

Presentation 4 – Richard Briggs

Neuroimaging Innovations to Detect Subtle Alterations in Brain Function

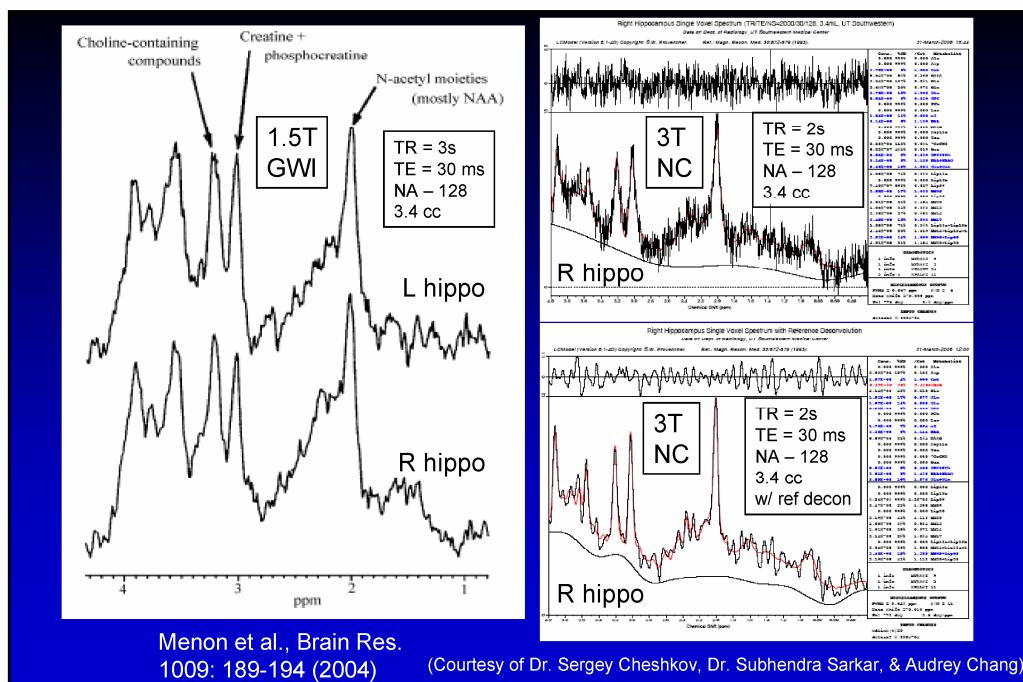
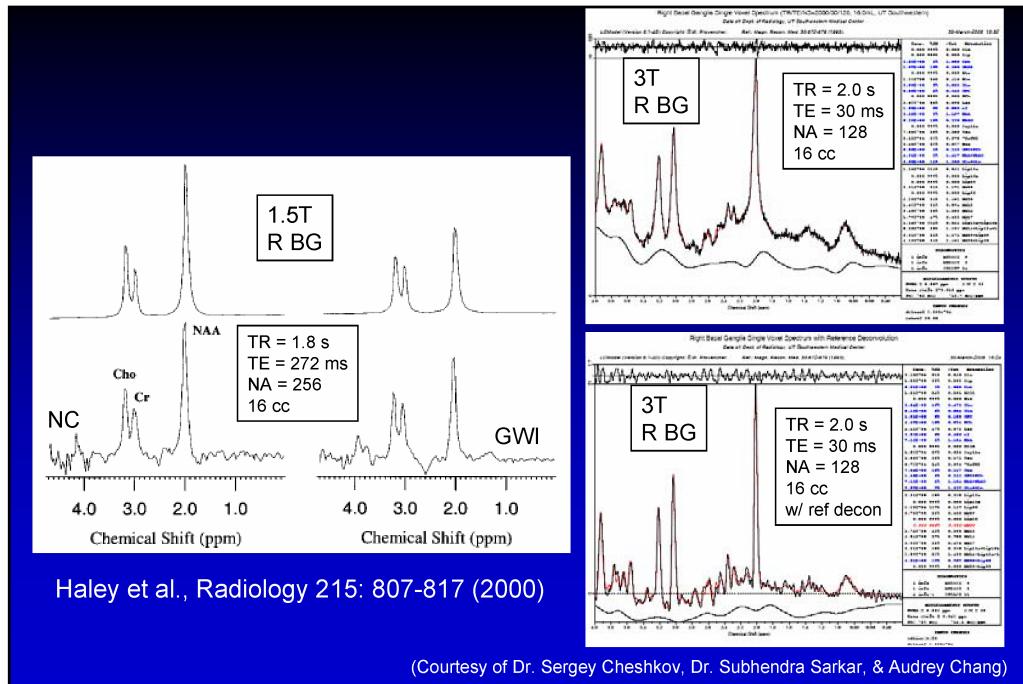
Richard W. Briggs, Ph.D.

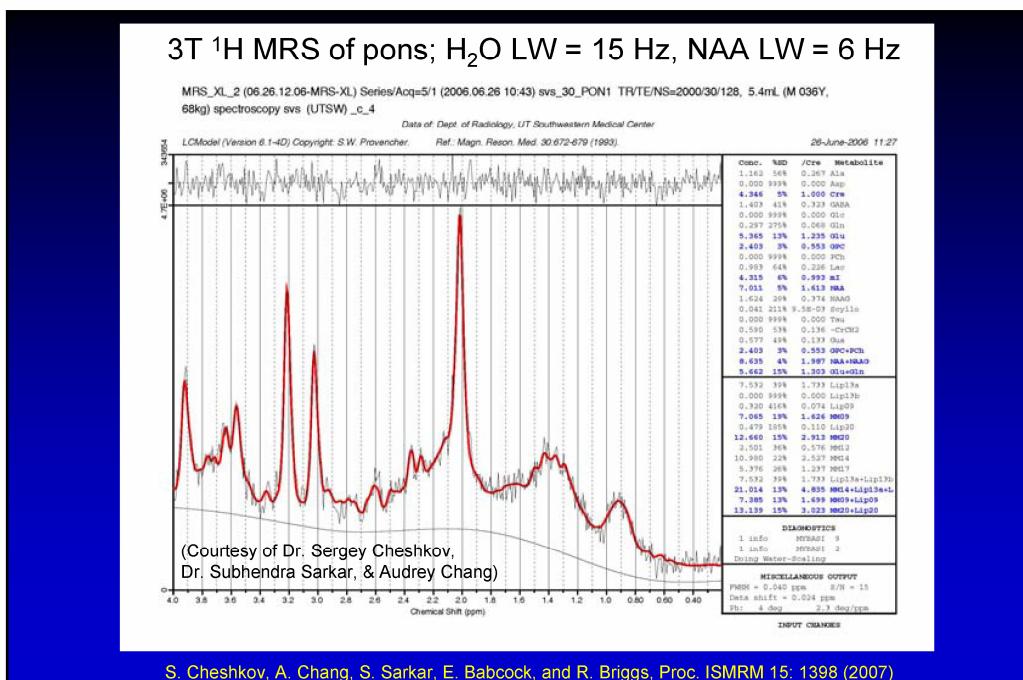
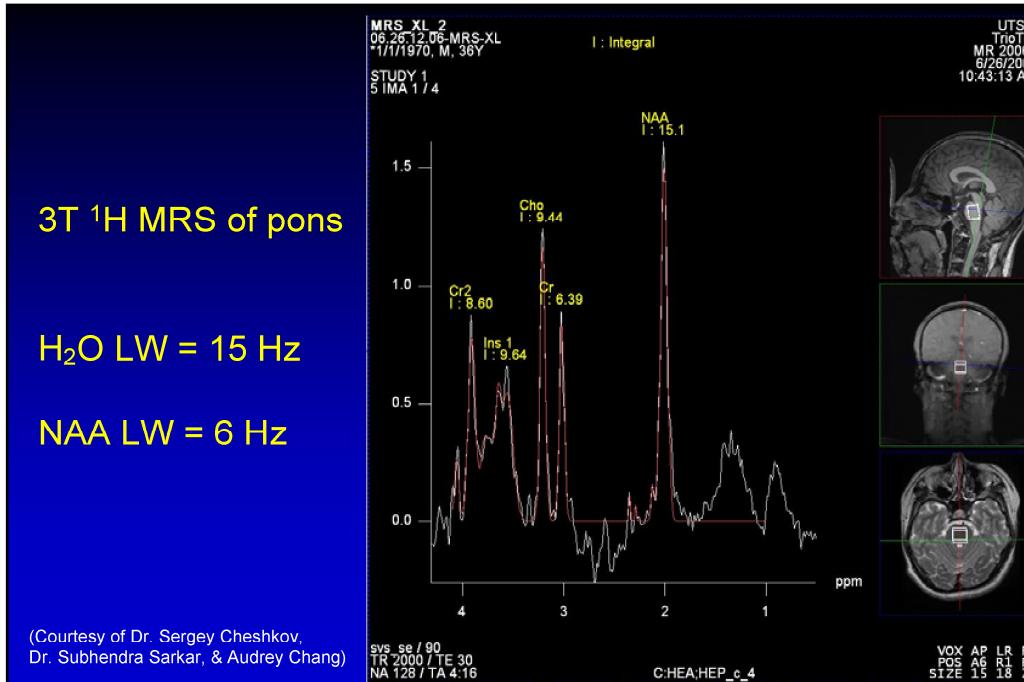
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Imaging Methods of Assessing Brain Structure and Function

- **^1H Spectroscopy**
- **Perfusion and CBF Imaging (ASL)**
- **BOLD fMRI**
 - > Connectivity mapping
 - > HRF analysis of temporal information
- **Diffusion Tensor Imaging (DTI)**
- **EEG (high-density, source localization)**
- **NIRS (optical imaging of oxy-, deoxy-Hb)**

