
ABCD Human Subjects Study

Adolescent Brain Cognitive Development – ABCDSTUDY.org

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

Structural Magnetic Resonance Imaging (sMRI)

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

March 2019

Change Log

March 2019

- Initial release

List of Instruments

Instruments	Short Name
ABCD sMRI Part 1	abcd_smrip101
ABCD sMRI Part 2	abcd_smrip201
ABCD sMRI Destrieux Parcellation Part 1	abcd_mrisdp101
ABCD sMRI Destrieux Parcellation Part 2	abcd_mrisdp201

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
 - T₁-weighted (T₁w) 3D structural images
 - T₂-weighted (T₂w) 3D structural images
- Image processing
 - corrected for gradient nonlinearity distortions (Jovicich, et al., 2006)
 - T₂w images registered to T₁w images using mutual information (Wells, et al., 1996)
 - intensity non-uniformity correction based on tissue segmentation and sparse spatial smoothing
 - resampled with 1 mm isotropic voxels into rigid alignment with an atlas brain
- Cortical surface reconstruction
 - FreeSurfer v5.3.0 (<https://surfer.nmr.mgh.harvard.edu>)
 - skull-stripping (Segonne, et al., 2004)
 - white matter segmentation, initial mesh creation (Dale, et al., 1999)
 - correction of topological defects (Fischl, et al., 2001; Segonne, et al., 2007)
 - surface optimization (Dale, et al., 1999; Dale and Sereno, 1993; Fischl and Dale, 2000)
 - nonlinear registration to a spherical surface-based atlas (Fischl, et al., 1999b)
- Morphometry
 - subcortical regional volume
 - cortical volume
 - cortical thickness (Fischl and Dale, 2000)
 - cortical area (Chen, et al., 2012; Joyner, et al., 2009)
 - sulcal depth (Fischl, et al., 1999a)
- Image intensity measures
 - T₁w and T₂w intensity measures in white matter (-0.2 mm from gray/white boundary)
 - T₁w and T₂w intensity measures in gray matter (+0.2 mm from gray/white boundary)
 - Normalized T₁w and T₂w cortical gray/white intensity contrast (Westlye, et al., 2009)
- Regions of interest (ROIs)
 - 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)
 - fuzzy-cluster parcels, based on genetic correlation of surface area (Chen, et al., 2012)

References

- Chen, C.H., Gutierrez, E.D., Thompson, W., Panizzon, M.S., Jernigan, T.L., Eyler, L.T., Fennema-Notestine, C., Jak, A.J., Neale, M.C., Franz, C.E., Lyons, M.J., Grant, M.D., Fischl, B., Seidman, L.J., Tsuang, M.T., Kremen, W.S., Dale, A.M. (2012) Hierarchical genetic organization of human cortical surface area. *Science*, 335:1634-6.
- Dale, A.M., Fischl, B., Sereno, M.I. (1999) Cortical surface-based analysis. I. Segmentation and surface reconstruction. *Neuroimage*, 9:179-94.
- Dale, A.M., Sereno, M.I. (1993) Improved Localization of Cortical Activity by Combining EEG and MEG with MRI Cortical Surface Reconstruction: A Linear Approach. *J Cogn Neurosci*, 5:162-76.
- Desikan, R.S., Segonne, F., Fischl, B., Quinn, B.T., Dickerson, B.C., Blacker, D., Buckner, R.L., Dale, A.M., Maguire, R.P., Hyman, B.T., Albert, M.S., Killiany, R.J. (2006) An automated labeling system for subdividing the human cerebral cortex on MRI scans into gyral based regions of interest. *Neuroimage*, 31:968-80.
- Destrieux C, Fischl B, Dale A, Halgren E. (2010) Automatic parcellation of human cortical gyri and sulci using standard anatomical nomenclature. *Neuroimage*. 2010 Oct 15;53(1):1-15.
- Fischl, B., Dale, A.M. (2000) Measuring the thickness of the human cerebral cortex from magnetic resonance images. *Proc Natl Acad Sci U S A*, 97:11050-5.
- Fischl, B., Liu, A., Dale, A.M. (2001) Automated manifold surgery: constructing geometrically accurate and topologically correct models of the human cerebral cortex. *IEEE Trans Med Imaging*, 20:70-80.
- Fischl, B., Salat, D.H., Busa, E., Albert, M., Dieterich, M., Haselgrove, C., van der Kouwe, A., Killiany, R., Kennedy, D., Klaveness, S., Montillo, A., Makris, N., Rosen, B., Dale, A.M. (2002) Whole brain segmentation: automated labeling of neuroanatomical structures in the human brain. *Neuron*, 33:341-55.
- Fischl, B., Sereno, M.I., Dale, A.M. (1999a) Cortical surface-based analysis. II: Inflation, flattening, and a surface-based coordinate system. *Neuroimage*, 9:195-207.
- Fischl, B., Sereno, M.I., Tootell, R.B., Dale, A.M. (1999b) High-resolution intersubject averaging and a coordinate system for the cortical surface. *Hum Brain Mapp*, 8:272-84.
- Jovicich, J., Czanner, S., Greve, D., Haley, E., van der Kouwe, A., Gollub, R., Kennedy, D., Schmitt, F., Brown, G., Macfall, J., Fischl, B., Dale, A. (2006) Reliability in multi-site structural MRI studies: effects of gradient non-linearity correction on phantom and human data. *Neuroimage*, 30:436-43.

Joyner, A.H., J, C.R., Bloss, C.S., Bakken, T.E., Rimol, L.M., Melle, I., Agartz, I., Djurovic, S., Topol, E.J., Schork, N.J., Andreassen, O.A., Dale, A.M. (2009) A common MECP2 haplotype associates with reduced cortical surface area in humans in two independent populations. *Proc Natl Acad Sci U S A*, 106:15483-8.

Segonne, F., Dale, A.M., Busa, E., Glessner, M., Salat, D., Hahn, H.K., Fischl, B. (2004) A hybrid approach to the skull stripping problem in MRI. *Neuroimage*, 22:1060-75.

Segonne, F., Pacheco, J., Fischl, B. (2007) Geometrically accurate topology-correction of cortical surfaces using nonseparating loops. *IEEE Trans Med Imaging*, 26:518-29.

Wells, W.M., 3rd, Viola, P., Atsumi, H., Nakajima, S., Kikinis, R. (1996) Multi-modal volume registration by maximization of mutual information. *Med Image Anal*, 1:35-51.

Westlye, L.T., Walhovd, K.B., Dale, A.M., Espeseth, T., Reinvang, I., Raz, N., Agartz, I., Greve, D.N., Fischl, B., Fjell, A.M. (2009) Increased sensitivity to effects of normal aging and Alzheimer's disease on cortical thickness by adjustment for local variability in gray/white contrast: a multi-sample MRI study. *Neuroimage*, 47:1545-57.