

Joint Psychophysical and Physiological Investigations of the Precedence Effect and Echo Threshold in the Inferior Colliculus of the Behaving Cat

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The precedence effect (PE) is an auditory spatial illusion where the apparent location of two similar stimuli presented from two different spatial locations but separated by a brief delay is determined primarily by the spatial attributes of the leading stimulus. To study the mechanisms that produce the PE, we have recorded the responses of single units in the inferior colliculus (IC) of cats that were simultaneously engaged in a psychophysical sound localization task. Cats were trained to make saccadic eye movements to the apparent location of transient stimuli delivered from either single locations or pairs of transients delivered from two different locations but separated by a delay. Psychophysically, the cats exhibited the PE in that the apparent location of the paired stimuli with delays of 1-10 ms approximated the location of the leading sound only. For greater delays, the cats often saccaded to either the leading or lagging location, suggesting that these delays exceeded the echo threshold (ET). For the delays that the cats experienced the PE, the physiological responses of a population of IC cells to the lag stimulus were substantially reduced relative to their responses to stimuli presented from the lag location presented alone, but little effect was seen on the response to the lead. Hence, the responses of these cells were correlated with the cats' reports of apparent location in that, for delays encompassing the PE, the reported location was also similar in the presence or absence of the lag. At the psychophysically determined ET the IC responses to the lag were nearly fully recovered to the responses obtained to the lag presented in isolation. Together these results support the hypothesis that the IC is an important neural substrate of the PE and ET, and as such, a population of IC cells could account for many aspects of the PE and ET and potentially sound localization in general. Supported by grants NIDCD DC00116, DC02840, and DC00376