Секция «Психофизиология, когнитивные нейронауки и искусственный интеллект»

A network-level analysis of cognitive flexibility in resting-state fMRI

Научный руководитель – Арсалиду Мари

Чуйкова Ж.В.[1], *Фабер А.Ю.*[2]

1 - Национальный исследовательский университет «Высшая школа экономики», Факультет социальных наук, Москва, Россия, *E-mail: zhanna7496@mail.ru*; 2 - Национальный исследовательский университет «Высшая школа экономики», Факультет социальных наук, Москва, Россия, *E-mail: zhanna7496@mail.ru*

Cognitive flexibility is broadly defined as a mental ability to switch between mental sets, operations or different task rules [1]. This ability in an executive functions (EF) which are supported by a superordinate cognitive control network (CCN) [2]. The specifics of activating CCN are directly related to the task being performed. For task switching, there is an increase in activation in different regions of network, including the frontoparietal network and the cingulo-opercular network [4]. However, the majority of research focuses on task-based functional magnetic resonance imaging (fMRI), therefore the resting state conditions remains unexplored. Consequently, the purpose of our research is to examine a functional connectivity within cognitive flexibility networks in adults in resting - state.

Nineteen participants were recruited for the study (9 males and 10 females, 21-30 years old). For all participants, MR images were acquired using a 3T Philips scanner. The participants were instructed to relax, close their eyes and remain awake throughout the 6 min 6 seconds. Resting state data were analyzed using CONN, a Matlab/SPM-based software. We used the CONN's default preprocessing pipeline. Eleven ROI were defined from the meta-analysis of Wu and colleagues [3]. On the next step, we conducted graph theory analyses that allows to quantify and visualize the connectivity between selected nodes (Figure 1). For each subject a graph adjacency matrix was computed by thresholding the associated ROI-to-ROI Correlation (RRC) matrix by the threshold of $z > 0.5$.

Topological properties of each ROI from the resulting graphs show that left anterior cingulate cortex and right middle frontal gyrus have significant contribution to connectivity in CCN, which is consistent with the literature. In addition, right inferior frontal gyrus voxels had lower functional connectivity with parietal cortex areas comparing to connectivity with cingulate cortex. These results cam inform current theories of neurobiological foundations of cognitive flexibility.

Источники и литература

1) Miyake A., Friedman N. The nature and organization of individual differences in executive functions: Four general conclusions // Current Directions in Psychological Science. 2012. Vol. 21. № 1. P. 8–14. doi: 10.1177/0963721411429458

2) Niendam T. Meta-analytic evidence for a superordinate cognitive control network subserving diverse executive function // Cognitive, Affective and Behavioral Neuroscince. 2012. Vol. 12. №2. P. 241–268. doi:10.3758/s13415-011-0083-5.

3) Wu T. The functional anatomy of cognitive control: A domain-general brain network for uncertainty processing // The Journal of comparative Neurology. 2020 Vol.528. №8. P.1265-1292. doi: 10.1002/cne.24804

4) Yin, S., Deak, G. Coactivation of Cognitive Control Networks During Task Switching // Neuropsychology. 2017. Advance online publication. doi: http://dx.doi.org/10.1037/neu0000406