Parcellation

The act or process of dividing.

Understanding the amazingly complex human cerebral cortex requires a map (or parcellation) of its major subdivisions, known as cortical areas. Making an accurate areal map has been a century-old objective in neuroscience.

Human cerebral cortex, like that of other primates, contains a complex mosaic of areas that differ in structure, function, and connectivity. Based on postmortem architectonic analyses, many competing parcellation schemes of human cortex have been described.

Using multi-modal magnetic resonance imaging from the Human Connectome Project (HCP) and an objective semi-automated neuroanatomical approach, we delineated 180 areas per hemisphere bounded by sharp changes in cortical architecture, function, connectivity, and/or topography in a precisely aligned group average of 210 healthy young adults. We characterized 97 new areas and 83 areas previously reported using post-mortem microscopy or other specialized study-specific approaches. To enable automated delineation and identification of these areas in new HCP subjects and in future studies, we trained a machine-learning classifier to recognize the multi-modal 'fingerprint' of each cortical area. This classifier detected the presence of 96.6% of the cortical areas in new subjects, replicated the group parcellation, and could correctly locate areas in individuals with atypical parcellations. The freely available parcellation and classifier will enable substantially improved neuroanatomical precision for studies of the structural and functional organization of human cerebral cortex and its variation across individuals and in development, aging, and disease.

Most previous parcellations were based on only one neurobiological property (such as architecture, function, connectivity or topography), and many cover only part of the cortex. Combining multiple properties provides complementary as well as confirmatory information, as different properties distinguish different sets of areal boundaries, and more confidence can be placed in boundaries that are consistent across multiple independent properties. We analysed all four properties across all of neocortex in both hemispheres, using new or refined methods applied to the uniquely rich repository of exceptionally high-quality magnetic resonance imaging (MRI) data provided by the Human Connectome Project (HCP), which benefited from major advances in image acquisition and preprocessing