HARVARD
MEDICAL SCHOOL

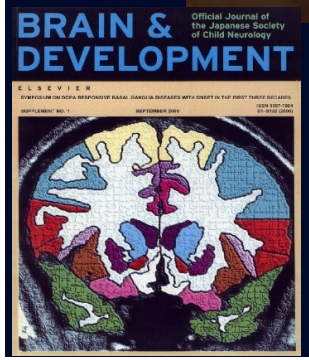
Mass General Brigham

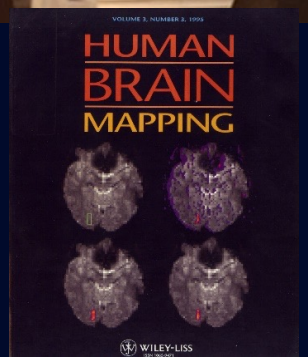
The Center for Morphometric Analysis (CMA)

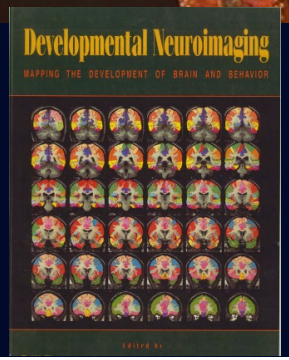
Dr. Verne Caviness with colleagues David Kennedy, a PhD in nuclear physics from MIT, **and Pauline Filipek**, a child neurologist**, founded, in 1988**, at MGH main campus and later on the"non-wet bench" end of the 6th floor of the CNY-MGH in Charlestown Navy Yard, the imaging Center for Morphometric Analysis (CMA).

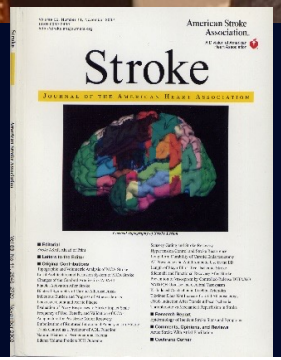
The CMA Snapshot (the founders)

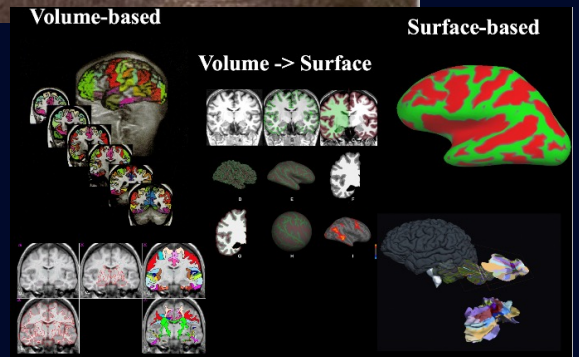
Dr. Verne Caviness with colleagues David Kennedy, a PhD in nuclear physics from MIT, **and Pauline Filipek**, a child neurologist**, founded, in 1988**, at MGH main campus and later on the"non-wet bench" end of the 6th floor of the CNY-MGH in Charlestown Navy Yard, the imaging Center for Morphometric Analysis (CMA), **among the first centers internationally to develop computer assisted programs for precise volumetric imaging of human brain MRIs.**





