G149 Characteristic Traits of Mild cognitive impairment in Parkinson's disease

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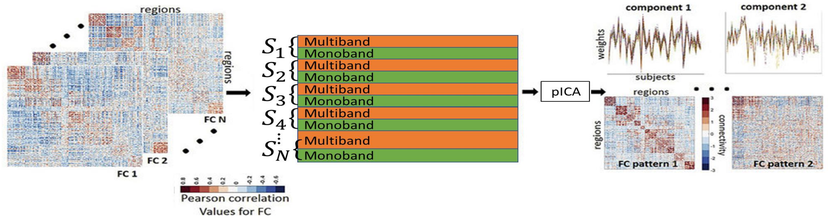
Background

- Mild cognitive impairment (MCI), frequent in Parkinson Disease (PD), is a well-known risk factor for dementia.
- Important Resting state networks (RSNs), such as DMN, DAN, CEN, SN, have been reported to correlated with cognitive deficits in PD. Inter-network connectivity is crucial as well. [1,2]
- Coupling/decoupling between the RSNs are detected in functional connectivity (FC) matrices
- This study investigates how whole-brain functional networks are affected by MCI in PD using a Connectome ICA (connICA) analysis with resting state functional MRI (RS-fMRI).

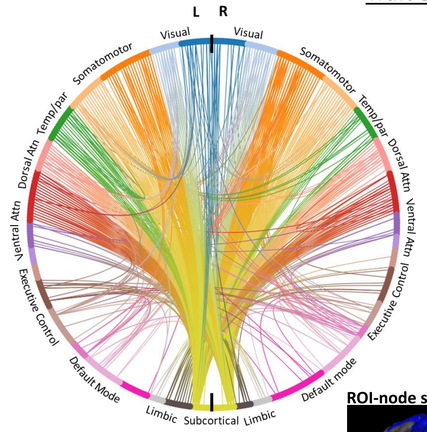
Methods

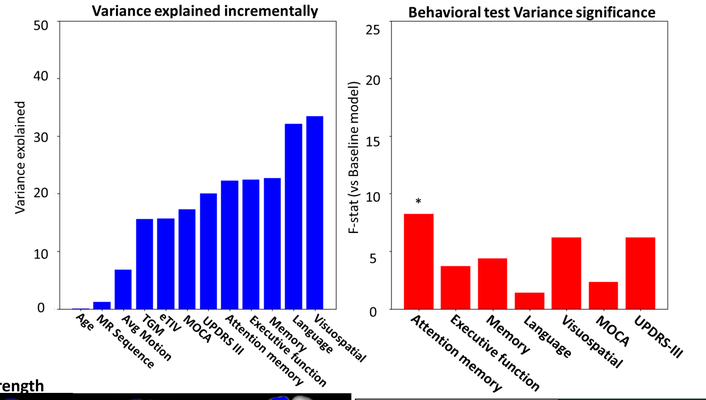
- 59 PD patients (26 PD cognitively normal (PDCN) and 33 PD-MCI) vs 28 healthy controls (HC).
- MRI data acquisition: 3T Siemens Trio with 32 ch. head coil.
- T1-w (MPRAGE) & T2-w (TSE) anatomical scans (1 mm^3 voxels). Two 10 min eyes-open RS-fMRI acquisitions (EPI, 3 mm iso voxels, TE= 28ms) at TR = 2s and TR = 0.8 s (multiband factor = 3).
- Anatomical preprocessing: Brain parcellation was performed using Schaefer's atlas [3] plus subcortical areas of the Freesurfer's Destrieux atlas (Aparc2009) [4]. Anatomical images were coregistered to the functional space.
- fMRI preprocessing: Despiking, slice timing, distortion correction, head realignment, motion scrubbing and nuisance regression (6 Legendre polynomials, realignment parameters + temporal derivatives, 5 principal components of WM, ventricle CSF voxels, and brain's edge voxels).
- After scrubbing [5] 21 HC, 21 PDCN and, 23 PD-MCI subjects remained for further analysis
- FC matrices (Pearson correlation) were computed. A ConnICA [6] using MELODIC with 65 independent FC-traits was applied, which was the optimal PCA component for subject identifiability [7].



