



SOCIETÀ DEI NEUROLOGI, NEUROCHIRURGI  
E NEURORADIOLOGI OSPEDALIERI



AZIENDA AUSL 7  
PRESIDIO OSP. GUZZARDI  
UO di Neurologia:  
Direttore Prof. FRANCESCO RIMOLDI



UNIVERSITÀ  
DI CATANIA  
E RAGUSA



ASSOCIAZIONE  
ALZHEIMER ITALIA



Corso Nazionale di Aggiornamento  
delle Scienze Neurologiche Ospedaliere

## **DETERIORAMENTO COGNITIVO** **tra neurodegenerazione,** **lesioni vascolari e psicopatologia**

27-29 Marzo 2008

### **MODICA**

Palazzo della Cultura  
e Palazzo Grimaldi

### **RAGUSA**

Castello di Donnafugata



*Facoltà di  
Medicina  
e  
Chirurgia  
Università  
di  
Perugia*

**Plasticità cerebrale  
e  
neuroimaging  
funzionale**

*Massimo Piccirilli*

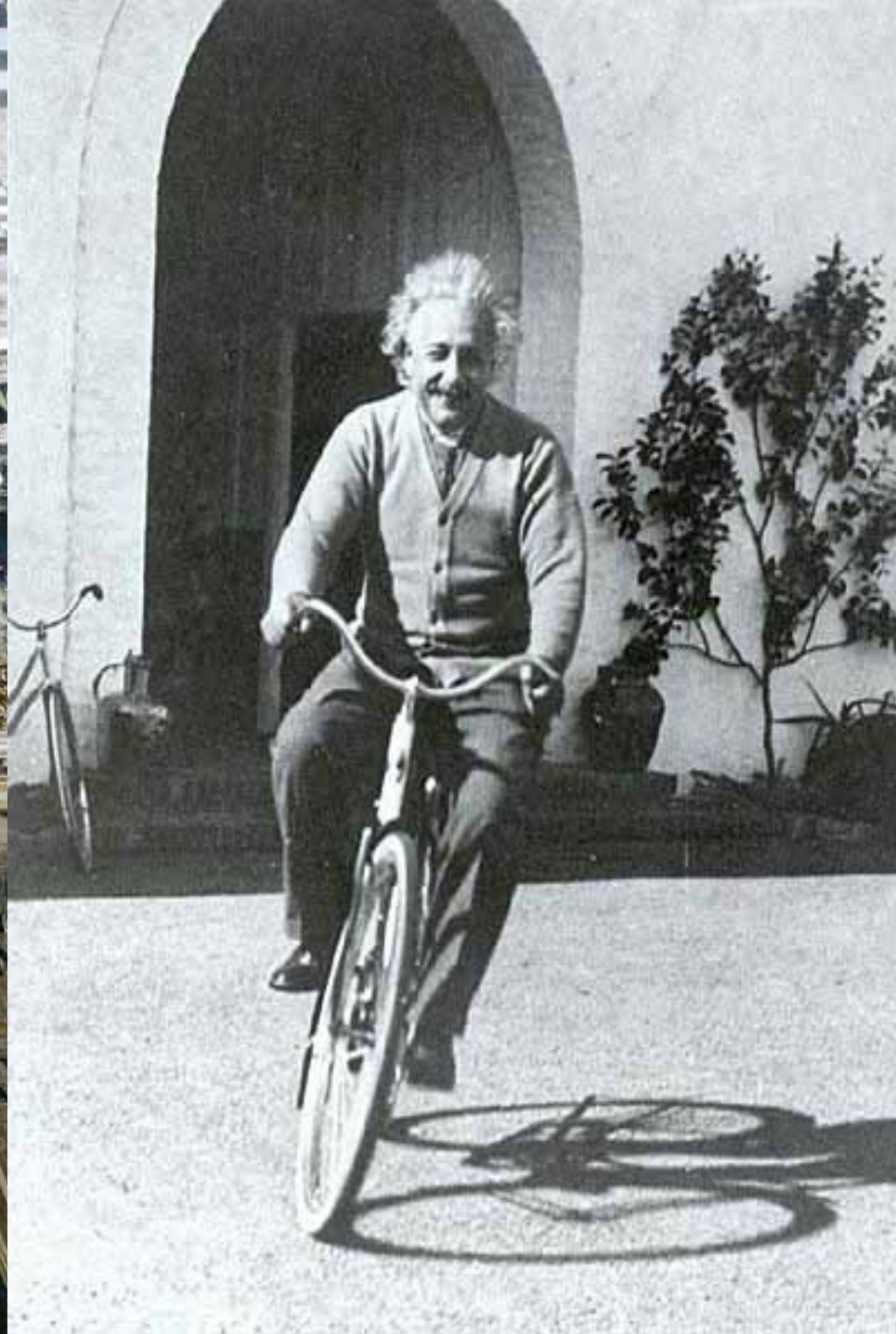
Dolezal H

*Living in a world transformed.*

(Perceptual and performatory  
adaptation to visual distortion)

