BEHAVIORAL AND COGNITIVE NEUROSCIENCE

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Home People Research Publications Funding Events Partecipa! Press Release

Molecular Mind Laboratory

MoMiLab is a research group of the IMT School for Advanced Studies Lucca (Italy)

Lab Mission

The MoMiLab integrates basic neuroscience methods with experimental psychophysiology, cognitive neuroscience and structural/functional brain imaging.

…oped its own lines of research on the topics of perception and representation of the external world, and …ith it.

…text of the ERC SH4 '*The Human Mind and Its Complexity*', the research areas of the MoMiLab include …d multidisciplinary aspects tha… …functions. In the specific …hool, the lines of research … …r has offered a new tool …interdisciplinary quest… …engineering, from social …legal sciences).

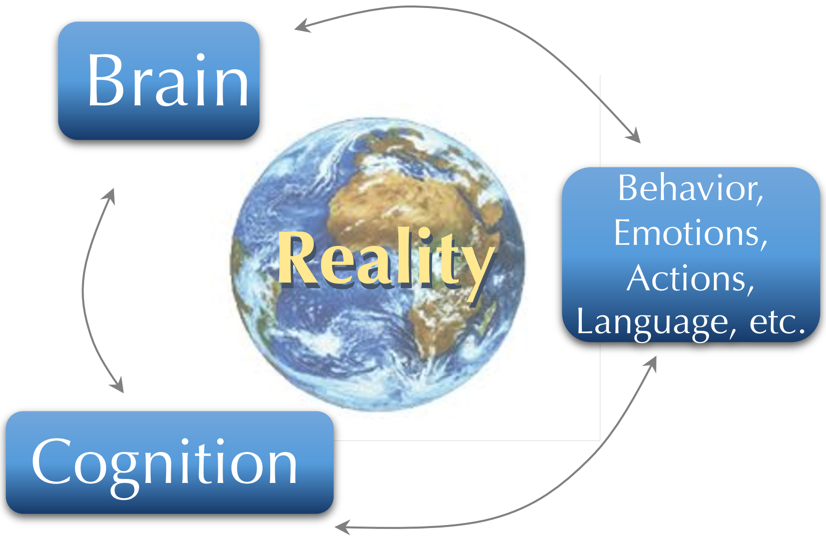
…marily enroll healthy individuals across di… …collaborates with …rested in neuropsychiatric disorders a… …computational …ced data processing in brain imagi…

EDUCATION

RESEARCH

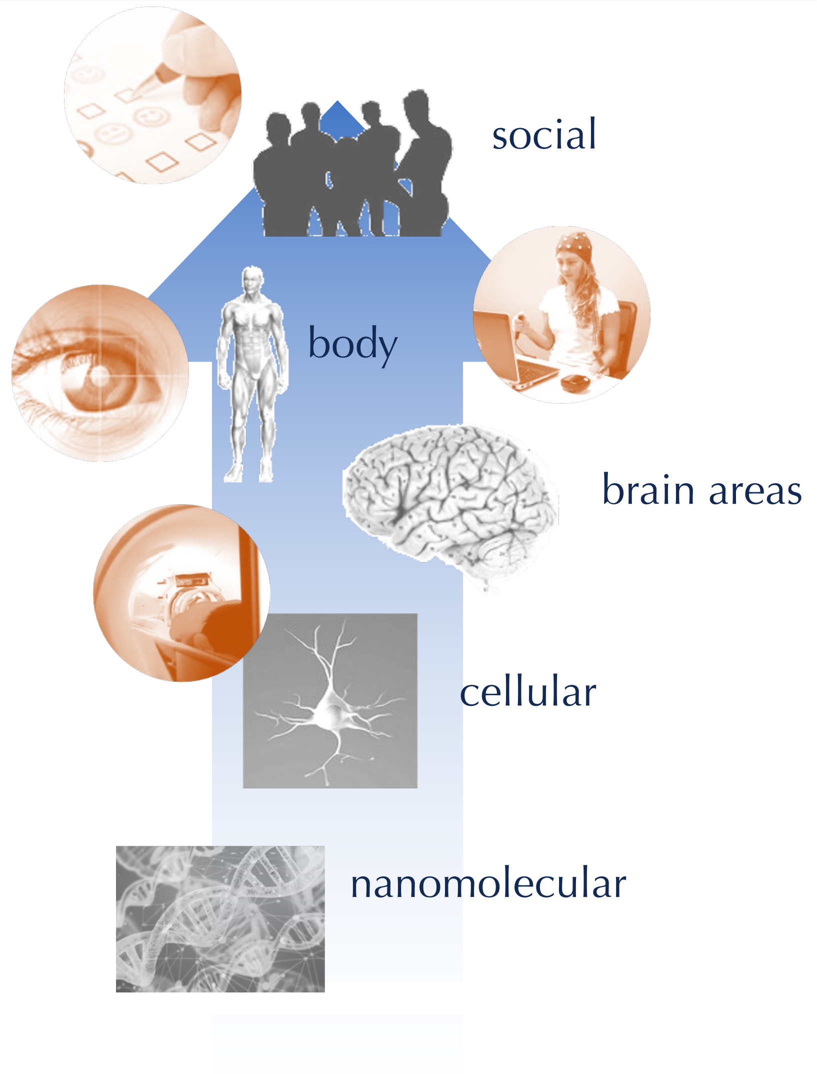
THIRD MISSION

MISSION



The MoMiLab/CCSN track:

- develops its own lines of research on the topics of perception and representation of the external world, and on the interaction with it
- integrates basic neuroscience with experimental psychophysiology, cognitive neuroscience and brain imaging



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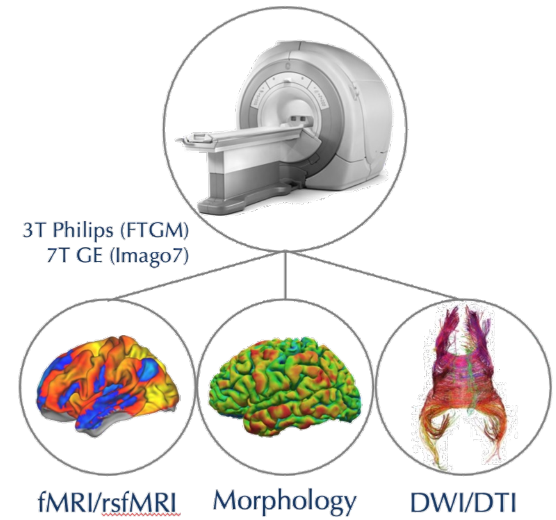
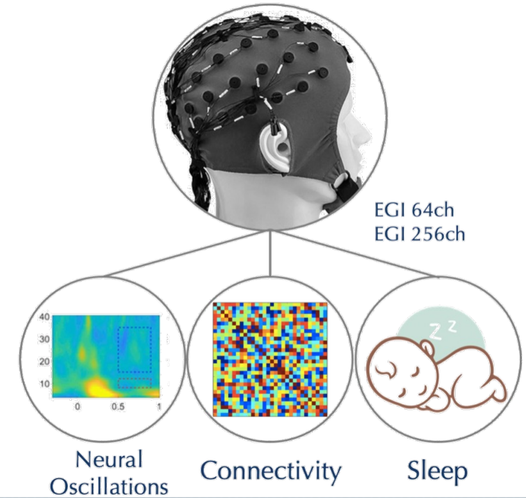
RESEARCH

Topics

- Sensory Experience Dependence and Plasticity
- Sensorimotor Experiences and Mental Representations
- Sleep, Plasticity and Conscious Experience
- Social and Affective Neuroscience
- Forensic Neuroscience and Psychiatry
- Models, Inference, and Decisions
- Reasoning and Economic Decisions
- Methods for Advanced Biosignal Analyses

Facilities





Funding

PRIN

erc

PRO.CO.P.E.

Fondazione Cassa di Risparmio di Lucca

AVIS

REGIONE TOSCANA

NS LAB NEURO SCIENCE Iniziativa di INTESA SANPAOLO INNOVATION CENTER

Multidisciplinary Lab@IMT

Sleep Lab@FTGM

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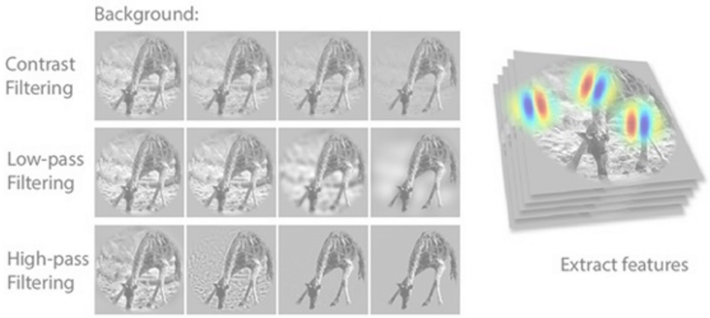
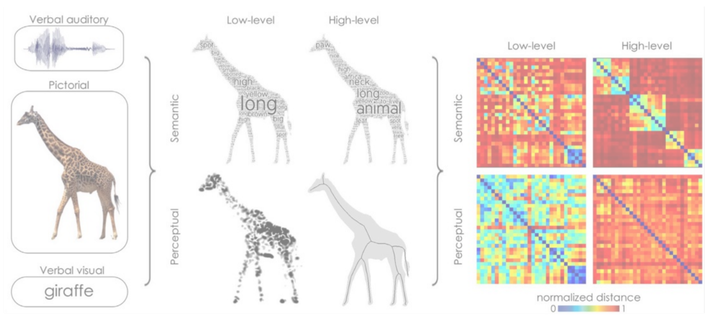
BASIC RESEARCH

Multisensory Perception

How sensory features are processed and integrated: hearing, tactile and vision; a neurophenomenological perspective



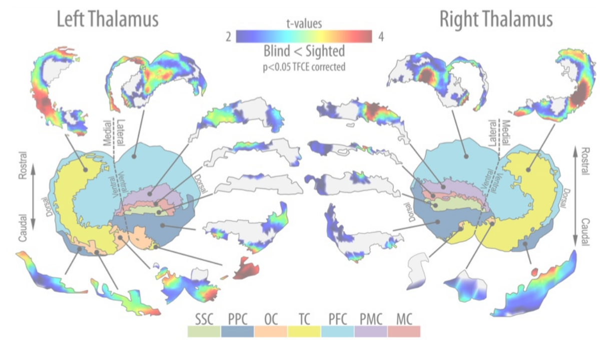


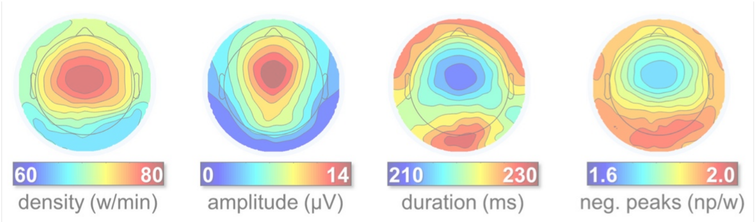
Knowledge organization

The mental representation of the external world: from sensory-based percept to a more abstract concept; the neural bases of semantic processing

Experience-dependent plasticity

How sensory-experience shapes brain functional development: supramodality and plasticity, sensory deprivation and restoration





Sleep and consciousness

Local sleep, sleep-dependent plasticity, dreaming, sleep determinants

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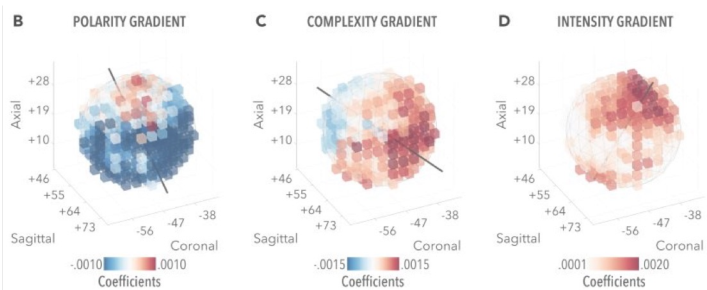
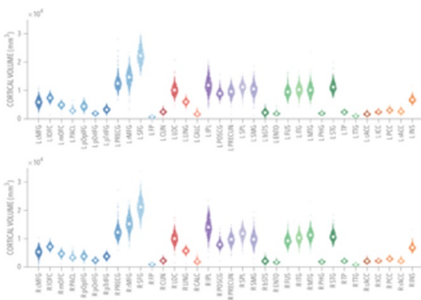
TRANSLATIONAL AND CLINICAL RESEARCH

Emotions and social interaction

Novel approaches to the neurobiological characterization of emotional responses; implications for AI



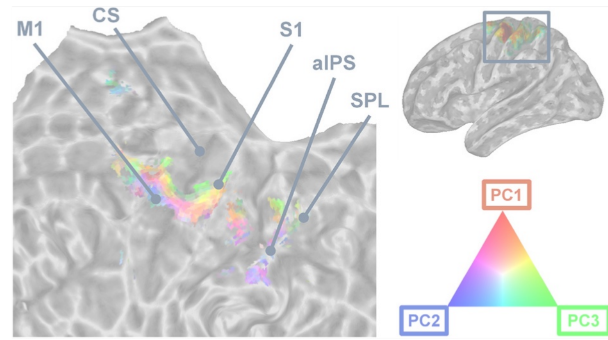


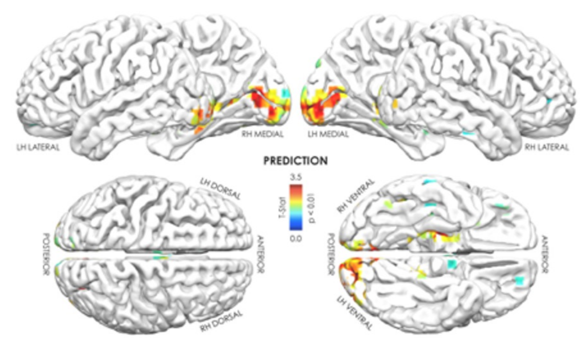
Forensic neuroscience:

biological determinants of human behavior, anti/pro-sociality, impulsive behavior, ethics in neuroscience

Motor control

How do we control and recognize actions?
Implications for bionics and neurorehabilitation





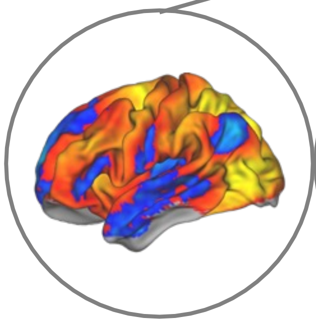
Decision making

Which factors drive our decisions?
Fostering a dialogue between brain and business

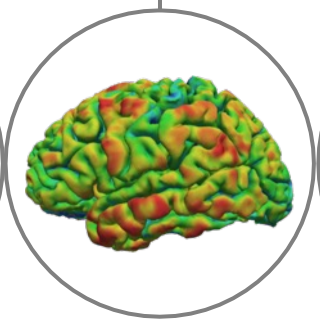
RESEARCH METHODS

3T Philips (FTGM)
7T GE (Imago7)

EGI 64ch
EGI 256ch

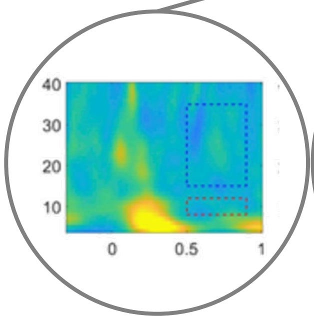


fMRI/rsfMRI

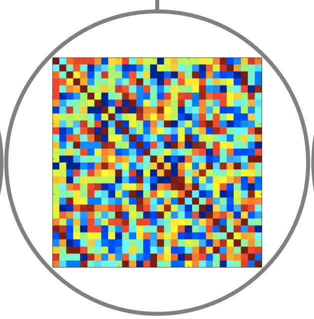


Morphology

DWI/DTI



Neural Oscillations



Connectivity

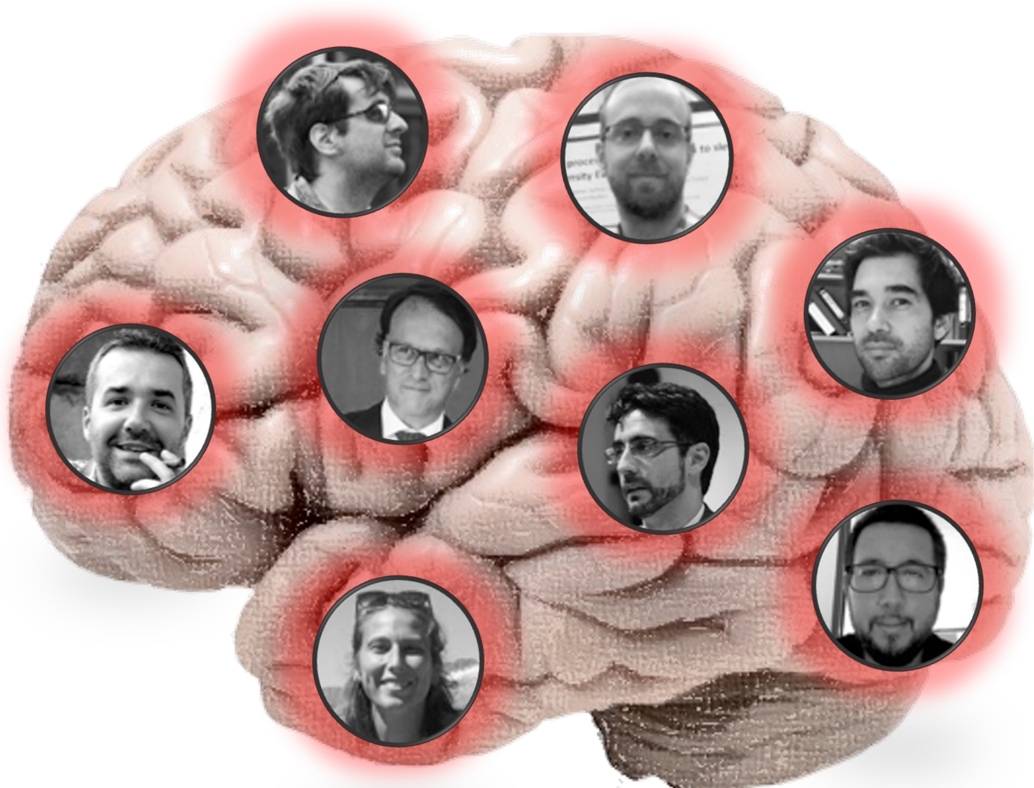
Sleep

Multidisciplinary Lab @IMT

The team

MOlecular MInd Lab

- **Pietro Pietrini**
- **Emiliano Ricciardi**
- **Giulio Bernardi**
- Gustavo Cevolani
- **Luca Cecchetti**
- **Giacomo Handjaras**
- Davide Bottari
- Monica Betta
- All CCSN postdocs and PhD students



http://momilab.imtlucca.it/

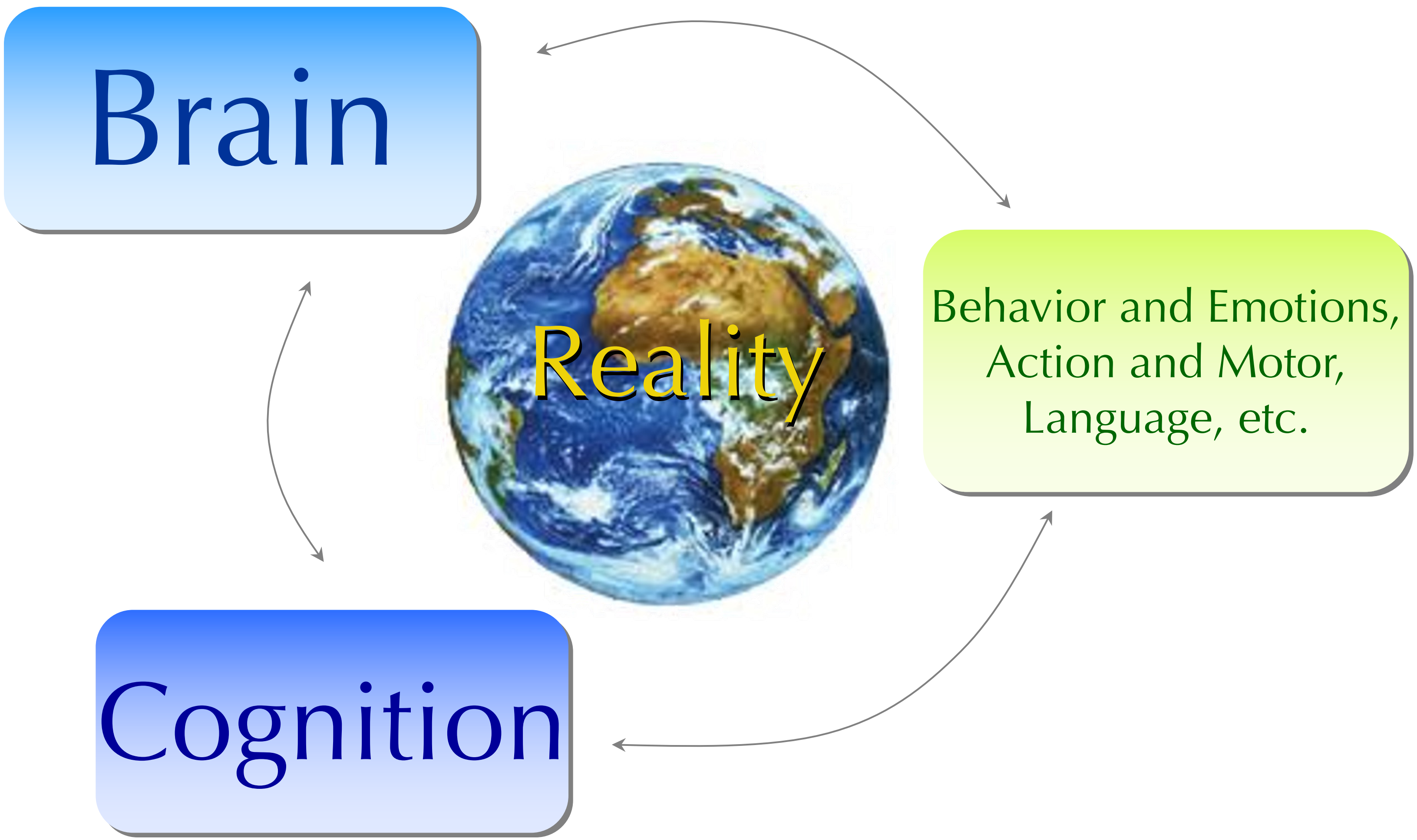
BASIC PRINCIPLES AND APPLICATIONS OF BRAIN IMAGING METHODOLOGIES TO NEUROSCIENCE

- Do not forget that cognitive neuroscience uses neuroimaging as one of the tools to answer its questions
- Different levels of actions:
  - Original question
  - Rationale and Experimental Design
  - Sample selection
  - Data acquisition
  - Data processing
  - Data interpretation

BASIC PRINCIPLES AND APPLICATIONS OF BRAIN IMAGING METHODOLOGIES TO NEUROSCIENCE

- Calendar (some lessons in Lucca)
- Exam
- Sources and bibliography: ask for…
- IMT facilities
- Ask when next experimental sessions will be held!

