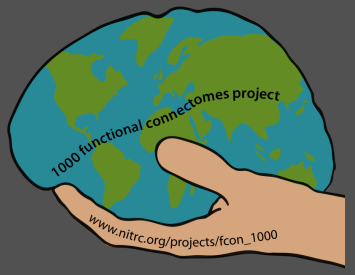
Presentation Delivered at: Second Biennial International Conference on Resting State Brain Functional Connectivity (Sept. 19, 2010)

1000 Functional Connectomes Later: Where We Are And Where We Are Going…



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Associate Director, Phyllis Green and Randolph Cōwen Institute for Pediatric Neuroscience, NYU Child Study Center

Terminology…

- "That which we call a rose by any other name would smell as sweet.." (Shakespeare, 1600)
- Same rules can apply to a "mess" of data…
  - 1000 Functional Connectomes Project
  - 1000 Connectomes Project
  - Functional Connectomes Project (FCP)
  - KFC
  - F-1000
  - FCON_1000
  - The other connectomes project…

More Terminology…

- What kind of imaging are we talking about?
  - R-fMRI, RS-fMRI, fc-fMRI, RS-fcMRI, 'Rest'
- What are we looking at?
  - FC, RSFC, RSFBC, Resting State Networks, Default Mode Networks, Intrinsic Connectivity Networks (ICN), Intrinsic Functional Architecture, 'Couch-Potato' Networks
  - Low-frequency oscillations, low-frequency fluctuations, BOLD signal fluctuations, spontaneous fMRI fluctuations, spontaneous activity, noise
- A personal favorite….
  - Biswallian Networks (D. Margulies @ RSFBC, 2008)

In the Spirit of Saying I'm Sorry…

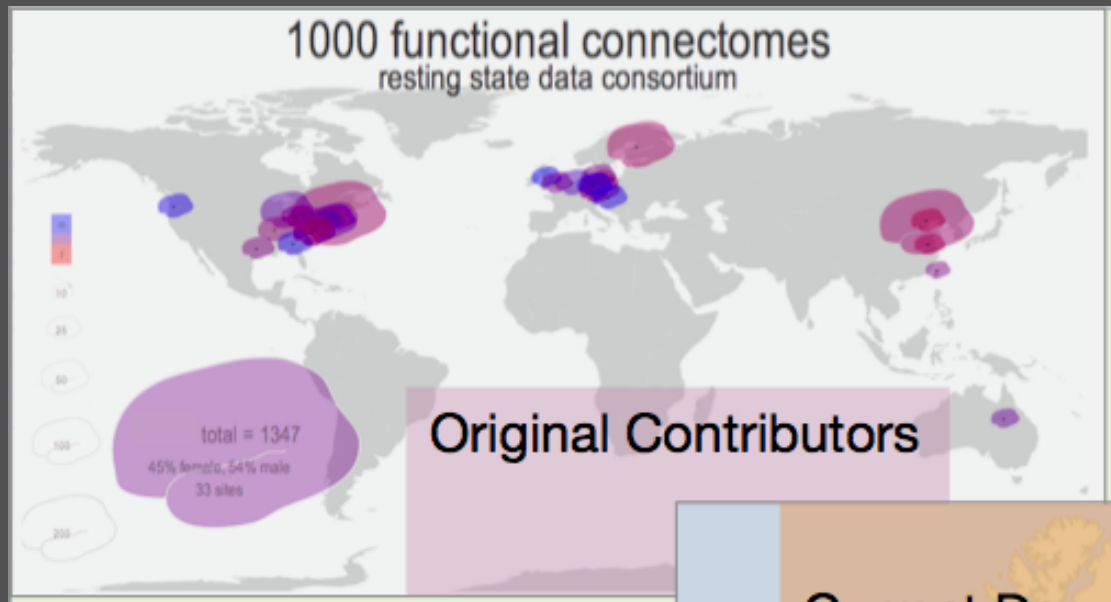
I WANT TO APOLOGIZE FOR ALL *CAPS ONLY* SUBJECT HEADLINES IN EMAILS TO FUNCTIONAL CONNECTOMES PROJECT CONSORTIUM MEMBERS, AND VARIOUS EMAIL GROUPS/LISTS… AND INDIVIDUALS.

