



Attività Didattica Elettiva  
Anno Accademico 2007-2008

Corso di Formazione ECM



## Neuroimaging funzionale in psichiatria

(1)

*FMRI e tecniche di imaging di risonanza magnetica:  
aspetti clinici e tecnici*

# Benvenuti

Massimo Piccirilli

## Dal *cervello* alla *mente*

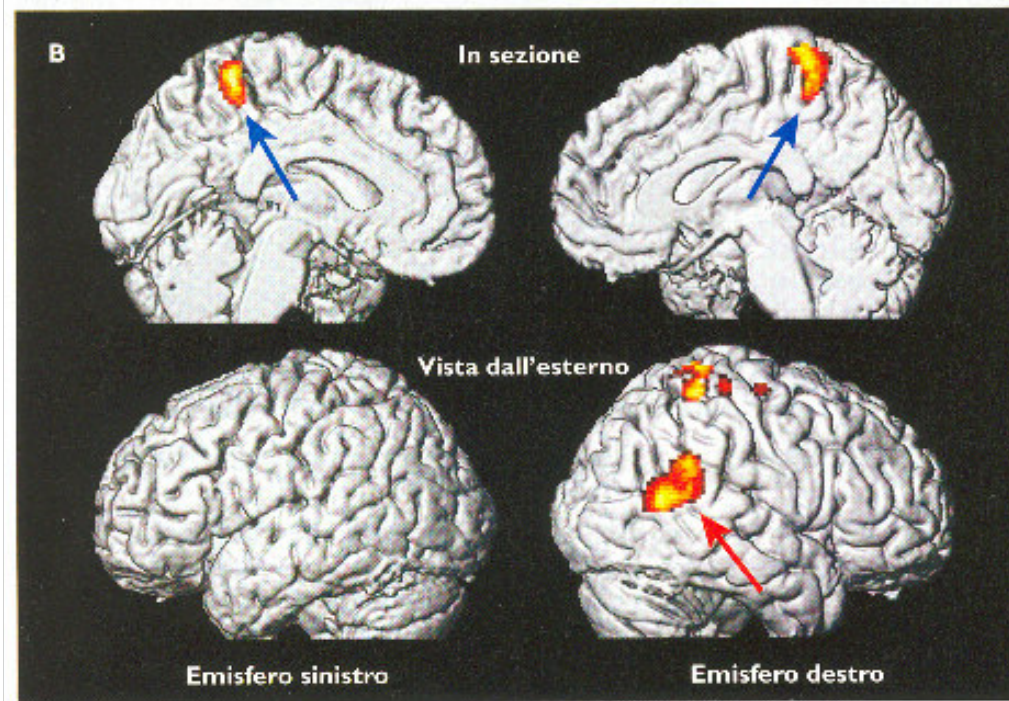
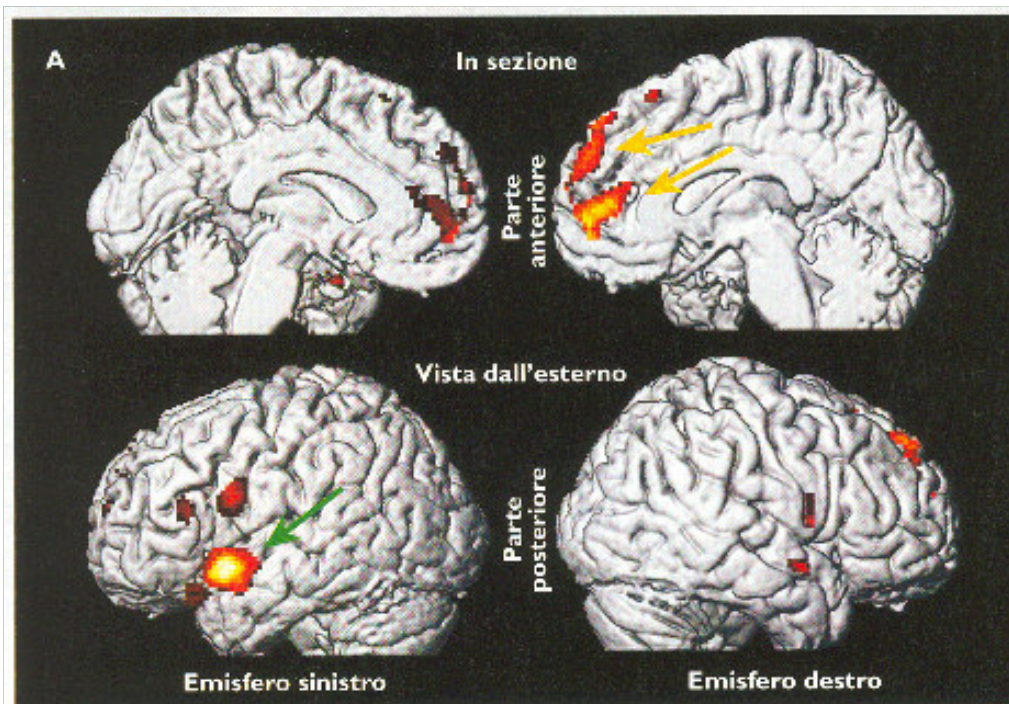
*appunti di neuropsicologia*



Morlacchi Editore

## Introduzione

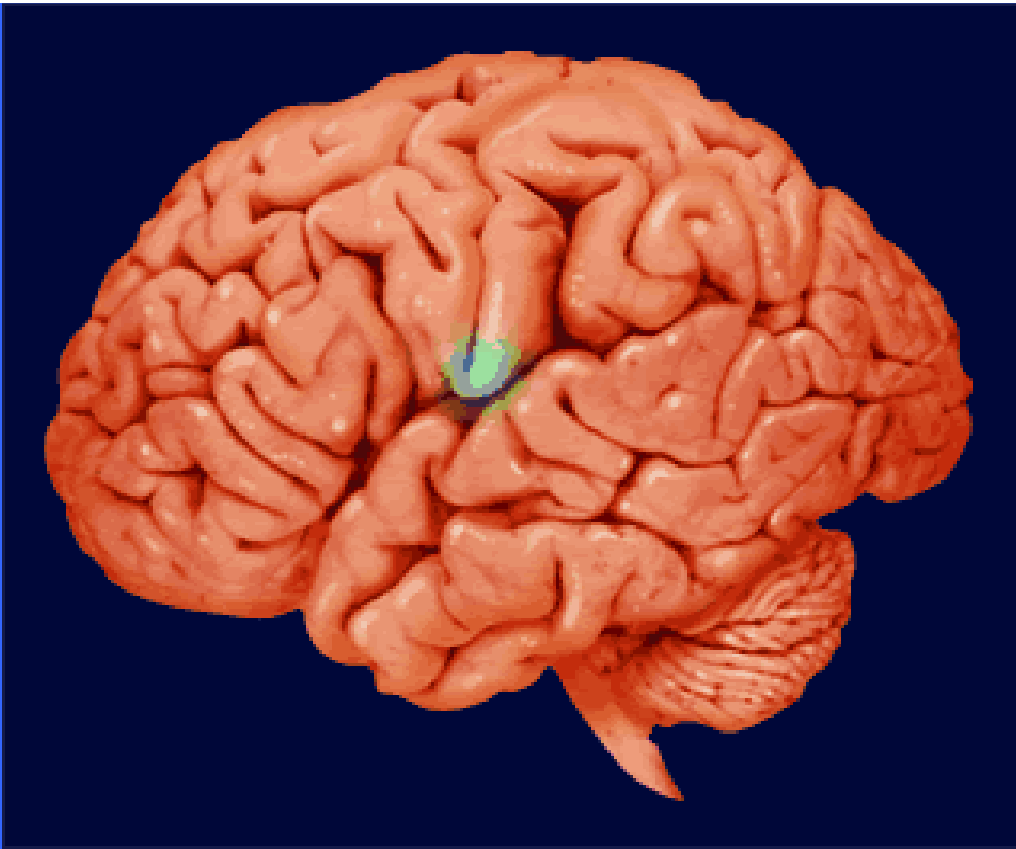
[www.dalcervelloallamente.com](http://www.dalcervelloallamente.com)



Michael Posner  
ha paragonato l'impatto delle  
neuroimmagini funzionali  
sulle neuroscienze  
a quello del telescopio  
sull'astronomia:

diventa possibile osservare  
direttamente  
ciò che poteva soltanto essere  
intuito ed ipotizzato  
basandosi su dati indiretti.

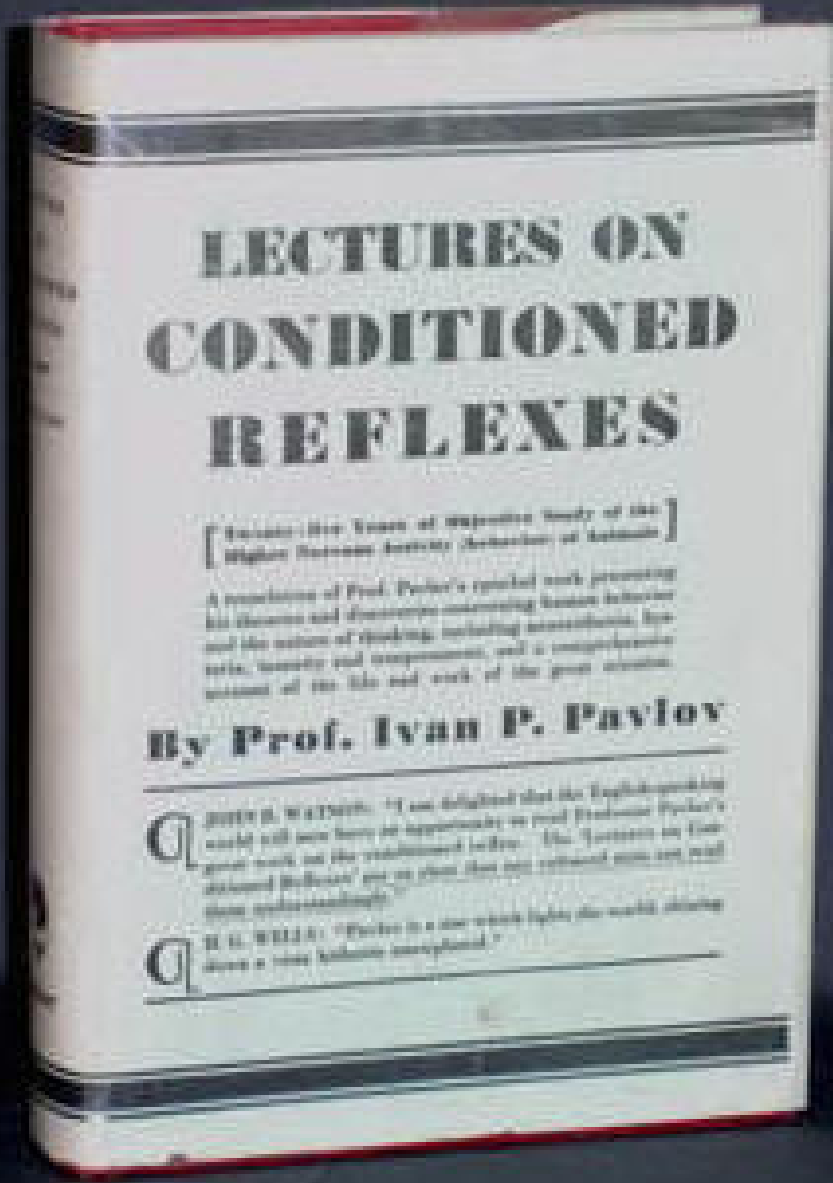




Thomas Stern Eliot  
nel poema “The love  
song of F. Alfred  
Prufrock”, describe  
il timido Prufrock  
che di fronte alla donna  
che ama si trova  
improvvisamente senza  
parole  
 (“mi riesce impossibile  
dire ciò che sento”)

e immagina che, invece di faticare per dire esattamente ciò che  
pensa, sarebbe stato possibile mostrare i lampi dell’attività  
mentale corrispondenti ai suoi pensieri

“come se una *lanterna magica*  
proiettasse i nervi in immagini su uno schermo”



# LECTURES ON CONDITIONED REFLEXES

[Second-Year Course of Dispositive Study of the  
Higher Nervous Activity (Behavior) of Animals]

A translation of Prof. Pavlov's original work presenting  
his theories and discoveries concerning human behavior  
and the nature of thinking, including consciousness, in-  
stincts, memory and imagination, and a comprehensive  
account of the life and work of the great scientist.

By Prof. Ivan P. Pavlov

Q. JOHN B. WATSON: "I am delighted that the English-speaking  
world will now have an opportunity to read Professor Pavlov's  
great work on the conditioned reflexes. The 'Lectures on Con-  
ditioned Reflexes' are in fact the first volume of a series which  
will be of great value."

