



## Abstract

Neuroimaging techniques such as MRI, fMRI, EEG, DTI, and PET are widely used in neuroscience and clinical research to understand the brain's connectivity, function, dynamics, anatomy, and pathology. However, it is necessary to preprocess and denoise the imaging data before analyzing it. In this study, we utilize the fMRIPrep pipeline to preprocess CogNIT structural MRI and resting state functional MRI with FSL, AFNI, FreeSurfer, and ANTs on UNC Longleaf. The fMRIPrep BOLD pipeline is then compared with the CONN toolbox's BOLD denoising pipeline concerning the detailed steps. In addition, we display one of our preprocessed subjects using the fMRIPrep pipeline and the functional connectivity values distribution before and after applying CONN toolbox's denoising pipeline. Our results highlight the importance of carefully designing the pipeline and preprocessing neuroimaging data to ensure the accuracy and reliability of further analyses.

## Worksite

**UNC Neurocognition and Imaging Research Lab (NIRL)** is part of UNC Department of Psychiatry and UNC School of Medicine.

### Mission

- To study the mechanisms of severe neuropsychiatric disorders by developing designs and experiments to examine brain functions using neuroimaging tools combined with clinical and cognitive assessments
- To educate and train next-generation researchers

### Research

- NIRL is interested in examining the functional anatomy of attention and information selection in the healthy human brain, and how these neural circuits breakdown in schizophrenia and other neurodevelopmental disorders

## fMRI Data Preprocessing & Denoising

### CogNIT Dataset

- Age Range: 9-16 years old
- Data Types: T1w & T2w images, DTI, resting-state fMRI, task-based fMRI (including all task sequences)
- Baseline Visit Data Collection

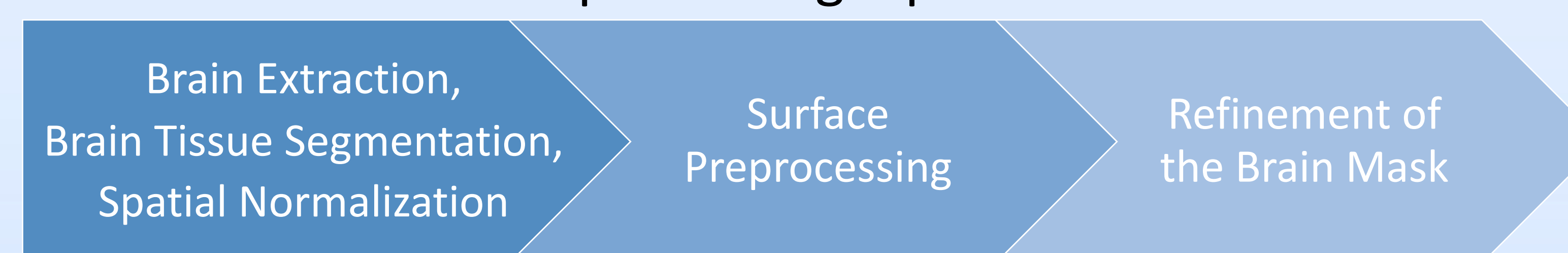
Anatomical Scan (7 min) → Resting State (6 min) → CIGAL Task-Based (3.5 min × 3)

3 Runs of the Montreal Imaging Stress Task (6 min × 3)

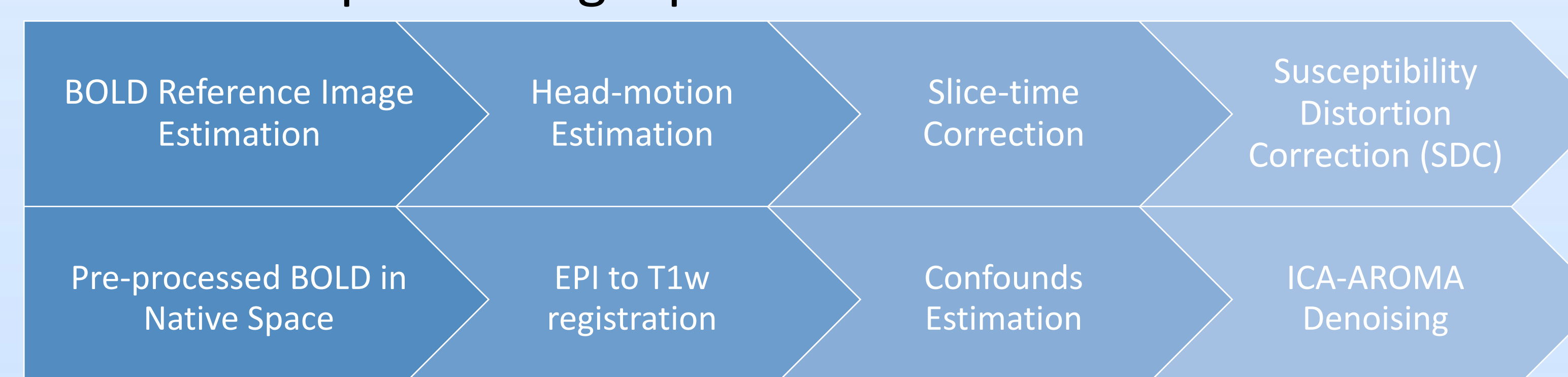
Resting State (6 min) → CIGAL Task-Based (3.5 min × 3) → DTI (9.5 min)

