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► To cite this version:

Rémy Ben Messaoud, Brigitte Charlotte Kaufmann, Paolo Bartolomeo, Fabrizio de Vico Fallani. Right and left hemispheres of the human brain compete for centrality. CCS2022 - Conference on Complex Systems CCS2022, Oct 2022, Palma de Majorque, Spain. hal-03997857

HAL Id: hal-03997857

<https://hal.science/hal-03997857>

Submitted on 20 Feb 2023

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Right and left hemispheres of the human brain compete for centrality

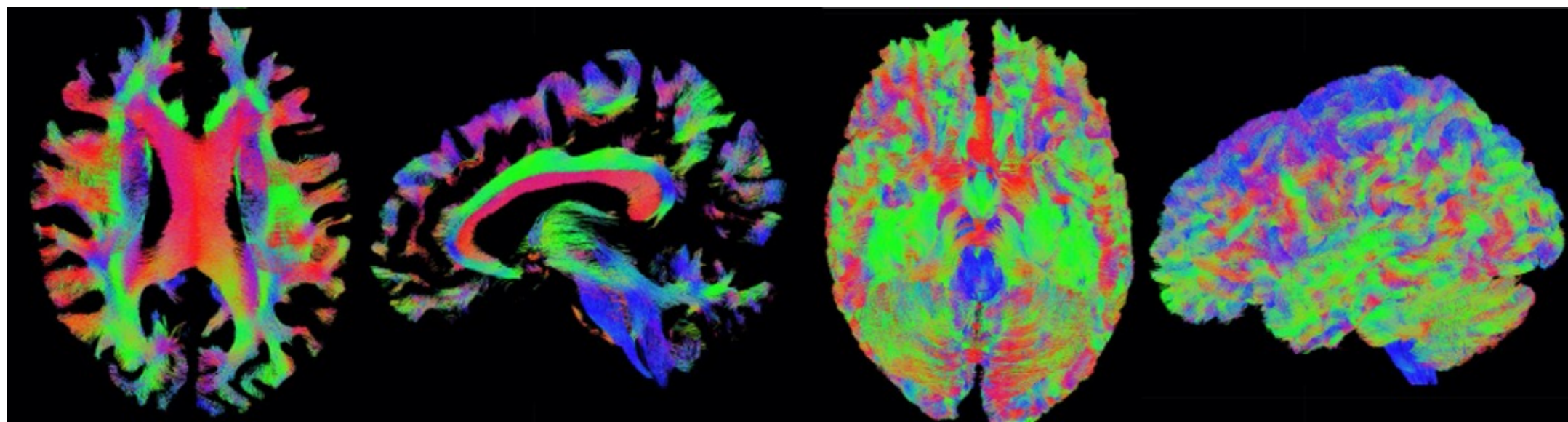
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INTRODUCTION

- The two hemispheres must cooperate efficiently but also compete for centrality in order to deal with attentional processes and to balance the cognitive load [1,2].
- Can we detect the dominance of one hemisphere over the other? And what are the network properties that contribute to it?

