

# The Functional MRI Core Facility

# Overview:

|   |        |
|---|--------|
| Inception:                              | 1999   |
| Total annual budget:                    | 2.32 M |
| Personnel budget:                       | 1.44 M |
| # of staff:                             | 12     |
| # of Principle Investigators Served:    | 34     |
| # of active protocols using FMRI:       | 60     |
| # of subjects scanned in 2007:          | 4708   |
| Approximate cost per hour of scan time: | \$246  |
| Hours of weekly scan time in 2006:      | 315    |
| Hours of weekly scan time in 2007:      | 420    |

# Overview:

- FMRI works extremely well at the NIH
- Because of our success, scan time is in very high demand. No easy solutions.

# Staff:

Peter Bandettini, Ph.D.

Sean Marrett, Ph.D.

Jerzy Bodurka, Ph.D.

Wen-Ming Luh, Ph.D.

Adam Thomas

Kay Kuhns

Janet Ebron

Alda Ottley

Ellen Condon

Sahra Omar

Paula Rowser

Chung Kan

- Director
- Staff Scientist
- Staff Scientist
- Staff Scientist
- IT Specialist
- Administrative Lab Manager
- Technologist
- Technologist
- Technologist
- Technologist
- Technologist
- Technologist

# Staff Budget:

|                           | 2004  | 2005  | 2006  | 2007  |
|---------------------------|-------|-------|-------|-------|
| Government Service<br>(7) | 836K  | 878K  | 893K  | 919K  |
| Contractors<br>(5)        | 242K  | 371K  | 501K  | 516K  |
| Total                     | 1.08M | 1.25M | 1.39M | 1.44M |

# Scanners:

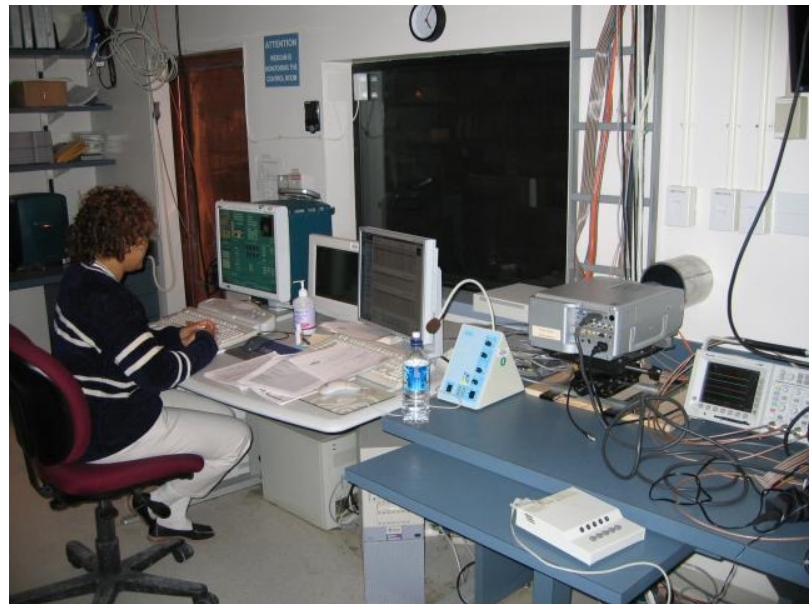
|              |         |             |
|--------------|---------|-------------|
| "3T-1"       | GE 3T   | (June 2000) |
| "3T-2"       | GE 3T   | (Nov 2002)  |
| "FMRIF 1.5T" | GE 1.5T | (Sept 2004) |



1.5T



3T-1



3T-2

# FMRIIF Budget (including staff)

|   | 2004   | 2005   | 2006   | 2007  |
|---|--------|--------|--------|-------|
| Personnel<br>(GS & Cont)                  | 1.08M  | 1.25M  | 1.39M  | 1.44M |
| Supplies<br>(incl.<br>scanner<br>service) | 861K   | 875K   | 892K   | 893K  |
| Total                                     | 1.938M | 2.125M | 2.282M | 2.32M |

563K service contract  
112K major equipment  
188K small equipment





NIMH Scanner Time (hrs/week) Usage

~~NINDS Scanner Time (hrs/week) Usage~~

Total NINDS and NIMH time = 254.3 hours per week

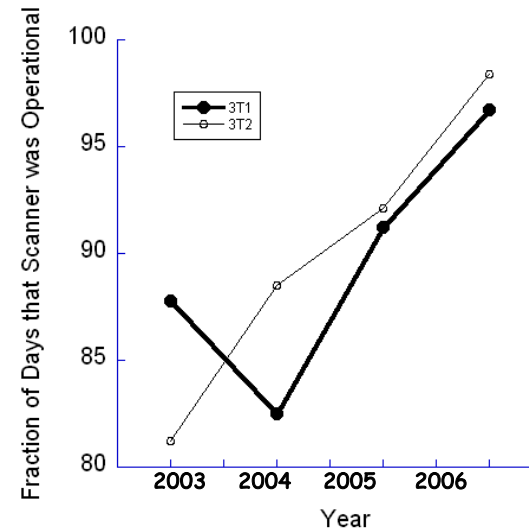
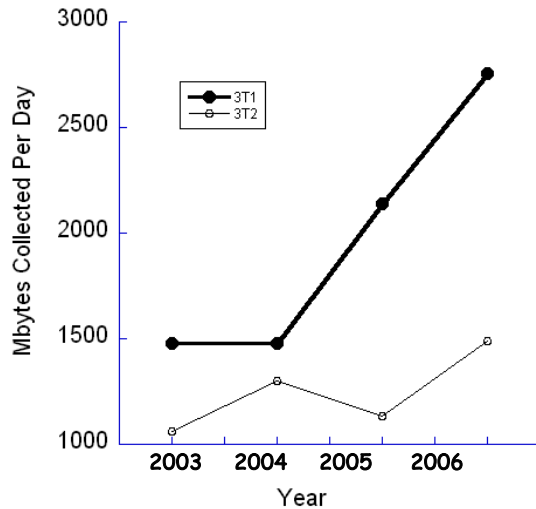
$NIMH / (NINDS + NIMH) = 55.3 \%$