The general framework



Back to the future…

Toward a Biochemistry of Mind?

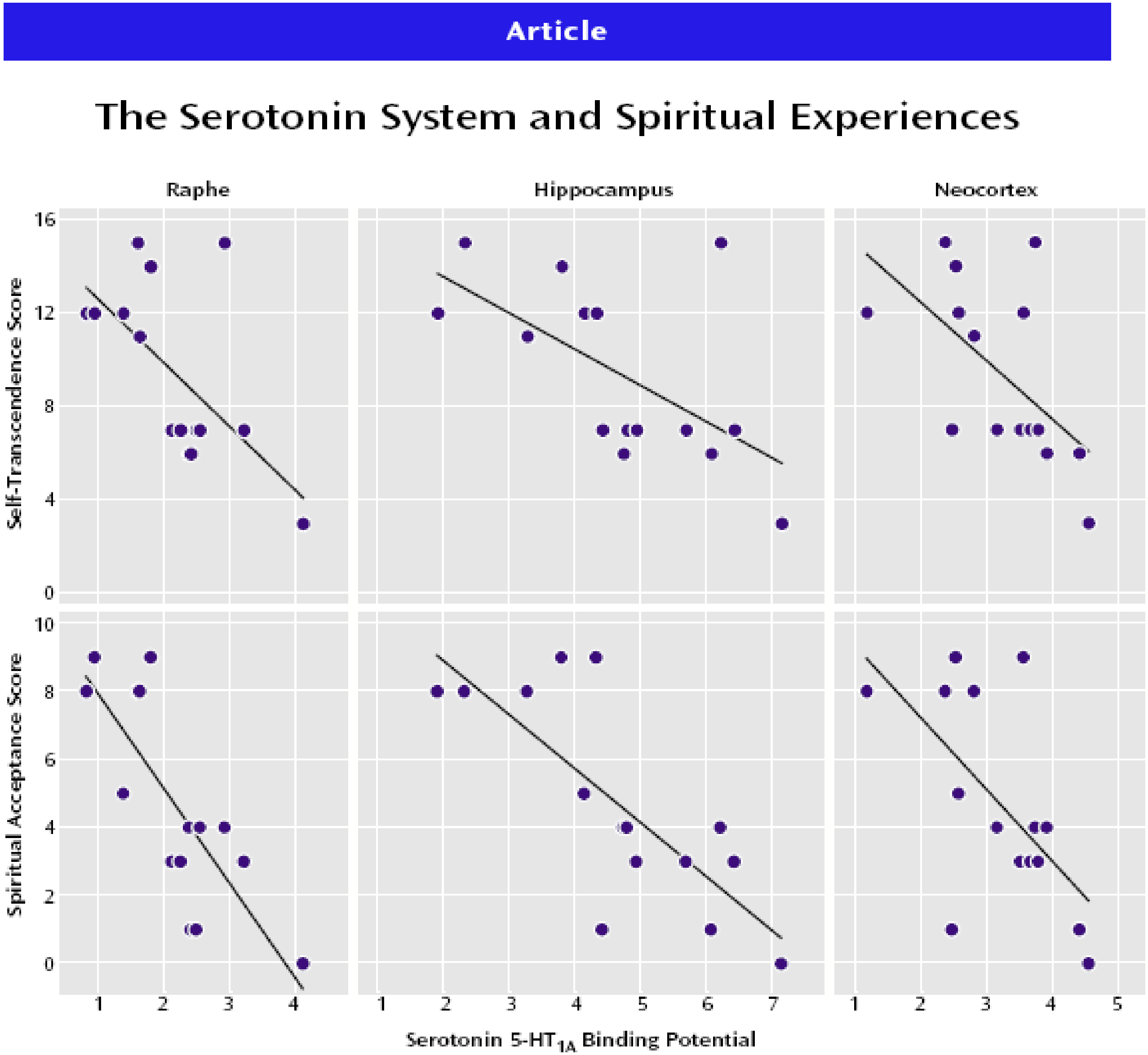
Those of us who entered neuroscience and psychiatry around the 1980s witnessed the birth and the rapid growth of an era: the in vivo metabolic and functional exploration of the human brain. Positron emission tomography (PET), magnetic resonance spectroscopy (MRS) and, more recently, functional magnetic resonance imaging (fMRI) have presented scientists from different fields with the unprecedented opportunity to investigate the biochemical bases of mental activities in the intact living human brain as well as in the presence of disease. Measures of regional cerebral glucose metabolism and blood flow obtained by PET (or blood flow-related phenomena by fMRI) represent reliable indices of neuronal/synaptic activity—the basis of whatever action, perception, thought, or feeling our brain may be capable of experiencing. Furthermore, PET studies with specific radioligands or neurotransmitter precursors have begun to disclose how receptors and neurotransmitters interact in distinct physiological and pathological conditions.

The quartet of papers included in this issue of the *Journal* represents an excellent example of how far we have gone in the journey inside human brain function during the last 25 years. Each of these studies deals with aspects of human cognition and behavior that until recently were often exclusively the domain of philosophy, anthropology, and religion and were considered too subjective and elusive to be the object of scientific investigation. Along with other pioneering articles that have appeared in previous issues of the

"By combining creativity with sound methodological designs, scientists may venture into the frontier of the neural basis of spirituality and feelings."

Pietrini P. Am J Psych, 2003

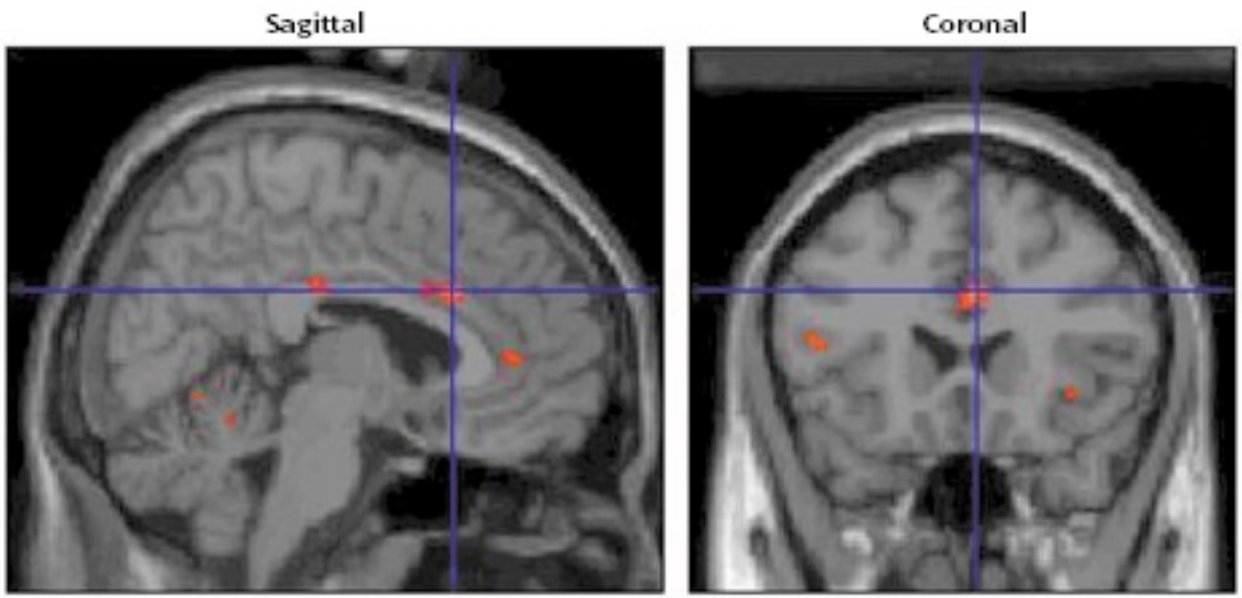
Back to the future…



Back to the future…

Article

Functional Neuroanatomy of Grief: An fMRI Study

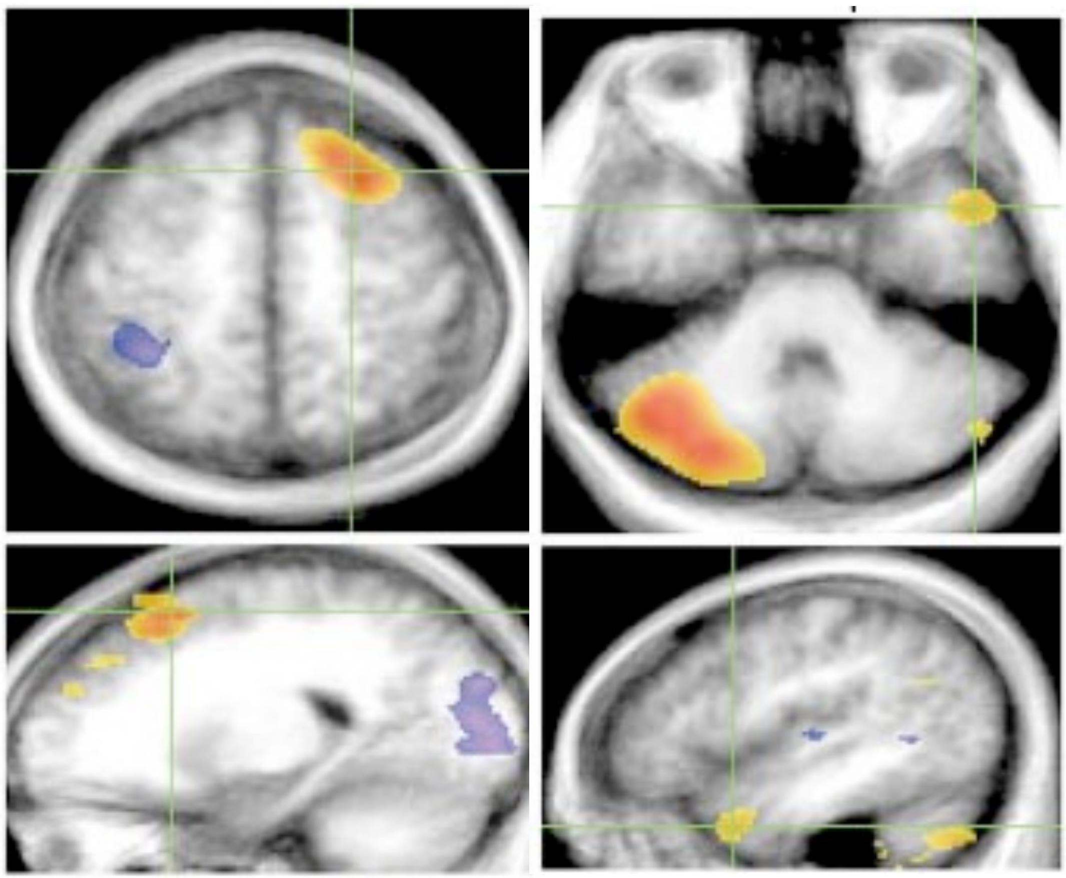


Gundel et al., Am J Psychiatry, 2003

Back to the future…

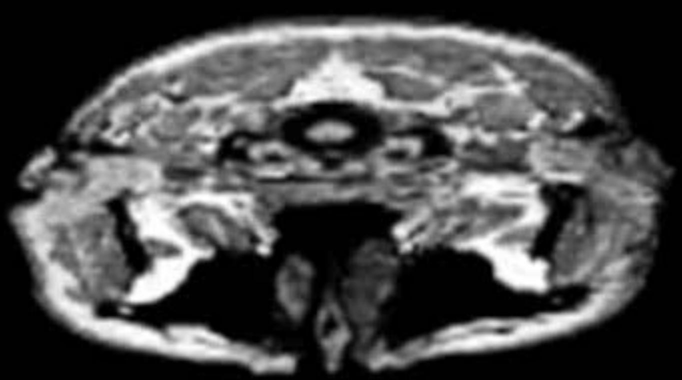
Article

Visualizing How One Brain Understands Another:
A PET Study of Theory of Mind



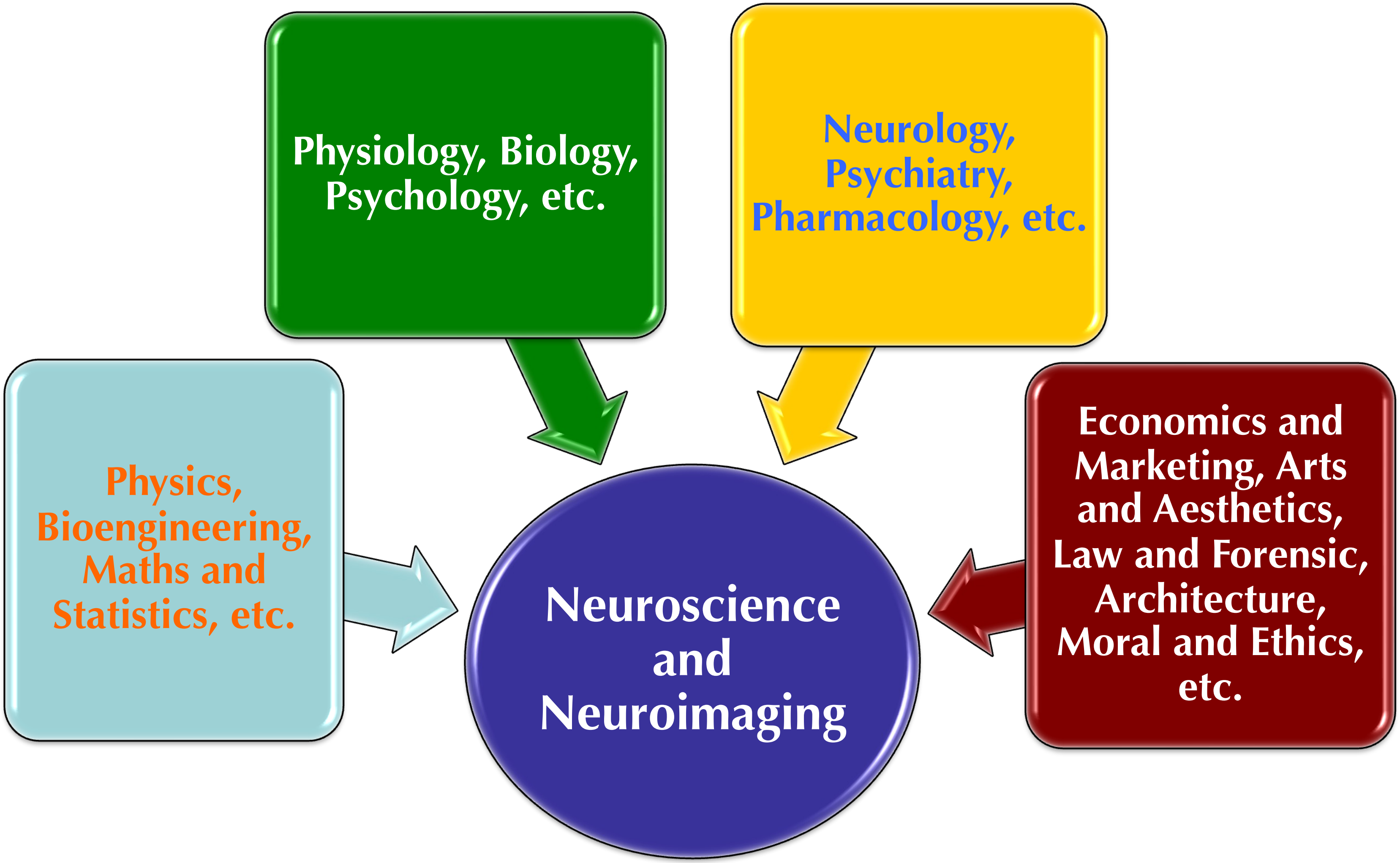
Calarge et al., Am J Psychiatry, 2003

In vivo brain functional methodologies



Towards a biochemistry of mind?

