# FMRI Quality Control with AFNI : Frontiers Project Topic

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NIH National Institute of Mental Health

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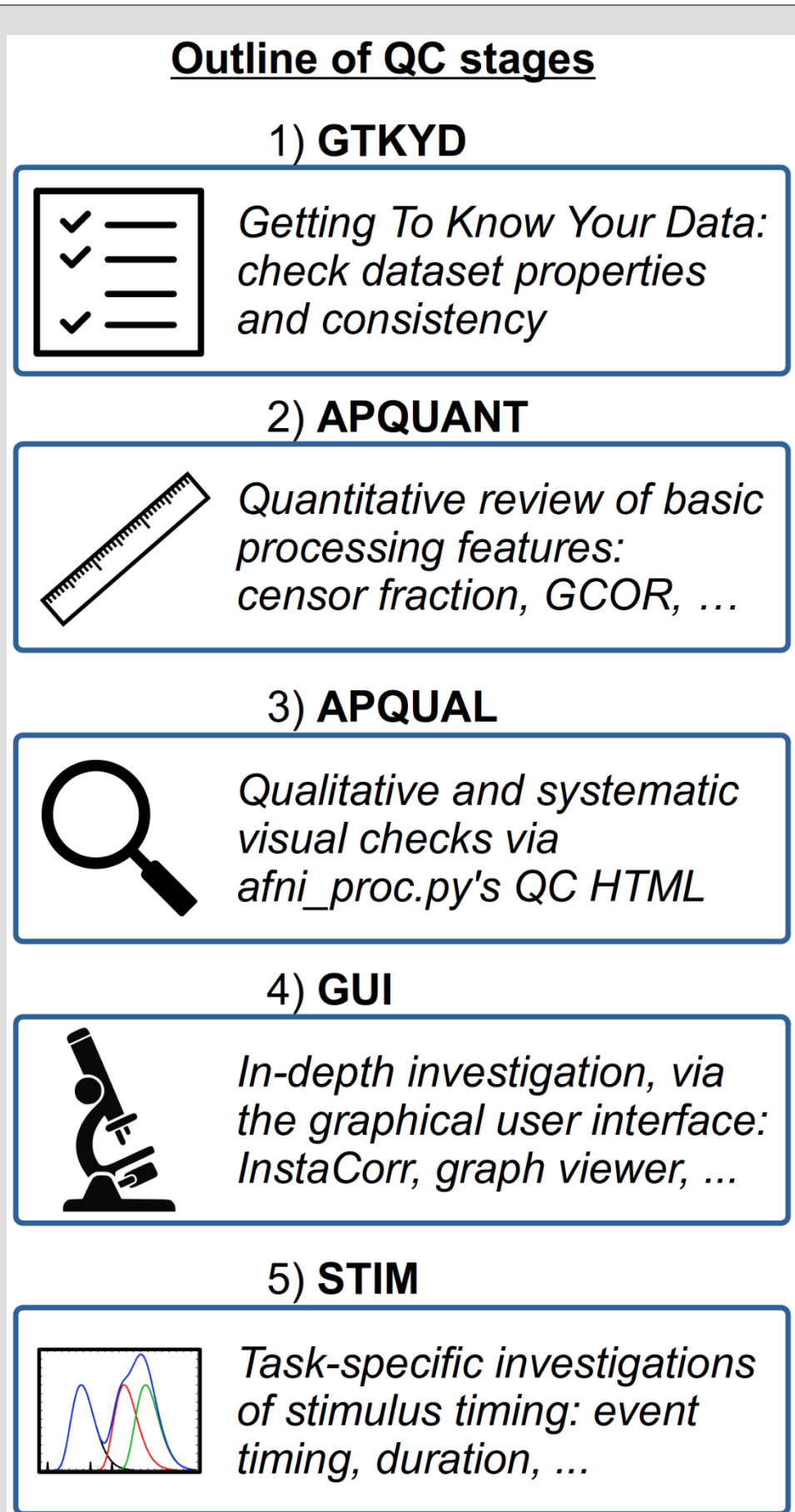
POSTER #715 Su Mo

## Introduction

We present an approach to assessing quality control (QC) of FMRI data using AFNI. This was a contribution to the community-wide Frontiers Research Topic, "Demonstrating Quality Control (QC) Procedures in fMRI," which used public resting state (7 sites; n=139) and task-based (1 site; n=30) FMRI data from the Functional Connectome Project, ABIDE and OpenNeuro. Each subject's dataset was classified as include, exclude or uncertain.

