Spatiotemporal characteristics of functional connectivity brain states in rest and cognitive tasks

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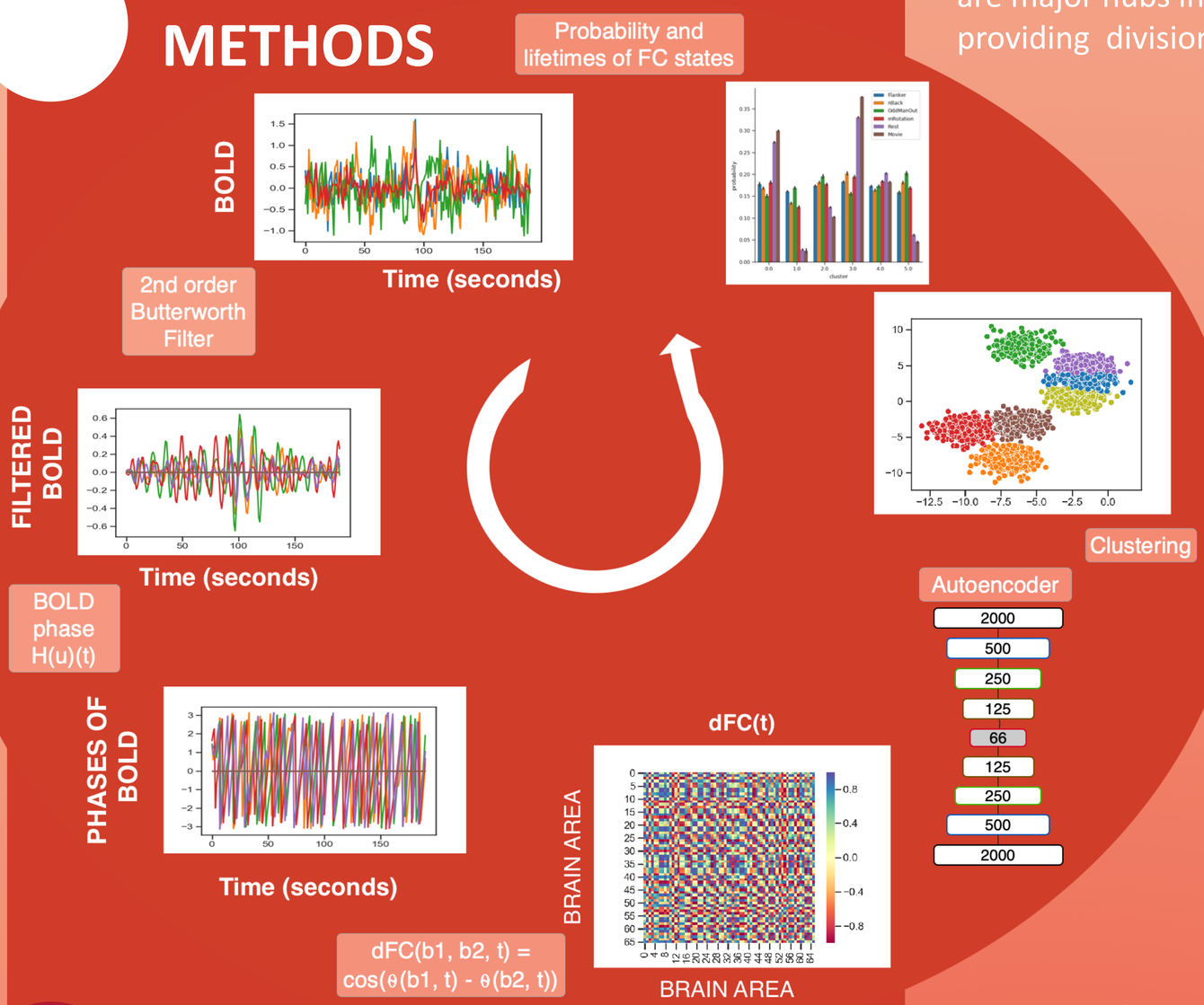
BACKGROUND