Q. H. HALL: "Pavlov is a man whose light the world should  
have a more adequate knowledge of."

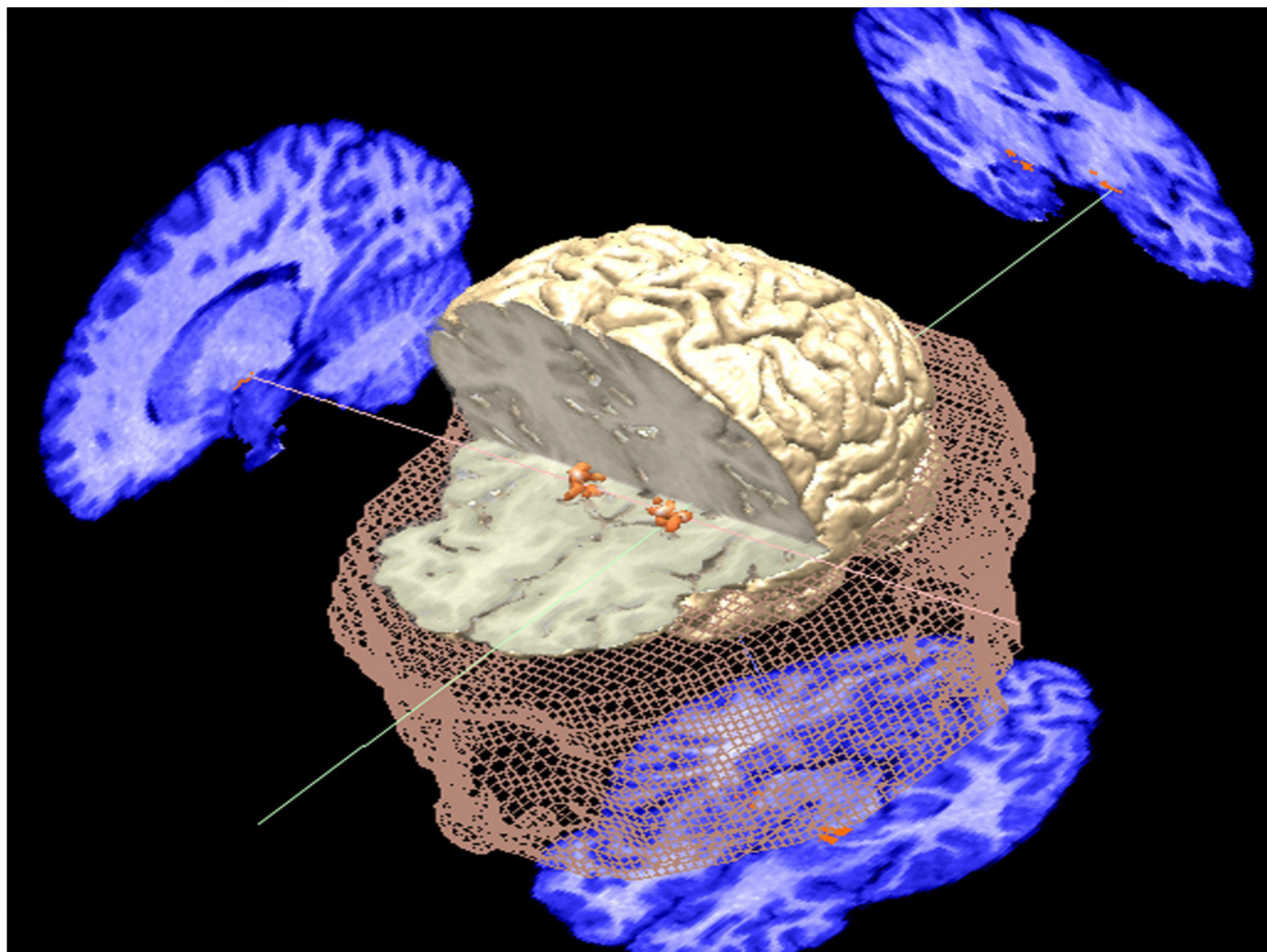
Se fosse possibile vedere  
attraverso la scatola cranica  
e se la zona maggiormente  
eccitata fosse luminosa,

si potrebbe seguire, in  
un uomo intento a pensare,

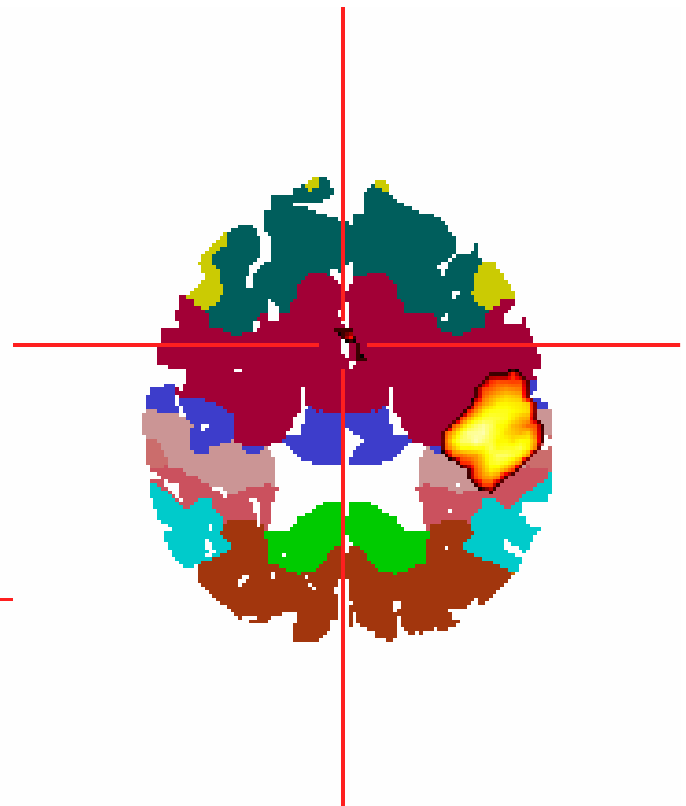
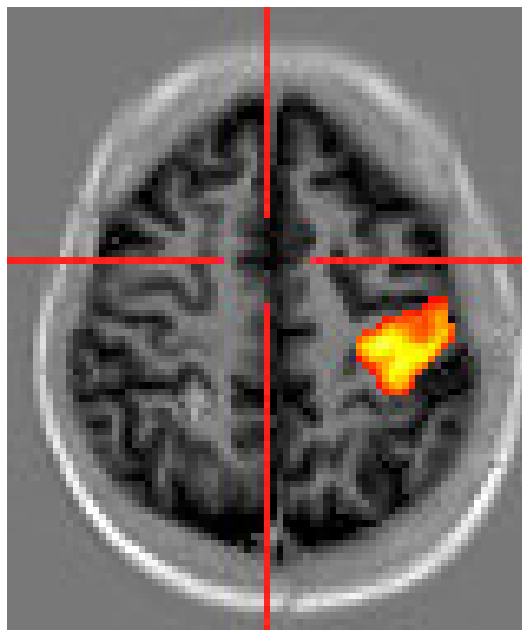
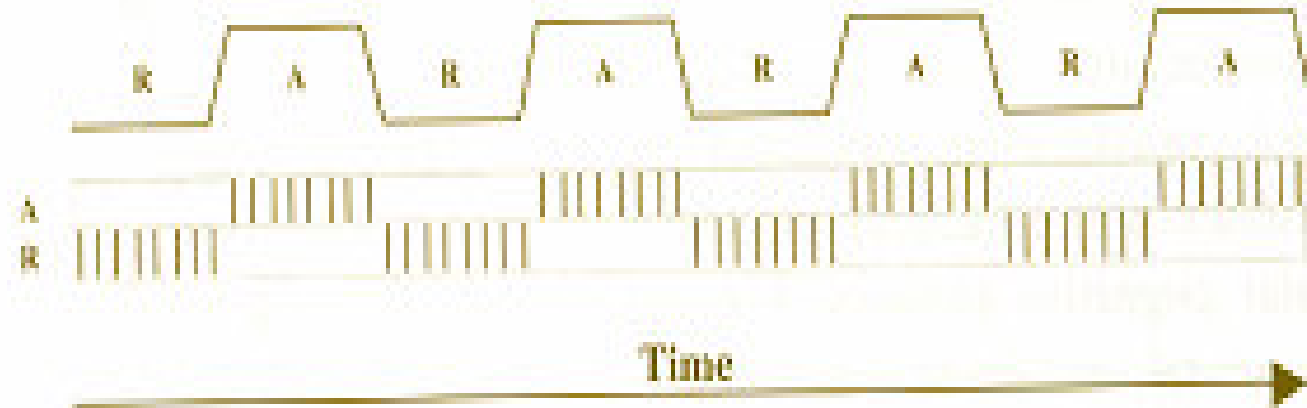
lo spostamento incessante  
di questo punto luminoso,

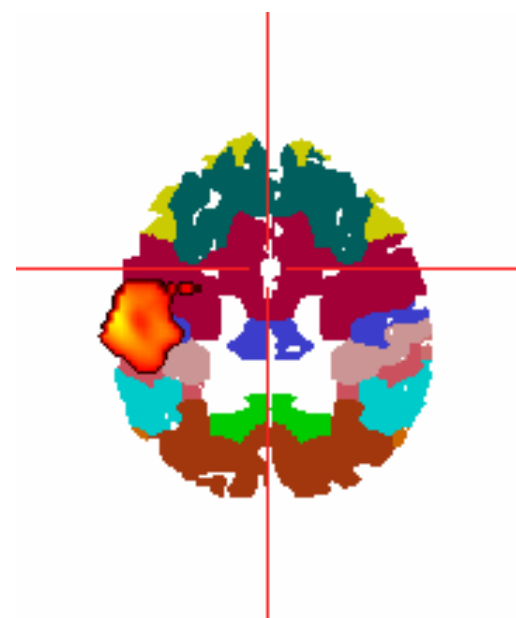
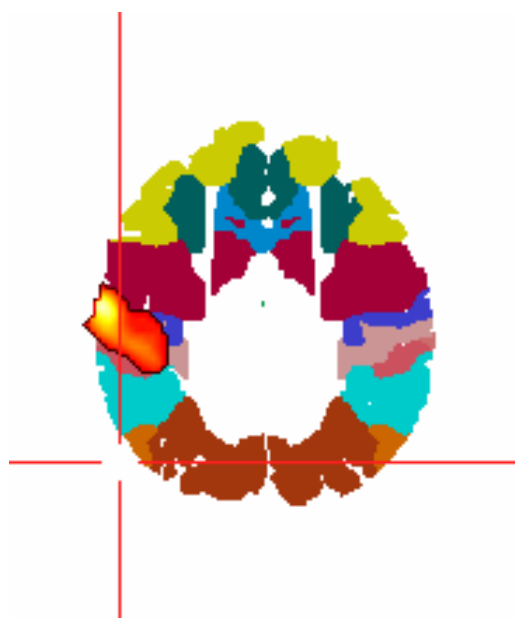
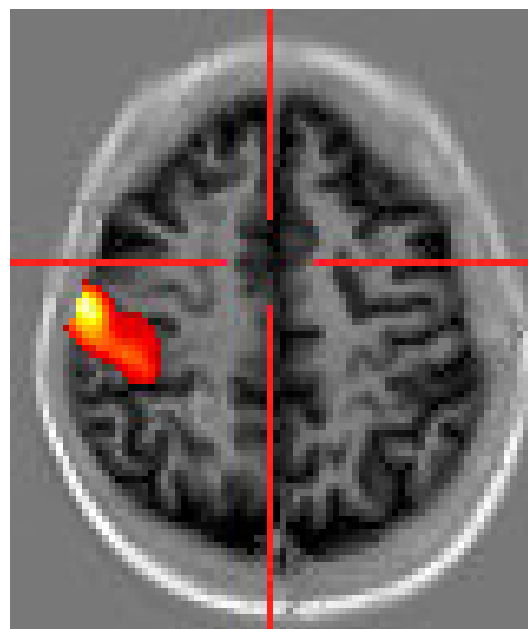
in un continuo cambiamento  
di forma e dimensione,  
e circondato da una zona  
d'ombra più o meno fitta  
che occuperebbe tutto  
il resto degli emisferi

(Ivan P Pavlov, 1927)

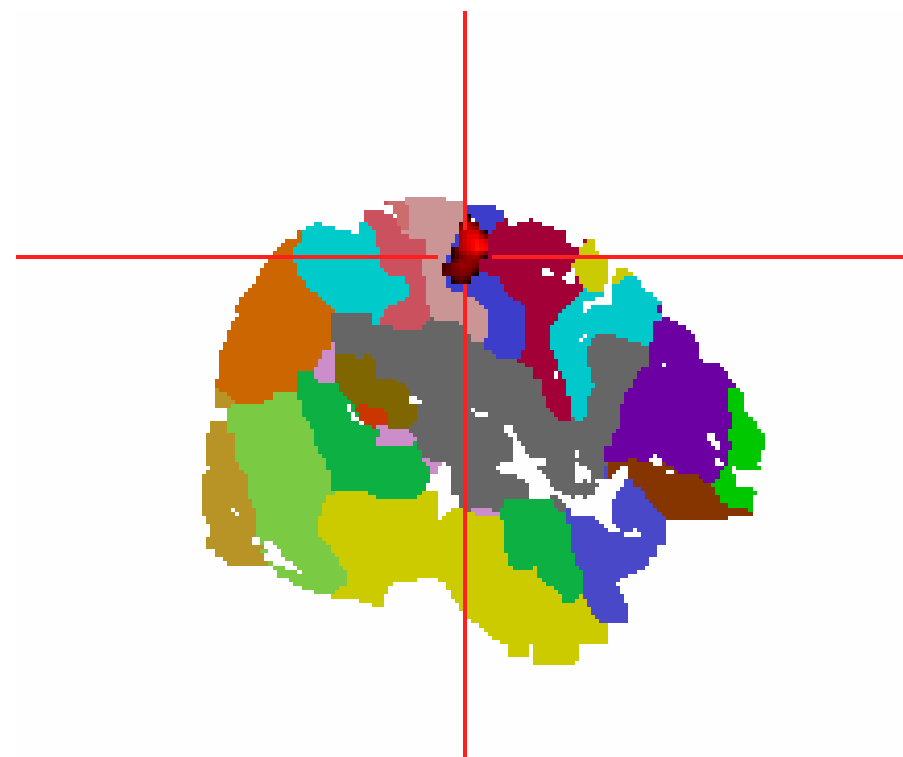
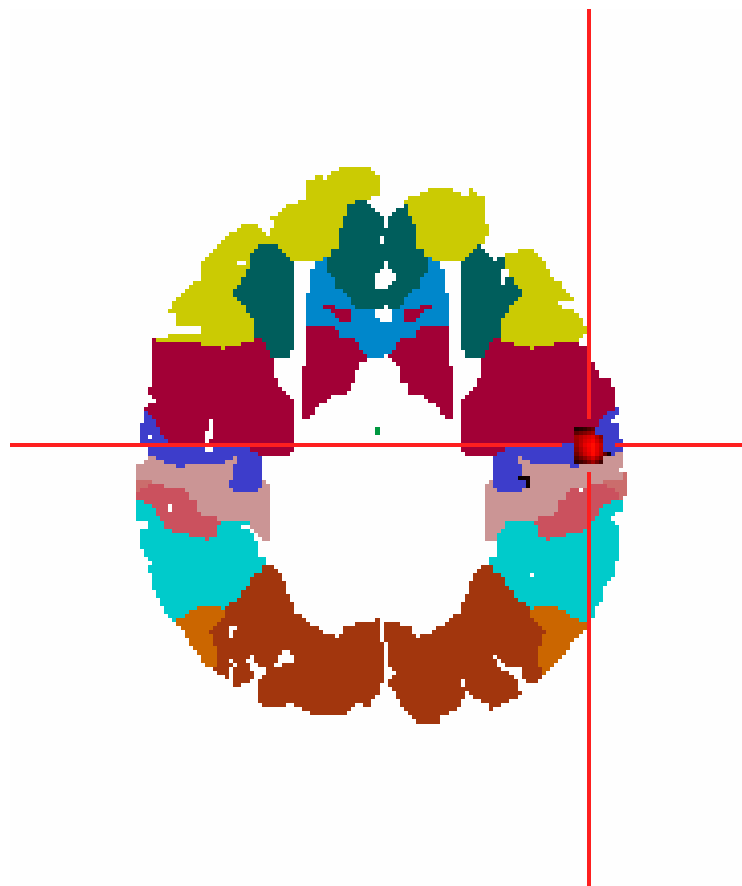