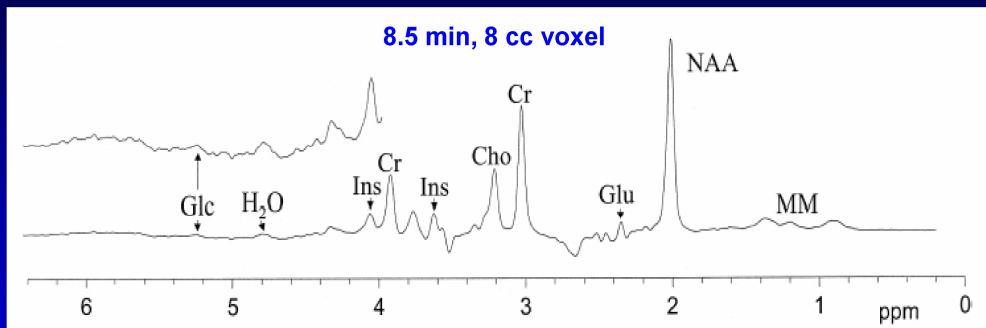




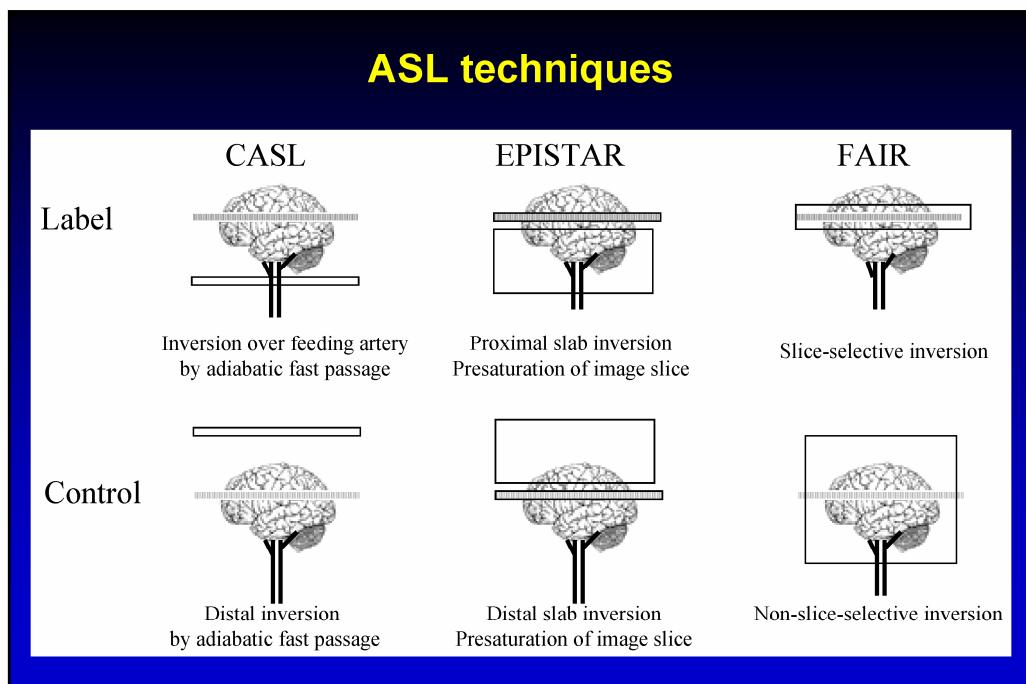
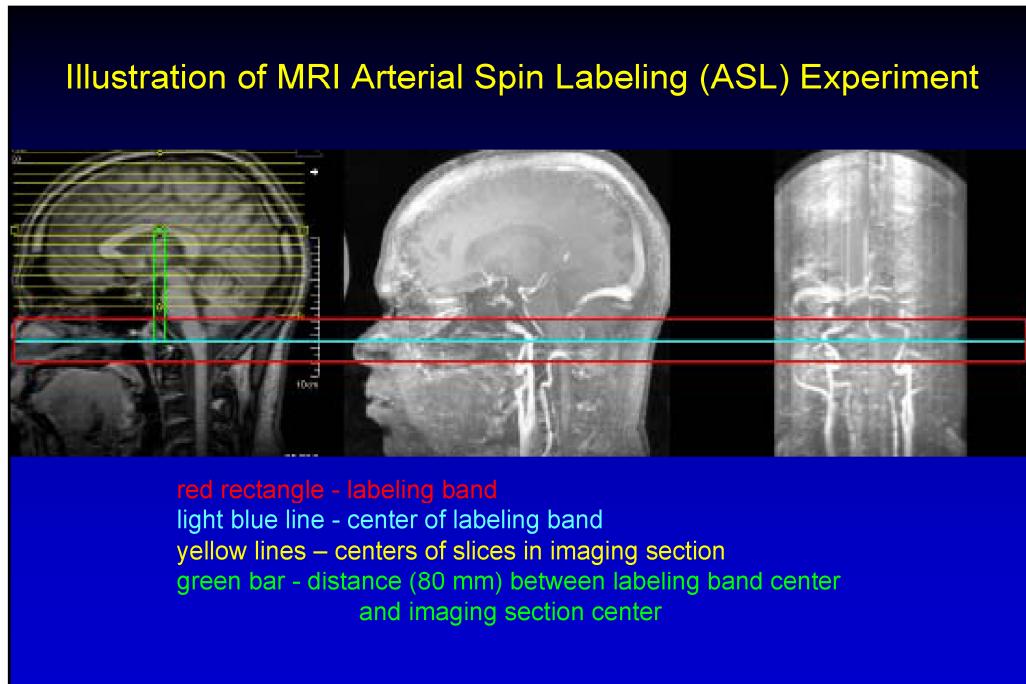
State-of-the-Art MRS Methods

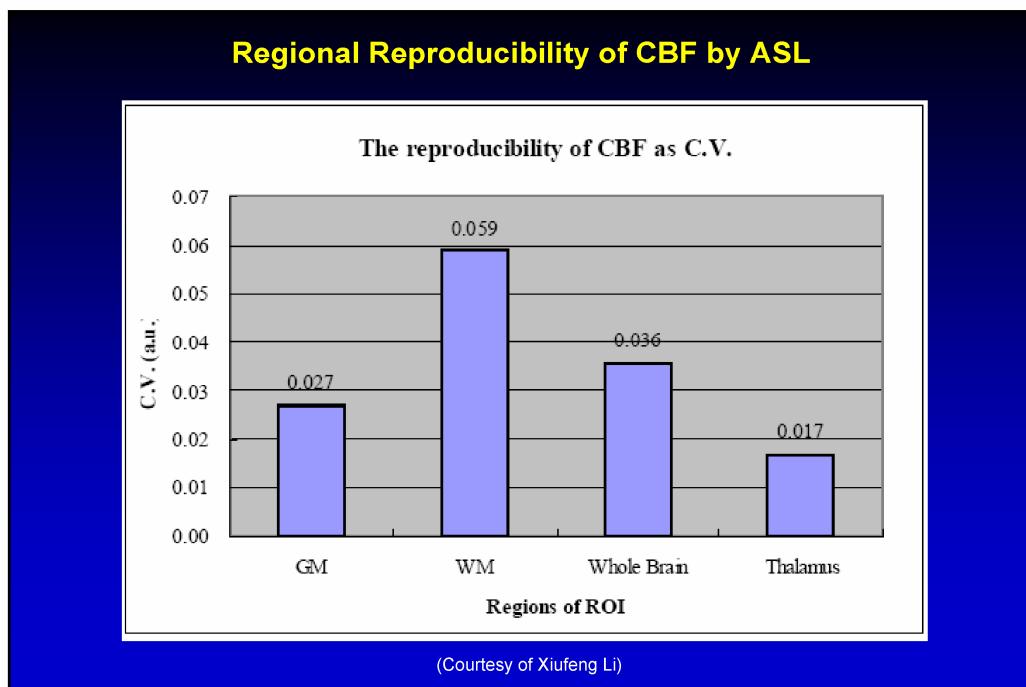
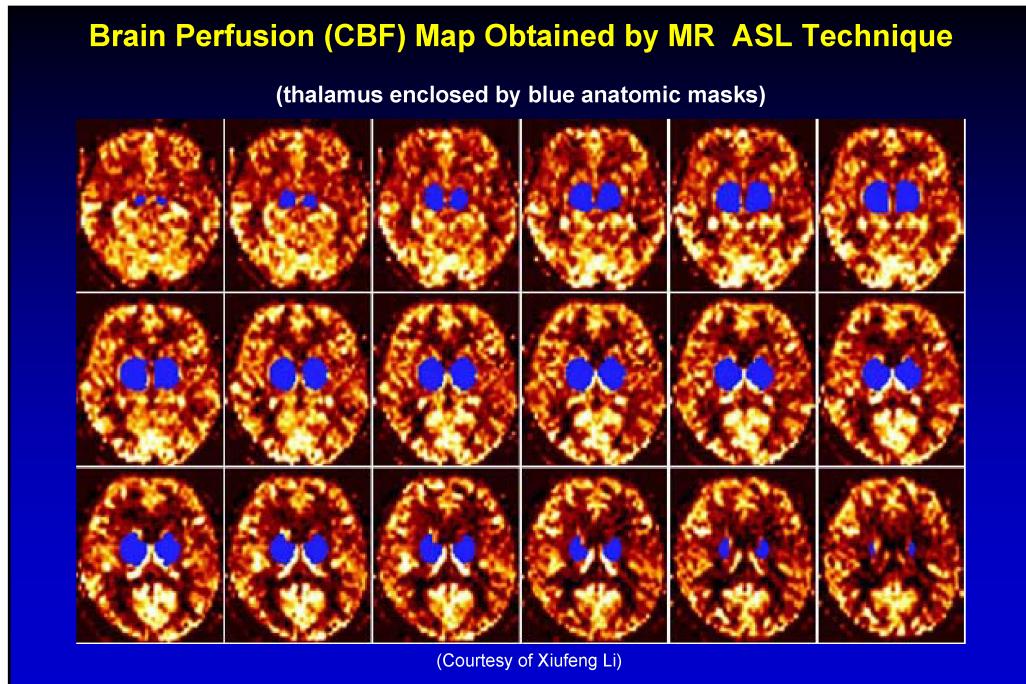
- Measurement of in vivo relaxation times T_1 and T_2 for quantifying absolute metabolite concentrations
- Implementing 2D and 3D CSI for efficient multi-voxel data collection – can be used for metabolite mapping and ROI-based spectral analysis
- Developing EPSI and parallel array acquisition for rapid accelerated CSI data acquisition
- Very high-field (7T) MRS for improved SNR and spectral and spatial resolution
- Use of multinuclear MR spectroscopy (^{31}P , ^{13}C) to investigate pH, high-energy phosphate status, and detailed metabolic pathways

