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Functional Connectivity of Language and Memory as a Cognitive Biomarker in Temporal Lobe Epilepsy : Preliminary Results

Roger, E.¹, Pichat, C.¹, Perrone-Bertolotti, M.¹, Cousin, E.^{1,2}, Minotti, L.³, Job, AS.³, Mosca, C.³, Kahane, P.³ & Baciú, M.¹

¹Univ. Grenoble Alpes, CNRS LPNC UMR 5105, F-38000 Grenoble, France

²Univ. Grenoble Alpes, UMS IRMaGe CHU, F-38000 Grenoble, France

³Univ. Grenoble Alpes, Grenoble Institute of Neuroscience & Neurology Department CHUGA, France



CONTEXT & GOALS

Background

Drug-resistant temporal lobe epilepsy (TLE) is a severe neurological condition. Epileptic seizures initially come from the temporal lobe but the whole brain is suffering. Thus, the large-scale brain connectivity is clearly modified in TLE patients compared to healthy subjects (Dinkelacker et al.; 2016) and two cognitive functions are particularly affected: language and memory (McDonald et al., 2008). This suggests a vulnerability of these functions and a plasticity of the related networks not always effective.

Main objectives

- 1) Specify the functional connectivity (FC) modifications that occur in the epileptic brains on a macroscopic language and memory network (LMN)
- 2) Consider the potential differences between patterns of FC according to the hemispherical lateralization of the epileptogenic zone (LH/RH)
- 3) Evaluate if reorganizations of the FC at rest can be related to cognition

METHODS

45 participants

28 healthy subjects

17 mesial TLE (8 Left mTLE; 9 Right; paired)

Neuroimaging

3T MR Achieva Philips imager with a 32-channel head coil

- Anatomical MRI (T1T2, 128 sagittal slices, 1.37 mm thickness, field of view = 224x256 mm, in-plane voxel size = 0.89x0.89 mm)
- Resting state fMRI (400 dyn, 13'34" total duration, 36 axial slices, 3.5 mm thickness, TR = 2.0 s, TE = 30 ms, flip angle = 75°, field of view = 192mm, in-plane voxel size = 3x3 mm)

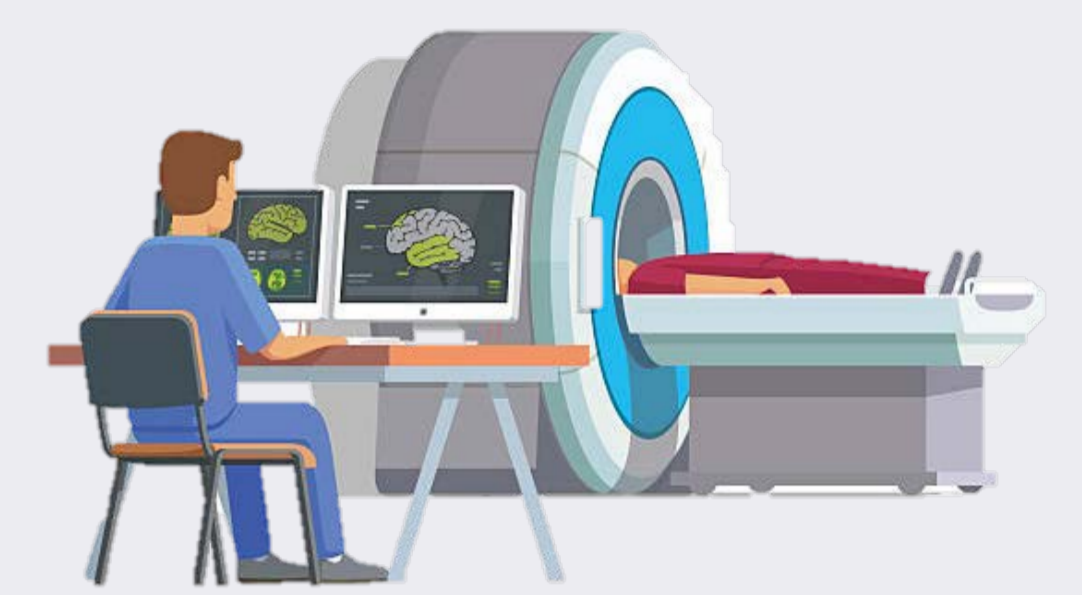
Cognitive scores

Several language & memory standard scores from the neuropsychological assessment (IMA = verbal memory, ICV = verbal IQ, fluency tasks, naming)