	Center	PI	*N*	*n**	Age years, mean (SD)	Age range years	Male sex %
1.	Baltimore, MD	J. J. Pekar/S. H. Mostofsky	23		29.26 (5.46)	20–40	35%
2.	Bangor, UK	S. Colcombe	20		23.4 (5.32)	19–38	100%
3.	Beijing, China	YF. Zang	198	193	21.16 (1.83)	18–26	39%
4.	Beijing, China	XC. Weng	28	27	20.41 (1.39)	18–24	27%
5.	Berlin, Germany	D. Margulies	26		29.77 (5.21)	23–44	50%
6.	Bethesda, MD	M. Ernst	18		33.00 (13.31)	18–53	22%
7.	Cambridge, MA	R. L. Buckner	198		21.03 (2.31)	18–30	38%
8.	Cambridge, MA	S. Whitfield-Gabrieli	39	35	25.09 (3.53)	20–32	49%
9.	Cleveland, OH	M. J. Lowe	31		43.55 (11.14)	24–60	35%
10.	Dallas, TX	B. Rypma	24		42.63 (20.07)	20–71	50%
11.	Hvidovre, Denmark	A.-M. Dogonowski/K. Madsen	28		41.75 (10.7)	21–68	50%
12.	Leiden, The Netherlands	S. A. R. B. Rombouts	31		22.19 (2.57)	18–28	74%
13.	Leipzig, Germany	A. Villringer	37		26.22 (5)	20–42	43%
14.	Magdeburg, Germany	M. Walter	29	28	30.43 (5.71)	22–43	93%
15.	Milwaukee, WI	SJ. Li	64		53.59 (5.79)	44–65	64%
16.	New Haven, CT	M. Hampson	19	18	31.61 (10.27)	18–48	56%
17.	New York, NY†	M. Milham/F. X. Castellanos	59		32.78 (8.83)	20–49	68%
18.	New York, NY†	M. Milham/F. X. Castellanos	20		29.75 (9.94)	18–46	40%
19.	Newark, NJ	B. B. Biswal	19		24.11 (3.91)	21–39	47%
20.	Orangeburg, NY‡	M. J. Hoptman	21	20	40.65 (11.03)	20–55	75%
21.	Oulu, Finland‡	V. J. Kiviniemi/J Veijola	103		21.52 (0.57)	20–23	36%
22.	Oxford, UK	S. M. Smith/C. Mackay	22		29 (3.79)	20–35	55%
23.	Queensland, Australia	K. McMahon	19	18	26.28 (3.71)	20–34	61%
24.	St. Louis, MO	B. L. Schlaggar/S. E. Petersen	31		25.1 (2.31)	21–29	45%

Data from the following centers will be included in the 1000 Functional Connectomes data release but are not included in the current analyses: Ann Arbor, MI: C. S. Monk/R. D. Seidler/S. J. Peltier; Atlanta, GA: H. S. Mayberg; Berlin, Germany: S. Schmidt; Durham, NC: D. J. Madden; Durham, NC: L. Wang; London, Ontario, Canada: P. Williamson; Munich, Germany, C. Sorg/V. Riedl; Nanjing, China: GJ. Teng/HY. Zhang; Pittsburgh, PA: G.J. Siegle; Portland, OR: D. Fair/B. J. Nagel; Taipei, Taiwan: CP. Lin; Vienna, Austria: C. Windischberger.

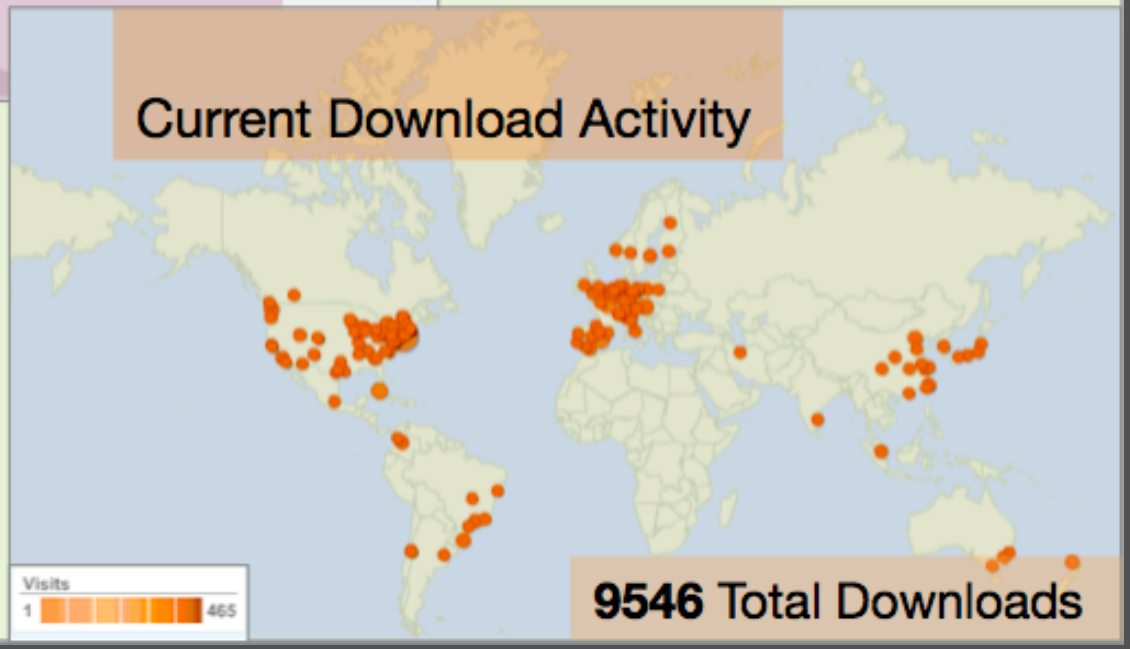
Cofounded by: Bharat Biswal and Michael Milham

