

Effects of sleepiness on resting-state connectivity

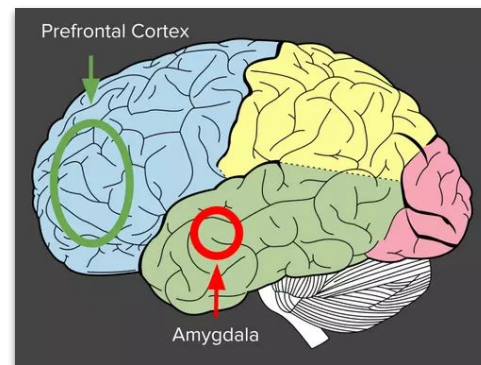
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BrainHack
School

Background

- Sleep deprivation is commonplace in society
- Sleepiness has effects on cognitive and affective functioning:
 - Associations with amygdala-prefrontal functional connectivity
 - Inhibition of top-down-control in emotion
- Further analysis on functional connectivity



Objectives

- Familiarize myself with neuroimaging data organization and open science practices
- Learn reproducible neuroimaging workflow from data access to visualization
- Visualize and compare functional connectomes of resting-state networks
- Create a pipeline to prepare the dataset for machine learning

Data

- What? Resting state fMRI from the Stockholm Sleepy Brain Study: Effects of Sleep Deprivation on Cognitive and Emotional Processing in Young and Old.
2 sessions/subject (normal sleep vs. sleep deprived)
- Why? Investigation on the effects of partial sleep deprivation (PSD) on resting state brain connectivity.
- Where? OpenNeuro



Tools & Methods

- Git and GitHub for project management
- DataLad for retrieval and version control of data
- BIDS-validator to check updated dataset integrity
- Neurodesk for a computing environment in browser
- fMRIPrep for data preprocessing
- Python for preparation and analysis (Nilearn)



Results - BIDS-compliant dataset

Before

ds000201

Summary

- 3254 Files, 14.65MB
- 86 - Subjects
- 2 - Sessions

Available Tasks

- Faces
- Sleepiness
- Arrows
- Hands
- Resting State
- PVT
- Working Memory Test

Available Modalities

- MRI

Your dataset is not a valid BIDS dataset.

view 5 errors in 5403 files

Error 1: [Code 55] JSON_SCHEMA_VALIDATION_ERROR

Invalid JSON file. The file is not formatted according to the schema.

659 files

Error 2: [Code 22] TSV_EQUAL_ROWS

All rows must have the same number of columns as there are headers.

171 files

Error 3: [Code 23] TSV_EMPTY_CELL

Empty cell in TSV file detected. The proper way of labeling missing values is "na".

171 files

Error 4: [Code 90] SIDECAR_WITHOUT_DATAFILE

A json sidecar file was found without a corresponding data file

1827 files

Error 5: [Code 129] SCANS_FILENAME_NOT_MATCH_DATASET

The filename in scans.tsv file does not match what is present in the BIDS dataset.

2575 files

view 3 warnings in 2315 files

After

BIDS Validator v1.11.0

Select a BIDS dataset to validate

Browse...

No directory selected.

Options:

☐ Ignore Warnings

☒ Ignore NIFTI Headers

☐ Skip Subject Filename Consistency Check

Note: Selecting a dataset only performs validation. Files are never uploaded.

input

Summary

- 3254 Files, 14.6MB
- 86 - Subjects
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Your dataset is not a valid BIDS dataset.

view 2 errors in 3611 files

view 3 warnings in 2315 files

Download error log for input

Click to view details on [BIDS specification](#)