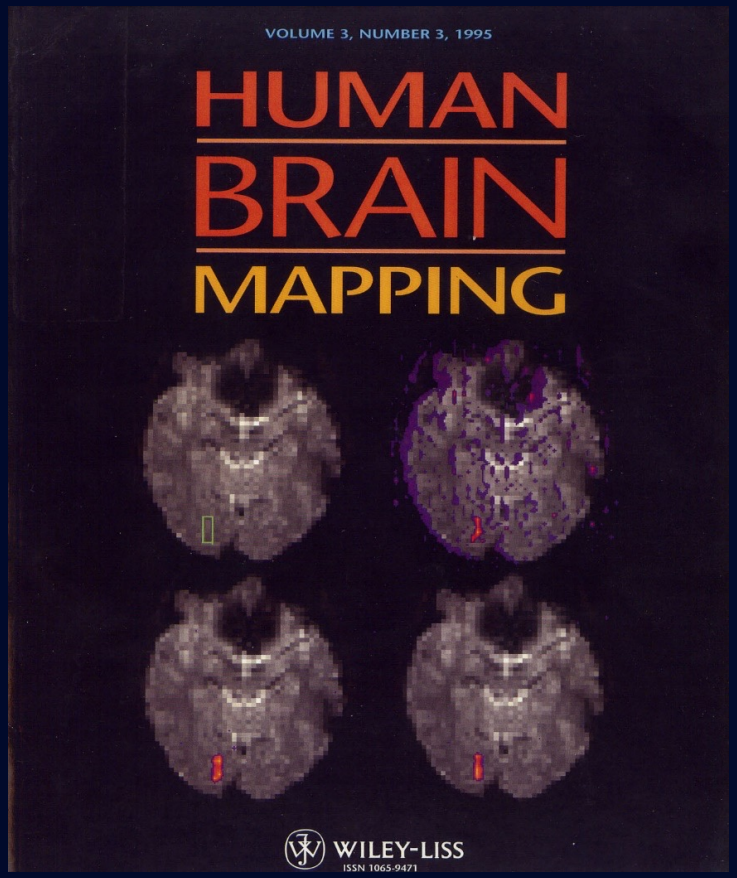






The CMA Snapshot (brief history)

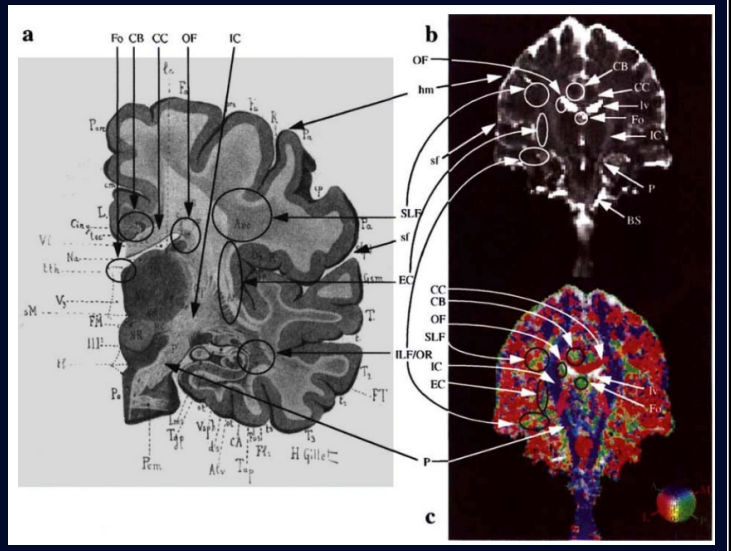
Among the early achievements of the CMA, Dr. David Kennedy developed the co-registration program for the first demonstration of fMRI by the MGH-NMR team headed by Drs. Jack Belliveau and Bruce Rosen.

