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Correlation of Resting State fMRI Data with Scores of the Amsterdam Resting-State Questionnaire

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An fMRI can detect the active areas in the human brain even at resting state condition. These active areas are forming resting state networks (RSN) (Biswal B., et al. 1995). There are now a variety of types of RSNs. The most known and the most studied is the default mode network (DMN) appearing in wakefulness without any cognitive tasks. (Raichle M.E., et al. 2001). P. Delamillieure with colleagues has constructed a questionnaire (The Amsterdam Resting-State Questionnaire) revealing categories of mental activity in percentages at rest condition (Delamillieure P., et al. 2010). It consists of 7 categories characterizing such mental processes as: discontinuity of mind, theory of mind, self, planning, sleepiness, comfort, and somatic awareness. In the current study we aimed to find possible correlations between the volume of activation of RSNs (fMRI data) and scores of the Amsterdam resting-state questionnaire (ARSQ).

Ten healthy right-handed volunteers participated in the study (3 males; mean age 28.3 ± 5). All participants haven't reported about any brain damages or mental illnesses. Participants lay supine in a magnetic resonance imaging (MRI) scanner (1.5 T MAGNETOM AVANTO MRI Scanner, Siemens, Germany) and were instructed to remain calm, with their eyes closed, not falling asleep and not thinking about something particular. Each participant underwent a high-resolution T1-weighted anatomic rapid gradient-echo imaging (T1 MPRAGE sequence: TR 1900 ms, TE 3.4 ms, FA 15°, 176 slices with slice thickness 1 mm and slice gap of 0.5 mm; field of view 256 mm with matrix size 256x256) and the followed T2*-weighted echo planar imaging session (TR 3 s, TE 50 ms, FA 90°, 35 slices with slice thickness of 3 mm and slice gap of 0.8 mm, the field of view was 252 mm and matrix size 64x64) containing 180 volumes (9 minutes). Immediately after scanning the subjects filled out the ARSQ.

Preprocessing of fMRI data was performed in the statistical parametric mapping toolbox (SPM8; Wellcome Department of Imaging Neuroscience, London, England) for Matlab 7.0.4 (Math Works, Natick, MA, USA). The group fMRI data was decomposed into 30 independent components (ICs) using Group ICA toolbox (GIFT, <http://icatb.sourceforge.net/groupica.htm>) by Infomax ICA algorithm. Seven RSNs were selected according to their spatial correlation with the known RSNs: three visual, sensorimotor, left and right fronto-parietal networks, salient network, speech network and attention network. Two components conformed to the default mode network: occipital-frontal and medial. The voxel volume of activation for each component was used for the correlation analysis with scores of seven mental processes, according to data of ARSQ for each participant.

Among all components only 4 showed a significant dependence on the ARSQ. The volume of activation of the visual network, in particular the medial occipital lobe, was negatively correlated with the discontinuity of mind (Pearson $r = -0.67$, $p = 0.025$). The volume of salient network negatively depended on sleepiness (Pearson $r = -0.77$, $p = 0.009$). The comfort sense correlated positively with the attention network (0.68, $p = 0.030$) and speech network volumes (0.72, $p = 0.019$). The inverse dependence of activation of the salient network with increasing of sleepiness is an expected result owing the fact that the main function of the salient network is to respond to behaviorally salient events in the environment (Seeley et al., 2007). The other findings require further research aimed at improving the statistical significance of the obtained

RSNs and their correlation with scores of psychological questionnaires by increasing a number of participants. The present results of the pilot study support a hypothesis that the brain activity at rest can be used as an additional indicator of cognitive and mental processes.

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Источники и литература

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