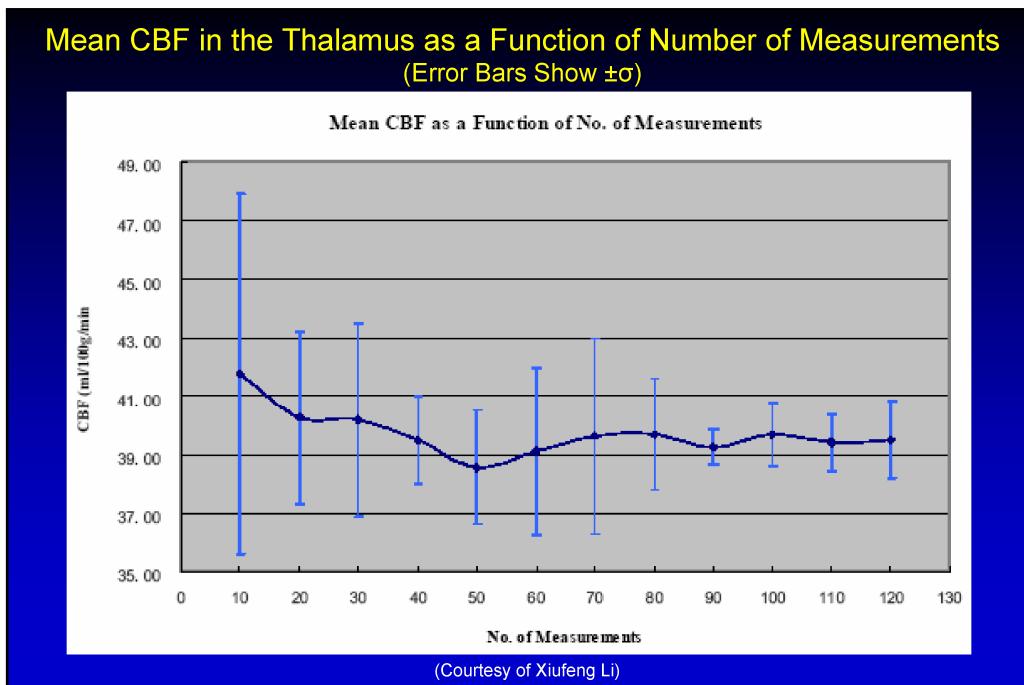
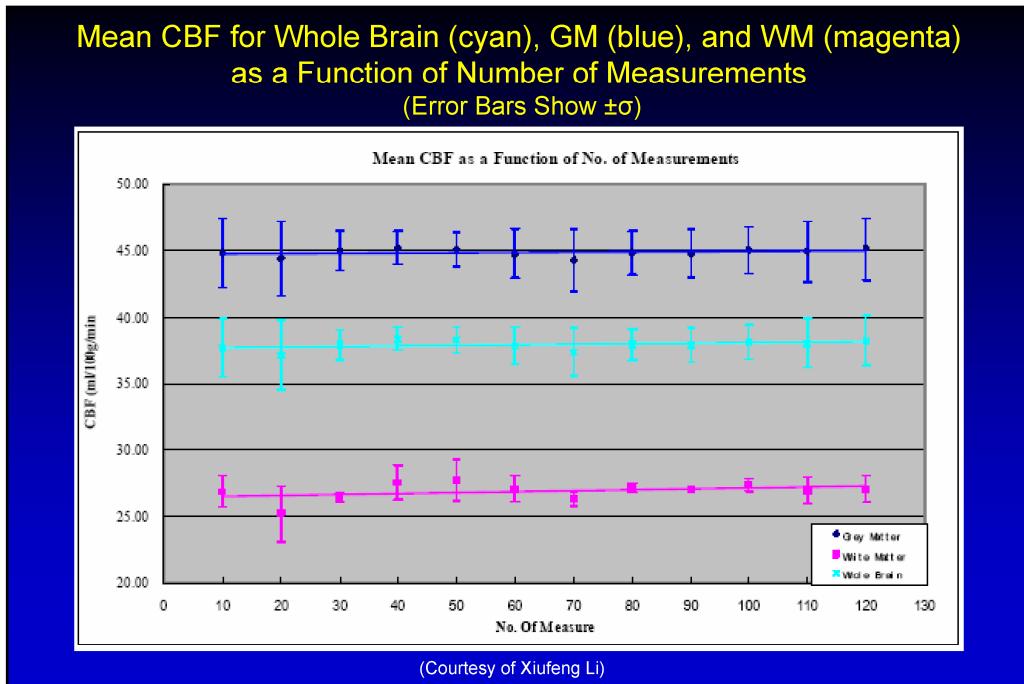
Water-Suppressed In Vivo Human Brain 1H Spectrum at 7T

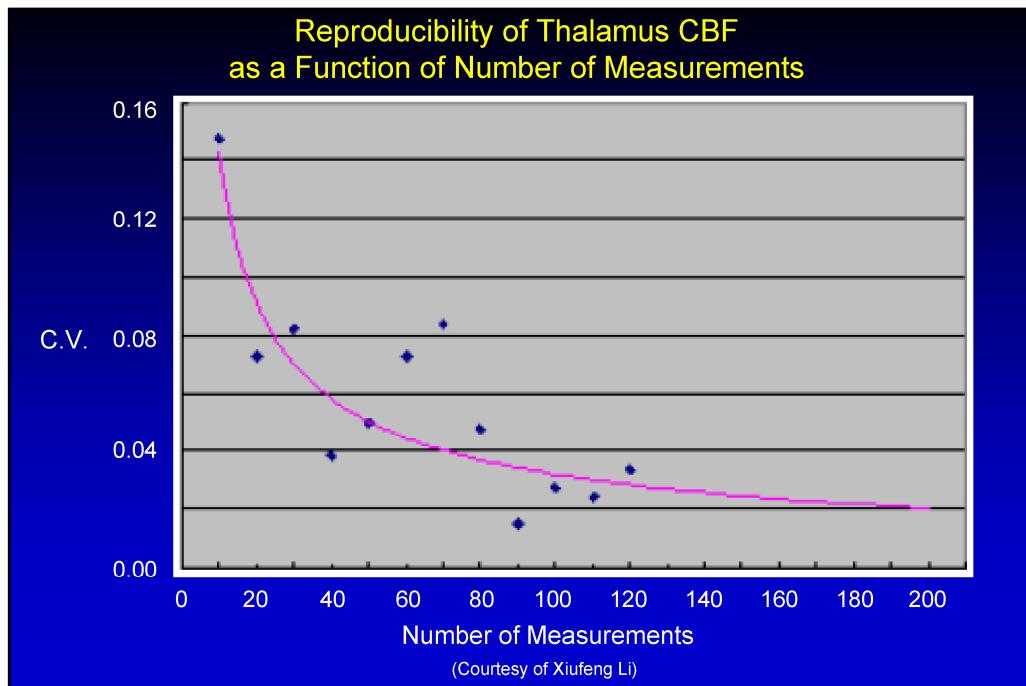


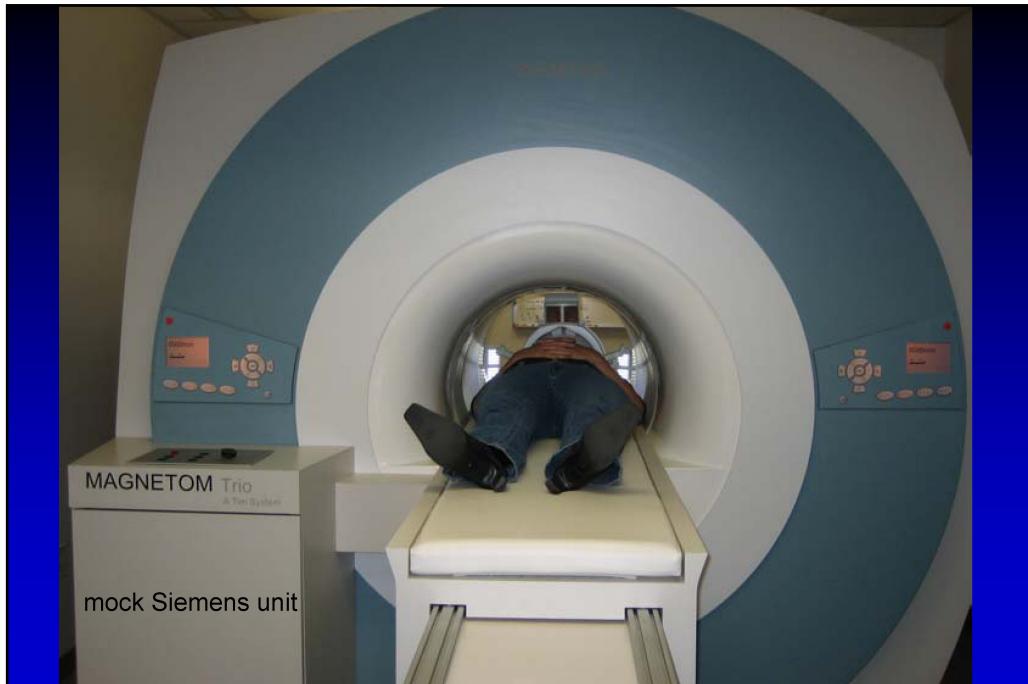
Terpstra, Ugurbil, and Gruetter, Magn. Reson. Med. 47: 1009-1012 (2002)