Neuroscience and neuroimaging



The brain "looks" at itself with the eyes of society

Prehistory

The brain "looks" at itself with the eyes of society

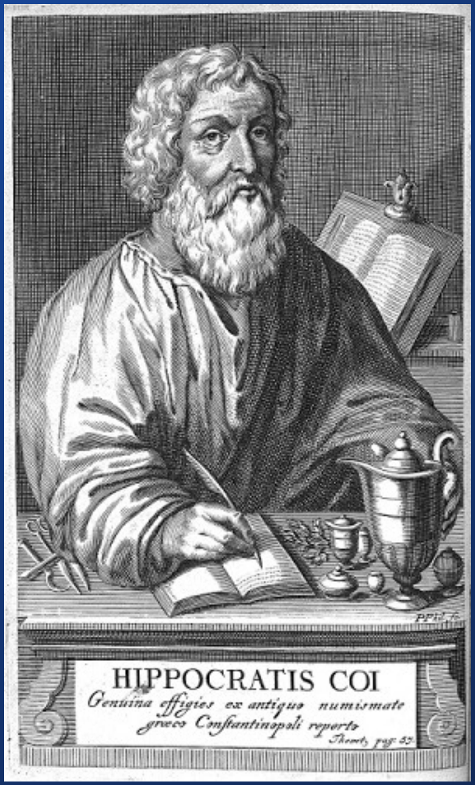


Illustrazione dei quattro umori dal trattato di Leonhart Thurneisser, *Quinta Essentia* (Lipsia, 1574)

Prehistory Ancient Greece

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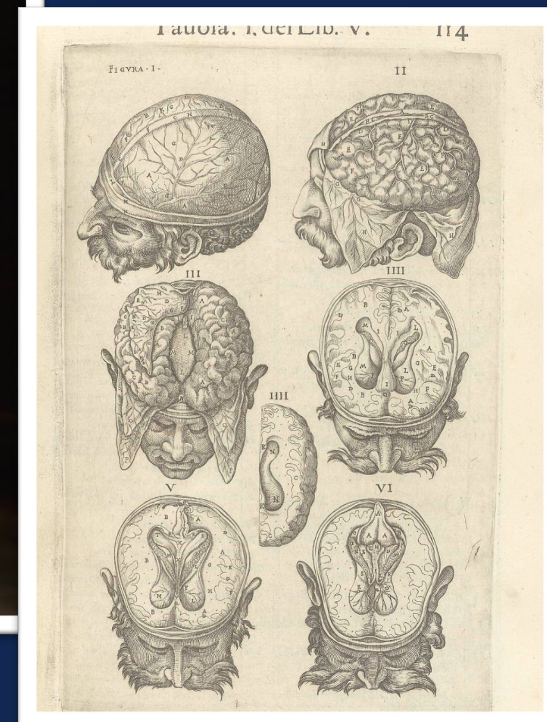
The brain "looks" at itself with the eyes of society

Galeno, Litografia di Pierre Roche Vigneron



http://www.siaecm.org/medici_famosi/medicina_galenica/teorie_della_mente_e_della_materia.asp

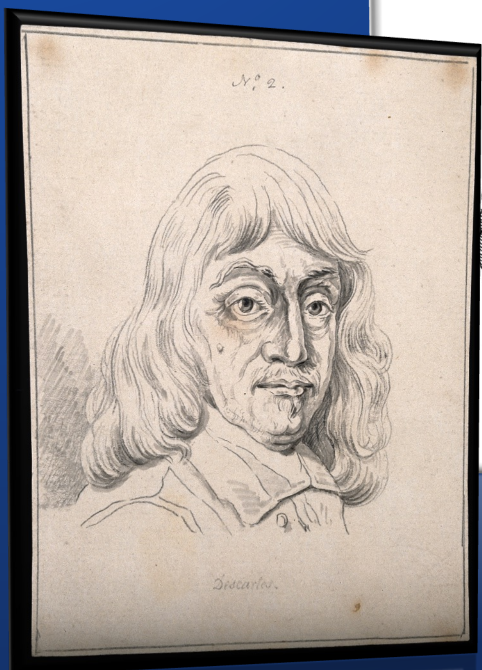
Prehistory

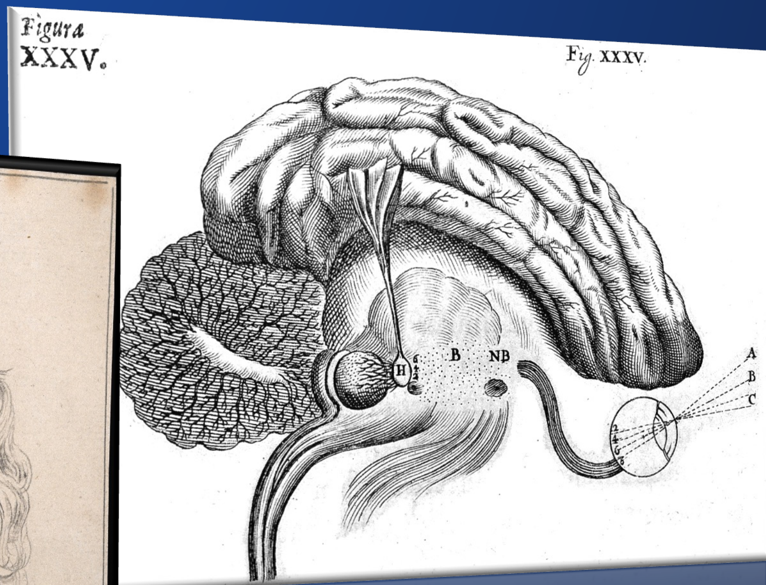
Ancient Greece

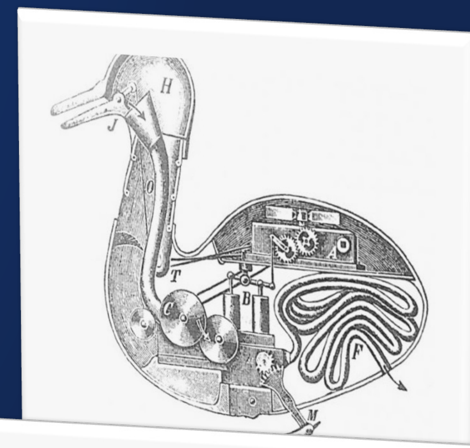
Ancient Rome

SCUOLA ALTI STUDI LUCCA

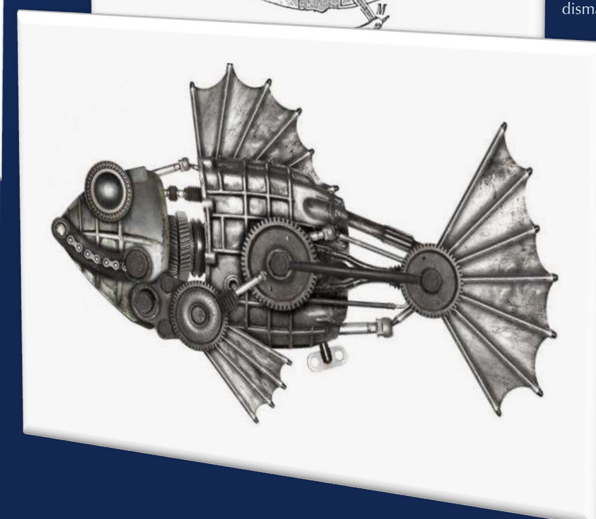
The brain "looks" at itself with the eyes of society







https://nonuthings.com/2020/05/29/man-the-machine-dismantled/



https://phys.org/news/2018-11-basically-machines.html

Prehistory — Ancient Greece — Ancient Rome — XVI-XVII — Today

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The brain "looks" at itself with the eyes of society

Prehistory

Ancient Greece

Ancient Rome

XVI-XVII

XVII-XVIII

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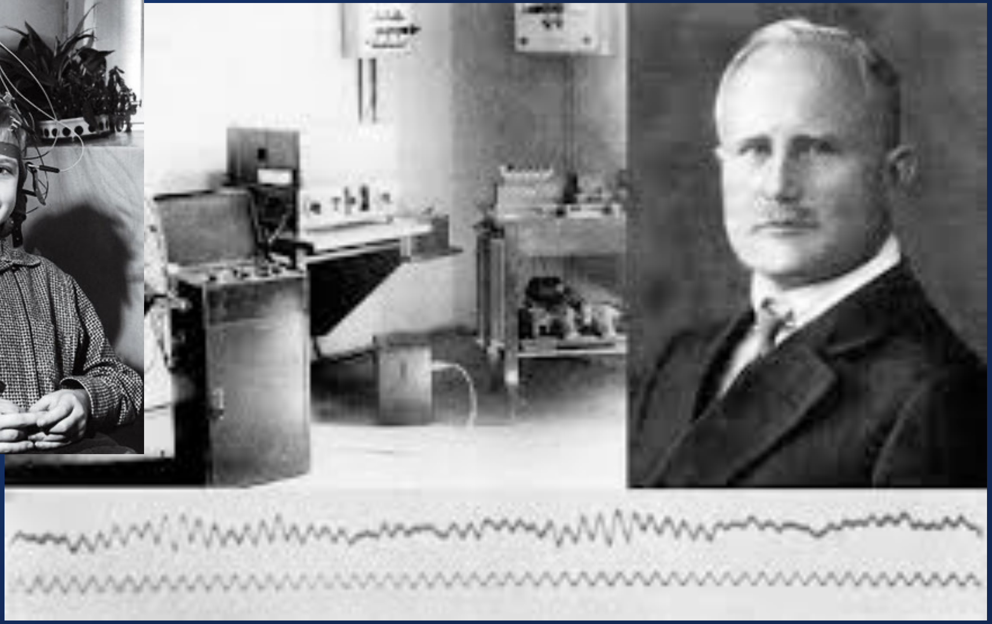
The brain "looks" at itself with the eyes of society

http://protomag.com/articles/hans-berger-eeg



https://cervelliacena.wordpress.com/2019/11/10/hans-berger-dalla-ricerca-della-telepatia-alla-nascita-delleeg/

Prehistory — Ancient Greece — Ancient Rome — XVI-XVII — XVII-XVIII — XIX-XX

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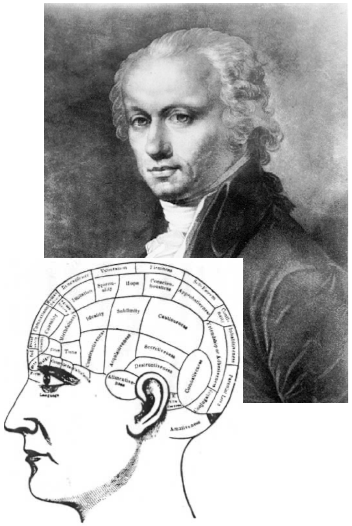
The brain "looks" at itself with the eyes of society

Glass brain flythrough - Gazzaleylab / SCCN / Neuroscapelab
http://neuroscape.ucsf.edu/glassbrain | http://neuroscape.ucsf.edu | http://sccn.ucsd.edu

Prehistory — Ancient Greece — Ancient Rome — XVI-XVII — XVII-XVIII — XIX-XX — Today

SCUOLA ALTI STUDI LUCCA IMT

Towards a biochemistry of mind?

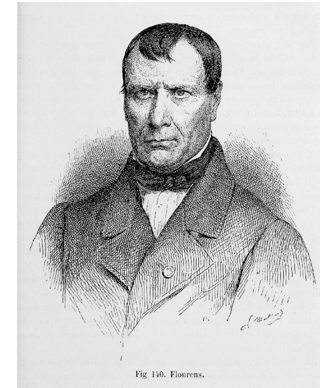


Localisationism

- Functions are localised in anatomic cortical regions
- Damage to a region results in loss of function

Functional Segregation

- Functions are carried out by specific areas/cells in the cortex that can be anatomically separated

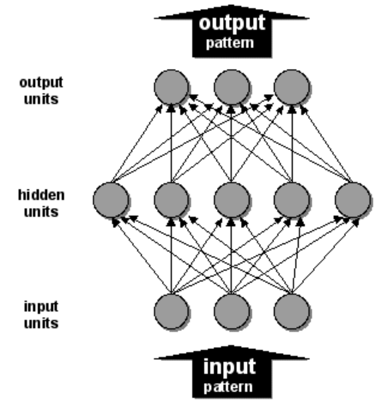


Globalism

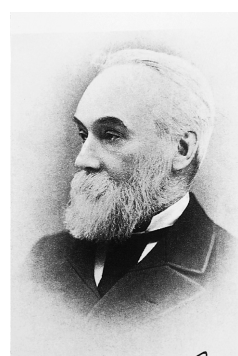
- The brain works as a whole, extent of brain damage is more important than its location

Connectionism

- Networks of simple connected units

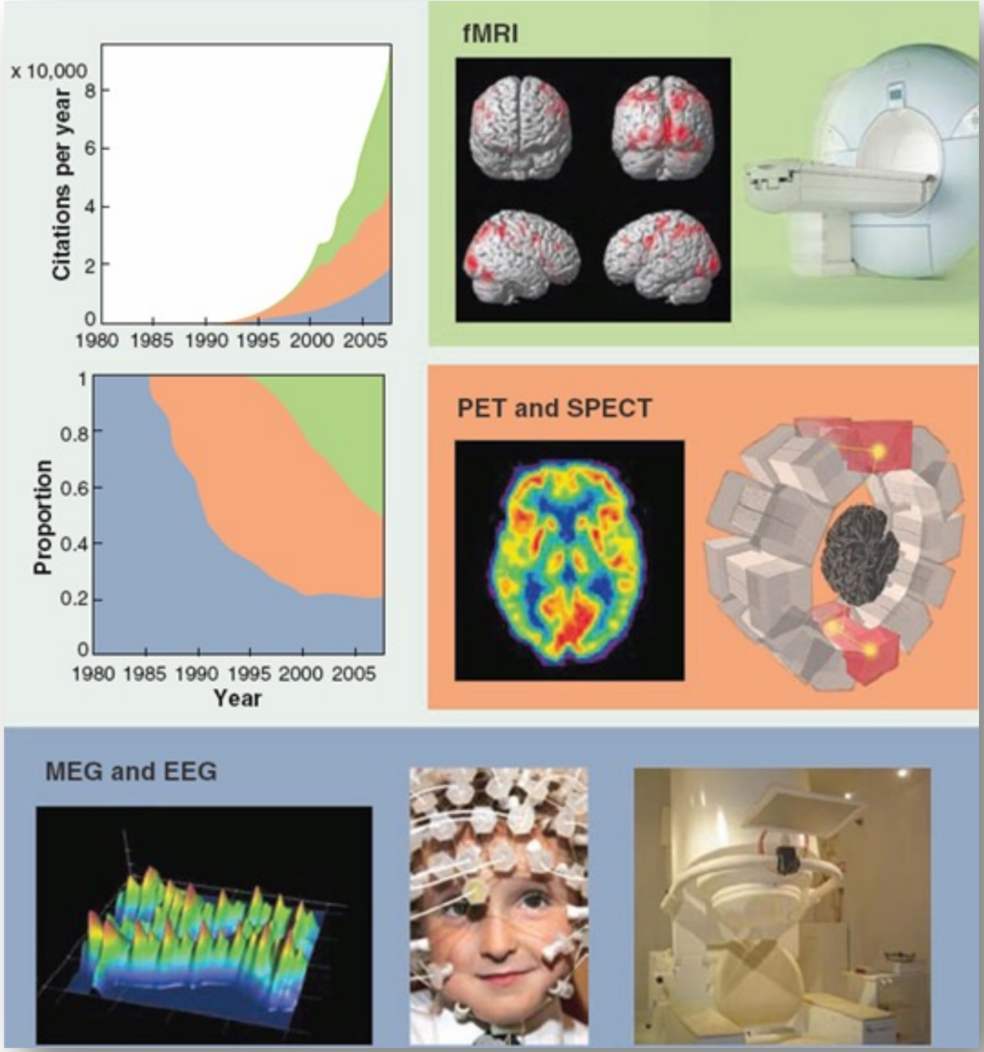


Functional Segregation
Different areas of the brain are specialised for different functions