NY Academic Press 1982



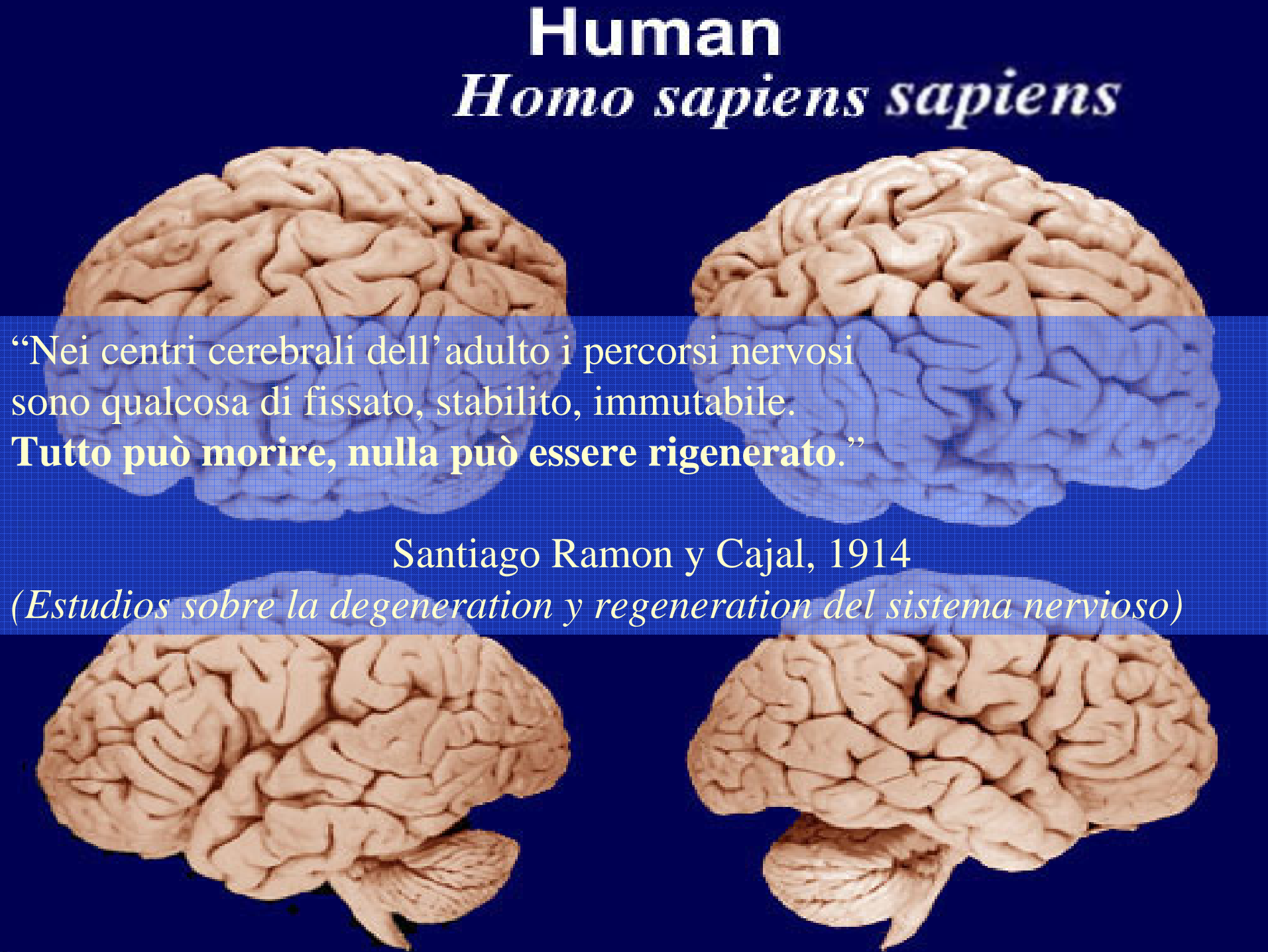


# Astronauti nella stazione spaziale internazionale ISS



# Human

## *Homo sapiens sapiens*

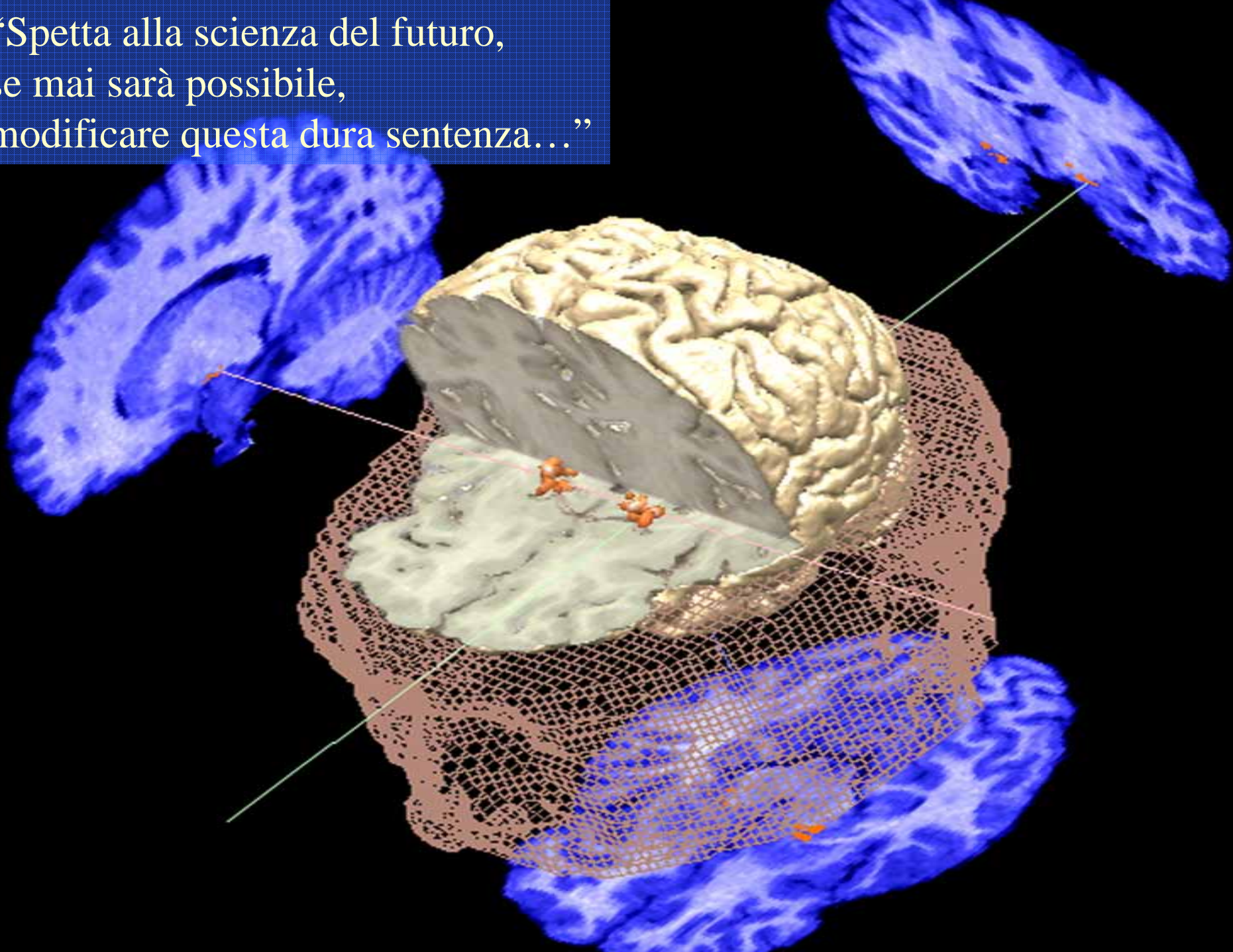


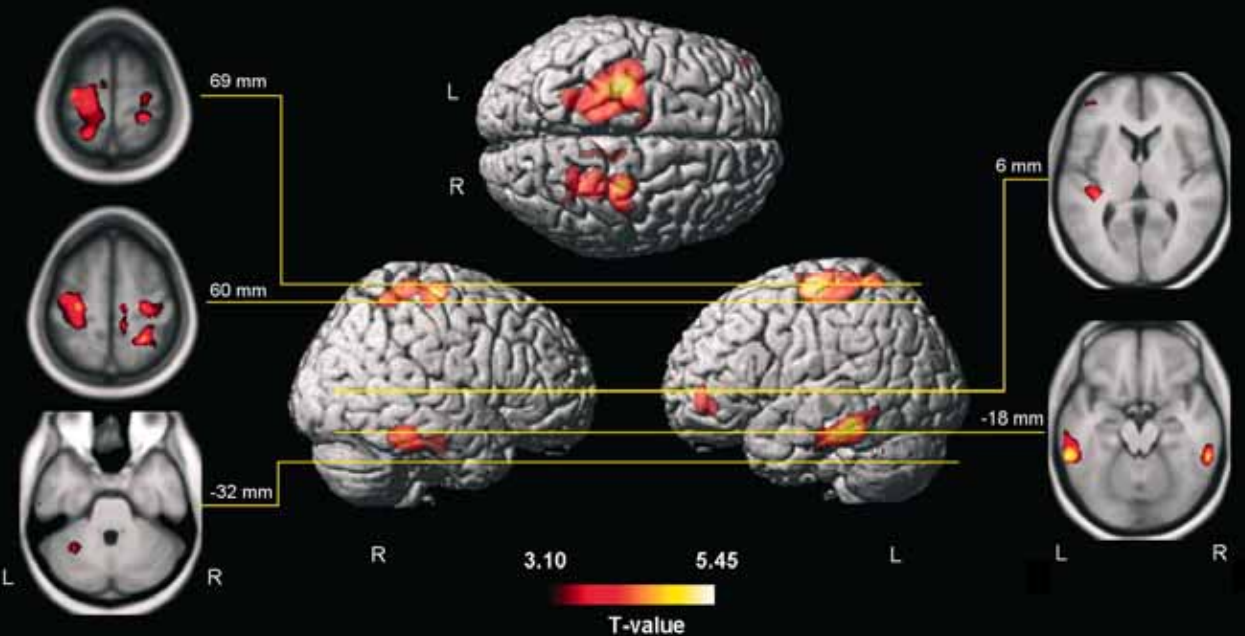
“Nei centri cerebrali dell’adulto i percorsi nervosi sono qualcosa di fissato, stabilito, immutabile.  
**Tutto può morire, nulla può essere rigenerato.”**

Santiago Ramon y Cajal, 1914

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

“Spetta alla scienza del futuro,  
se mai sarà possibile,  
modificare questa dura sentenza...”

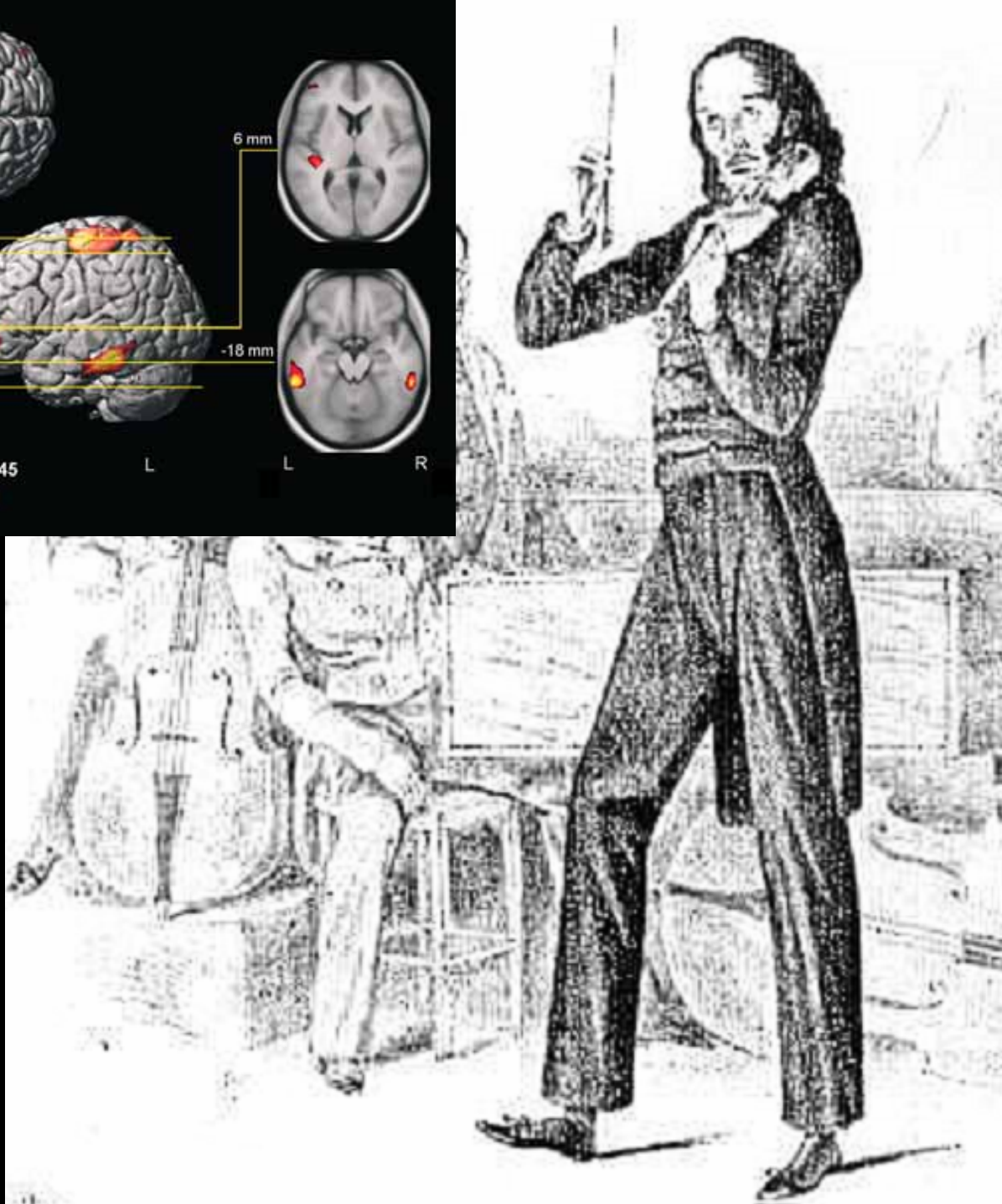




# Brain Structures Differ between Musicians and Non-Musicians

Gaser C, Schlaug G

J Neuroscience 2003



# Frontal Lobe

A detailed illustration of a human brain, viewed from the side, with a white arrow pointing to the frontal lobe. The brain is rendered in shades of blue and purple, with a grid-like pattern overlaid on it. The frontal lobe is the largest and most prominent part of the brain, located at the front. The arrow points to the frontal lobe, which is the largest and most prominent part of the brain.

