Functional MRI at the NIH

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&
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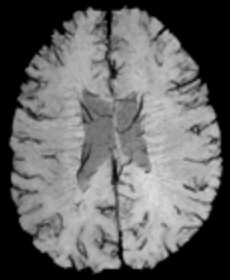
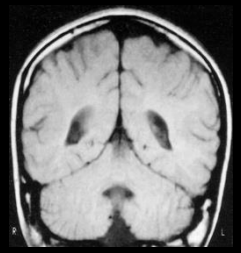
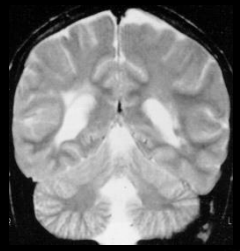
Venography



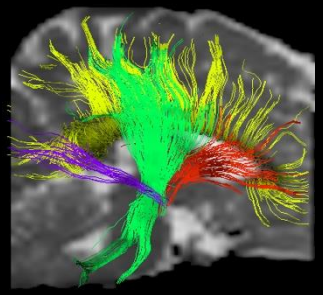
T1 weighted



T2 weighted



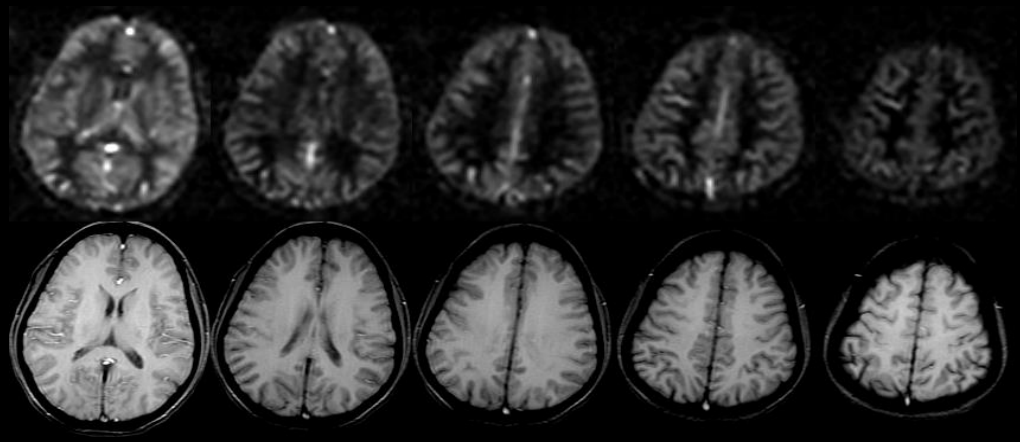
Fiber Track Imaging



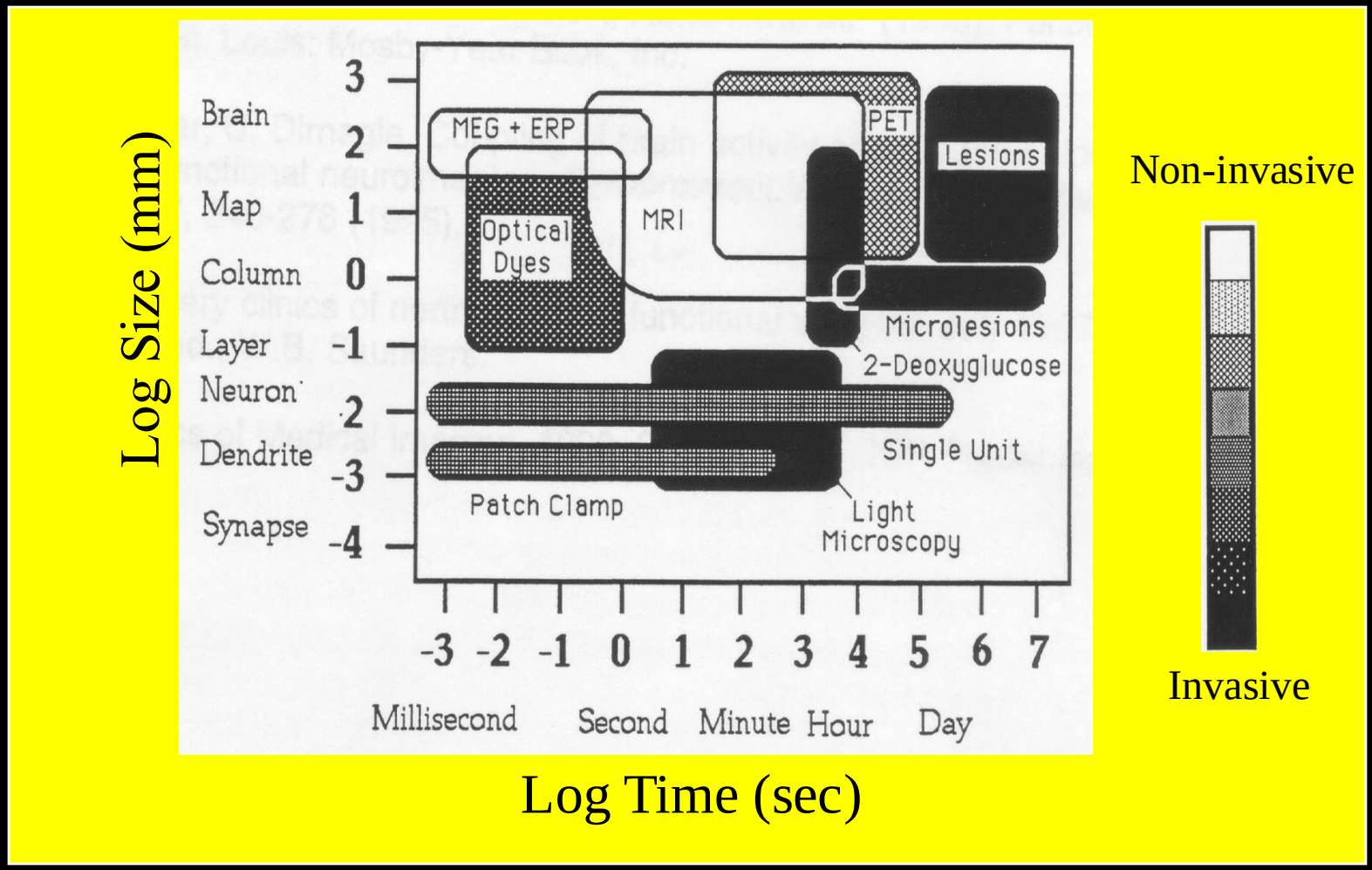