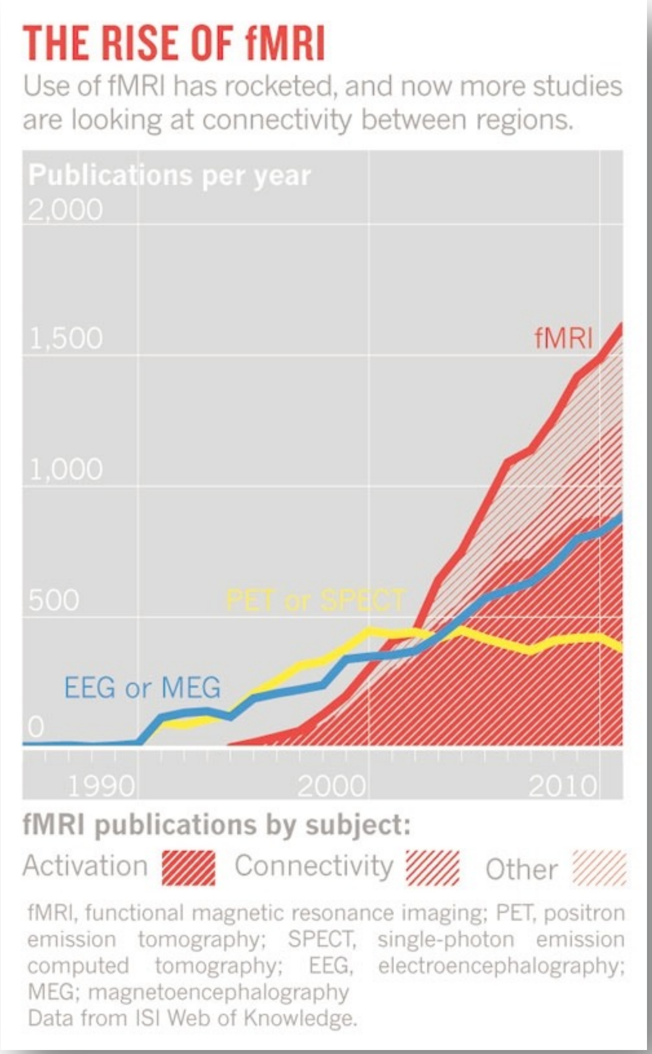


Functional Integration
Networks of interactions among specialised areas

Neuroscience and neuroimaging

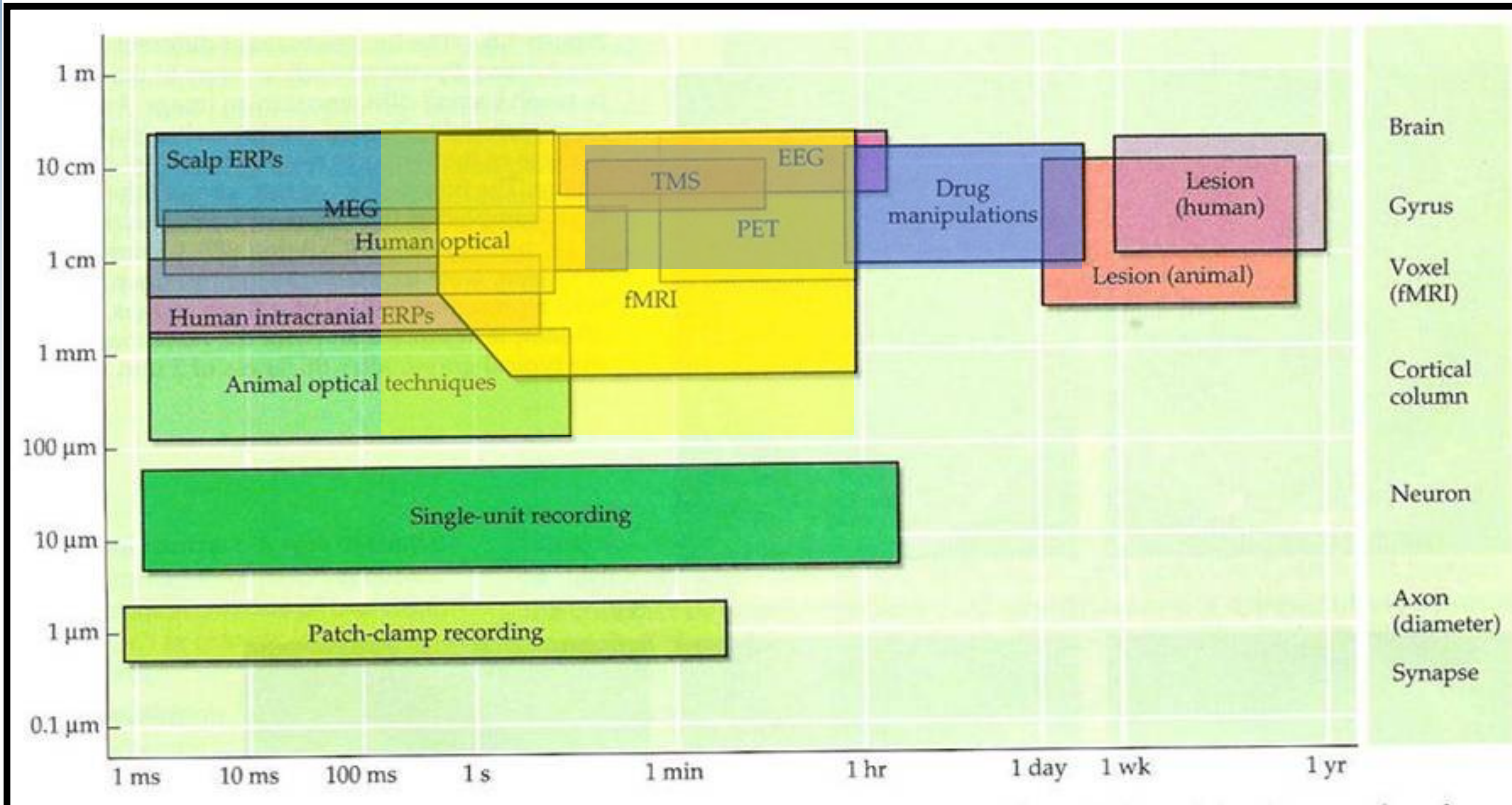


Friston, 2009



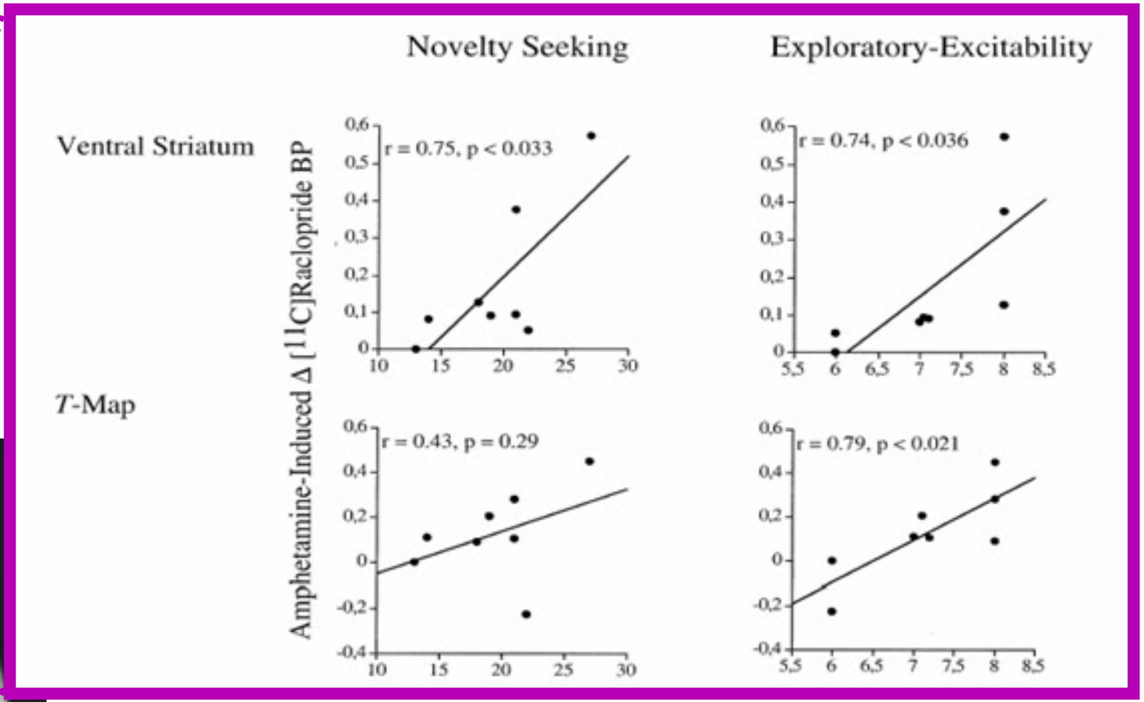
Smith, 2012

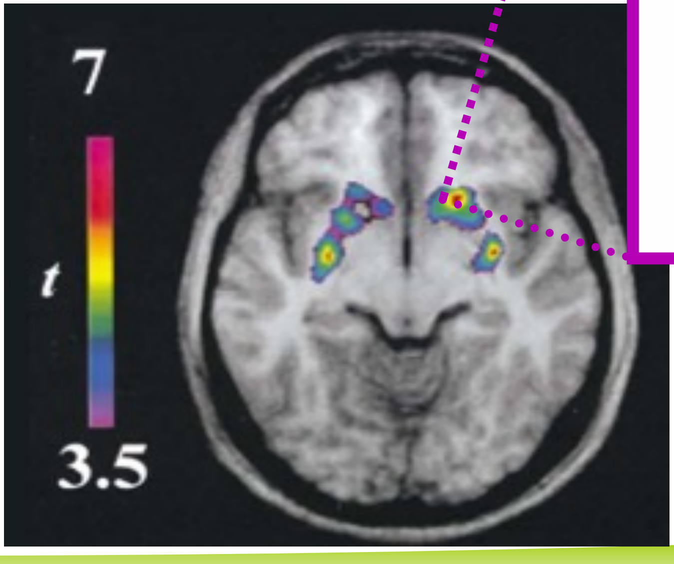
Neuroscience and neuroimaging



Advantages

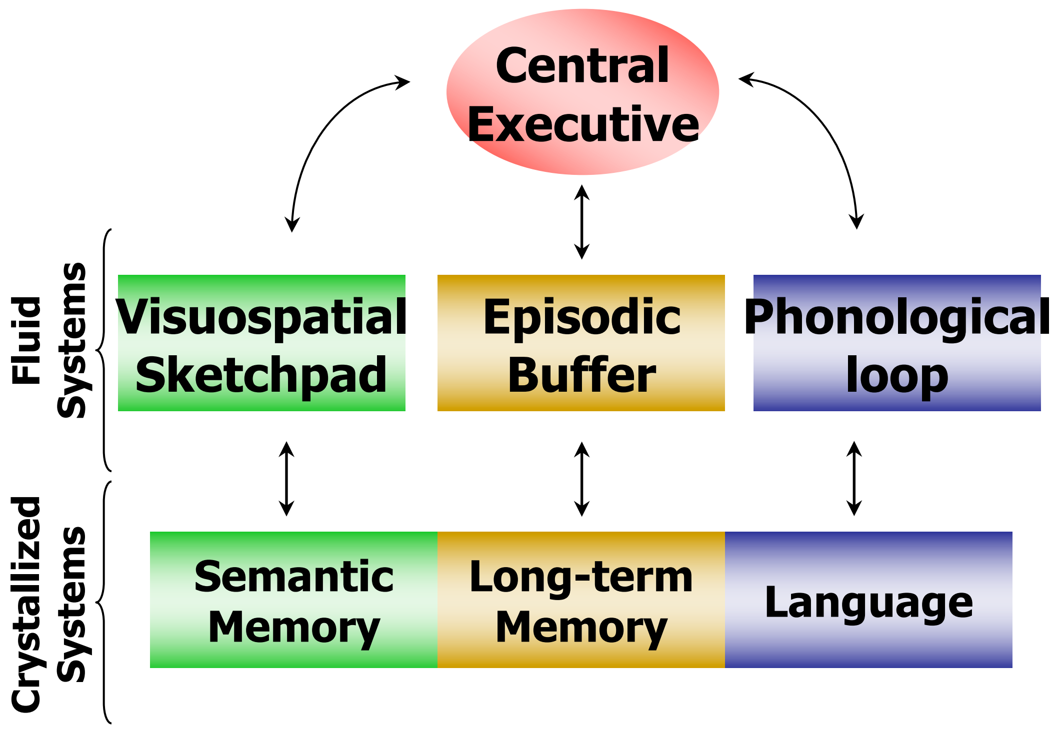
Both qualitative and quantitative characterization

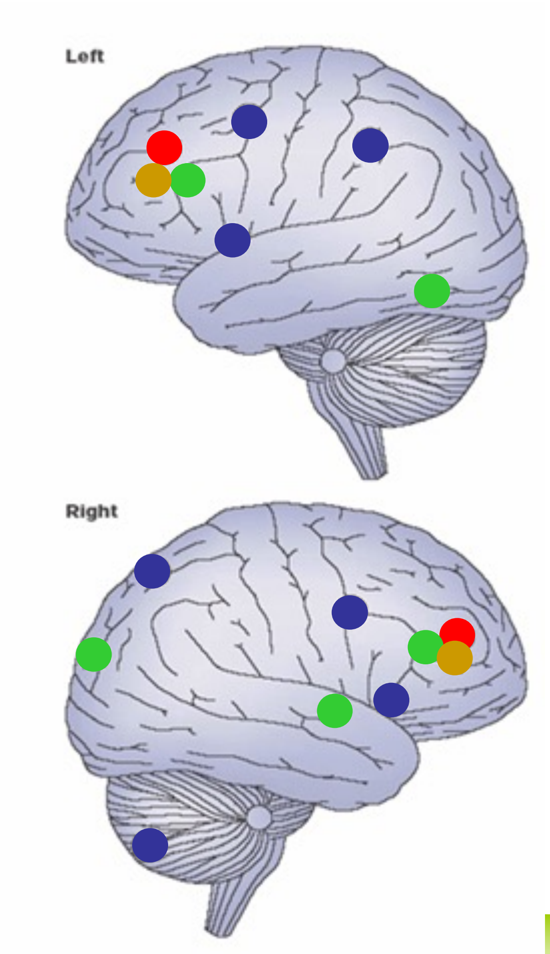




Advantages

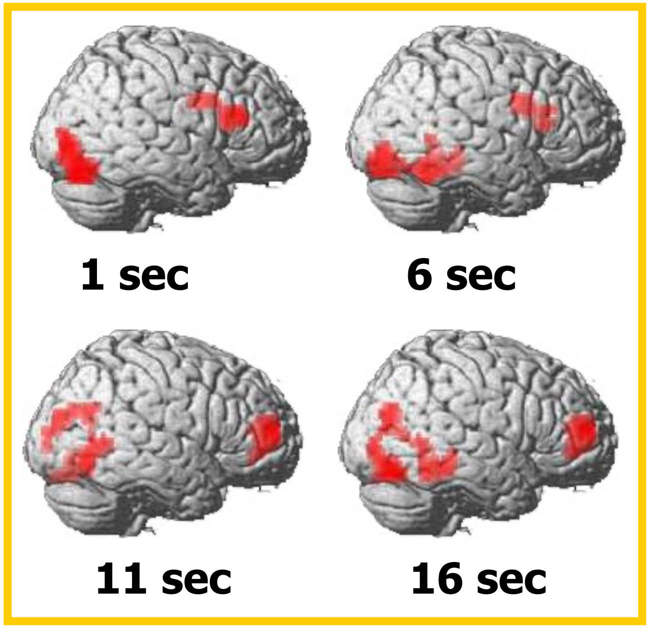
Dissection of different functional states or conditions in the processing of information



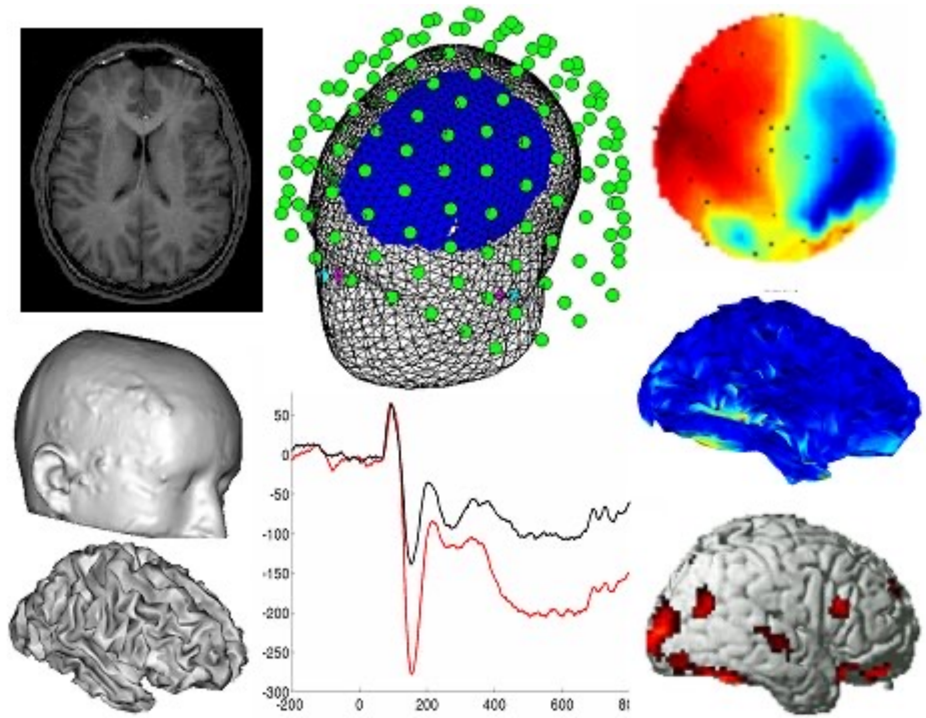


Advantages

Versatile methodologies (e.g. parametric changes, multimodality, pharmacological probes, etc.)



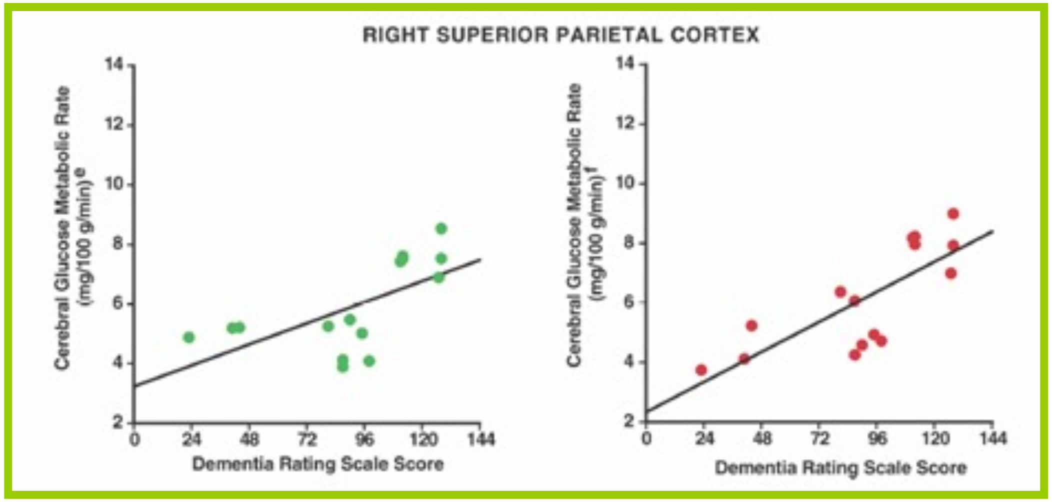
Ricciardi et al., Brain Res Bull, 2009



Advantages

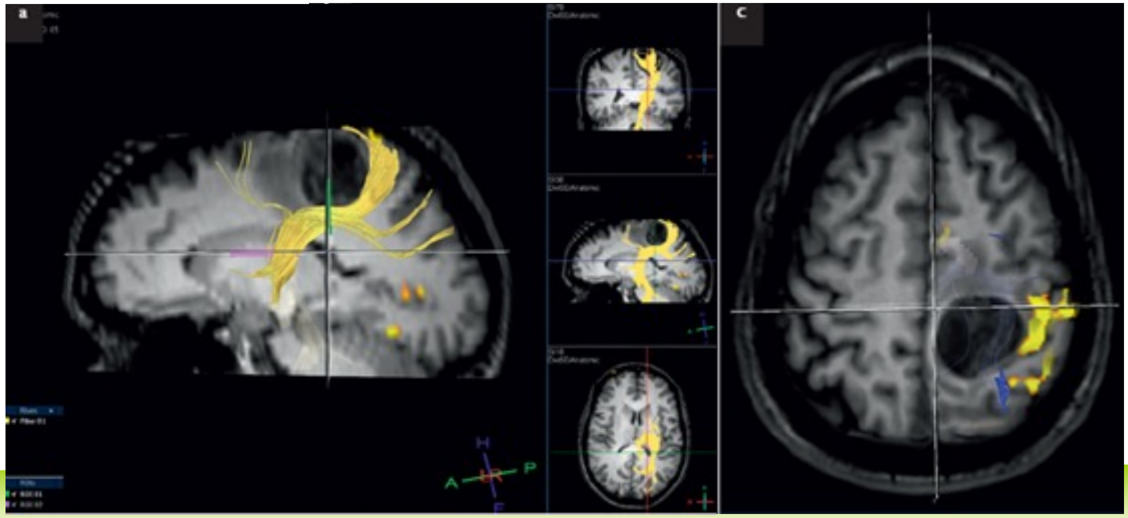
Correlation with several diagnostic methods

Pietrini et al., Am J Psychiatry, 1999



Peripheral parameters (HR, SCR, etc.), **neuropsychological characterization, behavioral measures**

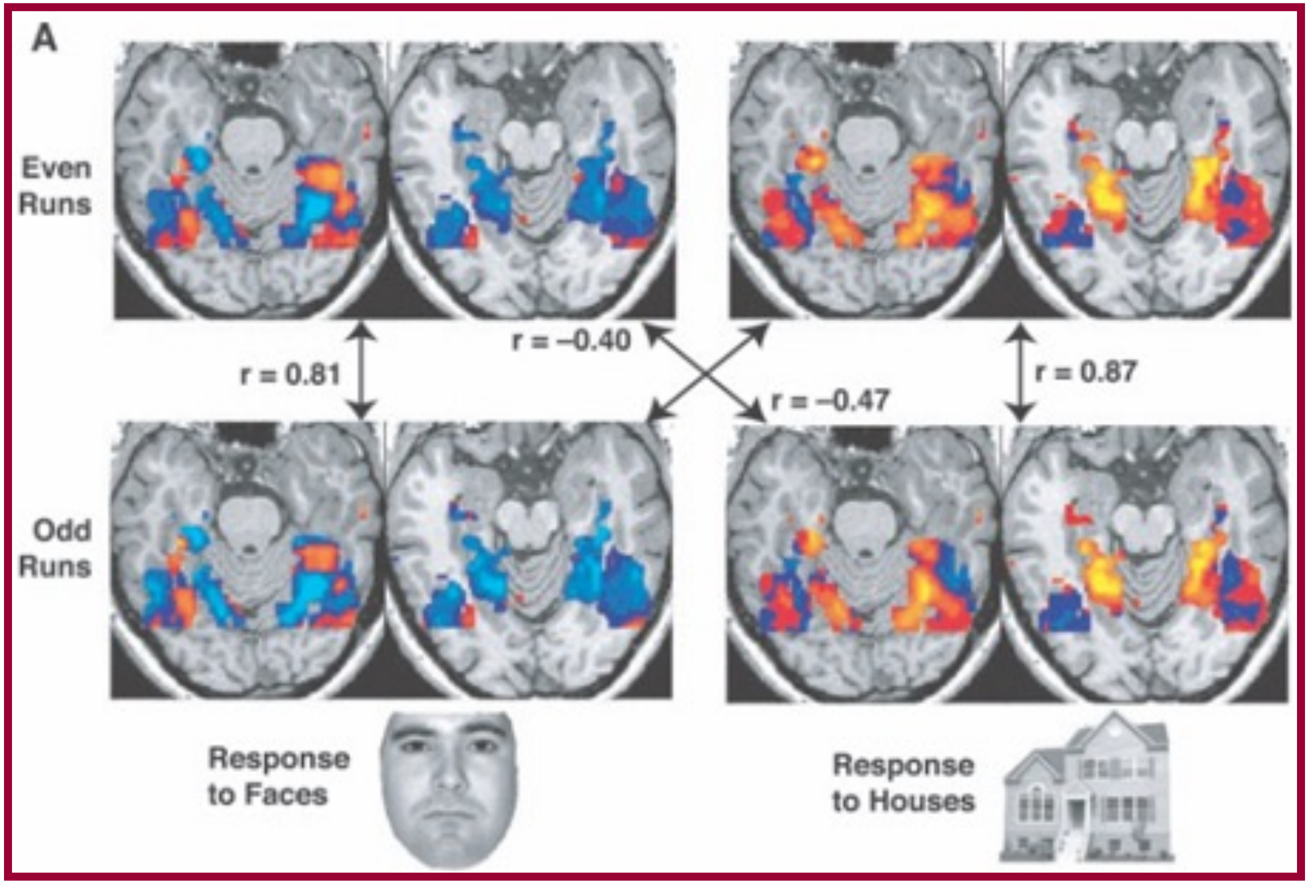
Structural data (e.g. anatomy, fiber tracking, cortical thickness, etc.)