$NINDS / (NINDS + NIMH) = 45.0 \%$

# Services:

1. State of the art MRI technology.
2. Maintenance and support of daily MRI scanner operation.
3. Trained MRI technologist coverage during all prime time hours and most off hours and weekends.
4. Training by technologists in scanning techniques and protocols.
5. Updated scheduling and a means for exchanging scan time between users.
6. The FMRI website (<http://fmrif.nih.gov/>).
7. Weekly fMRI discussion groups that focus on recent research and issues.
8. State of the art subject interface devices.
9. Short and long term automatic archiving of fMRI data.
10. Consulting with users on the best fMRI scanning and processing approaches.

# Scanner Performance



Critically due to Q/A time and development time

|                                |        |
|--------------------------------|--------|
| Total annual budget:           | 2.32 M |
| # of subjects scanned in 2007: | 4708   |
| Cost per hour of scan time:    | \$246  |
| Cost per subject:              | \$492  |

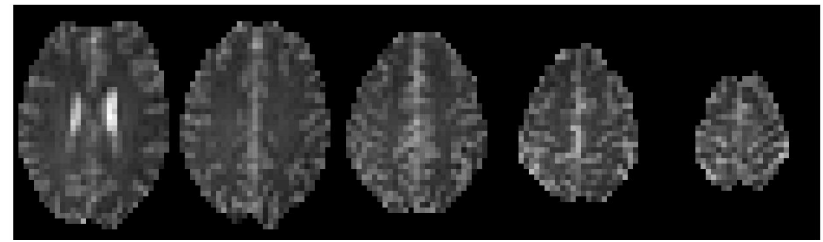
# Pulse Sequences

## BOLD imaging:

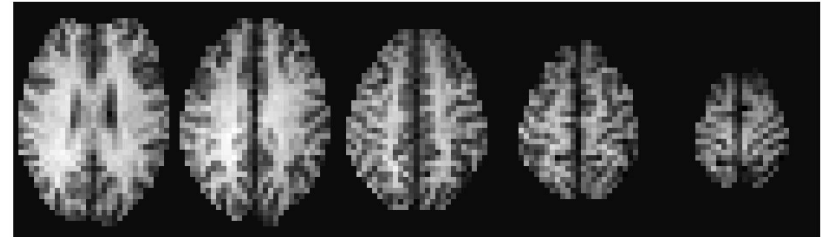
- *EPI-RT*: General purpose BOLD imaging with real time display
- *epi3, epi4*: NIH EPI sequences, epi4 for use with 16 channel system
- *SPEP*: Simultaneous perfusion and BOLD - spiral/EPI sequence with perfusion and diffusion modules and multi-echo and combined SE and GE capability
- *Clustered volume EPI-RT*: (for auditory studies)
- *NIH-EPI* (for use with 16 channel receiver system)

## Anatomical Imaging:

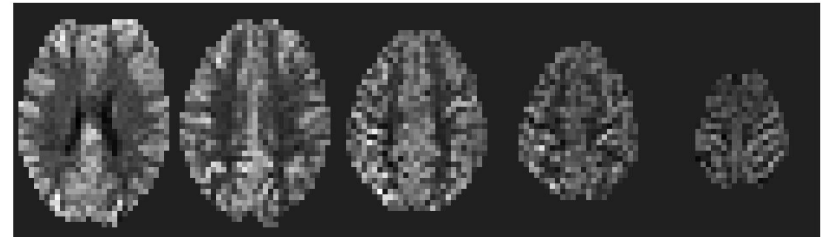
- *MP-RAGE*: T1 weighted sequence with excellent Gray/White matter contrast
- standard product multi-shot sequences like: SPGR, SE, FSE etc.



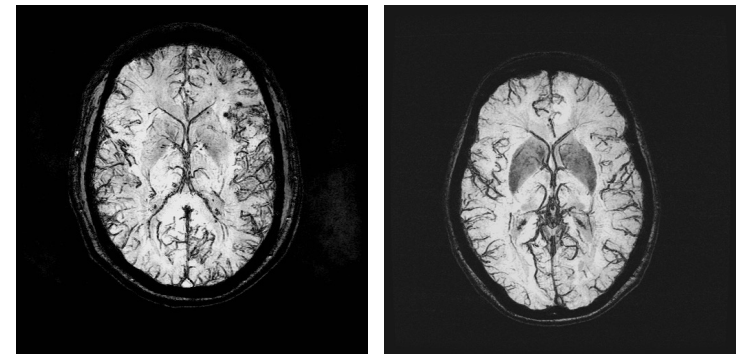
EPI



IR-EPI



Pulsed ASL (QUIPSS II)