Data-Sharing Progress to Date

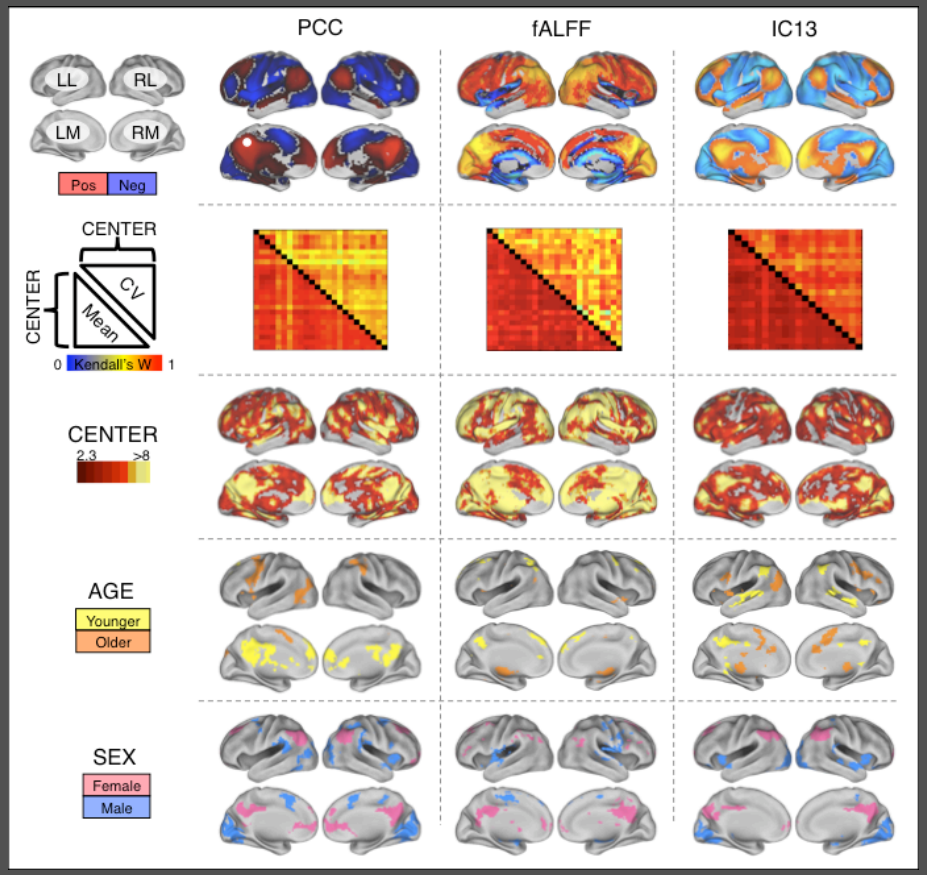


Since 11 Dec, 2009

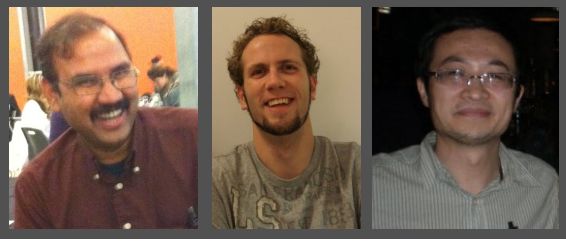
32467 Views
8889 Visits
3992 Visitors
1226 Cities
78 Countries