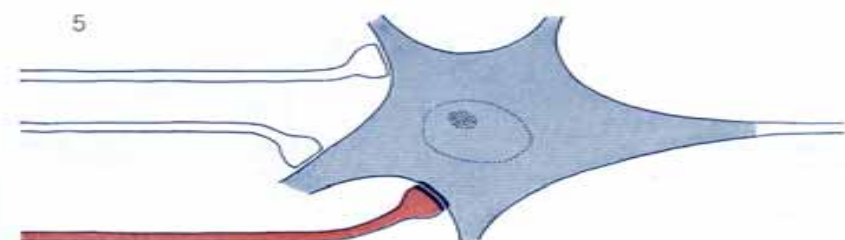
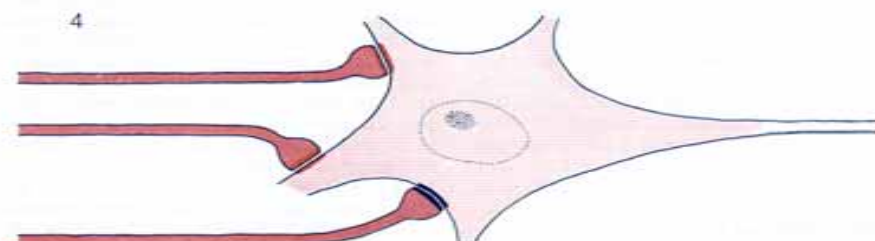
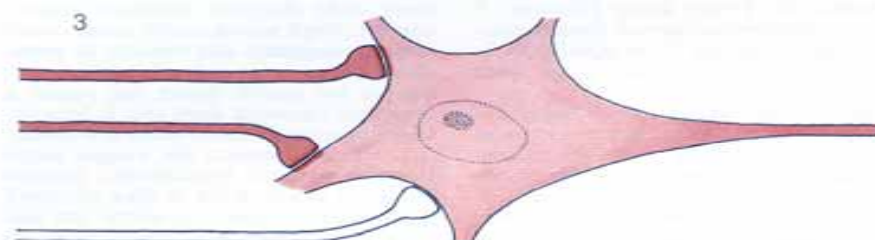
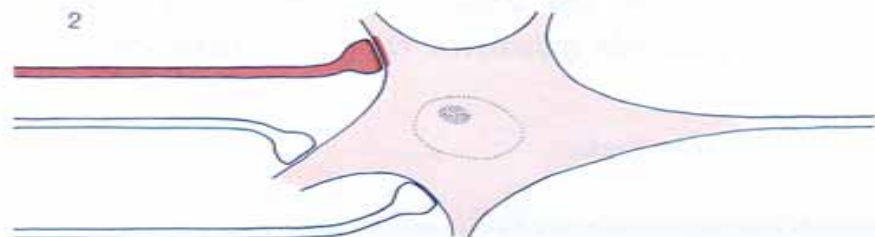
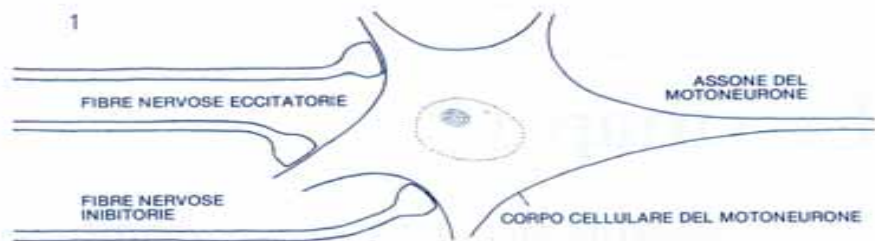
“Le capacità di un pianista ... sono inaccessibili ad un uomo non allenato  
.....

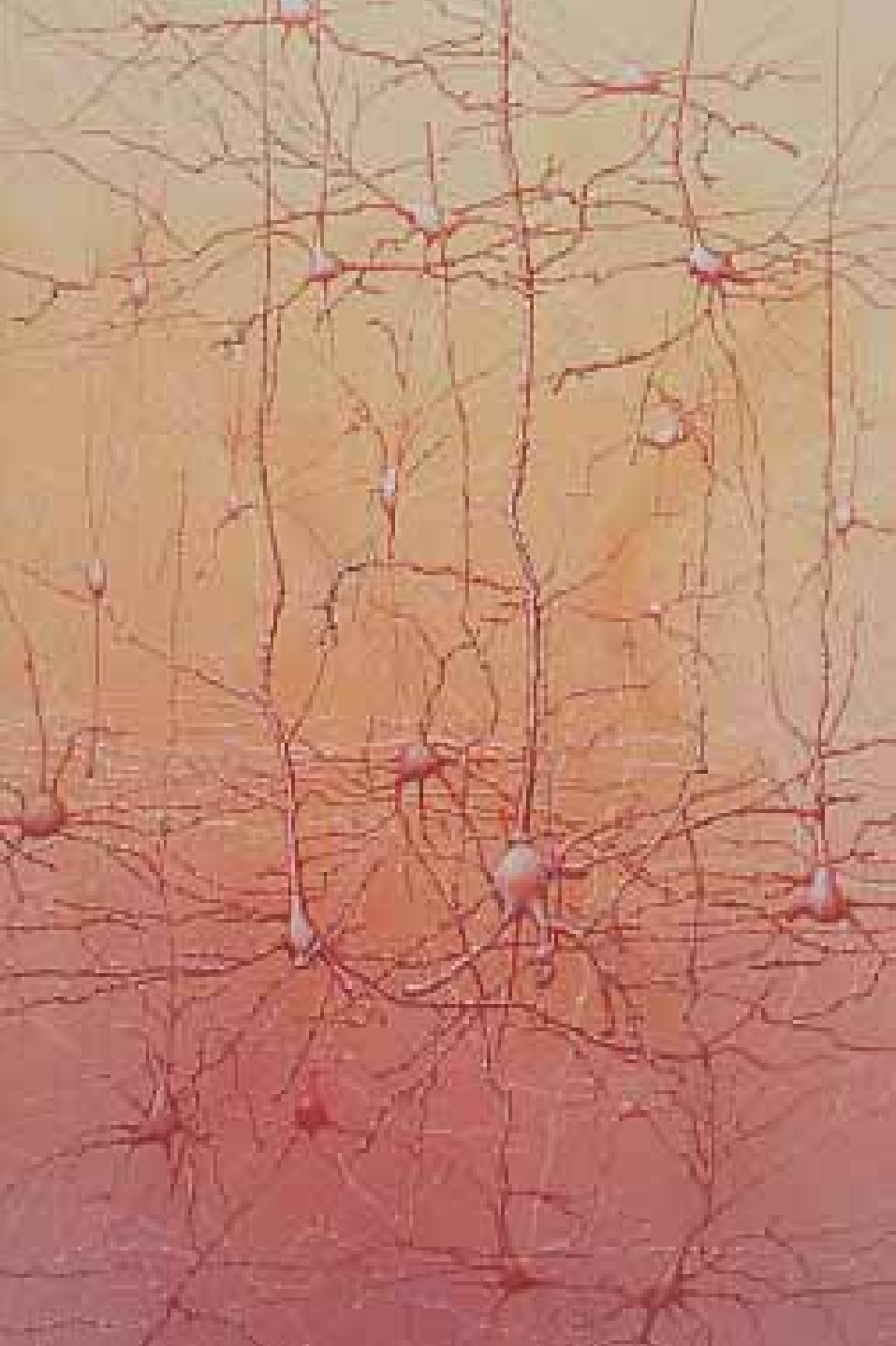
per capire a fondo questo fenomeno complesso è necessario ammettere,  
oltre al consolidamento di percorsi organici già stabiliti in precedenza,  
la formazione di percorsi nuovi, attraverso la ramificazione e la crescita  
progressiva dei dendriti e delle terminazioni nervose ...

.....  
un simile sviluppo ha luogo in risposta all’esercizio,  
mentre si interrompe e può essere invertito  
nelle regioni cerebrali che non vengono coltivate”

Santiago Ramon y Cajal, 1914

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





Il cervello è più vasto del cielo  
(Emily Dickinson)

“Il numero  
di possibili circuiti neuronali  
è nell’ordine di 10 seguito da  
almeno un milione di zeri;  
le particelle dell’universo  
conosciuto sono circa  
10 seguito da 79 zeri”

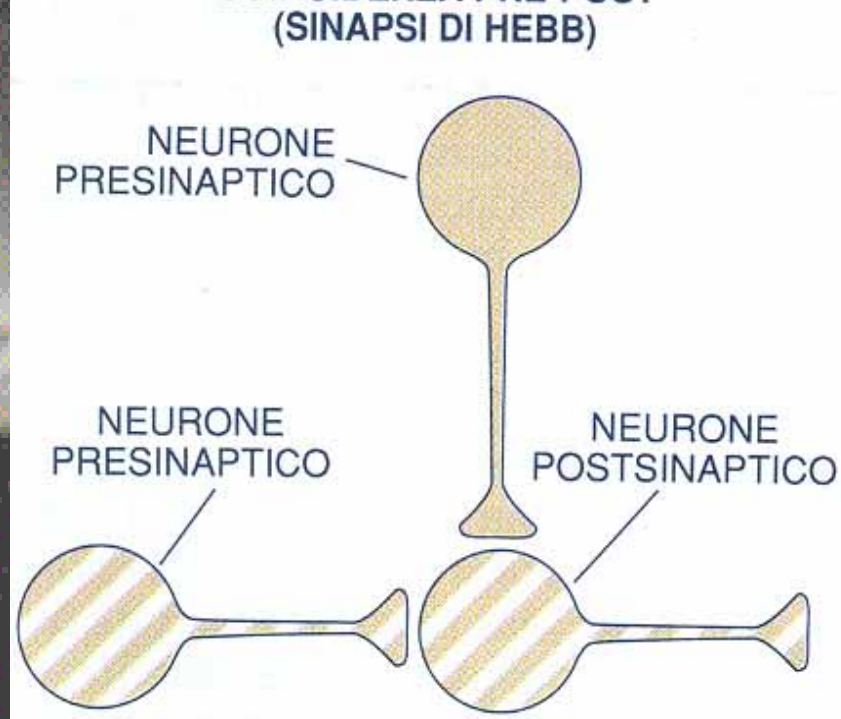
Gerald Edelman

Teoricamente la connessione tra neuroni può dar origine ad una infinità di configurazioni