Analyzes

Neuroimaging data (FC): after the pre-process step, ROI-to-ROI & graph theory analyzes were performed using the *Conn Toolbox* (Whitfield-Gabrieli et Nieto-Castanon, 2012). Then, Kruskal-Wallis tests (non-parametric tests of k independent samples) were applied to test de differences between groups.

Cognitive data: Spearman correlations were used to link FC and cog scores



RESULTS

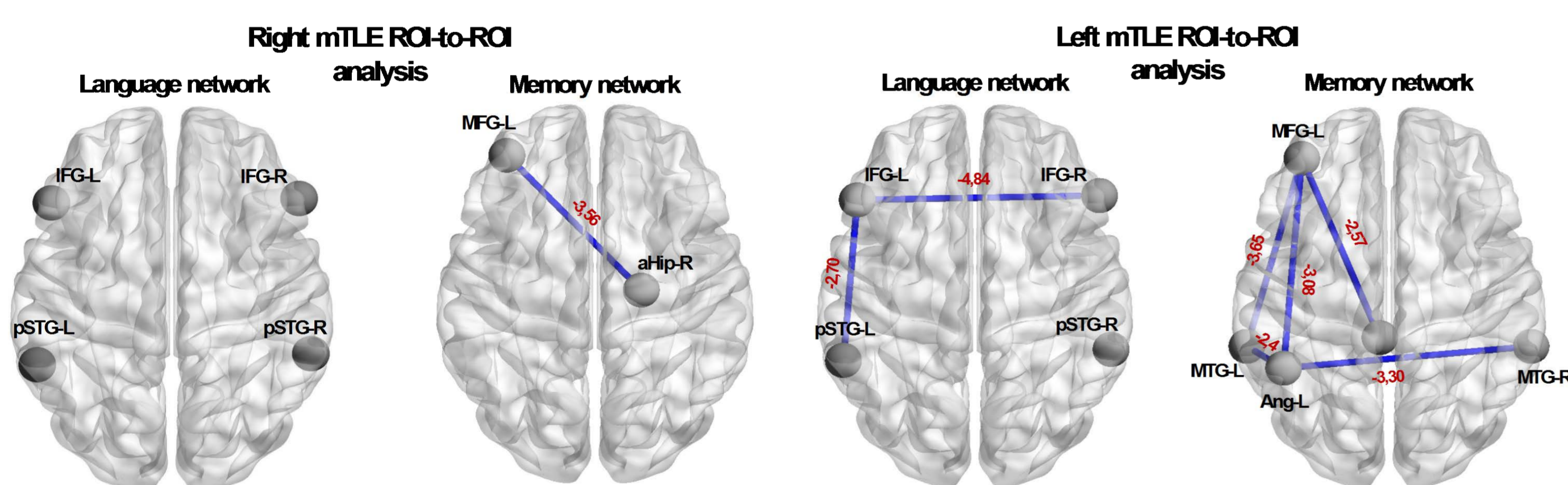


Figure 1. ROI-to-ROI analysis performed in RmTLE and LmTLE compared to healthy subjects. Results are shown on a $p < .05$ threshold corrected for multiple comparisons (FDR). Blue lines indicate a significant reduction in terms of FC between 2 specific nodes.