Anatomy

Angiography

Perfusion



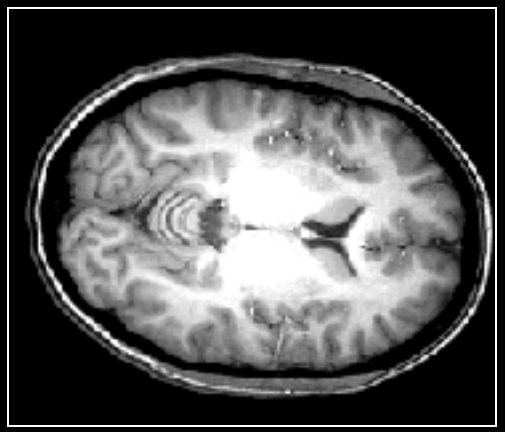
Functional Neuroimaging Techniques



MRI vs. fMRI

high resolution
(1 mm)

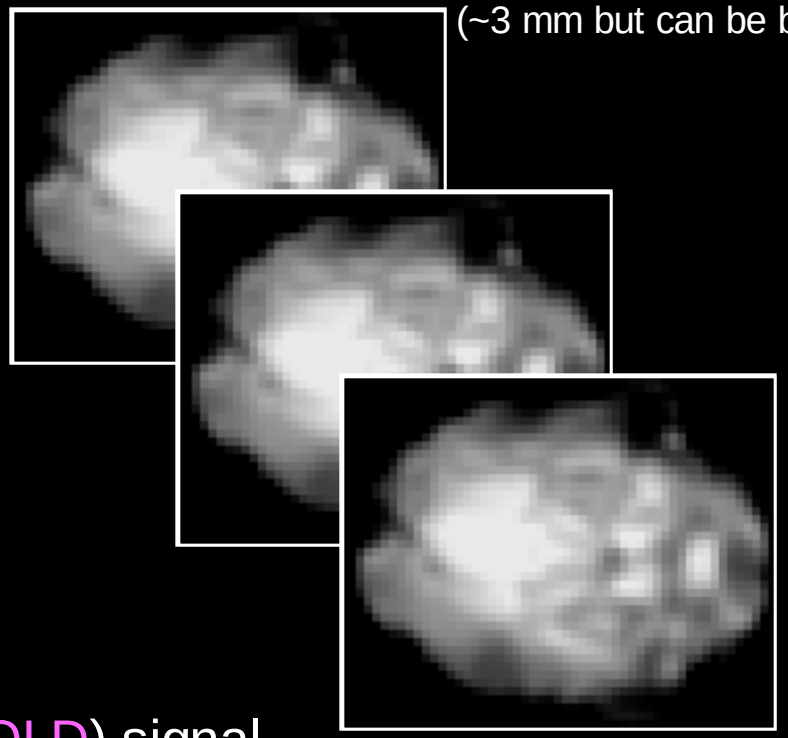
MRI



one image

fMRI

low resolution
(~3 mm but can be better)



...

many images
(e.g., every 2 sec for 5 mins)

fMRI

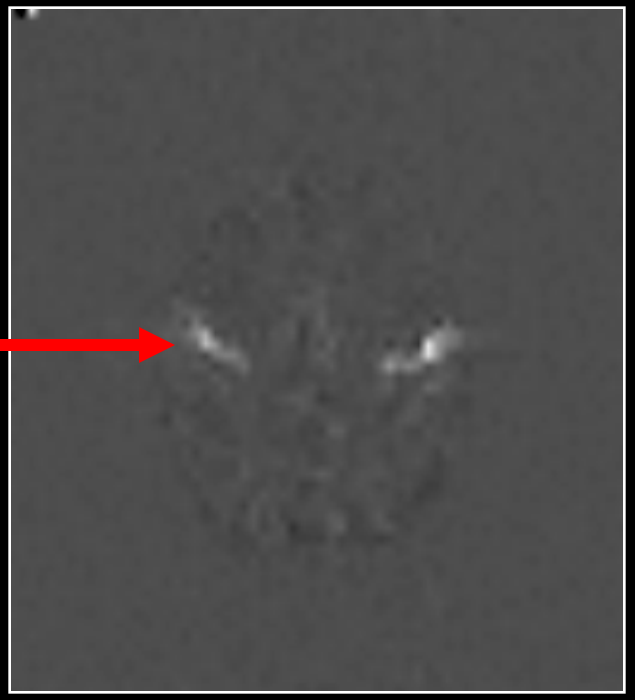
Blood Oxygenation Level Dependent (BOLD) signal
indirect measure of neural activity

