

ABCD Human Subjects Study

Adolescent Brain Cognitive Development – ABCDSTUDY.org

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

Resting-State Functional Magnetic Resonance Imaging (rs-fMRI)

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

March 2019

Change Log

March 2019

- Initial release

List of Instruments

Name of Instrument	Short Name
ABCD rsfMRI Gordon Network Correlations	abcd_betnet02
ABCD rsfMRI Network to Subcortical ROI Correlations	mrirscor02
ABCD rsfMRI Temporal Variance	abcd_mrirstv02
ABCD rsfMRI Destrieux	abcd_mrirsfd01

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*.

- Image types
 - field maps: spin echo images with opposite phase encode polarity
 - multi-frame, gradient echo, echo-planar imaging
- Image processing (common to all fMRI)
 - head motion corrected by registering each frame to the first using AFNI's 3dvolreg (Cox, 1996)
 - B_0 distortions were corrected using the reversing gradient method (Holland, et al., 2010)
 - displacement field estimated from spin-echo field map scans
 - applied to gradient-echo images after adjustment for between-scan head motion
 - corrected for gradient nonlinearity distortions (Jovicich, et al., 2006)
 - between scan motion correction across all fMRI scans in imaging event
 - registration between T_2 -weighted, spin-echo B_0 calibration scans and T_1 -weighted structural images performed using mutual information (Wells, et al., 1996)
- rs-fMRI specific pre-processing -- NOTE: not included in "minimal processing"
 - removal of initial volumes
 - Siemens: 8 TRs
 - Philips: 8 TRs
 - GE DV25: 5 TRs
 - GE DV26: 16 TRs
 - normalization and demean
 - divide by the mean of each voxel, subtract 1, multiply by 100
 - regression
 - linear regression to remove quadratic trends and signals correlated with motion and mean time courses of cerebral white matter, ventricles, and whole brain, plus first derivatives (Power, et al., 2014; Satterthwaite, et al., 2012)
 - motion regression included 6 parameters plus derivatives and squares
 - frames with displacement > 0.3 mm were excluded from the regression (Power, et al., 2014)
 - temporal filtering
 - band-pass filtered between 0.009 and 0.08 Hz (Hallquist, et al., 2013)
 - pre-processed time courses were sampled onto the cortical surface
 - projecting 1mm into cortical gray matter along surface normal vector
 - motion censoring to reduce residual effects of head (Power, et al., 2012; Power, et al., 2014)
 - motion estimates filtered to attenuate signals (0.31 - 0.43 Hz) associated with respiration (18.6 - 25.7 respirations / minute)
 - time points with FD > 0.2 mm excluded from variance and correlation calculations
 - time periods with < 5 contiguous, sub-threshold time points also excluded

- time points that were outliers in standard deviation across ROIs also excluded
- Regions of interest (ROI)
 - subcortical structures labeled with atlas-based segmentation (Fischl, et al., 2002)
 - cortical regions labeled with the Desikan atlas-based classification (Desikan, et al., 2006)
 - cortical regions labeled with the Destrieux atlas-based classification (Destrieux, et al., 2010)
 - functionally-defined parcels derived resting-state functional connectivity patterns (Gordon, et al., 2014)
- Functional connectivity analysis
 - seed-based, correlational approach (Van Dijk, et al., 2010)
 - adapted for cortical surface based analysis (Seibert and Brewer, 2011)
 - networks defined as pre-defined groups of cortical parcels (Gordon, et al., 2014)
 - e.g., default, fronto-parietal, dorsal attention, etc.
 - calculation of average within- and between-network mean correlation (Van Dijk, et al., 2010)
 - correlation between each pair of ROIs
 - Fisher transformed to z-statistics
 - averaged to provide measure of network correlation strength
 - calculation of correlation between each network and each subcortical ROI
 - variance across time calculated for each ROI
 - magnitude of low frequency oscillations

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