The fMRI Data Center

John Darrell Van Horn

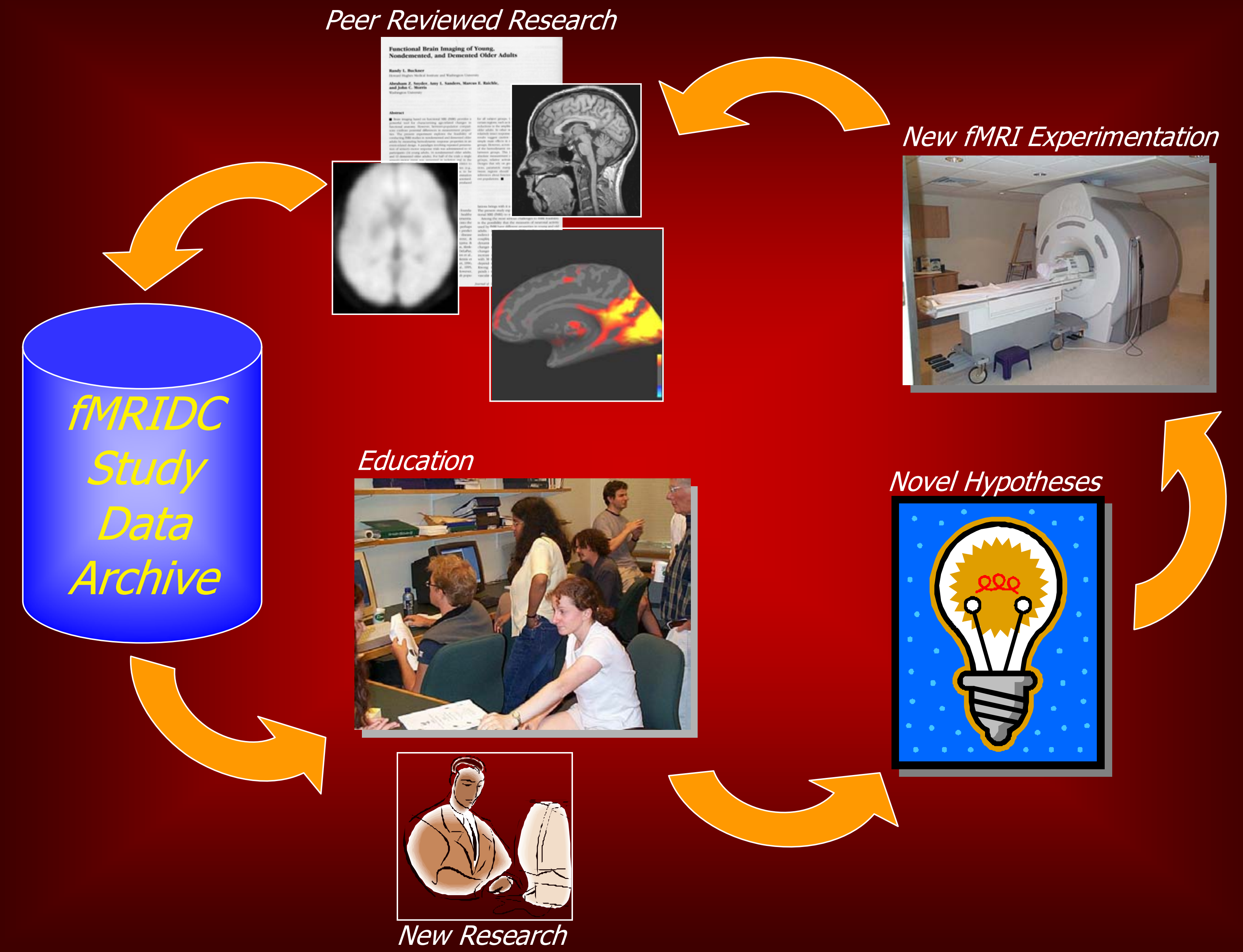
Dartmouth College

The fMRI Data Center (fMRIDC)

- Formed in 2000, The fMRIDC is a publicly accessible repository of peer-reviewed fMRI studies and their underlying data

- The mission of the fMRIDC is to advance progress in understanding cognitive processes by promoting open sharing of functional neuroimaging data both within and beyond the neuroscientific community.

- Supported by
  - *The National Science Foundation*
  - *William M. Keck Foundation*
  - *Human Brain Project/NIMH*
  - *Sun Microsystems, Inc.*


Peer Reviewed Research
Functional Brain Imaging of Young, Nondemented, and Demented Older Adults
New fMRI Experimentation
fMRIDC Study Data Archive
Education
Novel Hypotheses
New Research

Not Well Received?

news

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Deep views
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Prospect of data sharing gives brain mappers a headache

Peter Aldhous

An attempt to encourage the sharing of brain images has ignited a fierce controversy about neuroscientists' right to control their data. Some specialists in functional magnetic resonance imaging (fMRI) fear that the National fMRI Data Center, newly established at Dartmouth College in Hanover, New Hampshire, will take over control of their results. Others are concerned that the centre's operation might breach patient confidentiality.

Blood flow and energy consumption in the brain are mapped by fMRI, showing which brain structures are active when particular cognitive tasks are performed. But behind each image lies a mass of raw nuclear magnetic resonance data, statistical analyses and detailed anatomical records.

Having access to these underlying data could help fMRI specialists interpret one another's work. But brain mappers are divided over the merit of sharing primary data, and many of them object to the way in which Michael Gazzaniga, director of the National fMRI Data Center, has set about the task.

In mid-June, Gazzaniga wrote to fMRI specialists who had published in the *Journal of Cognitive Neuroscience*, which he edits. The journal would in fu… of fMRI papers to subm… data" to the centre, he sa…

The letter named *S… Neuroscience, Cerebral C…* participants in the da… Although the letter di… journals would adopt … compulsion, many reci… was its implication.

That prompted an a… dinated by Isabel Ga… University in Nashville … dozen fMRI specialists, … tre's financial backers — … ence Foundation and t… — and the editors of 14…

These included *Natu… science*, plus those nam… ter. "Mandatory submi… impinges on the rights … on the publication of…

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editorial

nature neuroscience

A debate over fMRI data sharing

…cognitive neuroscientist, has … community. Gazzaniga is the … National fMRI Data Center, a … College that seeks to provide … sets generated by fMRI exper… would seem to be a welcome …

second intervals for many minutes, yielding a time-series for each of many thousands of voxels. Once these four-dimensional maps are generated and corrected for noise and motion artifacts, they can be analyzed in many ways. The simplest is to compare the average activity between different cognitive tasks, in order to identify groups of voxels that are significantly activated (or deactivated) by a given task relative to a control condition. More…

nature

3 August 2000 Volume 406 Issue no 6795

Whose scans are they, anyway?

Raw data are useful for researchers wishing to replicate the results of an experiment. Care needs to be taken when, as with brain-imaging measurements, such data can be misused or misinterpreted.

Like motherhood and apple pie, the concept of sharing primary data is widely recognized among scientists as a good thing. The difficulty lies in putting this laudable aim into practice — and the current controversy surrounding the National fMRI Data Center, a new repository for brain-imaging data at Dartmouth College in Hanover, New Hampshire (see page 445), provides a case in point.

Michael Gazzaniga, director of the centre, is a respected cognitive…

from results they have worked hard to acquire. At the same time, they must devise robust procedures to protect confidentiality, for carelessly archived fMRI data could allow experimental subjects to be identified.

The problem is that fMRI is a young field, in which techniques for data acquisition and analysis are not yet standardized. For instance, some fMRI practitioners argue that data will increasingly be presented as flattened surface representations of the brain. Creating a database … ntations could in …

… delaying discus… provide a power… to artefact, with … s. With different … ive their images, it … s' claims. And as … many of whom … grow. Ultimately, … best solution.

… g (OHBM) has … was under discus… red the fray. But … 's deliberations a … tional fMRI Data …

… ut of its task force … produce interim … ience meeting in … *roscience* have no … s are deposited in … nsensus on data … at service.

SCIENCE'S COMPASS • VIEWPOINT

VIEWPOINT: NEUROSCIENCE

Neuroimaging Databases

The Governing Council of the Organization for Human Brain Mapping (OHBM)

These are comments written by the Governing Council of the Organization for Human Brain Mapping (OHBM), the primary international organization dedicated to neuroimaging research. The purpose of these comments is to identify and frame issues concerning data sharing within the neuroimaging community. Data sharing has become an important issue in most fields of science. The neuroimaging community is no exception, and it clearly perceives potential benefits in such efforts, as have been realized in other fields such as genomics. At the same time, such efforts can be costly (both in time and expense), and there are important factors that differentiate brain imaging from other fields and that pose specific challenges to the generation of useful neuroimaging databases. These include the rapid pace of change in brain imaging technologies; the complexity of the variables that must be specified to meaningfully interpret the results (such as the method of image acquisition, behavioral design, and subject characteristics); and concerns about participant confidentiality. These issues are outlined with the goal of framing and promoting a public discussion of the benefits and risks of data sharing, which can inform the field of neuroimaging as well as others that face similar challenges.

