Neuroanatomical priors improve image-based cortical thickness computation: ROI-DiReCT

Abstract

abstract

Keywords:

Introduction

Working memory is a temporal process to maintain and manipulate information over short periods of time. WM has been shown to be impaired in many neurological and psychiatric syndromes including Schizophrenia. It was thought to be tightly associated with cognitive deficits in Schizophrenia. WM itself is a complex process which has been multidimensionally related to the psychosis.

Thus, a examination of the underlying neurological mechanism provided us with insight into the causes, progression and even treatment of schizophrenia. There has been abundant imaging studies in this area, but the differences among the tasks and material make it difficult to make a conclusion. There have been evidence of multi-modality deficits: visual spatial, visual object, verbal, and other types of working memory. One popular and original model of WM is a system encoding and maintaining modality-specific short-term memory and central executive component to manipulate the information. Some studies have found evidence for different patterns of functional connectivity during different working memory task conditions (e.g., as a function of load, stimulus type, or task phase). Such ndings suggest that functional connectivity changes could reect differences in task engagement or responsivity of brain networks to modulation,rather than stable changes that persist across all task states. Some studies have found both impairments in the modality-specific perception component and the later manipulation component. In a recent meta analysis, the author draw attention to a consistent and restricted "core network" emerged form conjunctions across analyses of specific task designs and contrasts. This distributed network was believed to

be active in WM task ignoring the task type , stimulus type and WM load and may be act as a base part in WM.

Materials and Methods

Subjects

The resting state fMRI data presented here was collected from six hospitals in China which paticipated in the Brainnetome Project for Schizophrenia. The six hospitals are Patients and controls are matched as much as possible for age, sex, handedness, and race distributions with each site. Peking University Sixth Hospital (PKUH6); Beijing Huilongguan Hospital (HLG); Xijing Hospital (XJ); Henan Mental Hospital (HM); Renmin Hospital of Wuhan University (RWU); and Zhumadian Psychiatric Hospital (ZMD). Henan Mental Hospital provided two distinct MRI scanners: Siemens (HMS) and General Electric (HMG), for a total of eight scanning centers. The study at each center was approved by the local ethical review board. All the participants provided written informed consent.

All patients had a diagnosis of schizophrenia confirmed by trained psychiatrists using the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID-I/P). (First et al., 2002b). Exclusion criteria were a current neurologic disorder, a history of serious medical illness, substance dependence, pregnancy, electroconvulsive therapy within the last six months, or a diagnosis of any other Axis I disorder. The Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1989) was used to assess positive, negative, and general psychopathology symptoms in the patients. The healthy controls, who had no current axis I psychiatric disorders, were recruited from the lo-

cal community near each center through advertisements. None of the HCs had any personal history of psychotic illness and no family history of psychosis in their first, second, or third degree relatives. All the participants were Han Chinese in origin, right-handed, and had no contraindications to MRI scanning. After extensive quality checking of the brain imaging data, 662 patients and 613 HCs were included in the analysis.

Data acquisition and preprocessing

Two types of 3 T MRI scanners (four Siemens, three General Electric) were used at the participating centers. To ensure equivalent data acquisition protocol and high quality imaging data, the scanning parameters of the functional scans at each of the six centers were set up by an experienced researcher before data acquisition. An echo planar imaging sequence was used to obtain the functional images, the parameters were as follows: 30 axial slices, TR = 2000 ms, TE = 30 ms, matrix = 64 64, flip angle = 90, FOV = 240*240 mm 2, slice thickness = 4 mm, gap = 0.4 mm. A total of 250 brain volumes were collected, resulting in a total scan time of 500 s.The MRI scan sequences and parameters for each center are listed in eTable 1. To be noticed, the time point number of the images from ZMD is 180 and is different from the 240 of the other sites. We did not exclude this site since we are eager to keep as much data and sites as possible, to support the validation of the muli-site analysis.

The iamges were preprocessed with a based in-house software: Brainnetome Toolkit which utilized Statistical Parametric Mapping SPM8 (http://www.fil.ion.ucl.ac.uk/s
The pipeline includes the following steps: The first ten images were deleted for the signal equilibration. The remaining iamges were conducted for slice

acquisition correction and head motion correction. The fMRI data which had less than 3.0 mm of head motion and 3.0 of angular rotation were included. Moreover, the mean framewise displacement (FD) was computed by averaging FDi from every time point for each subject. There were no differences for the mean FD between groups (t = 0.413, p = 0.682) (Table 1). Then the fMRI images were normalized to the standard Montreal Neurological Institute (MNI) template provided by SPM and resample to the 3-mm isotropic voxels. Artefacts due to changes in global, ventricle and white matter signals, residual motion were removed using voxel-wise regression. A temporal filter (0.01 Hz ¡ f ¡ 0.08 Hz) were used to reduce the low-frequency drift and physiological high frequency respiratory and cardiac noise. Finally, the data was smoothed with an isotropic Gaussian kernel of 6 mm full-width at half-maximum.

For a single label,

$$E(\phi(\mathbf{x},1)) = \int_0^1 \|\mathbf{v}(\mathbf{x},t)\|^2 dt + \|P_w(\mathbf{x}) - P_{wg}(\mathbf{x})\|^2 \tag{1}$$

$$\sum_{n=1}^{N} E_n(\phi_n(\mathbf{x},1)) \tag{2}$$

Discussion

Conclusions

Acknowledgments

References