## Methods

We divided up the QC process into five stages, which are complementary and overlap. These include both qualitative and quantitative checks, which reinforce each other. There is also an important, initial stage of verifying input data properties and their consistency, which we call: *getting to know your data (GTKYD)*.

### Outline of QC stages

**1) GTKYD**
*Getting To Know Your Data: check dataset properties and consistency*

**2) APQUANT**
*Quantitative review of basic processing features: censor fraction, GCOR, …*

**3) APQUAL**
*Qualitative and systematic visual checks via afni_proc.py's QC HTML*

**4) GUI**
*In-depth investigation, via the graphical user interface: InstaCorr, graph viewer, …*

**5) STIM**
*Task-specific investigations of stimulus timing: event timing, duration, …*

Need to be convinced that QC is important? These are just **_some_** of the issues found in major repositories' datasets:
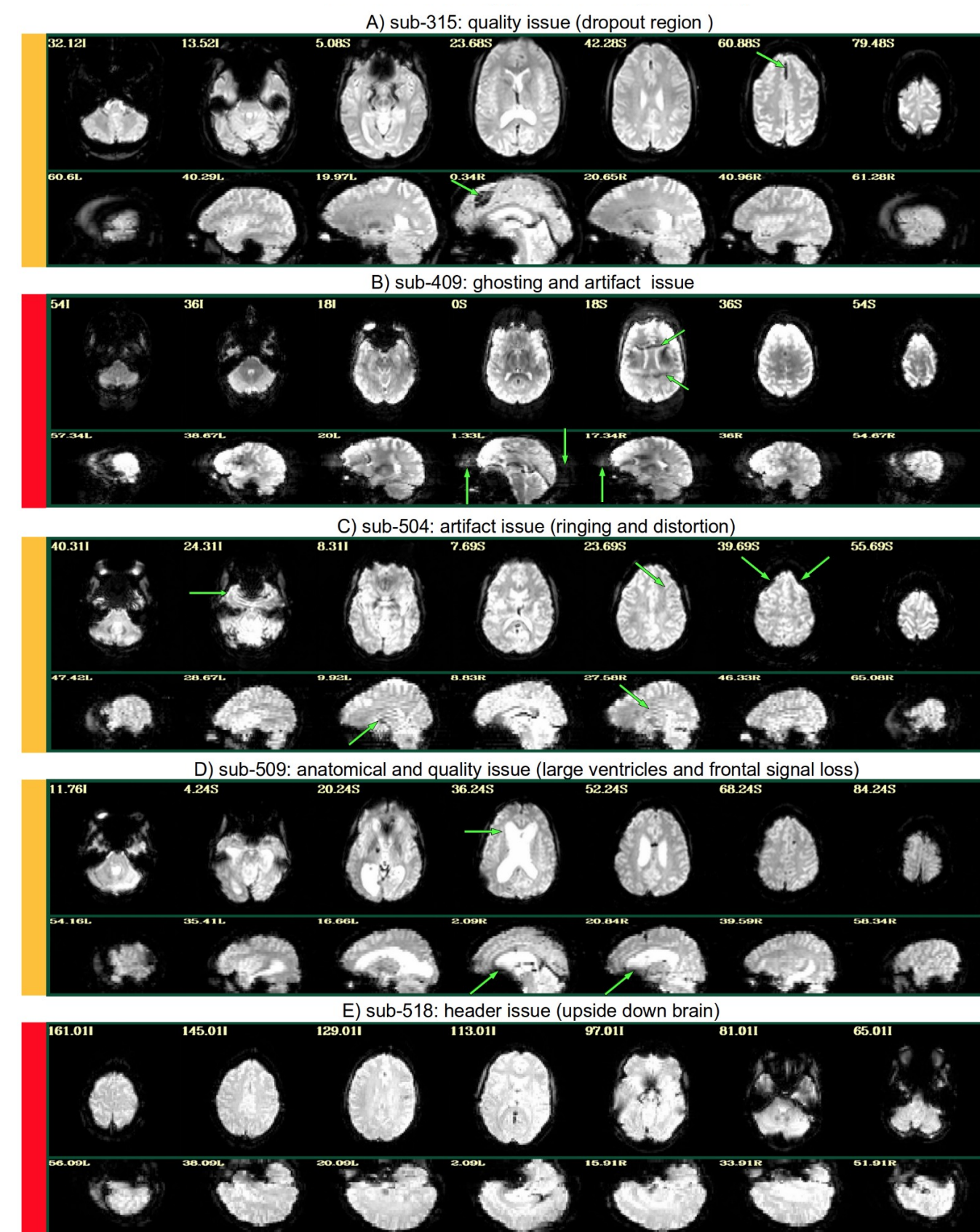- data inconsistency (grids different, number of TRs,...)
- mismatched subjects (EPI doesn't match anatomical)
- left-right flips
- upside-down brain
- excessive EPI motion and spikes
- EPI stripes, distortion, dropout, limited FOV

