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A SYSTEMIC MEANING OF THE EEG POSITIVE AND NEGATIVE WAVES

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A study of neuronal activity in behavior has revealed a systemic specificity of single neurons. It means that each neuron is included in only one definite system which determines a realization of definite behavioral act. A whole set of systems (memory, subjective reality) reflects a history of subject's behavior and consists of systems of different phylo- and ontogenetic "age". These systems are in the inter-action and the realization of numerous systems of different "ages" are observed at each moment of behavior. A consequent behavior is performed by means of changing of one set of active systems by another one. During this change a quantity of active neurons recorded is increased because of the overlapping of preceding and next behavioral acts and presence of some active "unnecessary" systems belonging to other behavioral acts. Probably, in this case a quantity of active neurons is an indicator of systems retrieved from memory simultaneously. Such an assumption allows us to formulate the problem of the systemic meaning of the EEG positive and negative waves and hope that an answer can be obtained by means of estimating the quantity and quality of active neurons within these phases of waves.

Two series of experiments with 5 rabbits in different kinds of food-acquisition behavior provided the data described here. In the first series a rabbit sat near a food-box and waited for pieces of carrot which were given to him by the experimentator. But the real carrot was alternated with a plastic one and a rabbit had to throw out the plastic from the food-box.

The spike activity of a single neuron and the EEG activity from the surface of the cortex with an electrode placed over the micro-electrode trace were recorded simultaneously.

Correlations between spikes of neurons and the phases of the EEG waves were calculated by means of amplitude histograms which characterized EEG potentials both interims of amplitude (positivity-negativity) and deviation (positive-negative shift) within different frequency bands: 0.5–3.0, 3.5–6.0 and 8.0–12.0 Hz. Probability of neuronal discharges during 4 phases of EEG was calculated both for each neuron and for a number of spikes of all the neurons. Differences between probabilities of neuronal discharges during this or that phase of the EEG waves were estimated by chi-square test and considered as significant with p 0.05.

115 neurons (67 in the visual and 48 in the motor cortex) were analyzed: 52 neurons increased their discharges in accordance with a concrete behavioral act and 63 neurons discharged without relation to food-acquisition behavior. All the neurons from the first group were divided into several types: specific neurons with a very strong correlation of their discharges to definite behavioral act and neurons whose activations were related with various behavioral acts. Thus, there were many different types of neurons which reflect the stage of learning of rabbit in experimental cage and it was possible to classify them regarding to the definite systems.

The spike activity of the 82 neurons (71%) correlated with the definite phases of the EEG waves. Moreover, 62 neurons were discharged with a high probability during the positivity and positive shift of the superficial EEG. Such relationships between EEG and neuronal activity were typical for different kinds of behavior as well as for different frequency bands of EEG and took place in the different cortical areas. These neurons could have different firing frequency, arrangement in different cortical layers and be related to the systems of different "age". The number of spikes of the neurons under the study was also significantly greater during positivity than during negativity.

A quantity of neurons with predominant spike activity during some phases of the EEG waves decreased with the increasing of EEG frequency. Thus 48 neurons had a significant relation of their spike with some phases of EEG within 0.5–3.0 Hz frequency band, pulse activity of 32 neurons were related with EEG phases within 8.0–12.0 Hz (p 0.01). These data permit to conclude that the more amplitude changes of EEG potentials the more neurons change their impulse activity.

From this study it was difficult to judge the "age" of the system by means of the EEG waves. Different relationships between the spike activity and the phases of EEG seem to be explained by the peculiarities of the intersystem relations.

In the second experimental series (3 rabbits) rabbit was placed into the cage where there were two food-boxes and two pedals. Rabbit taking the food from the food-box must press the pedal which was effective for this box. After a few pieces of carrot had been taken from the one-food-box, pieces of carrot were put into another food-box and the rabbit had to press another pedal to get food from it.

The activities of 62 cortical neurons were recorded and analyzed. It was found that some of these neurons increased their activity during this or that single definite behavioral act such as moving towards the pedal or food-box, pressing the pedal, food-seizure. Other neurons were active during a few behavioral acts. Thus, these neurons had behavioral specialization. It should be noted that during the definite behavioral act the neurons of different behavioral specialization could be active.

When rabbit pressed the pedal or bent the head towards the food-box there were negative waves in EEG-activity. Periods of changing of one behavioral act by another one were accompanied by positive potentials. The amplitude of these positive potentials seems to reflect the quantity of active systems and, accordingly, the magnitude of intersystem reconstructions. This suggestion is supported by the fact that maximal positive potential took place during the changing of one behavioral cycle by next one.

In sum, from the viewpoint of systemic specificity of neurons it can be suggested that EEG-deviations reflects alternation of the set of systems, namely, positive potentials reflect an increasing of simultaneously activated systems and negative potentials reflect a decreasing of activated systems.

RELATING 'NORMALITY' TO 'ABNORMALITY': A NEW MODEL AND A NEW THEORY

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This paper relates to each other neuroses, psychoses and other pathological states within a new theoretical framework, in which a 'dynamic model of style' accommodates definitions of so-called 'normal' and 'abnormal' ways of perceiving and behaving. It introduces some of the key models of a theory of mind called APM-A theory. The published title of the theory includes the concepts of 'perception', 'evolution, and 'style'[1] for the reason that, it provides an evolutionary framework in which variability in perceptual and conceptual styles is taken to hold crucial implications for understanding other aspects of human experience and behaviour. Within the new framework a potentially much greater range of variability than identified hitherto is explained in terms of the interaction of particular physiological characteristics, and concomitant need states, with environmental factors; and the notion of 'style' refers to attentional, perceptual and cognitive styles, as well as styles of expression.

The term APM-A derives from the fact that the theory and its models are rooted in what are seen to be the highly interactive processes of attention, perception, memory and arousal (APM-A). Instead of these seen to be occurring in a linear sequence such as attention $\rightarrow$ perception $\rightarrow$ thought $\rightarrow$ feeling $\rightarrow$ memory, they are conceived as a highly interactive and dynamic process which is defined by the theory and its models.

Acknowledgement of the highly interactive nature of the APM-A process also requires recognition of other kinds of interaction which are seen to underlie different kinds of experience and behaviour, e.g. interaction between consciousness and not consciousness; mind and body; and organism and environment.

The paper develops ideas from well-known data which indicate that qualitative differences in attention, perception, memory, emotion and performance occur at different levels of arousal, and includes references to less well-known data about kinds of arousal. It defines a hierarchy of states of awareness as 'levels of minding', before addressing the question of possible individual differences in kinds as well as base levels of arousal. These factors, as well as the satisfaction or not of particular kinds of needs in which people are seen to differ, are all seen to hold significant implications for degrees of vulnerability to particular kinds of so-called 'abnormality' in experience and behaviour.

Just as it is argued that qualitative differences in