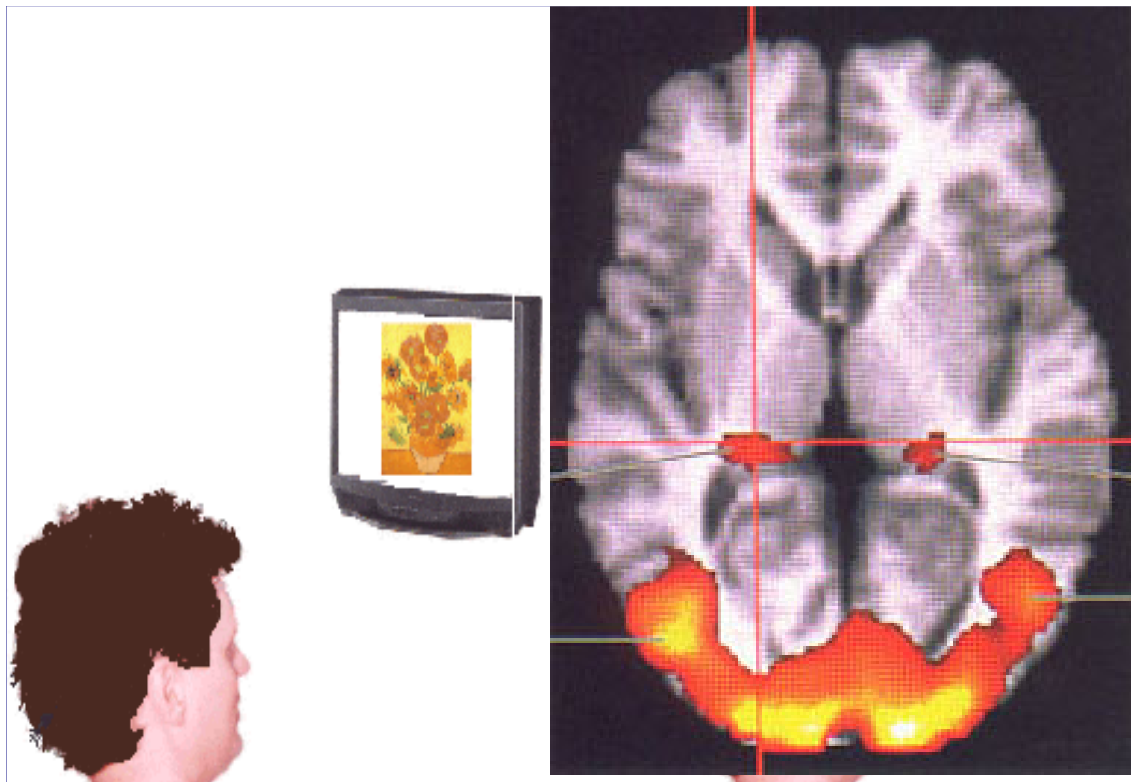
## Alternating Design









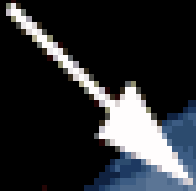


Ogni funzione richiede un sistema proprio: un sistema funzionale che serve per vedere non serve per camminare o per avvertire il dolore.

Le funzioni cognitive non hanno sede in un “centro nervoso” inteso come raggruppamento neuronale direttamente responsabile di una specifica funzione.

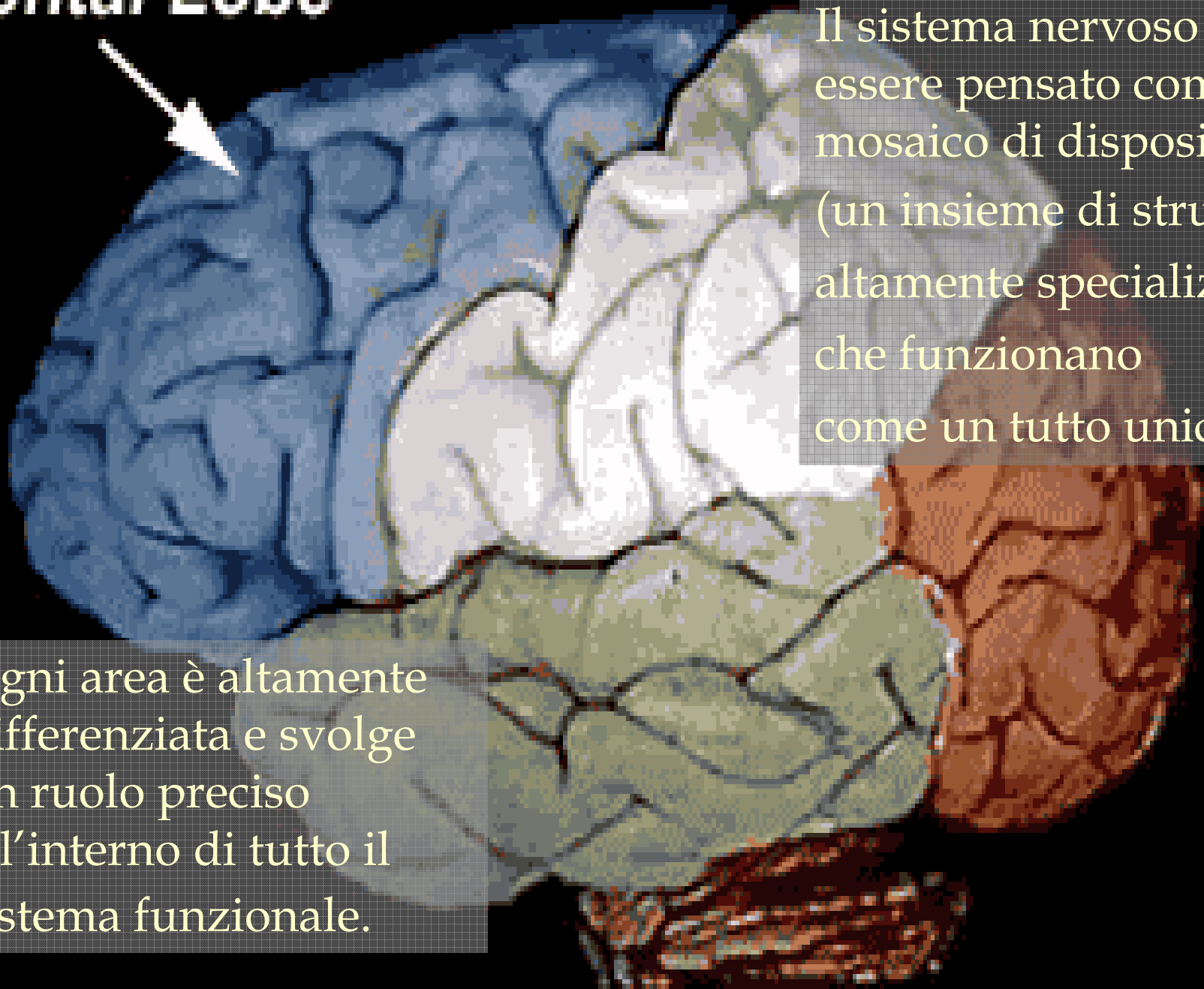
Per l'espletamento di qualunque processo mentale è necessario un intero sistema di aree corticali intimamente collegate tra loro, che lavorano in sintonia e si integrano.

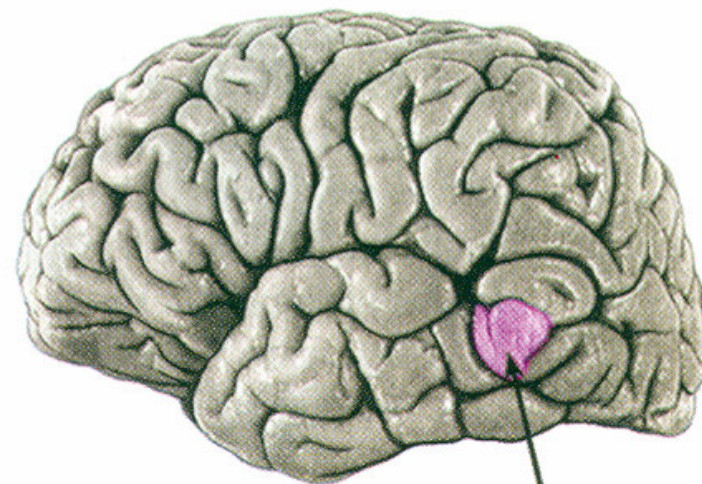
# Frontal Lobe



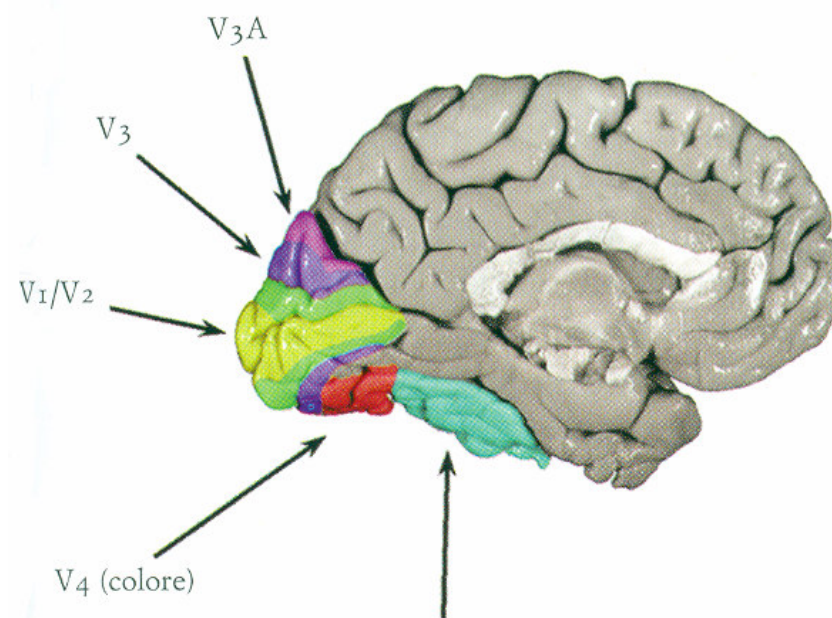
Il sistema nervoso può essere pensato come un mosaico di dispositivi (un insieme di strutture altamente specializzate) che funzionano come un tutto unico

Ogni area è altamente differenziata e svolge un ruolo preciso all'interno di tutto il sistema funzionale.





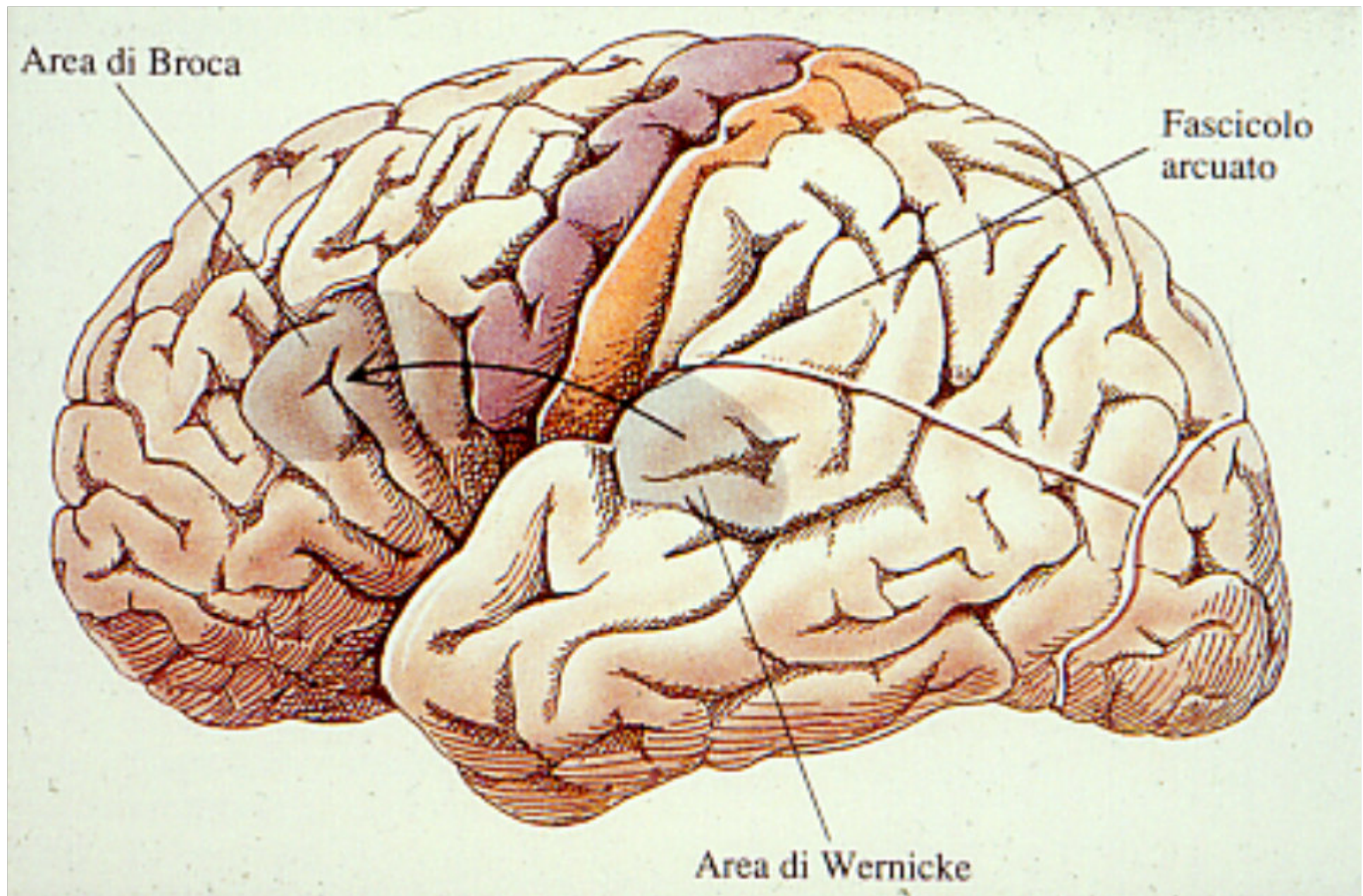
V<sub>5</sub> (movimento)



Aree del riconoscimento  
dei volti e degli oggetti







**“Nous parlons avec l’hémisphère gauche!” (P. Broca)**

# Fluenza verbale

generazione di

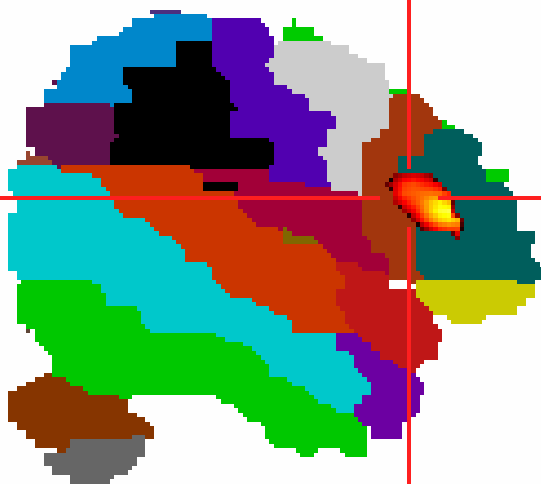
stimolo

suggerimento

parole  
verbi  
frasi  
....

acustico  
visivo  
.....

categoria semantica  
lettera iniziale  
.....