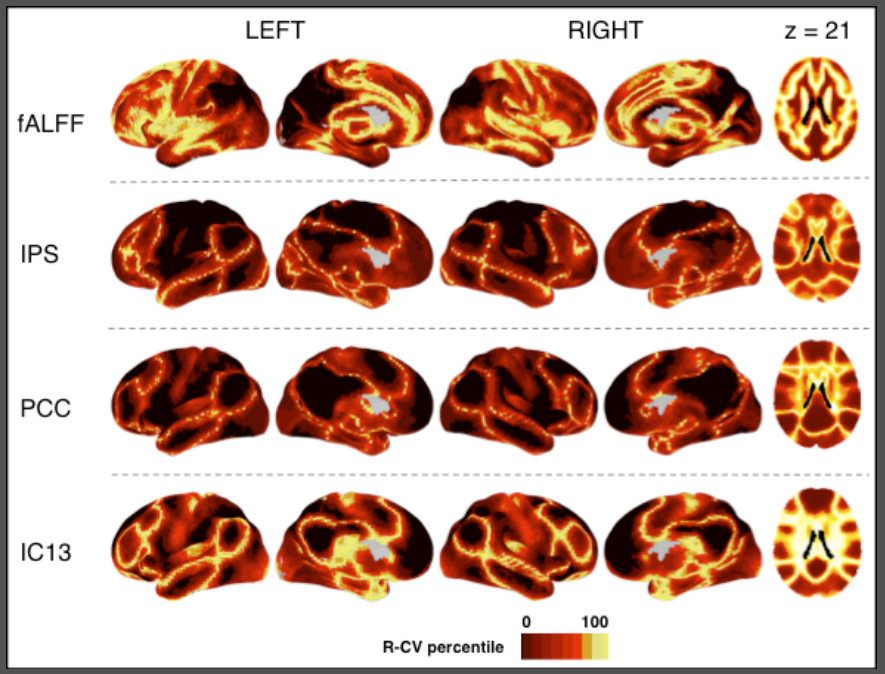


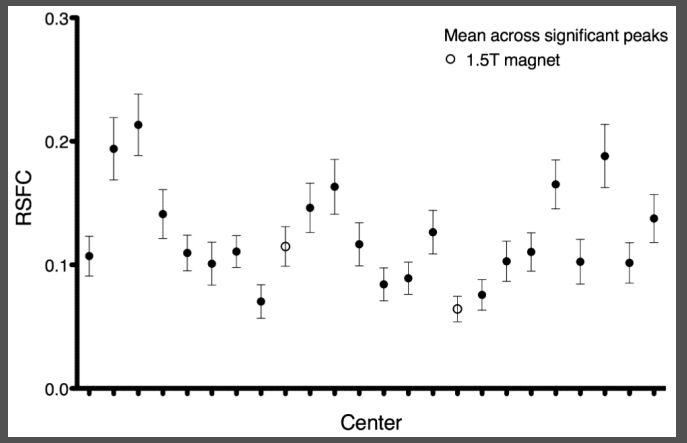
Announcing Discovery Science in R-fMRI