The following are comments prepared by the Governing Council of the Orga…

our field but to others that face similar issues. For example, the field of genomics now faces…

that obscures their full complexity. The data themselves take a variety of forms and typically are not accessible for widespread sharing and use. Making neuroimaging data more accessible for sharing would facilitate the comparison of findings across laboratories, to allow better assessment of the reliability of methods and reproducibility of results; encourage meta-analyses that explore phenomena that are not apparent in individual data sets; and give investigators who do not have access to neuroimaging facilities the opportunity to conduct research using existing data. All of these are more efficient uses of neuroimaging data, which are relatively expensive to collect.

Some challenges. These potential benefits and the success of data sharing in other communities have inspired the neuroimaging community to consider ways of doing the same with brain imaging data. However, past…

REVIEWS

NEUROIMAGE DATABASES: THE GOOD, THE BAD AND THE UGLY

Arthur W. Toga

The potential of neuroimage databases to accelerate the dissemination and use of information about brain structure and function is enormous and ever increasing. Numerous efforts are now underway to further develop the technology and sociology that are necessary to support this revolution. Each effort has its own approach and tackles some of the complex problems that are associated with creating and providing access to a database. This paper introduces many of the recent successes and future challenges that are faced by the developers and users of neuroimage databases.

The quest to understand the human brain, in all its complexity, has seen remarkable advances at all levels. The diversity of techniques that are used to study the brain and our knowledge of the nervous system are unparalleled in modern science, and there continues to be an astonishing annual increase in the number of specialized papers, journals and meetings on every aspect of brain function. Most investigators are forced to specialize in order to assimilate a rapidly increasing range of information. These forces tend to fragment the field and reduce access to related, but independent, observations.

Furthering our understanding of the structure and function of the nervous system clearly requires the management and integration of an enormous amount and variety of data. It requires databasing. We need an organizational schema that allows the testing of relationships between data that are derived from different experiments, using different methods, to study different aspects of the brain, on different…

analysed data. The relative newness of the technology, and the fact that the data are digital and often have a regularized structure, have motivated the neuroimaging community to initiate various databasing efforts. Databases hold the promise of achieving the integration and sharing that are needed to propel the study of the brain into the twenty-first century. Undoubtedly, the amalgamation of information that is achieved by databases will help to overcome the reductionist requirements for experimentation.

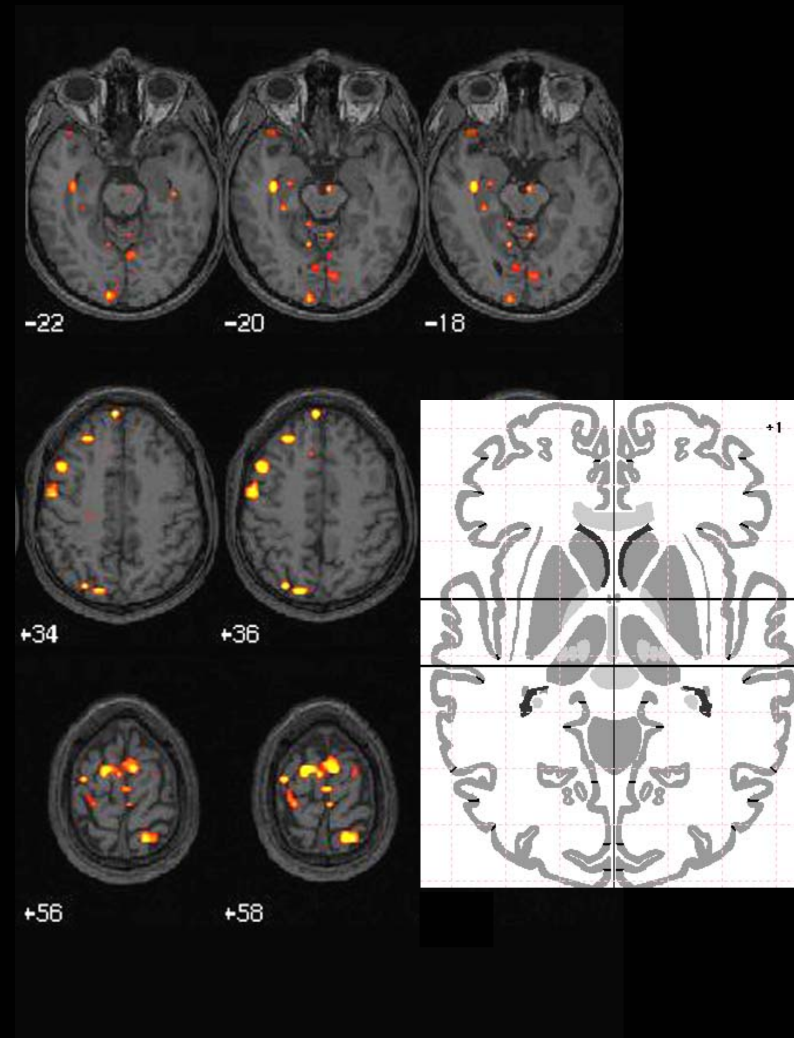
Although significant progress has been made in the development of imaging databases, particularly from the technological point of view, many issues still need to be tackled before these databases reach their full potential and fulfil their promise of becoming an invaluable asset in neuroscience research. Here, I discuss the good, the bad and the ugly aspects of our efforts to create neuroimaging databases.

Talairach and Tournoux Atlas Coordinates

Table 1. Maximal rCBF changes for pattern by frequency interaction contrast

Extent significance	Intensity significance, *Z*	Talairach space *x, y, z* coordinates, mm	Anatomical description (Brodmann area)
$P < 0.001$	6.09	−24, −12, 58	Left dorsal premotor area (BA 6)
$P < 0.001$	5.27	24, −8, 72	Right dorsal premotor area (BA 6)
$P < 0.001$	5.83	−2, 6, 48	Cingulate gyrus (BA 24)
$P < 0.001$	4.66	26, −56, −28	Right cerebellar hemisphere
$P < 0.001$	4.38	0, −52, −14	Cerebellar vermis
$P < 0.001$	3.79	2, −10, 62	Supplementary motor area (BA 6)
$P < 0.001$	3.50	0, −2, 76	Supplementary motor area (BA 6)
$P < 0.002$	5.62	−42, 12, 4	Broca's area (BA 45)
$P < 0.03$	4.14	−56, −38, 34	Left supramarginal gyrus (BA 40)

All tabulated activations were significant at the level of $P < 0.001$ (uncorrected). Multiple comparison corrections for cluster extent (column 1) and voxel intensity (column 2) are shown.



Why Store Raw fMRI Data?

- Claims in the literature suggest that heavily processed lists of Talairach results are scientifically "worth" more than the raw data from which they came [Fox and Lancaster, (2002) *Nat. Rev. Neurosci.*, **3**, 319-321]

- Mathematically speaking, with every step of processing, "information content" contained in the new data about the original data remains *unchanged or is reduced* (*The Data Processing Inequality*)

- "Clever data processing can never increase the amount of information contained in one data set about another"

- Information contained in a small collection of test statistics at Talairach coordinates about the original data likely to be very small indeed – difficult to see source of any added "worth". Useful as summary.

- Archive/share the raw fMRI time course data (*warts and all!*) as it possesses the greatest ***information content*** accompanied by descriptive information about the processing stream.

The Scale of fMRI Studies

For Example:

Bucker *et al.,* 2000, **JOCN**
41 participants
14 young adults
14 older adults with dementia
13 older unaffected adults

Anatomical Images:
3-4 high-resolution MPRAGE
Functional Images:
Four BOLD-EPI runs, 128 volumes each, 16 slices

~45 GIGABYTES (uncompressed)

Functional Brain Imaging of Young, Nondemented, and Demented Older Adults

Randy L. Buckner
Howard Hughes Medical Institute and Washington University

Abraham Z. Snyder, Amy L. Sanders, Marcus E. Raichle, and John C. Morris
Washington University

Abstract

■ Brain imaging based on functional MRI (fMRI) provides a powerful tool for characterizing age-related changes in functional anatomy. However, between-population comparisons confront potential differences in measurement properties. The present experiment explores the feasibility of conducting fMRI studies in nondemented and demented older adults by measuring hemodynamic response properties in an event-related design. A paradigm involving repeated presentation of sensory–motor response trials was administered to 41 participants (14 young adults, 14 nondemented older adults, and 13 demented older adults). For half of the trials a single sensory–motor event was presented in isolation and in the other half in pairs. Hemodynamic response characteristics to the isolated events allowed basic response properties (e.g., amplitude and variance) between subject groups to be contrasted. The paired events further allowed the summation properties of the hemodynamic response to be characterized. Robust and qualitatively similar activation maps were produced for all subject groups. Quantitative results showed that for certain regions, such as in the visual cortex, there were marked reductions in the amplitude of the hemodynamic response in older adults. In other regions, such as in the motor cortex, relatively intact response characteristics were observed. These results suggest caution should be exhibited in interpreting simple main effects in response amplitude between subject groups. However, across all regions examined, the summation of the hemodynamic response over trials was highly similar between groups. This latter finding suggests that, even if absolute measurement differences do exist between subject groups, relative activation change should be preserved. Designs that rely on group interactions between task conditions, parametric manipulations, or group interactions between regions should provide valuable data for making inferences about functional–anatomic changes between different populations. ■

