Natural head motion effects on anatomical covariance networks

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**Background:** Brain structural connectivity measurements derived from inter subject gray matter morphometry correlations can help characterize clinical populations¹. However, cortical and subcortical measures derived from structural T1 MR images can be biased by head motion², which can be estimated by measuring image properties like the average edge strength (AES)³. Here we investigated how natural head motion in healthy and Parkinson’s disease may affect whole brain networks of regional cortical-thickness covariance.

**Methods:** We calculated AES on 124 Parkinson’s Disease (PD) and 84 age and gender matched Healthy Control (HC) structural T1-weighted images acquired for the PPMI initiative³. We estimated cortical thickness (CT) using FreeSurfer version 5.3.0 for the 30 HC and 30 PD with lowest (highest motion) and highest (lowest motion) AES. Within each of these 4 subgroups we randomly sampled 1000 times 15 subjects and constructed a CT correlation matrix calculating the Pearson’s Correlation Coefficient (R) among average CT values calculated in 68 atlas based ROIs and retained the highest 10% R. We then performed a network similarity measure expressed by the distribution of 1000 normalized mutual information (NMI) extracted for the following pairs of networks: a) 15 lowest motion (lm) HC vs 15 highest motion (hm) HC; b) 15 lm PD vs 15 hm PD; c) 15 lm HC vs hm 15 PD; d) 15 hm HC vs 15 lm PD. Finally we compared the obtained NMI distributions using the two samples Kolmogorov Smirnov test.

**Results:** Figure 1 shows how the difference in network similarity (NMI) within and between the HC and PD groups are strongly dependent on the different amount of head motion, this effect being stronger in PD.

**Conclusions:** We demonstrated that the comparison of whole brain networks of regional cortical-thickness covariance in cross sectional studies may be biased by the difference in amount of natural head motion between the analyzed groups.