Biswal, Mennes, Zuo et al., 2010







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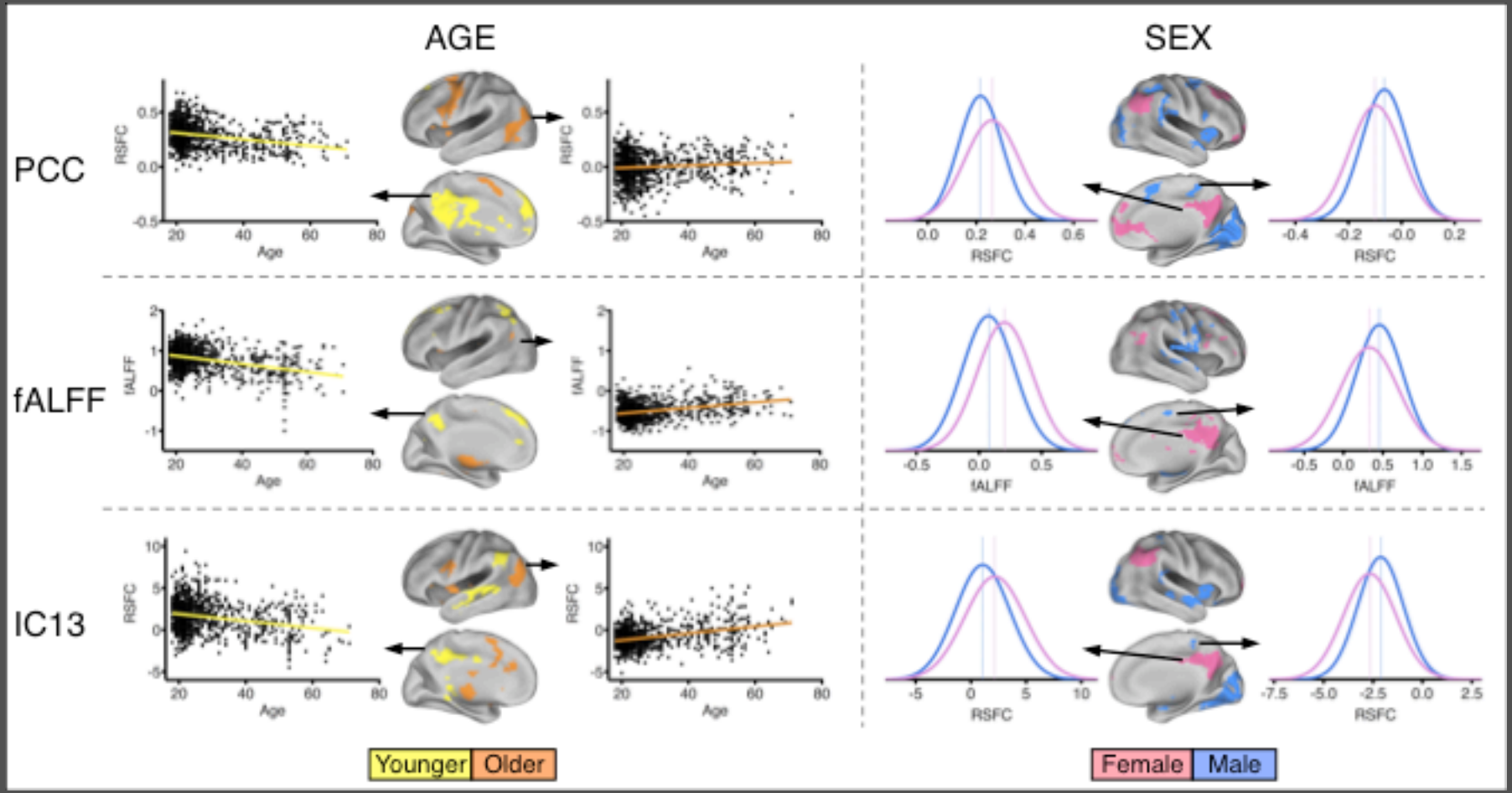
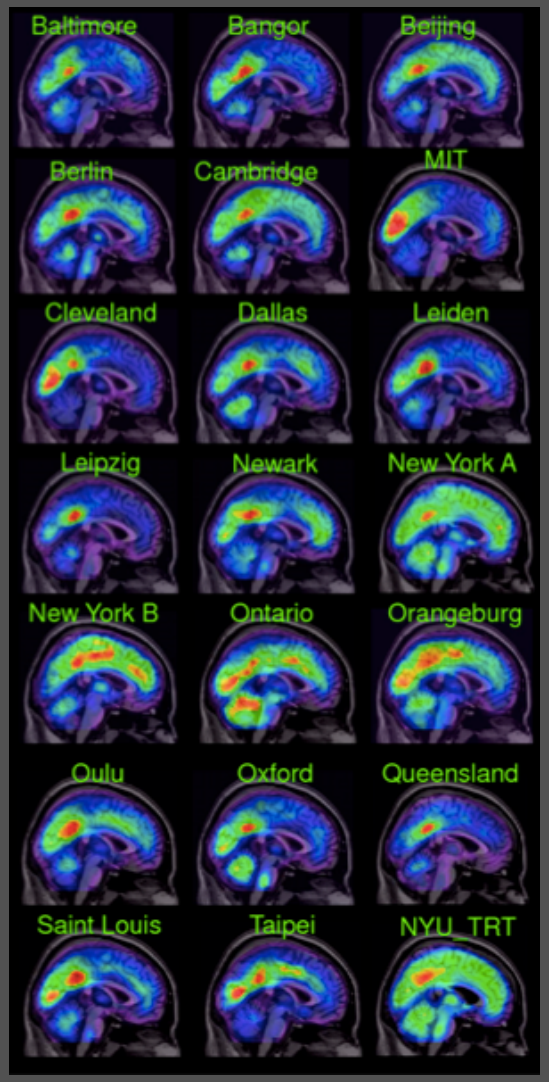
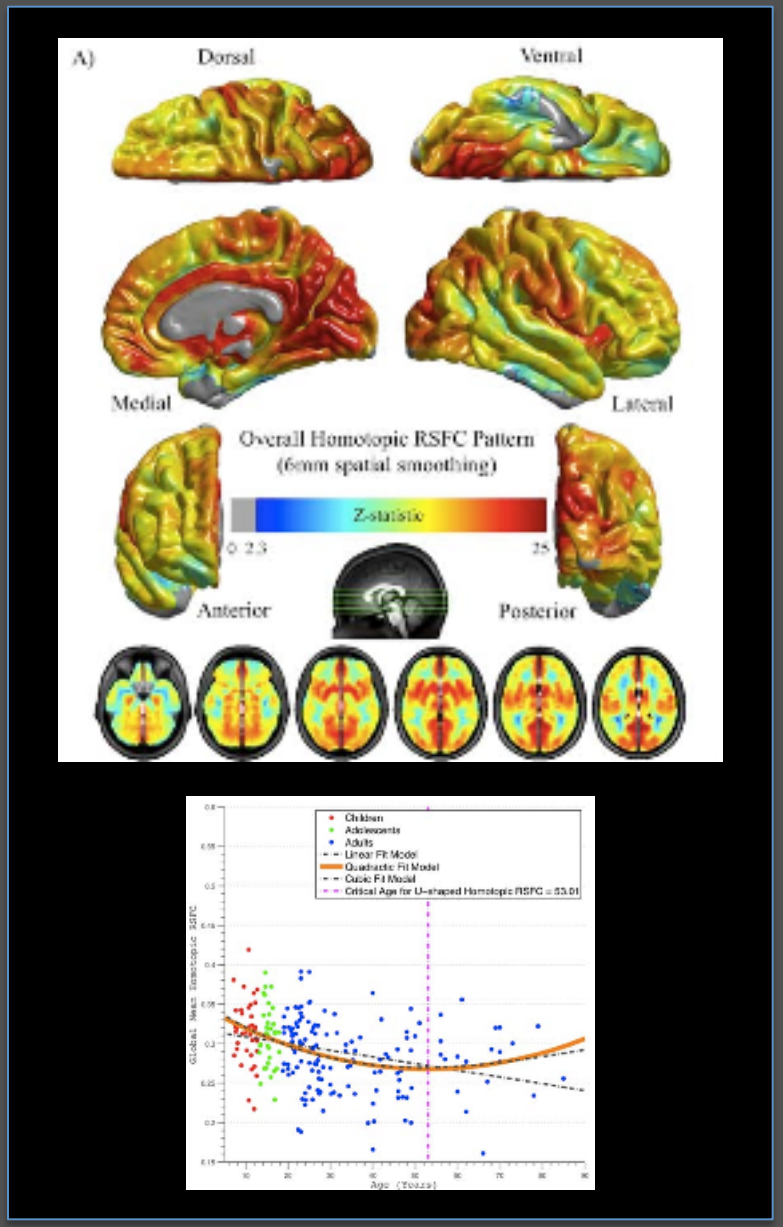


