Age-Related Changes in Default Mode Sub-Networks

Xueli Wang[1], Jin Xu[1], XiuFen Zhang[1], Xiaolong Peng[1], and Pan Lin[1]

[1]*Institute of Biomedical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi, China*

Introduction: Default mode network (DMN) plays an important role in neural cognitive research[1]. Previous studies have suggested that functional connectivity of DMN will decrease with age, which may also cause cognitive decline[2-4]. However, there is still lack of studies on age-related changes in default mode sub-networks such as anterior default mode network (aDMN) and posterior default mode network (pDMN). The aim of this study was to investigate the age-related effects on functional connectivity between aDMN and pDMN during resting state.

Methods: Sixty-one healthy participants were included in this study which consisted of 25 males and 36 females (between 19-79 years of age). Then they were divided into two groups based on age: younger group (19-27 years, n=18) and elder group (58-79 years, n=17). All of the data used in the study were from the ICBM 1000 Functional Connections Project (http://www.nitrc.org/projects/fcon_1000/). The imaging data were collected using a 3T MR scanner with the following parameters: TR = 2000 ms, scan order: sequential descending; slices = 23, voxel size=4×4×5.5 mm^3, volumes=128). SPM8 (http://www.fil.ion.ucl.ac.uk/spm) and REST (http://www.restfmri.net) were utilized for data preprocessing. The first five images for each session were discarded for magnetic saturation. And both motion correction and slice-timing correction were carried out on the remaining 123 images. The functional images were then normalized to the Montreal Neurological Institute (MNI) template in standard Talaraich space, and smoothed using a Gaussian Kernel with a full-width at half-maximum (FWHM) of 6mm. Finally, linear trends were removed and the images were temporally filtered, retaining frequencies in the 0.01Hz-0.08Hz band. All the preprocessed images were then analyzed using the GIFT software (http://mialab.mrn.org/software/gift/). Group independent component analysis was performed to decompose the resting state images into 25 spatially independent components. Then, default mode components were identified using a default mode template. In this study, the DMN was decomposed into two independent sub-networks, aDMN and pDMN. Then for each subject, Pearson's correlation coefficients were calculated from these two sub-networks. Fisher's z transformation was applied to improve the normality of the correlation coefficients. Finally, two-sample t test was performed to compare the correlations of the aDMN-pDMN of younger and elder groups. Regression model was also constructed to study the relationship between age and functional connectivity of sub-networks.

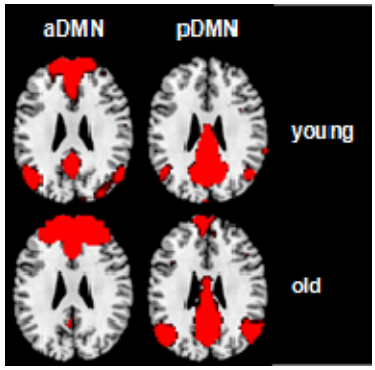

Figure 1. Sub-networks of the DMN for two groups

Results and Discussion: In this study, as shown in Figure 1, we studied the aging effects on functional connectivity between aDMN (including medial prefrontal cortex (mPFC)) and pDMN (including posterior cingulate cortex (PCC) and precuneus). Our results indicated that elder group showed a significant connectivity decrease between aDMN and pDMN compared with younger group (Figure 2, $p<0.01$). Particularly, a negative association between age and connectivity of aDMN and pDMN was obtained according to the age data ranging from 19 to 78 years (Figure 3). Some previous studies have indicated that the connectivity of PCC, which is the hub of DMN, will decrease with age and usually combined with atrophy of the gray matter[3,5]. Our findings further confirmed the previous conclusions that aging may disrupts the connectivity between sub-networks of DMN. Besides, they can also be used for understanding the mechanism of cognitive decline associated with age[6].

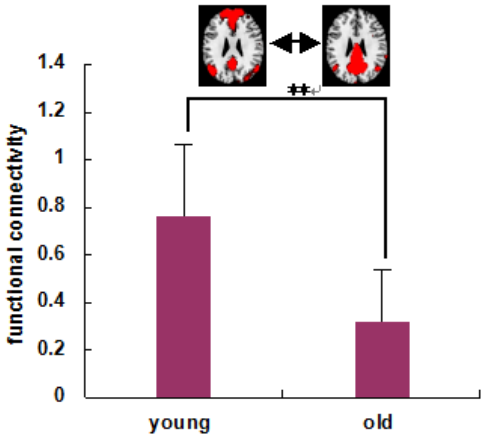

Figure 2. Comparison of the connectivity between aDMN and pDMN in two groups. **:p<0.01

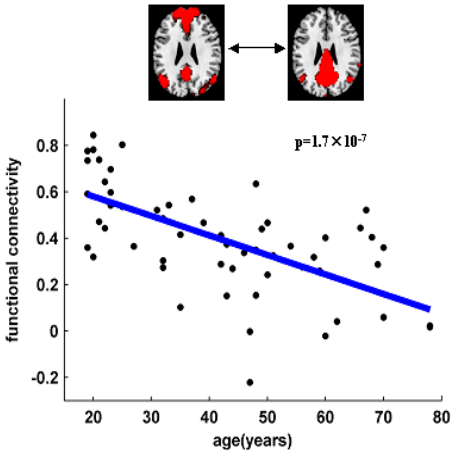

Figure 3. Developmental trajectory of the age-related connectivity between aDMN and pDMN

Acknowledgments: This work is funded by the National Natural Science Foundation of China (No. 61473221,No.31271061), Doctoral Fund of Ministry of Education of China (20120201120071) and the Fundamental Research Funds for the Central Universities (No. xjj2014134).

References: [1] Baojuan Li et al. BIOL PSYCHIATRY, 2013, 74:48-54. [2] SH Annabel CHEN et al. ISMICT, IEEE, 2013,218-222.
[3] Onoda K et al. ICME, IEEE, 2012,119-124.[4] Anne Hafkemeijer et al. Biochimica et Biophysica Acta, 2012,1822:431-441.
[5] E.A.Allen et al. Front Syst Neurosic, 2011,(5):2.[6] Dardo Tomasi et al. Mol Psychiatry, 2012,17(5):549-558.