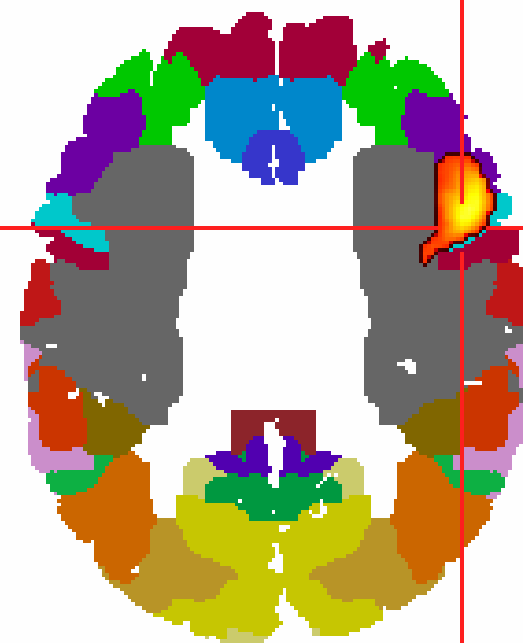


Frutta

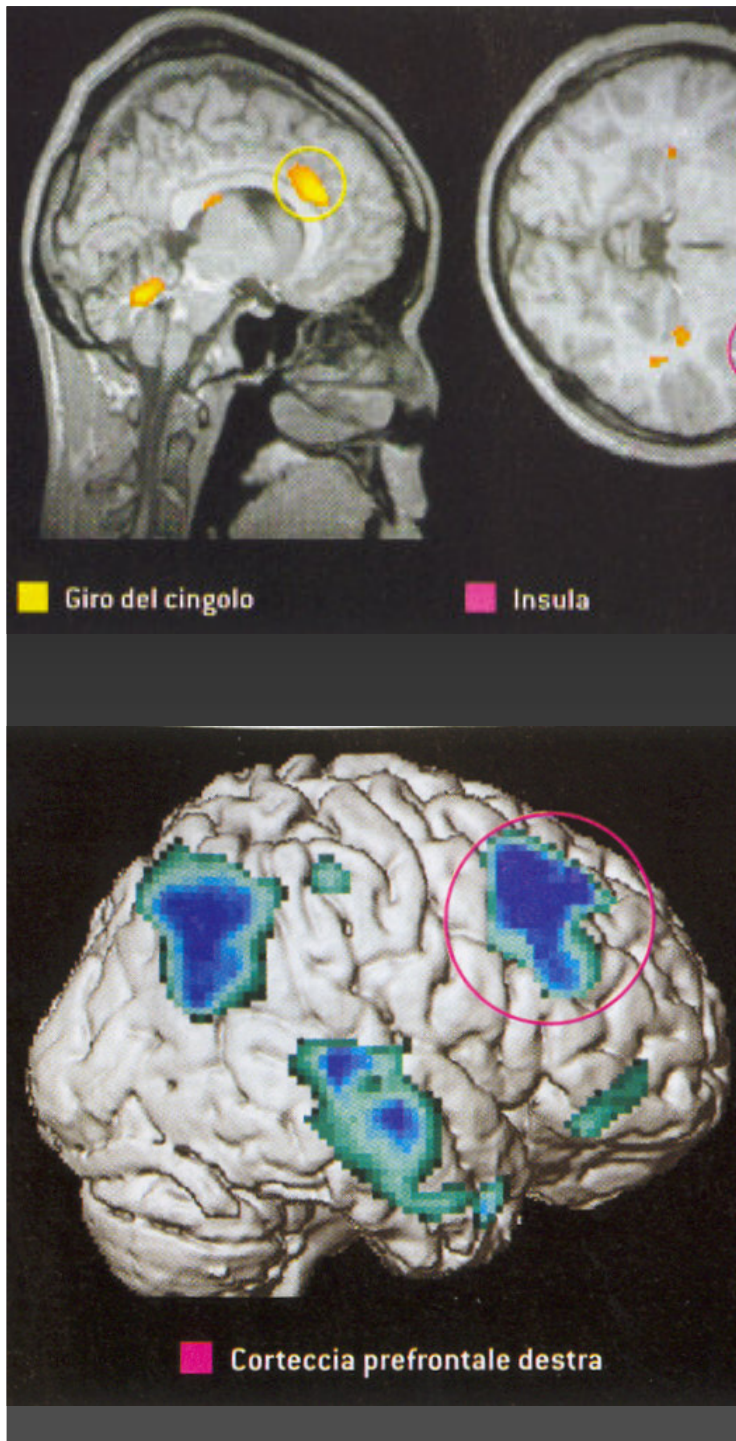
mela  
pera  
banana  
.....

Animali

cane  
gatto  
.....



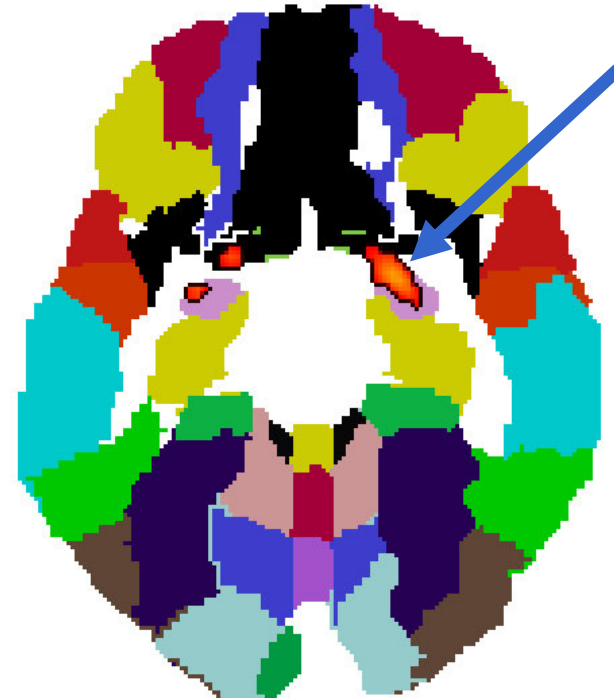
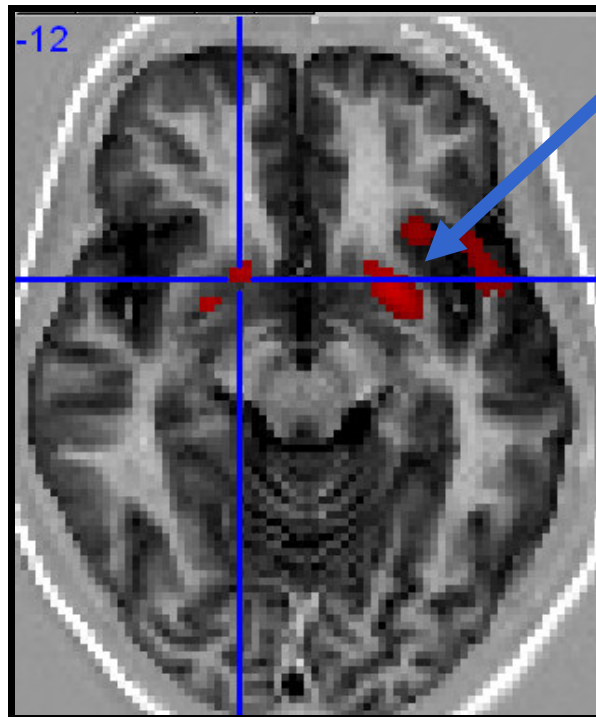
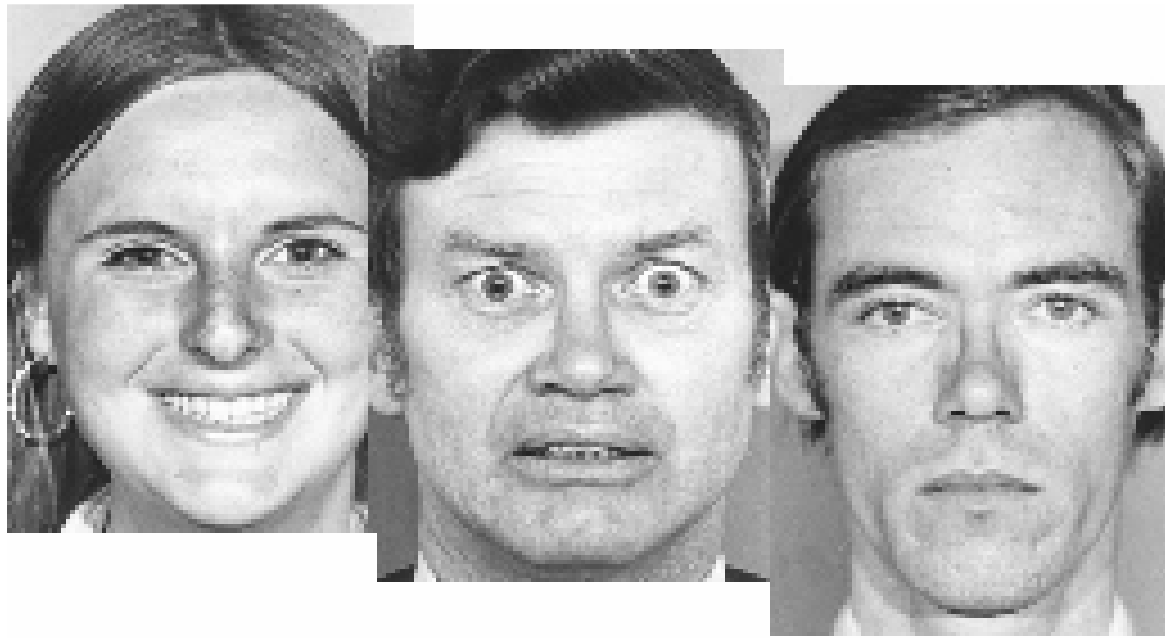