Biswal, Mennes, Zuo et al., 2010



Tomasi & Volkow, 2010; PNAS



Zuo et al., in press; J Neuroscience

Next Steps Towards Discovery Science?

- High throughput datasets are crucial for successful implementation of discovery science
  - Brain genomics
  - Markers of psychiatric illness
    - risk, diagnosis, treatment response
  - Dilemma: wait for best imaging, or move forward?
- Recruit/encourage widespread involvement of the scientific community

Current Goal

- **To make the aggregation and sharing of well-phenotyped datasets a cultural norm for the imaging community.**
  - Make comprehensive phenotypic information available with imaging datasets to facilitate sophisticated data-mining.
  - Shift from retrospective to prospective data sharing (e.g., weekly, monthly, or quarterly).
  - Dynamic ‘self-organizing’ network of investigators pushing technologies and approaches

International Neuroimaging Data-sharing Initiative (INDI)

- To enhance the 1000 FCP by including comprehensive phenotypic data.
- To help establish a common protocol for sharing phenotypic/metadata via the FCP.
- To initiate open, prospective data-sharing for the neuroimaging community (e.g., weekly, monthly, or quarterly uploads of data).

Initial Prospective Data-Sharing Commitments

SAMPLE	CONTRIBUTORS	RELEASE DATE/ FREQUENCY	SAMPLE INFO	Phenotypic Data
Baylor College of Medicine	Cameron Craddock Stephen LaConte The Neuro Bureau	1/1/11 25+ Quarterly	Psychiatrically Screened Sample	Various dimensional psychiatric scales & behavioral performance measures
Beijing	Yu-Feng Zang	12/1/10 5-10 Weekly	Community Sample	Various dimensional psychiatric scales & behavioral performance measures
Berlin Mind and Brain Institute	Daniel Margulies Arno Villringer The Neuro Bureau	1/1/11 25+ Quarterly	Community Sample	Health/activity screening information and cognitive/affective trait scales
Harvard-MGH	Randy Buckner	1/1/11 50+ Quarterly	Community Sample	Extended demographic information and a mix of trait/performance measures, as well as personality assessments.
MPI-Leipzig	Daniel Margulies Arno Villringer The Neuro Bureau	1/1/11 25+ Quarterly	Community Sample	Psychological questionnaires (e.g., PANAS, PDI, DSQ)
NKI-Rockland	Bharat Biswal Xavier Castellanos David Guilfoyle Matthew Hoptman Dan Javitt Bennett Leventhal Larry Maayan Maarten Mennes Michael Milham Kate Nooner Nunzio Pomara	10/1/10 5-10 Weekly	Psychiatrically Evaluated Sample (ages 6-90)	Intelligence testing, psychiatric diagnostic interview, executive function performance measures, dimensional psychiatric scales and laboratory results
NYU Institute for Pediatric Neuroscience	Xavier Castellanos Adriana Di Martino Clare Kelly Maarten Mennes Michael Milham	11/1/10 3-5 Weekly	Psychiatrically Screened Sample (ages 6-55)	Psychiatric diagnostic interview, cognitive testing (IQ/achievement), psychiatric/ behavioral questionnaires
Valencia Spanish Resting State Network	Xavier Castellanos Erika Proal Maria de la Iglesia-Vaya	Early 2011 10 Weekly	Community; clinically indicated studies	Clinical indication for MRI scans; diagnostic codes

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Harvard-MGH	Randy Buckner	1/1/11 50+ Quarterly	Community Sample	Extended demographic information and a mix of trait/performance measures, as well as personality assessments.
Kennedy Krieger Institute	Stewart Mostofsky	1/1/11 15-20 Quarterly	Psychiatrically Screened Sample (ages 8-12)	Demographic information, psychiatric diagnostic interview, psychiatric/ behavioral questionnaires, cognitive testing (IQ/achievement), executive function measures, motor function measures
MPI-Leipzig	Daniel Margulies Arno Villringer The Neuro Bureau	1/1/11 25+ Quarterly	Community Sample	Psychological questionnaires (e.g., PANAS, PDI, DSQ)
NKI-Rockland	Bharat Biswal Xavier Castellanos David Guilfoyle Matthew Hoptman Dan Javitt Bennett Leventhal Larry Maayan Maarten Mennes Michael Milham Kate Nooner Nunzio Pomara	10/1/10 5-10 Weekly	Psychiatrically Evaluated Sample (ages 6-90)	Intelligence testing, psychiatric diagnostic interview, executive function performance measures, dimensional psychiatric scales and laboratory results
NYU Institute for Pediatric Neuroscience	Xavier Castellanos Adriana Di Martino Clare Kelly Maarten Mennes Michael Milham	11/1/10 3-5 Weekly	Psychiatrically Screened Sample (ages 6-55)	Psychiatric diagnostic interview, cognitive testing (IQ/achievement), psychiatric/ behavioral questionnaires
Valencia Spanish Resting State Network	Xavier Castellanos Erika Proal Maria de la Iglesia-Vaya	Early 2011 5-10 Weekly	Community; clinically indicated studies	Clinical indication for MRI scans; diagnostic codes

Initial Retrospective Data-Sharing Commitments

SAMPLE	CONTRIBUTORS	RELEASE DATE	SAMPLE INFO	Phenotypic Data
ADHD-200	Jan Buitelaar Xavier Castellanos Damien Fair Bea Luna Michael Milham Stewart Mostofsky Joel Nigg Julie Schweitzer Katerina Velanova Yu-Feng Zang	1/1/11	~200 ADHD ~200 TDC (ages 7-14)	Psychiatric assessment resul dimensional measures
Beijing	Yu-Feng Zang	10/15/10	Community Sample	IQ+
NYU Institute for Pediatric Neuroscience	Clare Kelly Xavier Castellanos Michael Milham	11/1/10	30 cocaine dependent 30 healthy controls (ages 18-50)	Psychiatric assessment resul symptom severity measures, questionnaires
TRAIN-30	Art Kramer, Michelle Voss, Kirk Erickson, Ruchika Prakash	Spring, 2011	30 young adults trained 20 hours each on a complex video game	Phenotypic Data - age, genc performance (learning data) the video game