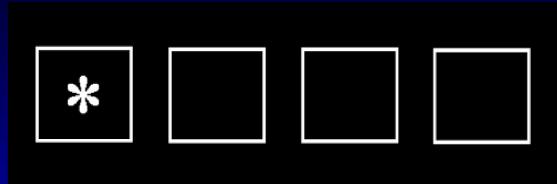






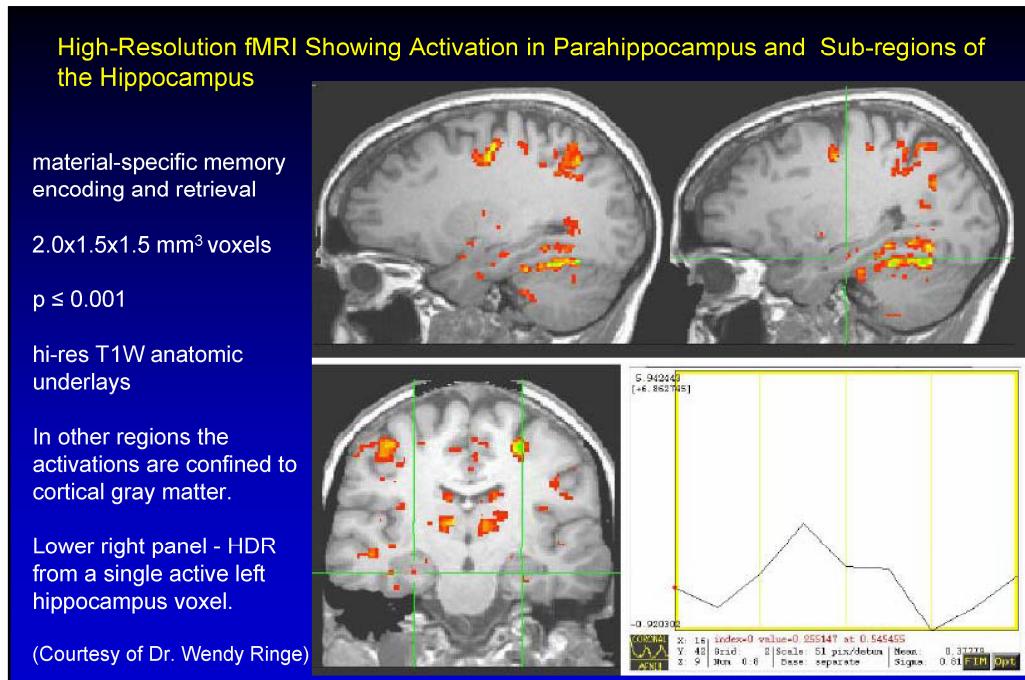
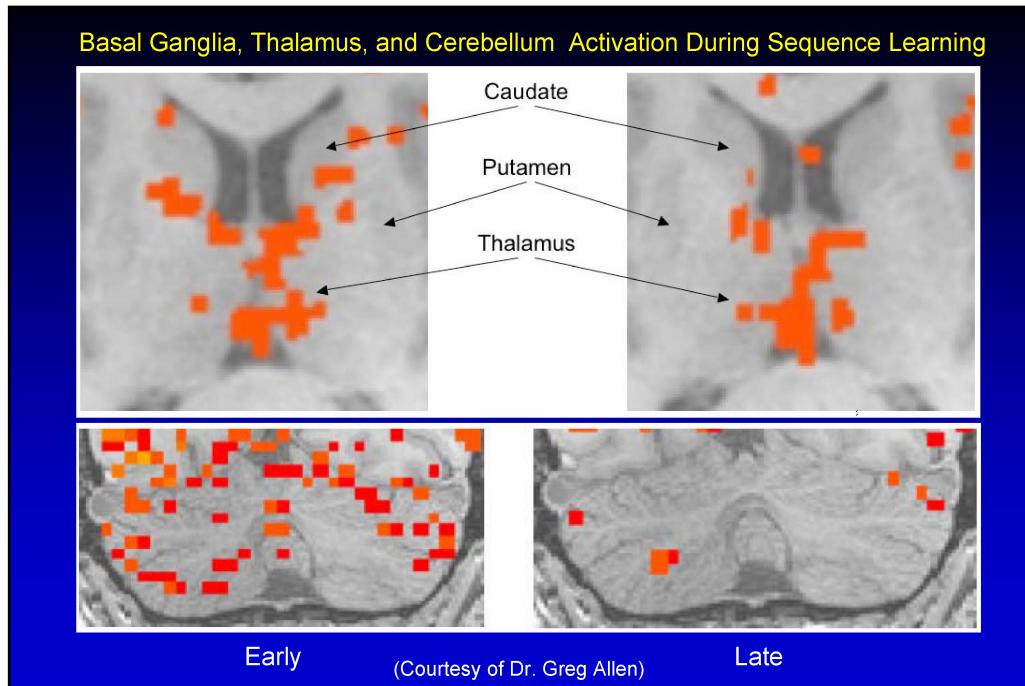


fMRI Serial Reaction Time Test (SRTT)



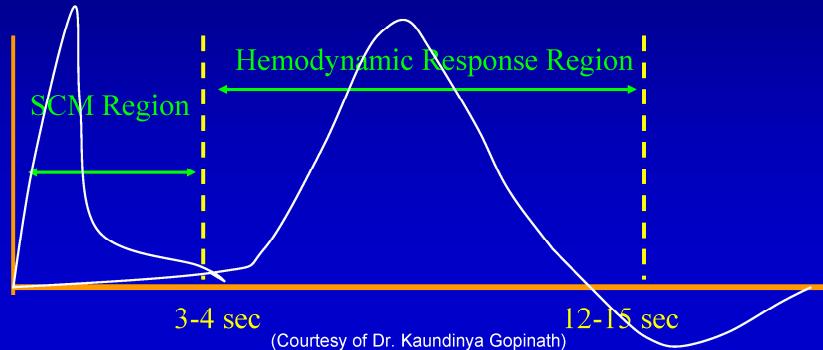
- Asterisk appears in one of boxes every second
- Asterisks appear pseudo-randomly (Random) or in a repeating 10-position sequence (Learn)
- Subjects press one of 4 buttons ASAP, corresponding to position of asterisk in 4 target boxes

(Courtesy of Dr. Greg Allen)



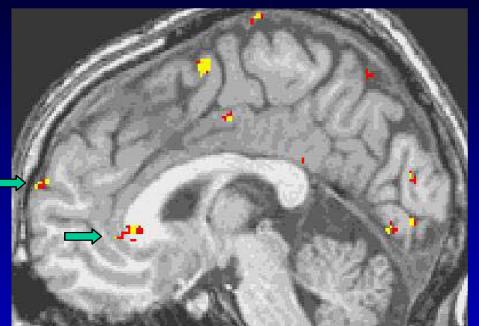
Removing Task-Correlated Motion Noise

- Our method reduces stimulus-correlated motion (SCM) (noise in event-related word generation paradigms).
- We use the idea that the system's impulse response to SCM is temporally resolved from task related hemodynamic response. (Birn et al; HBM 1999;5:106-114)

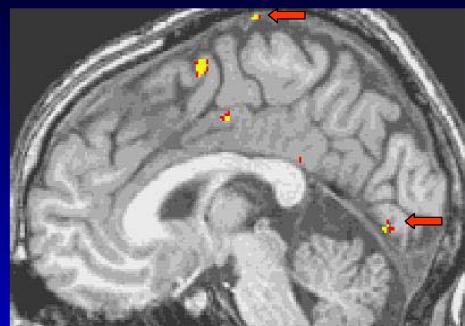


(Courtesy of Dr. Kaundinya Gopinath)

Results



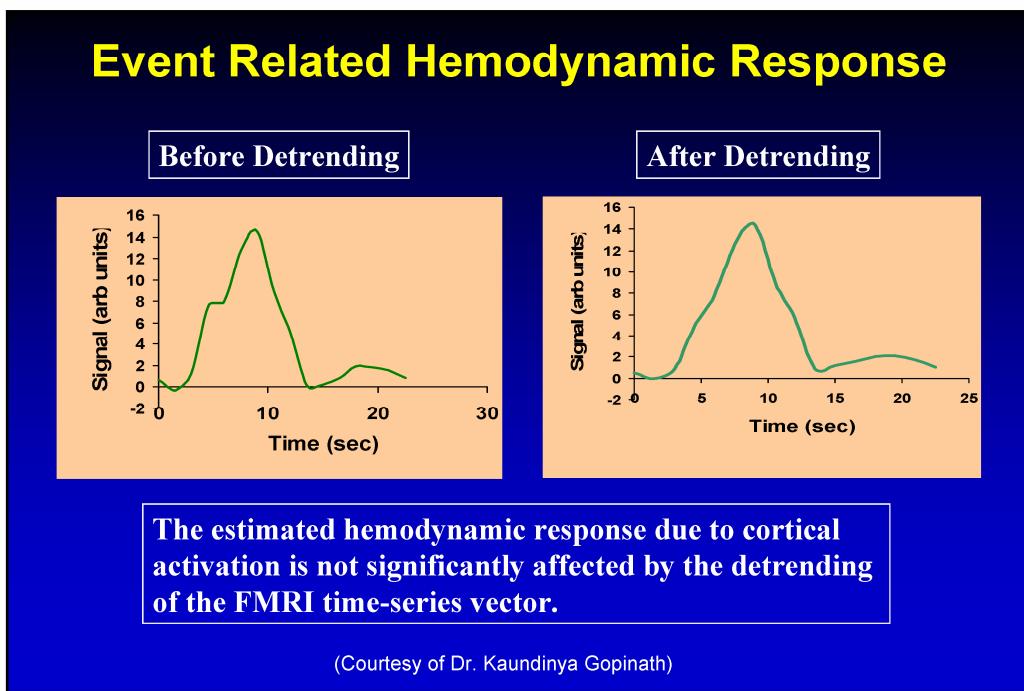
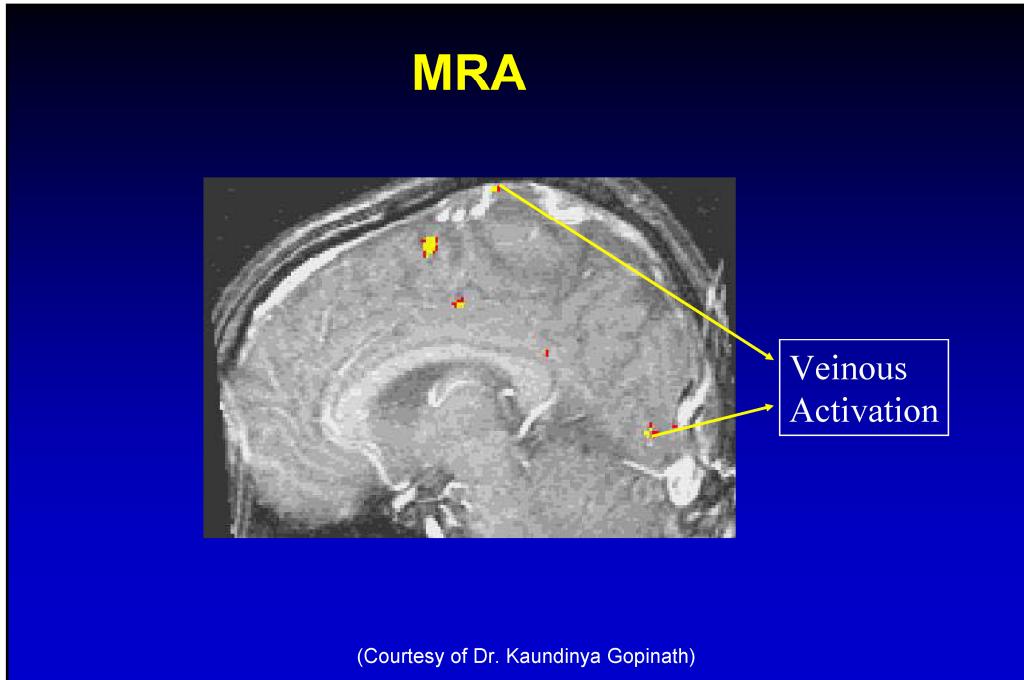
Before Detrending