High-resolution venogram

## *Stimulus presentation equipment*

- Back projection screen 48X36in (DaLite Polacoat 100) mounted on an aluminum stand.
- Sharp LCD projectors with Buhl lens
- Avotec Silent Vision fiber-optic glasses for visual stimulus with integrated eye-tracking system
- SMI iView system with long-range lens for video-camera based eye-tracking
- Avotec Silent Scan earphones
- Phone-Or Dual Channel Noise-canceling Microphone

## *Software and response devices*

- Presentation software
- e-prime (biological)
- Psychophysics Toolbox
- SuperLab
- Custom designed button response units and physiological interfaces RSB

## *New Devices*

- EEG
- Custom DLP projection (higher temporal resolution)
- DLP Backprojection
- Fiber-optic response systems
- MRI compatible power-injector
- Drug infusion pump

# "Real - Time" fMRI

[A] AFNI 2.55d: Data/RT2/rt.#001+orig & rt.#001@1+orig

x = 5.156 mm [L]  
y = 73.906 mm [P]  
z = -7.500 mm [I]

Color: green  
Gap: 5  
Index: 0

Original View  
AC-PC Aligned  
Talairach View

Define Markers  
See Markers

Define Function  
See Function

Define Datamode

Switch Session  
Switch Anatomy  
Switch Function  
Control Surface

Options  
Anat underlay  
Func underlay

Anat # 0 #0  
Func #0 Fit Coef  
Thr #1 Correlation

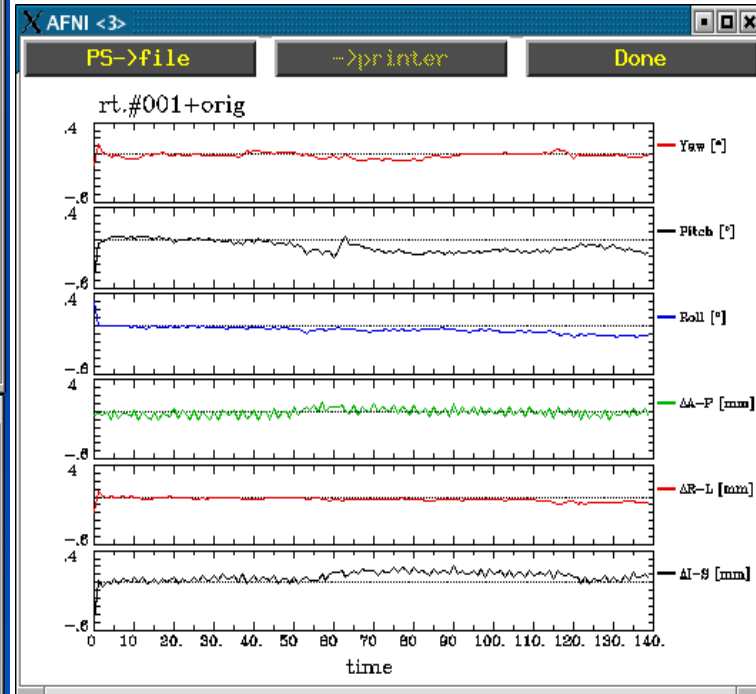
Anat 0: 7450  
Func -0.252845: 0.417904  
Thr -0.5232: 0.9005

autoRange: 0.417904

10000 Rota

See T1 Atlas Regions

1.1-6 # \*\* Anat = 2937  
\*\* 0 Func = 0.181984  
Pos? Thr = 0.9005



[A] AFNI 2.55d: Data/RT2/rt.#001+orig

[A] AFNI 2.55d: Data/RT2/rt.#001+orig & rt.#001@1+orig <3>

1609 [+158]

1451

AXIAL X: 33 index=0 value=2937 at 0.299999  
Y: 53 Grid: 20 Scale: 2 datum/pix  
Z: 3 Num: 140 Base: separate

AFNI! FIM Opt

Detailed description: This figure shows a motion tracking plot with three axial slices. The top plot is labeled 1609 [+158] and the bottom plot is labeled 1451. A yellow box highlights a region of interest in the middle plot. The x-axis represents time from 0 to 140 seconds. The y-axis represents signal intensity. The plot shows fluctuations in signal intensity over time, with a notable period of increased activity between 60 and 80 seconds. The bottom plot shows the axial slice location: X: 33, Y: 53, Z: 3. The grid size is 20, the scale is 2 datum/pix, and the number of slices is 140. The base is separate.

motion tracking

# Staff Scientist Projects

## Jerzy Bodurka

- *QA procedure*
- *Real time fMRI and AFNI display*
- *Linux based synchronized stimuli*
- *Multi-channel RF acquisition*
- *Physiologic noise assessment*

## Wenming Luh

- *Do-all modular pulse sequence*
- *Perfusion imaging*
- *Local shimming*
- *Primate shimming*

## Sean Marrett

- *High resolution T1 imaging optimization*
- *Routine retinotopy*
- *Eye tracking*
- *NIRS and fMRI comparisons*

# Education / Support:

- Weekly fMRI discussions (Fridays, 1pm, 10/4N230)
- Bi-Monthly user meetings (First Monday every other month, 3pm, 10/4N230)
- Bi-Monthly steering committee meetings (First Monday every other month, 3pm, 10/4N230)
- Meetings with each PI to address needs and concerns & guide purchases
- Training in scanner operation and use of subject interface devices
- Consulting on paradigm design