**Postsynaptic**

**Presynaptic**

**Before Learning**

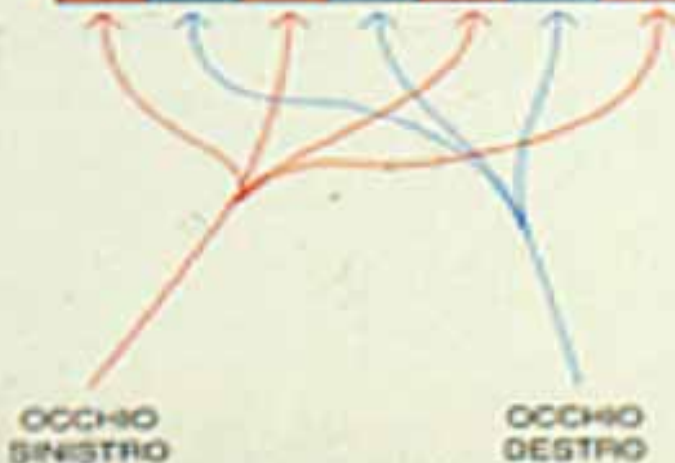


\* Neuroni che si attivano contemporaneamente formano una connessione privilegiata

\* Neuroni che non si attivano vicendevolmente perdono la loro connessione



CORTECCIA VISIVA



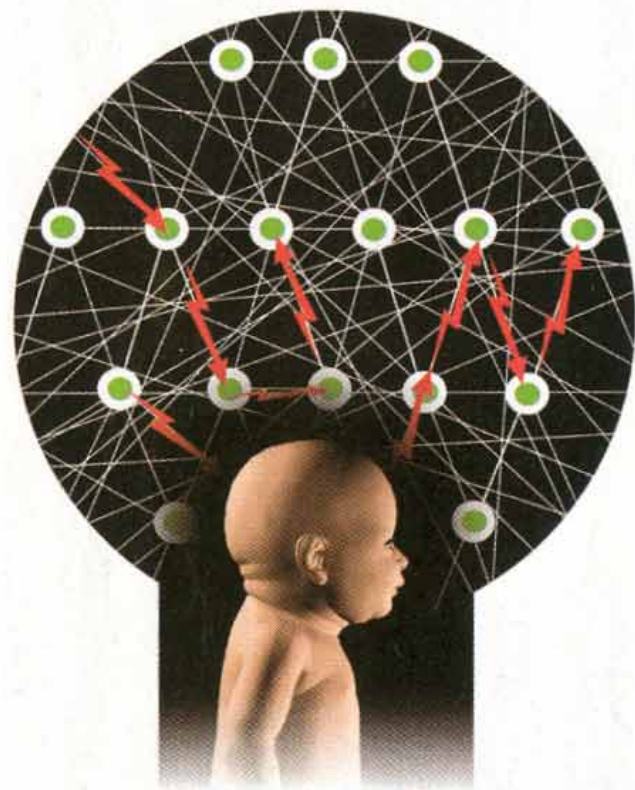
CORTECCIA VISIVA



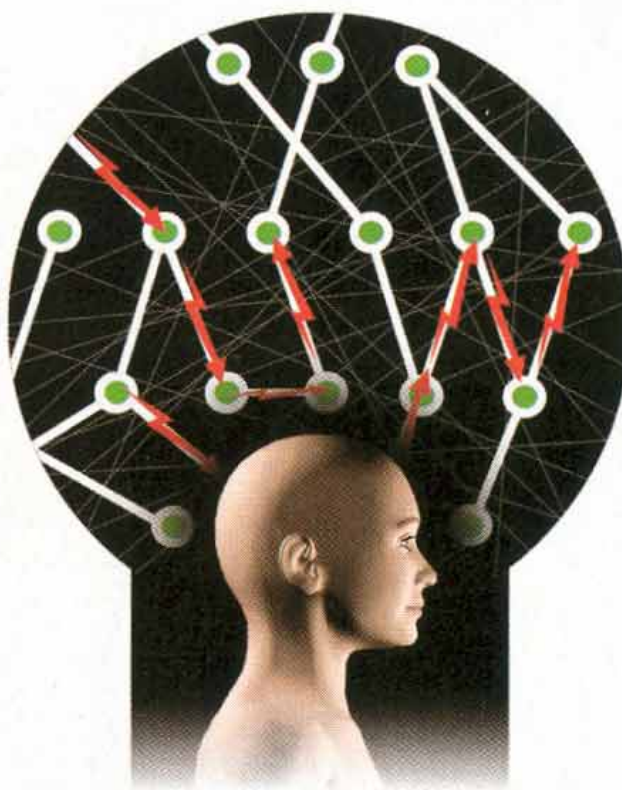
l'organizzazione della rete  
dipende in modo critico  
dalle informazioni  
presenti nell'ambiente

Sono le esperienze a realizzare  
l'organizzazione cerebrale  
utilizzando i meccanismi resi possibili  
dal corredo genetico

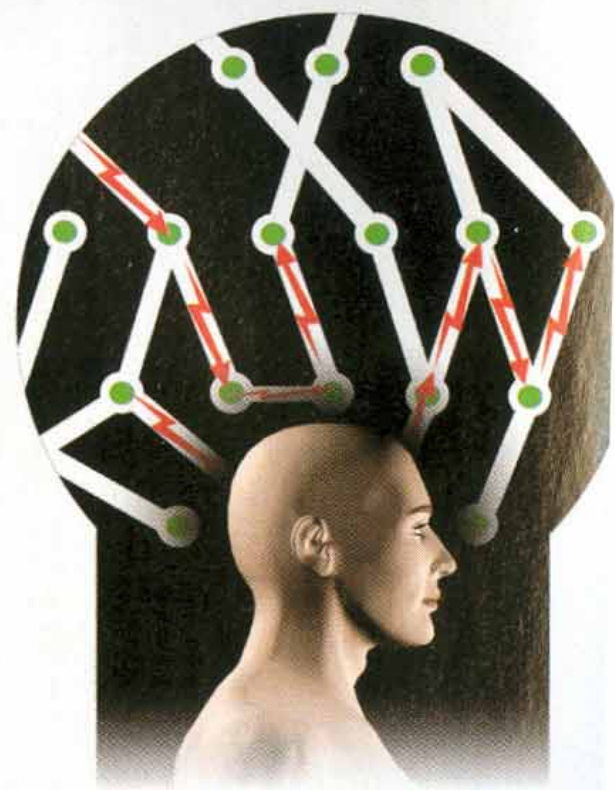
Darwinismo neuronale  
Le informazioni ambientali  
innescano  
una sorta di competizione



0 - 2 ANNI



2 ANNI - PUBERTÀ



ADULTO

Gli stimoli ambientali, come un giardiniere che pota un cespuglio di rose, selezionano fra tutte quelle possibili proprio le connessioni che risultano più appropriate a svolgere una determinata funzione.