### fMRIPrep Preprocessing Pipeline

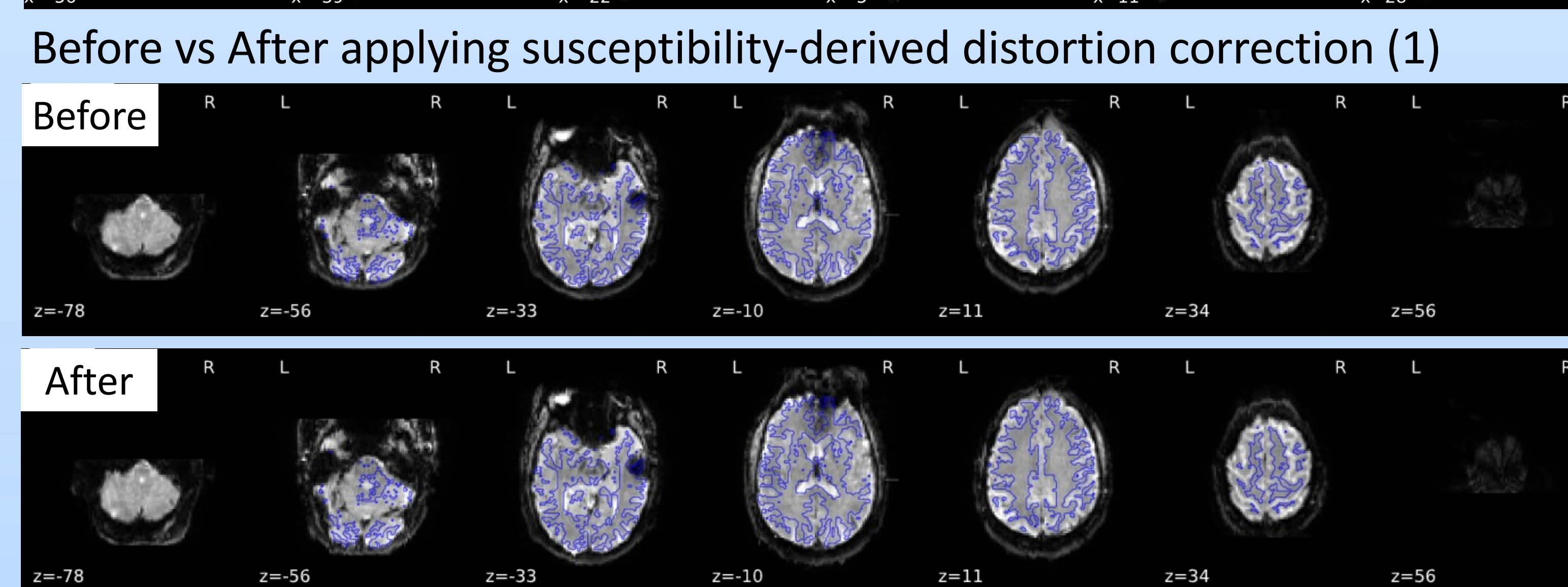
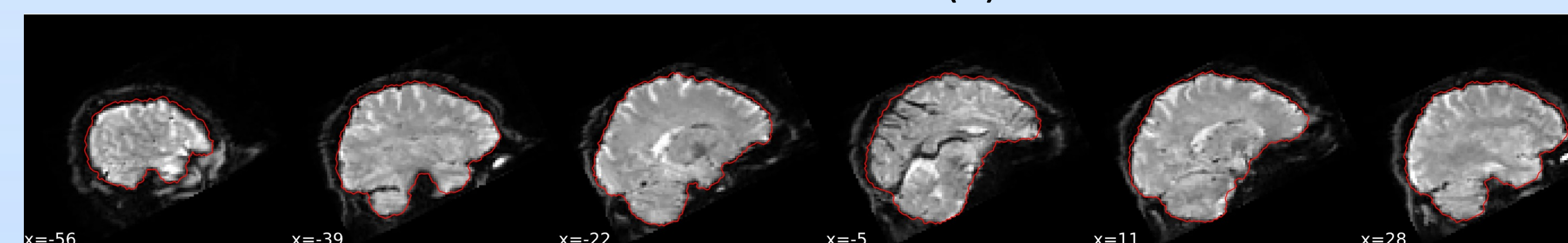
- Input: BIDS format, at least one T1w structural image, BOLD series
- Output: derivatives ready for analysis and visual quality assessment report for each subject
- Structural Data Preprocessing Pipeline