# The Website



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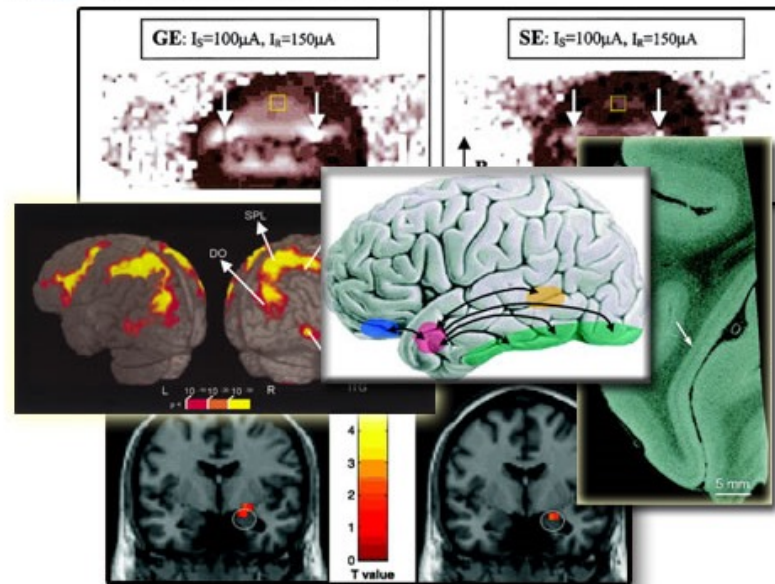
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## Welcome to the fMRI Facility at NIH

by [Root](#) — last modified 2005-11-03 11:53




Click on images to view recent research using the fMRI.

## news

- [New Projectors installed in 3T-1 and 3T-2](#)  
2006-01-13
- [Test of Stimulus/Computing News](#)  
2006-01-13
- [More news...](#)



# 3T - 1 Schedule



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Scanner: **FMRIF 3T-1** # Days: **7**  Show Researcher? Start Date: **2006/12/12**

[Printable Version](#)

|      | Tuesday<br>12/12/06 | Wednesday<br>12/13/06 | Thursday<br>12/14/06 | Friday<br>12/15/06 | Saturday<br>12/16/06 | Sunday<br>12/17/06   | Monday<br>12/18/06 |
|------|---------------------|-----------------------|----------------------|--------------------|----------------------|----------------------|--------------------|
| 7am  | DEV (qqa)           | DEV (qqa)             | DEV (qqa)            | DEV (qqa)          | DEV (qqa)            | DEV (qqa)            | DEV (qqa)          |
| 8am  | GCAP (dweinberger)  | GCAP                  | GCAP                 | LBC (ksimmons)     | NMRF (Braun)         | GCAP (ameyer-linden) | training           |
| 9am  | GCAP (dweinberger)  | GCAP                  | GCAP                 | LBC (ksimmons)     | NMRF (Braun)         | GCAP (ameyer-linden) | training           |
| 10am | GCAP (dweinberger)  | GCAP                  | GCAP                 | LBC (ksimmons)     | NMRF (Braun)         | GCAP (ameyer-linden) | GCAP               |
| 11am | GCAP (dweinberger)  | GCAP                  | GCAP                 | LBC (ksimmons)     | NMRF (Braun)         | LBC (sfriedman-hill) | GCAP               |
| Noon | X (posted)          | NMRF                  | GCAP                 | SIN (Berman)       | NINDS (Hallet)       | LBC (sfriedman-hill) | GCAP               |
| 1pm  | NINDS (Graffman)    | NMRF                  | GCAP                 | SIN (Berman)       | NINDS (Hallet)       | LBC (sfriedman-hill) | GCAP               |
| 2pm  | NINDS (Graffman)    | NMRF                  | GCAP                 | SIN (Berman)       | NINDS (Hallet)       | LBC (sfriedman-hill) | NINDS (Ludlow)     |
| 3pm  | NINDS (Graffman)    | NMRF                  | FIM (nkriegeskorte)  | SIN (Berman)       | NINDS (Hallet)       | LBC (jsilvers)       | NINDS (Ludlow)     |
| 4pm  | NINDS (wthodore)    | BEINIAAA (Hommer)     | FIM (nkriegeskorte)  | GCAP               | NINDS (Hallet)       | LBC (jsilvers)       | NINDS (Ludlow)     |
| 5pm  | NINDS (wthodore)    | BEINIAAA (Hommer)     | FIM (nkriegeskorte)  | GCAP               | NINDS                | LBC (jsilvers)       | NINDS (Ludlow)     |
| 6pm  | NINDS (wthodore)    | BEINIAAA (Hommer)     | FIM (nkriegeskorte)  | GCAP               | NINDS                | LBC (jsilvers)       | NINDS (Ludlow)     |
| 7pm  | NINDS (wthodore)    | BEINIAAA (Hommer)     | FIM (kmurphy)        | GCAP               | NINDS                | LBC (jsilvers)       | NINDS (Ludlow)     |
| 8pm  | DEV (jבודurka-dev)  | DEV                   | FIM (kmurphy)        | GCAP               | NINDS                | LBC (cbaker)         | GE                 |
| 9pm  | DEV (jבודurka-dev)  | DEV                   | FIM (kmurphy)        | GCAP               | NINDS                | LBC (cbaker)         | GE                 |
| 10pm | DEV (jבודurka-dev)  | DEV                   | FIM (kmurphy)        | GCAP               | NINDS                | LBC (cbaker)         | GE                 |