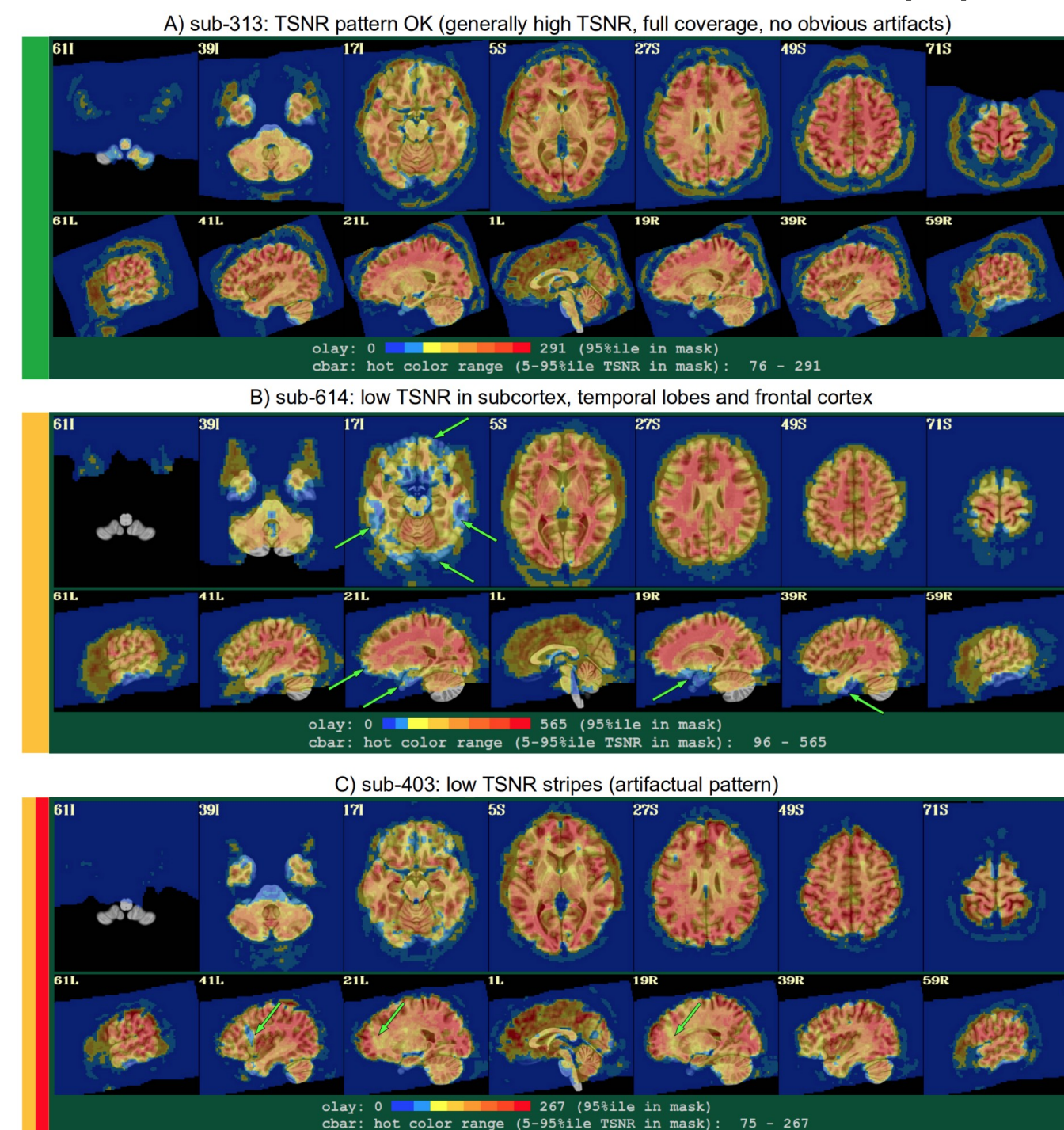See some examples of these (and