Some New Rules…

- DICOM, DICOM, DICOM…
- User registration required to access the data
  - Creative commons license agreement
  - non-commercial usage only
- XNAT (xnat.org; Marcus et al., 2007)

All the Old Rules Too…

- Unrestricted usage of all FCP datasets
- All data will be completely anonymized
- Please be sure to cite the website and the specify the datasets included in your study
- IRB/ethics board approval
- Usage FCP data at your own discretion and caution
- Report any data concerns to the FCP forums located on NITRC

The Nathan-Kline/Rockland Sample

Assessment Protocol

PROCEDURES COMPLETED BY ALL PARTICIPANTS
Demographics
Medication Form
Test Meal
Based Diagnostic Interview (KSADS/SCID)
Autism Spectrum Screening Questionnaire (ASSQ)
IQ Screening (WASI)
Physical measures (blood pressure, heart rate, height, weight and waist and hip measurements)
fasting blood draw (metabolic panel, hemogram, genetics)
Eating Questionnaire
Social Responsiveness Scale (SRS)
Delis-Kaplan Executive Fucntion System (D-KEFS)
Repetitive Behavior Scale-Revised (RBS-R)
6 minute walk
Achenbach System of Empirically Based Assessment (Child Behavior Checklist, Youth Self Report, Adult Self Report, Older Adult Self Report)

ASSESSMENTS TO BE COMPLETED BY ADULTS (AGE 18+)
Cognitive Appraisal of Risky Events (CARE)
Fagerstrom Test for Nicotine Dependence
Phsyical Activity Scale for the Elderly (PASE)
UPPS Impulsive Behavior Scale
State Traint Anxiety Inventory (STAI)
Trauma Symptom checklist for Adults
Beck Depression Inventory--II (BDI)

ASSESSMENTS TO BE COMPLETED BY CHILDREN (AGE 6-18)
Behavior Assessment System for Children –Second Edition (BASC-2)
Vineland Adaptive Behavior Scales-Revised
Adolescent Risk-taking Questionnaire (ARQ)
Fagerstrom Tolerance Questionnaire for Adolescents
Multidimensional Anxiety Scale for Children (MASC)
Trauma Symptom Checklist for Children (TSC-C)
Children’s Depression Inventory (CDI)

The Nathan-Kline/Rockland Sample

Imaging Protocol

- R-fMRI Scan
  - 3.0T Siemens Tim Trio
  - 3.0 mm isotropic voxel size, .3 mm inter-slice gap
  - TR = 2.5 sec
  - Scan Duration = 10 minutes
  - 32 channel coil
- DTI
  - 2.0 mm isotropic voxel-size
  - 64 directions
  - bVal = 1000

ADHD-200

- Anticipated Release Date: Jan 3, 2011
- 200+ children (ages 7-14) and 200 TDC collected across 4 or more sites
- Competition proposed for 2011 OHBM meeting in Quebec City
  - Feature identification
  - Diagnostic classification
- Damien Fair will be presenting initial results today

Re-release of FCP dataset in XNAT

- Target date: October 15
- Release will be in the form of a downloadable XNAT virtual machine
- Release will include complete imaging parameters for FCP data (when available)
  - Many thanks to Cameron Craddock and the Neuro-Bureau for overseeing collection of parameter information

What Can You Do?

- Contribute your data
  - Previously published datasets
    - Release some or all of the phenotypic information – your call, but simple rule is, the more the better!
  - Unpublished datasets
    - You set the upload schedule.
    - Release some or all of the phenotypic information – your call, but simple rule is, the more the better!
- Contribute your scripts/code
  - 817 downloads of FCP scripts since 3/10/10

That's All Folks!

Acknowledgments

1000 Functional Connectomes Project Consortium

- Contributing Sites
- Steering Committee

  Bharat Biswal, Randy Buckner, James Hyde, Rolf Kotter, Marcus Raichle, Arno Villringer, Yu-Feng Zang
- Individual thanks to Bharat Biswal, Maarten Mennes, Xinian Zuo, F. Xavier Castellanos, Clare Kelly, Steve Smith

INDI Contributors

- Contributing sites and site leaders for prospective data-sharing (Randy Buckner, Xavier Castellanos, Cameron Craddock, Stephen LaConte,

  Daniel Margulies, Stewart Mostofsky, Arno Villringer, Yu-feng Zang)
- ADHD-200 contributors, Clare Kelly, Art Kramer and Yu-Feng Zang for retrospective data-sharing
- Special thanks to Randy Buckner, Xavier Castellanos, Yu-Feng Zang for helping to think through initiative goals

NITRC

- David Kennedy
- Christian Haselgrove
- Nina Pruss