X Indicates time was not used.

|  | Institute | Program/Branch | Code      | Department Name  | Investigator              |
|--|-----------|----------------|-----------|--|---------------------------|
|  |           |                | GE        | GE Maintenance Time  |                           |
|  |           |                | (posted)  | Posted   |                           |
|  |           |                | NMRF      | NIH Magnetic Resonance Facility                                  |                           |
|  |           |                | training  | training   |                           |
|  |           |                | DEV       | Scanner Development  |                           |
|  | NINDS     |                | NINDS     | Neurological Disorders and Stroke                                |                           |
|  | NIMH      |                | NIMH      | National Institute of Mental Health                              |                           |
|  | NIMH      | CPB            | CPB       | Child Psychiatry Branch  |                           |
|  | NIMH      | CPB            | UBI       | Unit on Brain Imaging  | Giedd, Jay                |
|  | NIMH      | GCAP           | GCAP      | Genes, Cognition and Psychosis Program                           |                           |
|  | NIMH      | GCAP           | SNP       | Systems Neuroscience in Psychiatry                               | Meyer-Lindenberg, Andreas |
|  | NIMH      | GCAP           | SIN       | Section on Integrative Neuroimaging                              | Berman, Karen             |
|  | NIMH      | LBC            | LBC       | Laboratory of Brain and Cognition                                |                           |
|  | NIMH      | LBC            | SN        | Section on Neurocircuitry  | Ungerleider, Leslie       |
|  | NIMH      | LBC            | SCN       | Section on Cognitive Neuropsychology                             | Martin, Alex              |
|  | NIMH      | LBC            | FIM       | Functional Imaging Methods                                       | Bandettini, Peter         |
|  | NIMH      | LN             | LN        | Laboratory of Neuropsychology                                    |                           |
|  | NIMH      | MAP            | MAP       | Mood and Anxieties Program                                       |                           |
|  | NIMH      | MAP            | PDN       | Pediatrics & Developmental Neuropsychiatry Branch                | Susan Swedo               |
|  | NIMH      | MAP            | UACN      | Unit on Affective Cognitive Neuroscience                         | Blair, James              |
|  | NIMH      | MAP/ETPB       | SDAN      | Section on Development and Affective Neuroscience                | Pine, Daniel              |
|  | NIMH      | MAP/ETPB       | UAP       | Unit on Affective Psychophysiology                               | Grillon, Christon         |
|  | NIMH      | MAP/MIB        | SNMAD     | Section on Neuroimaging of Mood & Anxiety Disorders              | Drevets, Wayne            |
|  | NIMH      | MAP/MIB        | UMRS      | Unit on Magnetic Resonance Spectroscopy                          | Shen, Jun                 |
|  | NIDCD     |                | NIDCD     | National Institute on Deafness and Other Communication Disorders |                           |
|  | NICHHD    |                | NICHHD    | National Institute of Child Health and Human Development         |                           |
|  | NICHHD    | LIMB           | STBB      | Section on Tissue Biophysics and Biomimetics                     | Basser, Peter             |
|  | NIAAA     | DICBR          | BEI/NIAAA | Section of Brain Electrophysiology and Imaging                   | Hommer, Daniel            |
|  | NHLBI     |                | NHLBI     | National Heart, Lung, and Blood Institute                        |                           |
|  | NCI       |                | NCI       | National Cancer Institute  |                           |

# 3T - 2 Schedule



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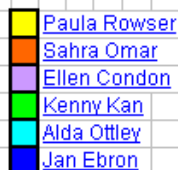
Scanner: **FMRIF 3T-2** # Days: **7**  Show Researcher? Start Date: **2006/12/12**

|      | Tuesday<br>12/12/06 | Wednesday<br>12/13/06 | Thursday<br>12/14/06 | Friday<br>12/15/06 | Saturday<br>12/16/06 | Sunday<br>12/17/06 | Monday<br>12/18/06 |
|------|---------------------|-----------------------|----------------------|--------------------|----------------------|--------------------|--------------------|
| 7am  | DEV (qqa)           | DEV (qqa)             | DEV (qqa)            | DEV (qqa)          | DEV (qqa)            | DEV (qqa)          | DEV (qqa)          |
| 8am  | training            | SNMAD (Drevets)       | NINDS (Hallet)       | NINDS (Koretsky)   | SNMAD (Drevets)      | LBC (abell)        | LBC (jbecker)      |
| 9am  | training            | SNMAD (Drevets)       | NINDS (Hallet)       | NINDS (Koretsky)   | SNMAD (Drevets)      | LBC (abell)        | LBC (jbecker)      |
| 10am | SNMAD (Drevets)     | SNMAD (Drevets)       | NINDS (Hallet)       | NINDS (Duyun)      | SNMAD (Drevets)      | LBC (abell)        | LBC (ksimmons)     |
| 11am | SNMAD (Drevets)     | SNMAD (Drevets)       | NINDS (Hallet)       | NINDS (Duyun)      | SNMAD (Drevets)      | LBC (lcase)        | LBC (ksimmons)     |
| Noon | SNP (ameyer-linden) | SNMAD (Drevets)       | NINDS (Hallet)       | NINDS (Duyun)      | SNMAD (Drevets)      | LBC (lcase)        | LBC (abell)        |
| 1pm  | SNP (ameyer-linden) | UMRS (jshen)          | NINDS (Hallet)       | NINDS (Duyun)      | SNMAD (Drevets)      | FIM                | LBC (abell)        |
| 2pm  | SNP (ameyer-linden) | UMRS (jshen)          | GCAP                 | NINDS (Duyun)      | SNMAD (Drevets)      | FIM                | LBC (abell)        |
| 3pm  | SNP (ameyer-linden) | UMRS (jshen)          | GCAP                 | NINDS (Duyun)      | SNMAD (Drevets)      | NINDS              | LBC (abell)        |
| 4pm  | SDAN (dpine)        | UMRS (jshen)          | GCAP                 | NINDS (Duyun)      | SNMAD (Drevets)      | NINDS              | NMRF               |
| 5pm  | SDAN (dpine)        | SDAN (dpine)          | NMRF                 | NINDS (Duyun)      | SNMAD (Drevets)      | NINDS              | NMRF               |
| 6pm  | SDAN (dpine)        | SDAN (dpine)          | NMRF                 | NINDS (Duyun)      | SNMAD (Drevets)      | NINDS              | NMRF               |
| 7pm  | SDAN (dpine)        | SDAN (dpine)          | NMRF                 | NINDS (Duyun)      | SNMAD (Drevets)      | NINDS              | NMRF               |
| 8pm  | GE                  | DEV                   | DEV                  | NINDS (Duyun)      | SNP (ameyer-linden)  | NINDS              | NMRF               |
| 9pm  | GE                  | DEV                   | DEV                  | NINDS (Duyun)      | SNP (ameyer-linden)  | NINDS              | NMRF               |
| 10pm | GE                  | DEV                   | DEV                  | NINDS (Duyun)      | SNP (ameyer-linden)  | NINDS              | NMRF               |