↑ neural activity ➔ ↑ blood oxygen ➔ ↑ fMRI signal

Courtesy, Robert Cox, Scientific and Statistical Computing Core Facility, NIMH

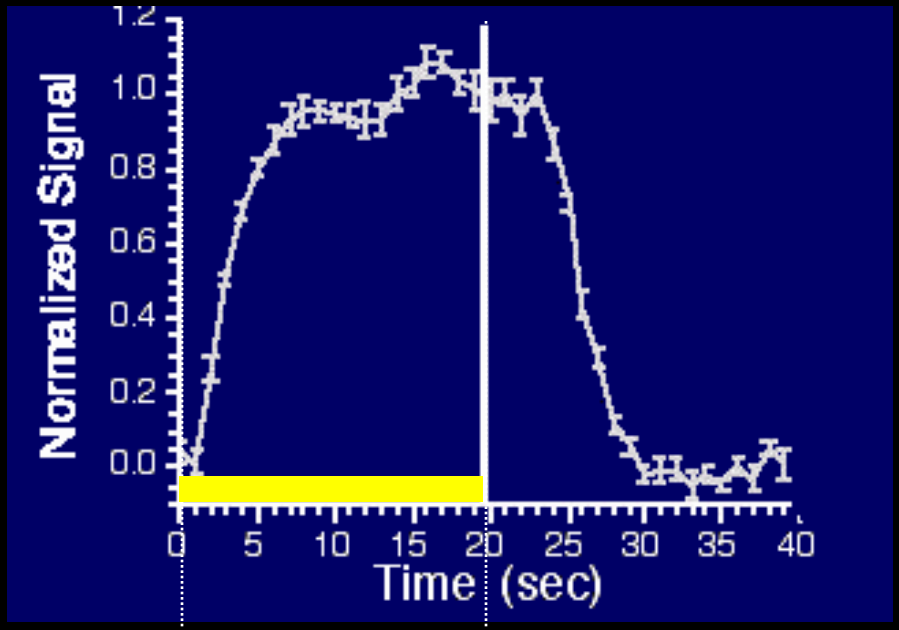
Motor Cortex Activation

ON ON ON ON ON

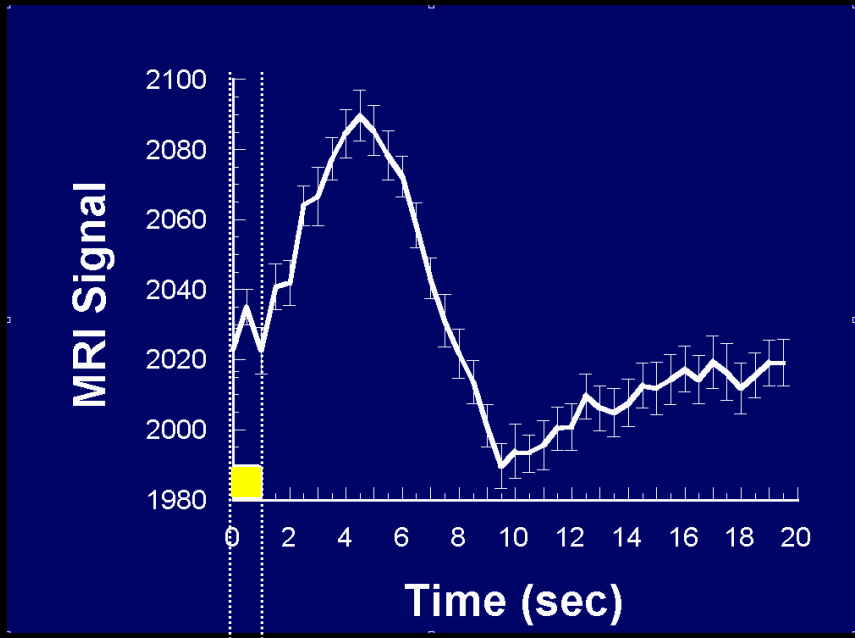


The FMRI Signal