White et al., FieldStrenght, 2008

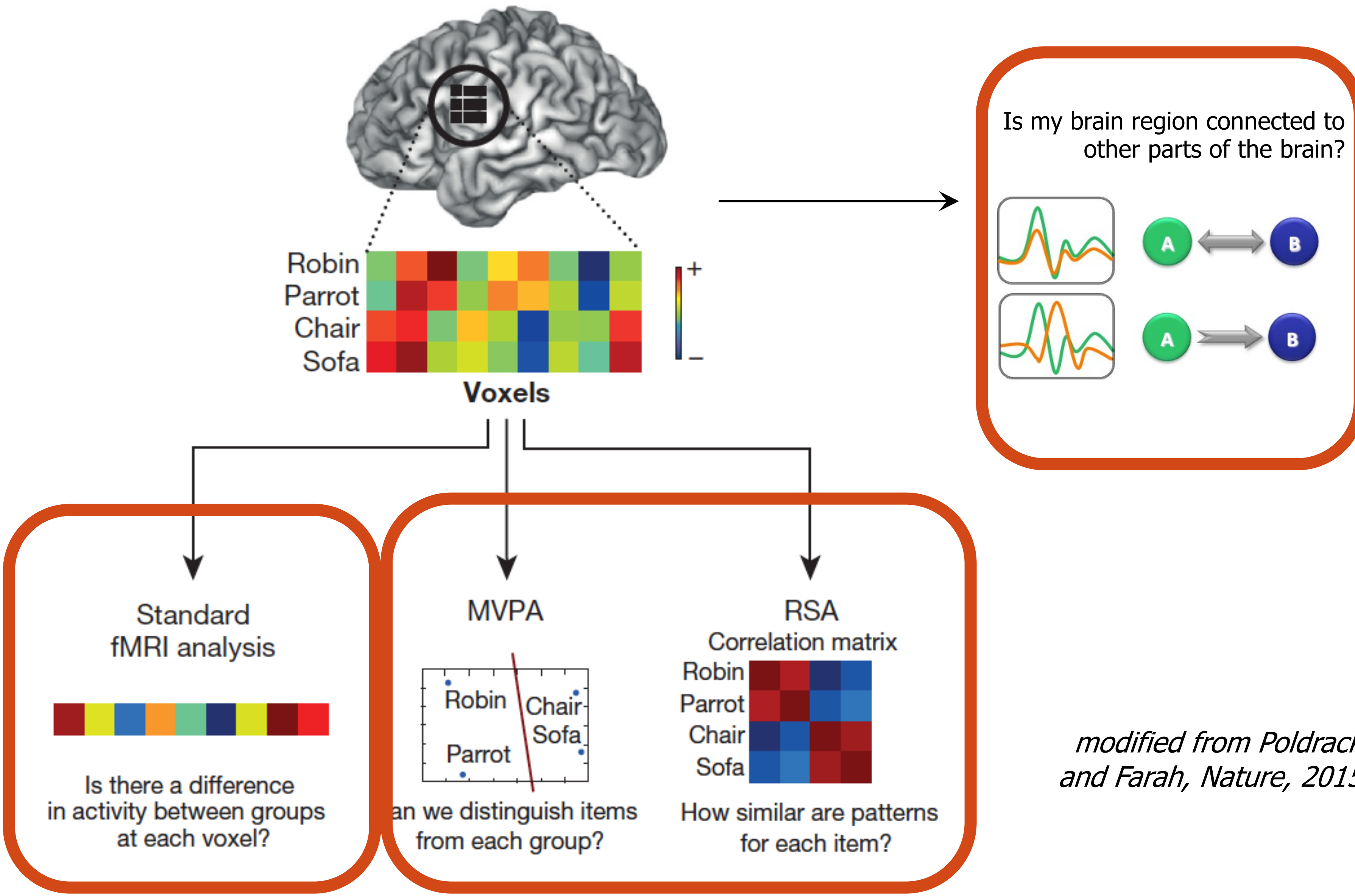
Advantages

Novel information as compared to other psychometric methodologies



Haxby et al., Science, 2001

Different approaches to data analyses

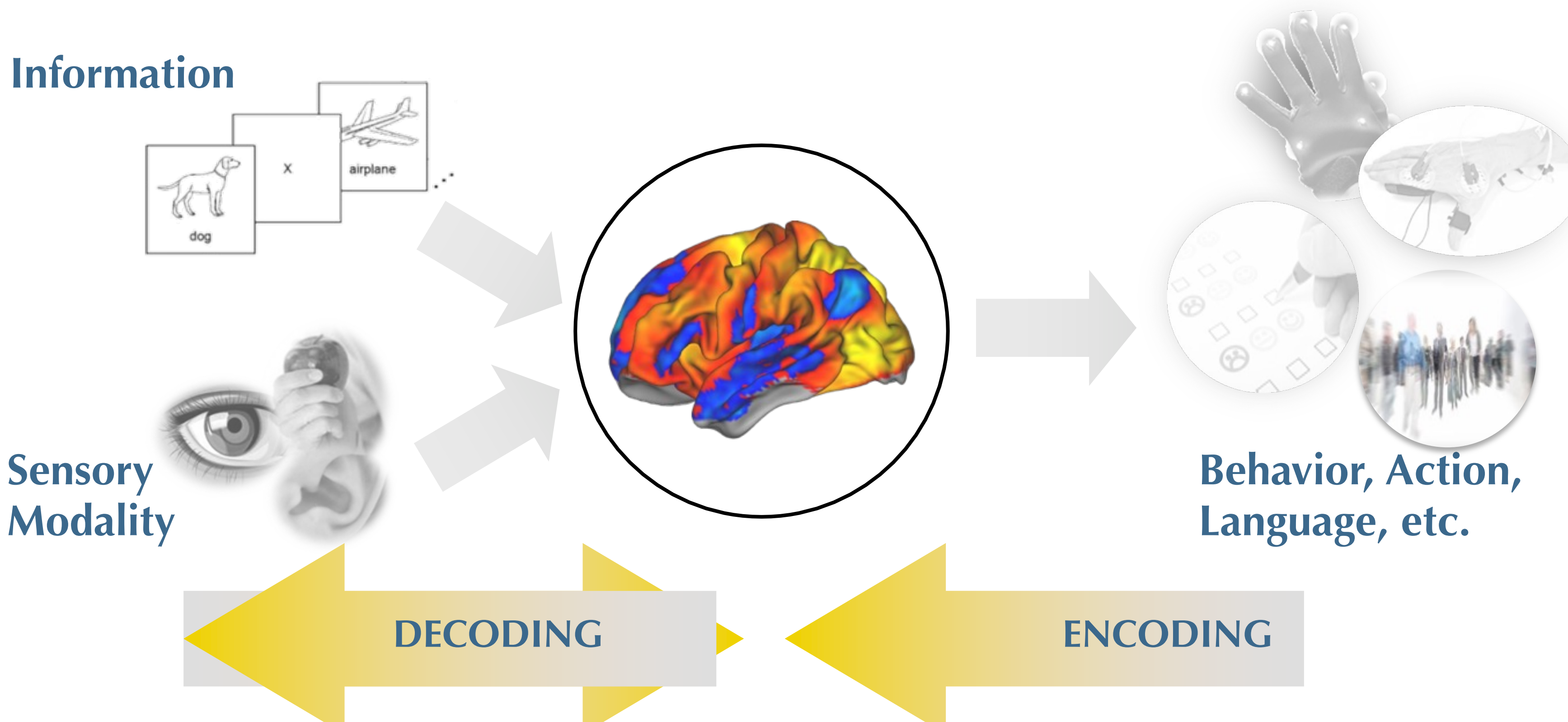


modified from Poldrack and Farah, Nature, 2015

The quantum leap in data processing

«Information is encoded in patterns of neural activity. This information can come from our experience of the world or can be generated by thinking. One of the ***great challenges for systems neuroscience is to break this code****»*

Haxby et al., Ann Rev Neurosci, 2014

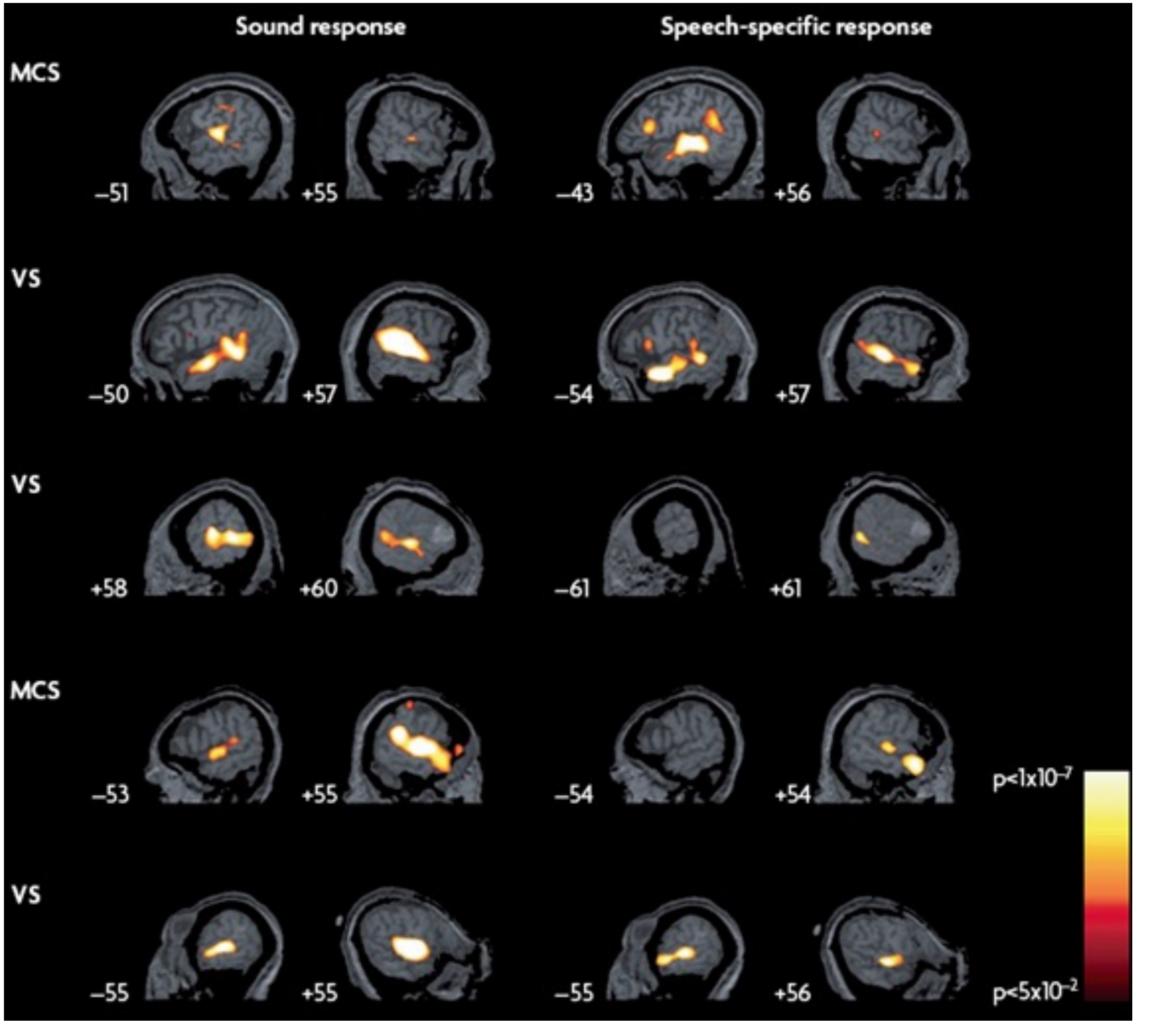


Consciousness: arousal and awareness

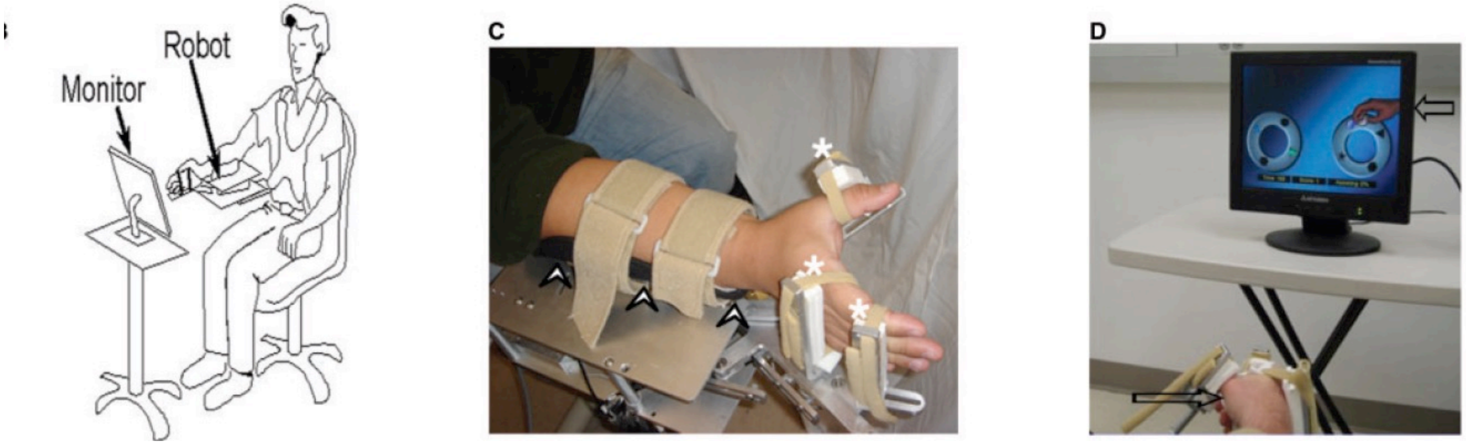
SCIENCE AND SOCIETY

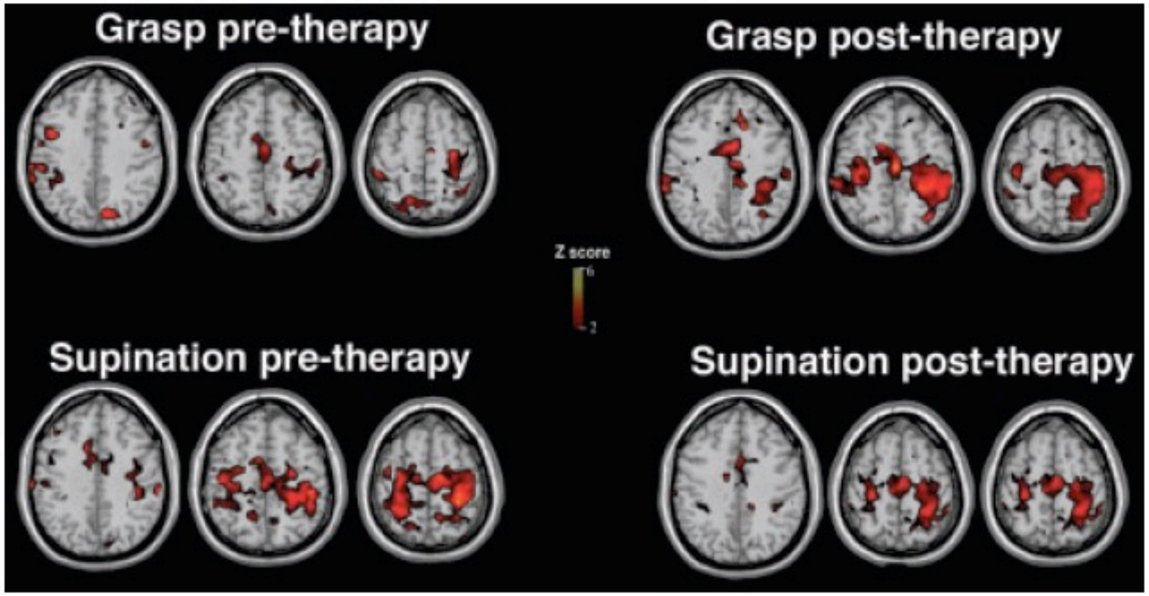
Functional neuroimaging of the vegetative state

Adrian M. Owen and Martin R. Coleman



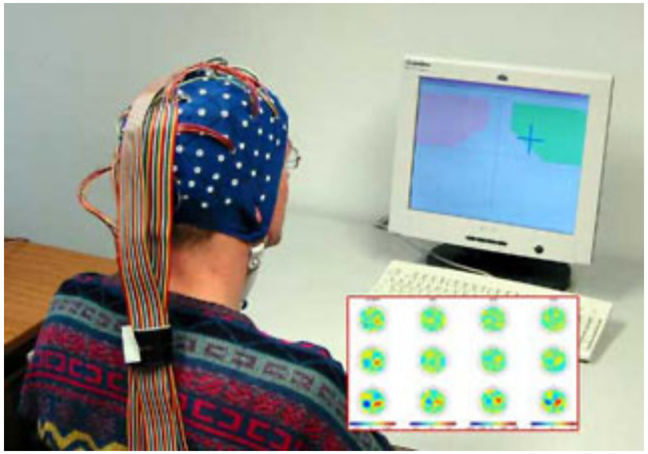
The "pathological" brain: recovery

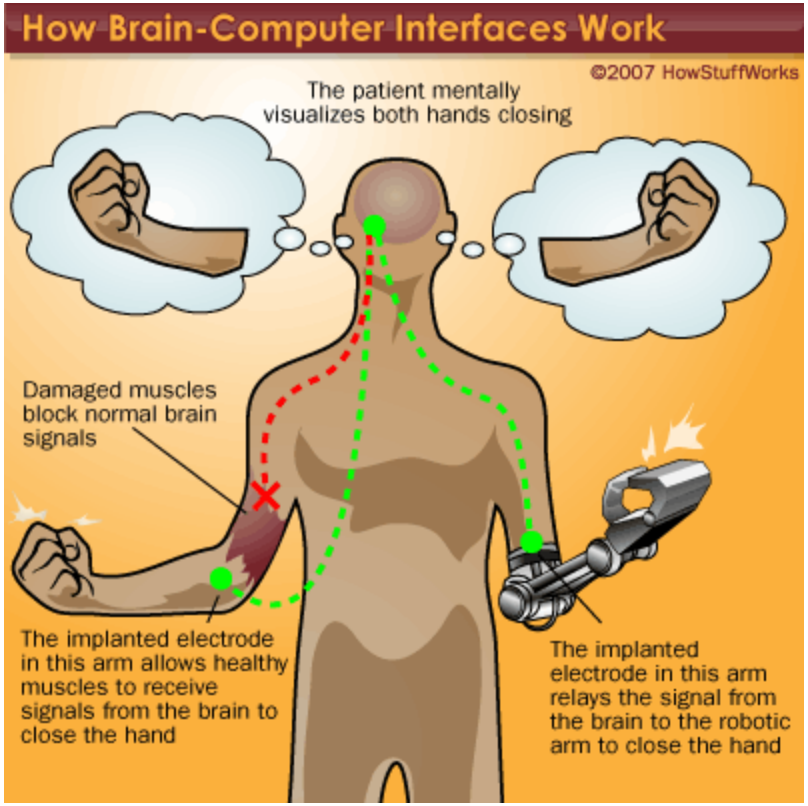




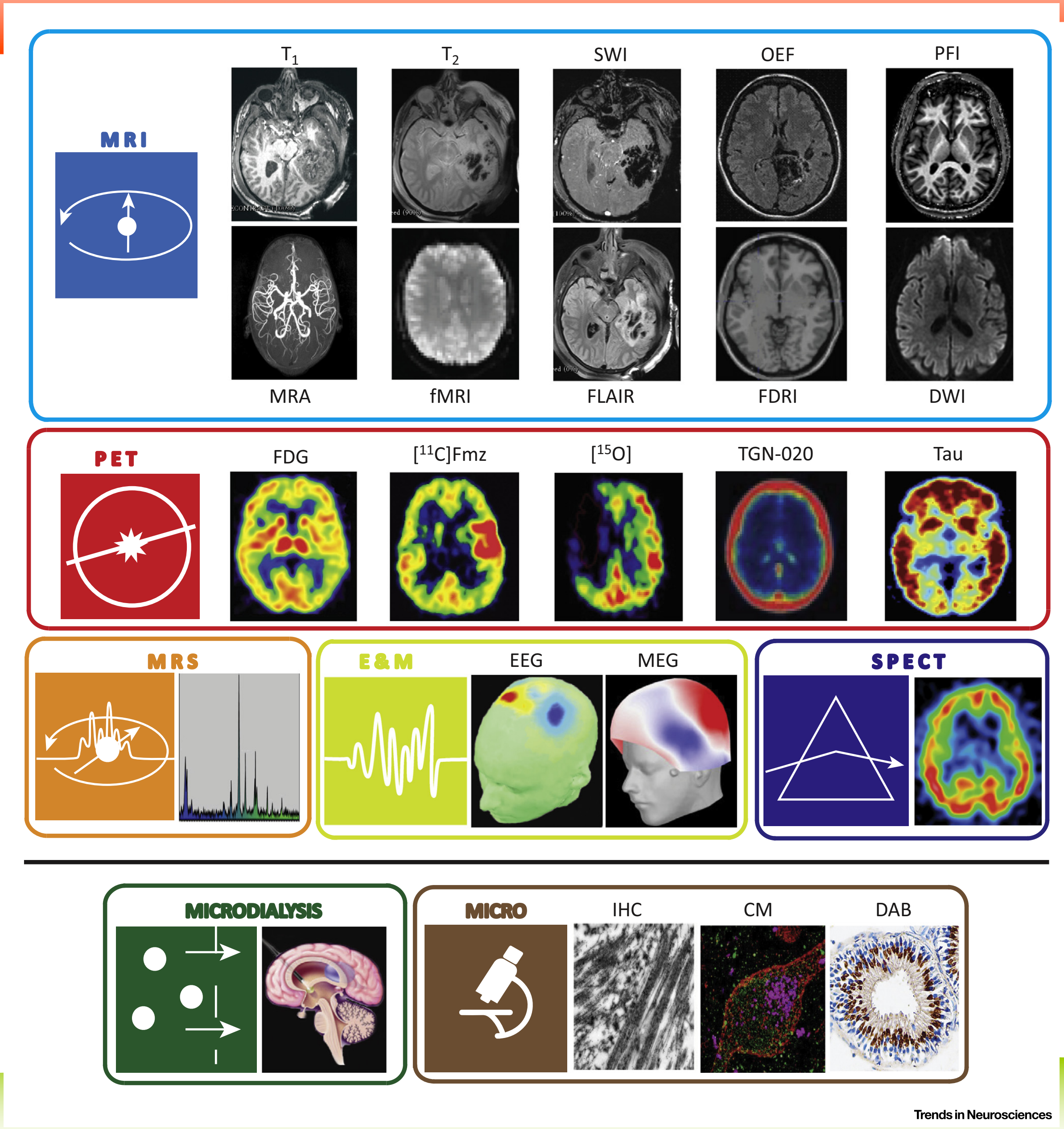
METHODOLOGY

Brain-computer interface





The "pathological" brain



The future?

Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg

Editorial

Prediction of Individual Differences from Neuroimaging Data

Brain imaging has been extensively applied to many different areas of health and disease, with many remarkable successes that, collectively, have profoundly shaped our understanding of brain function. However, most previous work has focused on identifying differences between groups or strived for aggregate results across multiple subjects. In most cases mass-univariate analyses, such as the general linear model (GLM), are employed to make local inferences about the effect of interest, typically at the group level. This approach is limited though as it does not capture linked relationships across voxels and is also not directly able to classify individuals into diagnostic groups based upon neuroimaging findings. As a consequence, neuroimaging has so far contributed only relatively few tools that have had practical impact on real-world problems, such as clinical diagnosis and prognosis. This poor translational track record has triggered a recent interest in machine learning approaches that can be applied to predict clinically relevant outcomes, such as diagnosis or treatment response, from individual subject neuroimaging measures.

multivariate lesion analyses to provide a more comprehensive characterization of how the impact of brain damage depends on interactions between multiple factors – such as the location, extent and age of lesions – and how these interactions explain variability across individuals. Beyond statistical predictions of individual outcome, they highlight the need for explanatory models of stroke-inflicted neural network dysfunction that are constrained by individual anatomical and physiological data. Gifford et al. tackle the important question of how well neuroimaging measures can predict the onset of psychosis. They review previous key findings and lay out the challenges that lie ahead in translating such work to the clinic. The combination of multiple imaging modalities has shown great promise in further increasing the sensitivity of predicting clinically important variables. Sui et al. present a generalized framework for prediction of cognitive and symptoms scores from the joint information provided by multiple modalities (functional MRI, structural MRI, diffusion imaging). They also show how such work can provide more information about localized brain deficits than conven-

The future?

…These changes in signal provide the ability to map activation in relation to specific mental processes, to identify functionally connected networks from resting fMRI, to characterize neural representational spaces and to decode or predict mental function from brain activity. These advances promise to offer important insights into the workings of the human brain but also generate the potential for a 'perfect storm' of irreproducible results. In particular, the high dimensionality of fMRI data, the relatively low power of most fMRI studies and the great amount of flexibility in data analysis contribute to a potentially high degree of false positive findings…

The future?

nature human behaviour

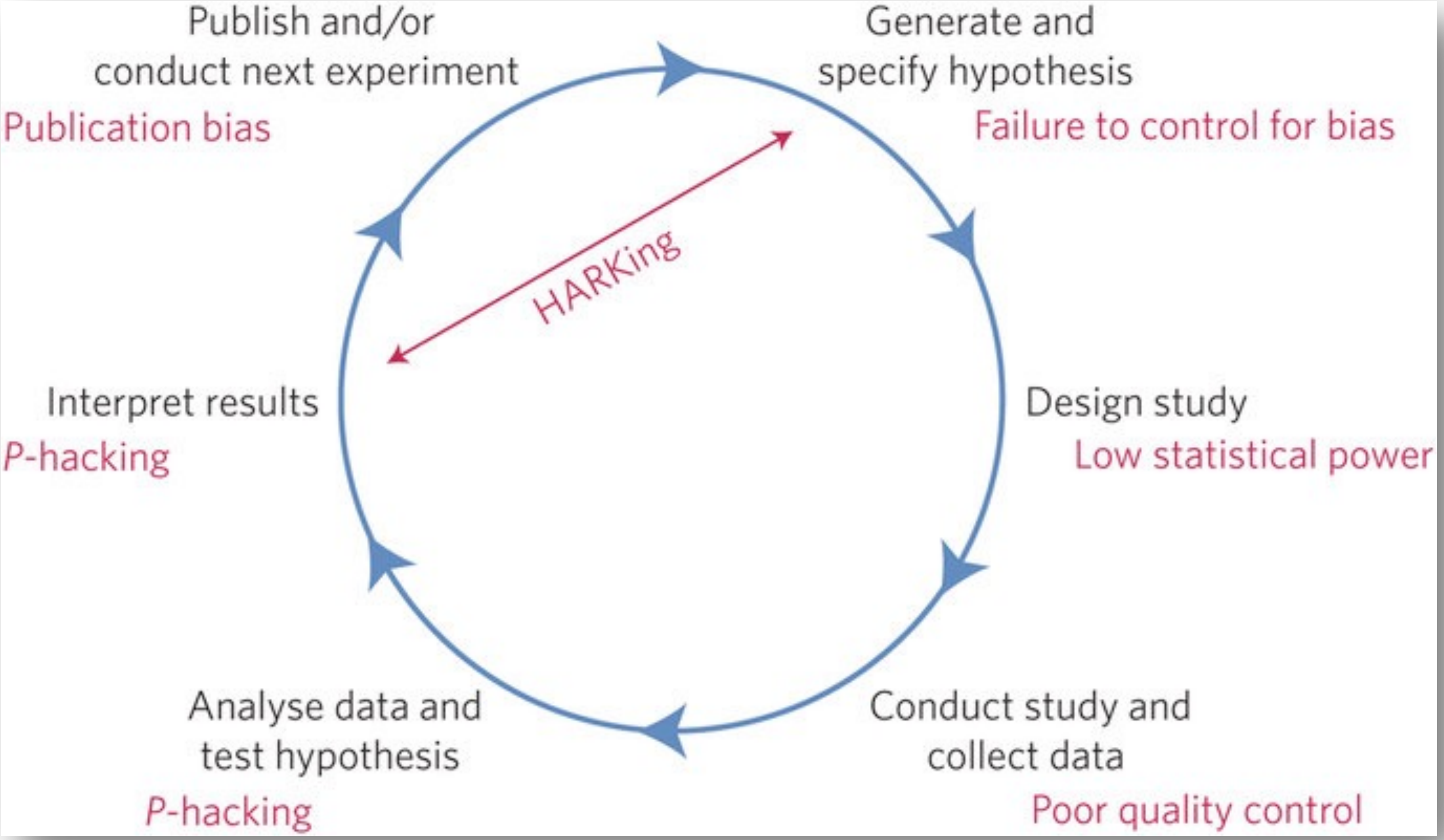
PERSPECTIVE

PUBLISHED: 10 JANUARY 2017 | VOLUME: 1 | ARTICLE NUMBER: 0021

OPEN

A manifesto for reproducible science

Marcus R. Munafò[1,2*], Brian A. Nosek[3,4], Dorothy V. M. Bishop[5], Katherine S. Button[6], Christopher D. Chambers[7], Nathalie Percie du Sert[8], Uri Simonsohn[9], Eric-Jan Wagenmakers[10], Jennifer J. Ware[11] and John P. A. Ioannidis[12,13,14]



Reseachers' degrees of freedom

Processing step	Reason	Options [suboptions]	Number of plausible options
Motion correction	Correct for head motion during scanning	• 'Interpolation' [linear or sinc] • 'Reference volume' [single or mean]	4
Slice timing correction	Correct for differences in acquisition timing of different slices	'No', 'before motion correction' or 'after motion correction'	3
Field map correction	Correct for distortion owing to magnetic susceptibility	'Yes' or 'no'	2
Spatial smoothing	Increase SNR for larger activations and ensure assumptions of GRF theory	'FWHM' [4 mm, 6 mm or 8 mm]	3
Spatial normalization	Warps an individual brain to match a group template	'Method' [linear or nonlinear]	2
High-pass filter	Remove low-frequency nuisance signals from data	'Frequency cut-off' [100 s or 120 s]	2
Head motion regressors	Remove remaining signals owing to head motion via statistical model	'Yes' or 'no' [if yes: 6/12/24 parameters or single time point 'scrubbing' regressors]	5
Haemodynamic response	Account for delayed nature of haemodynamic response to neuronal activity	• 'Basis function' ['single-gamma' or 'double-gamma'] • 'Derivatives' ['none', 'shift' or 'dispersion']	6
Temporal autocorrelation model	Model for the temporal autocorrelation inherent in fMRI signals	'Yes' or 'no'	2
Multiple-comparison correction	Correct for large number of comparisons across the brain	'Voxel-based GRF', 'cluster-based GRF', 'FDR' or 'non-parametric'	4
Total possible workflows			69,120

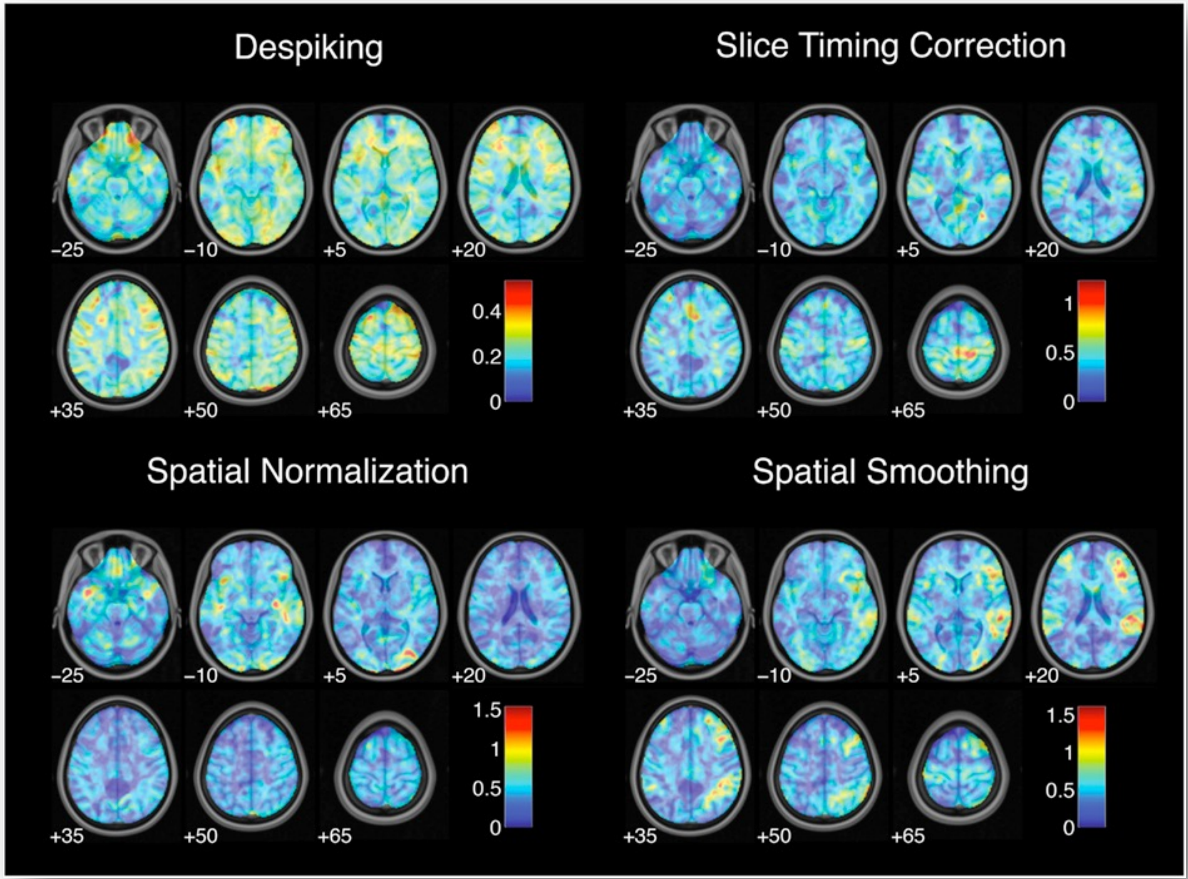
Reseachers' degrees of freedom

frontiers in
NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE
published: 11 October 2012
doi: 10.3389/fnins.2012.00149

On the plurality of (methodological) worlds: estimating the analytic flexibility of fMRI experiments

*Joshua Carp**



Reseachers' degrees of freedom

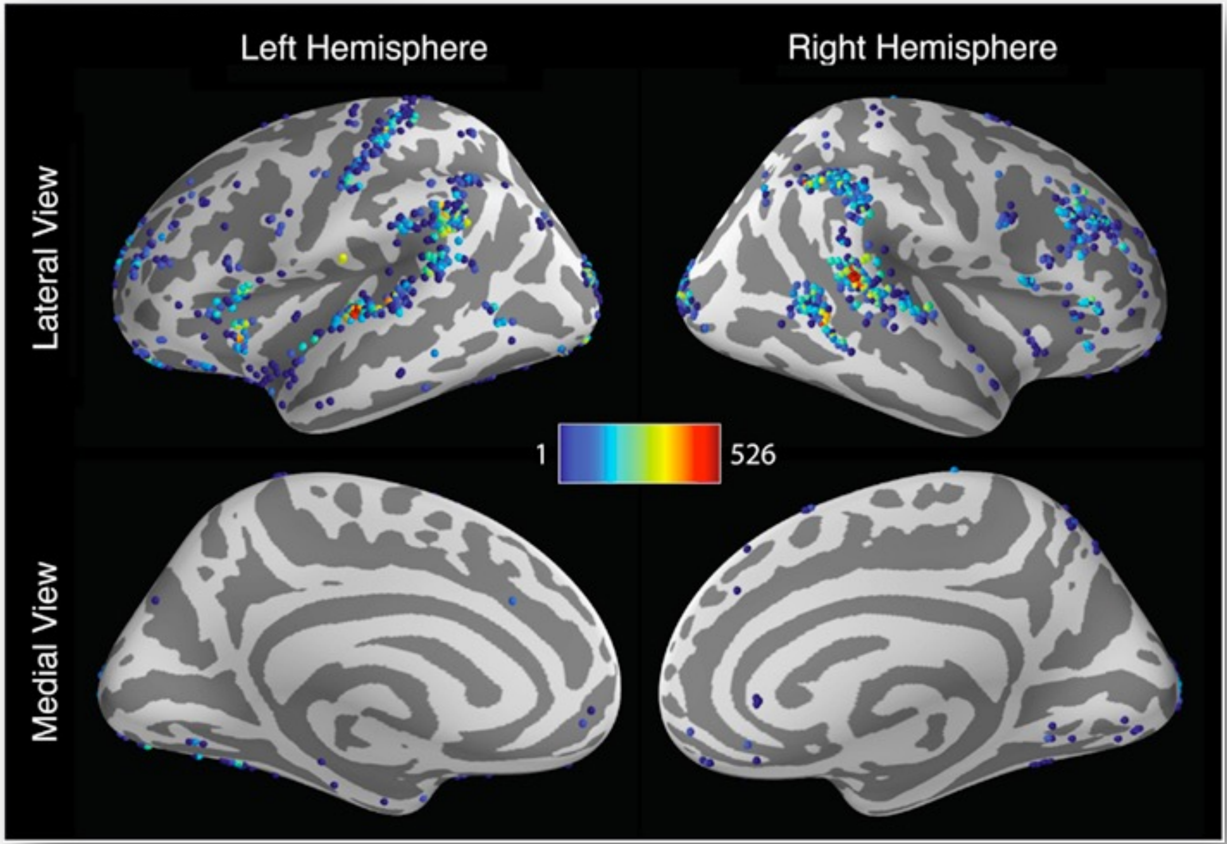
frontiers in
NEUROSCIENCE

ORIGINAL RESEARCH ARTICLE
published: 11 October 2012
doi: 10.3389/fnins.2012.00149

On the plurality of (methodological) worlds: estimating the analytic flexibility of fMRI experiments

Joshua Carp*

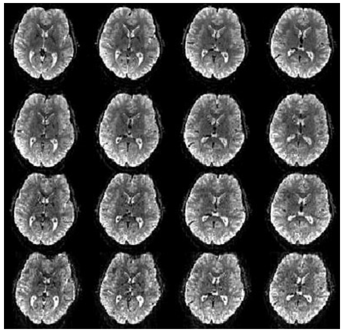
These 'researcher degrees of freedom' can lead to substantial inflation of type I error rates — even when there is no intentional 'P-hacking', and only a single analysis is ever conducted

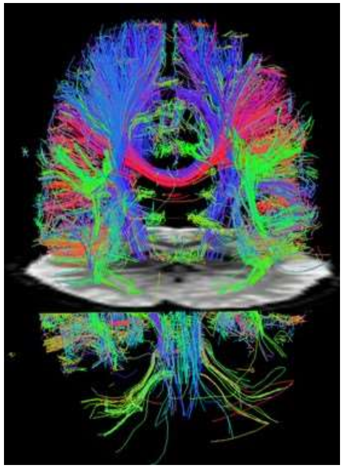


Big data…

Brain Research using Imaging

- Brain research is multi-faceted and data-intensive
  - The brain is impossibly complex!
  - Over 100 trillion synapses
  - Estimated to store between 50TB and 2PB of information
- Neuroimaging data analytics is complex and “big”
  - Image processing
  - Time series analysis
  - Statistical modeling
  - Multiple comparisons
  - Visualizing results
- Huge amounts of data collected and integrated across scales
  - Imaging (MRI/PET/CT)
  - EEG (electroencephalogram)
  - Genetic sequencing
  - Multivariate phenotyping
  - Microbiome





Courtesy of Jack Van Horn

Big data…

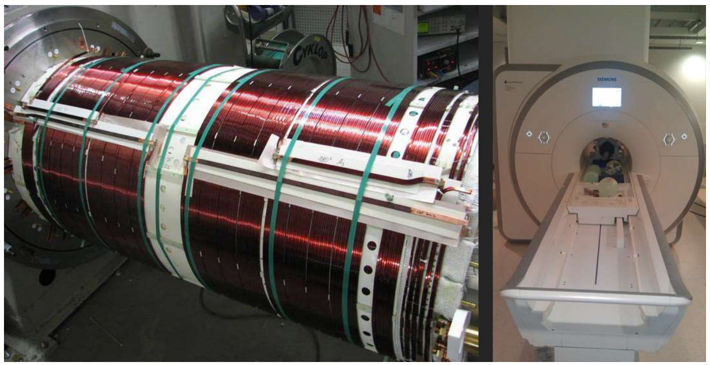
Big Data Motivations

- The world's technological per-capita capacity to store information doubles every 40 months
  - As of 2009, the entire World Wide Web was estimated to contain close to 500 exabytes, or half a zettabyte.
  - In 2012, 2.5 exabytes (2.5×10^{18}) of data/day
  - By 2025, the world’s “Datasphere” will grow to 175 zettabytes (175×10^{21})
    - Zettabytes!!
    - One zettabyte equals 1024 exabytes
    - One exabyte equals 1024 petabytes
- Relational database management systems and desktop statistics and visualization packages often have difficulty handling big data.
- Big Data: new driver for digital economy & society
  - Hundreds of billions of GDP in 2020.
  - Intangible factor after labor and capital
- The so-called “Fourth Paradigm” is upon us