grazie a questo meccanismo

l'ambiente plasma la materia cerebrale

ovvero

il sistema nervoso assorbe

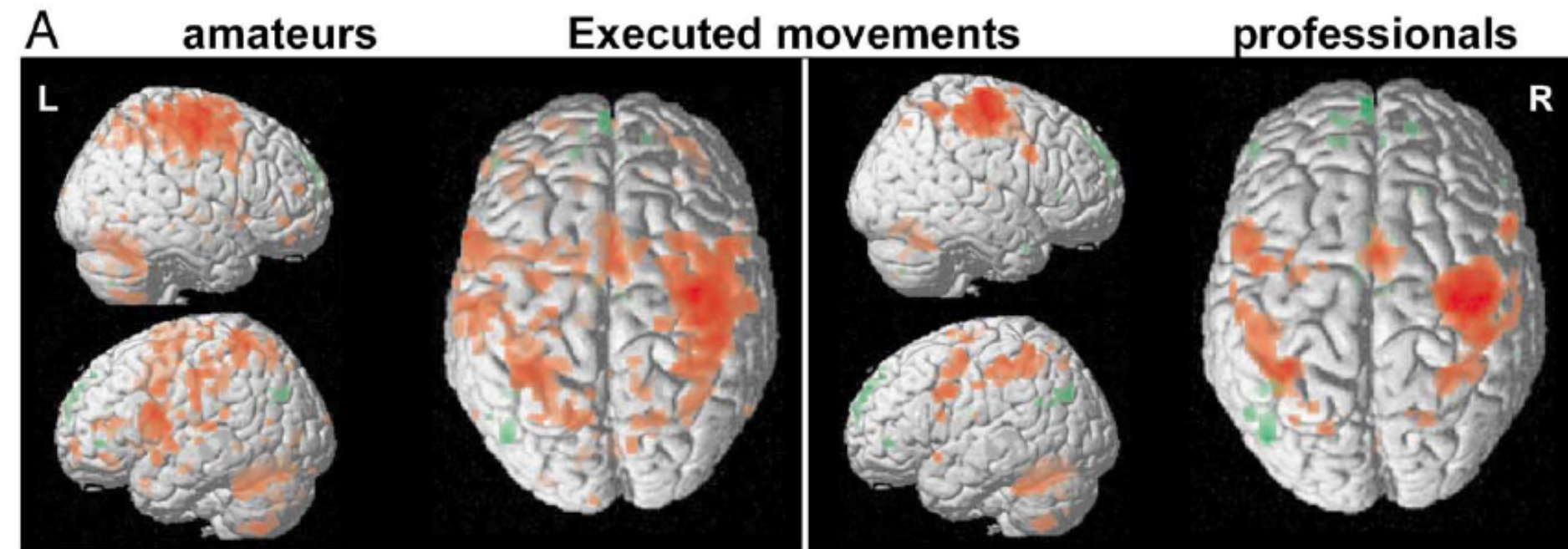
le caratteristiche dell'ambiente

in cui vive

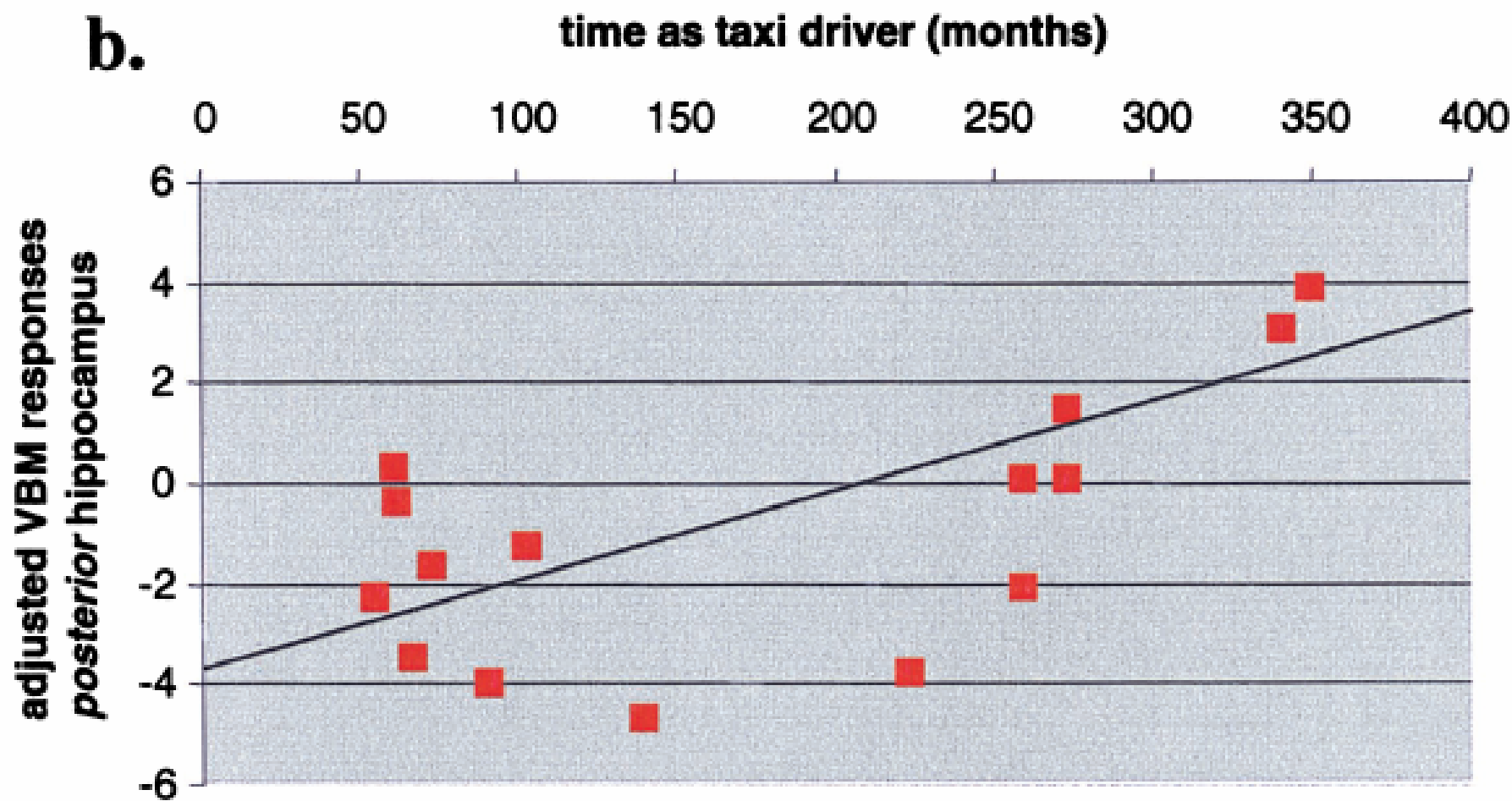
# Increased auditory cortical representation in musicians

Christo Pantev, R Oostenveld, A Engelien, B Ross, LE Roberts & M Hoke

Here we used functional magnetic source imaging to measure cortical representations in highly skilled musicians (**letters to nature**)



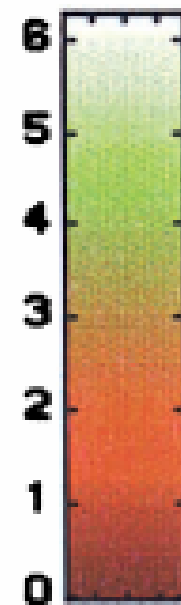
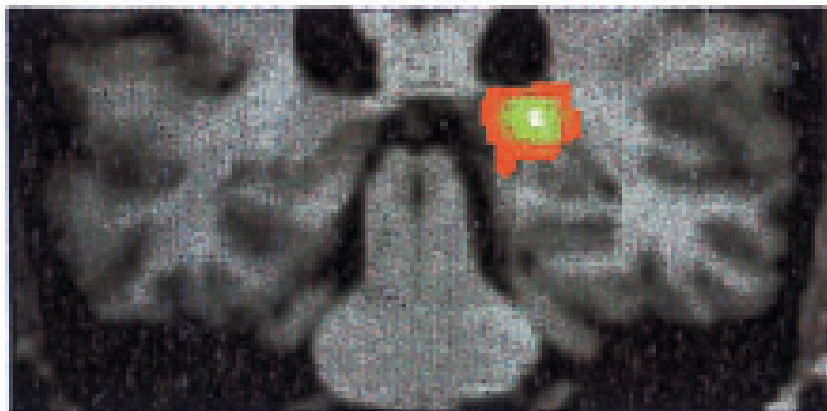
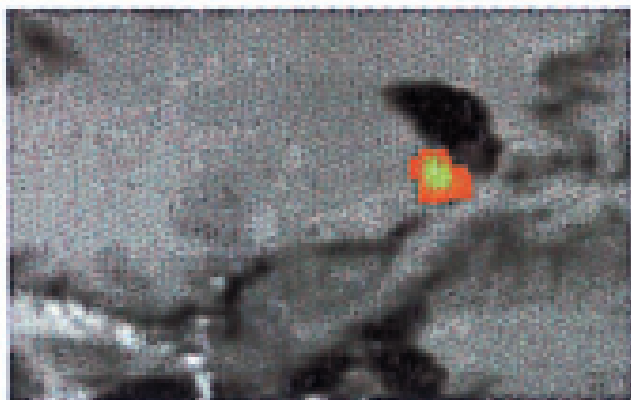
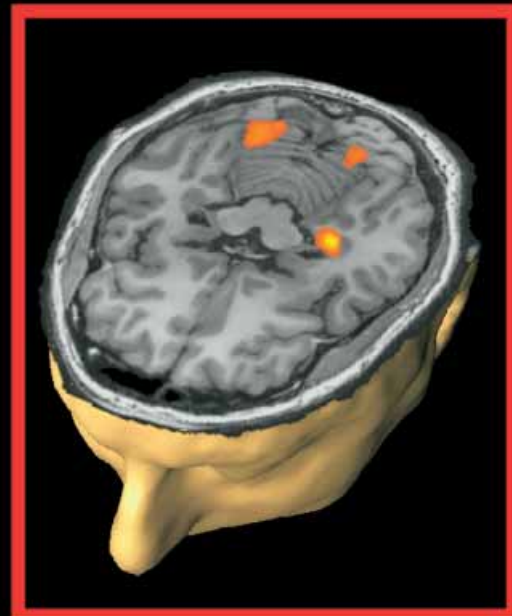
use-dependent functional reorganization



A



D



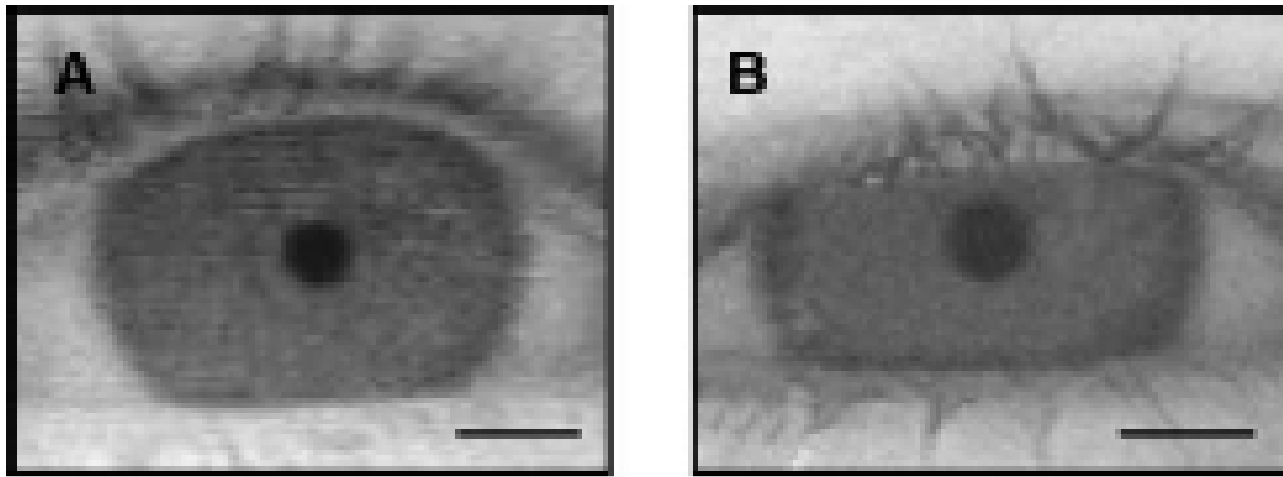
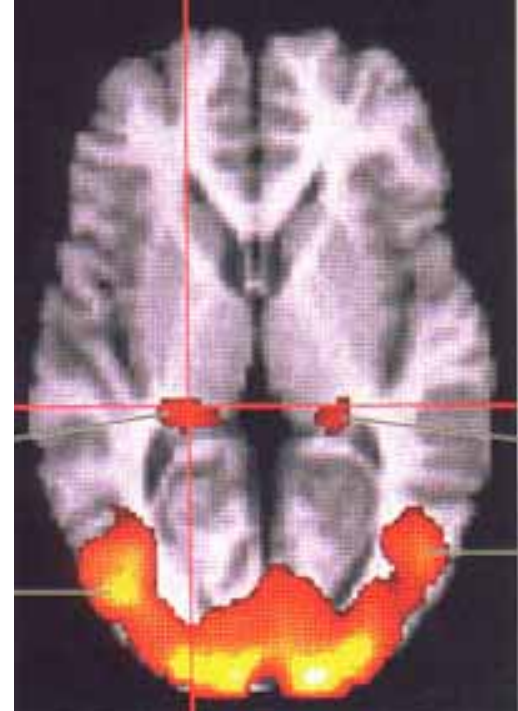
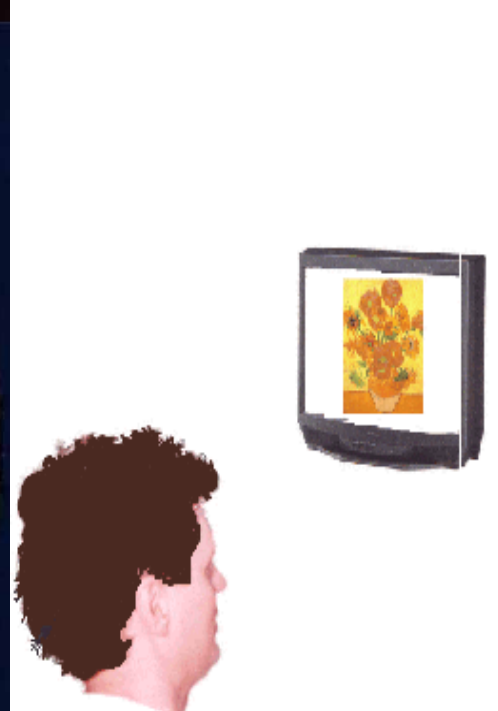