Based on Local Blood Flow Response in the Brain



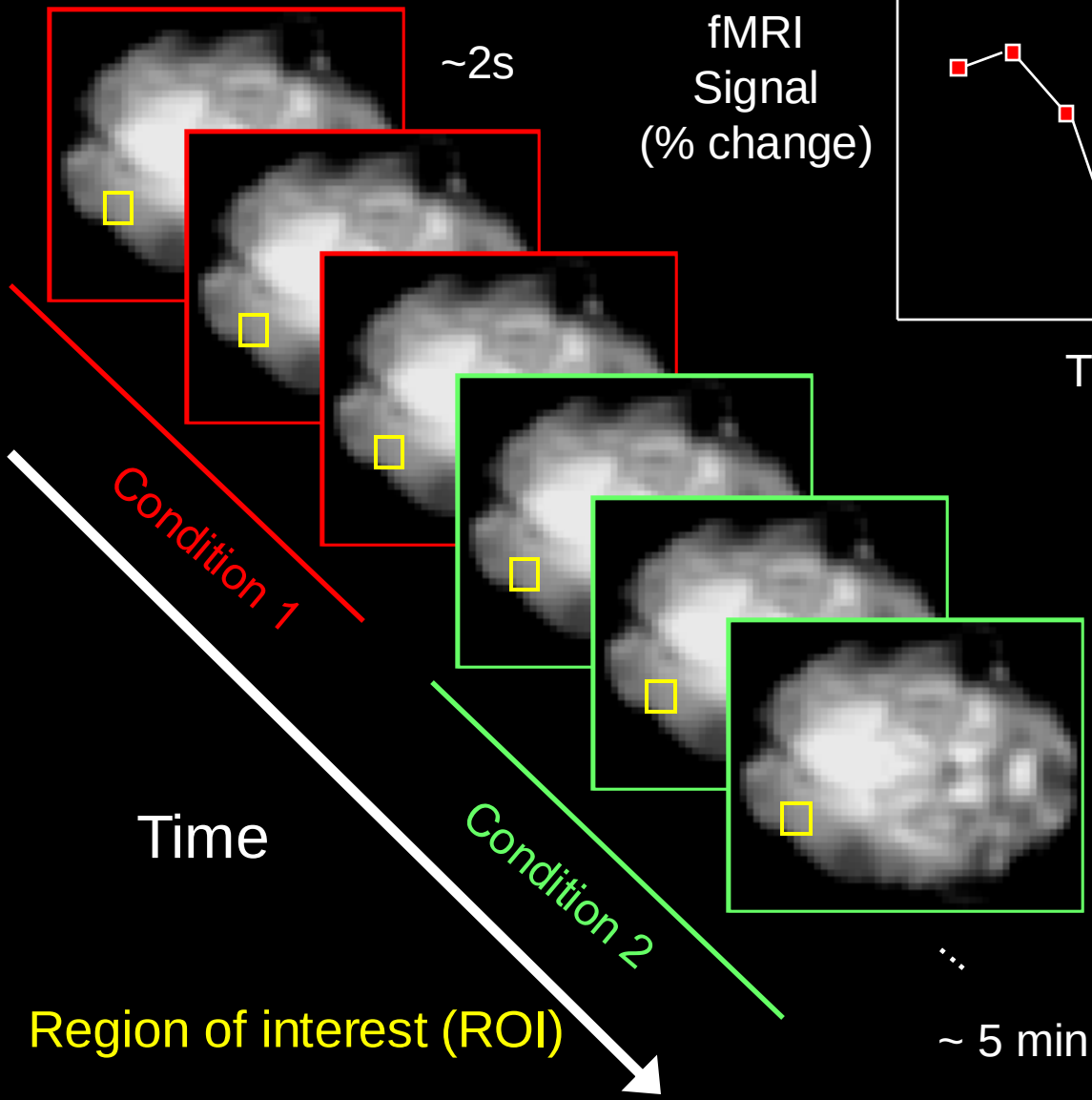
task



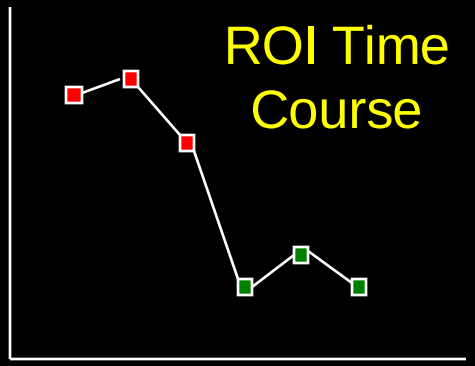
task

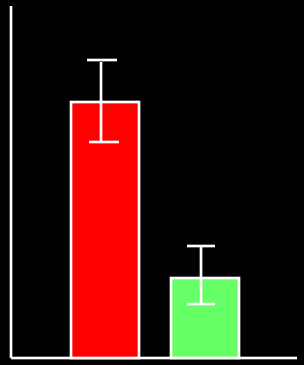
Activation Statistics

Functional images

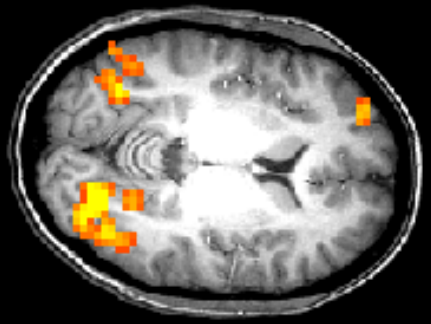


fMRI Signal (% change)