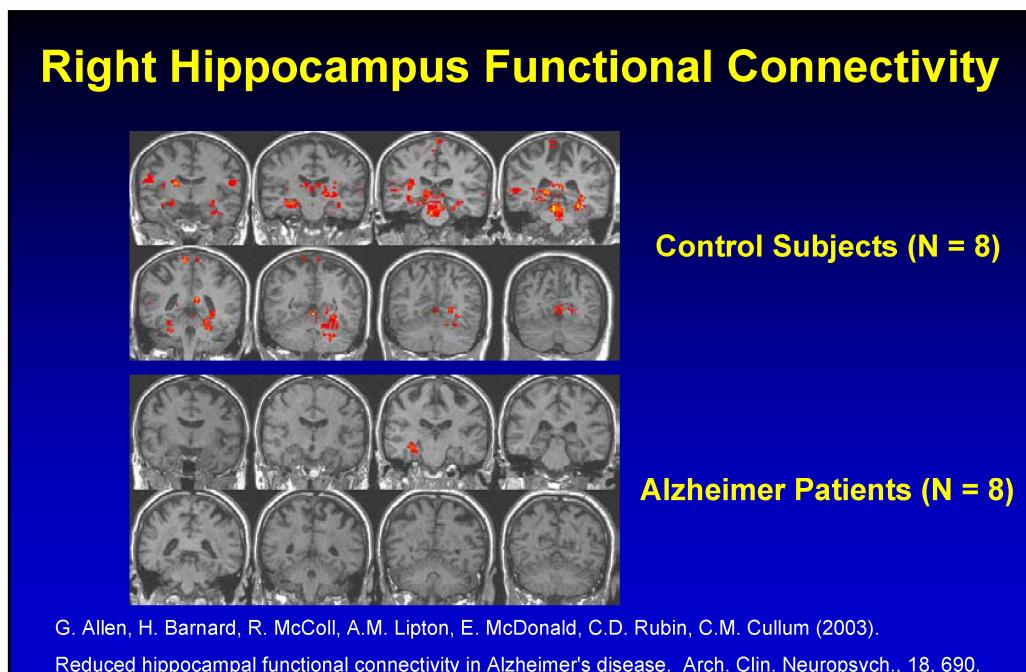
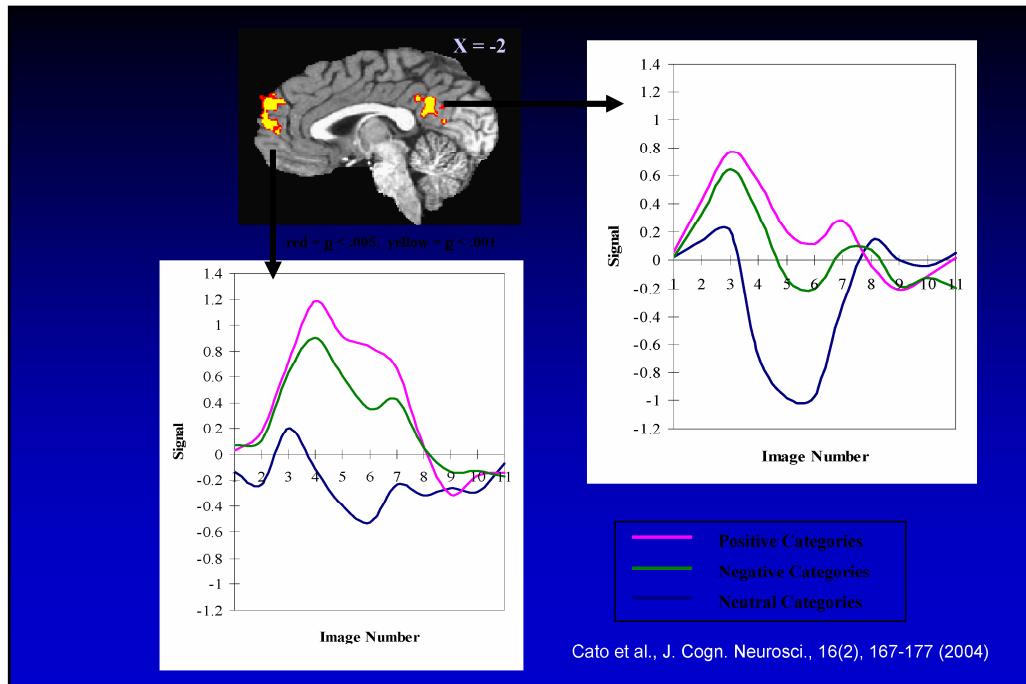


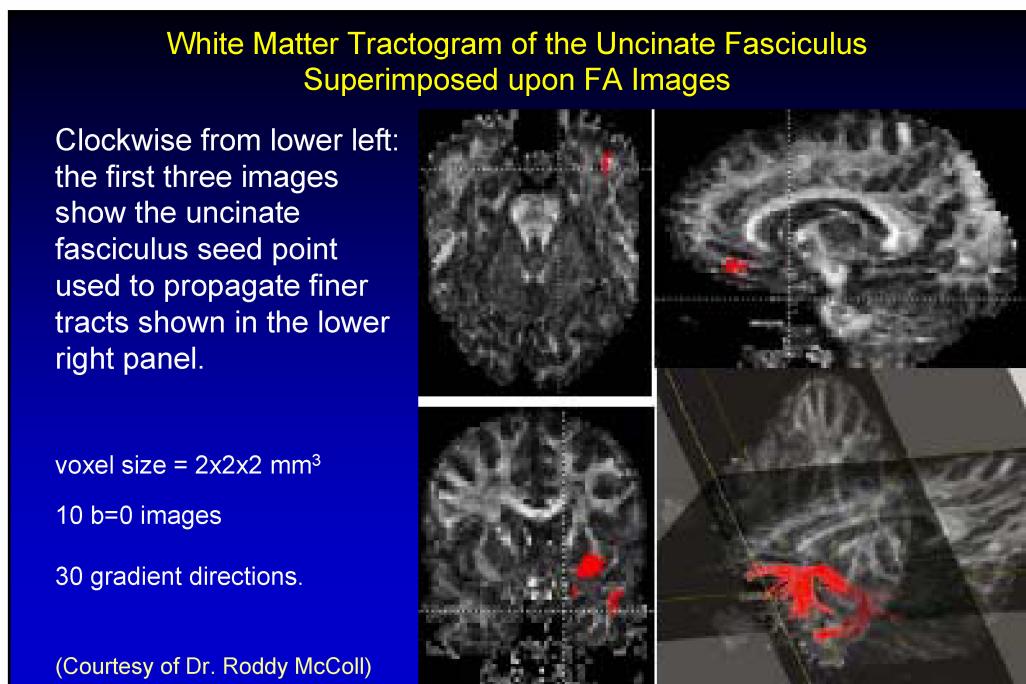
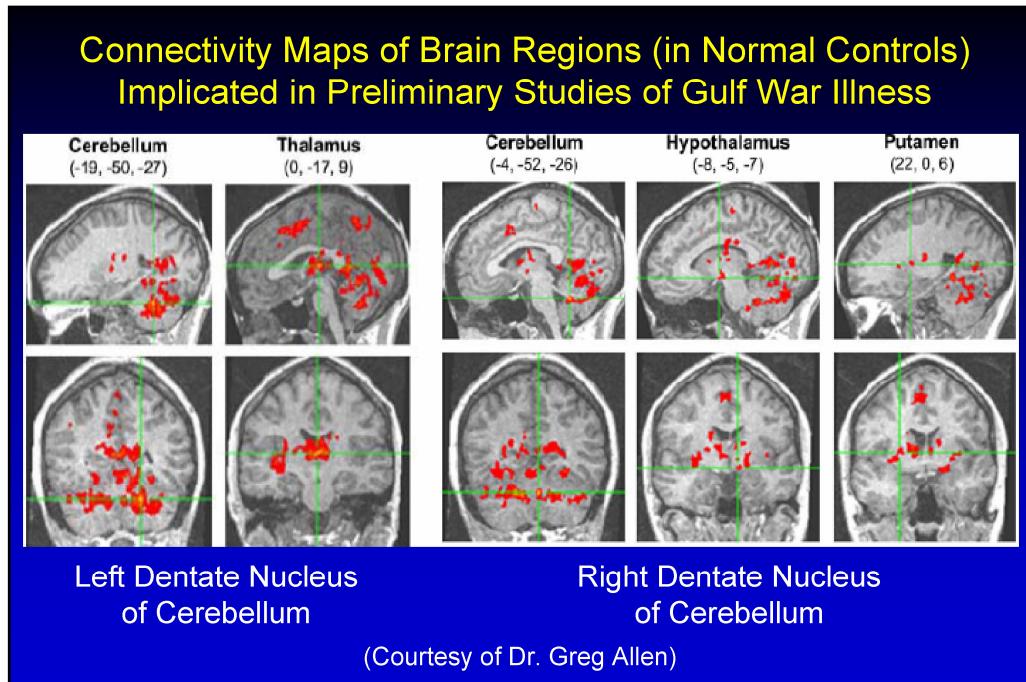
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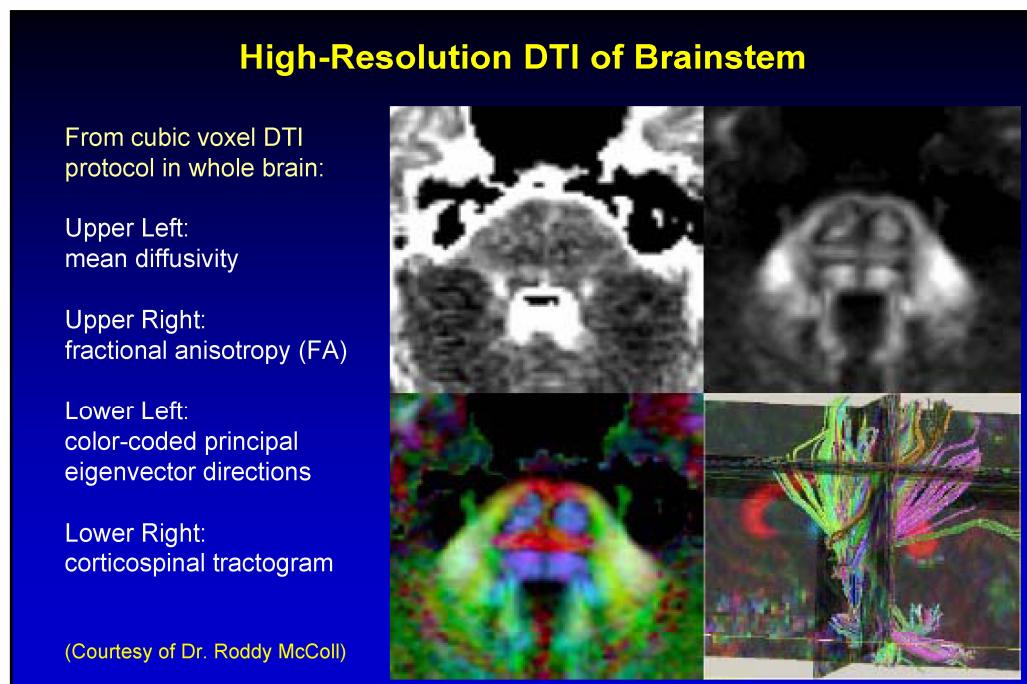
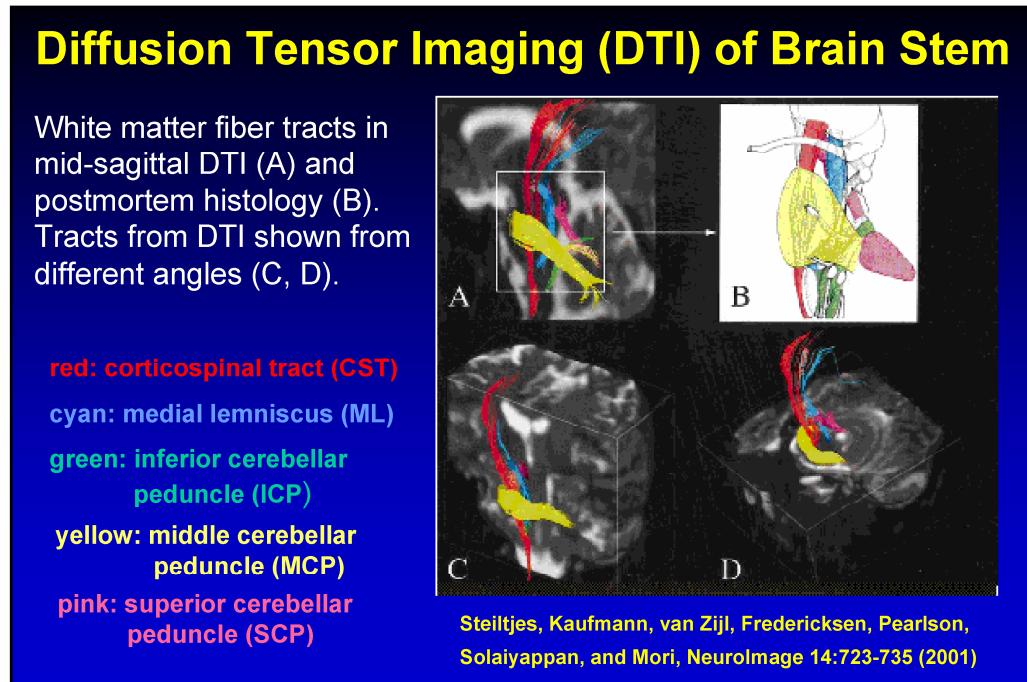
Red: $F(11,578) > 9$
Yellow: $F(11,578) > 11$