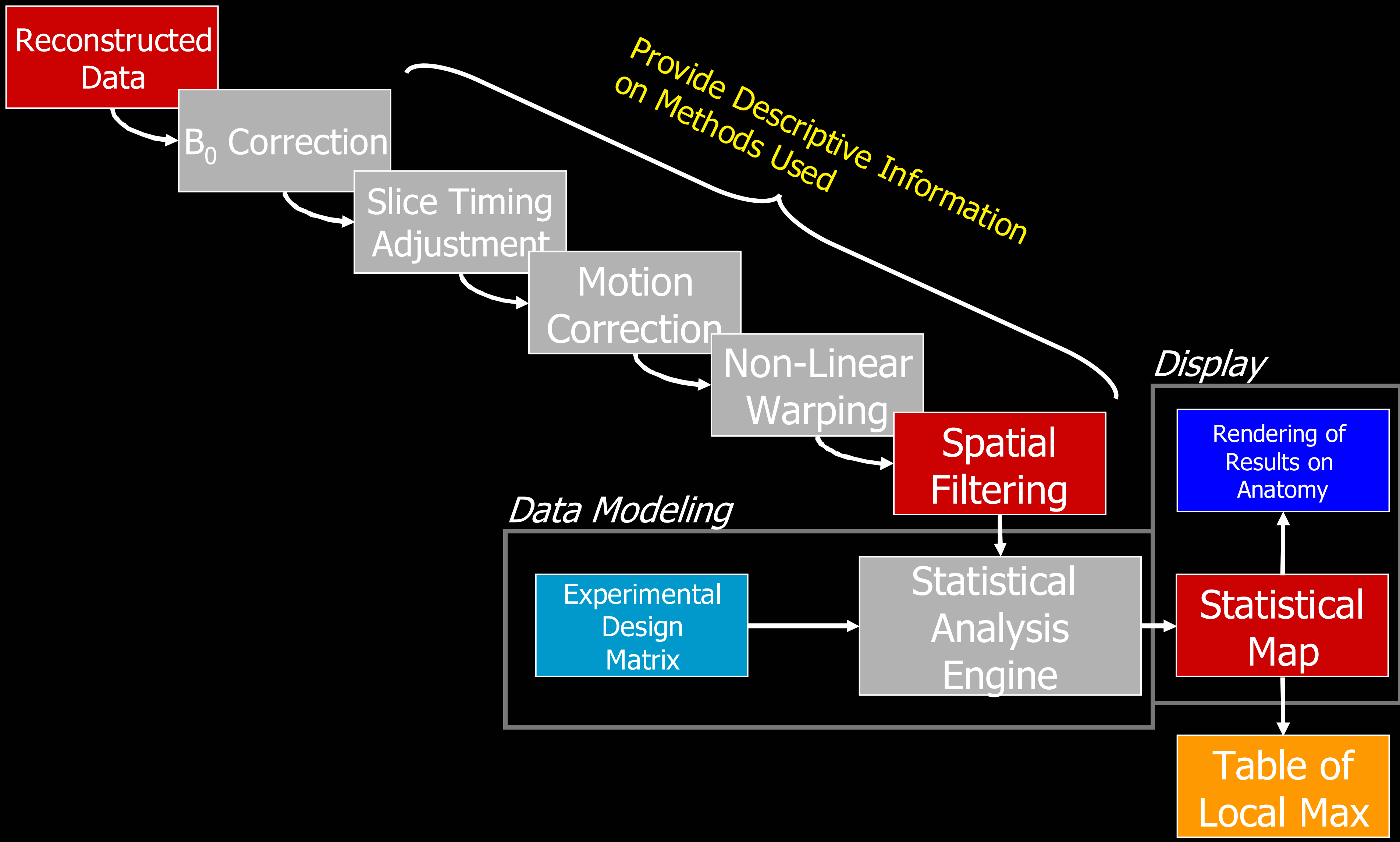
INTRODUCTION

Brain imaging studies in young adults provide a foundation for exploring the functional anatomy of healthy aging and aging associated with progressive dementia. Completing such explorations may yield insights into the origins of age-associated cognitive change and perhaps even provide functional–anatomic markers that predict cognitive decline associated with Alzheimer's disease (e.g., Jonides, Marshuetz, Smith, Reuter-Lorenz, & Koeppe, 2000; Reuter-Lorenz et al., 2000; Rypma & D'Esposito, 2000; Backman et al., 1999; Backman, Almkvist, Nyberg, & Andersson, 2000; Small, Perera, DeLaPaz, Mayeux, & Stern, 1999; Smith et al., 1999; Madden et al., 1999; Cabeza et al., 1997; Mentis et al., 1996; Mentis et al., 1998; Schacter, Savage, Alpert, Rauch, & Albert, 1996; Grady et al., 1993; Grady et al., 1994; Grady et al., 1995; Grady, McIntosh, Rajah, Beig, & Craik, 1999). However, extending brain-imaging research into older adult populations brings with it several methodological challenges. The present study explores the feasibility of using functional MRI (fMRI) to study older adults.

Among the most serious challenges to fMRI feasibility is the possibility that the measures of neuronal activity used by fMRI have different properties in young and old adults. In particular, most fMRI studies are based on indirect measures of neural activity that rely on a coupling of local neuronal activity to a vascular hemodynamic response. Increased neural activity leads to changes in blood flow and volume without concordant changes in oxygen utilization. The result is a local increase in blood oxygen content that can be imaged with MRI (often called the blood oxygenation level dependent, or BOLD mechanism; Ogawa et al., 1992; Kwong et al., 1992). The BOLD mechanism thus depends on the integrity and proper regulation of local vasculature (Kuschinsky, 1999; Villringer, 1999). The first

Journal of Cognitive Neuroscience 12:Supplement 2, pp. 24–34

Typical fMRI Data Processing Stream



fMRIDC Data Archive Philosophy

- Archive all the information needed to interpret, analyze and reproduce published fMRI studies and results
  - Request that authors provide all the information and data needed to thoroughly describe the details of their experiment
  - Request common information the neuroimaging community expects when describing an experiment
  - Allow for authors to utilize their own terminology where ever possible

Study information

subjects, scanning sessions, scanner protocols, experimental protocols, etc.

Images

raw reconstructed functional images, pre-processed images, anatomical scans, statistical results maps, etc.

Available fMRI Study Data Sets

Arrington, *et al.*
Hazeltine, *et al.*
Ishai, *et al.*
Leonards, *et al.*
Mechelli, *et al.*
Wagner, *et al.*
Crosson, *et al.*
Jovicich, *et al.*

Buckner, *et al.*
Hinrichs, *et al.*
Klein, *et al.*
Marschuetz, *et al.*
Simpson, *et al.*
Wessinger, *et al.*
Hasson, *et al.*
Ng, *et al.*

Heuttle, *et al.*
Laurienti, *et al.*
Bischoff-Grethe, *et al.*
Vouloumanous, *et al.*
Postle, *et al.*
Poldrack, *et al.*
Hirsch, *et al.*
Macaluso, *et al.*

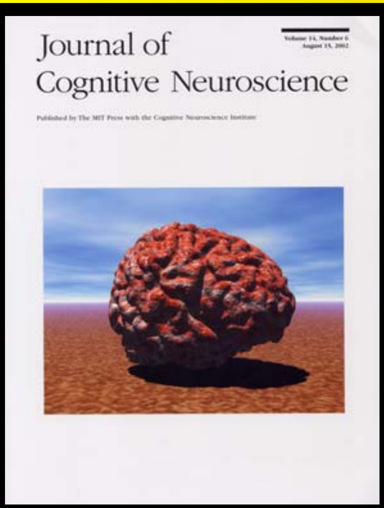
Kelley, et al.
Rypma, et al.
Kable, et al.
Tsukiura, et al.
Nakamura, et al.
Fabri, et al.
Iidaka, et al.

Note:

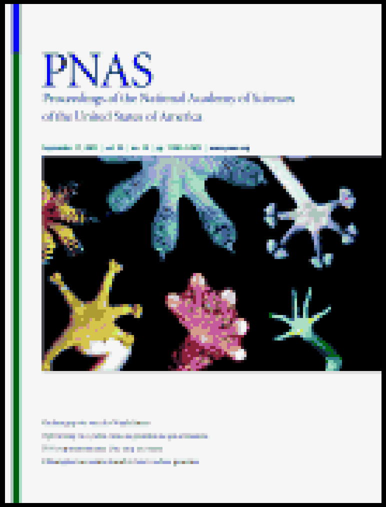
- Image file conversion, brain stripping, and document generation takes ~2-3 weeks. Initial study packaging takes on the order of 1 day. ***Slowest part increasingly the communication with/response from authors.***

- Numerous instances where contributed data sets are packaged and awaiting article publication before they can be released.