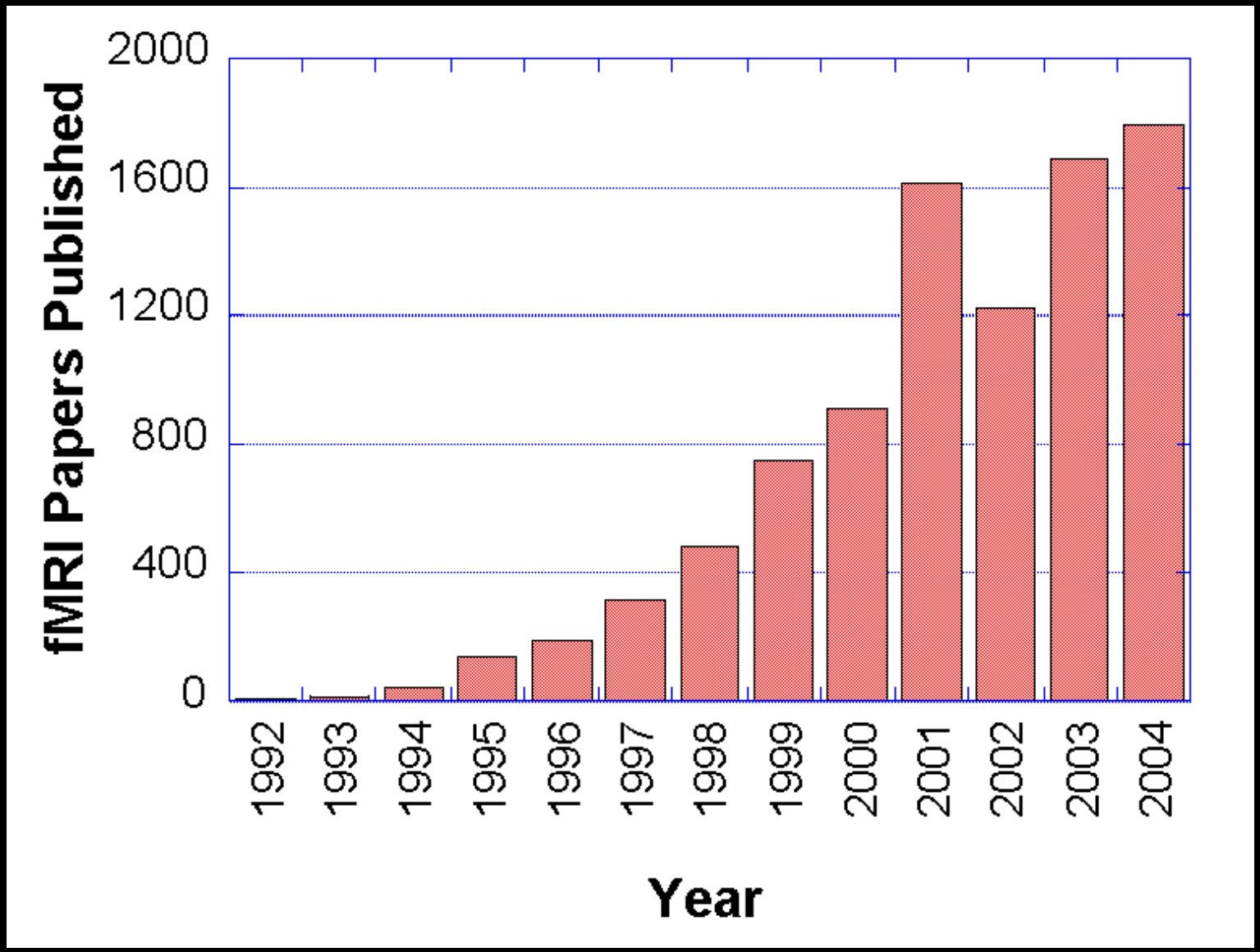




Statistical Map
superimposed on anatomical MRI image



Courtesy, Robert Cox, Scientific and Statistical Computing Core Facility, NIMH


fMRI Papers Published
2000
1600
1200
800
400
0
1992
1993
1994
1995
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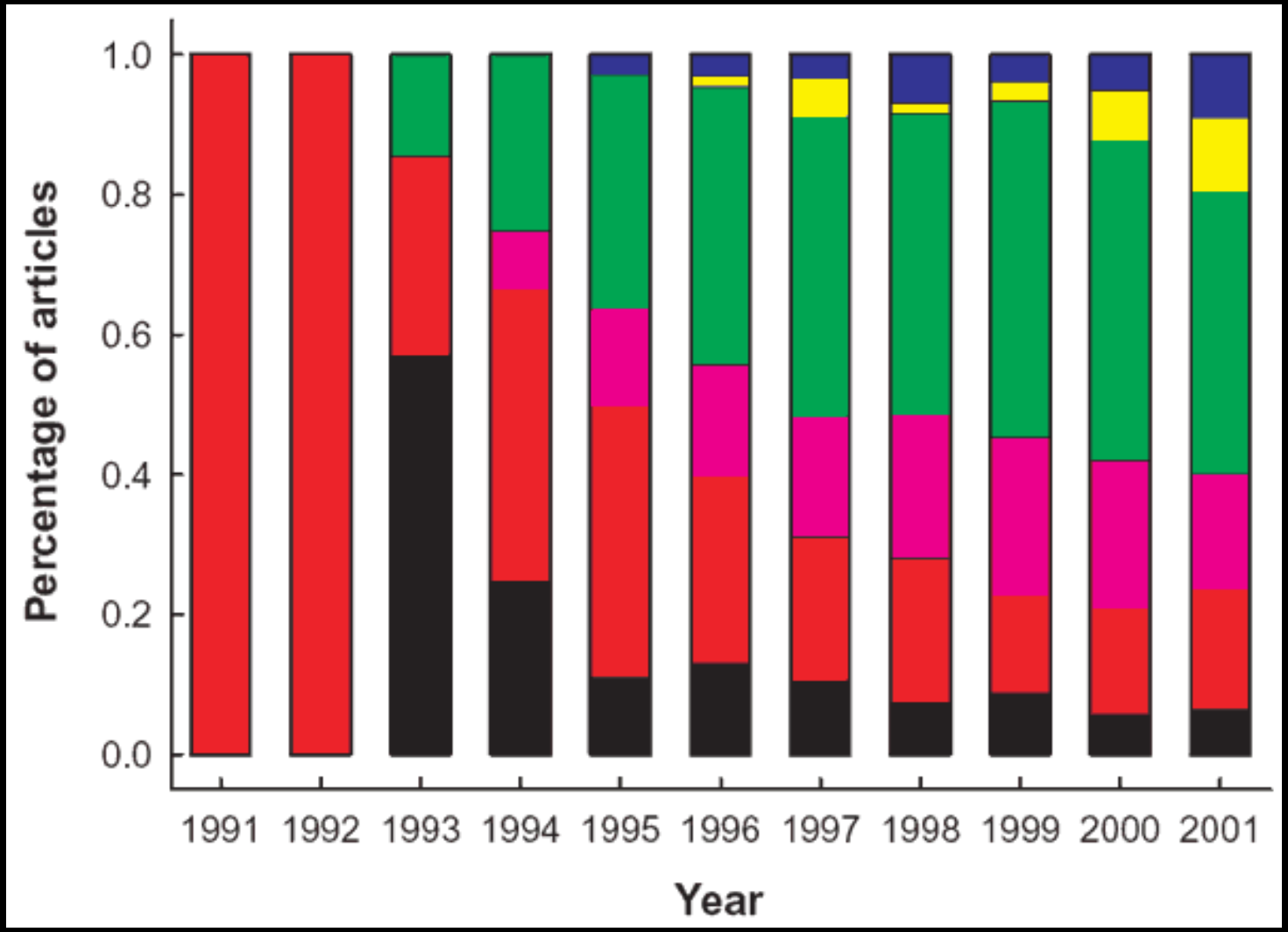
2002
2003
2004
Year