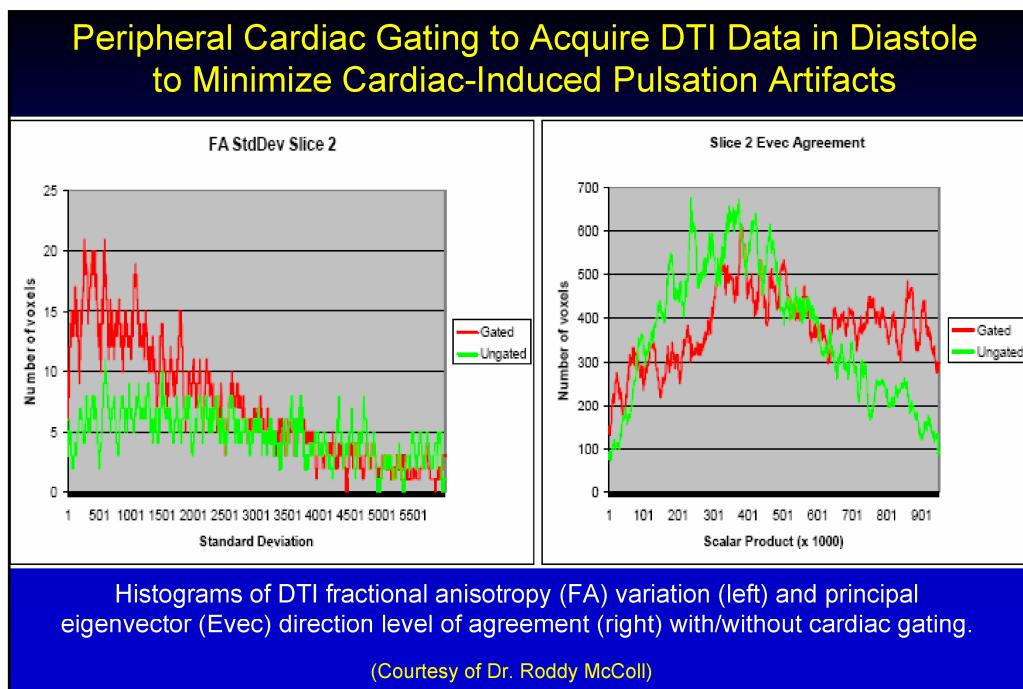
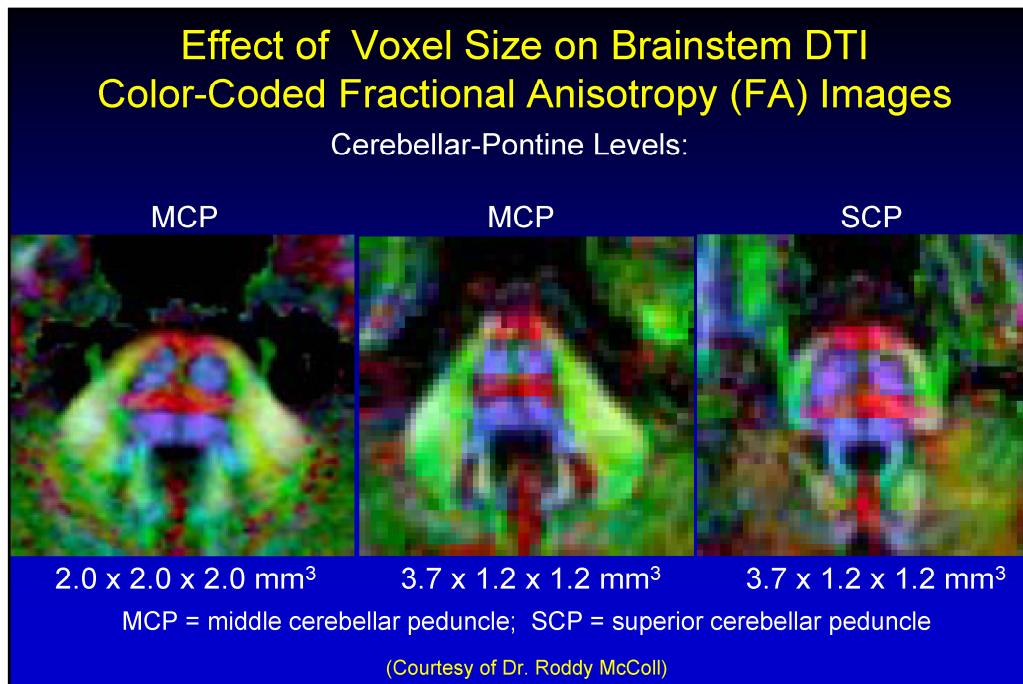
(Courtesy of Dr. Kaundinya Gopinath)