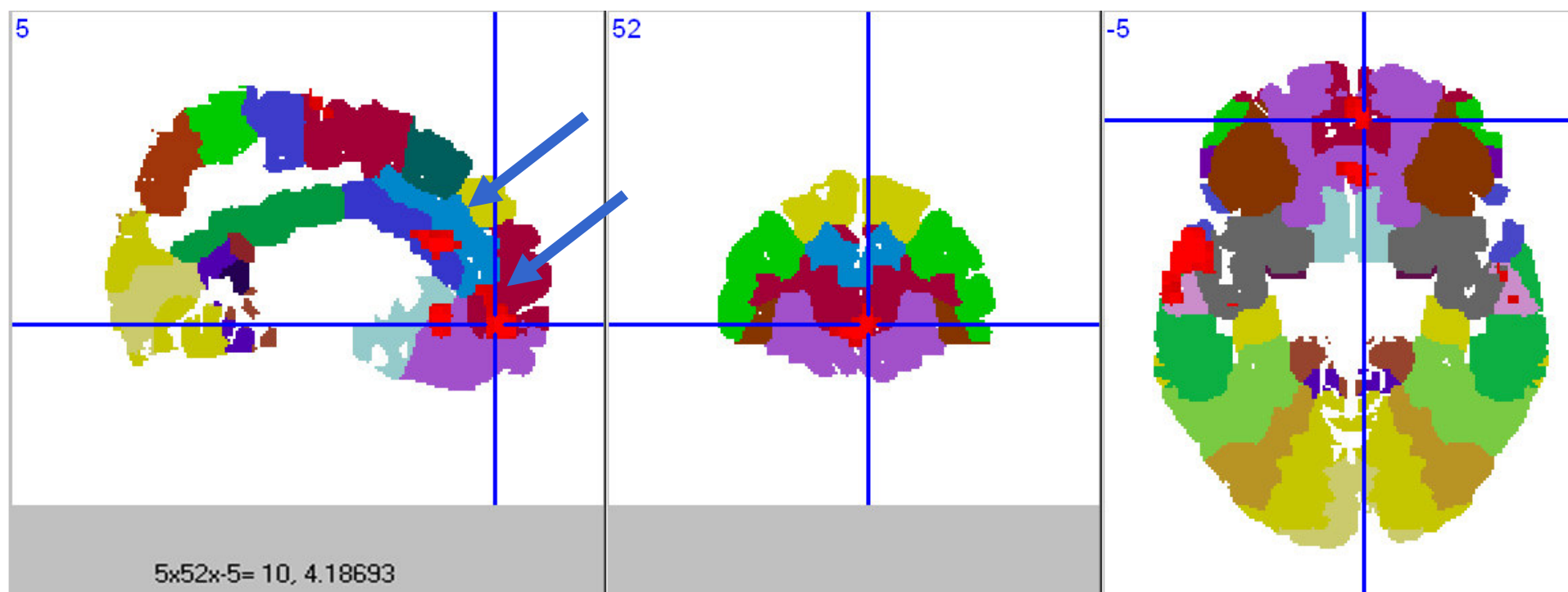


The neural basis of romantic love

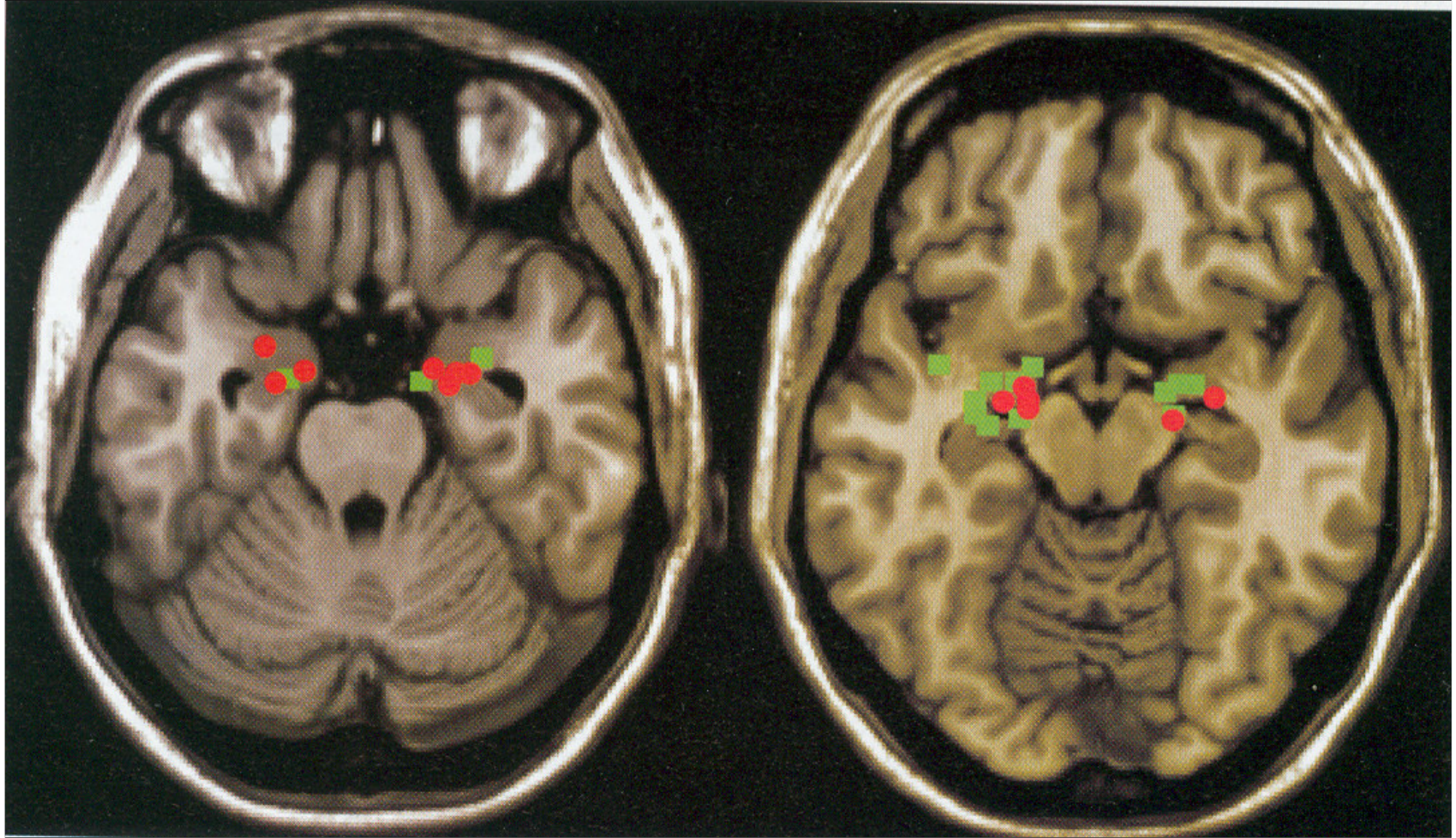
A Bartels e S Zeki, 2000













# Valori morali

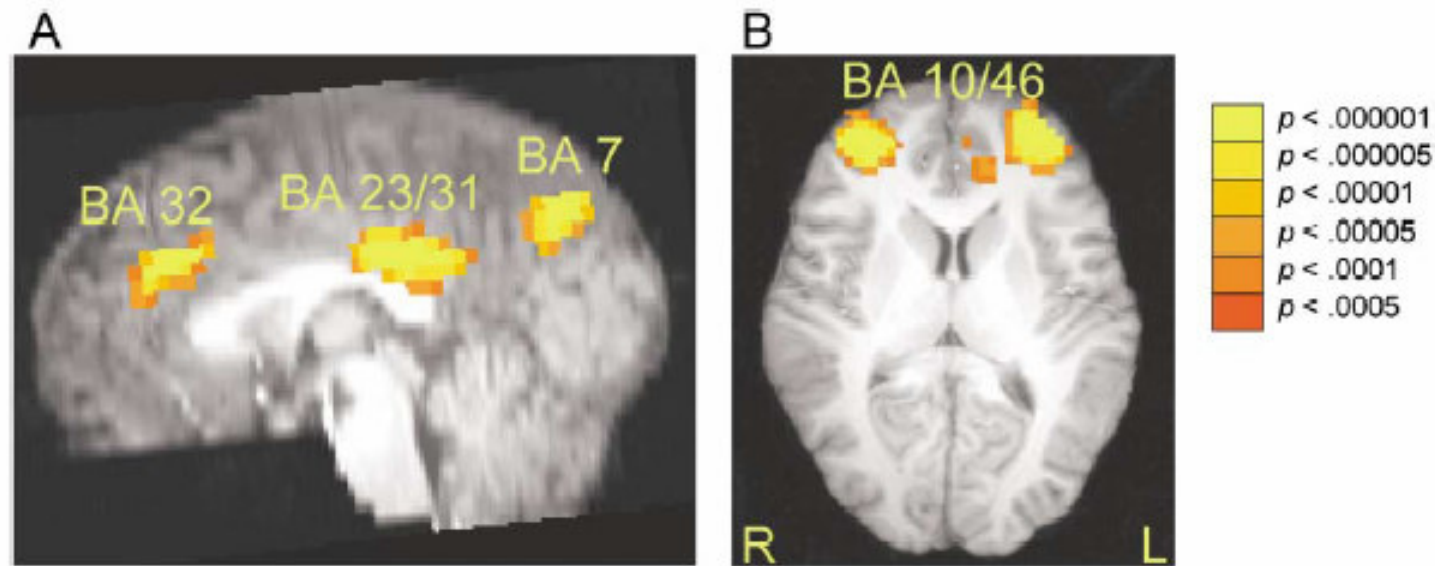
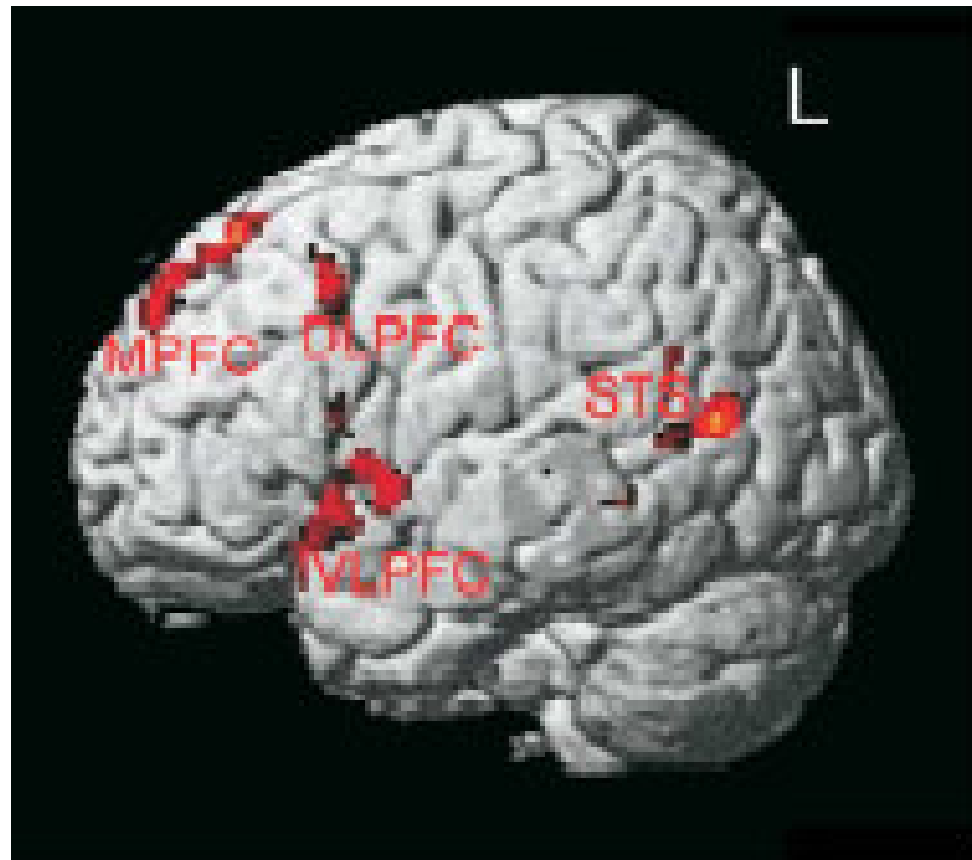


Figure 2. Difficult versus Easy Personal Moral Judgment

Selected brain regions (see Table 2) exhibiting significantly increased activity for difficult (high-RT), as compared to easy (low-RT), personal moral judgment: anterior cingulate cortex (BA 32), posterior cingulate cortex (BA 23/31), precuneus (BA 7), right and left middle frontal gyrus (BA 10/46). Statistical maps of voxelwise t scores were thresholded for significance ( $p < 0.0005$ ) and cluster size ( $\geq 8$  voxels). (A) Sagittal slice plane is  $x = 0$ ; (B) axial slice plane is  $z = +9$  (Talairach and Tournoux, 1988). Image is reversed right to left according to radiologic convention.




# Menzogna



Bloccare la risposta automatica per produrre la menzogna

# Human

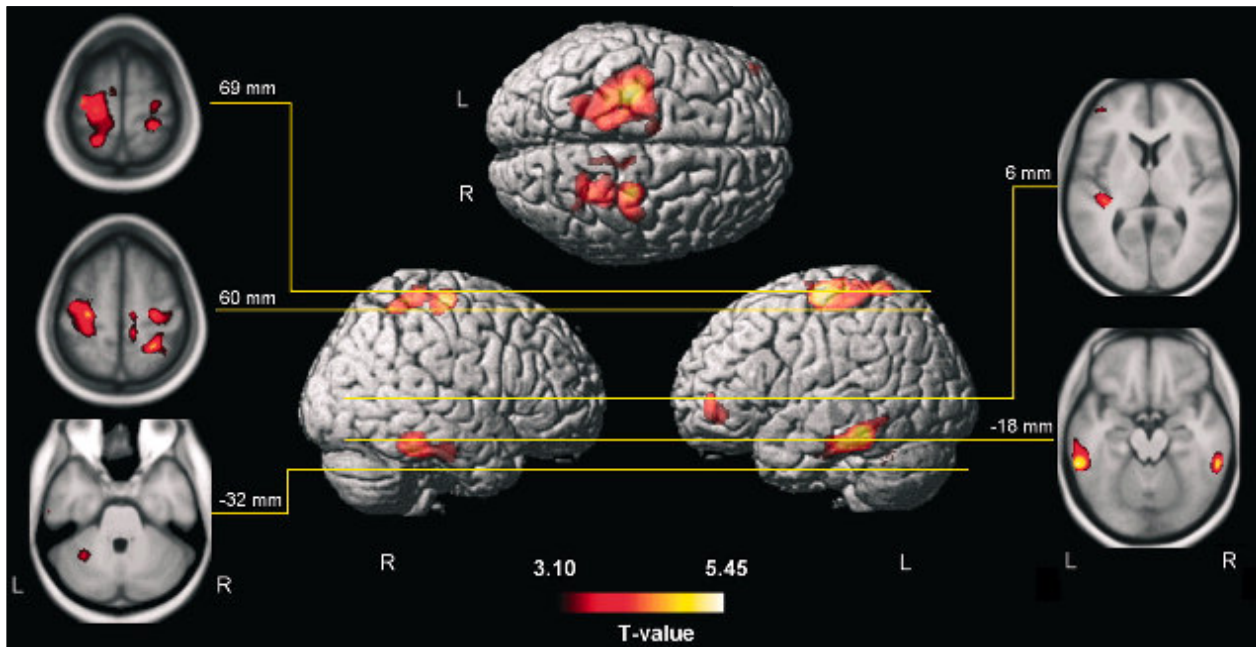
## *Homo sapiens sapiens*



“Nei centri cerebrali dell’adulto i percorsi nervosi sono qualcosa di fissato, stabilito, immutabile.  
**Tutto può morire, nulla può essere rigenerato.”**