more!) in the example figures, with rating coloration:
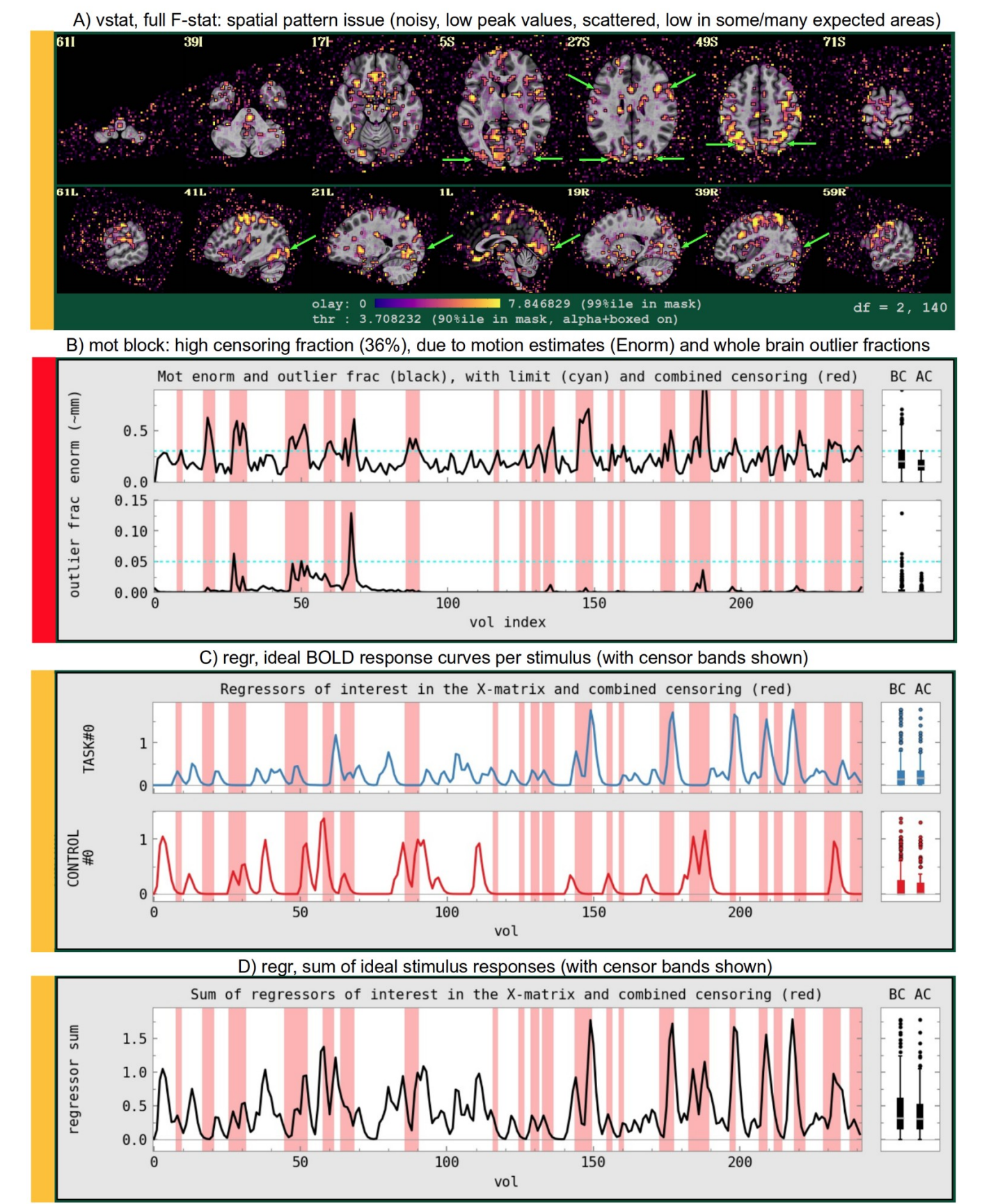