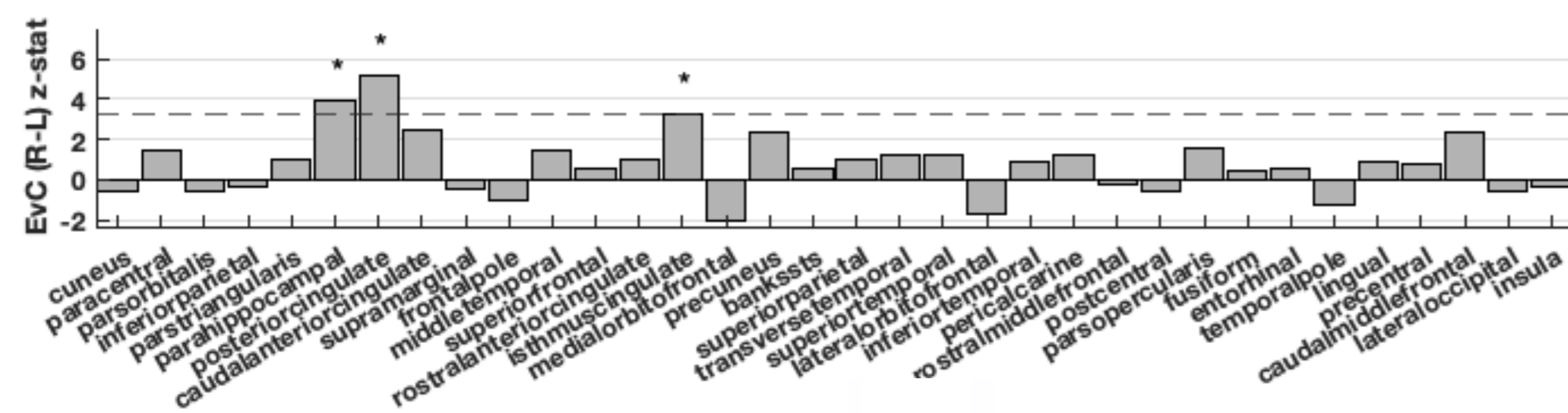
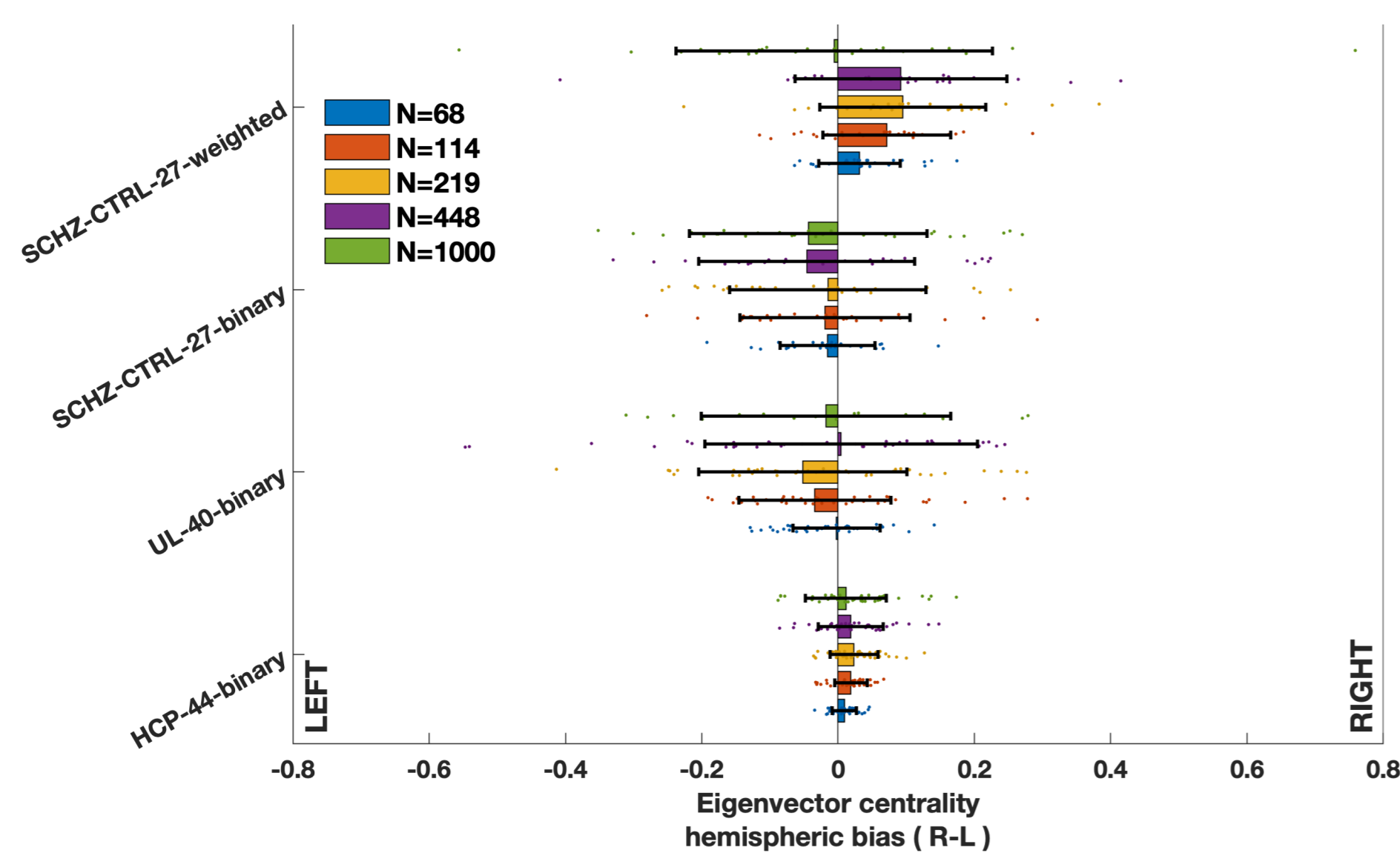