Santiago Ramon y Cajal, 1914

*(Estudios sobre la degeneration y regeneration del sistema nervioso)*



## Brain Structures Differ between Musicians and Non-Musicians

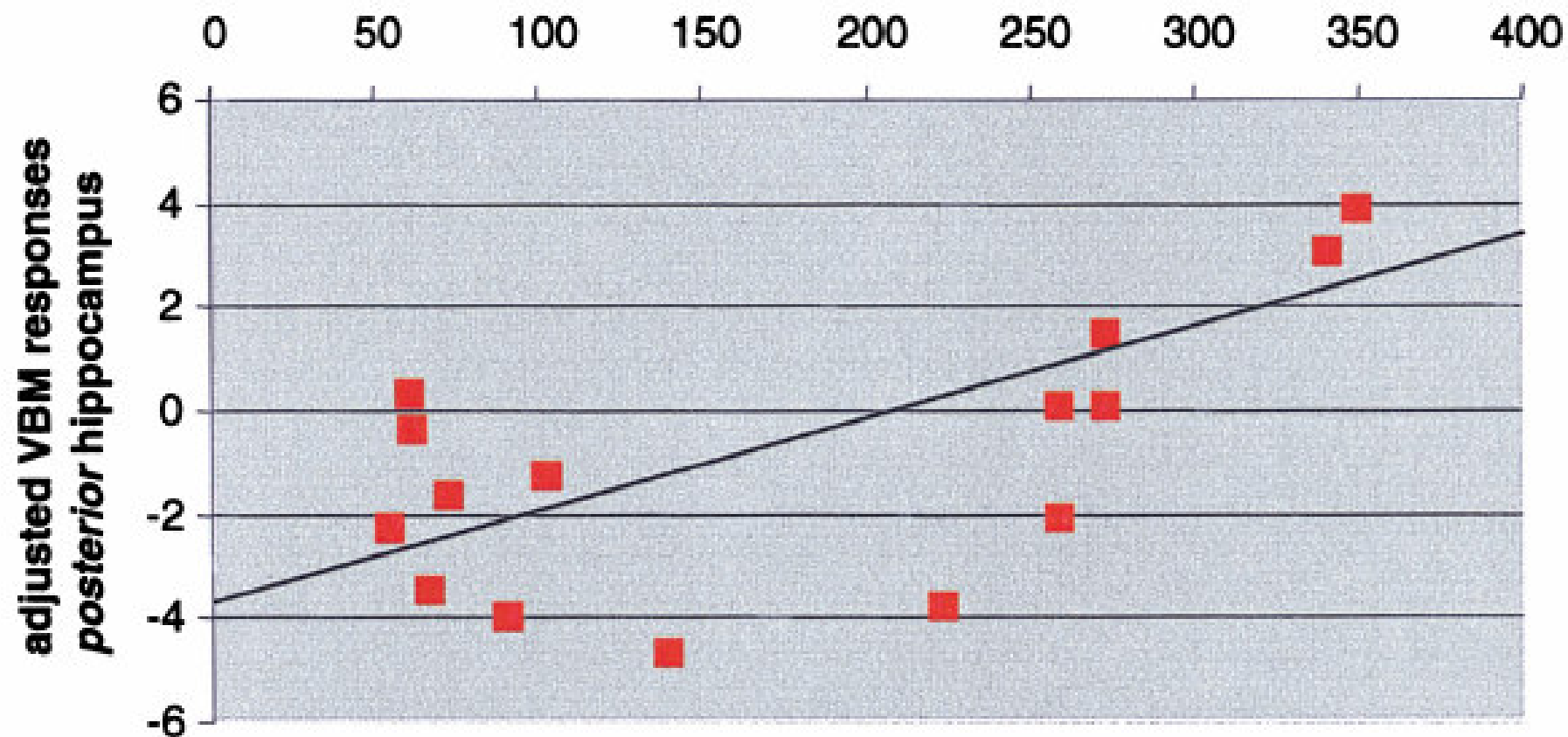
Gaser C, Schlaug G

J Neuroscience 2003

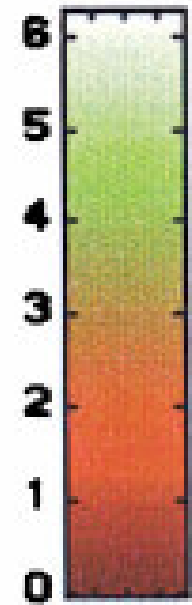
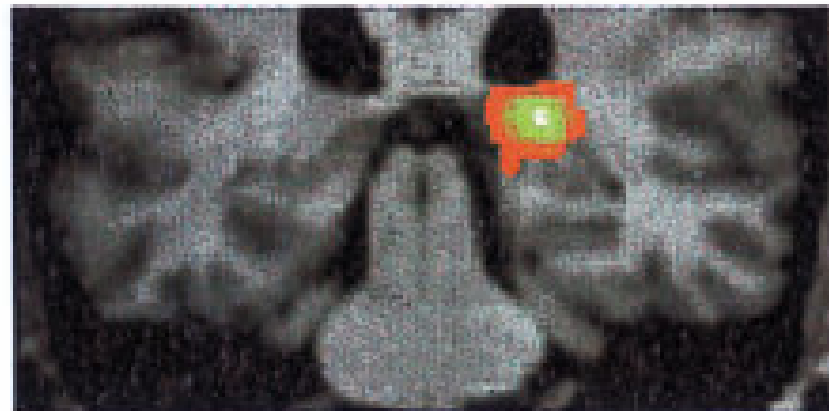
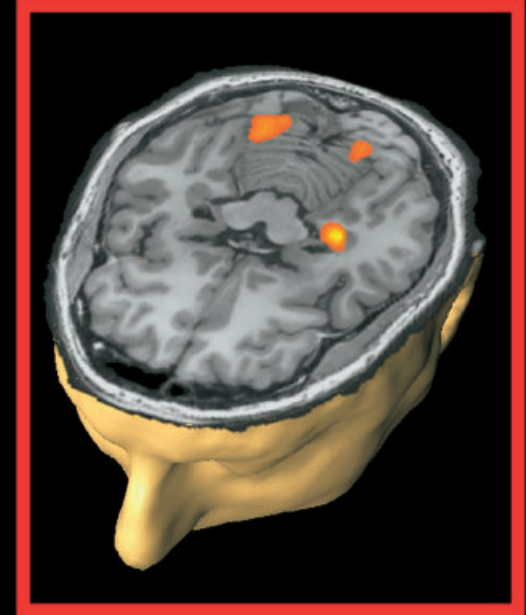


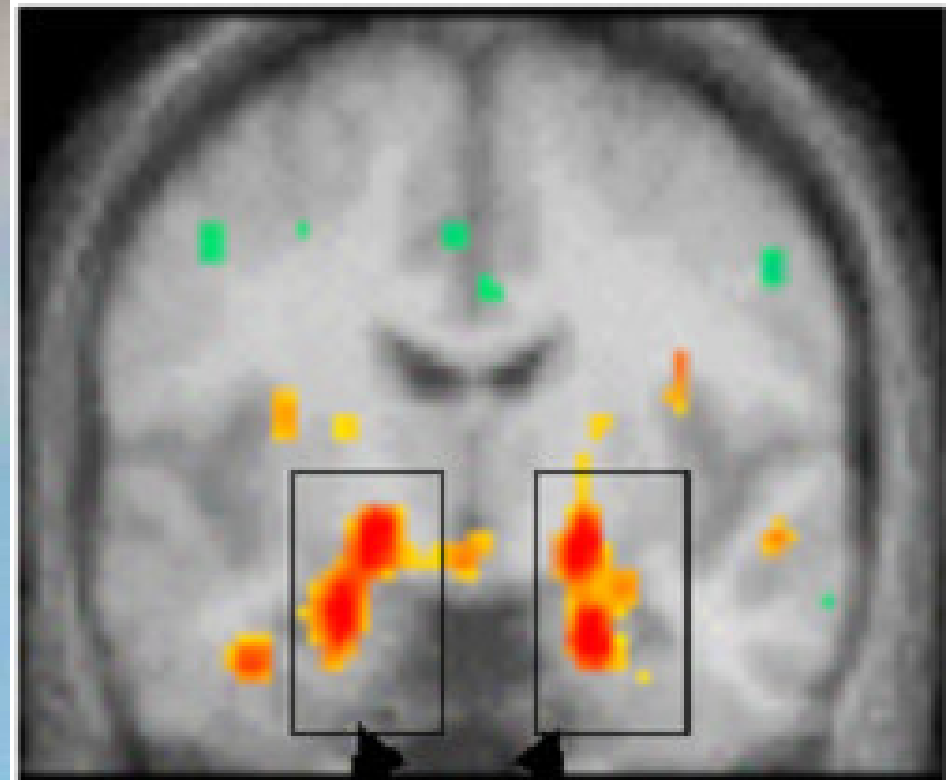
**b.**

**time as taxi driver (months)**



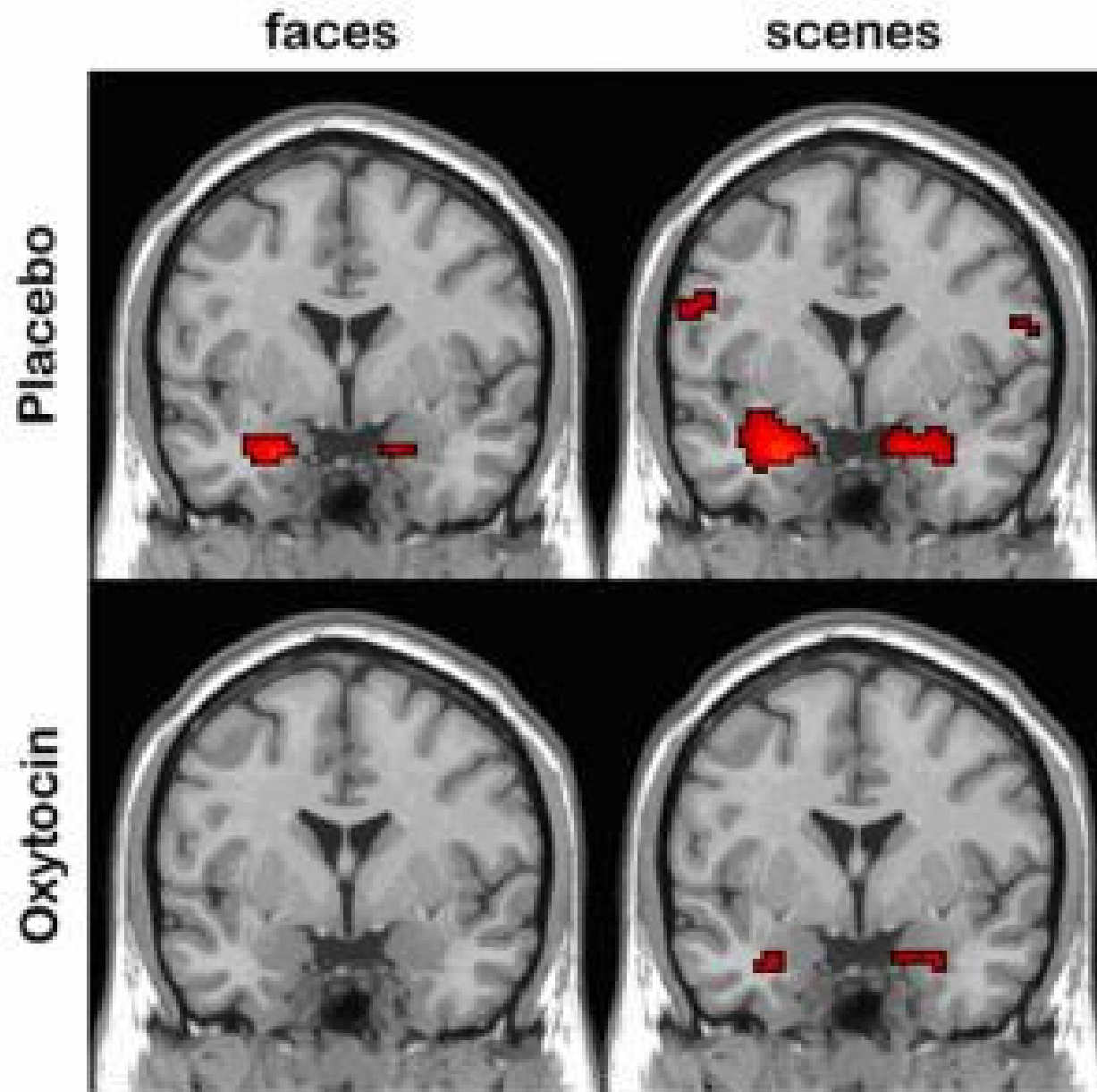


**A****D**



1

Amygdala



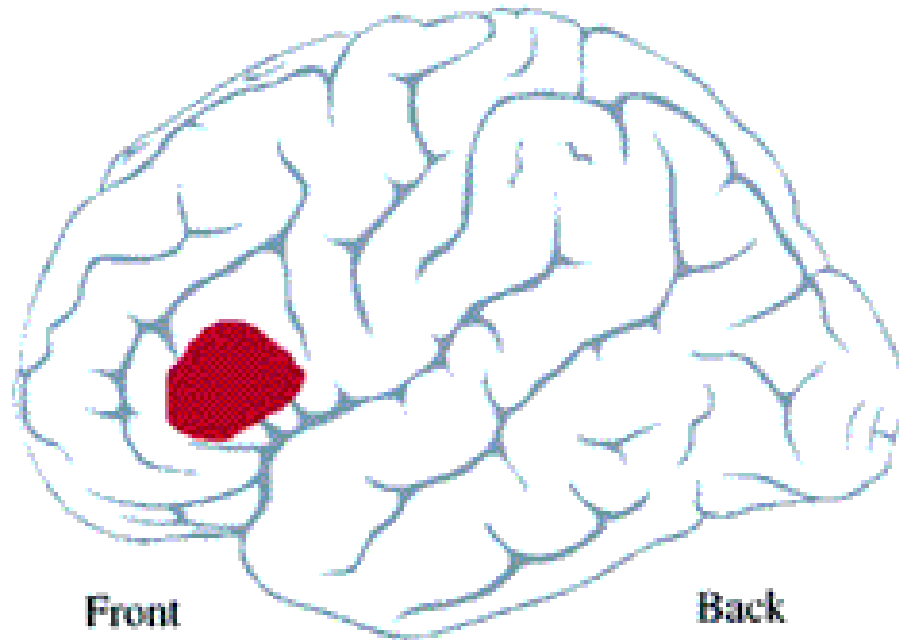
*Frightful faces  
triggered a dramatic  
reduction in  
amygdala activity  
in subjects who had  
sniffed oxytocin,*