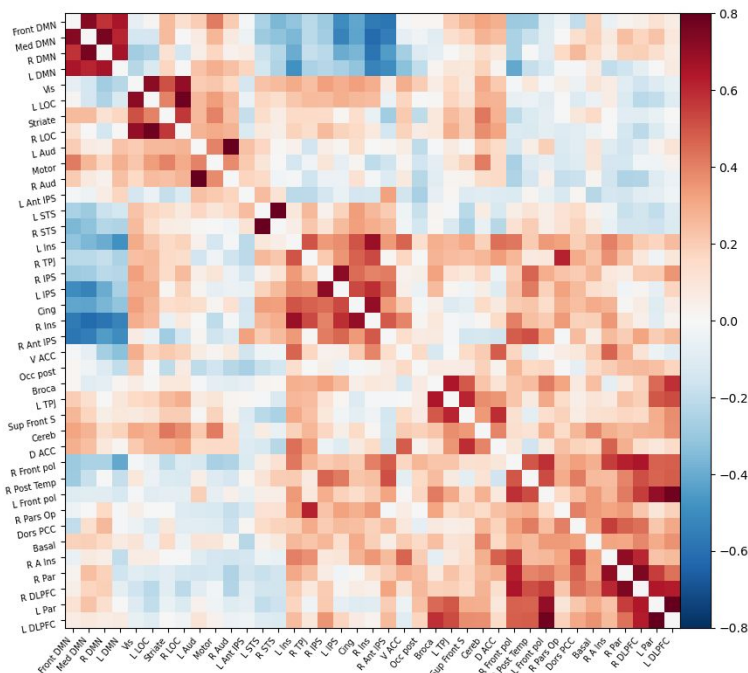
If you have any questions please post on [Neurostars](#)

The source code for the validator can be found [here](#)