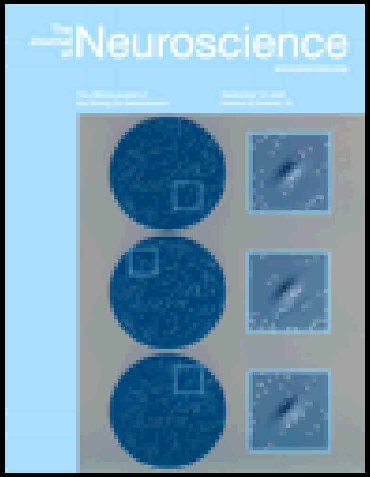
Journals Supporting fMRI Data Sharing



JOCN

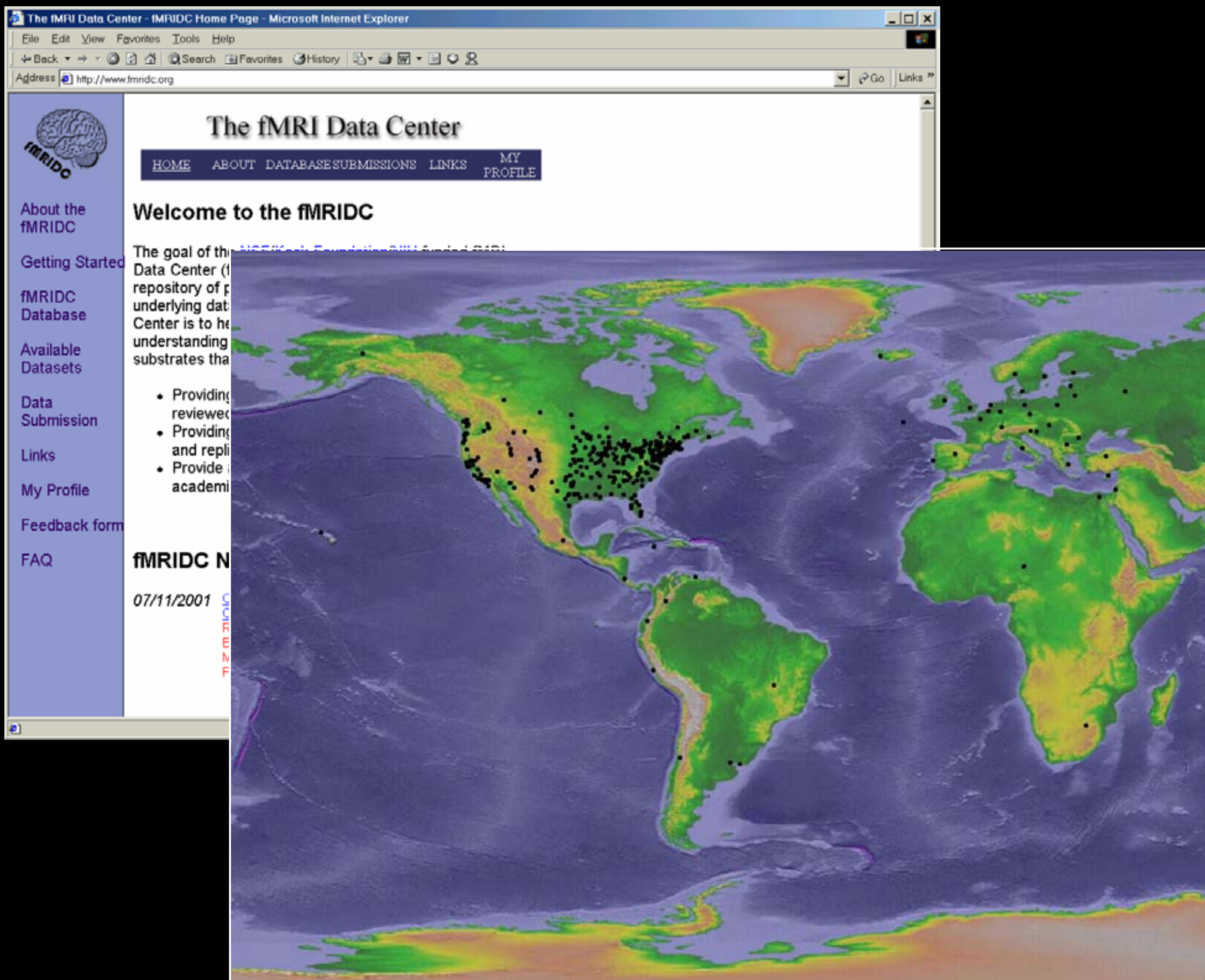


PNAS



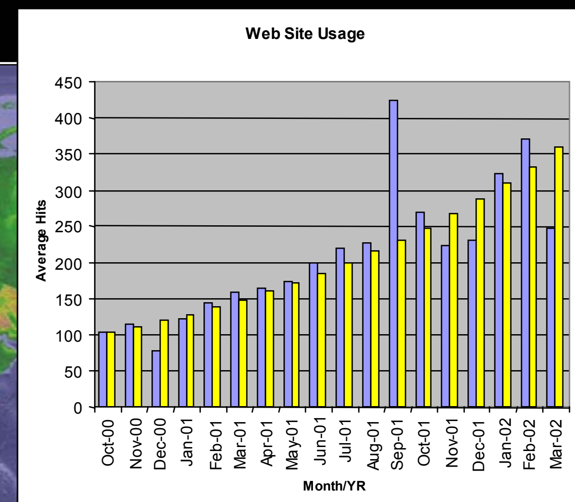
J. Neurosci.

fMRIDC Web Usage Statistics



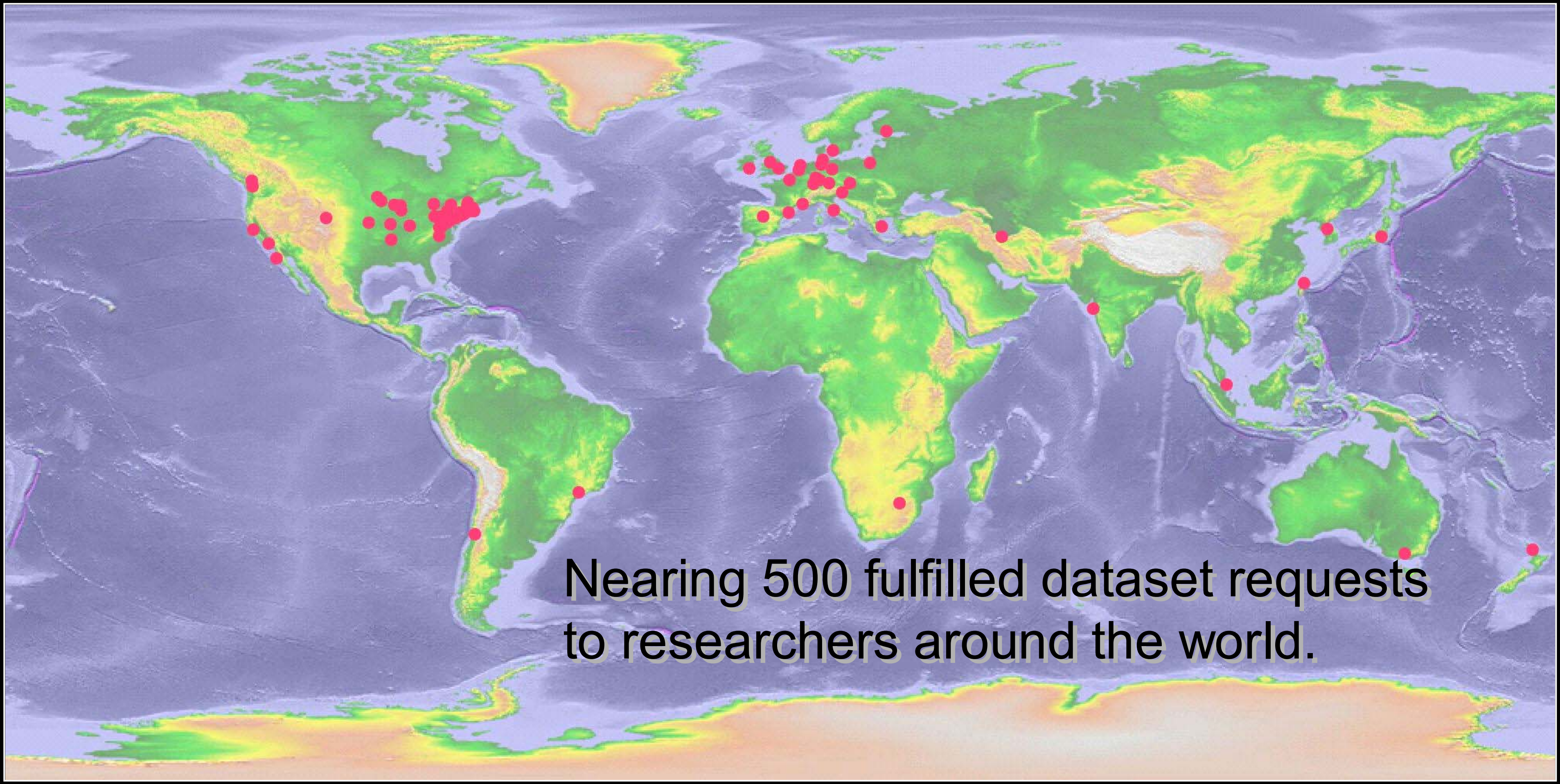
$Y = 76.3 \cdot e^{0.074 \cdot t}$

$R^2=0.87$, $F(1,10)=51.42$. $p<2.5\times10^{-6}$



Observed Predicted

Distribution of Data Set Requests



fMRIDC Data Request Shipping

Health Information Portability and Accountability Act of 1996

- **PRIVACY AND CONFIDENTIALITY**
  - The Final Rule for Privacy published as President Clinton was leaving office, on December 28, 2001. Compliance will be required on April 14, 2003 for most covered entities.
  - Privacy concerns who has the right to access personally identifiable health information. The rule covers all individually identifiable health information in the hands of covered entities, regardless of whether the information is or has been in electronic form.
- **THE PRIVACY STANDARDS**
  - limit the non-consensual use and release of private health information;
  - give patients new rights to access their medical records and to know who else has accessed them;
  - restrict most disclosure of health information to the minimum needed for the intended purpose;
  - establish new criminal and civil sanctions for improper use or disclosure;
  - establish new requirements for access to records by researchers and others.

