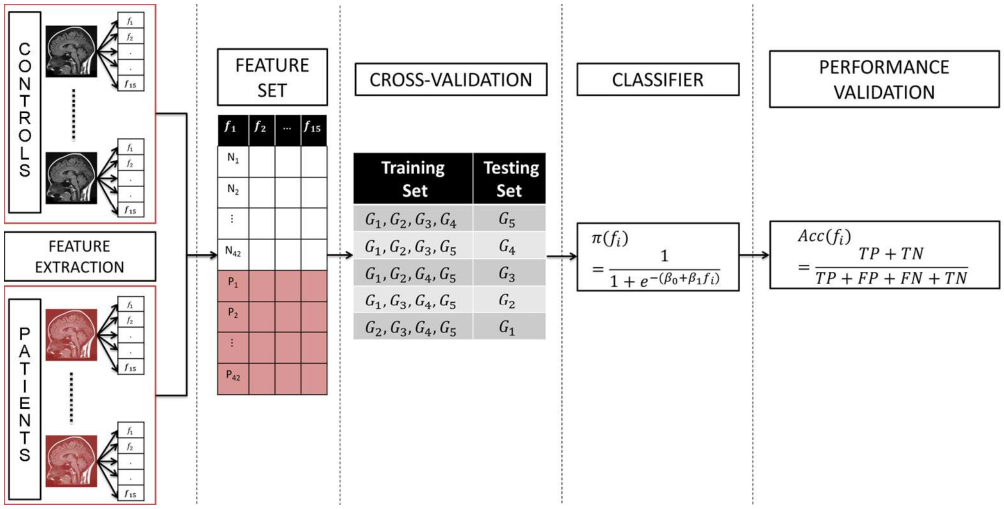
Automated processing steps within BrainSuite

For each scan included in this study (some patients had multiple scans), the T1-weighed MPRAGE images were converted into NIfTI-1 format and underwent a series of automated processing steps within BrainSuite:

1. Skull is stripped using the Brain Surface Extractor tool,{Shattuck, 2001 #5} which uses a combination of anisotropic diffusion filtering, edge detection and mathematical morphology to extract the brain from the surrounding skull and scalp tissues.
2. Spatial variations in signal gain are corrected using the Bias Field Corrector tool.{Shattuck, 2001 #5}
3. Tissue classification is performed using the Partial Volume Classifier (PVC),{Shattuck, 2001 #5} which assigns an integer label to each voxel in the image. The label represents the types of tissue present in the voxel, and is modeled to include cerebral spinal fluid (CSF), white matter (WM), gray matter (GM), and pairwise combinations of these. PVC also estimates a fractional content for each voxel, indicating what proportion of each type of tissue is present.
4. A labeled reference atlas{Rex, 2003 #8} is aligned using volumetric registration{Woods, 1998 #1} to map a set of labeled regions (cerebrum, cerebellum, brainstem, subcortical regions, left/right hemisphere) to the subject brain. These labels are then used (together with the PVC tissue classification result) to automatically produce a binary mask identifying the cerebral white matter.

5. The initial cerebral white matter mask is then processed using a series of filters to enhance the boundary of the object and ensure that a topologically spherical surface can be produced from the mask. These steps consist of: filling small pits in the boundary of the binary mask; applying the Topological Correction Algorithm{Shattuck, 2001 #7} to remove topological holes and handles in the binary object; and removing small strands of voxels that remain attached to the cerebral white matter mask.
6. An inner cortical surface model is generated from the cerebral white matter mask using the Marching Cubes Algorithm{Lorensen, 1987 #13}. A pial surface model is produced by expanding the inner cortical surface outward through the brain volume until it reaches the GM/CSF boundary. The surface models are split into left and right hemispheres based on the volumetric labeling produced in Step 4.
7. Automated Spatial Alignment and Labeling is performed by the Surface/Volume Registration (SVReg) tool. It uses anatomical information from both the surface models and volume of the brain images for accurate automated co-registration between the subject and an atlas. This mapping allows consistent surface and volume labeling.{Joshi, 2012 #19;Joshi, 2005 #18} The atlas is a stereotaxic average of 27 scans of an individual. The inner, middle, and pial cortical surfaces were carefully extracted for the atlas brain scan. The surfaces and volumes of the atlas were hand-labeled by an expert neuroanatomist. The final parcellation by SVReg computes volumes of 140 brain regions (70 for each hemisphere). WM, GM and CSF volumes are reported separately by SVReg for each of these ROIs. For each patient this process takes approximately 2 hours on a regular PC.



Supplementary Figure 1. Statistical workflow. Volumetric ratio measures (15 in total) from 42 controls and 42 patient scans were used to train a logistic regression classifier. The performance of the classifier was assessed via 5-fold cross-validation. The mean values of accuracy across the five trials were used to quantify the performance of the classifier.

Supplementary Figure 1

203x101mm (300 x 300 DPI)