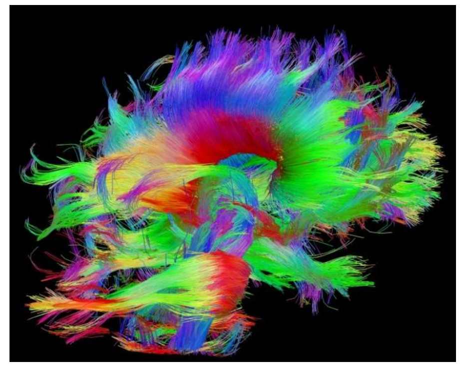
Courtesy of Jack Van Horn

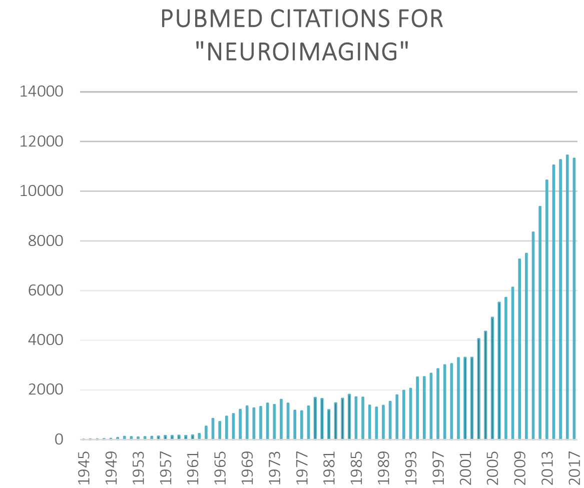
Big data…

Neuroimaging as “Big Data”



MGH CONNECTOM 3T Scanner (Human Connectome Project)





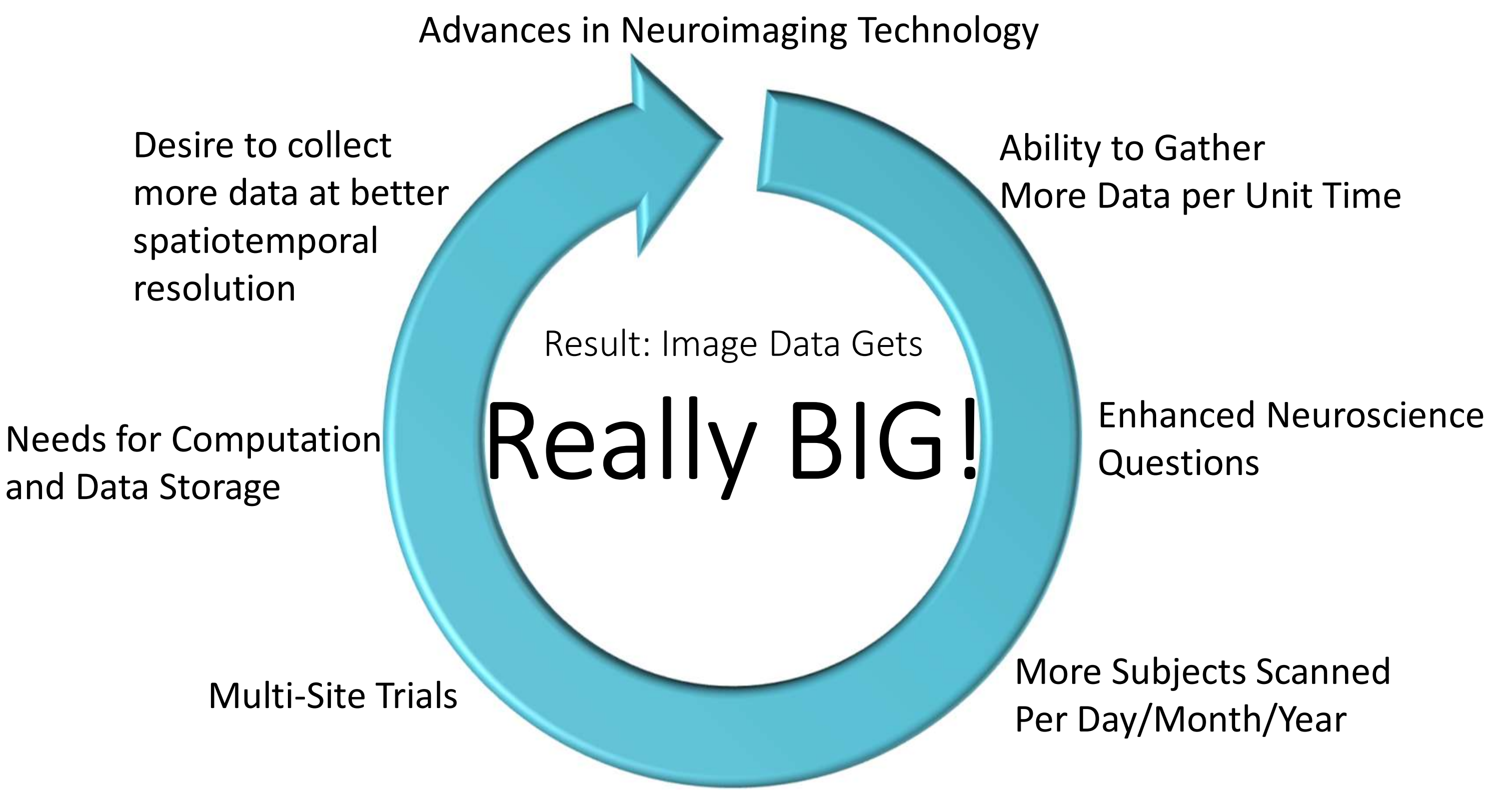
“The methods by which these data are obtained are themselves contributing to this growth, involving finer spatial and temporal resolution as MR physicists push the limits of what is possible and as brain scientists then rush to meet those limits. It is safe to say that human neuroimaging is now, officially, a ‘big data’ science.”

Van Horn and Toga, 2014, *Brain Imaging and Behavior*

Courtesy of Jack Van Horn

Big data…

A Cycle of Data Multiplication



Courtesy of Jack Van Horn

Big data…

bioRxiv
THE PREPRINT SERVER FOR BIOLOGY

New Results

View current version of this article

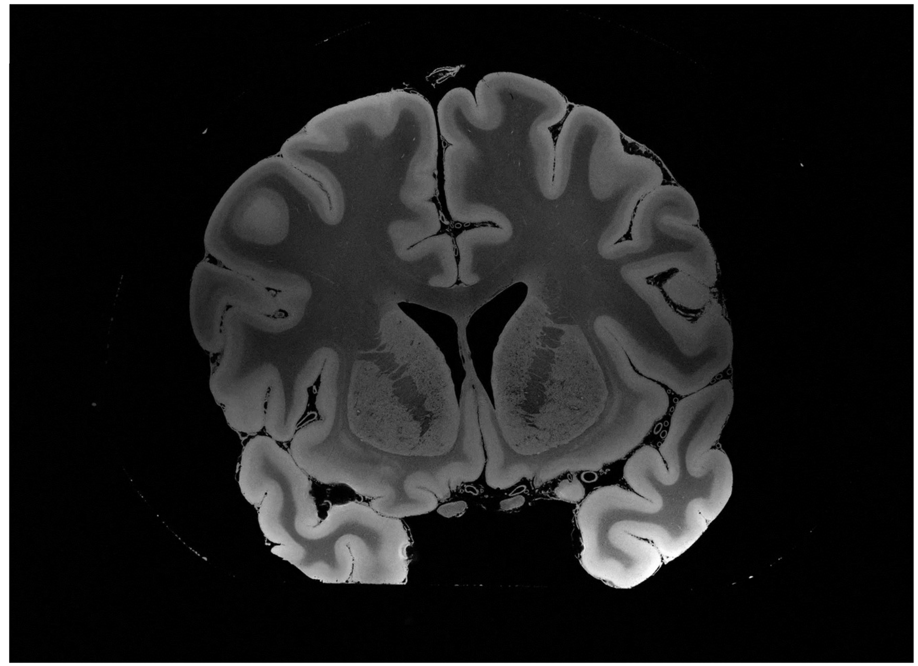
2 comments

7 Tesla MRI of the *ex vivo* human brain at 100 micron resolution

Brian L. Edlow, Azma Mareyam, Andreas Horn, Jonathan R. Polimeni, M. Dylan Tisdall, Jean Augustinack, Jason P. Stockmann, Bram R. Diamond, Allison Stevens, Lee S. Tirrell, Rebecca D. Folkerth, Lawrence L. Wald, Bruce Fischl, Andre van der Kouwe

doi: https://doi.org/10.1101/649822

- This is a 100 micron isotropic resolution magnetic resonance imaging (MRI) scan of an ex vivo human brain specimen.
- The brain specimen was donated by a 58-year-old woman who had no history of neurological disease and died of non-neurological causes. Her family provided written informed consent.
- We imaged her brain for **5 days continuously on a 7 Tesla MRI scanner using a custom-built 31-channel receive array coil**. The images shown here are from the acquired FA25 volume.



100 micron resolution MRI @ 7T

DRYAD

https://datadryad.org/stash/dataset/doi:10.5061/dryad.119f80q

Complete dataset: 34GB

Courtesy of Jack Van Horn

Big data…

Recent studies illustrate the need for sheer magnitude of subject sample size in order to make reliable, reproducible, and meaningful inferences relating brains to genes.


ARTICLES
https://doi.org/10.1038/s41588-022-01024-z
nature genetics

OPEN

New insights into the genetic etiology of Alzheimer's disease and related dementias

NATURE GENETICS | VOL 54 | APRIL 2022

Article

Reproducible brain-wide association studies require thousands of individuals

https://doi.org/10.1038/s41586-022-04492-9
Received: 19 May 2021
Accepted: 31 January 2022
Published online: 16 March 2022
Open access

www.nature.com/npp

American College of Neuropsychopharmacology

ARTICLE OPEN

Association between polygenic risk for Alzheimer's disease, brain structure and cognitive abilities in UK Biobank

Rachana Tank, Joey Ward, Kristin E. Flegal, Daniel J. Smith, Mark E. S. Bailey, Jonathan Cavanagh and Donald M. Lyall

© The Author(s) 2021

Previous studies testing associations between polygenic risk for late-onset Alzheimer's disease (LOAD-PGR) and brain magnetic resonance imaging (MRI) measures have been limited by small samples and inconsistent consideration of potential confounders. This study investigates whether higher LOAD-PGR is associated with differences in structural brain imaging and cognitive values in a relatively large sample of non-demented, generally healthy adults (UK Biobank). Summary statistics were used to create PGR scores for $n = 32,790$ participants using LDpred. Outcomes included 12 structural MRI volumes and 6 concurrent cognitive measures. Models were adjusted for age, sex, body mass index, genotyping chip, 8 genetic principal components, lifetime smoking, apolipoprotein (*APOE*) e4 genotype and socioeconomic deprivation. We tested for statistical interactions between *APOE* e4 allele dose and LOAD-PGR vs. all outcomes. In fully adjusted models, LOAD-PGR was associated with worse fluid intelligence (standardised beta [β] = −0.080 per LOAD-PGR standard deviation, $p = 0.002$), matrix completion (β = −0.102, $p = 0.003$), smaller left hippocampal total (β = −0.118, $p = 0.002$) and body (β = −0.069, $p = 0.002$) volumes, but not other hippocampal subdivisions. There were no significant *APOE* x LOAD-PGR score interactions for any outcomes in fully adjusted models. This is the largest study to date investigating LOAD-PGR and non-demented structural brain MRI and cognition phenotypes. LOAD-PGR was associated with smaller hippocampal volumes and aspects of cognitive ability in healthy adults and could supplement *APOE* status in risk stratification of cognitive impairment/LOAD.

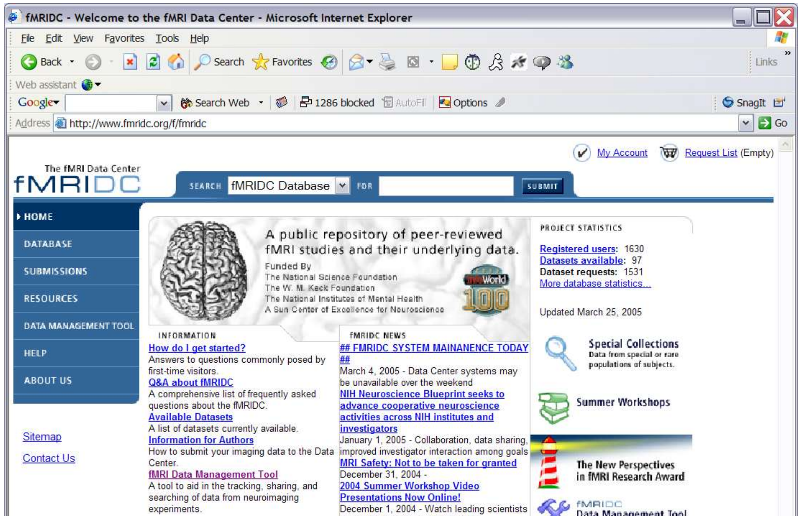
Neuropsychopharmacology (2022) 47:564–569; https://doi.org/10.1038/s41386-021-01190-4