Health Information Portability and Accountability Act of 1996

The new regulation reflects the five basic principles outlined in 1996:

- **Consumer Control:** The regulation provides consumers with critical new rights to control the release of their medical information
- **Boundaries:** With few exceptions, an individual's health care information should be used for health purposes only, including treatment and payment.
- **Accountability:** Under HIPAA, for the first time, there will be specific federal penalties if a patient's right to privacy is violated.
- **Public Responsibility:** The new standards reflect the need to balance privacy protections with the public responsibility to support such national priorities as protecting public health, conducting medical research, improving the quality of care, and fighting health care fraud and abuse.
- **Security:** It is the responsibility of organizations that are entrusted with health information to protect it against deliberate or inadvertent misuse or disclosure.

Requirements on the Protection of Human Subjects

- The Nuremberg Code (1947)
- The Helsinki Declaration (1964, 1965)
- The Belmont Report (1979)
- US Federal Regulations [45 CFR 46] aka “The Common Rule” (1991)

"There are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of data."

Criteria For Institutional Review Board (IRB) Approval of Research Involving Human Subjects, OHSR Information Sheet #3

•**Source**: the individual who provided the sample or from whom data were collected.

•**Identified**: samples or data that are still attached to a readily available subject identifier *e.g.* name, SSN, address, telephone number, medical record number, etc.

•**Coded**: collected samples or data are unidentified for research purposes by use of a random or arbitrary alphanumeric code but the samples may still be linked to their sources through use of a key to the code available to an investigator or collaborator.

•**Unlinked**: human data or samples that were initially collected with identifiers but, prior to research use, have been *irreversibly stripped of all identifiers by use of an arbitrary or random alphanumeric code and the key to the code is destroyed, thus making it impossible for anyone to link the samples to the sources*.

Removal of Identifiers

IDENTIFIERS that must be removed from all data in compliance with NIH Guidelines and HIPAA Privacy Rules:

- Names
- Addresses
- Dates directly related to an individual (birth dates)
- Phone numbers
- Fax numbers
- Email address
- Social security numbers
- Medical record numbers
- Health plan beneficiary numbers
- Account numbers
- Certificate/license numbers
- Web universal resource Locators (URLs)
- Biometric identifiers (face portion or skull structure of MRI of the head)
- Identifiable photographic images
- Other unique identifiers

- Contributing researchers are asked to ensure that subject identifiers have been properly removed and that the data are unlinked.

- Data received from researchers will be inspected for potential subject identifiers and these identifiers will be removed from any and all behavioral and neuroimage data.

- Researchers may download from the Data Center web site a letter that they may provide to their Human Subjects committee explaining the Data Center and the steps being taking to protect subject anonymity.

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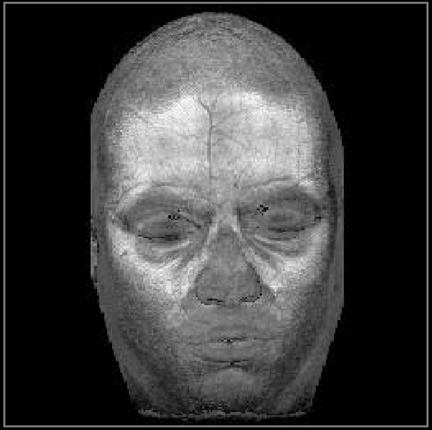
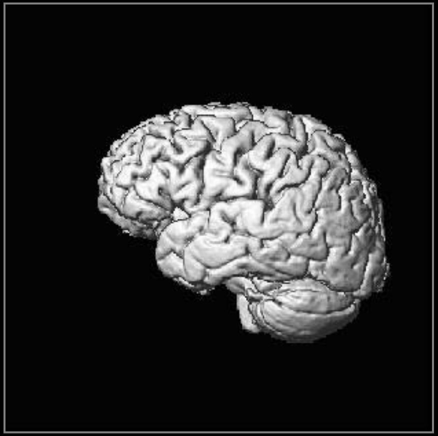




Researchers contributing data to the fMRI Data Center may provide high-resolution structural images that they have stripped themselves or may leave it to the Data Center to do the stripping for them.

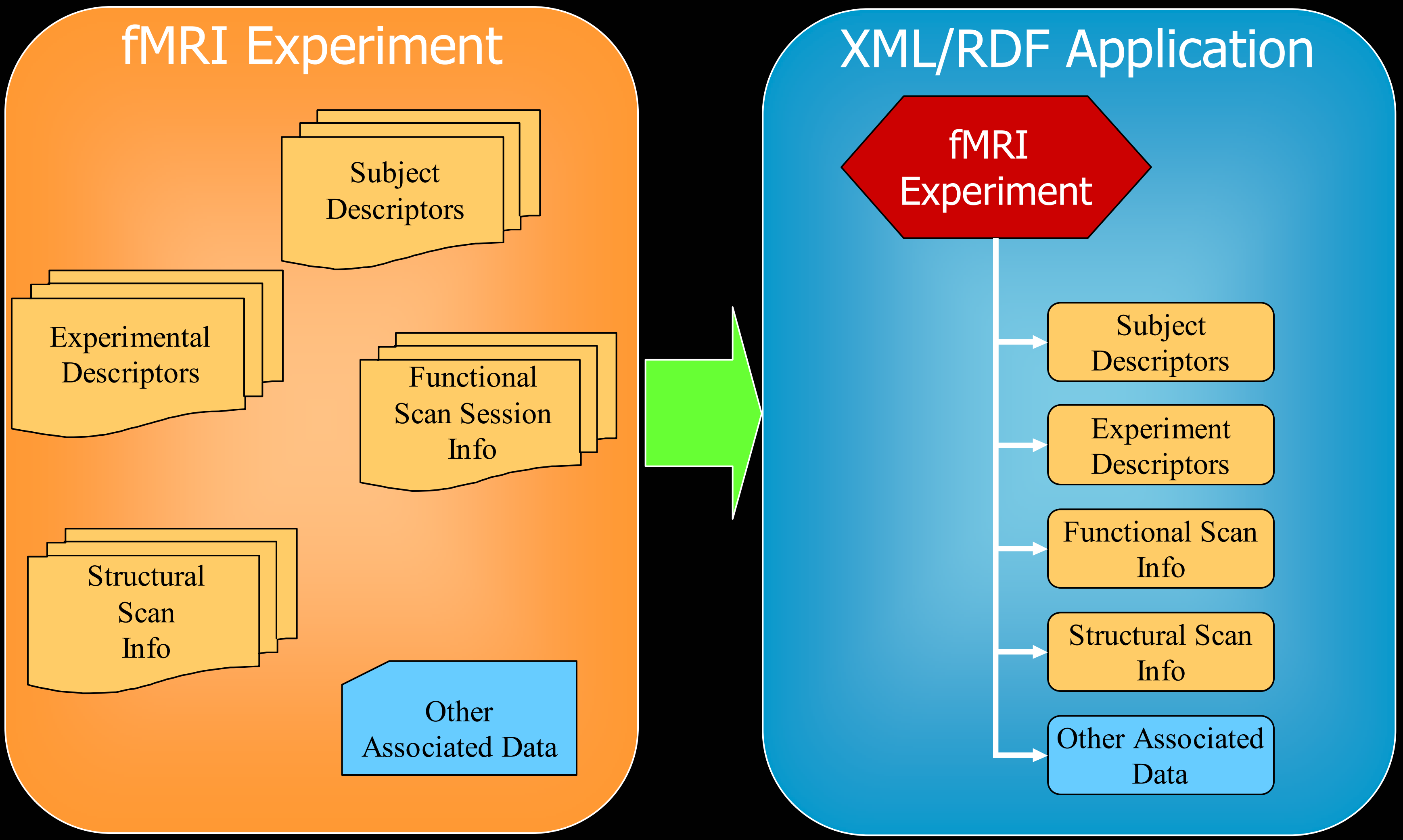
Use of Data from the Data Center: Human Subjects Considerations

“The *NIH Multiple Project Assurance* and the *Federal Regulations* provide an exemption from the need to obtain IRB review and approval for ‘research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.’" 45 CFR 46.101(b)(4).

