Oral 24-4

ACCELERATION OF PEAK PRESSURE, NOT SOUND PRESSURE LEVEL, DETERMINES FIRST-SPIKE LATENCY OF AUDITORY CORTICAL NEURONS

P. Heil and D.R.F. Irvine
Department of Psychology, Monash University, Clayton, Victoria 3168

In auditory cortex, most cells discharge only one or a few spikes in response to simple acoustic stimuli. Hence, the timing or presence of the first stimulus-evoked spike is likely to contain crucial information about the stimulus. We show here that the timing of the first spike of neuronal responses to tonal stimuli in primary auditory cortex of cats anesthetized with sodium pentobarbitone (40 mg/kg i.p.) is an unambiguous function of the acceleration of peak pressure, an acoustic parameter whose importance has not been recognized. By employing tone bursts with rise/fall times which were shaped by a cosine-squared function and by varying the plateau sound pressure level (SPL) and the duration of the rise time, we could separate the effects of acceleration of peak pressure from those of rate of change of peak pressure or plateau SPL on first-spike latency. The striking similarity in the shape of the latency - acceleration functions among different neurons offers the possibility for a representation of acceleration in a scale-invariant fashion by means of a time-advance code, such as recently suggested by Hopfield (1). This finding, together with the fact that the horizontal position of the latency - acceleration functions varies with frequency and parallels the cat's audiogram, favours a peripheral origin of the acceleration sensitivity and thus suggests an even greater similarity of the auditory system with its relative, the vestibular system, also hair-cell based and long-known to be sensitive to linear and angular accelerations of the head.


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:

Persistent Link:
http://hdl.handle.net/11343/26939

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

Terms and Conditions:
Terms and Conditions: Copyright in works deposited in Minerva Access is retained by the copyright owner. The work may not be altered without permission from the copyright owner. Readers may only download, print and save electronic copies of whole works for their own personal non-commercial use. Any use that exceeds these limits requires permission from the copyright owner. Attribution is essential when quoting or paraphrasing from these works.