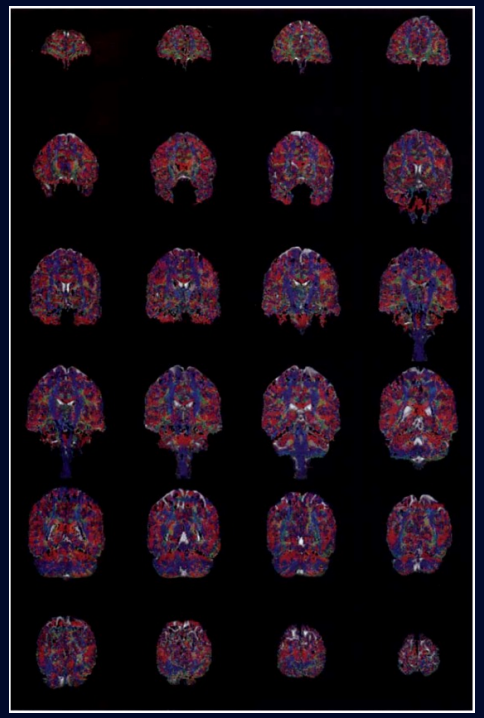


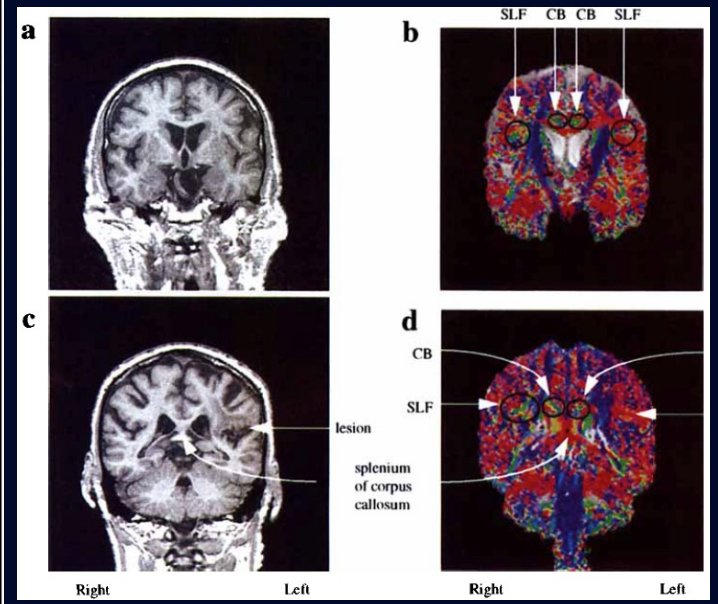
Belliveau, Kennedy, et al., Science, 1992

The CMA Snapshot (brief history)

Dr. Nikos Makris, trained primarily in psychiatry, early became a member of the CMA and later became its director. **Working with Drs. Deepak Pandya, Edith Kaplan, David Kennedy, Andy Worth, Van Wedeen, Tim Davis, Greg Sorensen, and George Papadimitriou, in 1997 Dr. Makris published the first use and validation of DTI for the study of patterns of associative axonal distribution in the human brain**. This was the first peer-reviewed publication of the RGB (Red-Green-Blue) color-coding scheme for diffusion tensor visualization of XYZ spatial dimensions. This quickly became the standard convention in the field of research and clinical diffusion tensor imaging (DTI).