MRI tractography

RESULTS

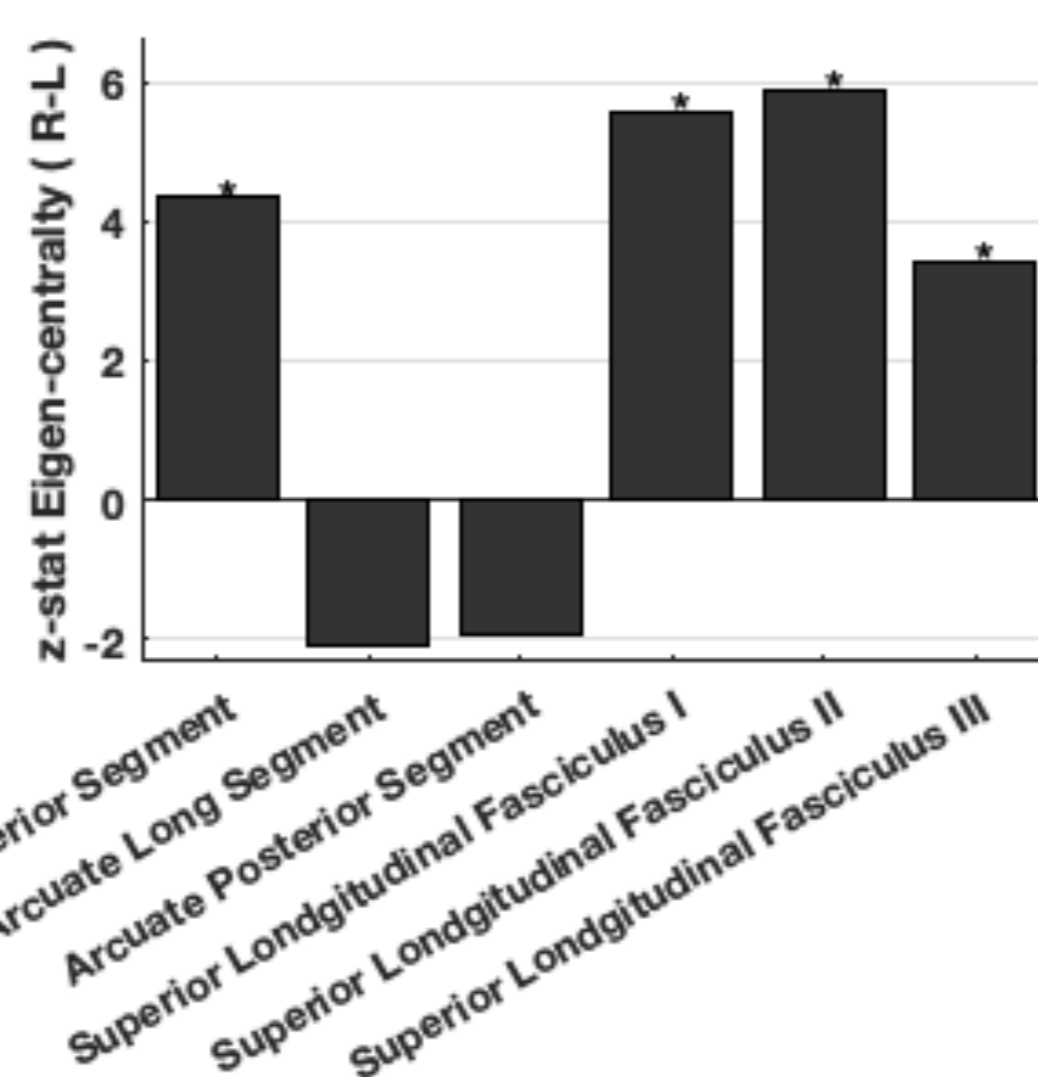
1/ Hemisphere competition across population and scales:

- There is no significant difference at the hemispheric level: only a tendency towards right dominance.
- Significant differences exist at the nodal level.



