Session 1: Hands-on exercise: Basics of fMRI preprocessing

Dr. Elena Galeano Weber

e.galeano-weber@dipf.de

Education and Human Development & Individualized Learning Laboratory, DIPF | Leibniz Institute for Research and Information in Education

Basics of MRI and preprocessing. Hands-on exercises.

Let's explore the raw datasets.
~/<workshop_folder>/<dataset-folder>/BIDS/

e.g. /Users/lena/Documents/Lena/Lehre/fMRI/fmri_analysis_intro-main/fMRI_data/process-specific/BIDS

Things to look for:

- Can you locate anatomical and functional files? Are there any other files the data folders contain?
- Can you see individual voxels? Can you see the value of each voxel?
- Can you see the difference between anatomical and functional images?
- Can you see the different volumes? Do you notice anything odd when browsing through the volumes?

Group Activity: Dataset Studies

1. Form 3 groups

Each group reads one of the following papers:

1. Verstynen et al. (2014) – "Process": Predict future behavior
2. Peacock & Postle (2008) – "Content": WM and LTM
3. Kay et al. (2019) – "Spatial": Ultra-high-res fMRI

2. Work together to summarize the paper, covering:

- Introduction – What question does the study address?
- Methods – How was the research conducted?
- Results – What were the main findings?
- Discussion – What do the findings mean? What are the implications or open questions?

3. Present your summary to the class (approx. 5–7 minutes per group)

💬 Tip: Focus on clarity, key insights, and takeaways

Recap: The Datasets

- All information on the seminar can be found at the following Github repository: https://github.com/lenagaleano/fMRI-method

- The datasets can be downloaded from the following links. The total file size is ~17GB so make sure you have a stable connection and enough time. Pull the data from OpenNeuro:

Content-3t dataset
- Data at: https://openneuro.org/datasets/ds001497/versions/1.0.2
- Original publication at: https://www.jneurosci.org/content/28/35/8765.short

Process-specific dataset
- Data at: https://openneuro.org/datasets/ds000164/versions/00001
- Publication at: https://pubmed.ncbi.nlm.nih.gov/25143543/

Recap: The Preprocessed Data

Data needed:

Know my repository: https://github.com/lenagaleano/fMRI-method

All the steps involved in preprocessing take a while to complete (up to several hours sometimes!)

All the images have been already preprocessed with fMRIPrep. You can find them under here:

https://cloud.educs-hosting.net/s/PE2gKNKqRPJLGgx

Content-specific Dataset

An example of how to investigate brain activity related to the processing
of different domains (faces, places, body-parts)

Behavioral/Systems/Cognitive

Temporary Activation of Long-Term Memory Supports Working Memory

Jarrod A. Lewis-Peacock and Bradley R. Postle

Department of Psychology, University of Wisconsin–Madison, Madison, Wisconsin 53706

Process-specific Dataset

This dataset allows to look at brain activity during a Stroop task and to identify brain regions underlying processing of congruent vs incongruent infomation

The organization and dynamics of corticostriatal pathways link the medial orbitofrontal cortex to future behavioral responses

Timothy D Verstynen [1]

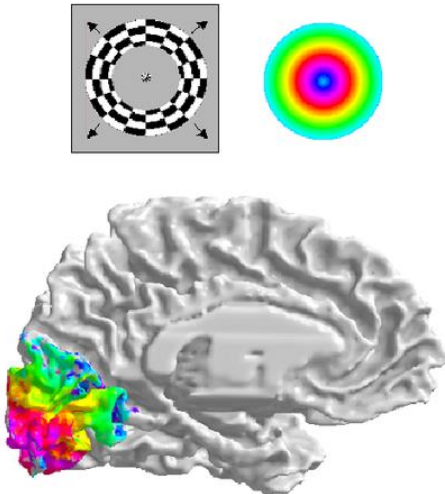Affiliations + expand

- Stroop-Effekt -

Conditions:

Congruent
Incongruent
Neutral

RED GREEN
CHAIR DOG

Spatial Dataset

Since the visual cortex is retinotopically organized, we can map participants' visual field to specific parts of the occipital lobe.

A critical assessment of data quality and venous effects in sub-millimeter fMRI

Kendrick Kay [a] [⊠], Keith W. Jamison [a, 1], Luca Vizioli [a], Ruyuan Zhang [a], Eshed Margalit [b], Kamil Ugurbil [a]

Intro to the basics of itk-SNAP

https://www.youtube.com/watch?v=-tjVN5GwjKg&t=44s

Basics of MRI and preprocessing. Hands-on exercises.

Let's explore the raw datasets.

~/<workshop_folder>/<dataset-folder>/BIDS/

e.g. /Users/lena/Documents/Lena/Lehre/fMRI/fmri_analysis_intro-main/fMRI_data/process-specific/BIDS

Things to look for:

- Can you locate anatomical and functional files? Are there any other files the data folders contain?
- Can you see individual voxels? Can you see the value of each voxel?
- Can you see the difference between anatomical and functional images?
- Can you see the different volumes? Do you notice anything odd when browsing through the volumes?

Basics of MRI and preprocessing.
Hands-on exercises.

Dataset description: Fill in this table.

Dataset	N participants	runs	n_vols functional	resolution anatomicals	n_slices	task
Spatial mapping						
Content-specific						
Process-specific						

Basics of MRI and preprocessing. Hands-on exercises.

Preprocessing. Many of the steps involved in preprocessing take a long time to compute. The data are already preprocessed for you in fMRIPrep. Luckily, fMRIPrep outputs very nice interactive plots with the outputs of the process. Let's explore them!
~/<workshop_folder>/<dataset-folder>/preproc_data/.

Things to look for:
- Can you locate *.html files?
- Can you see the distortion correction?
- Can you see the anatomical-functional registration?
- Compare raw vs preprocessed T1w. Do you see any differences?