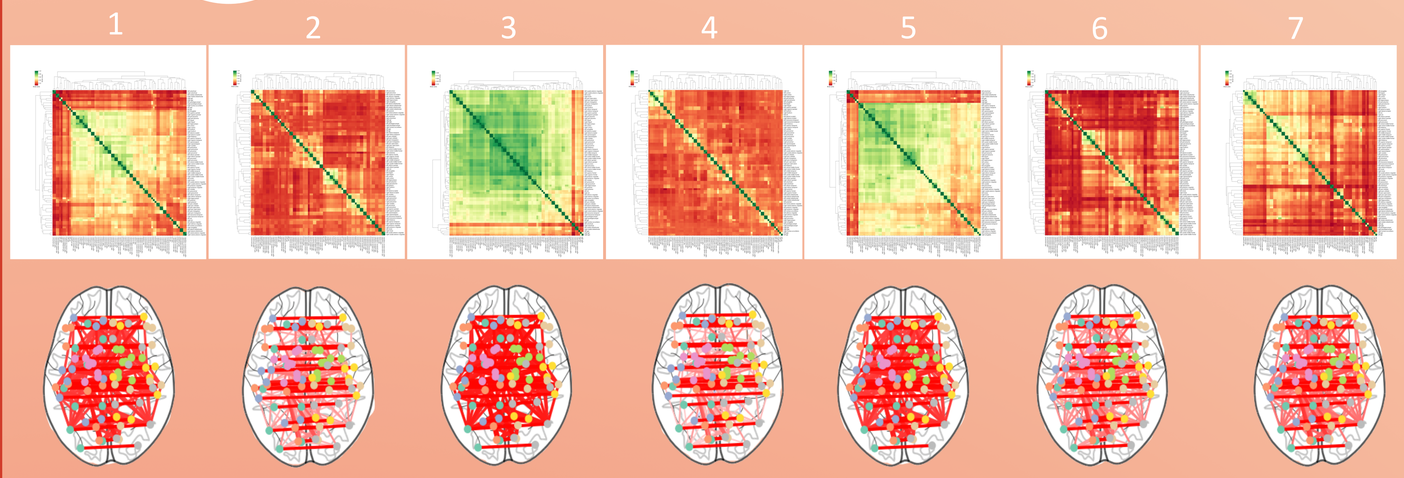
- The whole brain involves functionally connected networks (FC) in order to process information
- Previous fMRI static FC studies found significant decrease of entropy in a task evoked activity (Ponce-Alvarez et al. 2015)
- But we detected **time-resolved** FC patterns in fMRI data while in rest and during 6 different tasks (Barch et al. 2013): emotion, gambling, language, motor, social, and working memory (n = 100), DBS parcellation: 80 brain areas, TR = 0.72s.

