

ABCD Human Subjects Study

Adolescent Brain Cognitive Development – ABCDSTUDY.org

Release Notes: Adolescent Brain Cognitive Development Study (ABCD) Data Release 2.0

MRI Quality Control (QC)

<http://dx.doi.org/10.15154/1503209>

March 2019

Change Log

March 2019

- Initial release

List of Instruments

Name of Instrument	Short Name
ABCD MRI QC Raw Part 1	mriqc102
ABCD MRI QC Raw Part 2	mriqcp202
ABCD MRI QC Raw Part 3	mriqcp302
FreeSurfer QC	freesqc01
ABCD dMRI Post Processing QC	dmriqc01

General Information

The following information refers to the Adolescent Brain Cognitive Development (ABCD) Study Annual Release 2.0 available from <https://data-archive.nimh.nih.gov/abcd>. An overview of the ABCD Study is at <https://abcdstudy.org> and detailed descriptions of elements of the study are listed in <https://abcdstudy.org/scientists/protocols>.

This document describes the contents of various instruments available for download. To understand the context of this information, see *Release Notes ABCD README FIRST* and *Release Notes ABCD Imaging Instruments*.

ABCD MRI QC Raw Part 1 - 3

- Protocol compliance checking
 - performed by on-site FIONA workstations to provide feedback to scan operators
 - out-of-compliance series reviewed by DAIC staff
 - criteria included whether key imaging parameters matched expected values for a given scanner, such as voxel size or repetition time
 - presence or absence of B0 distortion field map series was checked for diffusion MRI (dMRI) and functional MRI (fMRI) series
 - each imaging series checked for completeness (i.e., no missing files)
- Automated quality control metrics
 - Structural MRI (sMRI): mean and standard deviation of brain values and spatial SNR
 - dMRI: mean motion (average framewise displacement), and the number of slices and frames affected by slice dropout caused by abrupt head motion
 - fMRI: mean motion (average framewise displacement), the number of seconds with framewise displacements less than 0.2, 0.3, or 0.4 mm (Power, et al., 2012), temporal SNR (tSNR) (Triantafyllou, et al., 2005)
- Manual review of data quality
 - reviewers assigned binary QC score
 - 0 = reject
 - most severe artifacts or irregularities
 - rejected series excluded from subsequent processing and analysis
 - 1 = accept
 - types of images reviewed
 - T1w, T2w, dMRI, dMRI field map, fMRI, and fMRI field map
 - raw and some derived images were reviewed
 - dMRI derived images included average b=0 image, FA, MD, tensor fit residual error, and direction encoded color image

- fMRI derived images included the average across time and the temporal standard deviation
- inspected for signs of artifacts and poor image quality
 - presence of wrap-around field of view artifacts
 - brain cut-off due to the participant motion outside prescribed slices
 - magnetic susceptibility artifacts due to dental implants
 - T1w and T2w motion artifact (e.g. smearing and ghosting)

FreeSurfer QC

- Manual review of FreeSurfer cortical surface reconstruction
 - reviewers assigned binary (0/1) QC score
 - 0 = reject
 - most severe artifacts or irregularities
 - results still included in shared tabulated data
 - recommended exclusion from group analyses involving cortical surface ROIs
 - 1 = accept
 - reviewers gauged the severity of five types of artifact
 - motion
 - intensity inhomogeneity
 - white matter underestimation
 - pial overestimation
 - magnetic susceptibility artifact
 - numeric values assigned on a scale of 0-3
 - absent, mild, moderate, or severe, respectively
 - QC score of 0 assigned if severity score of 3 for any artifact type

Note: imaging-derived results are included in shared tabulated data regardless of post-processing QC. QC variables (derived from procedures described above) are included in shared tabulated data. The overall, binary QC score described above indicates whether inclusion or exclusion is recommended.

ABCD dMRI Post Processing QC

- Manual review of DTI reconstruction
 - reviewers assigned binary (0/1) QC score
 - 0 = reject
 - most severe artifacts or irregularities
 - results still included in shared tabulated data

- recommended exclusion from group analyses involving cortical, subcortical, and tract-based ROIs
- 1 = accept
- reviewers gauged the severity of five types of artifact
 - B0 warping
 - image quality based on motion, intensity inhomogeneity and magnetic susceptibility artifact
 - full head coverage
 - registration with T1w image
 - registration with FreeSurfer segmentation
- numeric values assigned on a scale of 0-3
 - absent, mild, moderate, or severe, respectively
 - QC score of 0 assigned if severity score of 3 for any artifact type

Note: The dMRI Post Processing QC covers all subjects from Release 1.1, but does not have ratings for the additional subjects added in Data Release 2.0.

References

Power, J.D., Barnes, K.A., Snyder, A.Z., Schlaggar, B.L., Petersen, S.E. (2012) Spurious but systematic correlations in functional connectivity MRI networks arise from subject motion. *Neuroimage*, 59:2142-54.

Triantafyllou, C., Hoge, R.D., Krueger, G., Wiggins, C.J., Potthast, A., Wiggins, G.C., Wald, L.L. (2005) Comparison of physiological noise at 1.5 T, 3 T and 7 T and optimization of fMRI acquisition parameters. *Neuroimage*, 26:243-50.