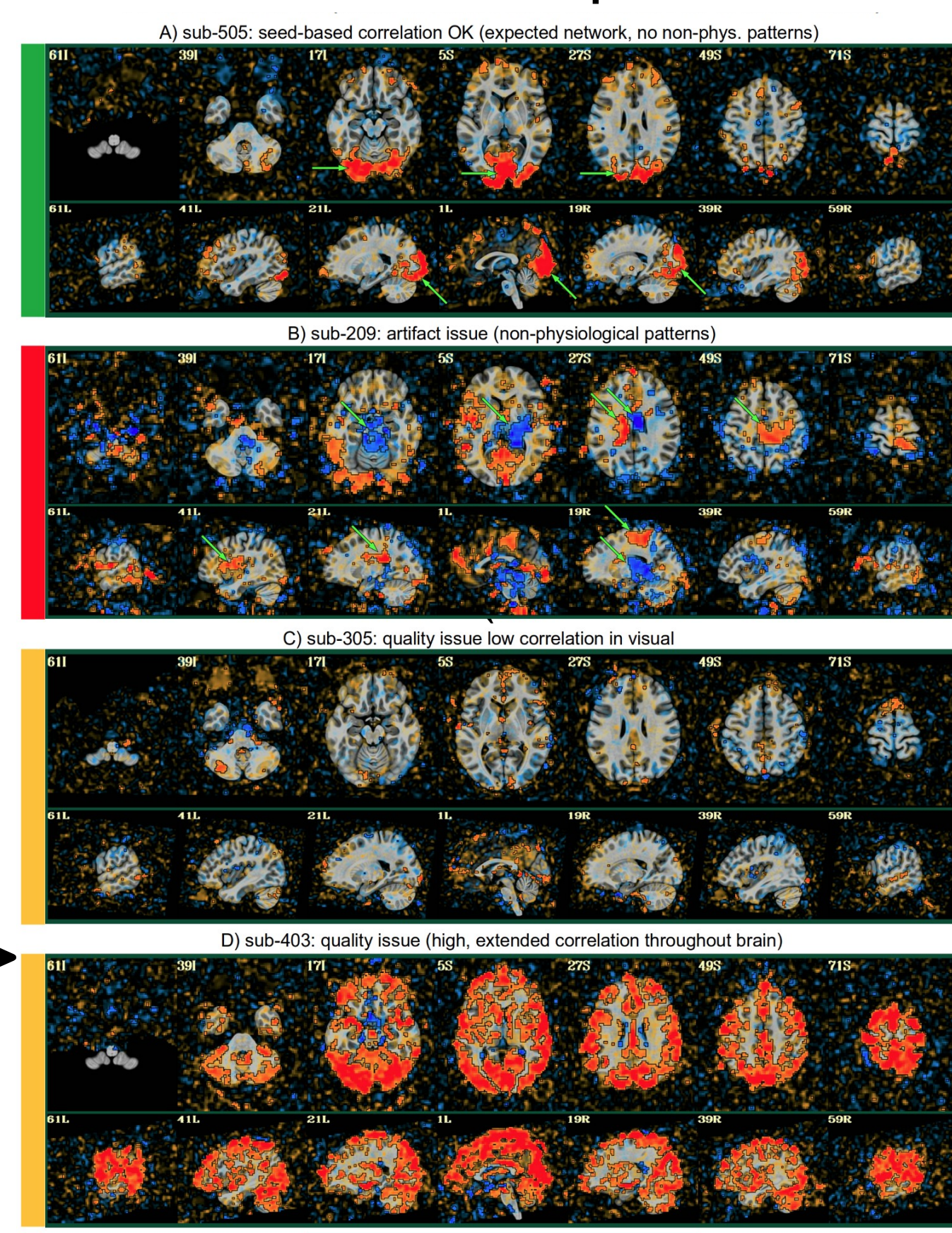
### Color Ratings