Indicates time was not used.

|  | Institute | Program/ Branch | Code      | Department Name  | Investigator              |
|--|-----------|-----------------|-----------|--|---------------------------|
|  |           |                 | GE        | GE Maintenance Time  |                           |
|  |           |                 | (posted)  | Posted   |                           |
|  |           |                 | NMRF      | NIH Magnetic Resonance Facility                                  |                           |
|  |           |                 | training  | training   |                           |
|  |           |                 | DEV       | Scanner Development  |                           |
|  | NINDS     |                 | NINDS     | Neurological Disorders and Stroke                                |                           |
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|  | NIMH      | MAP             | UACN      | Unit on Affective Cognitive Neuroscience                         | Blair, James              |
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|  | NIMH      | MAP/ETPB        | UAP       | Unit on Affective Psychophysiology                               | Grillion, Christon        |
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|  | NICHD     |                 | NICHD     | National Institute of Child Health and Human Development         |                           |
|  | NICHD     | LIMB            | STBB      | Section on Tissue Biophysics and Biomimetics                     | Basser, Peter             |
|  | NIAAA     | DICBR           | BEI/NIAAA | Section of Brain Electrophysiology and Imaging                   | Hommer, Daniel            |
|  | NHLBI     |                 | NHLBI     | National Heart, Lung, and Blood Institute                        |                           |
|  | NCI       |                 | NCI       | National Cancer Institute  |                           |

# Technologist Coverage



| Week 1       |   | Monday |   |   |   |   | Tuesday |   |    |   | Wednesday |   |    |   | Thursday |   |   |   |   | Friday |   |   |    | Sat |   | Sunday |  |
|--------------|---|--------|---|---|---|---|---------|---|----|---|-----------|---|----|---|----------|---|---|---|---|--------|---|---|----|-----|---|--------|--|
|              | P | S      | E | K | A | S | K       | E | Ja | P | S         | E | Ja | P | S        | K | E | A | P | S      | K | A | Ja | A   | A | A      |  |
| 6:00 AM      | ■ |        |   |   |   |   |         |   |    | ■ |           |   |    | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 6:30am       | ■ | ■      |   |   |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 7:00am       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 7:30am       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 8am          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 8:30am       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 9am          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 9:30am       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 10am         | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 10:30am      | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 11am         | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 11:30am      | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 12noon       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 1pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 1:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 2:00pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 2:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 3pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 3:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 4pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 4:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 5pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 5:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 6pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 6:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 7pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 7:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 8pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 8:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 9pm          | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 9:30pm       | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| 10pm         | ■ | ■      |   | ■ |   |   |         |   | ■  | ■ |           |   | ■  | ■ |          |   |   |   | ■ |        |   |   |    |     |   |        |  |
| <b>Hours</b> | 9 | 9      | 8 | # | 8 | 9 | #       | 8 | #  | 9 | 9         | # | 13 | 9 | 9        | 8 | 8 | 7 | 9 | 8      | # | 7 | 12 | 10  | 8 |        |  |

# Future Directions...

- Dissemination of new methodology to and across groups.
- Standardization of subject interface devices across scanners.
- Simultaneous EEG/fMRI.
- High resolution single shot fMRI (1.8 mm<sup>3</sup>).
- More routine access to perfusion imaging methods.
- Improved shimming at base of brain.
- Physiologic noise assessment and correction.
- Enhanced website collaboration tools.
- Increased scanning capacity.

