ANALYSIS OF INTERACTION BETWEEN EVOKED POTENTIALS TO STIMULI OF DIFFERENT MODALITIES IN THE AUDITORY, SENSOMOTOR, AND VISUAL CORTEX IN CATS

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Multisensory convergence, i.e., the ability of the same nerve cells to respond to afferent volleys arising along different sensory channels, is an essential condition for integrative activity of the brain. This accounts for the great interest shown in recent decades in the study of interaction between stimuli of different modalities on single neurons at higher levels of the CNS [4, 5, 10, 16]. A no less fruitful approach to the electrophysiological study of the integrative function of the brain is by recording global evoked potentials (EPs), for short-latency EPs can be recorded in any primary cortical projection area both to the adequate stimulus and to stimuli of other modalities [2, 3, 6-9, 20].

Special importance in phenomena of convergence and integration of sensory communications differing in quality is attached to the motor system, for the effector motor response of the organism in response to a wide range of different external environmental influences is formed in it [12], and it is the somatic cortex which plays the leading role in regulating the activity of lower structures [15]. Asratyan [1] showed experimentally that the structure of the cortical end of the motor analyzer does not differ from the structure of other analyzers, and its scattered elements, to use Pavlov's terminology [11], are represented just as widely in different regions of the cortex as are those of other analyzers. It therefore seemed interesting to study the functional organization of inputs for qualitatively different afferentations (arising from acoustic and electrodermal stimulation) in two areas of the cortex: in the primary projection area of any indifferent stimulus and in the area responding to reception and processing of information about a biologically meaningful stimulus, in fact in the motor cortex. There is reason to suppose that this aspect of the study of afferent cortical inputs will permit new data to be obtained later (after conditioned reflex formation) by which to judge the mechanism of formation of the temporary connection. The concrete object of this investigation was to study relations between global EPs to clicks and to electrodermal stimulation of the orbicularis oculi muscle in the auditory, sensomotor, and visual areas of the cortex (the last as a possible control).

METHOD

Chronic experiments were carried out on eight cats. Silver recording electrodes were implanted above the foci of maximal activity of three cortical areas — primary auditory, primary visual, and sensomotor (the projection of the orbicularis oculi muscle). Reference electrodes were inserted into the nasal bone or the occipital crest. Derivations were monopolar. During the experiment the cat was lightly fixed with a special binder. A dynamic telephone was located 30 cm from the animal's left ear. The clicks used evoked neither rest-
Fig. 1. Restoration of averaged EPs during application of paired stimuli in the "clicks + EDS" order. A) Example of test to study restoration of averaged EP to testing EDS in auditory (I), sensomotor (II), and visual (III) areas of cortex with different intervals between stimuli (numbers on left). Top row of traces represents EPs to isolated clicks (C) and EDS (E). B) Curves showing recovery of EPs to testing EDS in auditory (1), sensomotor (2), and visual (3) areas of cortex. Abscissa, interval between conditioning and testing stimuli (msec); ordinate, amplitude of EP to testing stimulus as a percentage of amplitude of EP to its isolated application. Averaged data from tests on all cats. EP parameters analyzed are indicated on schemes of EPs in auditory (1), sensomotor (2), and visual (3) areas of cortex. Calibration: 40 msec, 50 μV.

less movements nor a local blinking reflex (50-60 dB above the threshold of appearance of EPs in the auditory cortex). To stimulate the orbicularis oculi muscle and also to record the myogram, padded silver electrodes were used (the stimulating electrodes were applied near the outer angle of the eye, the recording electrodes 1 cm above the upper border of the orbit). The current used for electrodermal stimulation (EDS) evoked distinct blinking of the eye without any general restless movements (3-3.5 times above the threshold of evocation of the blinking reflex, usually 15-18 V). The pulse duration for the clicks and EDS was the same, namely 0.1 msec.

There were two series of experiments. In the first series isolated clicks and EDS were used (in different experiments or alternately in the same experiment, in no definite order). The stimuli were applied in bursts of five pulses, with a frequency of 1 Hz within the burst. The interval between bursts was 2-6 min. In the second series of experiments, besides these