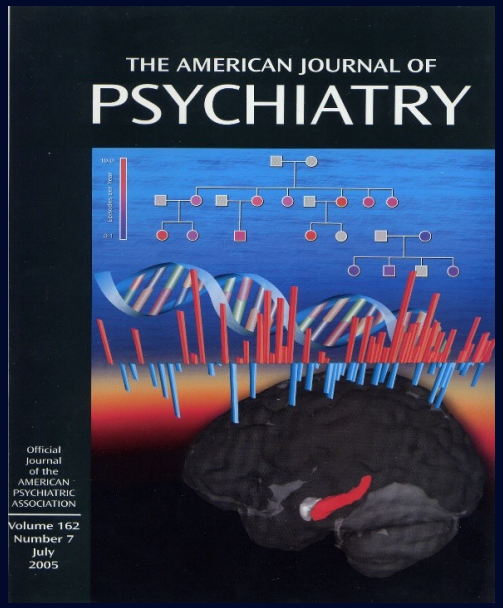


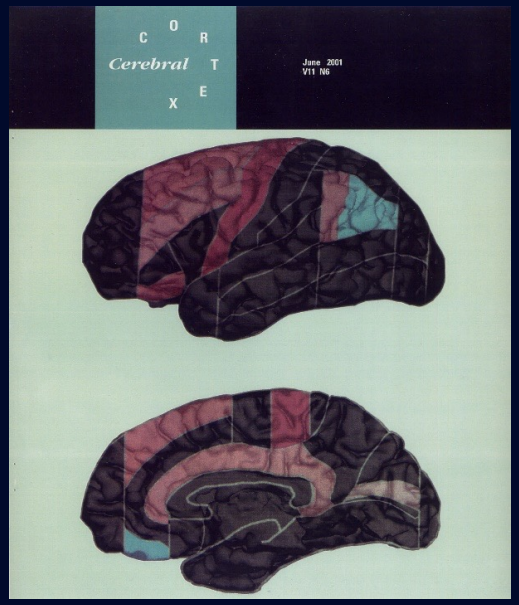


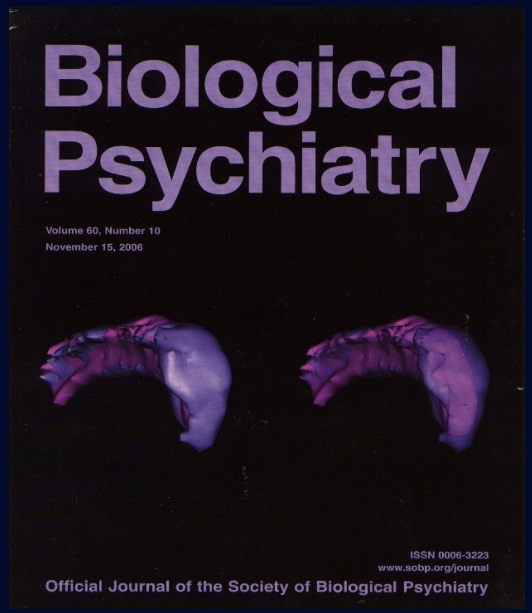
Makris, Kennedy, Pandya, et al., Ann Neurol, 1997

The CMA Snapshot (brief history)

A specific brain data visualization and analysis program, Cardviews (Cardinal Views), developed in the CMA by James Meyer, has been the basis for landmark studies, *inter alia*, of patterns of normal brain development and sexual dimorphism in the brain, the earliest studies establishing morphometric features of autistic brains and developmental language disorders, and the morphometric profiles of early onset bipolar disorder and schizophrenia. The principal investigators in these programs were Dr. Martha Herbert, a graduate of the Pediatric Neurology training program, Dr. Jean Frazier, a child psychiatrist, and Drs. Larry Seidman and Jill Goldstein from the Harvard Department of Psychiatry.