Figure 2. Images of Pupils Underwater

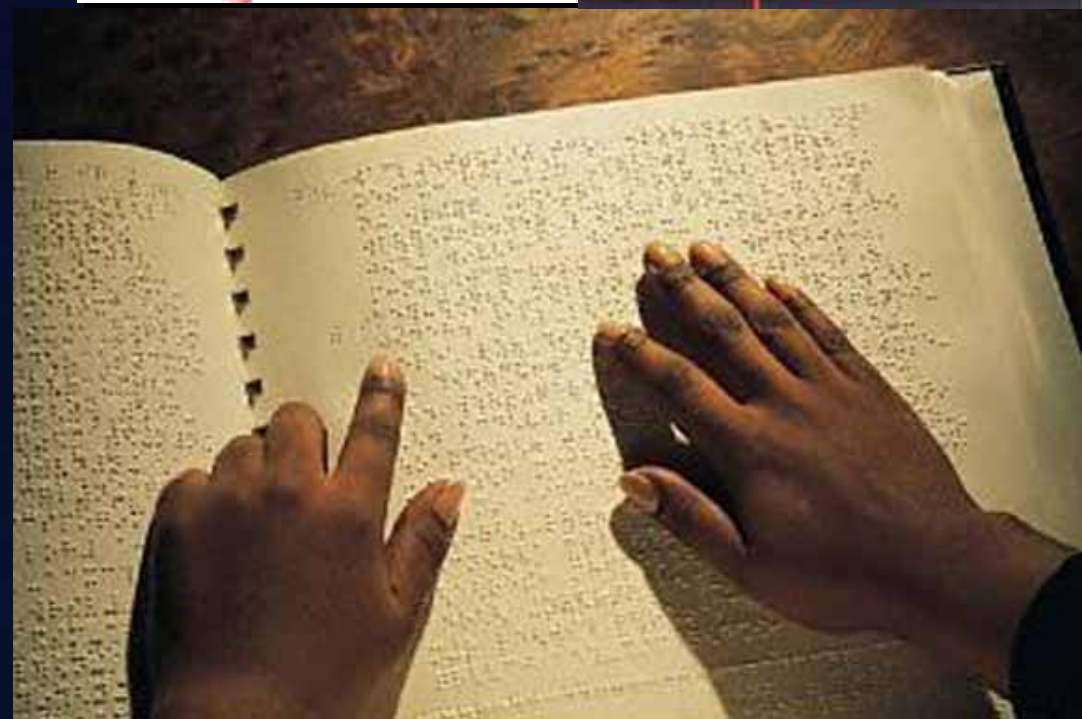
The pupil of a Moken child (A) is smaller than the pupil of a European child (B). Both images were taken with infrared light. Scale bars = 4 mm.

Superior Underwater Vision in a Human Population of Sea Gypsies  
*Anna Gislen, M Dacke, RHH Kroger, M Abrahamsson*

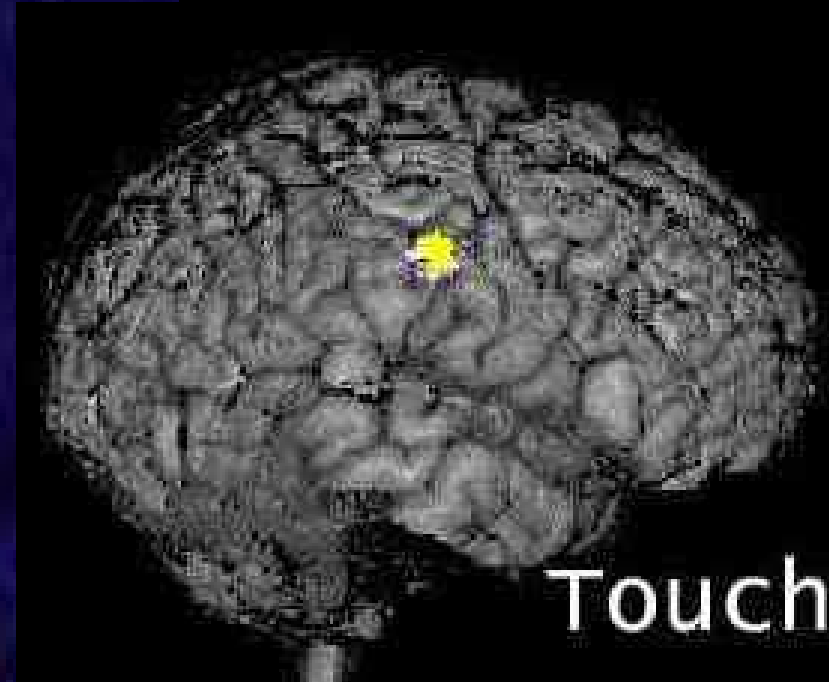
Visual training improves underwater vision in children  
*Anna Gislen, EJ Warrant, M Dacke, RHH Kroger*  
Vision Research 46 (2006) 3443–3450



•	••	•••	••••	•••••	••••••	•••••••	••••••••	•••••••••	••••••••••
a	b	c	d	e	f	g	h	i	j
k	l	m	n	o	p	q	r	s	t
u	v	x	y	z	ç	é	â	ê	û
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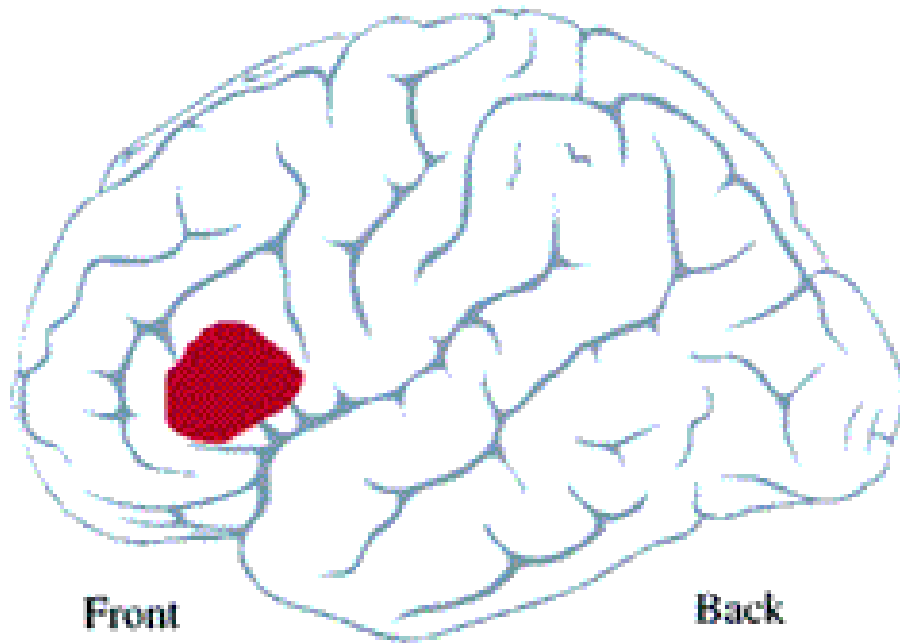


Le reti neurali sono *sempre*  
pronte a riorganizzarsi  
in risposta alle modificazioni ambientali

