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Short communication

ALTERNATION OF EEG ALPHA AND NON-ALPHA PERIODS DOES NOT DIFFER IN OPEN AND CLOSED EYE CONDITION IN DARKNESS

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Abstract. In relaxed subjects sitting in darkness no difference in the duration of EEG alpha and non-alpha (mostly desynchronized) periods were found under conditions of open and closed eyes.

Since its discovery by Berger (2) the human EEG alpha activity is believed to be extremely dependent both upon external stimuli, mostly visual, and internal psychic activation (like that during mental arithmetic, etc.). From the morpho-functional point of view EEG desynchronization — alpha blocking is mediated by the reticular ascending system (7). The presence of alpha activity is more pronounced when the eyes are closed (2, 8). However, periods of alpha and non-alpha activity (the latter being represented almost exclusively by EEG desynchronization) do alternate; it happens spontaneously with eyes closed or in the darkness, i.e., without any visual input, in relaxed subjects not bothered by any external stimuli or mental task.

The aim of the present experiments is to analyze, and evaluate quantitatively, the relevance of the eyes open vs. eyes closed condition with respect to spontaneous alternation of alpha and non-alpha periods. The study is performed in complete darkness, in relaxed subjects when neither visual information is being processed, nor mental activation re-

lated to task solving takes place; under such conditions the main factors influencing the above process are excluded.

Twenty eight students, who were paid for their participation in the experiment, served as subjects. They ranged from 19 to 25 years and were of both sexes. The subjects had no previous experience in EEG recordings. Each participant, reclining comfortably in a chair, was individually tested in a completely dark, sound-attenuated and electrically shielded room. After a 10–15 min introductory relaxation period, during which the electrodes were placed and the subjects instructed, the actual recording started. One half of the subjects was instructed to keep their eyes open for the whole duration of the first session (approximately 15 min). The other half kept their eyes closed. Then, he/she was allowed to relax, move etc. for 5 min and another 15 min record with opposite eye condition was obtained.

To avoid any additional distress during recording and to make the subjects feel as comfortable as possible, all unpleasant additional recordings were omitted (e.g., EOG). The subject was asked to avoid any kind of thinking, but not to fall asleep.

The electrode was placed at O_z, referenced to A_1 (according to the Ten-Twenty International System); A_2 served for grounding. Electrode impedance was maintained below 5 kOhm throughout the experiment. The signal was amplified, monitored on the oscilloscope and recorded on the FM tape recorder.

The recordings were analyzed off-line on the Tesla JPR 12 minicomputer; first the EEG signal was passed through band-pass 8–13 Hz filter; then medians of the amplitude maxima were estimated repeatedly; their mean served as threshold level differentiating alpha and non-alpha periods in a way described previously (3, 4).

The mean alpha and non-alpha period durations were computed for each subject for eyes open and closed conditions, based on 300 consecutive values for each type of activity. For the whole group of subjects the obvious difference (see 3) was shown between the duration of alpha and non-alpha periods $F\ (1.108) = 147.12$; $P < 0.05$, the non-alpha periods lasting longer. However, the same test revealed no difference $F\ (1.108) = 0.02$; $P > 0.05$ for the open and closed eyes conditions. The actual values are displayed in Fig. 1. In order to ascertain that no difference exists in EEG amplitude levels which could interfere with automatic detection of alpha and non-alpha onset and offset, the medians of EEG amplitude maxima obtained under both conditions were compared as well (Fig. 2). This data were submitted to t-test resulting in a non-significant effect for this measure, expressed by median $T\ (27) = -0.01$; $P > 0.05$. As regards the shape of histograms for alpha

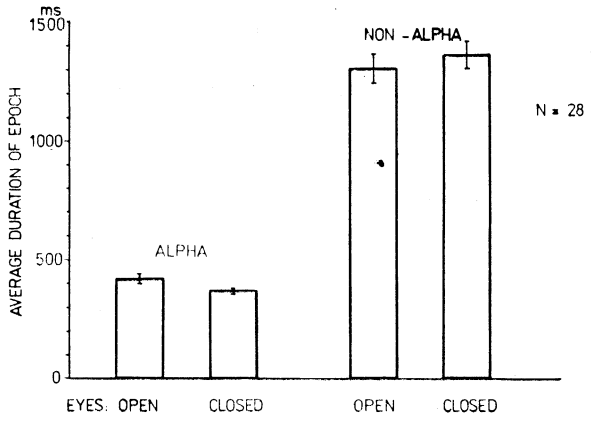

Fig. 1. The comparison of the duration of alpha and non-alpha periods for open and closed eyes conditions.

and non-alpha periods duration, a slight, not significant increase in number of shifted exponential type of distributions under the condition of open eyes was observed.

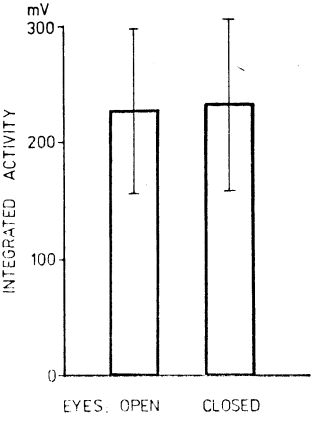

Fig. 2. The comparison of the amplitude medians for open and closed eyes conditions.

The results reaffirm first the distinction between alpha and non-alpha periods duration under the particular condition in total darkness. In addition, however, they prove that alternation of alpha and non-alpha periods does not depend upon the circumstance whether subjects' eyes are closed or open.

Two alternative suggestions were offered as the cause of cerebral excitation reflected in EEG by the corresponding alpha blockade: efferent or "oculomotor" theory and afferent or "visual input" one (6). The former, originally suggested by Mulholland (8, 9) considers that

EEG alpha activity is contingent upon eye position (namely in the case of extreme upward eye position). The latter (5) relates all changes in alpha pattern to visual input only. Our results do not support the hypothesis that visual input is the only factor determining alpha blocking. As no eye movement recordings were taken, no data has been gained on the possible significance of eye position in the above condition (darkness and relaxed state).

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