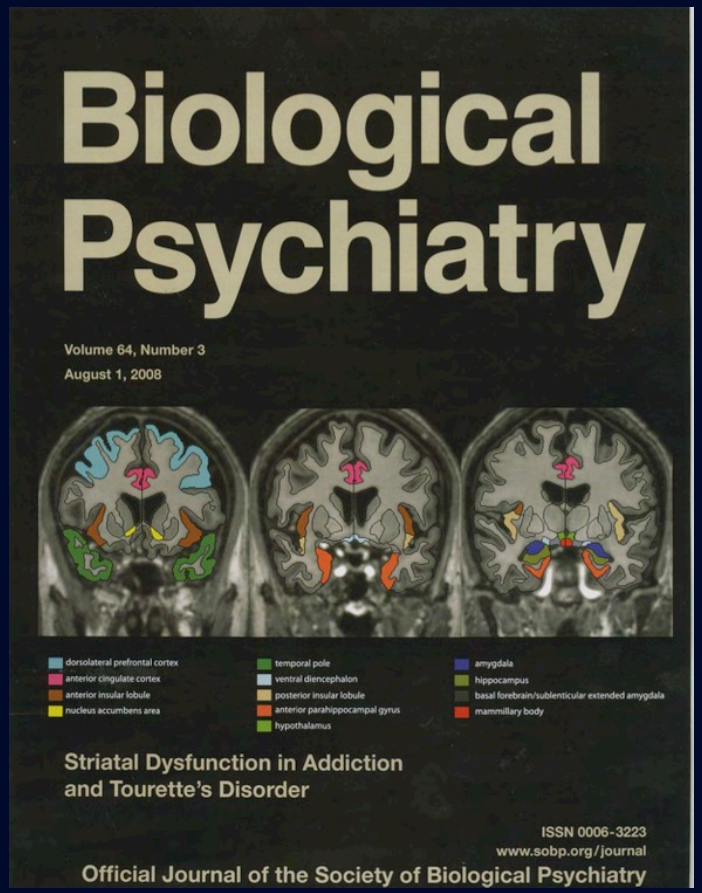


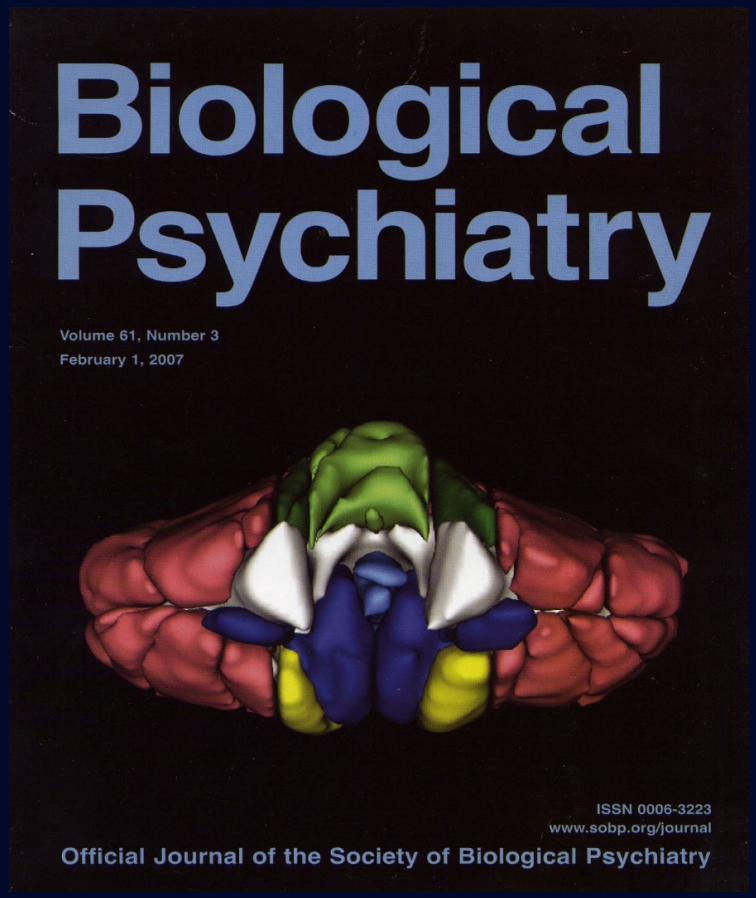




The CMA Snapshot (brief history)

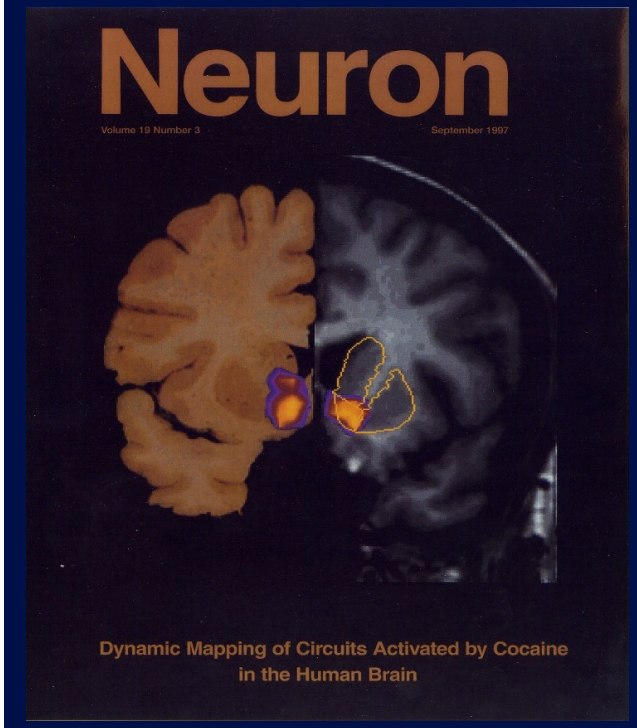
- **Pioneering studies of morphometric analysis in obsessive-compulsive disorder (OCD) were conducted by Dr. Scott Rauch**, then Director of Psychiatric Neuroimaging at MGH and currently the President and Psychiatrist-in-Chief of McLean Hospital in Boston.