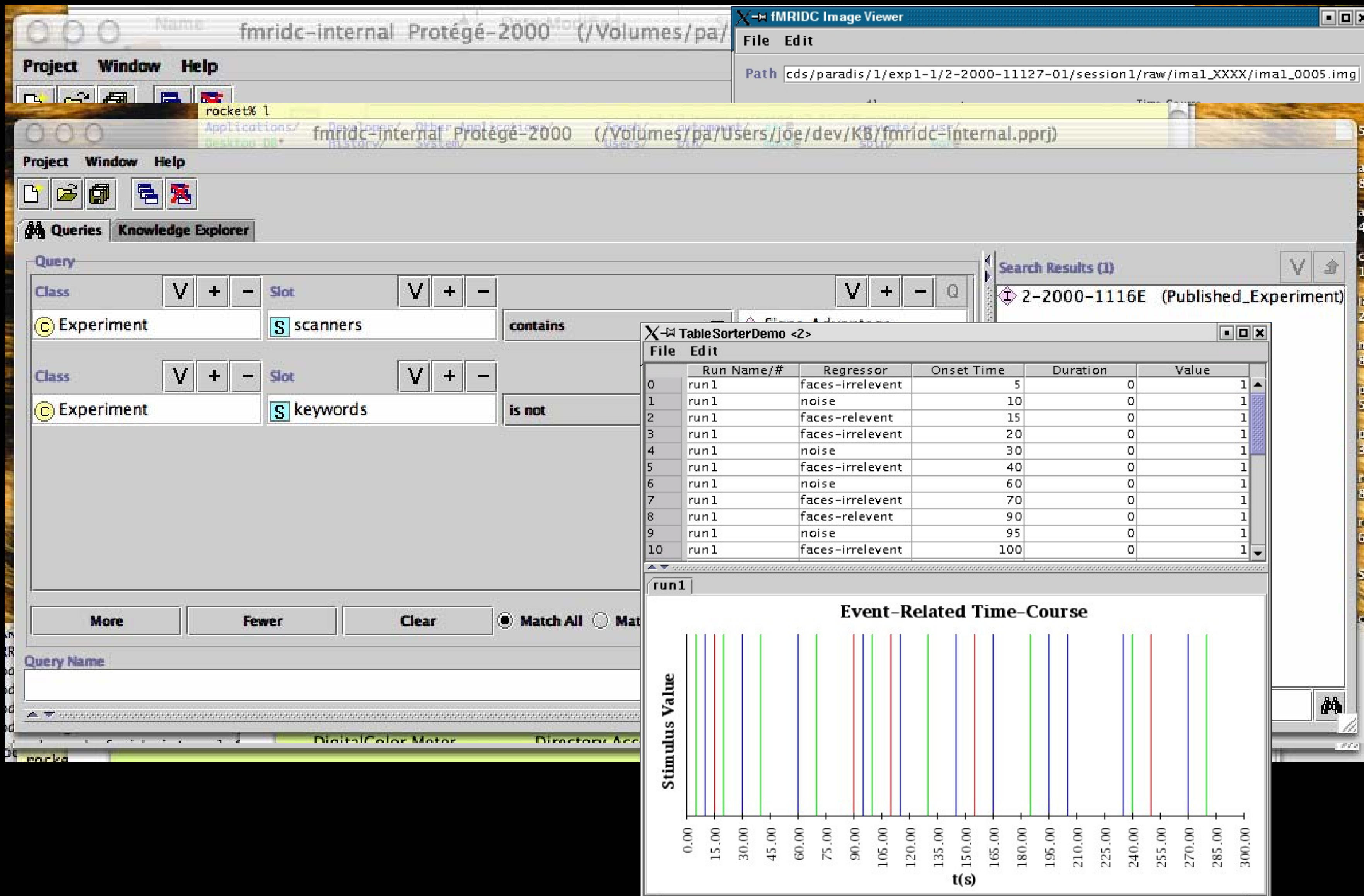
From Guidance on the Research Use of Stored Samples or Data, OHSR Information Sheet #14

The research use of *existing, unidentified or unlinked* samples or data is generally exempt from the requirement for prospective review and approval by an IRB.