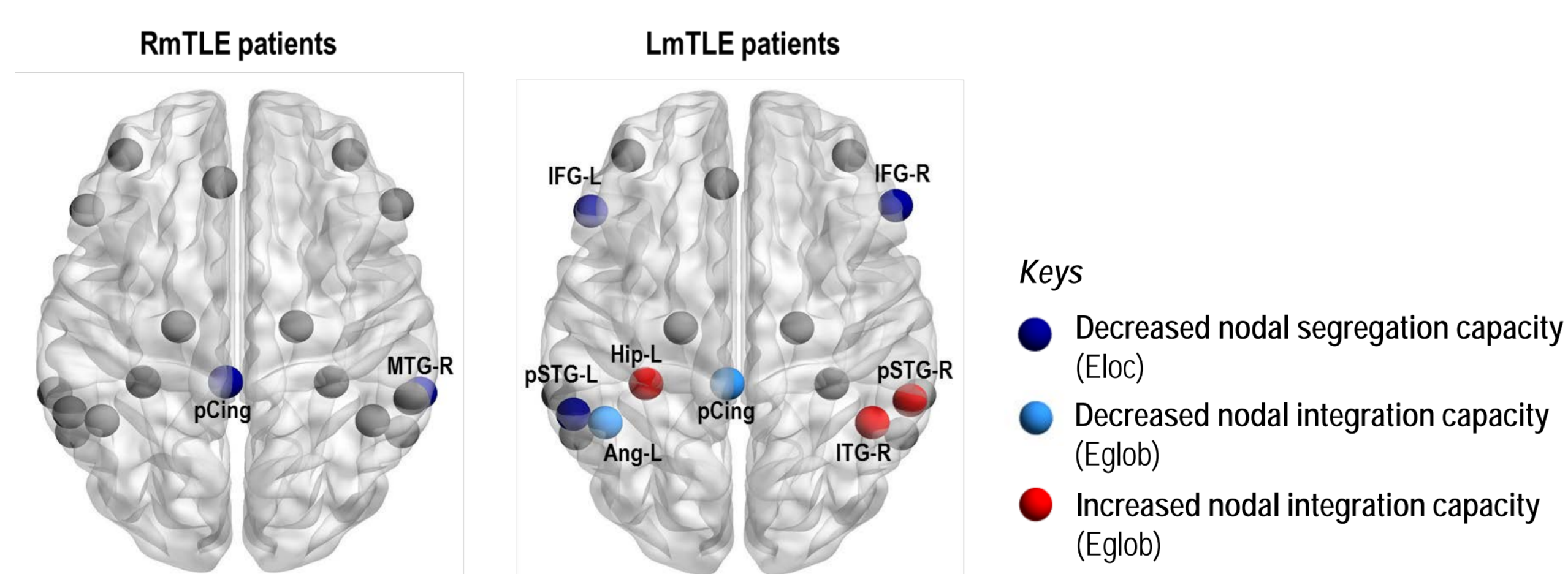


Figure 2. Graph theory analysis performed in RmTLE and LmTLE compared to healthy subjects. Results are shown on a $p < .05$ threshold corrected for multiple comparisons in a cost interval from 0,2 to 0,4.