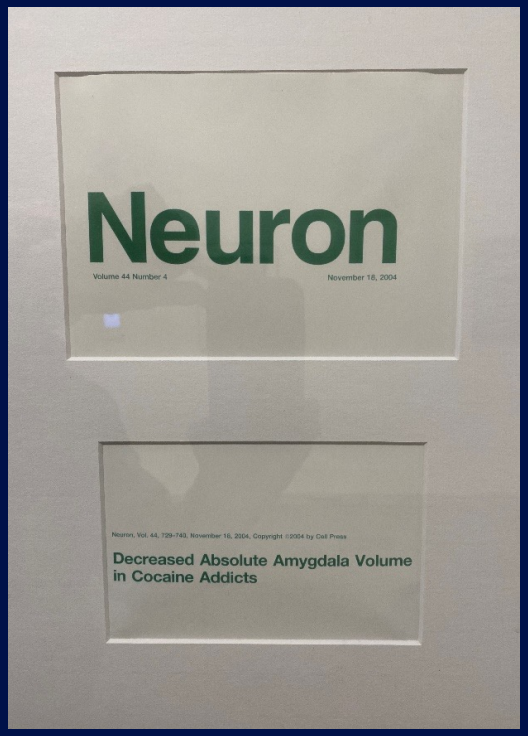


The CMA Snapshot (brief history)

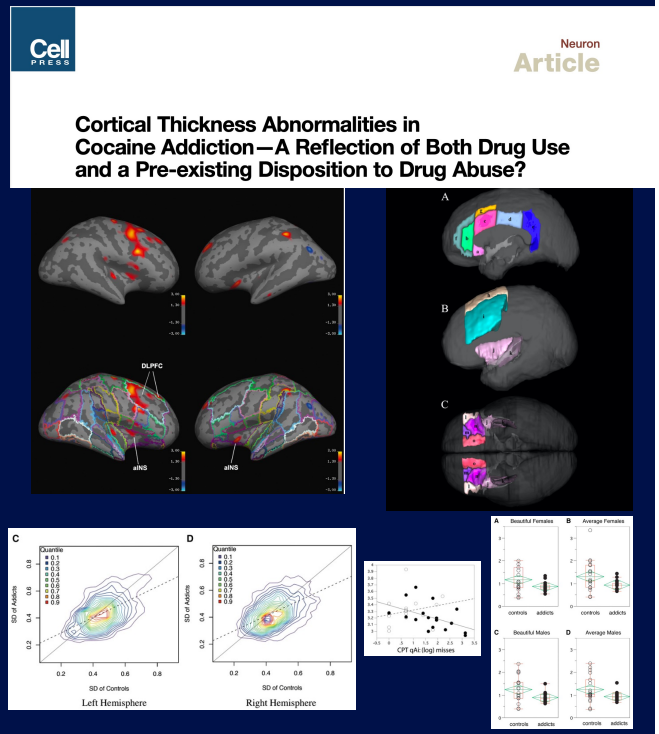
- The close collaboration of neurobiologically and clinically-oriented scientists with technologists (CMA and NMR Center at MGH) became the basis for landmark studies in brain imaging such as in cocaine addiction with colleagues Hans Breiter, Greg Gasic and Steve Hyman.



