Oral 24-5

A NEURAL MODEL FOR THE TIME/PERIOD CODING OF FREQUENCY FOR ACOUSTIC AND ELECTRIC STIMULATION

G.M. Clark, L.S. Irlicht, T.D. Carter
Department of Otolaryngology, The University of Melbourne, Victoria. 3002

Interspike intervals convey information for a time/period code for frequency. The spikes are phase-locked to the sine wave and the intervals are a multiple of the period of the sound wave. It is not clear, however, how the information is decoded. There are significant differences in the distribution of the population of interspike intervals for acoustic and electric stimulation. These differences need to be considered when developing any models for the decoding of frequency. Extra cellular recordings were made from primary-like units in the anteroventral cochlear nucleus of 21 cats, bipolar intracochlear as well as monopolar extracochlear electrical stimulation were used. Anaesthesia was induced with xylazine 10mg and ketamine 50mg I.P. and maintained with pentobarbital sodium (40mg/kg I.P.). In analyzing interspike intervals the peaks in the histograms were determined by a least squares fit of Gaussian curves to the actual distribution. Peaks could not be detected above 2000Hz as phase locking was poor above this frequency. The results showed that the first and predominant peak was of the same duration as the period of the sound wave for frequencies up to 600Hz. Above 600Hz it was a multiple of the period greater than one. With electric stimulation there was a single interval the same as the period of the stimulus over the greater part of the dynamic range at rates up to 200 pulses/s. At 400 and 600 pulses/s there were multiple peaks which were multiples of the period. Psychophysical studies have also shown that at the low stimulus rates (100 and 200 pulses/s) there is a good pitch matching. Psychophysical studies at higher rates (600 pulses/s and above) show poor pitch matching even though interspike interval histograms are more similar but lack intervals of one period. The above data suggests that two mechanisms operate for decoding the two frequency ranges. Coincidence detection models are investigated to help explain the temporal decoding of frequency and the psychophysical differences between acoustic and electric stimulation.

Author/s:
Clark, Graeme M.; Irlicht, L. S.; Carter, T. D.

Title:
A neural model for the time/period coding of frequency for acoustic and electric stimulation [Abstract]

Date:
1996

Citation:
Clark, G. M., Irlicht, L. S., & Carter, T. D. (1996). A neural model for the time/period coding of frequency for acoustic and electric stimulation [Abstract]. In Proceedings of the Australian Neuroscience Society (16th Annual Australian Neuroscience Meeting), Adelaide, S.A.

Persistent Link:
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