Motor (black)
Primary Sensory (red)
Integrative Sensory (violet)
Basic Cognition (green)
High-Order Cognition (yellow)
Emotion (blue)

J. Illes, M. P. Kirschen, J. D. E. Gabrielli, Nature Neuroscience, 6 (3)m p.205

Current Uses of fMRI

Understanding normal brain organization and changes

- -networks involved with specific tasks (low to high level processing)
- -changes over time (seconds to years)
- -correlates of behavior (response accuracy, performance changes…)

Clinical research

- -correlates of specifically activated networks to clinical populations
- -presurgical mapping
- -epileptic foci mapping
- -drug effects

Potential uses of fMRI

Complementary use for clinical diagnosis

- -utilization of clinical research results

Clinical treatment and assessment

- -drug, therapy, rehabilitation, biofeedback

Non clinical uses

- -complementary use with behavioral results
- -lie detection
- -prediction of behavior tendencies (many contexts)
- -brain/computer interface (potentially clinical)

Principle Investigators:

NIMH:

Peter Bandettini, Ph.D.
Karen Berman, M.D.
James Blair, Ph.D.
Robert Cohen, M.D., Ph.D.
Christian Grillon, Ph.D.
Wayne Drevets, M.D.
Ellen Liebenluft, M.D.
Daniel Pine, M.D.
Jun Shen, Ph.D.
Leslie Ungerleider, Ph.D.
Daniel Weinberger, M.D.

NINDS:

Leonardo Cohen, M.D.
Jeff Duyn, Ph.D.
Jordan Graffman, Ph.D.
Mark Hallet, Ph.D.
Alan Koretsky, Ph.D.
Chrsity Ludlow, Ph.D.

NIAAA:

Daniel Hommer, M.D.

NICHD:

Peter Basser, Ph.D.
Allen Braun, M.D.

Topics Studied with fMRI at the NIH

- Epilepsy
- Visual processing
- Mood disorders
- Learning
- Habituation
- Plasticity/Recovery
- Motor Function
- Auditory processing
- Attention
- Language
- Speech
- Stroke
- Social Interaction
- Development
- Aging
- Genetics
- Decision making
- Mood disorders

Scanners:

“3T-1”	GE 3T	(June 2000)
“3T-2”	GE 3T	(Nov 2002)
“FMRIF 1.5T”	GE 1.5T	(Sept 2004)
Currently being Cited	GE 3T	(Aug 2003)