METHODS

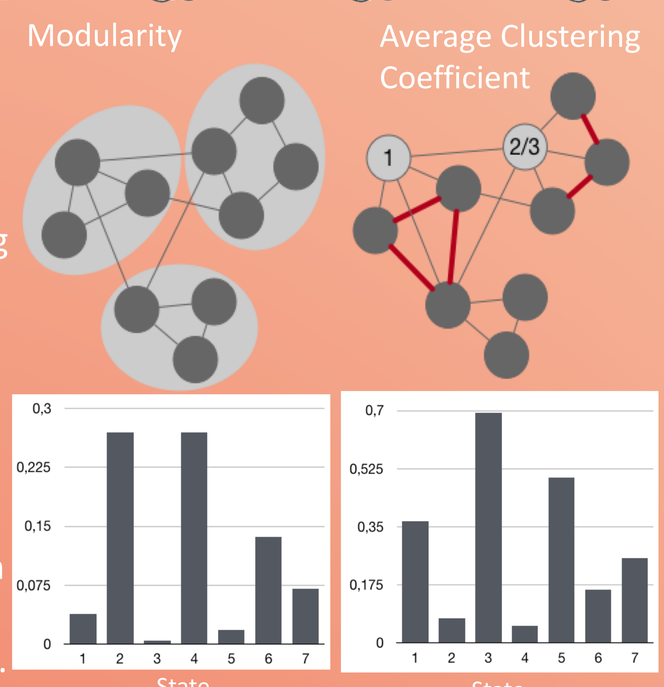


RESULTS

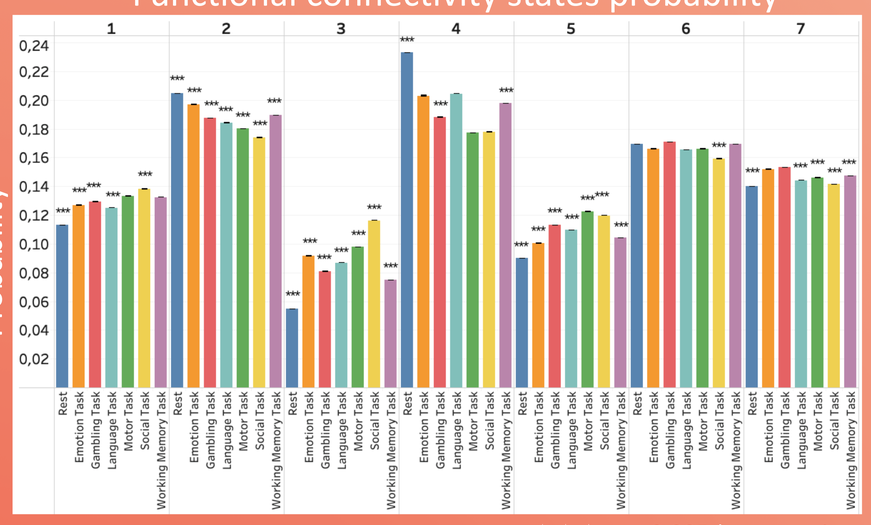
Average functional connectivity state characteristics



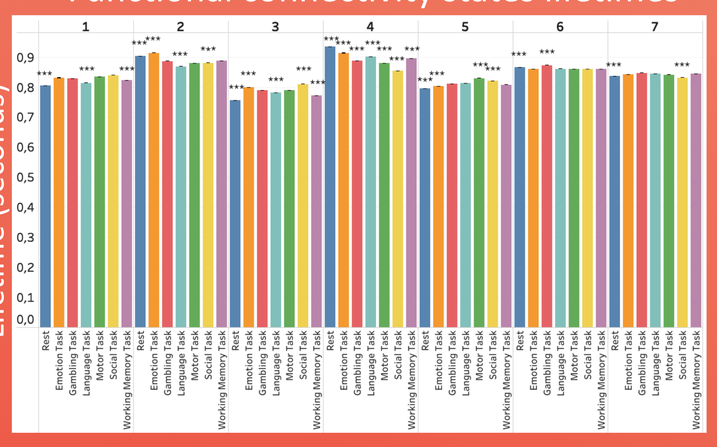
- The difference in modularity and clustering coefficient suggests that there are major hubs in disconnected states providing division into communities.
  - Low average clustering coefficient suggests that there is a lower connectivity in these communities.
  - In highly connected states there is a low community separation as local and global are both highly connected.



Functional connectivity states probability



Functional connectivity states lifetimes



- Rest condition is mostly present in state #4 representing the lowest functional connectivity and least present in the connected state #3.
- Task conditions dwell in all the states more homogenously, therefore, they are more metastable in functional connectivity states compared to rest.
- All states lifetimes are quite homogenous around 0.9 seconds.

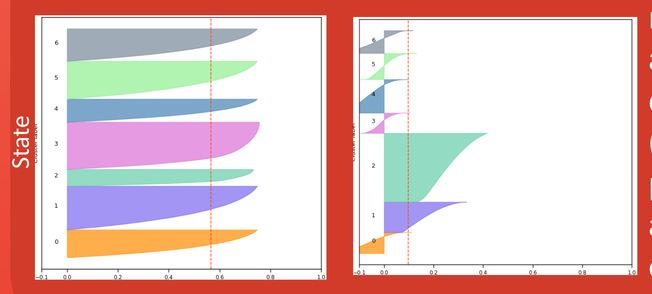
KEY FINDINGS

- Functional connectivity states are more metastable in tasks when compared to rest
- During rest most visited states are disconnected with high modularity and low average clustering coefficient.
- Short homogenous lifetimes of states indicate rapid switching.

PRO TIP

Autoencoder

Leading Eigenvector



Silhouette coefficient values in clustering are much higher with autoencoder dimensionality reduction (0,57) compared to previously used (Cabral et al. 2017) leading eigenvector decomposition (0,1)

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