

# EEG PATTERN USED FOR RECEPTION AND TRANSMISSION OF COMMANDS TO DEVICES

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## Abstract

Using tools and methods for measuring the electrical activity of the brain (EEG), based on specific algorithms, a determination was made for the level of attention of the person participating in a specific time period.

Measurements were made on a group of students, during the realization of short-term educational activities, to determine the level of attention / focus and reporting it to possible personal behavior. In the study were taken for processing about 30,000 lines of EEG values per each minute of EEG signal recorded. Measurements are realized with a NeuroSky headset, and are taken already transformed from their processing digital sensor system. We made EEG data acquisition and processing. The conclusions are encouraging the use of level of attention as a possible element of personal EEG pattern.

**Keywords:** EEG, attention, mind focus, students, pattern, commands, devices.

## 1. Introduction

Electroencephalogram (EEG) is a mixture of low frequency signals, non-routine or quasi-periodical, having amplitude between (10 ... 100)  $\mu\text{V}$  (typically approx. 50  $\mu\text{V}$ ). EEG is where several frequency bands are separated by spectral analysis.

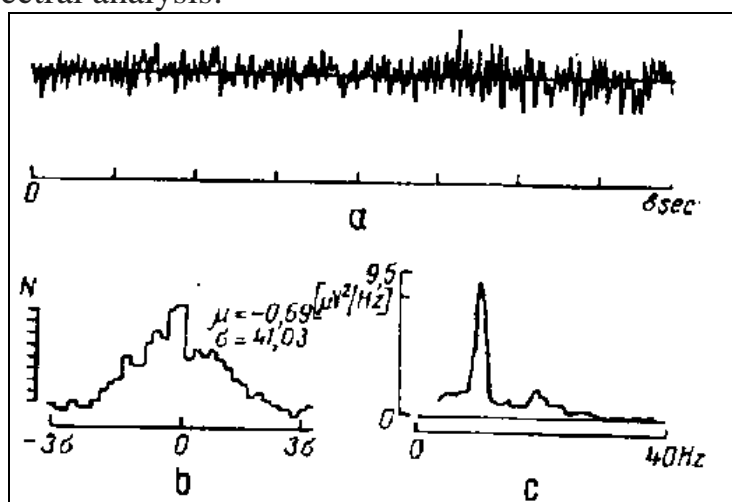


Figure 1. EEG (a) the amplitude distribution; (b) the spectral density

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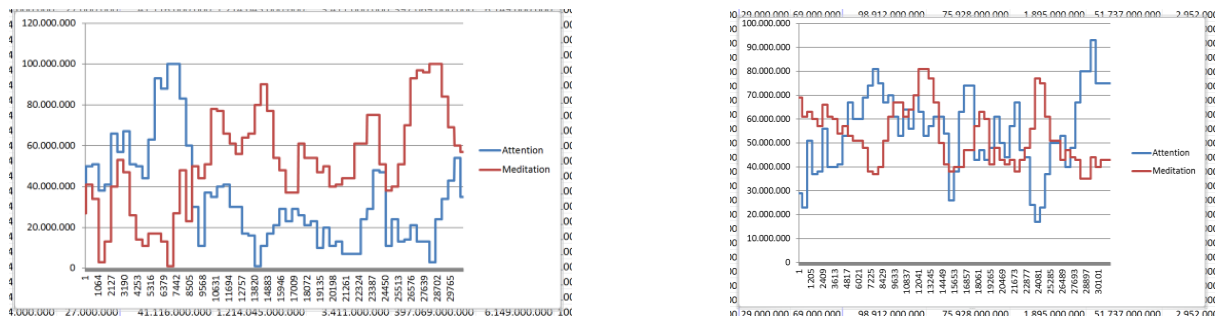
These waves are specific:

- (a) The  $\alpha$  rate is 8 ... 13 Hz band and appears in periods of wakefulness and relaxation. For deep relaxation waves of 10 Hz are prevalent ("biological clock"), coinciding with the resonance frequency of the magnetic field;
- (b) The  $\beta$  has components from 14 ... 32 Hz, amplitude below 30 is associated  $\mu\text{Vv}$  and thinking;
- (c) The  $\gamma$  has frequency band from 33 ... 55 (even 70) Hz;
- (d) The  $\delta$  has frequencies between 0.5 ... 3 Hz, amplitudes of 50-150  $\mu\text{Vv}$  and occurs in children and adult sleep. On waking adult it is pathological.
- (e) The  $\theta$  have components from 4 ... 7 Hz, 30-70  $\mu\text{Vv}$  amplitudes are meeting frequently and adult children in isolated cases. A high percentage indicates adult mental problems.