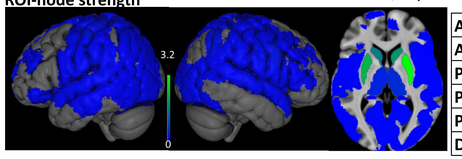
- Linear mixed effect (LME) model on the weights of each FC-trait with group (HC, PDCN, PD-MCI) with the sequence (monoband, multiband) as fixed factor, and subjects as random factor. Anova p-values are corrected (Bonferroni method).
- Incremental ANOVAs and individual F-tests were computed to evaluate the relationship between the FC-traits and neuropsychological assessments.

Trait 5: Subcortical-cortical connectivity



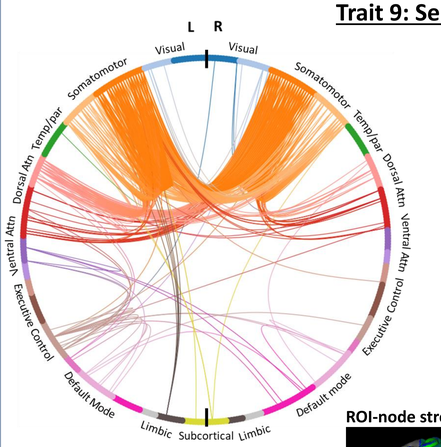


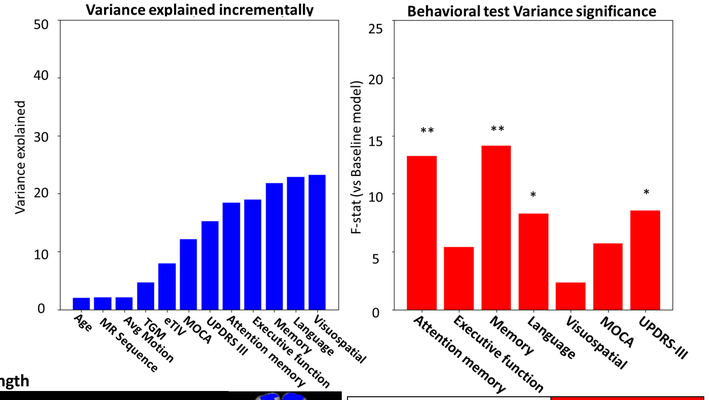
ROI-node strength



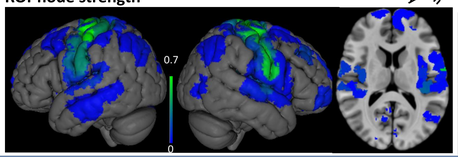
Anova F-test	8.60350
Anova p-value corrected	0.02077
P-value HC vs PDCN	0.00056
P-value HC vs PD-MCI	0.00094
P-value PDCN vs PD-MCI	0.40528
Differenciated group	HC

Trait 9: Sensorimotor and Attention Networks





ROI-node strength



Anova F-test	18.93280
Anova p-value corrected	0.00000
P-value HC vs PDCN	0.30756
P-value HC vs PD-MCI	0.00000
P-value PDCN vs PD-MCI	0.00001
Differenciated group	PD-MCI

Discussion

- The subcortical hubs in putamen, caudate and thalamus is likely a manifestation of the ganglia-thalamo-cortical alterations [8] at the onset of PD. This FC-trait is mainly associated with attentional tests implying attentional deficits at the beginning of PD.
- FC-trait 9 mainly involves inter- and intra-hemispheric connections between regions of the primary and secondary motor and somatosensory cortices and Dorsal-ventral attention networks. Although UPDRS-III is link to this trait, attention and memory behavioral test are significantly linked suggesting a motor disfunction in the PD-MCI patients that is related to attentional and memory impairments. The significance of language test could be an effect from the semantic fluency test.

In conclusion, functional connections between attentional and sensorimotor regions are key for PD-MCI development, and explain deficits in attention and memory abilities that are typically observed in PD-MCI patients.

Cognitive and motor tests

- Unified Parkinson Disease Rating Scale (UPDRS)
- Montreal Cognitive Assessment (MOCA)

MCI diagnosis was done according to the Movement Disorder Society Task Force Guidelines (level II) using the following tests:

- Attention and Memory: Inverse digit span memory test, Symbol digit modalities test
- Executive function: trail making test B, phonetic fluency
- Memory: Rey Auditory Verbal Learning Test (RAVLT), Rey–Osterrieth complex figure test (ROCF)
- Language: semantic fluency test, Boston naming test
- Visuospatial: Object decision and number location from the Visual Object and Space Perception Battery (VOSP)

References

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