*suggesting that  
oxytocin mediates  
social fear and trust*

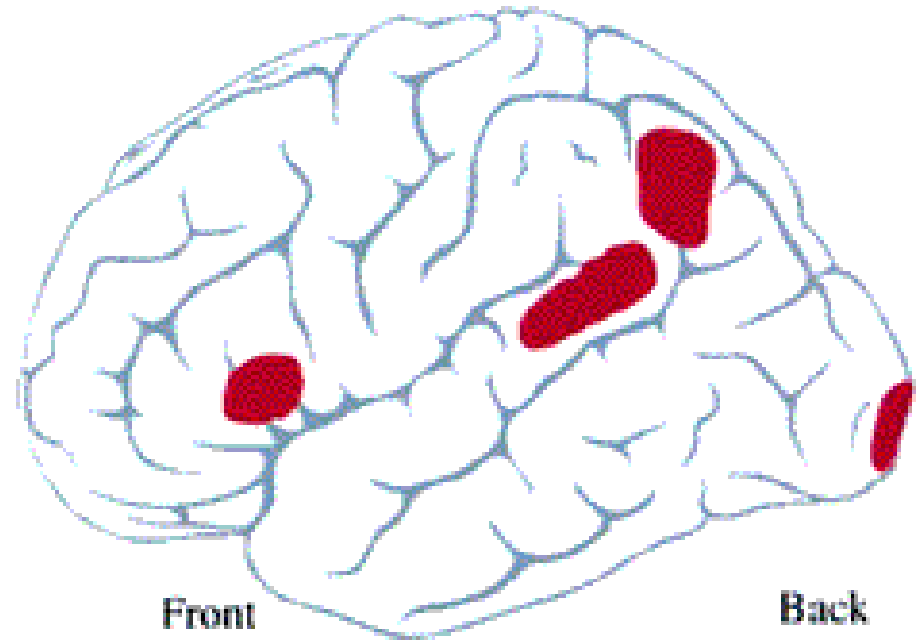
*via the amygdala  
and related circuitry.*



# READING



**DYSLEXIC**



**NONIMPAIRED**

## **Disruption of posterior brain systems for reading in children with developmental dyslexia**

Bennett A. Shaywitz, Sally E. Shaywitz, Kenneth R. Pugh, W. Einar Mencl, Robert K. Fulbright, Pawel Skudlarski, R. Todd Constable, Karen E. Marchione, Jack M. Fletcher, G. Reid Lyon, John C. Gore (1998-2002)



**Dyslexia-specific brain activation profile becomes normal following successful remedial training**

**P.G. Simos, J.M. Fletcher et al**

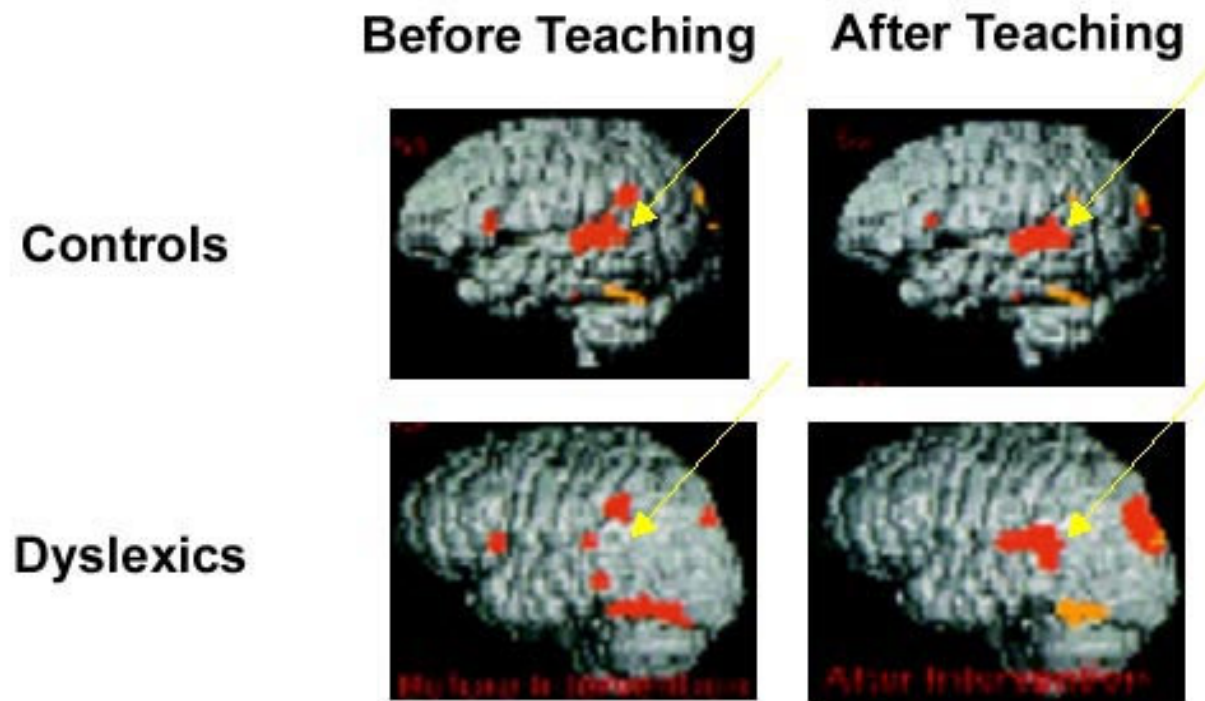
Plastic neural changes and reading improvement caused by audiovisual training in reading-impaired children

T. Kupala<sup>1</sup>, K. Kormi<sup>2</sup>, L. Caicedo<sup>1</sup>, S. Daitch<sup>1</sup>, P. Turkeltaub<sup>3</sup>, M. Tzourzou<sup>1</sup>, and R. Kover<sup>1,4</sup>

Development of left occipitotemporal systems for skilled reading in children after a phonologically-based intervention

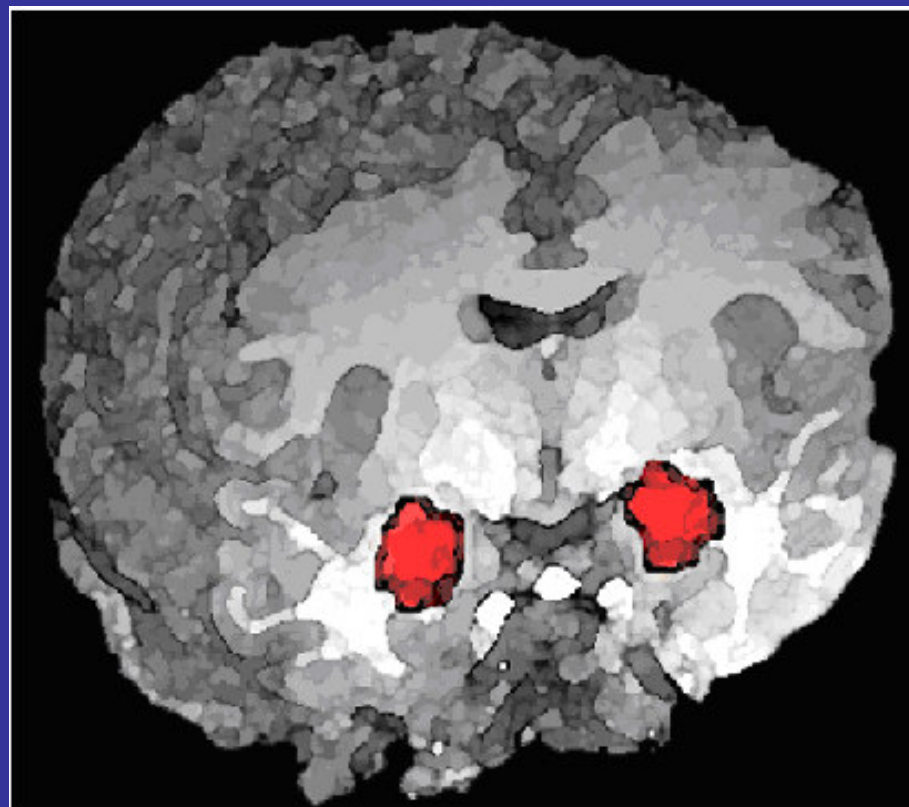
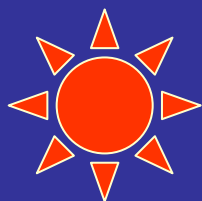
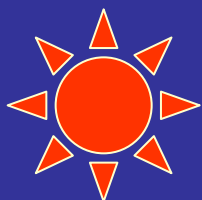
Bennett A. Shaywitz, Sally E. Shaywitz et al

# Teaching Corrects Dyslexia Pattern By MRI



80 hrs (1-2 hrs / day) one-on-one instruction  
Phonological Processing & Decoding  
Multisensory & Visual Imagery Instruction





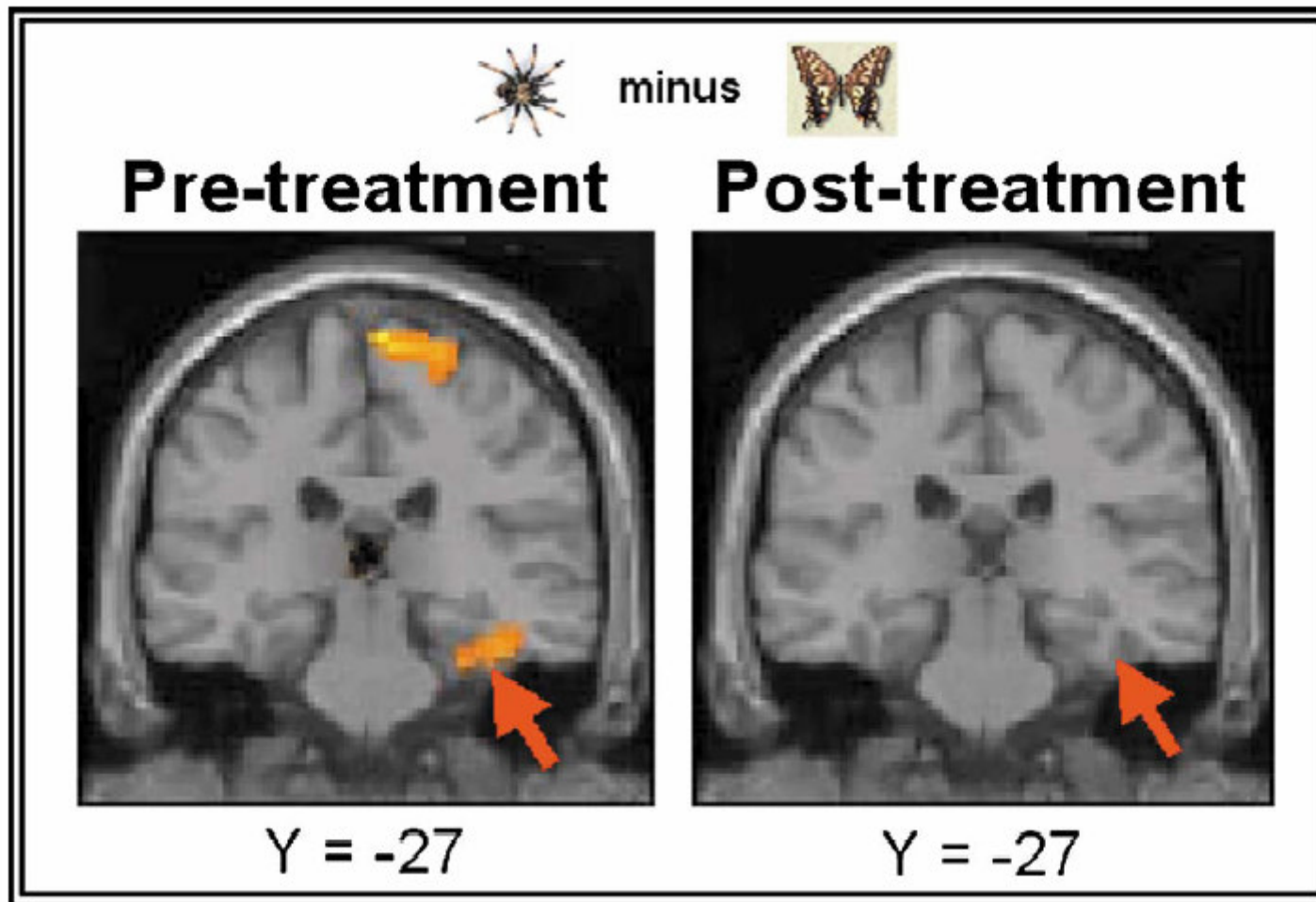
# “Change the mind and you change the brain”: effects of cognitive-behavioral therapy on the neural correlates of spider phobia

Vincent Paquette,<sup>a,d</sup> Johanne Lévesque,<sup>a</sup> Boualem Mensour,<sup>b</sup> Jean-Maxime Leroux,<sup>b</sup> Gilles Beaudoin,<sup>b,c</sup> Pierre Bourgouin,<sup>b,c</sup> and Mario Beauregard<sup>a,b,c,d,\*</sup>

<sup>a</sup> Centre de Recherche, Institut Universitaire de Gériatrie de Montréal, Montréal, Canada

<sup>b</sup> Département de Radiologie, Centre Hospitalier de l'Université de Montréal (CHUM), Hôpital Notre-Dame, Montréal, Canada