# Users

## **NIMH:**

Peter Bandettini, Ph.D.  
Chris Baker, Ph.D.  
Karen Berman, M.D.  
James Blair, Ph.D.  
Jay Giedd, M.D.  
Christian Grillon, Ph.D.  
Wayne Drevets, M.D.  
Ellen Liebenluft, M.D.  
Alex Martin, Ph.D.  
Husseini Manji, M.D.  
Andreas Meyer-Lindenberg, M.D.  
Mort Mishkin, Ph.D.  
Elizabeth Murray, Ph.D.  
Daniel Pine, M.D.  
Judith Rapaport, M.D.  
Jun Shen, Ph.D.  
Susan Swedo, M.D.  
Leslie Ungerleider, Ph.D.  
Daniel Weinberger, M.D.

## **NINDS:**

Roscoe Brady, M.D.  
Leonardo Cohen, M.D.  
Jeff Duyn, Ph.D.  
Jordan Grafman, Ph.D.  
Mark Hallet, Ph.D.  
John Hallenbeck, M.D.  
Alan Koretsky, Ph.D.  
Christy Ludlow, Ph.D.  
Henry F. McFarland, M.D.  
Edward Oldfield, M.D.  
William Theodore, M.D.

## **NIAAA:**

Daniel Hommer, M.D.

