INDIVIDUAL BRAIN CURRENT SYNCHRONIZATION MAY BE GENETIC

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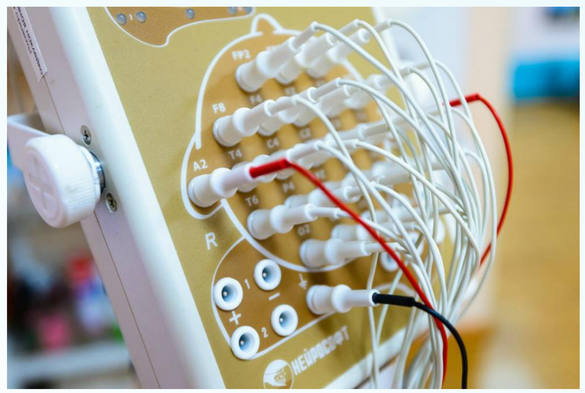
Introduction

Many of the early analyses of human brain connectivity data were aimed at finding out the overall picture of interactions within the brain, patterns of which differ between people. The obtained preliminary data showed that a significant part of brain connections is unique for each person [Barch, D. M. et al.Function in the human connectome: TaskfMRI and individual differences in behavior. Neuroimage 80, 169–189 (2013)].Based on the study of data on the neuronal activity of 126 subjects at rest and when performing cognitive tasks, the authors of the study [Finn Emily S. et al., 2015] found that the pattern of interconnected activity of brain zones was sufficiently individual, that is, it was possible to distinguish one person from another. On the basis of a brain scan in an fMRI machine it was almost 90% accurate to say that this brain pattern belongs to a given person at a mental task, the accuracy of distinction falls to 70%, but still remained quite high. We assume, as well as authors who study individual patterns of brain activity, that the data obtained allow us not only to identify the individual pattern of the subject , but also, probably, to predict his cognitive traits of intelligence. In addition, the studied data on individual profiles of electrical activity of the brain can reflect their genetic nature and allow us to determine the functional parameters of health or manifestations of functional neuropsychiatric disorders.

Methodology

Spectral frequency values of principal rhythms on electroencephalograms (EEGs) of 49 fit males aged between 20 and 35 have been analyzed. Multichannel EEGs were recorded by means of a "Encephalan-EEGR-19/26" in the modification of "Mini" (European certificate CE 538571 British Institute of Standards, BSI), from eight and sixteen cup electrodes connected to ear electrodes and positioned in accordance with the 10-20 system.

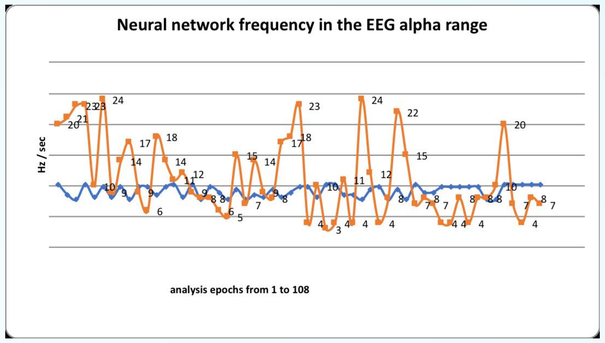
The functional tests were as follows: background record (BR), open eyes test (OE), eyes closing (EC), solving arithmetical problems where they were to subtract 5 and 2 from 200 in turns, as well as the Torrens verbal test for compiling a set of words from a set of letters (Tunic, E.E. 1998). The EEG sampling rate was 250 Hz. Computer-assisted EEG included spectral, periodometrical, coherent, and correlation analyses conducted by using the software provided by the manufacturer company.



Results

Spectral analysis suggests that brain current synchronization at a frequency dominant in a specific subject can be observed throughout an EEG record. Regular synchronization is observed in individual neural networks in both background records and functional tests, with an active neural network pattern containing synchronization of 50% or more deflections. An individual alpha-wave synchronization pattern characteristic of a specific subject is observed in every subject at a certain frequency, regardless of a test being done. These facts can indicate that **bioelectric activity of the operative neural network of a specific subject can be genetic.**

A synchronization in question appears as an outline of a neural network on an EEG, with the each subject's pattern being periodical throughout the EEG. We refer to any such regular synchronization pattern that occurs in certain deflections as **"synchronization pattern."** Synchronization periodicity varies between 5 and 70 seconds, depending on a subject and a functional test being done. While in background mode, an average periodicity of any such "synchronization patterns" ranges between 10 to 40 sec. The frequency of the alpha rhythm, at which the synchronization pattern is formed, is individual for each subject; it changes both when performing a specific functional test and when changing the test.



Four various pattern types of synchronization (Fig. 2) have been found among deflection synchronization variance being observed within alpha-wave rhythm. Type One Pattern is synchronization between fronto-centro-temporal cortex deflections – the "anterior synchronization pattern type." Type Two Pattern is periodic interactions between fronto-centro-occipital deflections at the same alpha-wave frequency – the "longitudinal pattern type." Regular synchronization between centro-temporo-occipital deflections is characteristic of Type Three Pattern – the "posterior type pattern." Type Four Pattern was synchronization between centro-temporal deflections, with frontal or occipital deflections periodically involved – the "transversal type pattern."

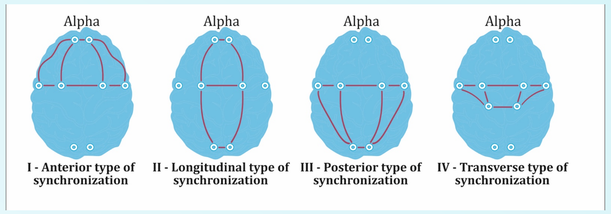


Fig. 2 Four various pattern types of synchronization neuronet

Conclusion

In all neural network synchronization types and various configurations, the connection nucleus of all types included synchronization of somatosensory area deflections. While remaining unchanged, any principal deflection stack characteristic of any specific subject (e.g., fronto-centro-temporal type) and a portion of the deflections in question (up to 25% of all the pattern deflections) can change by expanding or shifting pattern boundaries towards the left or the right hemisphere area. Thus, a synchronization pattern remains typical of a specific subject, while changes in the pattern boundaries maintain their dynamical nature. Neural network synchronization pattern types are linked to personality types, which can also be indicative of their genetic nature.

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