

Unit Responses of the Lateral Geniculate Body to Light Flashes in Free Moving Unrestrained Cats

The neurons of the lateral geniculate body (LGB) exhibit in darkness, as well as under steady illumination, a 'spontaneous' activity which changes according to the state of wakefulness or sleep¹⁻⁶. The relationships between the background activity and the responsiveness of the cells to a natural stimulation have never been studied in free-moving animals. The only available data concern the waking (W) and slow synchronized sleep (SS) in mid-pontine pretrigeminal cats^{2,3}. As previously described, a technique of eye and pupil immobilization⁷ overcomes the difficulty of obtaining a stable visual stimulation, which has been the main hindrance in facing the problem in chronic preparations. The present communication refers to attempts to determine how the changes of background activity correlated with different states of sleep and wakefulness modify the responsiveness of LGB neurons.

The experiments were carried out in unrestrained, free-moving cats, carrying chronically implanted electrodes, in which, 1 month before the electrode implantation, 1 eye and the pupil were surgically immobilized. The EEG and EOG (ocular movements) were recorded through screw electrodes, while the EMG was recorded through silver wires sewn into the neck muscles. Tungsten microelectrodes moved by an hydraulic microdriver⁸ recorded the single neurons activity in the dorsal part of the LGB. With the same microelectrode and a low-pass filter, also the LGB slow activity was recorded. The firing rate of the LGB cells was measured on a Beckman EPUT counter. A gas-filled lamp (Philips ZA 1004), cemented to a contact lens, was used to deliver flashes, 2 sec in duration, whose start and end were synchronized with the counter gate. As absolute response, for the prevalently 'on' cells, the number of spikes in the 1-sec interval starting with the beginning of the flash was used, while for the prevalently 'off' cells the number of spikes was counted in the 1-sec interval starting with the end of the flash. Relative response has been called the ratio of the absolute response to the 'spontaneous activity' (No. of spikes/unit time) in a short time stretch (from 2-4 sec) before the stimulation.

(1) During SS unit activity typically occurs in high frequency bursts with long intervals in between. During both W and desynchronized sleep (DS), a steady and

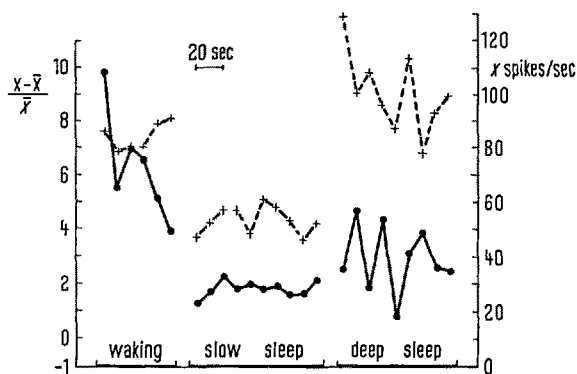
regular impulse discharge is dominant. The appearance of slow monophasic waves^{9,10} is accompanied in most cells by bursts during SS, and by sustained discharges during DS. (2) The responsiveness to light flashes has been tested in 35 cells. The absolute responses are minimal during SS, increase during W and are maximal during DS. The Figure shows the values of absolute responses (crosses) for 1 'on' cell. However, in 15% of the units the absolute values of the responses for the waking state is, at a difference with the Figure, in the same range as those of SS. (3) The maximal values of the relative responses has been found during W, the minimal during SS. During DS a large variability from response to response, as shown also in the Figure (DS, filled circles), has been the rule. The average of the relative responses during DS has been in 60% of the cells smaller than during W and greater than during SS, in 20% as great as in W, and in 20% as small as in SS.

Our findings show that the firing rate of LGB units in response to a natural stimulation increases from SS to W and from W to DS. However, in a structure exhibiting as the LGB does a 'spontaneous' activity, the background level must be taken into account in the analysis of the responses. Assuming tentatively that the signal-to-noise ratio, as our relative response might also be called, is a meaningful parameter for evaluating the transmission efficiency of the neuron, the wakefulness turns out to be the best condition for the transmission of information in the LGB¹¹.

Riassunto. È stata eseguita la registrazione di singole unità della parte dorsale del corpo genicolato laterale, in gatti non anestetizzati liberi di muoversi. Si dimostra che nella maggiore parte dei casi, le risposte ad un lampo di luce espresse in «spikes/sec» sono minime nel sonno sincronizzato, aumentano nella veglia e sono massime nel sonno desincronizzato. Qualora le risposte vengano riferite all'attività «spontanea» precedente il flash, il rapporto risposta-attività spontanea è maggiore nella veglia rispetto agli altri stati.

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'On' neuron. Absolute responses (crosses) and relative responses (filled circles) to flashes of light of 2 sec in duration, delivered every 10 sec. Scale of absolute responses (x) on right hand and scale of relative responses ($(x - \bar{x})/\bar{x}$) on left hand. For the relative responses, the average rate of 'spontaneous' firing (\bar{x}) was calculated during 4 sec prior to the pulse. The values on the plot have been joined by lines for an easier reading. The waking of the animal was induced by loud noise outside the cat's cage.

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