

## **ECHOIC CUES USED BY A BOTTLENOSE DOLPHIN DURING MULTIPLE CROSS-MODAL MATCHING TASKS**

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A bottlenose dolphin performed a matching task in which he was presented with an object (e.g., tin cup) in one modality (e.g., vision) and then asked to choose the same object from a group of three objects using another modality (e.g., echolocation) or the same modality (e.g., vision). Object sets were presented in two cross-modal conditions (visual sample with echoic choices or vice versa) and two intra-modal conditions (visual sample with visual choices or echoic sample with echoic choices). Objects in the first matching task varied along several dimensions (e.g., size, shape, and material) whereas objects in the second matching task varied along only one dimension (i.e., size or shape or material). Acoustic measurements of the objects were made to evaluate how the dolphin might have used the cues that were available in the echoes to perform the task. After the matching task was completed, objects were ensonified by dolphin-like clicks from several different angles and the signals were captured and digitized. Analysis of the pattern of errors made by the dolphin on both tasks revealed that the dolphin appeared to use the following properties of the echo signals to discriminate among objects: variations in echo highlight structure as a function of angle, variations in echo intensity as a function of angle, and absolute echo intensity. The dolphin seemed to use different cues for different object sets. Unidimensional objects, while varying along only one dimension, will still provide multiple echoic cues which the dolphin may use in combination to make his choices. This study elucidates the useful cues available to dolphins in echo signals for intramodal and crossmodal tasks; reveals the possibility of flexible, adaptive cue use by dolphins; and provides a look at how echoic features correspond to visual features of objects for dolphins.

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