<sup>d</sup> Centre



<sup>a</sup>

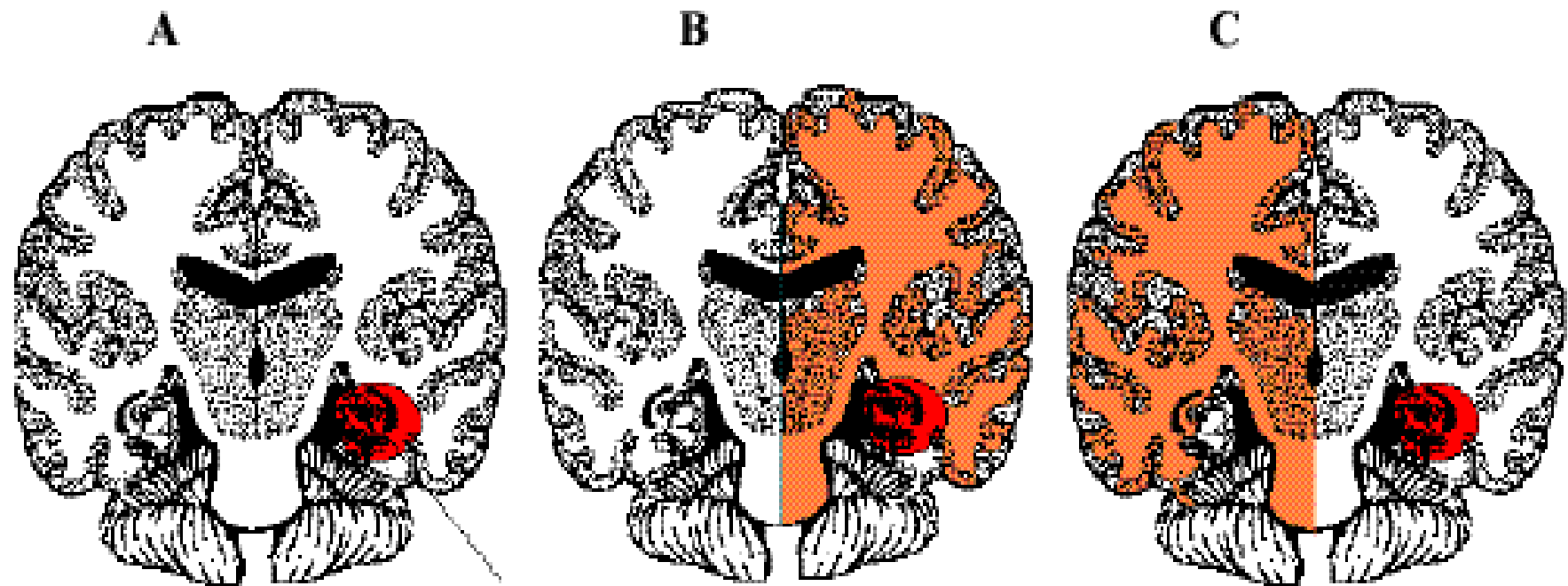
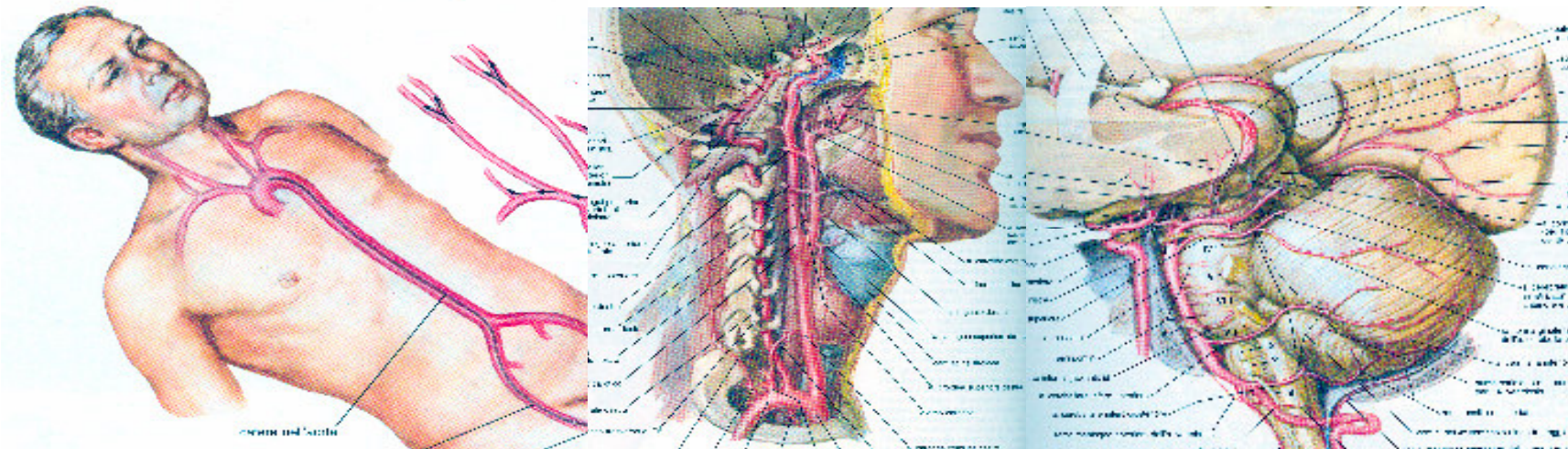
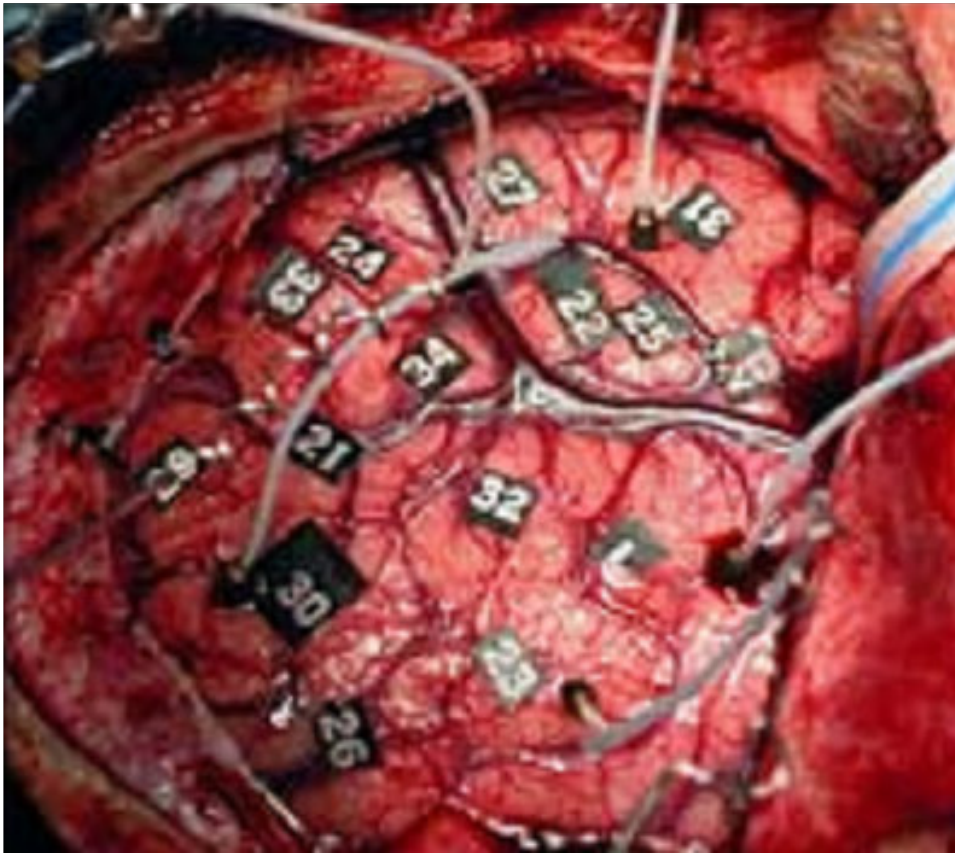


Fig1. Diagrammatic representation of the intracarotid amobarbital procedure.





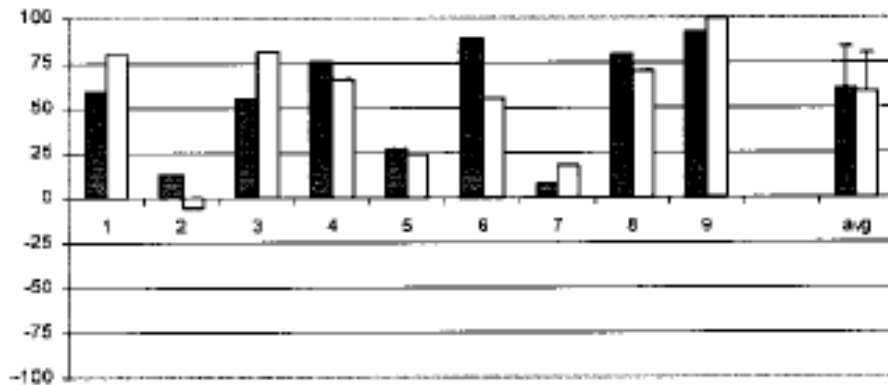


Neuroradiology. 2005 Nov;  
47(11):835-44.

## Evaluating functional MRI procedures for assessing hemispheric language dominance in neurosurgical patients.

Baciu MV, Watson JM, Maccotta L,  
McDermott KB, Buckner RL, Gilliam  
FG, Ojemann JG.

Laboratory of Psychology and Neurocognition, UMR  
CNRS 5105, Pierre Mendes-France University, BP  
47, 38040, Grenoble Cedex 09





# Brain–computer interface using fMRI: spatial navigation by thoughts

Seung-Schik Yoo,<sup>1,2,CA</sup> Ty Fairney,<sup>3</sup> Nan-Kuei Chen,<sup>1</sup> Seh-Eun Choo,<sup>4</sup> Lawrence P. Panych,<sup>1</sup> HyunWook Park,<sup>5</sup> Soo-Young Lee<sup>2</sup> and Ferenc A. Jolesz<sup>1</sup>

<sup>1</sup>Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, 75 Francis St, Boston, MA 02115, USA; <sup>2</sup>Department of BioSystems;

<sup>5</sup>Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Korea; <sup>3</sup>Department of Biomedical Engineering;

<sup>4</sup>College of Communication, Boston University, Boston, MA, USA

<sup>CA</sup>Corresponding Author and Address: yoo@bwh.harvard.edu

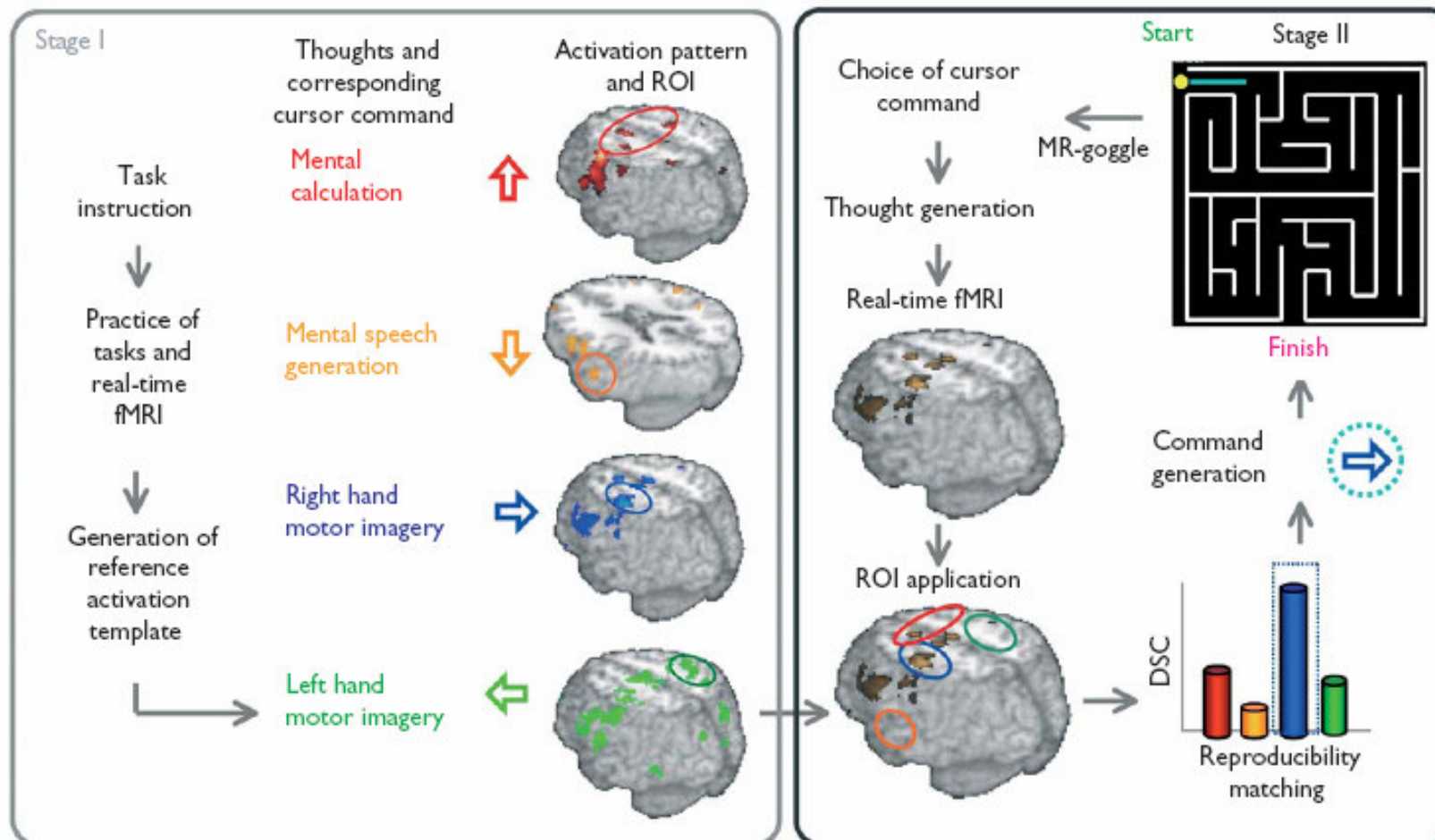
Received 8 April 2004; accepted 28 April 2004

DOI: 10.1097/01.wnr.0000133296.39160.fe

A brain–computer interface (BCI) is a way of conveying an individual's thoughts to control computer or electromechanical hardware. Capitalizing on the ability to characterize brain activity in a reproducible manner, we explored the possibility of using real-time fMRI to interpret the spatial distribution of brain function as BCI commands. Using a high-field (3 T) MRI scanner, brain activities

associated with four distinct covert functional tasks were detected and subsequently translated into predetermined computer commands for moving four directional cursors. The proposed fMRI-BCI method allowed volunteer subjects to navigate through a simple 2D maze solely through their thought processes. *NeuroReport* 15:000–000 © 2004 Lippincott Williams & Wilkins.

**Key words:** Biofeed; Cognition; fMRI; Imagery; Mental task; Rehabilitation



**Fig. 1.** Overall schematics of the fMRI procedure for the BCI. The procedure is split up into two stages. The first stage is data calibration and subject preparation. The second stage is the BCI experiment.

SCIENTIFIC  
AMERICAN

September 16, 2002

# Controlling Robots with the Mind

By Miguel A. L. Nicolelis and John K. Chapin



People may one day be able to command wheelchairs, prosthetics and even paralyzed arms and legs by "thinking them through" the motions

Massimo Piccirilli

## Dal *cervello* alla *mente*

*appunti di neuropsicologia*



Morlacchi Editore

- . Valutazione clinica
- . Valutazione neuropsicologica
- . Paradigma sperimentale
- . Esecuzione esame
- . Elaborazione dati
- . Interpretazione risultati

[www.dalcervelloallamente.com](http://www.dalcervelloallamente.com)