## 2. Method

We did an analysis in terms of maximum / minimum, attention and meditation separately, following these aspects: the number of variations on the maximum number of variations on the minimum duration of the cumulative average maximum average minimum cumulative duration (in seconds in measuring a minute), the median distance in generic units (compared to median chart) for maximum and minimum.

Analysis is performed in graphical / visual projection made in Excel as a .csv file on primary data obtained in measuring input. We considered all relevant notable variations and oscillations in the range of 15% variation relative to minimum and maximum variation. The value of 15% is determined as relevant correlative after visual analysis of graphs in their ensemble.



**Figure 2.** „Attention” and „meditation” - graphical representation

<b>Graphic variation - S1</b>						
<b>ATTENTION</b>						
<i>MEASURE S1</i>	<i>No maximum (variation 15%)</i>	<i>No minimum (variation 15%)</i>	<i>Cumulative duration on max (seconds)</i>	<i>Cumulative duration on min (seconds)</i>	<i>Maxim median distance (on max in generic units)</i>	<i>Maxim median distance (on min in generic units)</i>
M1 morning	1	6	3	7	40	58
M1 after noon	1	3	1	4	45	32
M2 morning	1	4	2	6	38	38
M2 after noon	1	4	4	5	50	46
M3 morning	0	6	0	14	0	38
M3 after noon	2	6	6	11	28	33
M4 morning	9	2	15	8	20	30
M4 after noon	1	2	20	8	50	50
M5 morning	2	4	5	10	28	28
M5 after noon	1	5	8	14	40	34
<b>MEDITATION</b>						
<i>MEASURE S1</i>	<i>No maximum (variation 15%)</i>	<i>No minimum (variation 15%)</i>	<i>Cumulative duration on max (seconds)</i>	<i>Cumulative duration on min (seconds)</i>	<i>Maxim median distance (on max in generic units)</i>	<i>Maxim median distance (on min in generic units)</i>
M1 morning	2	3	4	3	40	58
M1 after noon	2	5	3,5	10	32	14
M2 morning	3	1	3	2	18	42
M2 after noon	4	3	8	7	50	38
M3 morning	3	6	3	15	35	38
M3 after noon	2	2	4	2	40	45
M4 morning	3	3	12	18	12	32
M4 after noon	2	1	14	5	35	45
M5 morning	3	3	25	8	32	12
M5 after noon	2	1	6	4	34	40



Figure 3. „Attention” vs „Meditation” - density

### 3. Conclusions

Looking at the graphs for the period Morning / Afternoon note / Meditation few conclusions can be drawn:

- For the same subject, there is a clear difference in the ratio of oscillations at high / low for Attention / Meditation (maximum 19 variations attention, minimum 42 variations, meditation 26 minimum 28 maximum); meditation practice is similar to the number of variations in exchange for attention that there is an important difference can be an element of pattern;

- The same trend is maintained oscillations on the cumulative average length variations but with the observation that the difference is not as great in terms of percentages (54% and 7% in terms of number of oscillations, compared with 26% in those 12 % in terms of aggregate figures seconds of oscillation or in relation to the median maximum vs minimum distance where we have reports of 12% and 10%); Such oscillations report the percentage ratio seconds oscillations can not be an element of pattern; Similarly no median distance in maximum-minimum ratio can not be an element of pattern;

- The higher the number of oscillations per interval is higher represented on the chart (maximum or minimum median reported to work) shows an orientation of the subject during measurement;

- As for the subject one can conclude that in terms of attention, it is oriented measurements whole spectrum of minimum and maximum values, while meditation is oriented balanced between minimum and maximum spectrum.

- In the report the morning / afternoon S1 shows the minimum balance spectrum for both features (attention and meditation) and a maximum spectrum imbalance in attention and maximum spectrum balance for meditation

- Another observation in maximum spectrum is related to the fact that there is no measuring the maximum amount of attention was below the median, can enunciate theory that for that time period manifested a generic phenomenon called "escape attention." In a monitor longer-lasting, more manifestation of such periods escape the attention of the analysis may be the possibility of the existence of illnesses / problems concentrating and focusing. Such material can be used as a point of pattern to detect certain diseases / behavioral predictions. Usually such moments that should be correlated with the action taken by the subject practice (since it would impose a video recording sessions measurement) to determine if "escape attention" is not based on subjective factors such as subject's predisposition to certain themes / her personal preferences / other local disturbance.

*Establishing a pattern element can therefore consider including taking a minimum-maximum number of oscillations in the framework of relevant repetitive measurements. EEG can be a good technical context in order to establish some personal pattern elements.*

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