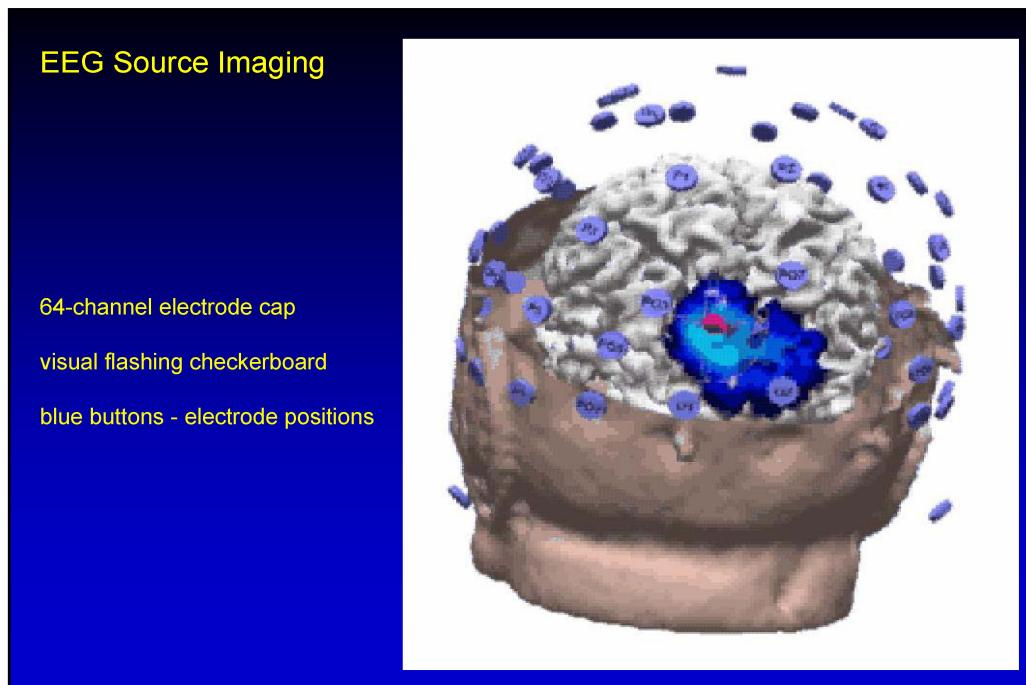


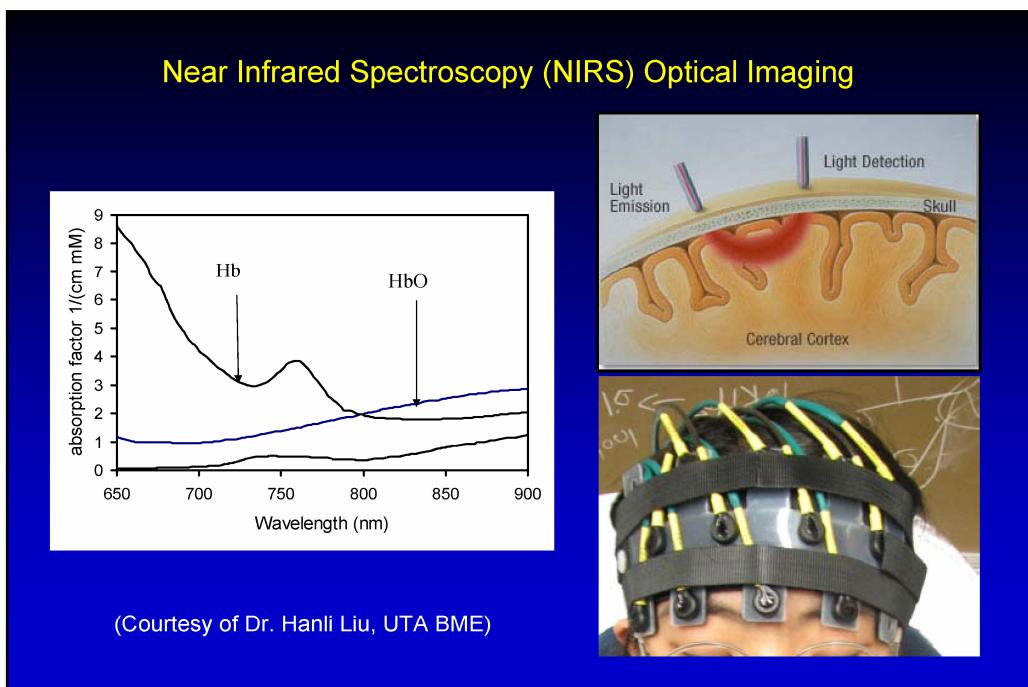


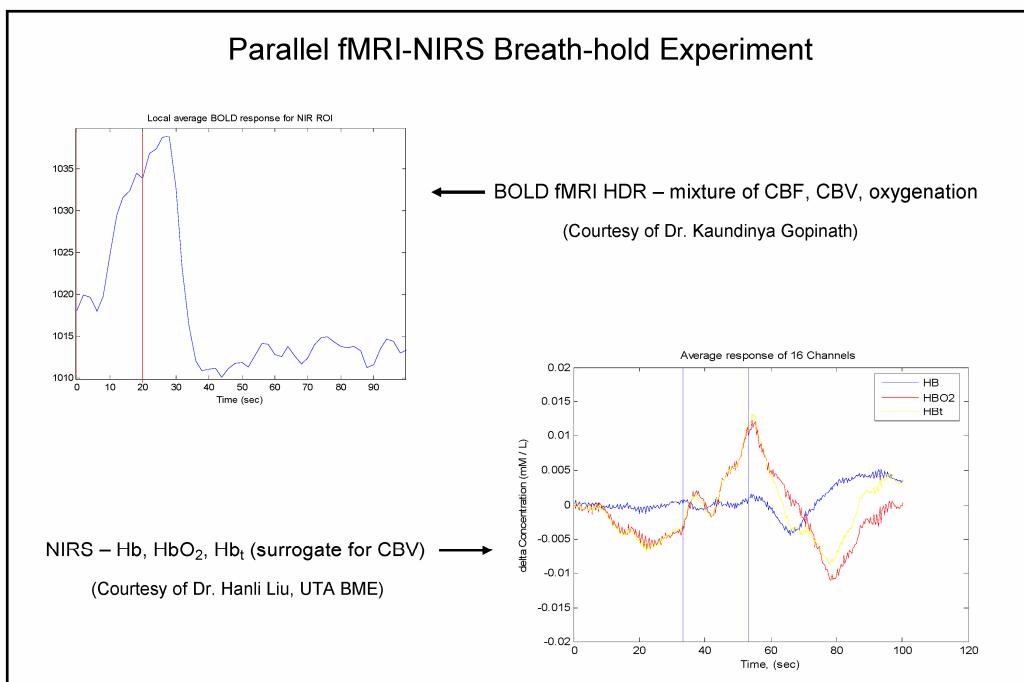
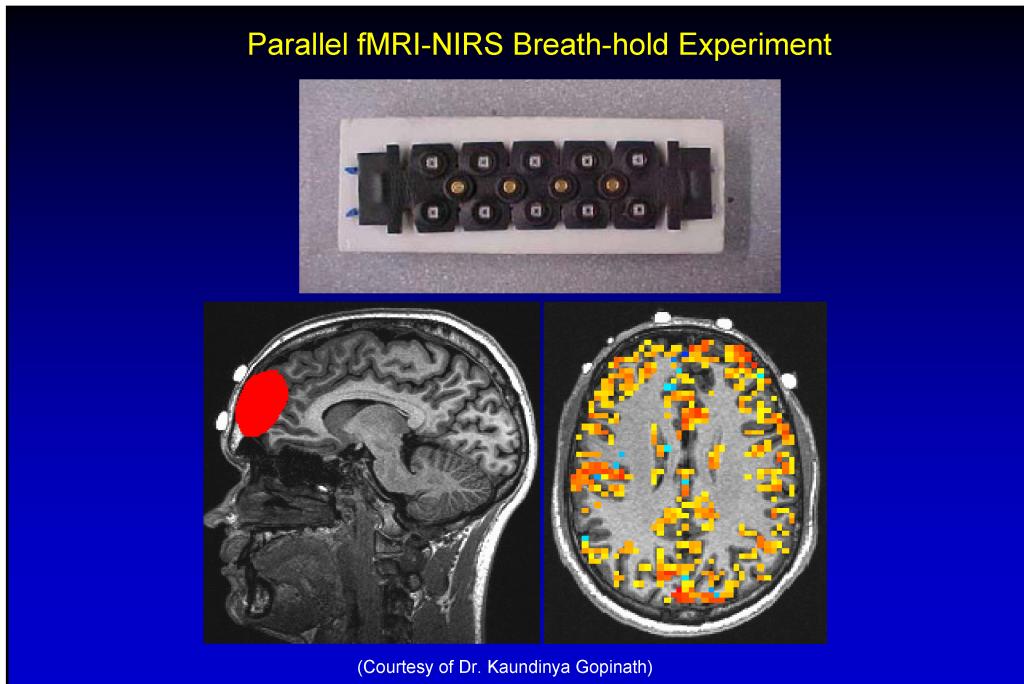


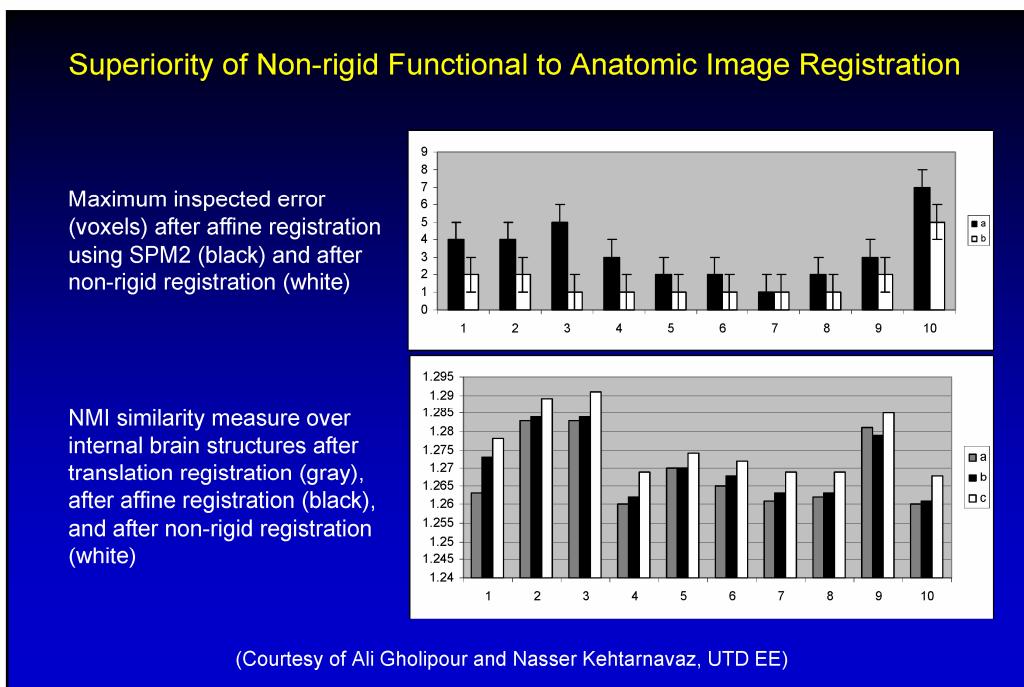
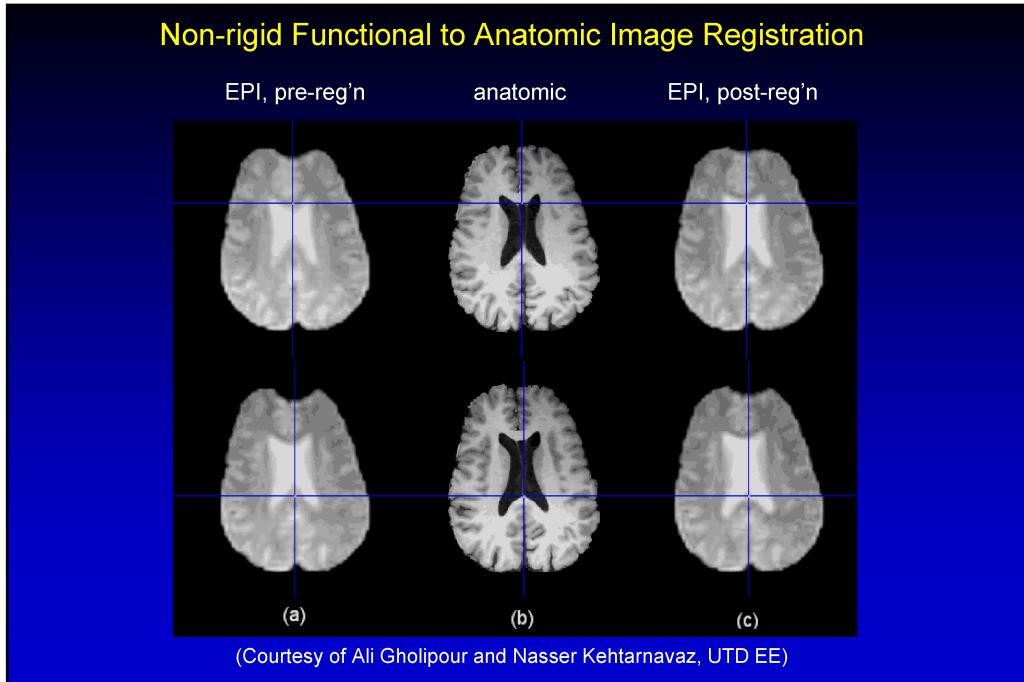