Last 2 errors due to DataLad

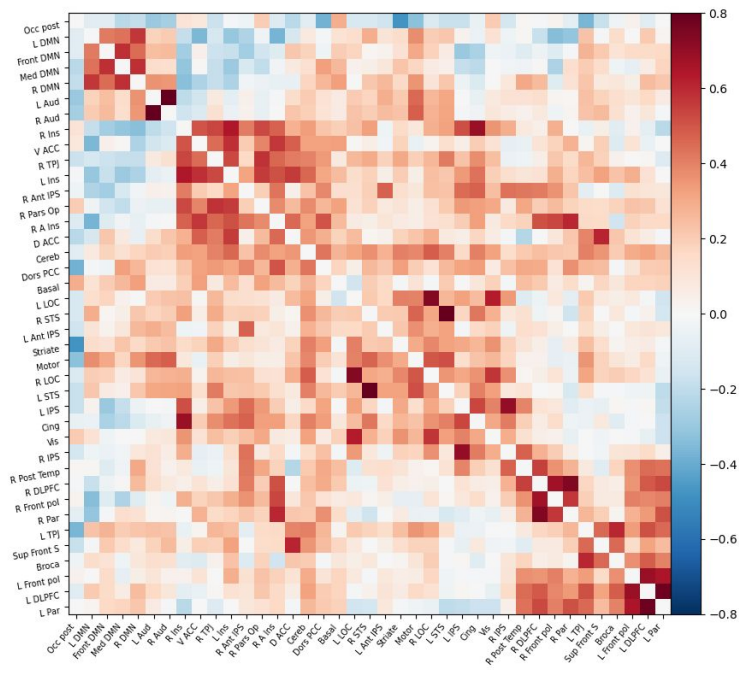
Results - Correlation matrix

Normal sleep



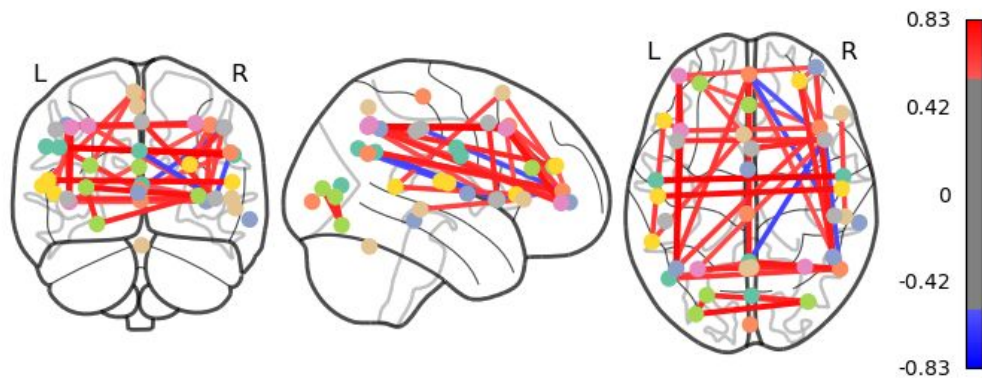
MSDL brain Probabilistic atlas

Sleep deprived

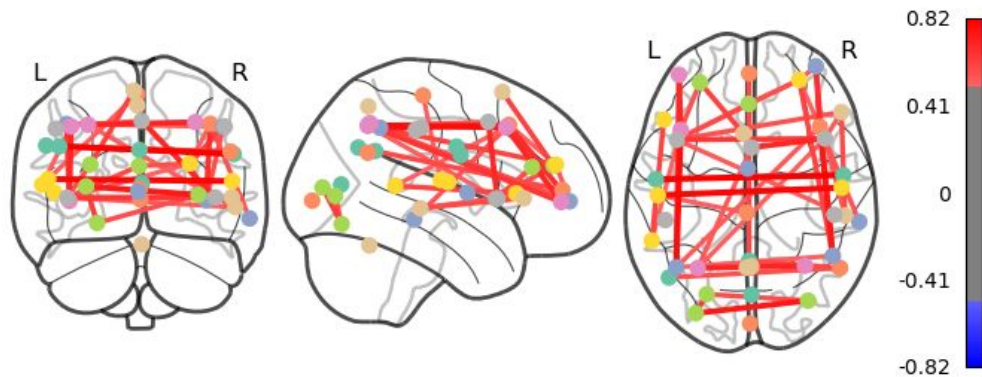


Results - Connectome

- Normal sleep



- Sleep-deprived



5% of edges with the highest value

Results - What I have learned

- Using version control (Git, GitHub and DataLad)
- Installing the software on different OS (Ubuntu and Windows with WSL)
- Sharing my work (with myself) to work on multiple computers
- BIDS organization
- Neuroimaging pipeline: management → preprocessing → preparation

⇒ Open-science best practices

Deliverables

- GitHub repository containing all the elements of the project
- Markdown file for the project description
- Python script to update dataset to BIDS
- Bash code for Datalad and fMRI preprocessing
- Jupyter Notebook for visualization

Conclusion

- Challenges encountered
 - Balance research and implementation
 - Limitations in software installation
- Solutions
 - Use cases are helpful
 - Using NeuroDesk



References

- Killgore WD. Effects of sleep deprivation on cognition. *Prog Brain Res*. 2010;185:105-29. doi: 10.1016/B978-0-444-53702-7.00007-5. PMID: 21075236.
- Reidy BL, Hamann S, Inman C, Johnson KC, Brennan PA. Decreased sleep duration is associated with increased fMRI responses to emotional faces in children. *Neuropsychologia*. 2016 Apr;84:54-62. doi: 10.1016/j.neuropsychologia.2016.01.028. Epub 2016 Jan 25. PMID: 26821063.
- Gustav Nilssonne and Sandra Tamm and Paolo d'Onofrio and Hanna Å Thuné and Johanna Schwarz and Catharina Lavebratt and Jia Jia Liu and Kristoffer NT Månsson and Tina Sundelin and John Axelsson and Peter Fransson and Göran Kecklund and Håkan Fischer and Mats Lekander and Torbjörn Åkerstedt (2020). The Stockholm Sleepy Brain Study: Effects of Sleep Deprivation on Cognitive and Emotional Processing in Young and Old. *OpenNeuro*. [Dataset] doi: 10.18112/openneuro.ds000201.v1.0.3
- Tamm S, Schwarz J, Thuné H, Kecklund G, Petrovic P, Åkerstedt T, Fischer H, Lekander M, Nilssonne G. A combined fMRI and EMG study of emotional contagion following partial sleep deprivation in young and older humans. *Sci Rep*. 2020 Oct 21;10(1):17944. doi: 10.1038/s41598-020-74489-9. PMID: 33087746; PMCID: PMC7578048.
- Dimitrijevic A, Exploratory Work on the Predictive Clinical Neuroscience (PCN) Toolkit, BrainHackCloud_steps, https://github.com/brainhack-school2022/dimitrijevic_project.git