1.5T

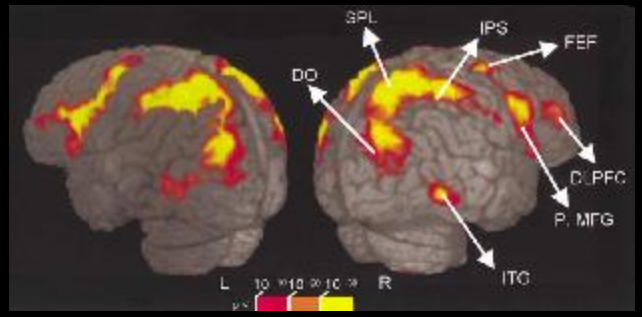
3T-1

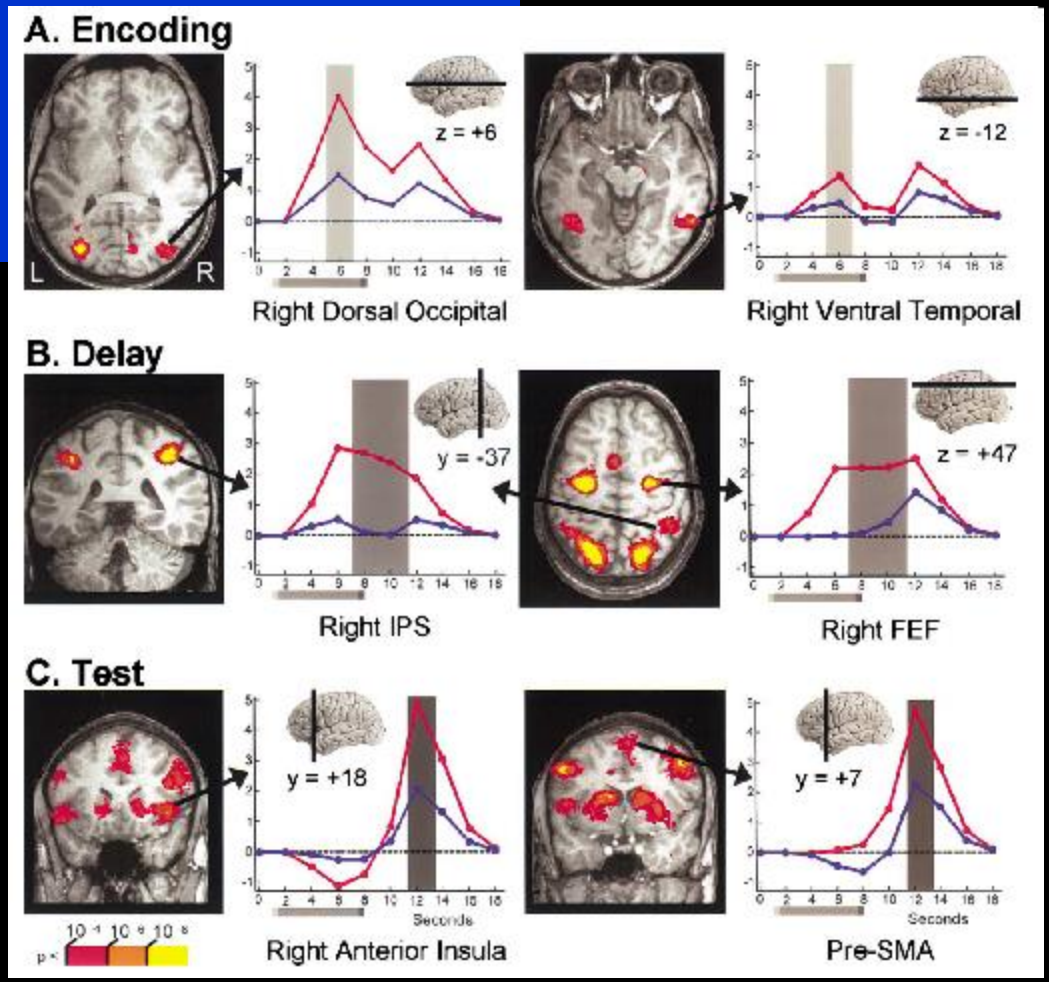
3T-2

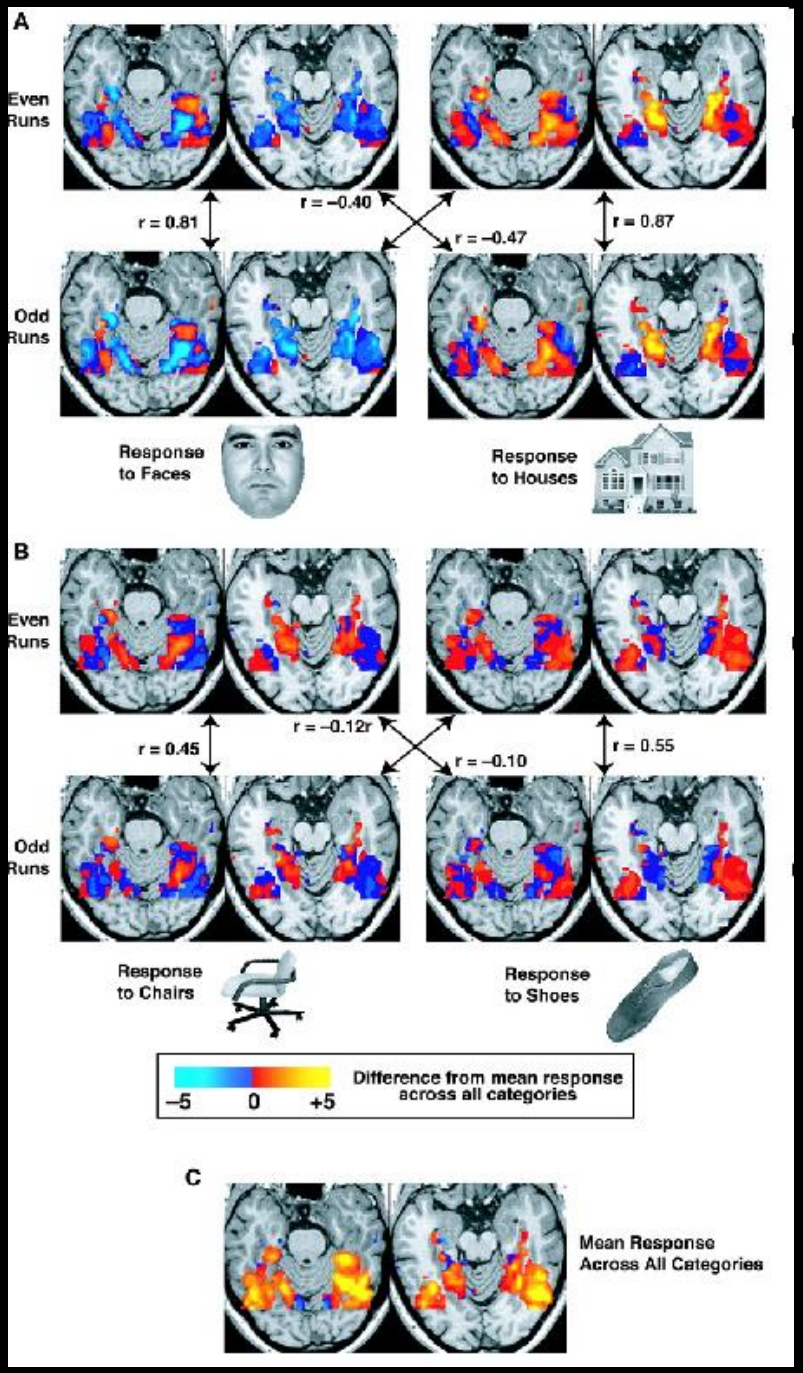
Neuron, Vol. 35, 975–987, August 29, 2002, Copyright ©2002 by Cell Press