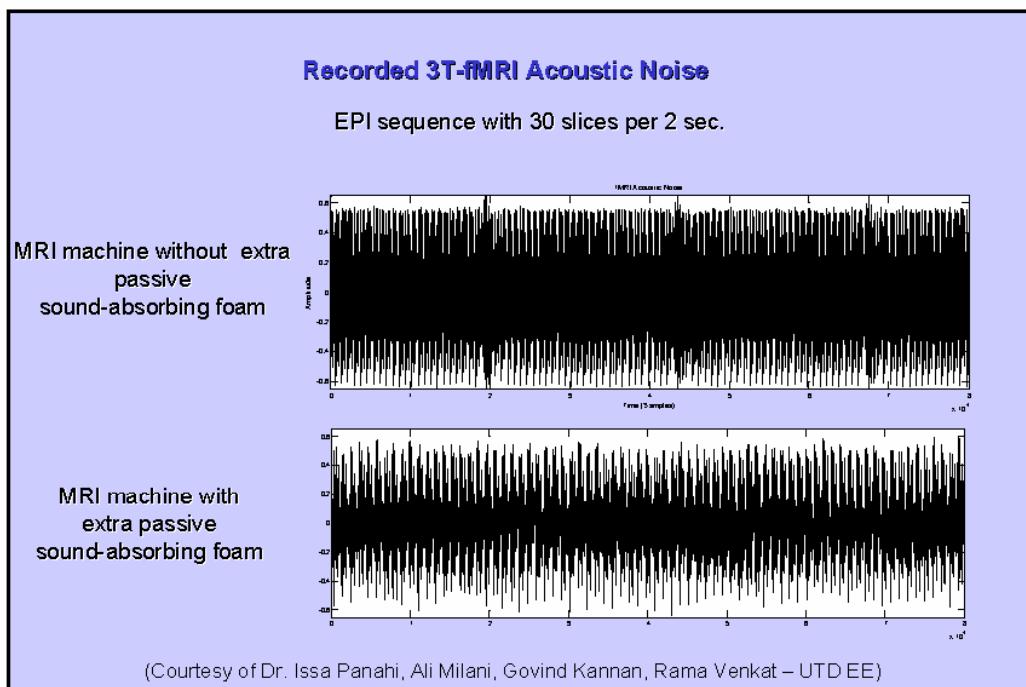
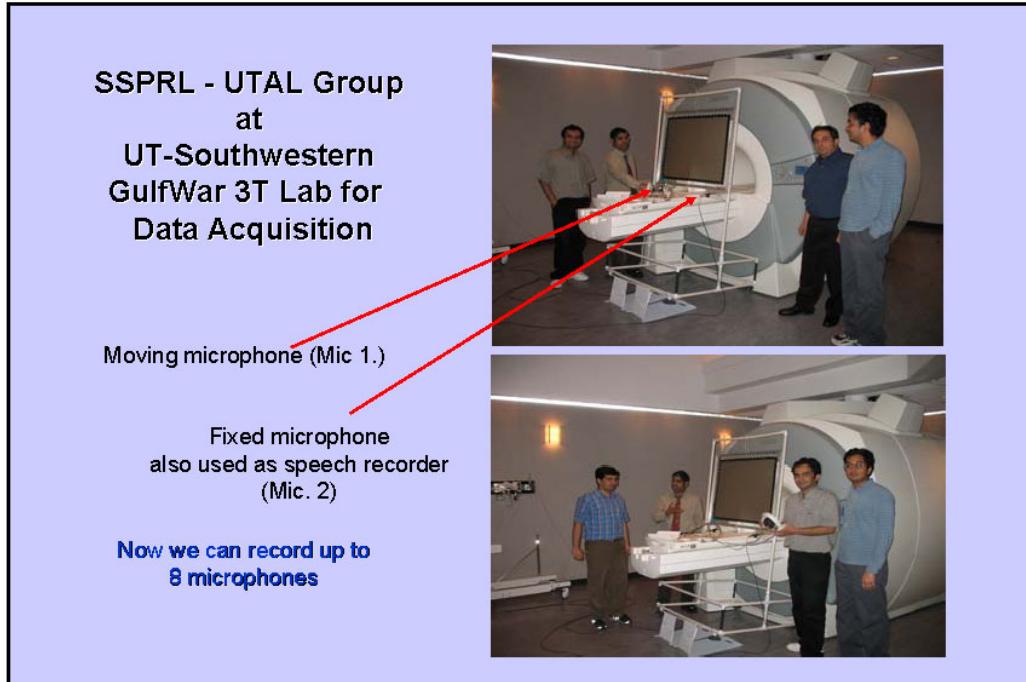


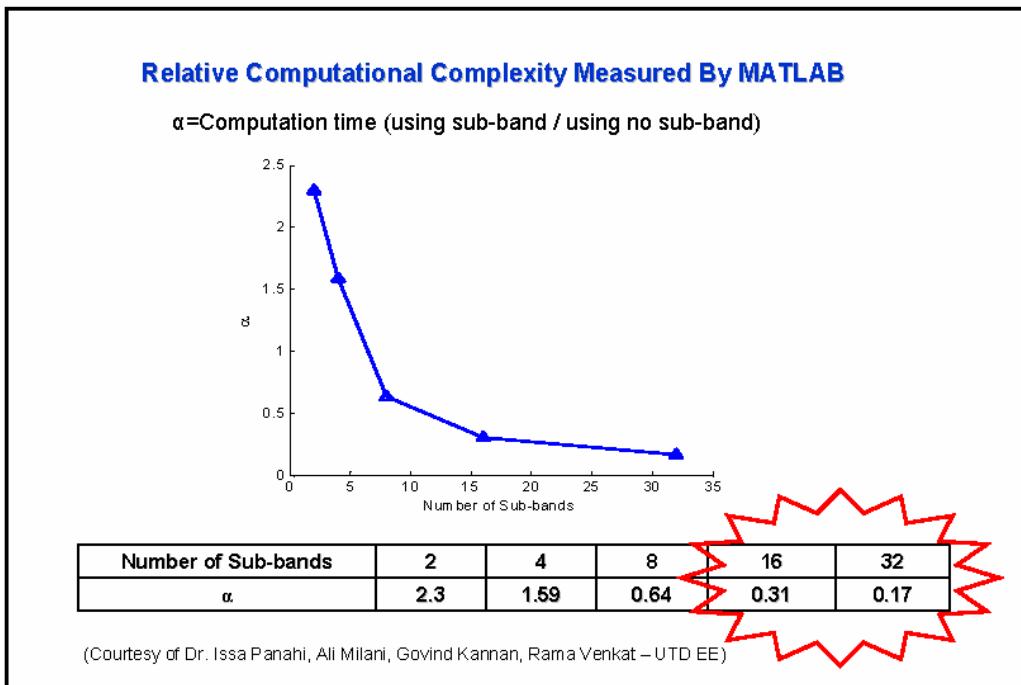
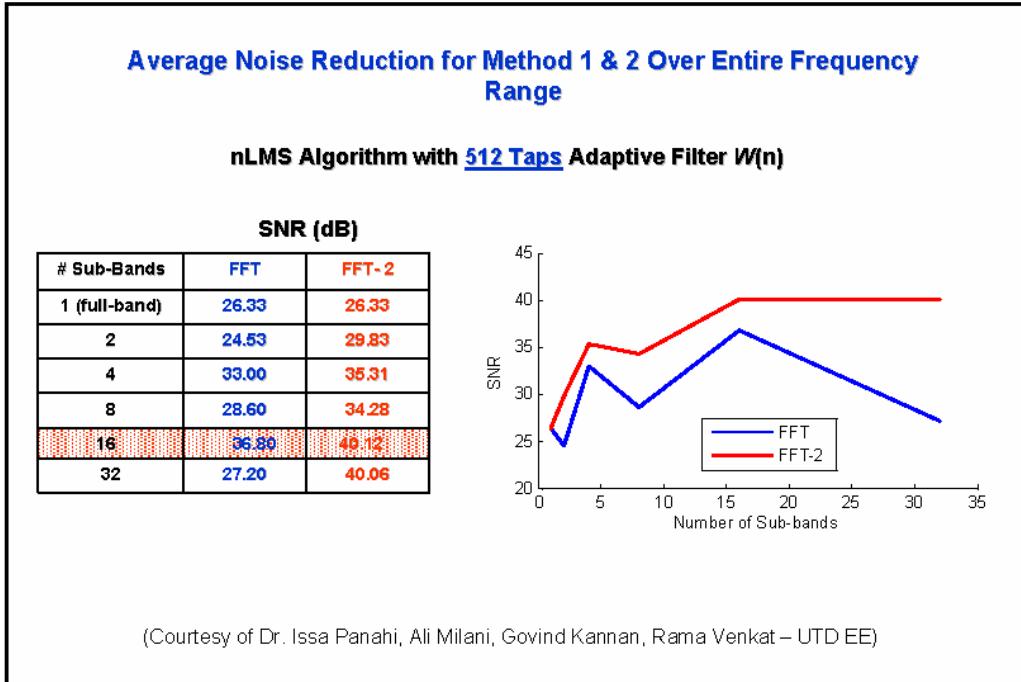












Results for the different number of sub-bands

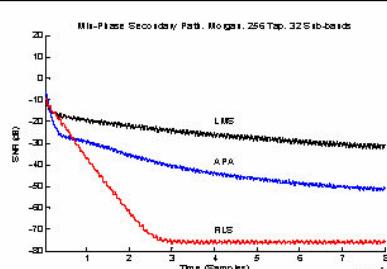
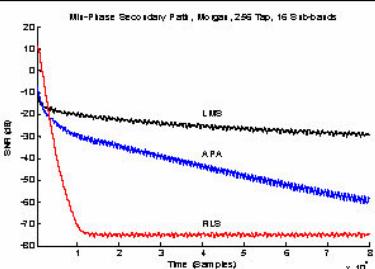
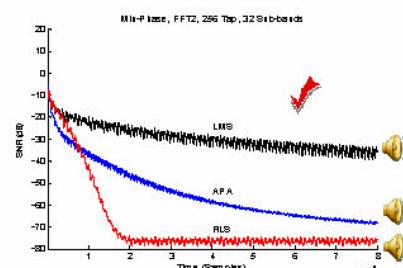
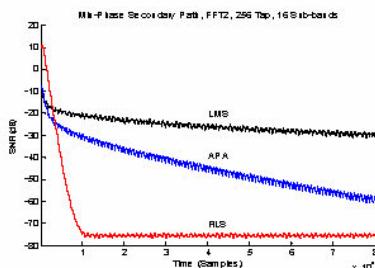
Initial SNR= -10 dB

Number of Bands	Convergence Sound
2	Speaker icon
4	Speaker icon
8	Speaker icon
16	Speaker icon with a red checkmark
32	Speaker icon

fMRI Noise	Speaker icon
Cancelled fMRI Noise by ANC	Speaker icon
Speech + fMRI Noise	Speaker icon
Recovered Speech (SE)	Speaker icon

(Courtesy of Dr. Issa Panahi, Ali Milani, Govind Kannan, Rama Venkat – UTD EE)

Minimum Phase Secondary Path 16 Sub-bands 32 Sub-bands



(Courtesy of Dr. Issa Panahi, Ali Milani, Govind Kannan, Rama Venkat – UTD EE)