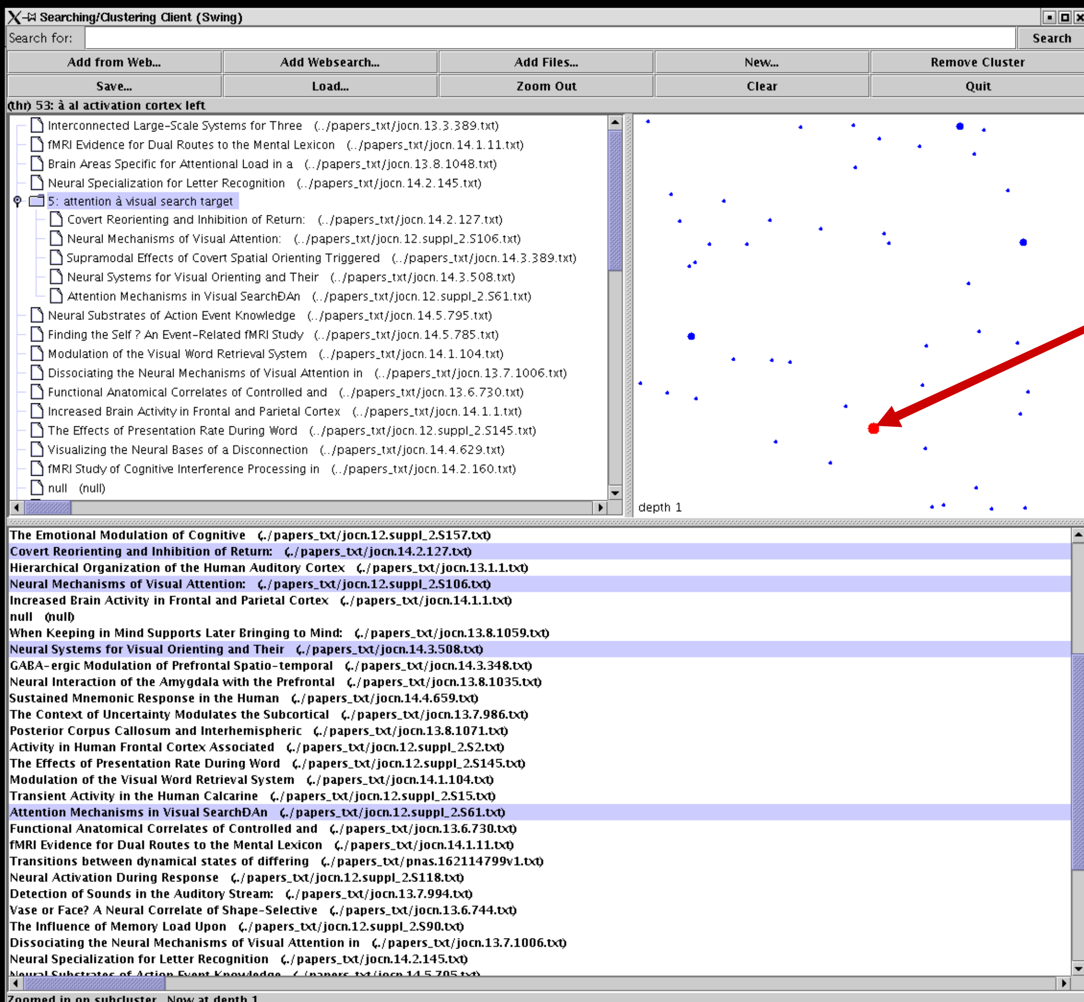
Experiment Meta-Data Organization



fMRIDC Data Management Tool Suite

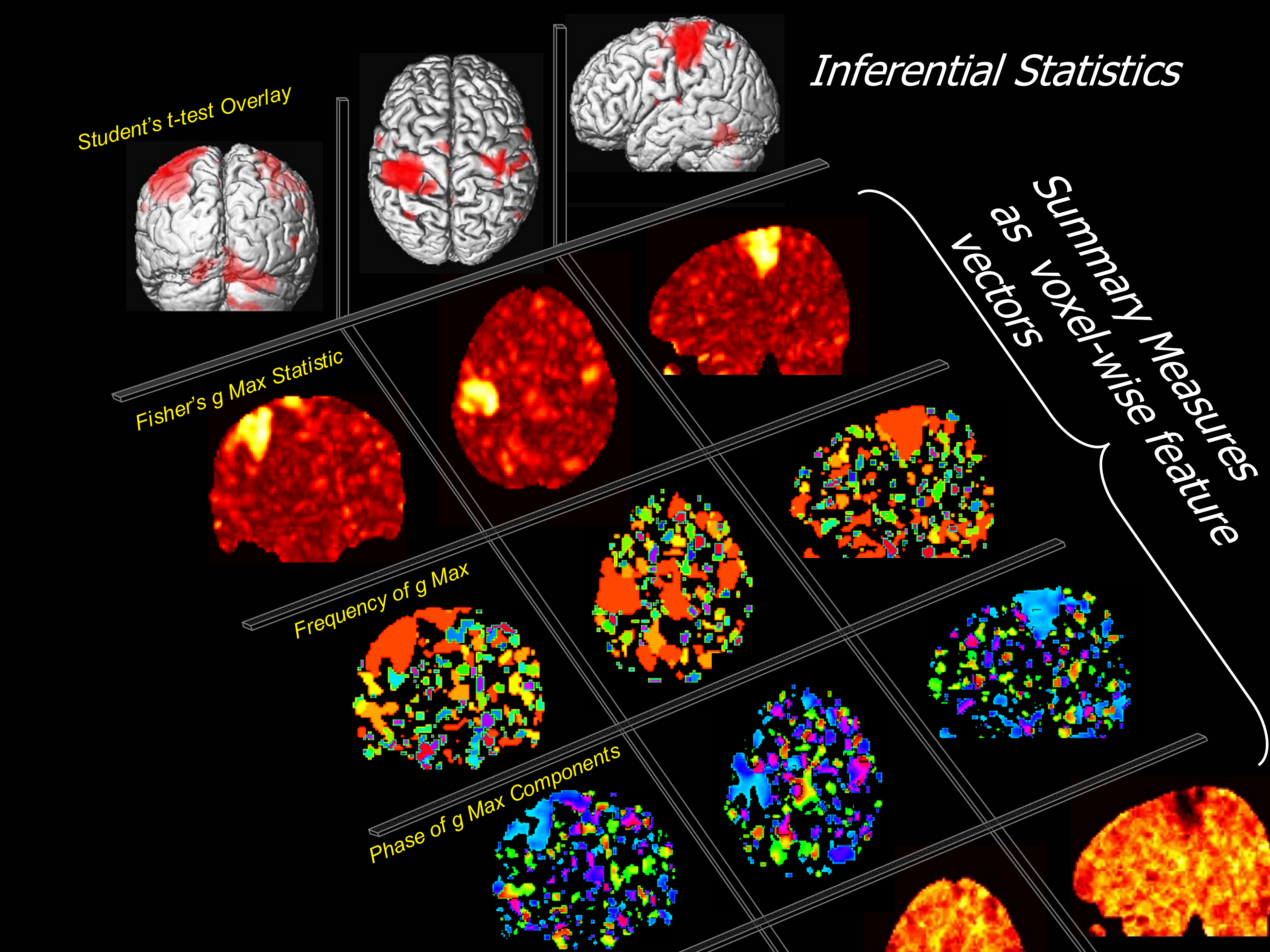


Searching/Clustering of Published Articles

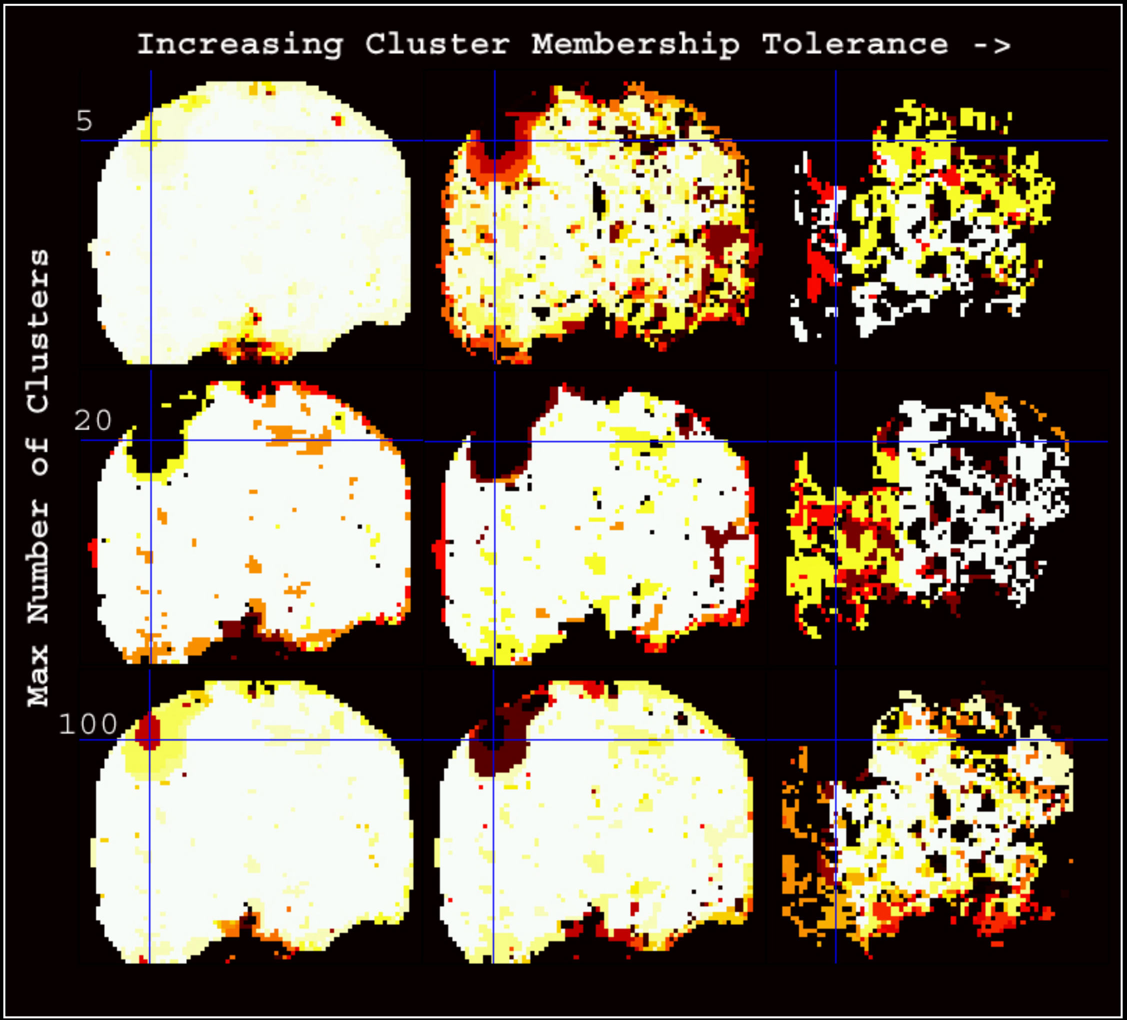


5 studies pertaining to human visual attention

"Covert Reorienting and Inhibition of Return"
"Neural Mechanisms of Visual Attention"
"Supramodel Effects of Cover Spatial Orienting…"
"Neural Systems for Visual Attention …"
"Attention Mechanisms in Visual Search"


Inferential Statistics
Summary Measures as voxel-wise feature vectors
Student's t-test Overlay
Fisher's g Max Statistic
Frequency of g Max
Phase of g Max Components

Voxel Level Clustering and Beyond



Hierarchical clustering at the levels of
- *Entire Studies*
  - *Groups of Subjects*
    - *Individual Subjects*
      - *Conditions*
        - *Voxels*

<u>Recent work on clustering:</u>

Baune, *et al.*, 1999, *NeuroImage*
Goutte, 1999, *NeuroImage*
Goutte, 2000, *Hum. Br. Mapping*
Balslev, *et al.*, 2002, *Hum. Br. Mapping*

2002 fMRIDC Summer Workshop

2002 Workshop Faculty:

Peter Bandettini, NIMH
Roger Woods, UCLA
Carey Priebe, JHU
Ben Fry, MIT
Tom Mitchell, CMU
Daniela Rus, Dartmouth
Benjamin Martin-Bly, Rutgers
Alumit Ishai, NIMH
Jack Van Horn, Dartmouth

Response to the *New Perspectives in fMRI Research Award* Call for Papers

CALL FOR PAPERS

The **fMRI Data Center** has experienced an overwhelming response from the scientific community. This publicly available archive of published functional magnetic resonance imaging studies is intended to facilitate data sharing across the fields of computer science, mathematics, physics, and the neurosciences. Since its inception, the Data Center has provided researchers in over 20 countries with complete, raw, functional and structural MRI data sets. To further encourage this unique opportunity for scientific exchange ***The Journal of Cognitive Neuroscience*** would like to announce a call for papers for the

New Perspectives in fMRI Research Awards

Submitted papers will be adjudicated by leading experts in fMRI research. The evaluation of manuscripts will be focused upon

1) The best utilization of one or more data sets housed at the fMRI Data Center and
2) How the findings of the original functional imaging investigation have been expanded through re-analysis.

Three finalists will be selected to receive cash awards of **$5000, $2000, $1000**, respectively, and all three manuscripts will be published in the JOCN. Additionally, the authors of the original research articles, from which data have been utilized, will be invited to provide a published commentary on the new analyses.