| Include | Uncertain | Exclude |
|---------|-----------|---------|

## Results



Some EPI issues

TSNR: dropout, stripes(?)
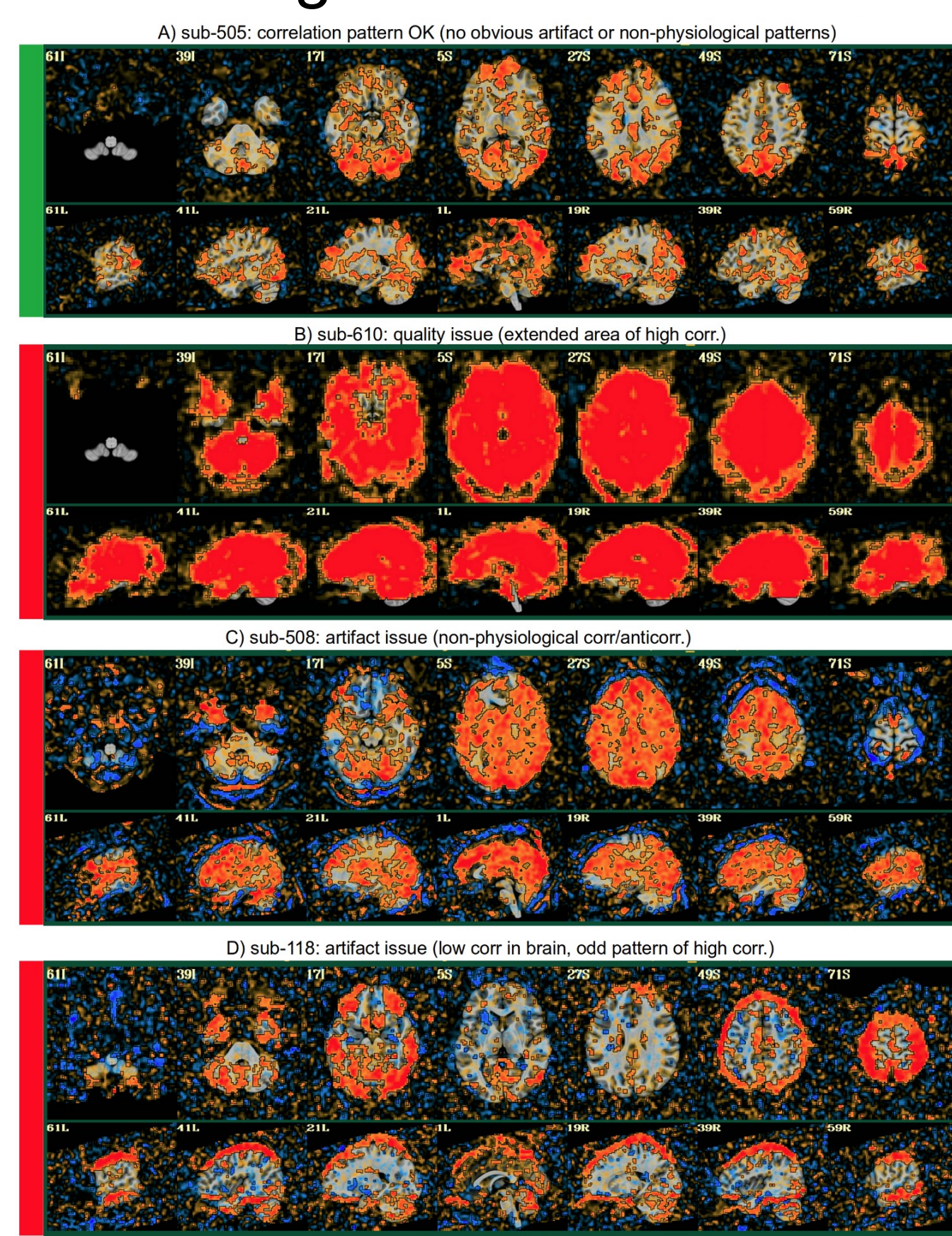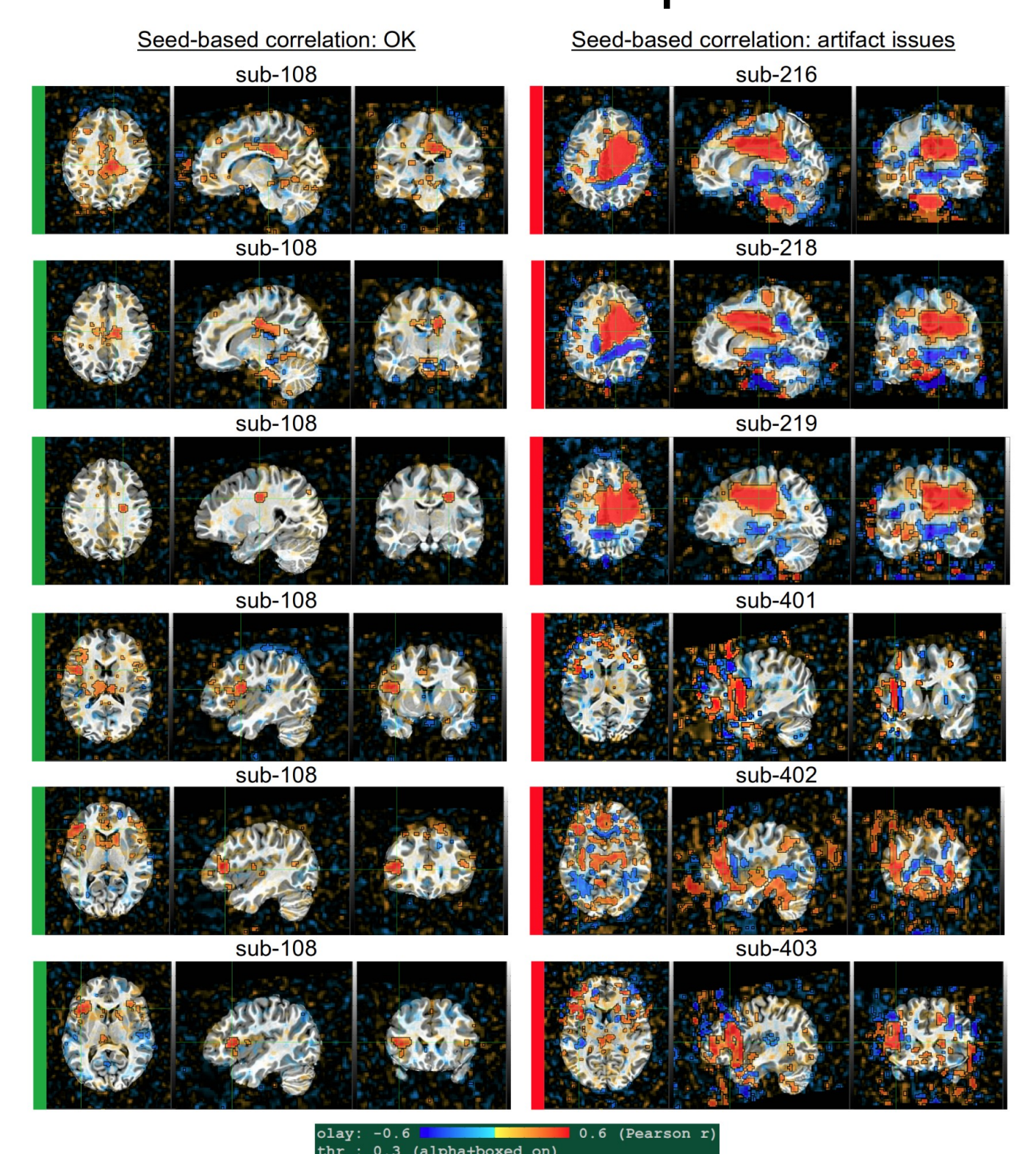
Task-correlated motion?

