

The following paragraphs describe the methods that were used on the different version(s) of the LPBA40 Atlas.

LPBA40 Atlas

Delineation

MRI data from 40 subjects were preprocessed according to existing LONI protocols to produce skull-stripped brain volumes. These volumes were aligned to the ICBM305 atlas using rigid-body transformation to correct for head tilt and reduce bias in the delineation process. This produced a transform from native space to delineation space and an associated inverse transform. In each of the 40 subjects, 58 structures were delineated manually according to protocols developed for this project (see LPBA40 Protocols) using BrainSuite.

Image processing

Brain masks were constructed from the manual delineations and projected back to the native delineation space. The MRI volumes in native space were masked to produce brain-only MRI volumes. These volumes were then corrected for non-uniformity using BrainSuite's Bias Field Corrector. The bias-corrected brain data were processed with the Partial Volume Classifier software to produce maps of grey matter, white matter, and cerebrospinal fluid for each subject volume. The brains were then aligned to atlas targets using 3 widely used methods. The atlas targets were chosen based on the method.

LPBA40.AIR (ICBM452 Warp 5 Atlas)

Each corrected brain volume was aligned from its native space to the ICBM-452 Warp 5 T1 average using AIR align_warp. This produced a native space to ICBM452 space transform. Volumes were cropped prior to registration (pad: 8); the cropped volumes were aligned to the ICBM-452 atlas (settings: -m 12 -t1 1 -t2 1). The corrected brain volumes were resliced into the ICBM452 space using chirp-Z interpolation (AIR).

LPBA40.FLIRT

Using FLIRT with the default settings, each corrected brain was aligned, each brain was aligned to the avg152T1_brain.

LPBA40.SPM5

Using SPM5's unified segmentation method with the default settings, each whole-head scan in the native space was aligned to the avg152T1 target.

Atlas construction

For each of the three atlas variants, we constructed a series of maps from the transformed data.

- Intensity atlas (LPBA40intensityavg) - a voxel-wise average of the skull-stripped MRI volumes in ICBM452 space
- Tissue class probabilistic atlas (LPBA40tissue) - three volumes, where each voxel contains a count of the number of subject volumes that had that voxel labeled as a the associated tissue type (GM, WM, or CSF)

LPBA40 Atlas continued

- Structure probability maps (LPBA40structure) - 56 volumes, each of which contains the voxel-wise count of the number of subjects that had that voxel labeled as the given structure
- Grey matter masked structure probability maps (LPBA40GMstructure) - 56 volumes, each of which contains the voxel-wise count of the number of subjects that had that voxel labeled as the given structure and also as GM
- Maximum likelihood atlas (LPBA40) - for each voxel, we computed the most likely tissue type based on the 40 delineated subject volumes; in the case of a tie, the tissue type was chosen at random from the equilikely labels. This data set contains both the maximum likelihood label volume and a volume composed of the maximum count at each voxel
- Maximum likelihood grey matter atlas (LPBA40) - This is similar to LPBA40, above, but the tissue labels were pre before performing the maximum likelihood computation

Data Distribution

Each variant of the atlas can be downloaded as a zip file containing the above data. The LPBA40.AIR atlas is available in either NIFTI or Analyze format (note that we use a right-handed coordinate system to be consistent with the ICBM452 atlas downloads). The LPBA40.SPM5 and LPBA40.FLIRT atlases are available in NIFTI format, since both SPM5 and FLIRT support NIFTI. All files are gzipped to reduce the size of the total dataset.

Each zip file contains the following directories:

PDF: the estimated probability density functions for each structure

PDFGM: the estimated GM probability density functions for each structure

avg: the LPBA40 average intensity brain in that space

maxprob: the most likely label and highest probability value at each voxel

tissue: the CSF, GM, and WM probability density maps

Each component file is stored using the following naming convention:

lpba40.{registration method}.{atlas target}.{description}.nii.gz

(for the Analyze version of the LPBA40.ICBM452 variant, .img.gz is used). For example, lpba40.flirt.avg152T1_brain.wm.pdf.nii.gz is the density map for white matter in the LPBA40.FLIRT atlas.:

The dataset also includes a text file which provides the name of each structure and the integer ID number used in the label volumes.