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Analysis of behavioral and EEG responses given the performing tasks to control attention and behavior in children with emotional instability

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Executive brain functions are a system of cognitive processes in the brain, including cognitive flexibility, inhibition (the ability to control impulsive or automatic reactions and generate rational ones), self-control, activity initiation, multitasking, monitoring, planning, working memory, decision making, abstract thinking, and the ability to switch attention. These functions are involved in practically every activity, learning and memory processes and, when impaired, can affect the correct regulation of other cognitive processes. Disruption on executive functions causes disorganized behavior, lack of adaptation to the environment, personality and mood changes. Also control of executive functions directs selective attention to the right stimuli. The P300 component in healthy people is detected during cognitive tasks and is associated with the involvement of attention, especially to new or meaningful stimuli. In an EEG study in the "oddball" paradigm, when polyphonic and monophonic stimuli were presented, an increase in the P300 amplitude on a non-target monophonic stimulus was observed in the central and parietal areas of the brain in children with various emotional disturbances. The ability to concentrate attention on the stimulus was normal, but the ability to ignore the non-target and irrelevant signal was impaired. The sound structure of the signal is likely to be important for the ability to isolate the desired signal.

Materials and Methods: In our work, we examined a sample of 12 children with diagnosed emotional instability compared to 12 healthy control subjects (mean age in both samples 8 ± 2 years, samples balanced by gender).

All children took part in EEG study while they performed tests for directed attention (monophonemic and polyphonemic odd-ball), motor control (stop-signal paradigm), and cognitive control (Stroop test). EEG was recorded on an amplifier from Brain Products, Germany, using 64 electrodes arranged according to the international 10–10 % scheme. In addition, the children's parents completed a set of questionnaires aimed at assessing the child's ability to self-monitor behavior. The amplitude of the P300 peak in the frontal and parietal cortices recorded in different behavioral tests was chosen as neurophysiological markers.

Results: The most pronounced differences between the groups of children with emotional instability and healthy control children were found for the monophonemic odd-ball test. In this test, in response to the target stimulus, the amplitude of the P300 peak in children with the diagnosis did not differ from that in healthy children, but differences in this index were found for the response to the non-target stimulus. In

children with emotional instability, the amplitude of the P300 peak in the medial frontal and medial parietal cortex was significantly higher compared to the group of healthy children. This result can be interpreted as a marker of impaired selective attention in children with emotional instability. Healthy children responded more strongly to the target signal and ignored the non-target signal, whereas children with emotional control disorders responded equally to both types of signals.
Conclusion: Analysis of the P300 peak amplitude under the conditions of the selective attention test revealed differences in cognitive signal processing between healthy children and children with emotional instability. For children with emotional instability, impairments related to the evaluation of signals as non-targeted were diagnosed, but no impairments related to the evaluation of target signals were diagnosed.
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