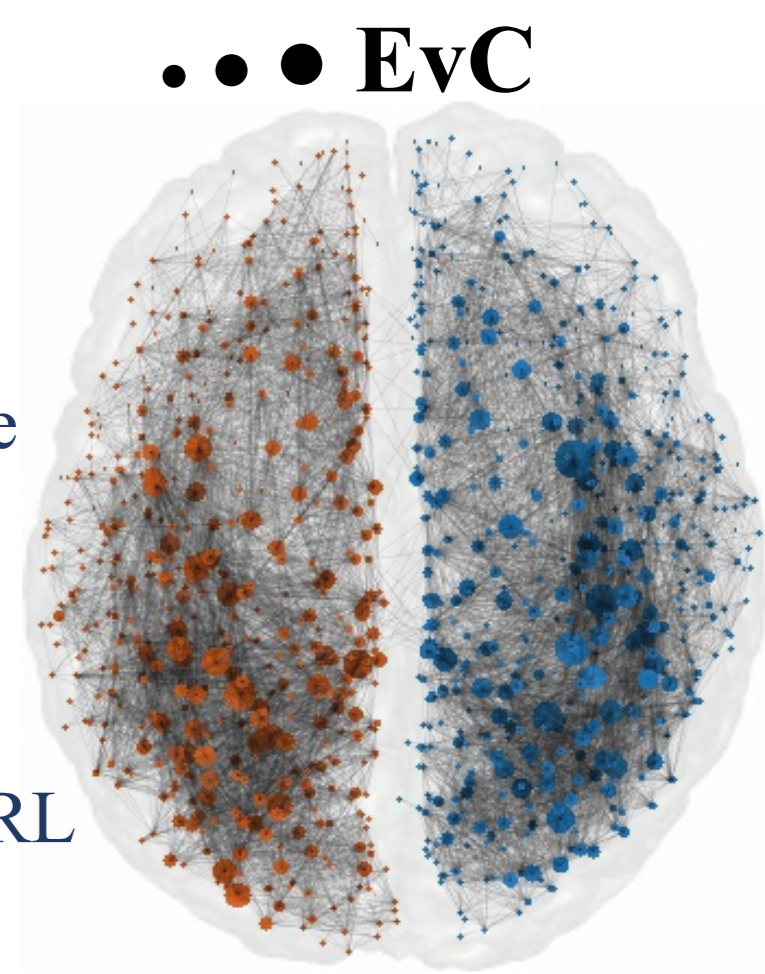
2/ Lateralization supports cognition

- The 3 most dominant regions in the right hemisphere are traversed by the Superior Longitudinal Fasciculus tracts I, II and III. These tracts are known to play an important role in the integration of information during attentional processes [1,2].
- Arcuate segments are involved in the language processing that is known to be lateralized in the left hemisphere [1,2].



