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Sex differences in the temporal dynamics of fMRI resting-state networks

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Introduction

Temporal dynamics of (EEG/fMRI) brain activity during rest are characterized by long-range temporal correlations which differ across brain networks and are altered in several brain disorders (Lai et al. 2010).

In this study we investigated if the temporal dynamics of fMRI resting-state networks are also influenced by gender.

Methods

Participants (Table 1, top):

42 Dizygotic Opposite Sex (DOS) twin pairs and 5 carefully matched male-female pairs, between 19-57 years.

Neuroimaging data:

Structural T1-weighted sMRI and fMRI during 2 resting state sessions of 6 minutes.

Data Analysis :

After Independent Component Analysis (ICA) with temporal concatenation (in FSL), resting-state networks were selected based on visual inspection and cross-correlation with previously identified networks (Smith et al. 2009).

Average time series of the set of voxels included in each network (i.e., all voxels with Z-scores > 2.8) were computed, with fluctuations in white matter and CSF regions regressed out.

Long-range temporal correlations of the time series were quantified by Detrended Fluctuation Analysis (DFA: Linkenkaer-Hansen et al. 2001).

Results

Functional networks:

We identified 9 functionally relevant resting-state networks (fig. 1).

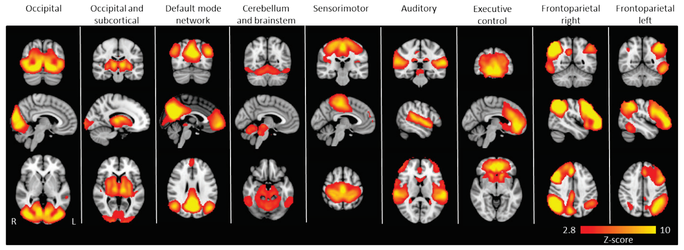

Fig. 1: colorbar indicates Z-scores

Time series power spectra:

Normalized power spectra of the temporal dynamics of each network plotted in log-log scale were characterized by a linear decrease with increasing frequency ; i.e., $1/f^{\beta}$ type between 0.02 and 0.1 Hz (Fig. 2), which indicates power-law scaling behavior.

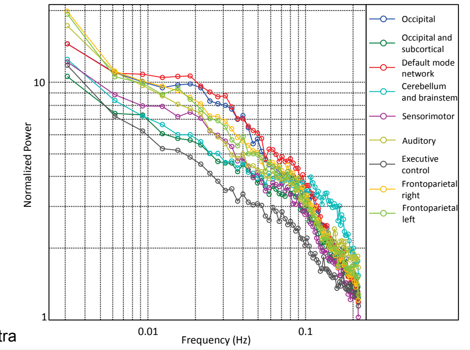

Fig. 2: power spectra

DFA exponent α

The DFA exponents per resting-state network, shown in figure 3, were significantly different from 0.5 (p<0.001), which indicates long-range temporal correlations.

Six networks exhibited a significantly higher scaling exponent in males than in females (paired t-test, p<0.05).

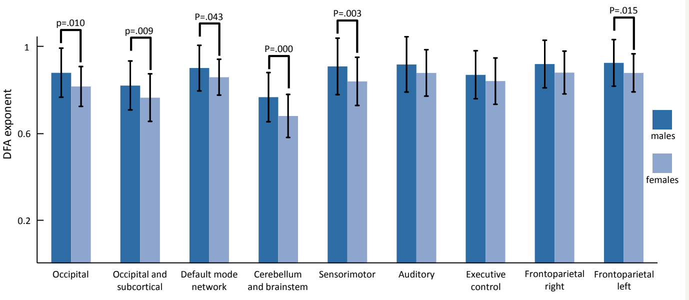

Fig. 3: DFA exponents per identified network

Conclusions

Temporal dynamics of brain networks during resting including occipital, sensorimotor and frontoparietal regions, as well as the default mode network, exhibited higher scaling exponents in males compared to females.

Our findings adds to a growing body of evidence on gender differences in brain structure and function (Sacher et al. 2013) .

Future studies should address the cognitive and/or behavioral interpretations of these functional differences.

References:

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