

IMPACT OF THE GLOBAL AVERAGE IN RESTING STATE FUNCTIONAL CONNECTIVITY: QUANTIFICATION OF ANTI-CORRELATIONS

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Abstract

The variance explained by the global fluctuations in resting state fMRI increases the correlation between functional systems, beyond the correlation that reflects their specific functional connectivity. Hence, removal of the global average (GA) signal facilitates the observation of specific physiological relationships among major functional systems (Fox et.al, 2009). However, removal of GA may introduce artifactual negative correlations, mainly between the attention and the default mode networks (Murphy et.al, 2009). Therefore, it is not clear whether the reported anti-correlation between these networks (Fox et.al, 2005) is real, or is artificially introduced by regressing out the GA. In the current work we introduce the notion of Impact of the Global Average in Functional Connectivity (IGAFC) for quantifying the sensitivity of seed-based correlation analysis to the inclusion of the GA as a confounding effect. The IGAFC index is defined as the correlation between the GA and the BOLD at a particular voxel times the correlation between the GA and the seed time course of interest. This definition enables the calculation of a threshold at which the impact of the GA would be large enough to artificially introduce negative correlations. In particular, it would reveal those locations where anti-correlations were introduced by regressing out the GA.

Applications

Data: 17 normal subjects downloaded from the BS002 database (www.brainscape.org), four runs each. TR = 2.16 sec, 194 volumes per scan.

Pre-processing: Slice timing correction, motion correction, CORSICA, Band-pass filtering (0.01-0.1Hz), re-sampling to MNI space and 6 mm spatial smoothing.

Seed Correlation Analysis: Hierarchical random effects model (fMRIStat). Two 6 mm spherical-shaped seeds were placed on the posterior cingulate/precuneus ([-2 -36 37]) and on left MT ([-47 - 69 -3]).

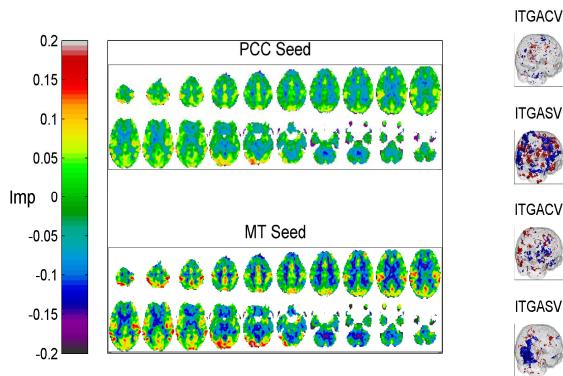


Figure: IGAFC map for a single run. Thresholded 3D maps for the impact of the GA as a confounding variable (ITGACV) and suppressor variable (ITGASV). Blue spots in the ITGASV map correspond to those negative correlations artificially introduced by the removal of the GA.

Conclusions

Quantifying the impact of the GA on the seed-based resting state functional connectivity analysis allowed us to elucidate those spatial locations where negative correlations were artificially introduced. This yielded a post hoc thresholding strategy to accurately determine the specific non spurious resting state correlations. We then showed that consistent anti-correlations are not introduced by the regression of the global effect.

References

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