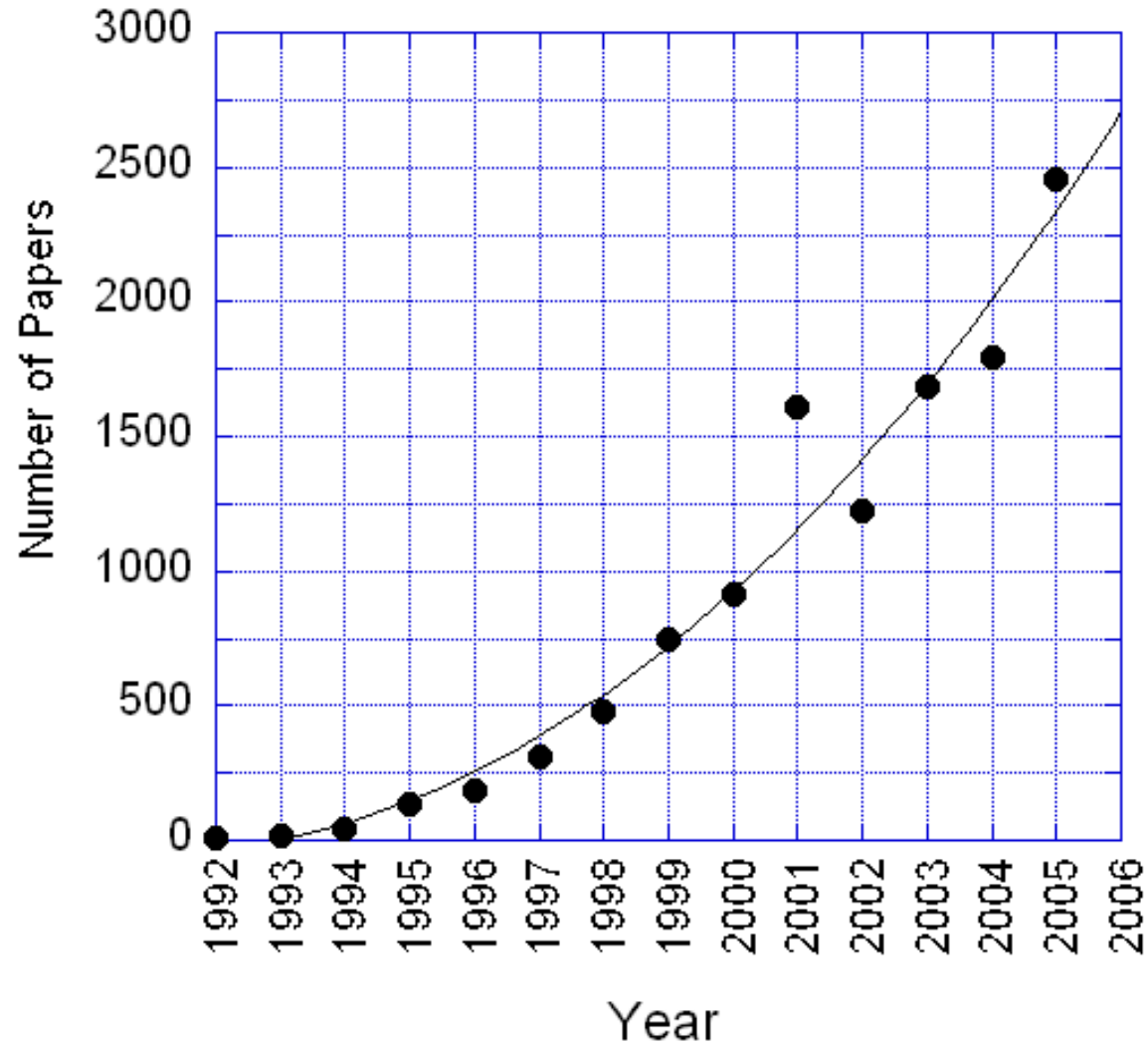
## **NICHD:**

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

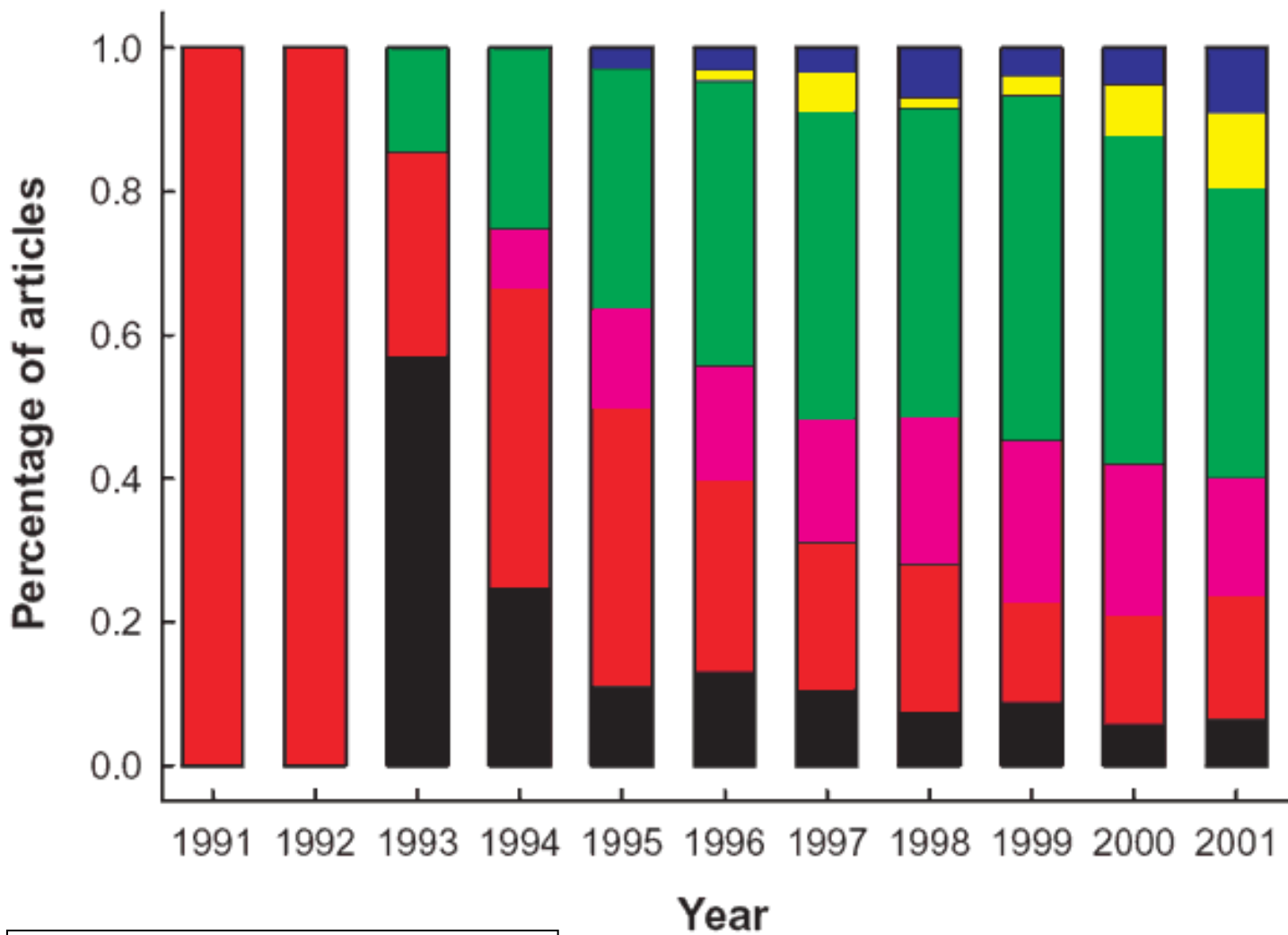
## **NCI:**

Kathy Warren, M.D.

## FMRI Papers Published per Year



"fMRI" or "functional MRI"



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



# What works

- One staff scientist per scanner.
- Two technologists per scanner.
- Time give-away mechanism, and website in general.
- Steering and user committee meetings, and feedback in general.
- Scanner Q/A and development time for maintenance.
- Stable scan time allocation.

# What FMRI needs to improve

- We need more scan time (will be getting extra 105 hours).
- With this new scanner, we need one staff scientist and two technologists
- We need a transparent, stable, yet updatable allocation of scan time.
  - NIMH hours/wk will increase from 141 to about 181
  - NINDS hours/wk will increase from 113 to about 153
- Subject recruitment flexibility.
  - Normal volunteers could have separate status than patients.  
(would allow for more efficient short term scheduling).

- NIMH hours/wk will increase from 141 to about 181
- NINDS hours/wk will increase from 113 to about 153

## 34 Principle Investigators

Now:  $254/34 = 7.5$  hrs/week per PI

Future:  $334/34 = 9.8$  hrs/week per PI

### Issues:

- Not all PI needs are the same.
- Need stability and ease of access for established groups, yet we need to allow for continual change and growth.

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## **NIAAA:**

Daniel Hommer, M.D.

## **NICHD:**

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

## **NCI:**

Kathy Warren, M.D.

# Conclusion

- By all measures, fMRI is a powerful technique that's growing extremely rapidly in range of applications.
- The NIH is likely performing fMRI at a higher level of technical sophistication and cost effectiveness than any other fMRI center in the world.
- The current system here works incredibly well. The quality of the fMRI research is uniformly high across groups - we all benefit from shared resources, highly integrated communication, and the scale of the operation.
- To maintain the NIH's current lead in fMRI worldwide, I believe we should increase total scanner time, ease of access to scanner time, and stability of scanner time to established groups, while encouraging groups not currently performing fMRI to jump in by having some time allocated as "start up" time.
- All this translates to yet another scanner.