Effects of sleepiness on resting-state connectivity

Thomas PERRIN – Polytechnique Montréal

BrainHack School

POLYTECHNIQUE MONTRÉAL

Background

Sleep deprivation is commonplace in modern society, but little is known about the functional mechanisms and correlates of sleepiness in the awake brain.

Sleepiness is a brain state with pervasive effects on cognitive and affective functioning (Killgore, 2010, Tamm et al., 2020).

Adult functional neuroimaging (fMRI) studies have demonstrated associations between restricted sleep and amygdala-prefrontal functional connectivity (Reidy et al., 2016), with inhibition of top-down-control in emotion (Tamm et al., 2020).

Therefore, it would be interesting to predict whether a participant is sleep depried or not based on a functional connectivity estimation.

Main Question

Does sleep deprivation affect resting-state functional connectivity?

Can resting-state functional connectivity predict sleep deprivation?

Data:

- Data used: **Resting state fMRI from the Stockholm Sleepy Brain Study**: Effects of Sleep Deprivation on Cognitive and Emotional Processing in Young and Old. A functional brain imaging study where 86 healthy participants underwent MRI after normal sleep and partial sleep deprivation (only 3 hours of sleep) in a crossover design. Three experiments were performed investigating emotional mimicry, empathy for pain, and cognitive reappraisal, as well as resting state fMRI.
- Fit with the research question: This study aimed to investigate the effects of partial sleep deprivation (PSD) on **resting state brain connectivity**, emotional contagion, empathy, and emotional regulation.
- Obtained from: **OpenNeuro**, the full dataset is multimodal (T1- and T2-weighted structural images, diffusion images, raw polysomnography data, task-based and resting state fMRI images).

Tools & Methods

- Git and GitHub for project management
- DataLad for retrieval and version control of data
- BIDS-validator to check updated dataset integrity
- FMRIPrep for data preprocessing
- Python for
  - neuroimaging machine learning (PyBIDS, nilearn, sklearn, etc.)
  - visualization (matplotlib, seaborn, etc.)

Objectives

- Familiarize myself with neuroimaging data organization and open science practices
- Build a machine learning model to see if sleep deprivation can be predicted from resting-state functional connectivity
- Visualize and compare functional connectomes of resting-state networks

Deliverables

- A GitHub repository containing all the elements of the project
- A markdown file for the project description
- Bash code for fMRI preprocessing
- A requirements.txt file to specify the Python environment
- Python scripts for machine learning and visualization

References

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