targets with accuracy predictable directly from the sonar waveforms down to the region where echo and noise powers are about equal. Detection and ranging performance are closely linked. Equivalence of performance in simultaneous- and successive-presentation procedures indicates that bats make absolute range judgments and store range images of targets for subsequent comparisons. Targets separated in range and/or angular direction are perceived as distinct events. Although target range is perceived noncoherently, target fine structure may be perceived coherently. Information about the occurrence and timing of transmitted sounds and echoes is conveyed in the time domain over frequency-specific primary auditory neurons and appears, still in the time domain, ascending the lateral lemniscus and in the inferior colliculus. Behavioral data suggest ultimate spatial "receptor-field" representation of range in the brain, so echo-timing information may be recoded into range-specific neurons at or above the inferior colliculus. The data generally suggest that target range is processed by channels used for periodicity-pitch perception in nonecholocating animals. [Work supported by NSF.]

10:40

B6. Range resolution by an echolocating bottlenosed dolphin (*Tursiops truncatus*). A. Earl Murchison (Naval Undersea Center, Hawaii Laboratory, P.O. Box 997, Kailua, HI 96734)

Utilizing a two-alternative, forced-choice (simultaneous stimuli presentation) procedure, the ability of a bottlenosed dolphin (*Tursiops truncatus*) to discriminate differences in target range by echolocation was determined. Target-range difference discrimination trials were conducted at three different absolute ranges (1, 3, and 7 m). The range resolution acuity of the dolphin varied with absolute range. His 0.79 hit rate probability for the absolute range of one m was 0.9-cm range difference; for the absolute range of 3 m it was 1.5 cm and for an absolute range of 7 m it was 2.8 cm. Behavioral data suggest that these levels of perceptual acuity are not usually attained and/or maintained during the dolphin's normal nonstatic prey pursuit. [Work supported by NUC.]

11:00

B7. Periodicity pitch difference limens in the bottlenose dolphin (*Tursiops truncatus*). R.H. Defran and Nancy G. Caine (Department of Psychology, San Diego State University, San Diego, CA 92182)

An Atlantic bottlenose dolphin (*Tursiops truncatus*) was trained to differentiate between similar streams of sonarlike pulse pairs. The interval between pulses of a pair was of primary interest and was varied from trial to trial. All signal parameters were designed to simulate the emitted signals and returned echoes present in a dolphin sonar task. Discriminative responding to variations in the interpulse interval allowed for an estimation of the dolphin's temporal discrimination ability. Psychophysical functions constructed from the data were orderly, asymptotic, monotonically related to the duration of the comparison intervals, and statistically reliable. Psychophysical thresholds, defined as the 75% correct level of responding, indicated that the dolphin was capable of resolving differences as fine as 100 μsec. Further, the results confirmed that the dolphin's temporal discrimination is most accurate for pulse pair intervals simulating the shortest distances. Results were interpreted within the framework of a periodicity pitch analysis. Extrapolation of the data suggest that sonar discrimination of distance in the dolphin involves a complex frequency discrimination rather that a correlation discrimination.

11:20

B8. Echolocation discrimination of complex planar targets by the Beluga whale (*Delphinapterus leucas*). V.S. Gurevich (Hubbs-Sea World Research Institute, San Diego, CA) and W.E. Evans (Naval Undersea Center, San Diego, CA 92132)

Results of a study of a Beluga trained to discriminate between two complex planar targets, indicate that this animal's echolocation discrimination capability with and without blindfolds is superior to that of bottlenosed dolphins tested on similar targets. The standard target used was a three-step pyramid constructed of three polyvinyl chloride sheets each 13 mm thick. The first step was 10×10 cm, the second step was 7×7 cm and the third step was 3×3 cm. The selection of the standard target was considered a correct response. The comparison targets (incorrect choice) differed from the standard target only in the size (surface area) of the third step. With a comparison of a third step of 2.9×2.9 cm versus the standard, 3.0×3.0 cm, the animal's mean correct response was 80.8% correct. When presented with two standard or identical targets the mean response dropped to chance (55.5%). The performance of the bottlenosed dolphins tested on similar targets dropped to chance on a comparison of 2.7×2.7 cm versus 3.0×3.0 cm. The pulses used by the Beluga during the echolocation discrimination task contain very little acoustic energy below 12 kHz with the