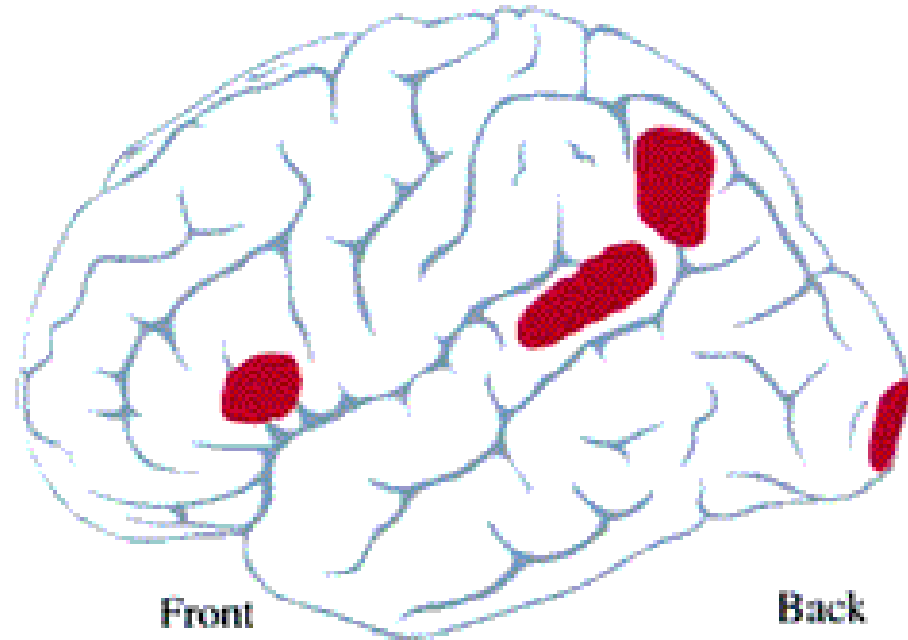


Touch

# 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**

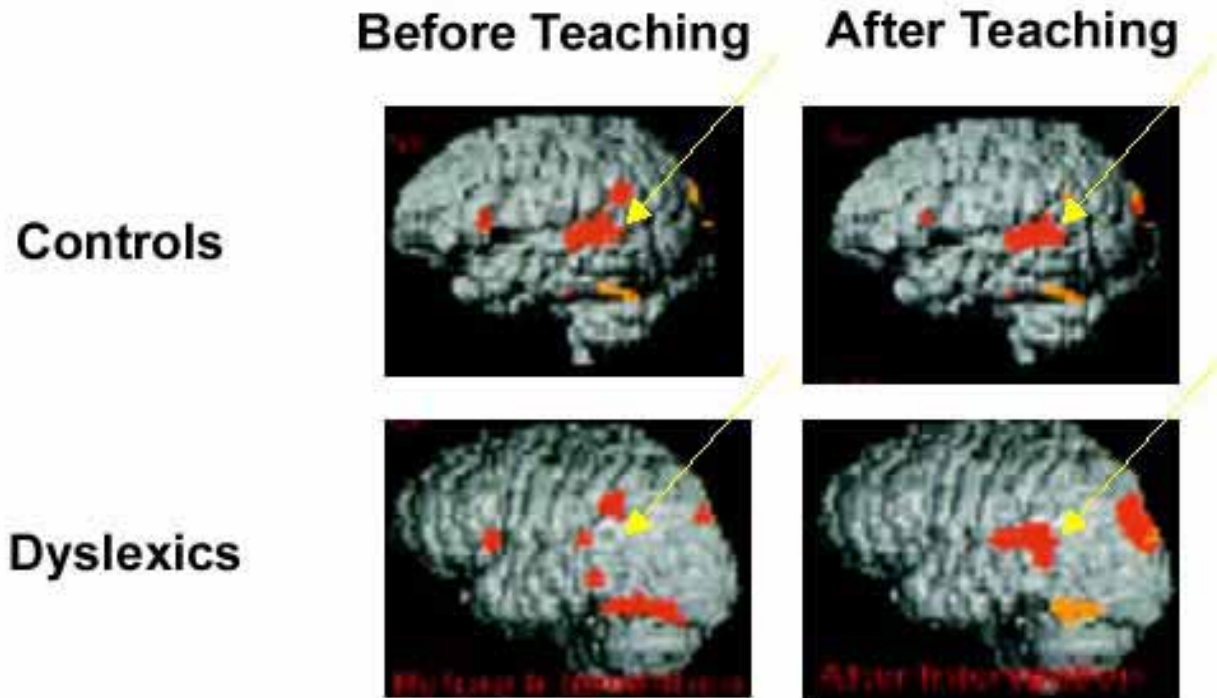
**Plastic neural changes and reading improvement caused by audiovisual training in reading-impaired children**

T. Kujala<sup>\*†</sup>, K. Karma<sup>‡</sup>, R. Ceponiene<sup>\*</sup>, S. Belitz<sup>\*</sup>, P. Turkkila<sup>‡</sup>, M. Tervaniemi<sup>\*</sup>, and R. Näätänen<sup>\*§</sup>

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

**Bennett A. Shaywitz, Sally E. Shaywitz et al**

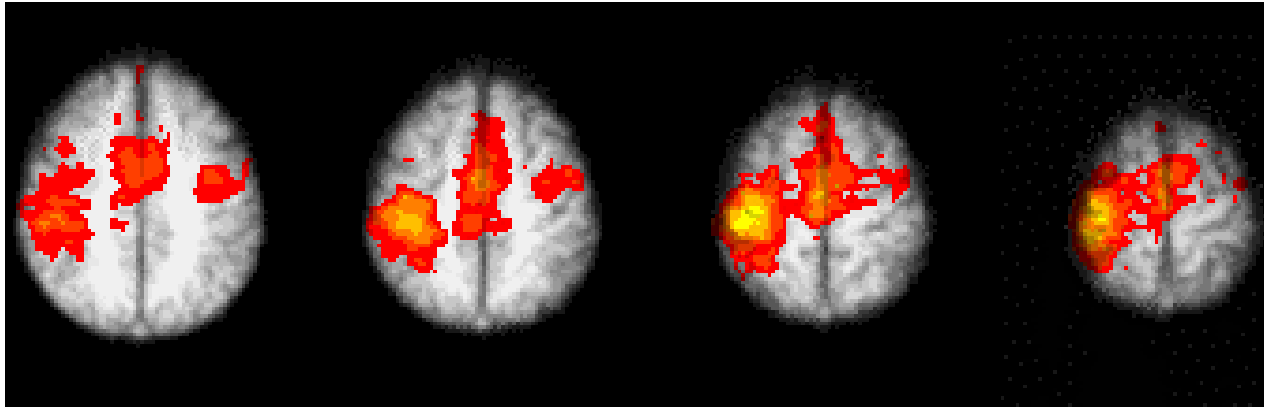
# Teaching Corrects Dyslexia Pattern By MRI



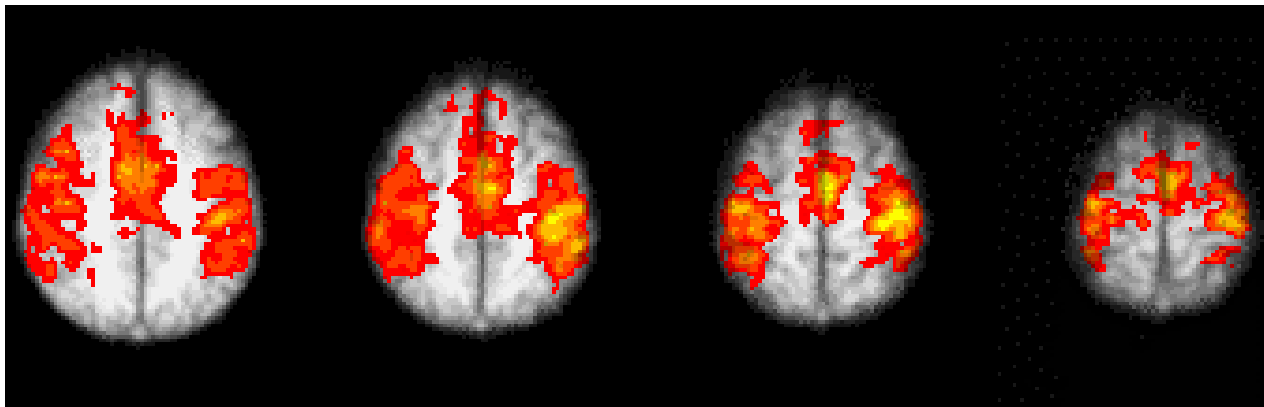
80 hrs (1-2 hrs / day) one-on-one instruction  
Phonological Processing & Decoding  
Multisensory & Visual Imagery Instruction

# Baseline FMRI shows more bilateral activation with affected hand movement

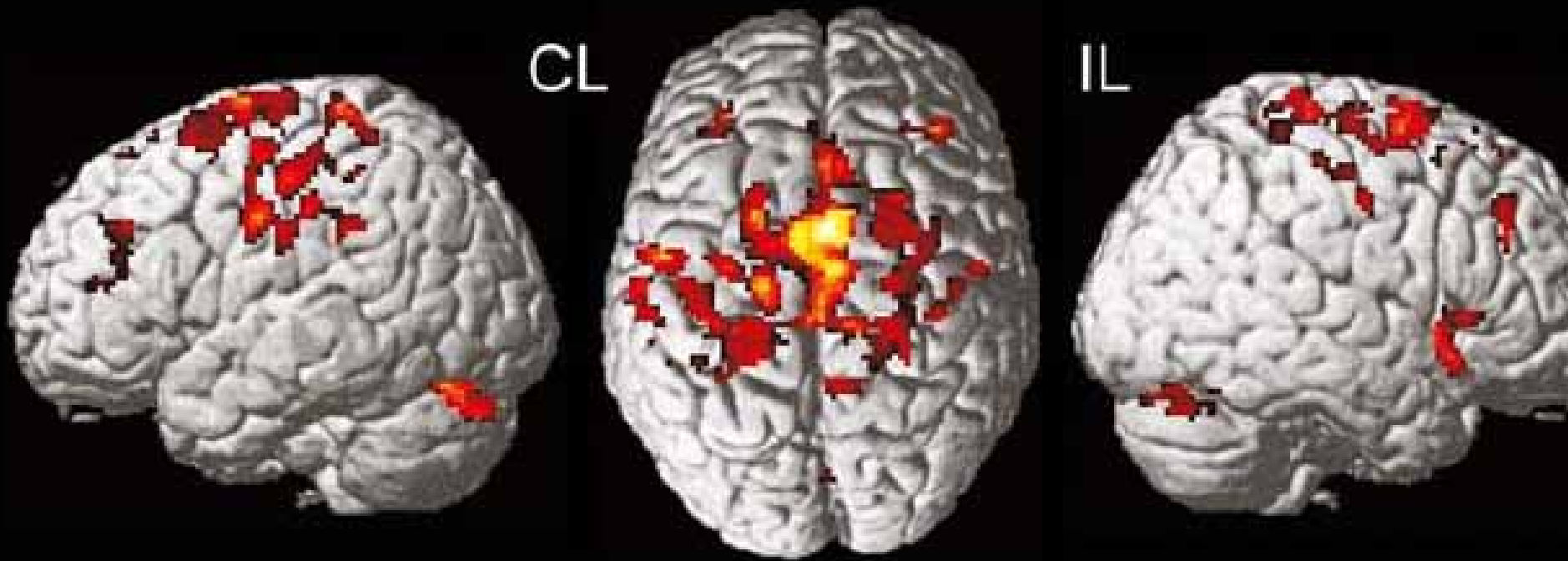
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Unaffected hand



Affected hand



Do stroke patients recruit different brain areas compared to normal subjects?

Are task-related brain activations correlated with outcome in patients?

How are task-related brain activations related to outcome?