Rest: odd seed patterns

Rest: global correlations

InstaCorr follow-up checks

## Conclusion

QC is an integral part of the processing itself, so all processing must include quality control. While the data examined here was a good sampling of FMRI data, the issues that led to exclusion of datasets are only a subset of possible issues. The warnings and the uncertain findings presented a wide variety of problems that may not be a cause for rejection for a general study, but we noted issues regarding issues in cerebellum or midbrain (these regions were often excluded or only partially included in the EPI FOVs). If the study involved those regions, then they would need to be excluded. Besides the limited set of problems here, there are numerous other problems that can plague an FMRI dataset.

The main focus of this study is the QC procedures: how to understand the contents of an FMRI dataset, to check for appropriateness, to verify processing steps, and to examine potential quality issues. Scripts for the processing and analysis are freely available.

## Download the Scripts

- Read QC Project description and download datasets:
  **https://osf.io/qaesm/wiki/home/**
- Checkout Reynolds et al. (2023):
  **https://www.frontiersin.org/articles/10.3389/fnins.2022.1073800/full**
- Download processing scripts:
  **https://github.com/afni/apaper_afniqc_frontiers**
- Project summary and editorial:
  **https://www.frontiersin.org/articles/10.3389/fnins.2023.1205928/full**

Also see Poster #730 , Sunday+Monday
Interactive FMRI Quality Control: NiiVue and Other Fun, New Features in afni_proc.py's QC HTML

## Acknowledgment & References

[1] Reynolds RC, Taylor PA, Glen DR. Quality control practices in FMRI analysis: Philosophy, methods and examples using AFNI. Front. Neurosci. 16:1073800, 2023

[2] Taylor PA, Glen DR, Reynolds RC, Basavaraj A, Moraczewski D, Etzel JA. Editorial: Demonstrating quality control (QC) procedures in fMRI. Front Neurosci. 2023 May 31;17:1205928..

[3] Cox RW. AFNI: Software for analysis and visualization of functional magnetic resonance neuroimages. Computers and Biomedical Research, 29:162-173, 1996.

[4] Glen DR, Taylor PA, Buchsbaum BR, Cox RW, Reynolds RC. Beware (Surprisingly Common) Left-Right Flips in Your MRI Data: An Efficient and Robust Method to Check MRI Dataset Consistency Using AFNI. Front. Neuroinformatics 14, 2020.