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Title: Does the Brain Work While Resting? Resting State fMRI

Running Head: Resting State fMRI

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Since the beginning of humankind has long wondered about what happens in the brain. The human brain is work even during the relaxing or resting time (1). Functional magnetic resonance imaging (fMRI) has grown rapidly and in a wide variety of fields like neuroscience, psychology, clinic medicine and political science has got applications in the past several years.

Functional magnetic resonance imaging (fMRI) is rooted on oxygenated and deoxygenated hemoglobin for the paramagnetic properties to show images of changing blood flow in the brain linked with neural activity (2). During the performance of different tasks or at resting state, it offers images to be generated that reflect which brain structures are activated (3). fMRI is increasingly popular method because of the noninvasive technique for brain functions such as emotion, memory, language etc (1). A time series of 3D images are collected for fmri data.

Since the discovery of functional magnetic resonance imaging, studies of resting state fMRI (rs-fMRI) have become widespread in the last two decades. rs-fMRI occurs in a resting that used in brain mapping to evaluate regional interactions, when an explicit task is not being performed external stimulation (4, 5).

Ogawa was demonstrated as the first person the potential importance of the blood oxygenation level-dependent (BOLD) contrast (6). The task related and rs-fMRI use BOLD contrast. Rs-fMRI works on spontaneous low frequency oscillations rising from spatiotemporal correlations, continuously communicating anatomical areas functionally linked networks (1). Biswal was first discovered as seed-based analysis to select a seed and find the linear correlation of this seed region with all the other voxels in the entire brain, finally to getting a seed-based functional connectivity (FC) map (1). Spontaneous low-frequency fluctuations are resting state signals in the range 0.01–0.08 Hz fluctuations of resting-state fMRI time-series. When resting state fmri scan was taken, volunteers are instructed to relax and they must not to think of anything in particular during these resting-state experiments (7). Three ways of rs-fMRI protocol can be applied: eyes open, eyes close and eyes open while seeing on a dash bar on the screen. The subjects must not to fall asleep during the eyes closed condition (7). Most of studies are used 1.5 T and 3 T MR scanners for the scanning session. For resting state fmri scan, it must be taken both structural imaging and gradient-echo echo-planar imaging T2* weighted sequences to measure to brain activity (8).

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Brain connectivity divided into two general network as anatomical connectivity, functional connectivity. (7). Functional connectivity (FC) analysis techniques composed of independent component analysis (ICA), seed-based and graph theory analysis for rs-fMRI connectivity analysis. ICA give rs-fMRI networks by working mathematical algorithms to spatially and temporally independent components to decompose the signal from whole brain voxels. ICA examined multiple simultaneous voxel to voxel interactions of distinct networks in the brain (1). Using these methods in some common neurologic and psychiatric brain disorders including schizophrenia (9), attention deficit hyperactivity disorder, Alzheimer's disease (AD) (10), depression (11), Parkinson disease (PD), and multiple sclerosis (12) were studied. It is known that default mode functional connectivity were decreased in AD (10). According to van den Heuvel, it was found a decrease between medial frontal cortex and precuneus in schizophrenic patients using default mode functional connectivity analysis. (7). In the early stage of Parkinsonism is disrupted the overall organisation of the brain network, it is decreased global efficiency, disconnected modularity and hub distribution (13).

For analyses rs-fMRI some software use such as statistical parametric map (SPM), REST, FSL, CONN for pre and post-processing analysis (1). For analysis, motion correction to the functional scan can be done and co-registered to each structural image using a six-parameter rigid-body transformation and a 12-parameter affine transformation (8). The preprocessing steps include slice timing, realignment to correct for head motion, coregistration to MPRAGE images and normalization to a standard template, after these process the images were smoothed and low pass filtered (8). A general linear model (GLM) should be use to statistical assumptions for activation brain map that converts a voxel time series into a space defined in the design matrix spanned by a set of basis vectors (3).

There are the different networks in the brain: the default mode network, auditory, salience, visuospatial, executive, language, precuneus, primary visual, sensory motor network etc (1). The most common use the default mode network which involves in medial prefrontal cortex and the posterior cingulate cortex and lateral parietal cortex. The default mode network performs only when the individual in the resting condition at increased activity (1).

Rs-fMRI is based on BOLD signal effective and change predominantly because of non-invasiveness. Rs-fMRI maybe use in diagnosis and prognosis of the some brain diseases of the brain activity thereby offering a promising option in the treatment in the resting state using brain connectivity analysis. Rs-fMRI may provide important information to be used for many potential clinical

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applications as well as fundamental cognitive neuroscience investigations. We can learn about of understanding of the human brain function using rs-fMRI.

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