Breiter, Hyman, et al., Neuron, 1997



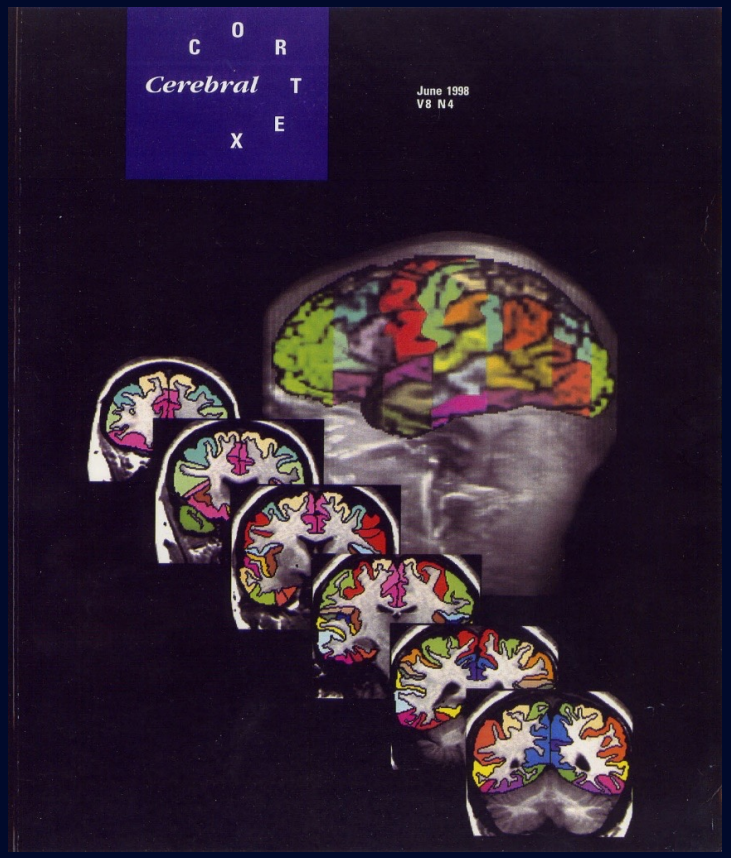
Breiter, Gasic, et al., Neuron, 2004



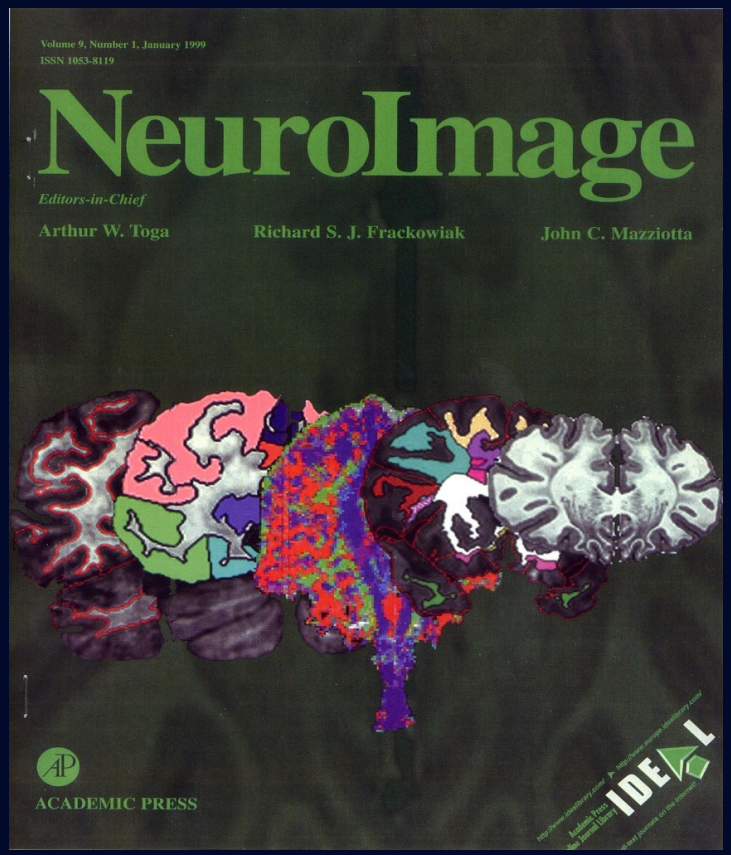
Breiter, Gasic, et al., Neuron, 2008

The CMA Snapshot (brief history)

By 1999, a description of the MRI brain volumetrics field of science (Caviness et al., 1999) was developed, consisting of a theoretical framework for quantitative brain imaging-based anatomy.



Kennedy, Caviness, Makris et al., Cer Cor, 1998



Makris, Meyer, Caviness, et al., NI, 1999

In 2000-2004, the CMA framework generated the human Harvard Oxford Atlas (HOA), which in the context of the CMA-NMR/A.A. Martinos Center for Biomedical Imaging partnership, provided the gold standard for validation of the fully automated FreeSurfer subcortical segmentation and cortical parcellation system (Fischl, et al. 2002, 2004).