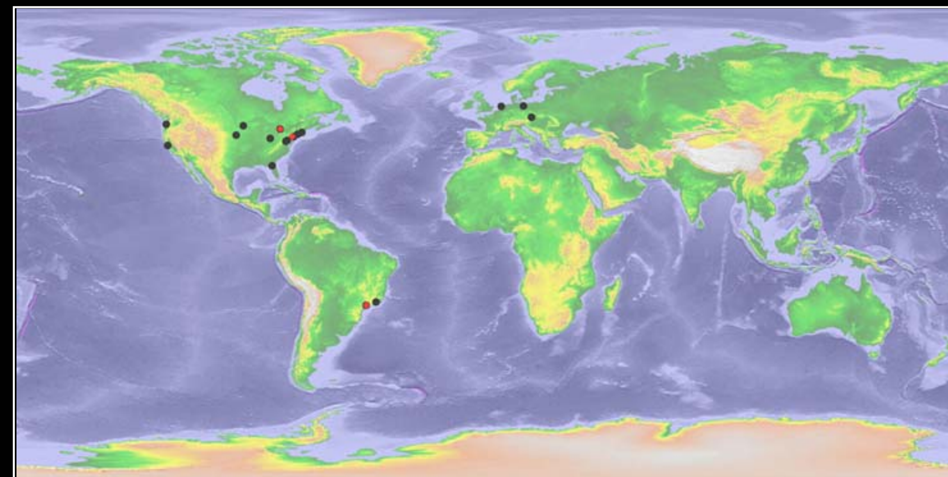
Please remit your Letter of Intent by October 1st, 2001 to

The Journal of Cognitive Neuroscience
6162 Moore Hall
Hanover, New Hampshire 03755

Deadline for manuscript submission: February 1st, 2002

Awardees will be notified by mail and publicly announced at the Cognitive Neuroscience Society 2002 Annual Meeting in San Francisco, CA.

For more information, please call the fMRI Data Center at (603) 646-0170



2002 New Perspectives Awardee:

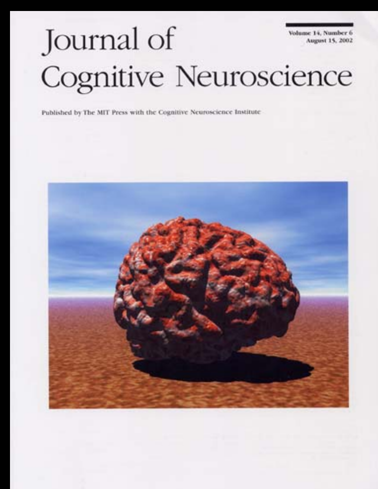
Dan Lloyd, Ph.D., *Trinity College*, Connecticut

Functional MRI and the Study of Human Consciousness

New Perspectives Award 2002

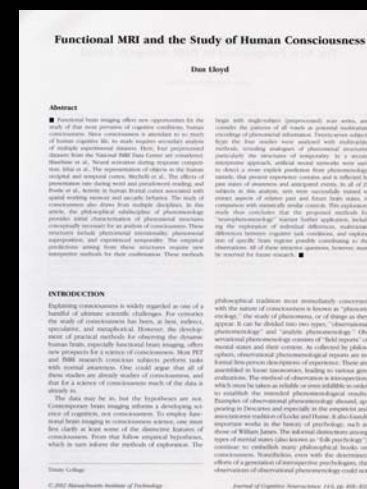
The New Perspectives Award

JOCN, 2002, 14:6



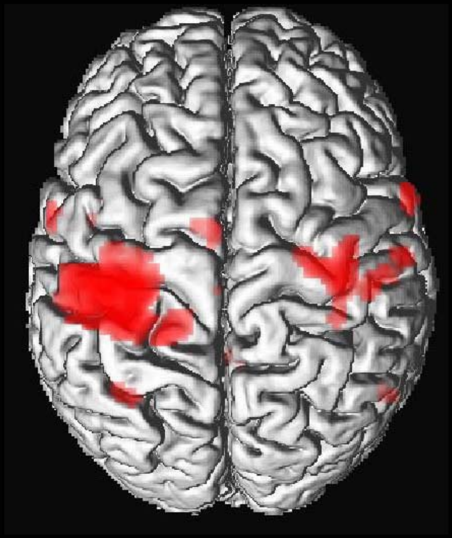
Daniel Lloyd, Ph.D. of Trinity College receiving his award

The award winning paper



Conclusions

➢What neuroimaging data is worth sharing and archiving?



➢All the raw and processed functional MRI timecourse, structural, experimental, and subject meta-data needed to reproduce the effects reported in the published literature.

➢Includes raw reconstructed image data from the scanner, the image data after pre-processing, statistical results images, and graphical overlays.

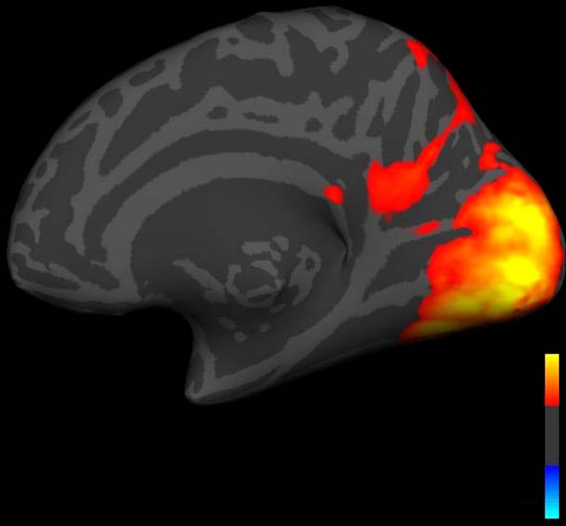
➢"Information" content is maximal in complete study data

➢The complete data permit a broader range of novel secondary analyses by other researchers to be performed for testing new hypotheses.

➢Care needs to be taken to protect subject anonymity in compliance with US Federal Govt regulations (HIPAA) and NIH Guidelines (45 CFR 46)

Conclusions

- The fMRIDC has made significant progress in the sharing and archiving of primary research data from fMRI studies
  - Presently, 1.4TB (uncomp) representing 30+ complete data sets from published studies



- Continued fMRIDC archive growth and usage expected
  - More studies contributed => more study data requested
  - Encourage further contribution of data from as many peer-reviewed periodicals as possible

- Encouraging education and new science
  - *The New Perspectives in fMRI Research Award – JOCN 2002, 14:6.*
  - Next Call for Papers Deadline – October 2002
  - 2003 fMRIDC Summer Workshop

fMRIDC Personnel

- Michael S. Gazzaniga, PhD PI, Director Center for Cognitive Neuroscience
- Daniel Rockmore, PhD Co-PI, Prof. of Mathematics
- Javed Aslam, PhD Co-PI, Prof. of Computer Science
- Jack Van Horn, PhD Operations Director, Res. Assoc. Prof., DBIC
- Jeffrey Woodward, Project Manager of Systems and Development
- Michael Schmitt, Systems Administrator
- Bennet Vance, PhD Research Associate
- Joseph Edelman, Research Associate
- Mark Montague, PhD Research Associate
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- Scott T. Grafton, MD Consultant, Prof. of Psychology & Brain Sciences, *Director DBIC*
- Daniela Rus, PhD Consultant, Prof. of Computer Science

References

Phil Trans Roy Soc., **356**, 1323-1339, (2001)

THE ROYAL SOCIETY

The Functional Magnetic Resonance Imaging Data Center (fMRIDC): the challenges and rewards of large-scale databasing of neuroimaging studies

John D. Van Horn, Jeffrey S. Grethe, Peter Kostelec, Jeffrey B. Woodward, Javed A. Aslam, Daniela Rus, Daniel Rockmore and Michael S. Gazzaniga*

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The Functional Magnetic Resonance Imaging Data Center (fMRIDC) (http://www.fmridc.org) was established in the Autumn of 1999 with the objective of creating a mechanism by which members of the neuroscientific community may more easily share functional neuroimaging data. Examples in other sciences offer proof of the usefulness and benefit that sharing data provides through encouraging growth and development in those fields. By building a publicly accessible repository of raw data from peer-reviewed studies, the Data Center hopes to create a similarly successful environment for the neurosciences.

In this article, we discuss the continuum of data-sharing efforts and provide an overview of the scientific and practical difficulties inherent in managing various fMRI data-sharing approaches. Next, we detail the organization, design and foundation of the fMRIDC, ranging from its current capabilities to the issues involved in the submitting and requesting of data. We discuss how a publicly accessible database enables other fields to develop relevant tools that can aid in the growth of understanding of cognitive processes. Information retrieval and meta-analytic techniques can be used to search, sort and categorize study information with a view towards subjecting study data to secondary 'meta-' and 'mega-analyses'. In addition, we detail the technical and policy challenges that have had to be addressed in the formation of the Data Center. Among others, these include: human subject confidentiality issues; ensuring investigator's rights; heterogeneous data description and organization; development of search tools; and data transfer issues. We conclude with comments concerning the future of the fMRIDC effort, its role in promoting the sharing of neuroscientific data, and how this may alter the manner in which studies are published.

Keywords: neuroinformatics; functional magnetic resonance imaging; neuroimaging; database; meta-analysis

1. INTRODUCTION

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Nature Reviews Neurosci., **3**, 314-318, (2002)

PERSPECTIVES

OPINION

Databasing fMRI studies — towards a 'discovery science' of brain function

John D. Van Horn and Michael S. Gazzaniga

Progress to date and current usage

Subject anonymity and protection.

Quality control.