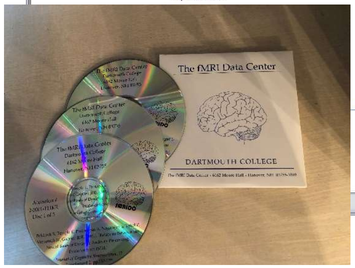
UK BioBank

Courtesy of Jack Van Horn

Big data…

fMRI Data Center – 1999-2007





http://www.fmridc.org

Courtesy of Jack Van Horn

Big data…

Neuroimaging Data Resources

COLLABORATIVEINFORMATICS
INS
NEUROIMAGINGSUITE

OpenfMRI

XNAT

debian

NITRC
Listed

DATASPACE
BETA

NDAR National Database for Autism Research
Serving the autism research community

LORIS

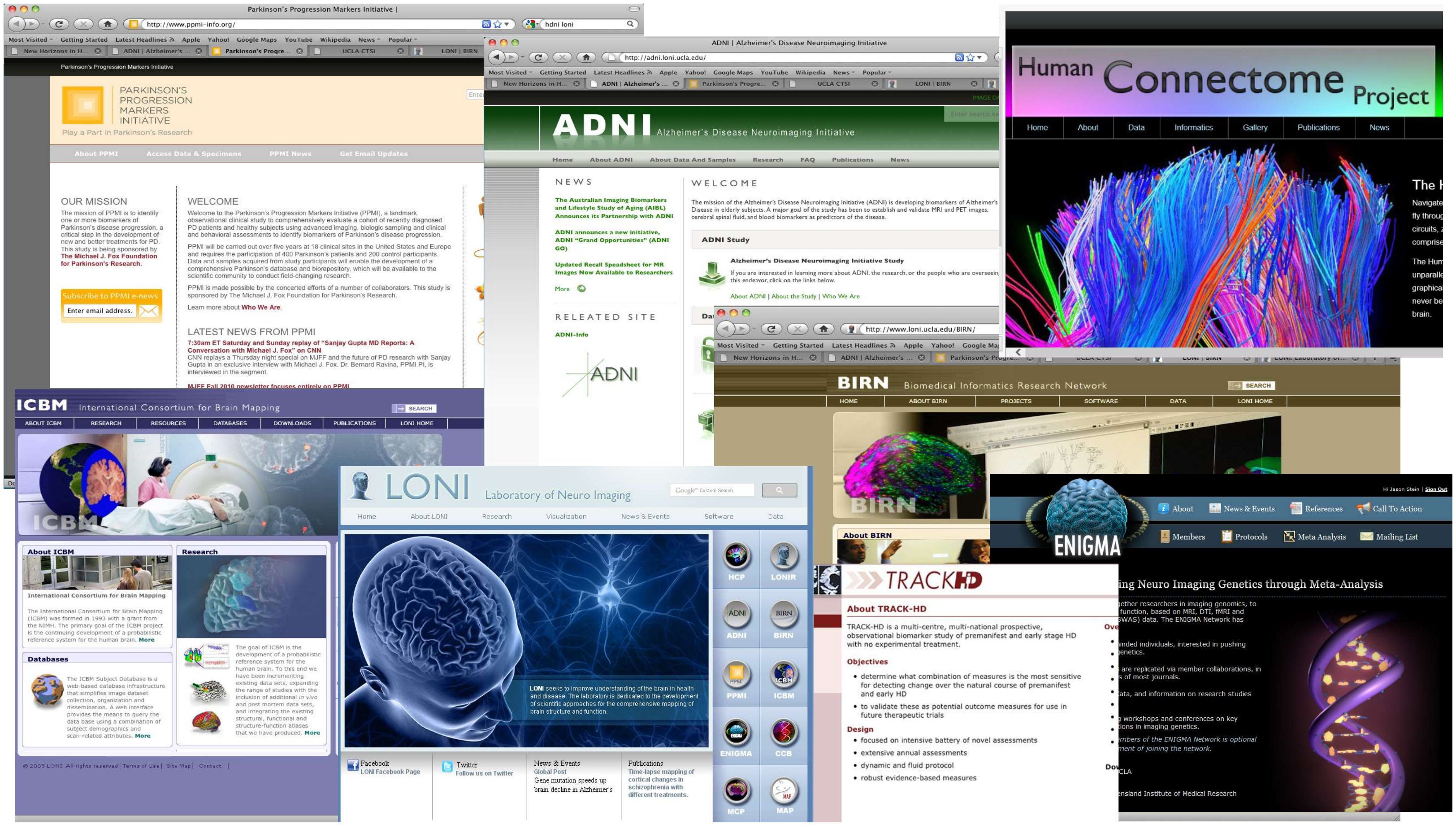
Human Connectome Project

HUMAN
Connectome
PROJECT

FITBIR
Federal Interagency Traumatic Brain Injury Research
INFORMATICS SYSTEM

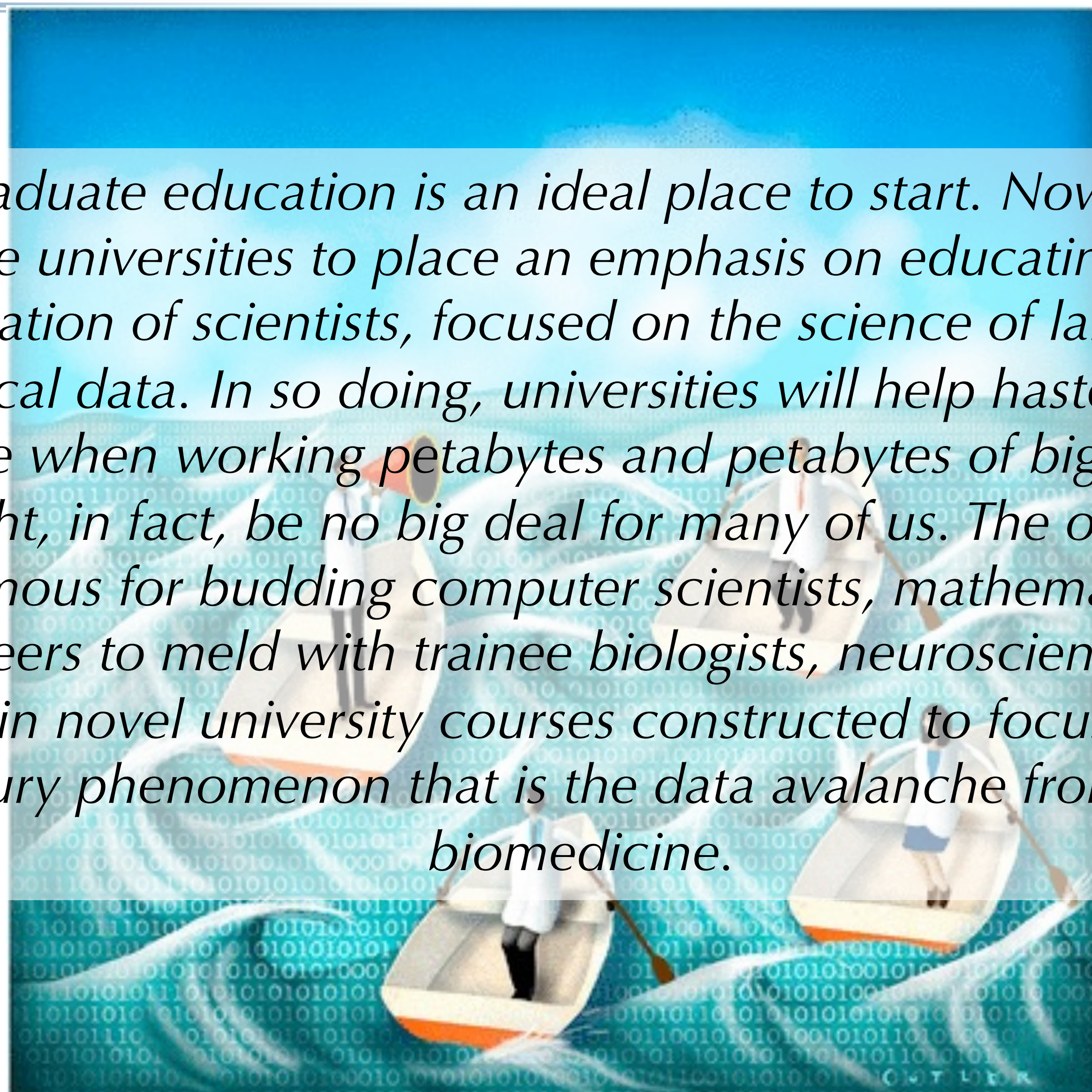
Courtesy of Jack Van Horn

Big data…



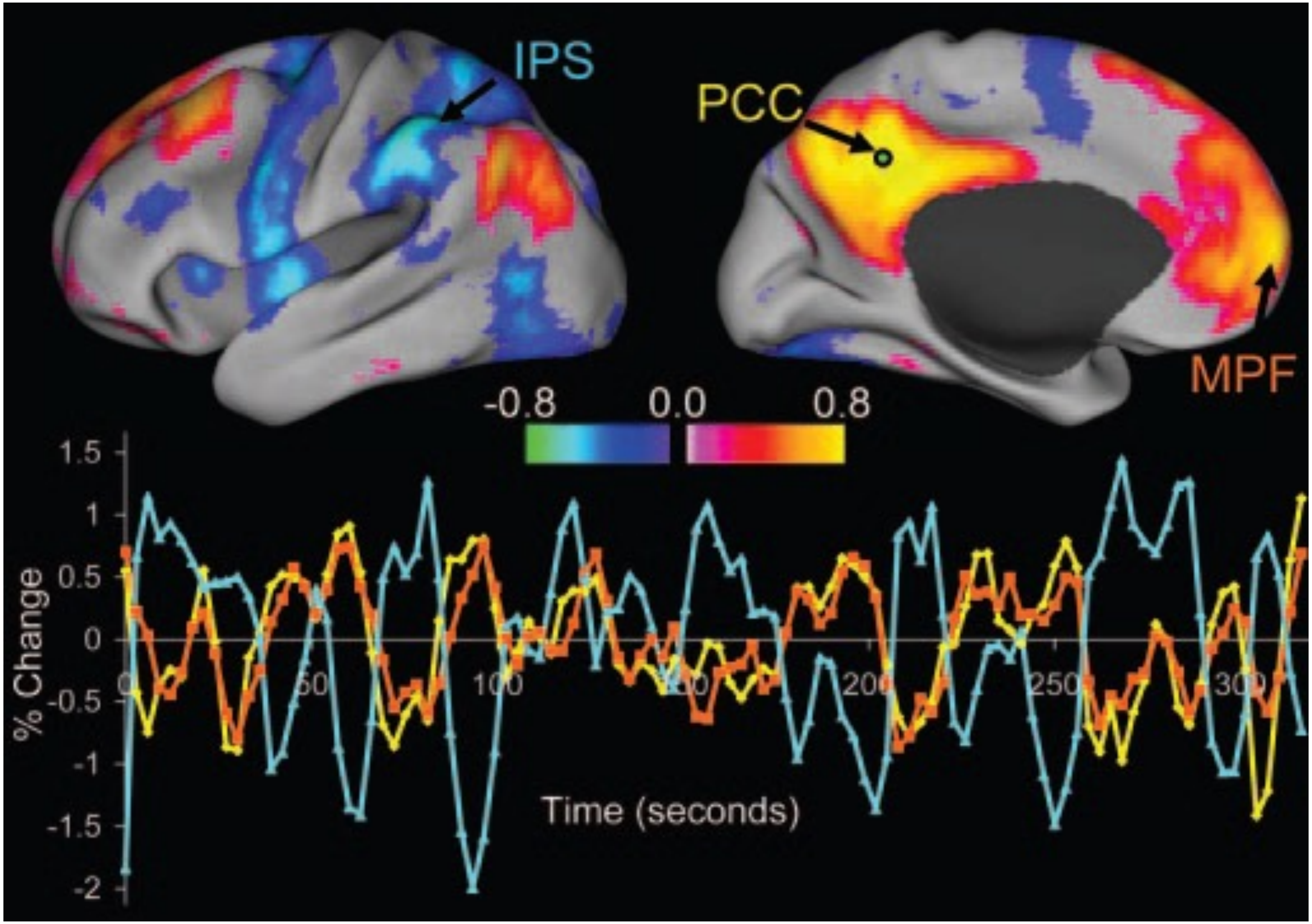
Courtesy of Jack Van Horn

Big data…



Undergraduate education is an ideal place to start. Now is the time for more universities to place an emphasis on educating this new generation of scientists, focused on the science of large-scale biomedical data. In so doing, universities will help hasten a time in the future when working petabytes and petabytes of big biomedical data might, in fact, be no big deal for many of us. The opportunities are enormous for budding computer scientists, mathematicians, and engineers to meld with trainee biologists, neuroscientists, and clinicians in novel university courses constructed to focus on the truly 21st century phenomenon that is the data avalanche from large-scale biomedicine.

Spontaneous brain activity as a validation tool?



Perspective: Brain scans need a rethink

Ben Deen & Kevin Pelphrey

Affiliations | Corresponding author

Nature **491**, S20 (01 November 2012) | doi:10.1038/491S20a
Published online 31 October 2012

PDF | Citation | Reprints | Rights & permissions | Article metrics

Head movement can bias brain imaging results, undermining a leading theory on the cause of autism, say Ben Deen and Kevin Pelphrey.

One of the most popular and widely accepted theories on the cause of autism spectrum disorders attributes the condition to disrupted connectivity between different regions of the brain. This 'connectivity hypothesis' claims that the social and cognitive a
can be explained by a dearth of connections between distant
of this theory also predict more connections between nearby

ANNALS *of* THE NEW YORK ACADEMY OF SCIENCES

Original Article

Measuring neural representations with fMRI: practices and pitfalls

Tyler Davis[1,*], Russell A. Poldrack[1,2,3,4]

Article first published online: 5 JUN 2013

DOI: 10.1111/nyas.12156

Issue

Annals of the New York Academy of Sciences

Early View (Online Version of Record published before inclusion in an issue)

ORIGINAL RESEARCH ARTICLE

Front. Hum. Neurosci., 13 February 2015 | http://dx.doi.org/10.3389/fnhum.2015.00071

Love-related changes in the brain: a resting-state functional magnetic resonance imaging study

Hongwen Song[1†], Zhiling Zou[1*†], Juan Kou[1], Yang Liu[1], Lizhuang Yang[2], Anna Zilverstand[3], Federico d'Oleire Uquillas[3] and Xiaochu Zhang[2,4,5*]

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[2]CAS Key Laboratory of Brain Function & Disease, School of Life Sciences, University of Science and Technology of China, Anhui, China

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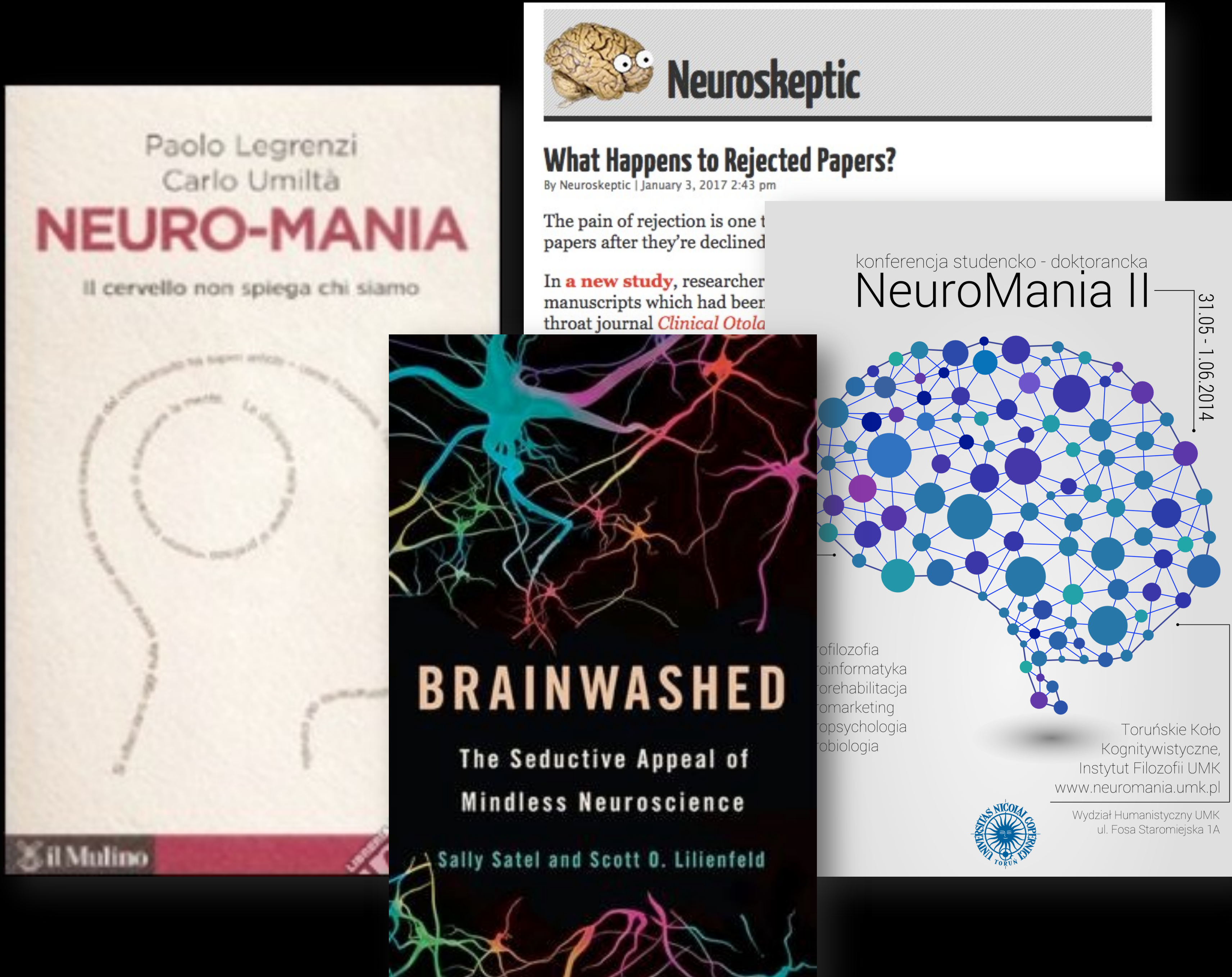
[4]CAS Center of Medical Physics and Technology, University of Science and Technology of China, Anhui, China

[5]School of Humanities and Social Science, University of Science and Technology of China, Anhui, China

Romantic love is a motivational state associated with a desire to enter or maintain a close relationship with a specific other person. Functional magnetic resonance imaging (fMRI) studies have found activation increases in brain regions involved in the processing of reward, motivation and emotion regulation, when romantic lovers view photographs of their partners. However, not much is known about whether romantic love affects the brain's functional architecture during rest. In the present study, resting state functional magnetic resonance imaging (rsfMRI) data was collected to compare the regional homogeneity (ReHo) and functional connectivity (FC) across an "in-love" group (LG, $N = 34$, currently intensely in love), an "ended-love" group (ELG, $N = 34$, ended romantic relationship recently), and a "single" group (SG, $N = 32$, never fallen in love). Results show that: (1) ReHo of the left dorsal anterior cingulate cortex (dACC) was significantly increased in the LG (in comparison to the ELG and the SG); (2) ReHo of the left dACC was positively correlated with length of time in love in the LG, and negatively correlated with the lovelorn duration since breakup in the ELG; (3) FC within the reward, motivation, and emotion regulation network (dACC, insula, caudate, amygdala, and nucleus accumbens) as well as FC in the social cognition network [temporo-parietal junction (TPJ), posterior cingulate cortex (PCC), medial prefrontal cortex (MPFC),


Paolo Legrenzi
Carlo Umiltà
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Il cervello non spiega chi siamo
il Mulino
Neuroskeptic
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By Neuroskeptic | January 3, 2017 2:43 pm
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papers after they're declined
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manuscripts which had beer
throat journal Clinical Otola
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The Seductive Appeal of
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Sally Satel and Scott O. Lilienfeld
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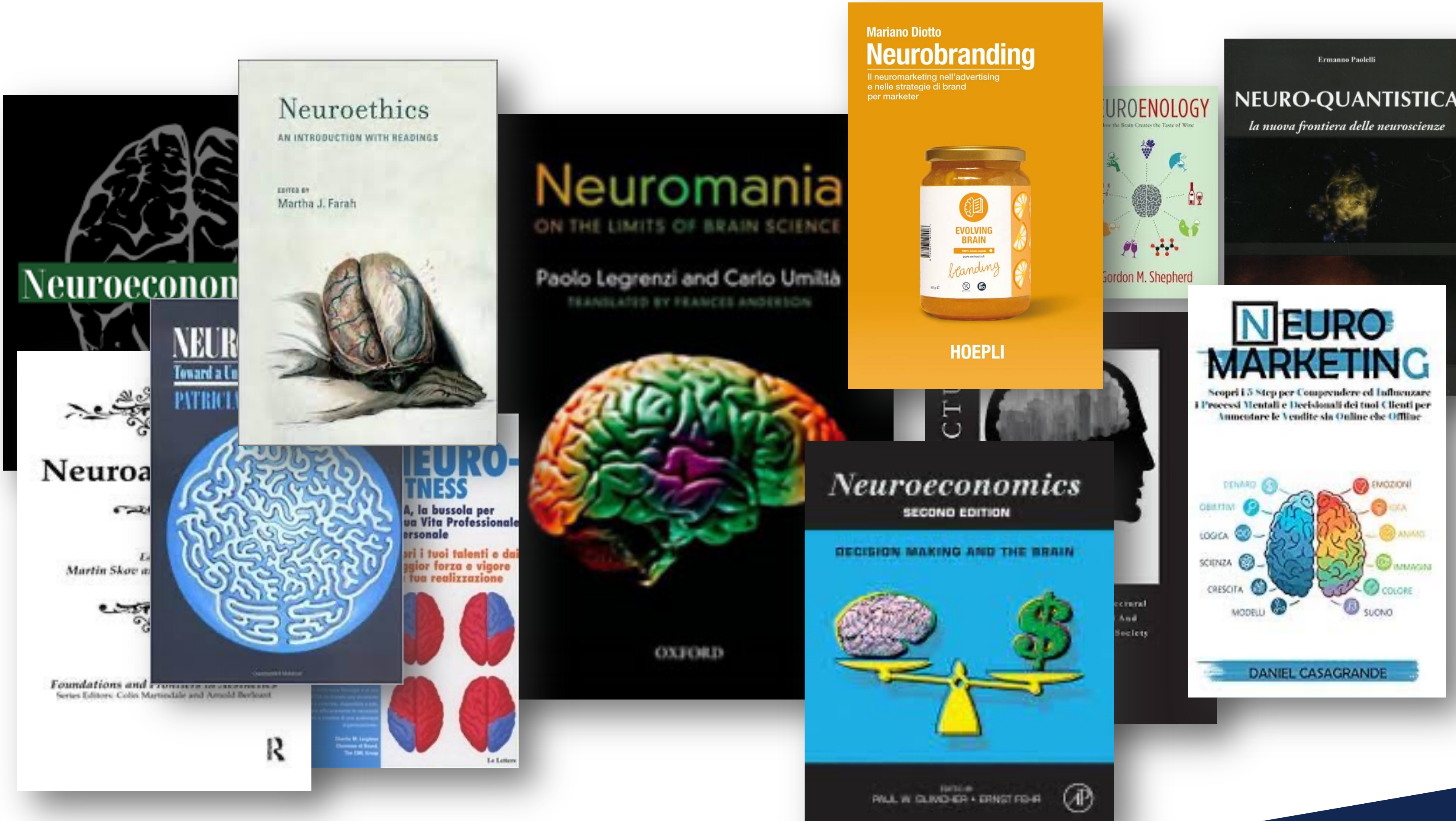
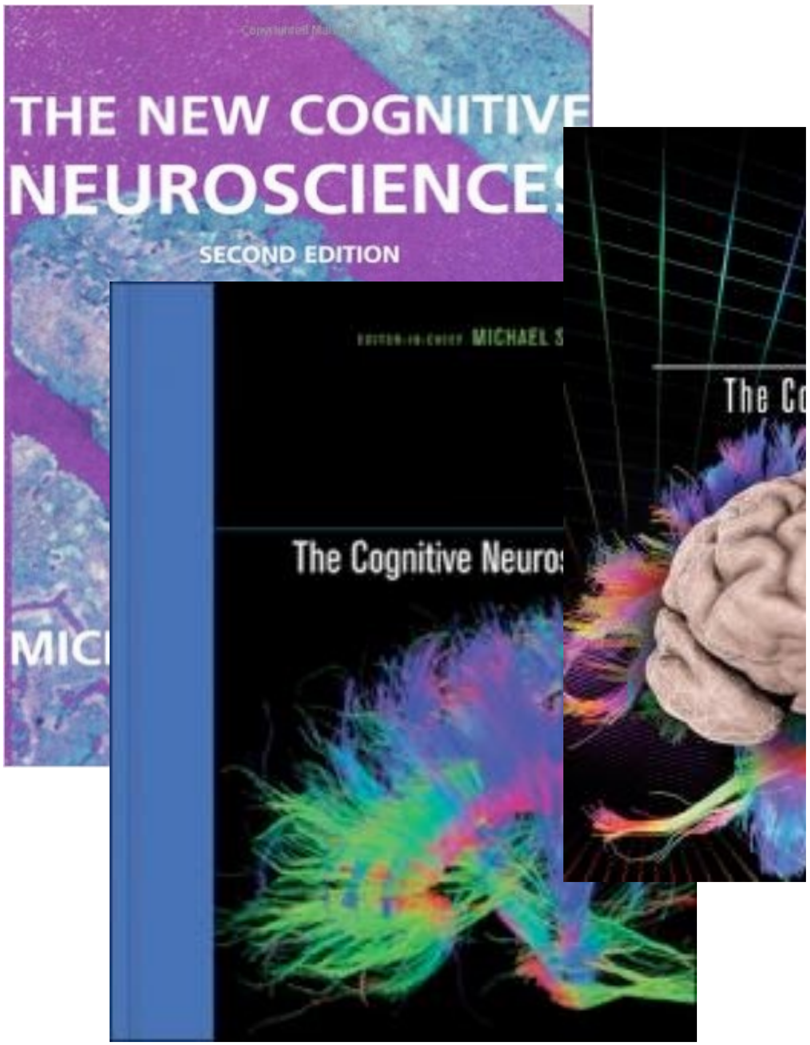
'Neuro-disciplines'?

Neuroscience contaminating



SCUOLA
IMT ALTI STUDI
LUCCA

Cognitive Neuroscience



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