

**Name and brief description of initiative:**  
**The NIH MRI Study of Normal Brain Development**

**Brief description of goals of initiative:**

The NIH MRI Study of Normal Brain Development seeks to elucidate developmental trajectories of healthy pediatric brain maturation in order to provide a basis for defining deviations in brain development in childhood disorders. A goal is to provide data from the study as a resource for use by the scientific community. Another goal is to provide improved imaging processing tools for pediatrics and pediatric age-based templates.

This multisite, longitudinal study uses MR technologies to map age-related changes in brain structure and metabolism in relationship to cognitive and behavioral development in an epidemiologically ascertained sample of approximately 500 typically-developing children from infancy to young adulthood whose demographics match that of the U.S. Census. All children receive structural MR imaging (T1, T2/PD); ancillary studies include diffusion tensor imaging (DTI) and magnetic resonance spectroscopy (MRS) (single voxel and some imaging). Children ages 4 1/2 and older are studied with imaging and clinical/behavioral measures at three time points, approximately two years apart. Infants, toddlers and preschoolers are studied at shorter intervals (from three months for the youngest to one year) at three or more time points (at present, some up to eight time points).

**Principal investigators:**

Coordinating Centers:

Data Coordinating Center (DCC): Alan Evans, Ph.D., Montreal Neurological Institute

DTI Processing Center (DPC): Carlo Pierpaoli, M.D., Ph.D., intramural NICHD

MRS Processing Center (MRC): Joseph O'Neill, Ph.D., UCLA

Clinical Coordinating Center (CCC): Kelly Botteron, M.D., Washington University

Pediatric Study Centers:

Boston Childrens: Michael Rivkin, M.D.

Children's Hospital of Philadelphia: D.J. Wang, Ph.D.

Children's Hospital of Cincinnati: William Ball, M.D.

Washington University: Robert McKinstry, M.D., Ph.D.

University of Texas at Houston: Michael Brandt, Ph.D.

UCLA: James McCracken, M.D.

**Program contact information:**

NICHD: Lisa Freund, Ph.D. (contracts for DTI Processing Center and Clinical Coordinating Center)

NIDA: Laurence Stanford, Ph.D. (financial and scientific support)

NIMH: Judith Rumsey, Ph.D. (contract for Data Coordinating Center)

NINDS: Katrina Gwinn-Hardy, M.D. (contracts for six Pediatric Study Centers)

**Website address of initiative:**

<http://www.brain-child.org/> (for participating families)  
NIH website under development

**Brief description of biomedical informatics and computational biology components and their goals:**

The DCC is developing and enhancing:

- Imaging segmentation, tissue classification, and regional parcellation techniques, especially as it pertains to young subjects
- Statistical models for brain-behavior relationship during development
- An integrated behavioral/imaging database with QC, automated data transfer, feedback to source sites of errors and statistics has been developed. The database provides for online data entry with range checking, automated scoring, uploading output of desktop instruments (e.g. CANTAB), and integration of image data and derived values
- A complete set of tools used in running the imaging pipeline will be made available to investigators.

**Brief description of resources and tools available for sharing:**

The imaging and clinical/behavioral database from the study will be made available to the scientific community through a NIH-website (under development). The data will be released in stages, with the first data release planned for 2006.

Age-specific structural MRI templates will be provided.

Software tools for public distribution: The image processing pipeline used at the DCC will be provided to the scientific community, along with file conversions to MINC. As the pediatric MRI study is being made available via the BIRN infrastructure, enhancements to existing scripts to support MINC file formats are being made. An updated version of MIPAV with SRB integration and MINC to DICOM format conversion has been released.

**Brief description of integrative efforts** (e.g., data standards, ontologies/terminologies, common software or workflows, available inventories of resources and tools, interactions with other initiatives):

As the data is being released to general access, it is being migrated to a BIRN rack at the NIH. As such, integration with BIRN tools (HID, Portal, MIPAV) are being undertaken. Image data is being provided in MINC, Analyze and NiFTI formats for easiest utility by researchers, and the study will track NiFTI II as those standards are released.

The imaging protocols developed in this study are being specified as a standard for the Autism Centers of Excellence (ACE) RFA, released through NICHD.

The investigators at the DPC are collaborating with NA-MIC and BIRN members on common DTI file formats, analysis tools and techniques.

**Possible opportunities for collaboration or synergy with the NCBCs:**

Obvious collaborations are with NA-MIC, CCB, and NCBO.

General collaborations in the areas of automated registration and segmentation in young subjects, use of the image and behavioral data as test cases for algorithm development.

NA-MIC: Work on DTI imaging standards, processing, analysis tools and pipelines.

CCB: Neuroimaging tool development, data source for CCB investigations, possible pediatric Atlas development, brain-behavior analysis in young subjects.

NCBO: Defining ontologies for behavioral instruments and defining a common coding for individual items on assessments, where appropriate to permit cross study data analysis.

**Publication describing major methods:**

The Brain Development Cooperative Group (corresponding author: Alan C. Evans), The NIH MRI Study of Normal Brain Development. NeuroImage, 30(1), 184-202.

Two manuscripts under review--one describing the methods for the younger cohort of infants, toddlers and preschoolers and one describing results of the neuropsychological test battery used to select and characterize subjects. Additional papers in preparation.