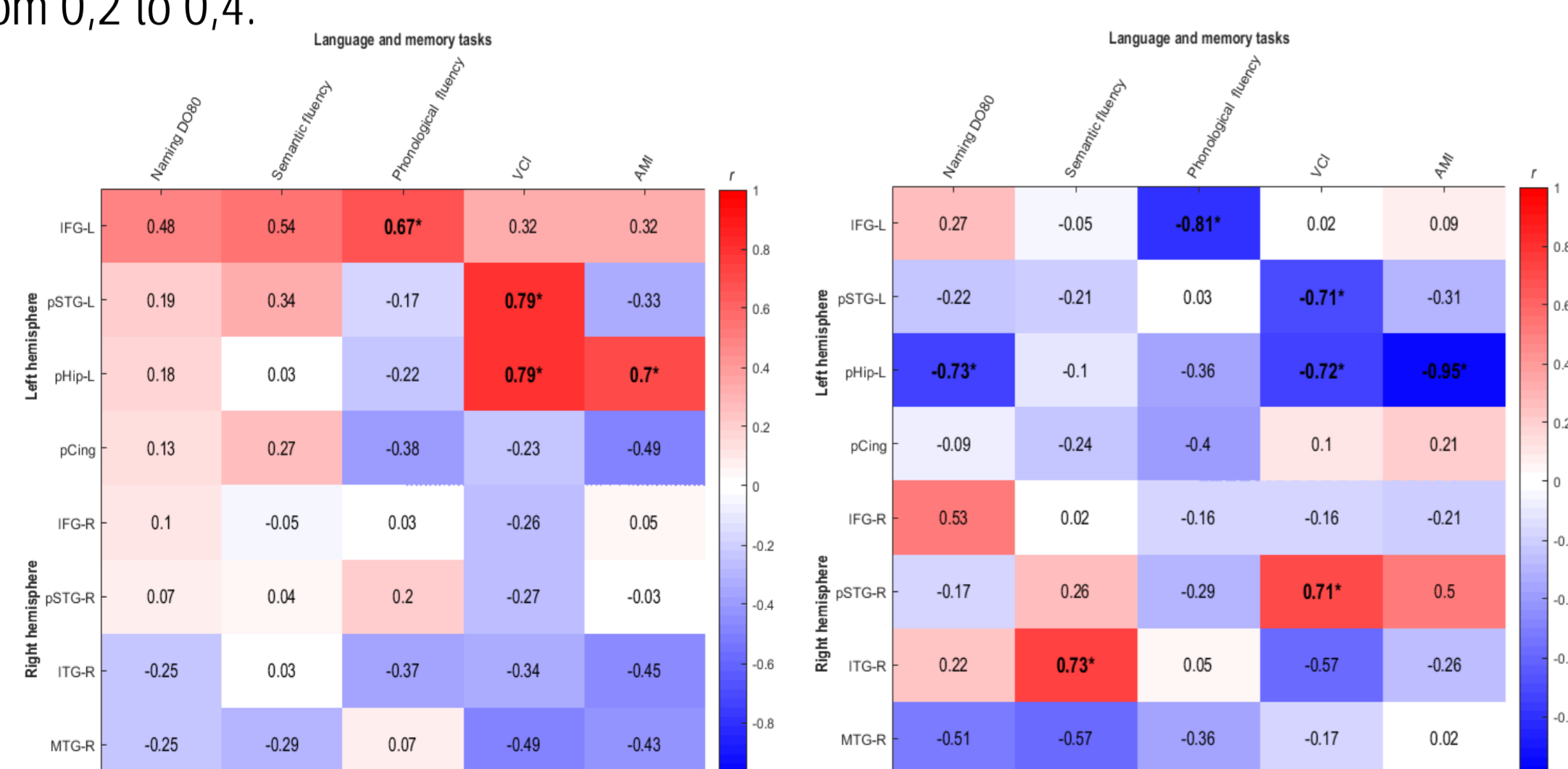


Figure 3. Heatmap of the Spearman correlations obtained between nodal graph theory parameters and language & memory standard scores. Significant correlations are shown in bold and the color gradient indicate positive (red) or negative (blue) correlations.

DISCUSSION & CONCLUSION

Main results

- (a) LMN FC is extensively modified in LmTLE patients (temporo-frontal and bilateral), compared to RmTLE (posterior-right mainly) and healthy
- (b) FC parameters correlate remarkably with cognitive scores
- (c) Hyper-connectivity (increased functional integration capacity) of certain brain regions is not necessarily efficient and can negatively correlate to LM performance (negative plasticity; eg. left hippocampus in LmTLE)

Limitations of the study

- Small sample size of patients studied due to the compromises that needs to be made between the number of patients included and the homogeneity of the pathological groups
- Other factors could have an impact on FC such as sex and age; handedness; duration or severity of the pathology (Ridley et al., 2015)
- The LMN used is an *a priori* and large macroscale subgraph containing few nodes ($n = 18$). Further study with a larger network should be carried out to confirm our results
- Clear methodological guidelines for graph theory analyzes are needed

Conclusion

These preliminary results tend to show that FC at rest is a good biomarker to understand the cognitive functioning of drug resistant TLE patients

References

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