Neural Correlates of Visual Working Memory: fMRI Amplitude Predicts Task Performance

Luiz Pessoa,[1] Eva Gutierrez, Peter A. Bandettini, and Leslie G. Ungerleider
Laboratory of Brain and Cognition
National Institute of Mental Health
National Institutes of Health
Bethesda, Maryland 20892





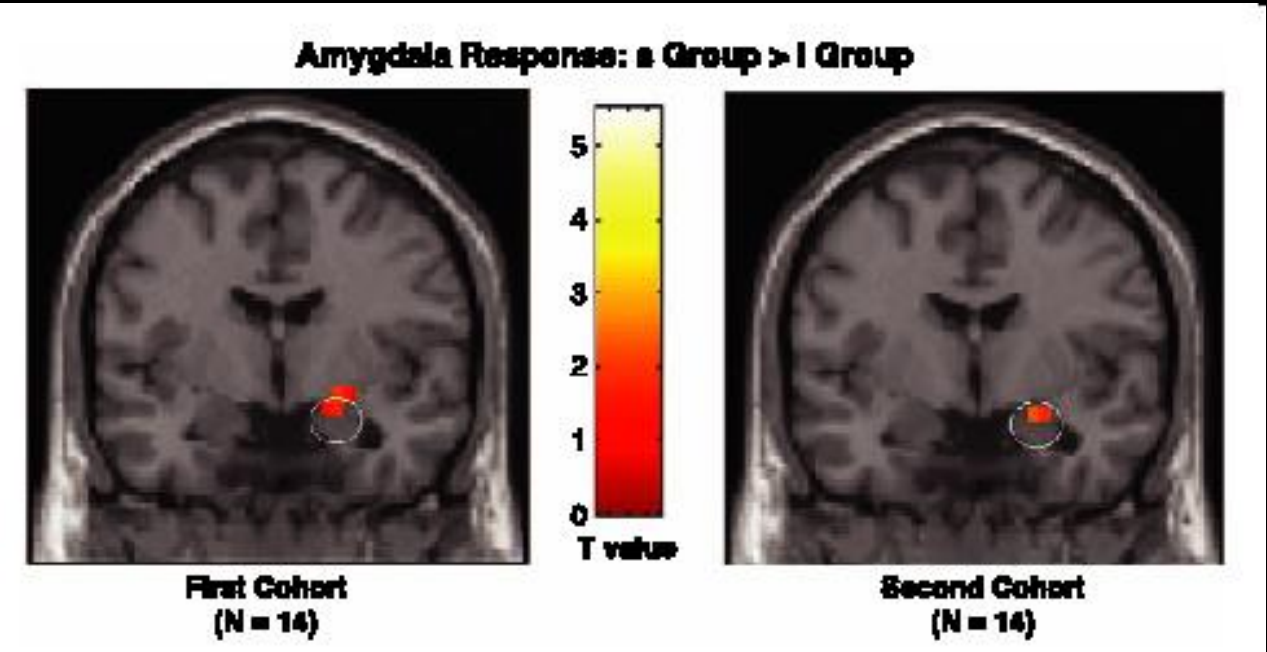


Haxby et al (2001)

Comparison of two groups of *normal* individuals with differences in the Serotonin Transporter Gene

Serotonin Transporter Genetic Variation and the Response of the Human Amygdala

Ahmad R. Hariri,[1] Venkata S. Mattay,[1] Alessandro Tessitore,[1] Bhaskar Kolachana,[1] Francesco Fera,[1] David Goldman,[2] Michael F. Egan,[1] Daniel R. Weinberger[1]*



SCIENCE VOL 297 19 JULY 2002

Who we are

Unit on Functional Imaging Methods

Peter Bandettini (Physics/Physiology/Neuroscience...)

Rasmus Birn (Physics)
David Knight (Neuroscience)
Anthony Boemio (Physics/Neuroscience)

Niko Kriegeskorte (Psychology/Statistics)

Natalia Petridou (Biomedical Engineering)
Ilana Levy (Psychology)
Hanh Nguyen (Neuroscience)

FMRI Core Facility

Jerzy Bodurka (Physics)
Sean Marrett (Neuroscience)
Frank Ye (Physics)
Wen-Ming Luh (Physics)

Adam Thomas (Computers/Neurosci)
Karen Bove-Bettis (MR Tech)
Paula Rowser (MR Tech)
Alda Ottley (MR Tech)