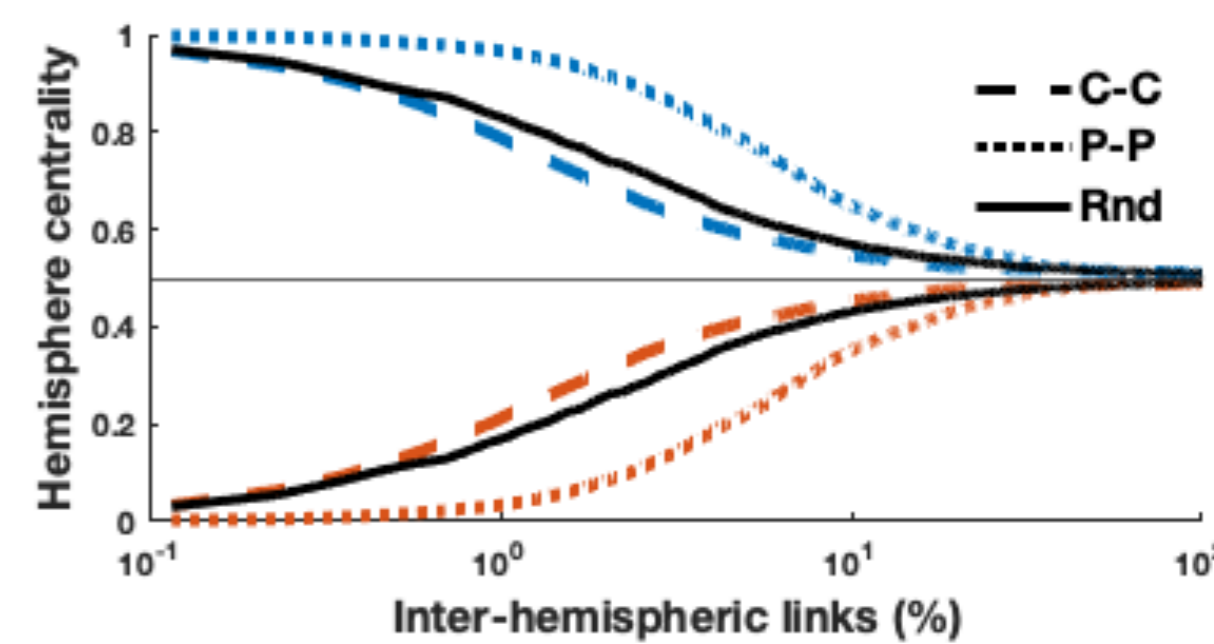
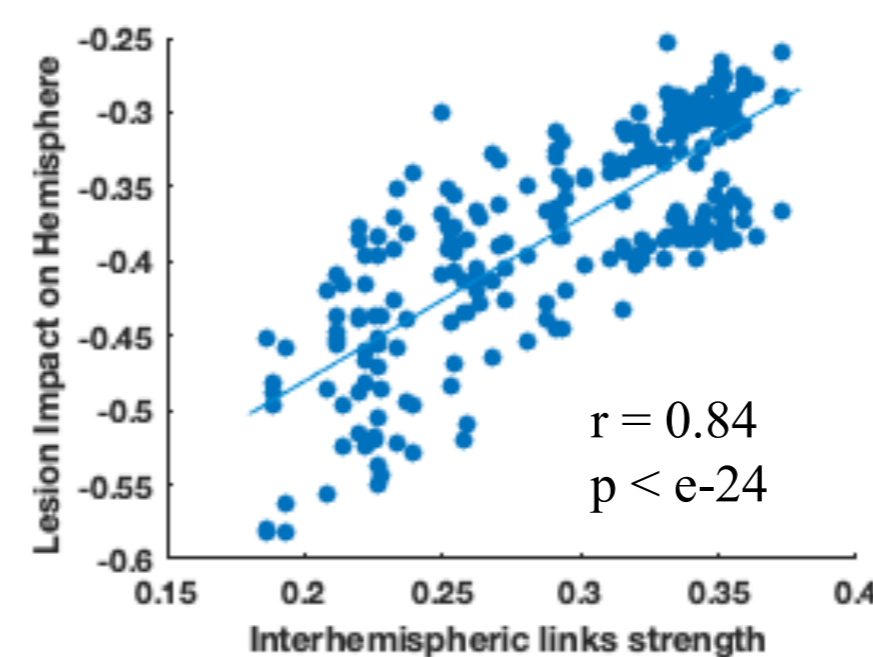
MATERIALS & METHODS

- Networks** of structural connectivity in the human brain
- Nodes** represent regions of grey matter of the Lausanne2008 atlas (symmetrical).
- Links** represent number of fibers in white matter tracts imaged by tractography.
- Dataset:** UL-HCP (binary) [3], SCHZ_CTRL 84 +27 brains, 5 scales: 68 to 1000 nodes
- Eigenvector centrality (EvC)** measures the global influence of a node and its properties are suitable for the competition framework.
- Null models** : all EvC values are normalized by averages over 100 realizations of null models for each network in order to suppress any effect not coming from the topology.



3/ Role of inter-hemispheric links: resilience and balance

- We simulated realistic strokes based on standard tracts atlas and extend node attack results of [5]. More interconnected brains are more resilient to strokes.
- After a stroke, the brain connectivity adapts. We simulated different reconnection priority strategies going from disconnected hemispheres (0%) to the biological wiring (100%). To quickly retrieve functionality of affected hemisphere and attain most balanced configurations, the brain must prioritize the reconnection of the most central nodes (C-C).



CONCLUSION

- Centrality distribution is equitable at the hemispheric level but is rather lateralized at the nodal level.
- At the mesoscale, the results support our knowledge of the localization of elementary cognitive skills such as attention and language.
- Eigenvector centrality offers a framework that can help understand stroke recovery and brain resilience mechanisms.
- Future work will imply larger and richer datasets. Notably, we hypothesize that, with enough data, we could unveil the relation between handedness and centrality lateralization in the brain.

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