Rapid communication

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Rapid phase shift of evoked potentials in barrel cortex accompanies conditioning

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INTRODUCTION AND METHODS. Rat barrel cortex undergo plastic changes during sensory experience (3). Twenty four hours of "pairing" of untrimmed whiskers leads to short lasting changes in supra- and infragranular layers of corresponding cortical columns. In order to reveal the early dynamics of this process we studied evoked responses recorded by bipolar electrodes chronically implanted in the barrel cortex of five hooded rats during classical conditioning. Rats were accustomed to resting in a plexiglass tube with head restrained in a holder. A piezoelectric device stimulated one vibrissa to produce evoked potentials (EP). The experiment consisted of 5 consecutive daily sessions. During one session, lasting for about an hour, the animal received 100 vibrissa stimulations with intervals randomly scattered from 30 to 45 s. The first two sessions allowed habituation of the EPs. During the third session, the stimulation of the vibrissa (CS) was followed by a weak electric shock (US) applied with a 250 ms delay to the ear on the same side.

RESULTS AND DISCUSSION. Because of the low noise in the recordings of the EPs, we used the direct Fourier transform for data parametrization. The fine linear trend was removed and data were tapered with a Hanning window on the segment of 75 ms including prestimulus baseline (Fig. 1). The distribution of harmonics corresponding to major spectral peaks was tested with the Rayleigh circular variance test. The observed nonrandom phase histograms were multimodal centred around 13.02 and 39.06 Hz. An unwrapping procedure was used to calculate the absolute values of phases (1). Phases of the single responses were always bimodally distributed with the low and high values (-1.6, 5 rads) almost equally frequent in the control period (Fig. 2). First application of the unconditioning stimulus (US, arrow at the 25 trial) shifts this balance to high value for 13 consecutive responses and this phase occurs almost three times more frequently than the low value, until the end of the session. The bimodal phase distribution as reported here is similar to stereotyped EPs found in visual system of cat and human (1,4). The time shift between the two types of the EPs has been calculated as 5.5 ms which fits the delay of the second component of typical barrel EPs (2), thus allowing recognition of the high phase component as related to bisynaptic response with sinks in supra- and infragranular layers (2). In these layers, short-lived plastic changes were recently found (3). We conclude that supra- and infragranular components of cortical evoked potential undergo plastic changes immediately with first trials of classical conditioning.

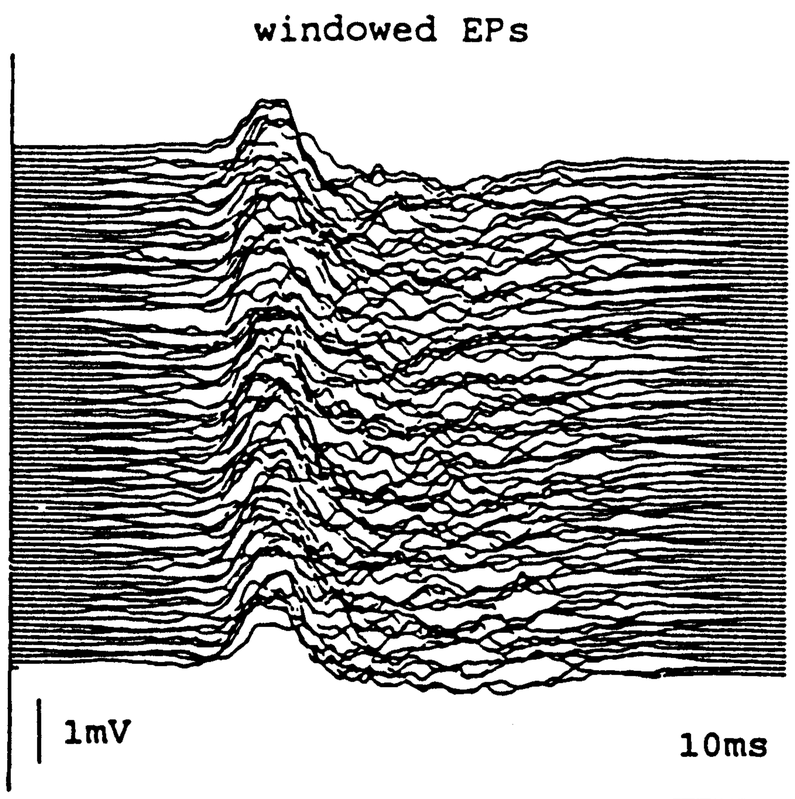

Fig. 1. Consequtive 90 EPs from the third session of Rat 2.

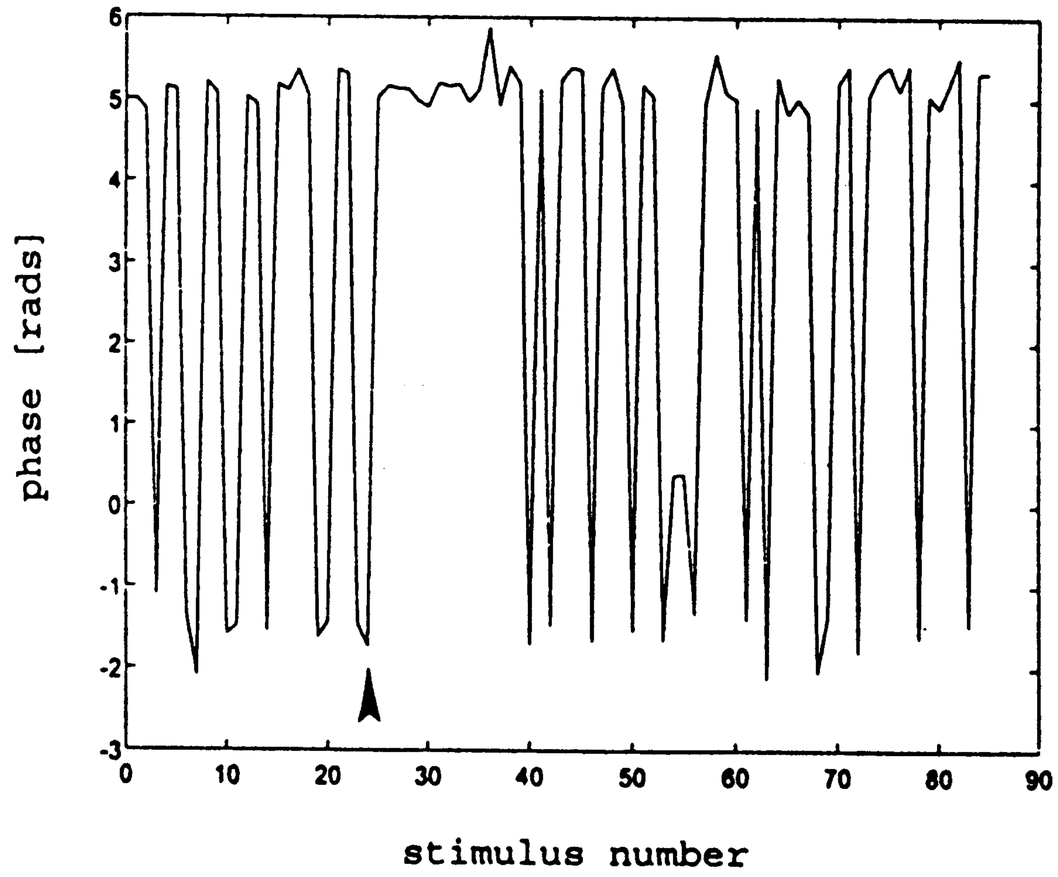

Fig. 2.Phase changes at 13 Hz calculated from EPs presented at the Fig. 1.

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