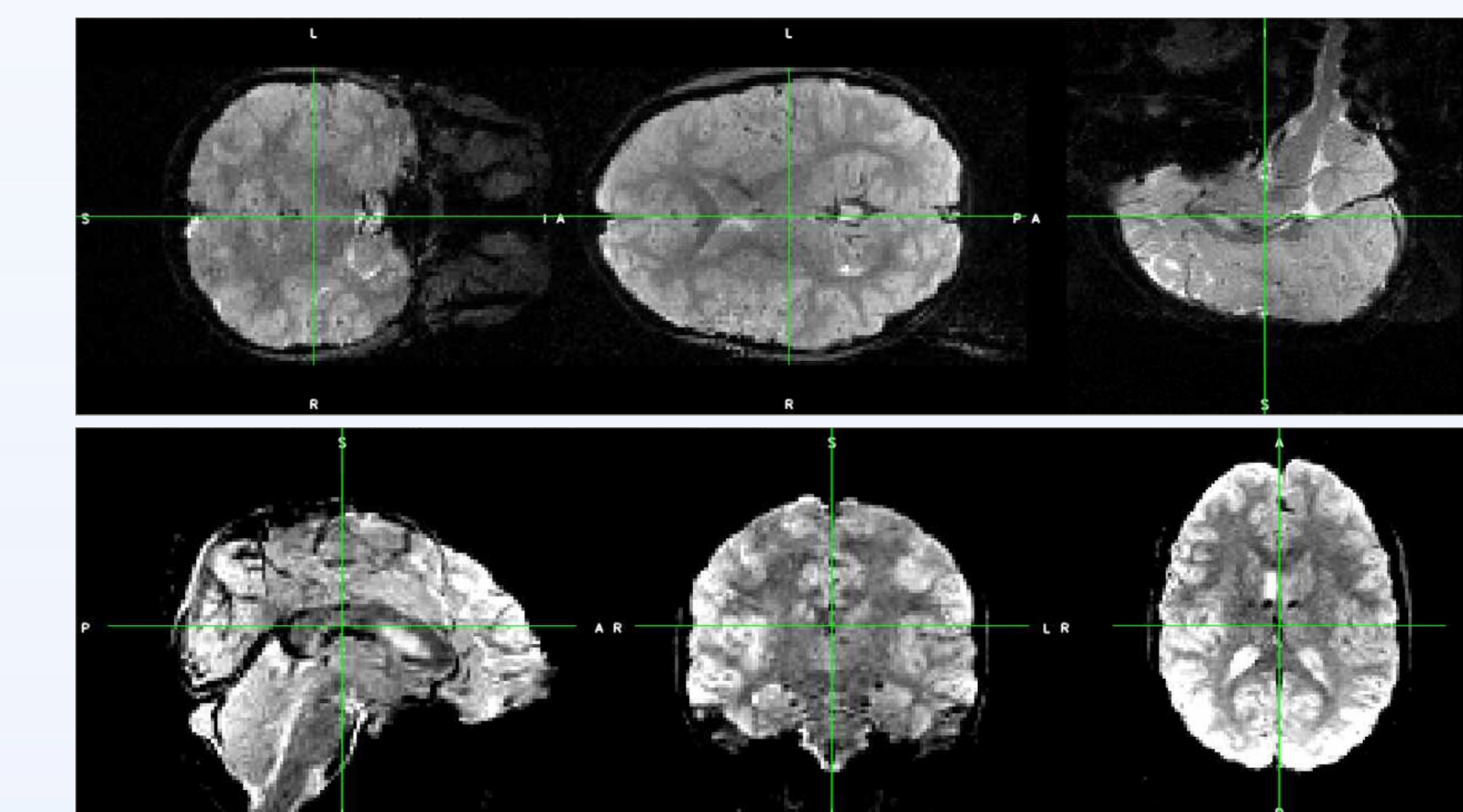
### BOLD Preprocessing Pipeline



Calculation of a brain mask from BOLD series (1)



- Our data (sub-cnt166\_rsfMRI\_PreStress)



Before  
Preprocessing

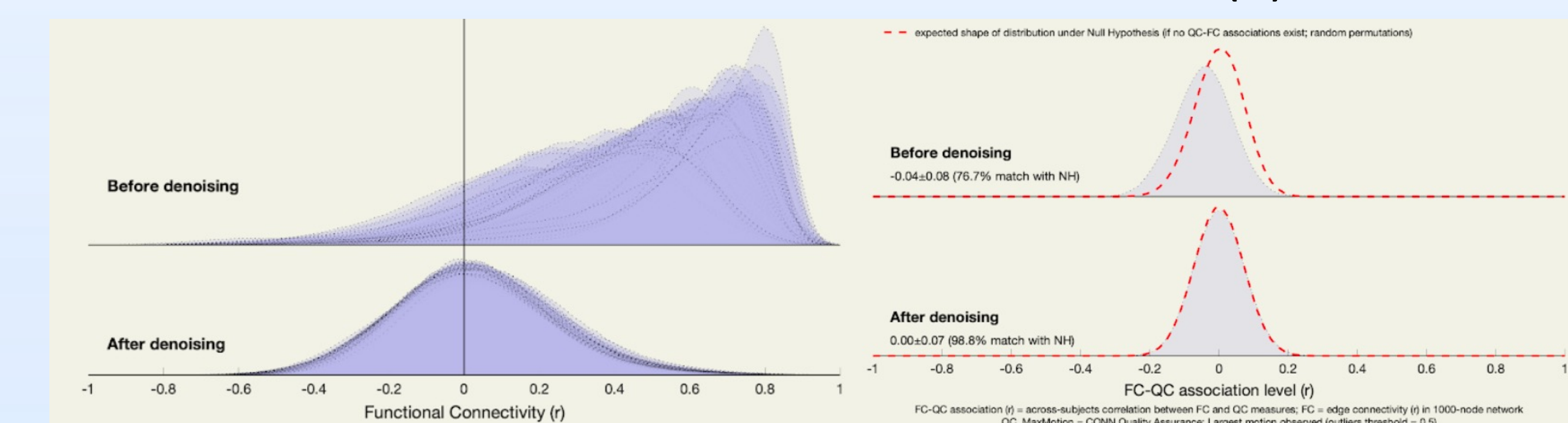
After  
Preprocessing

### CONN Toolbox Denoising Pipeline

- Input: preprocessed data
- Output: denoised data
- fMRI Denoising Pipeline



Distributions of FC Values and QC-FC Associations (2)



## Skills Development

### Softwares & Packages Use

- MATLAB
- FSL, AFNI, FreeSurfer, ANTs

### Programming

- Debugged shell scripts to preprocess data with fMRIPrep
- Wrote MATLAB scripts to denoise data with CONN Toolbox

## Acknowledgement

- Esteban, O., Markiewicz, C. J., Blair, R. W., Moodie, C. A., Isik, A. I., Erramuzpe, A., Kent, J. D., Goncalves, M., DuPre, E., Snyder, M., Oya, H., Ghosh, S. S., Wright, J., Durnez, J., Poldrack, R. A., & Gorgolewski, K. J. (2019). fMRIPrep: a robust preprocessing pipeline for functional MRI. *Nature Methods*, 16(1), 111–116. <https://doi.org/10.1038/s41592-018-0235-4>
  - Nieto-Castanon, A. (2020). Handbook of functional connectivity Magnetic Resonance Imaging methods in CONN. Boston, MA: Hilbert Press
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