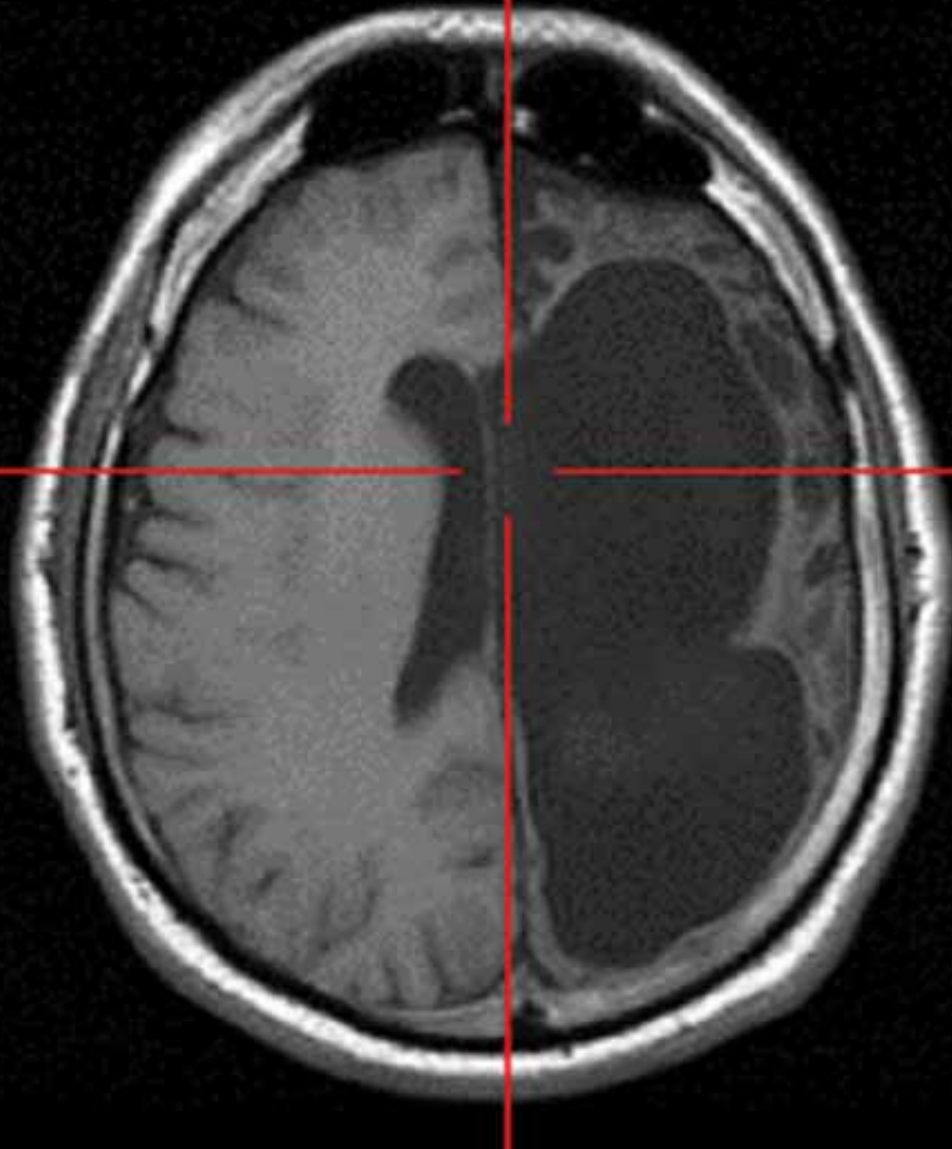
The functional anatomy of cerebral reorganisation after focal brain injury

Nick S. Ward \*, Richard S.J. Frackowiak

Journal of Physiology 99: 425–436,

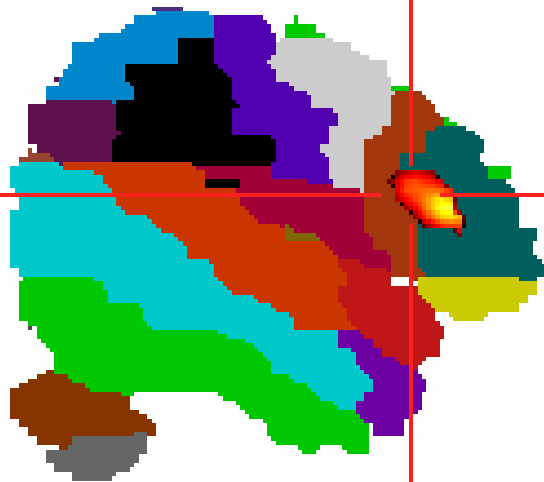
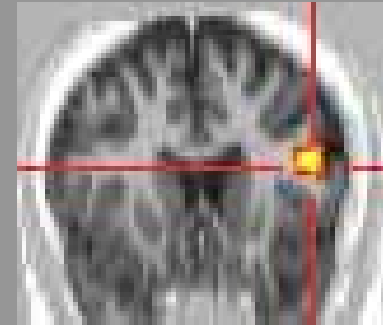
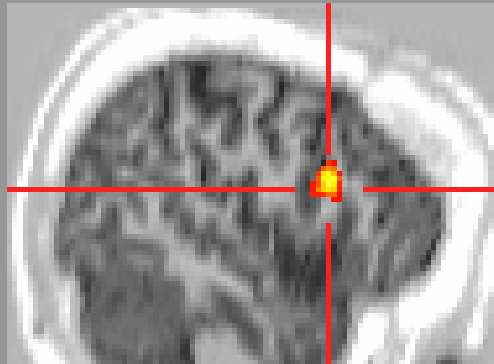
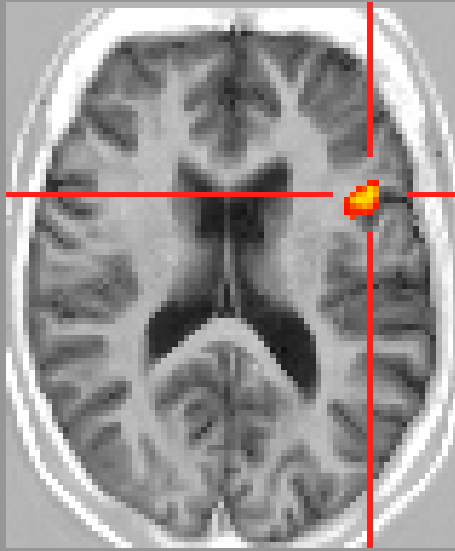
“Cognition without left hemisphere”

emisfero destro



D'Alessandro P e M Piccirilli, 2005

# Fluenza verbale



## Frutta

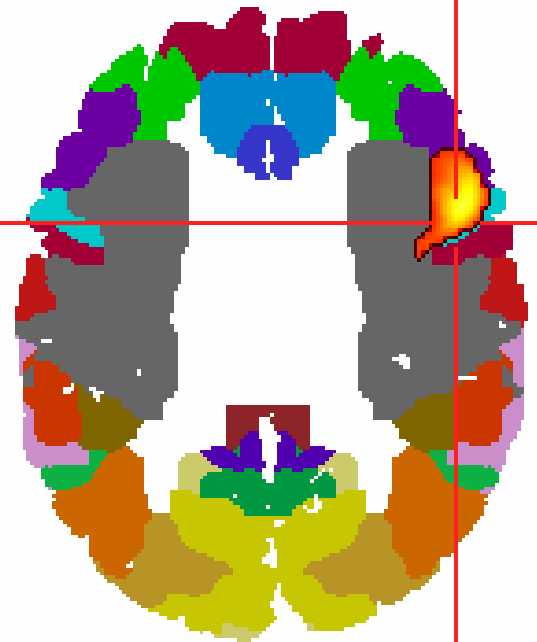
mela  
pera  
banana

.....

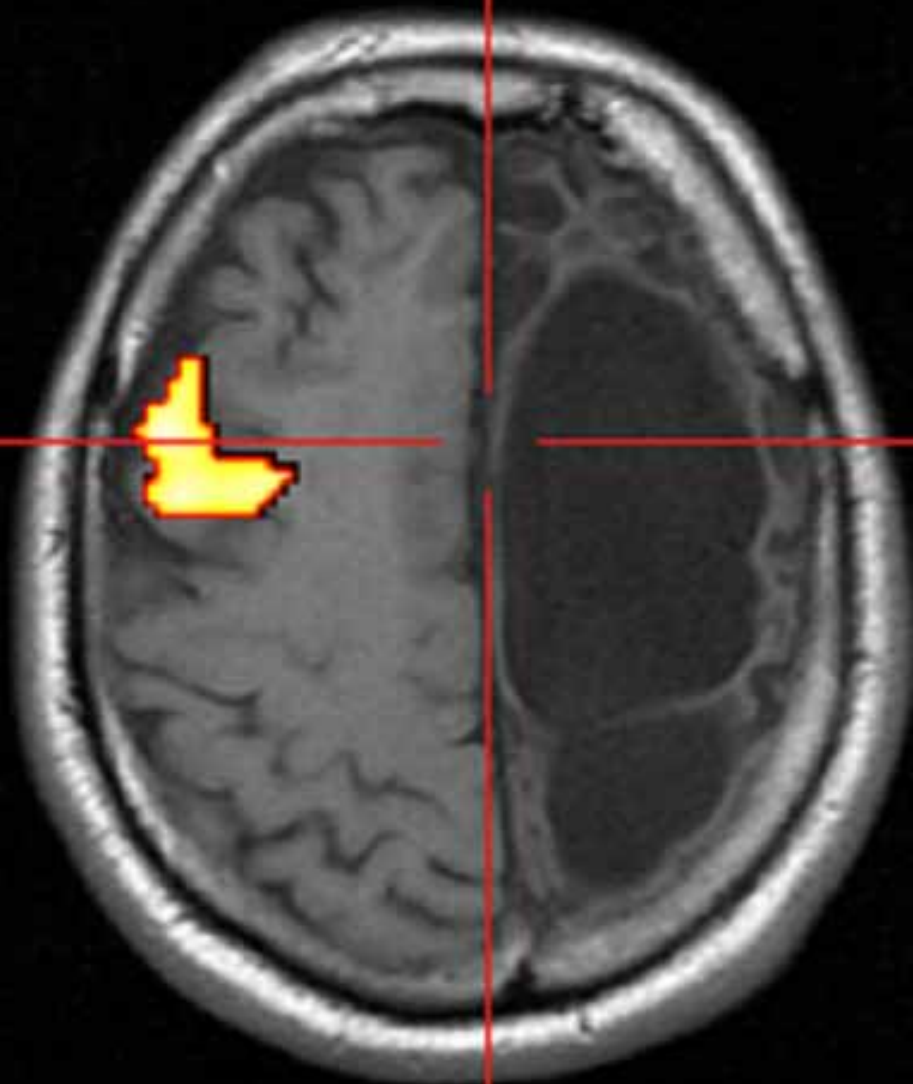
## Animali

cane  
gatto

.....



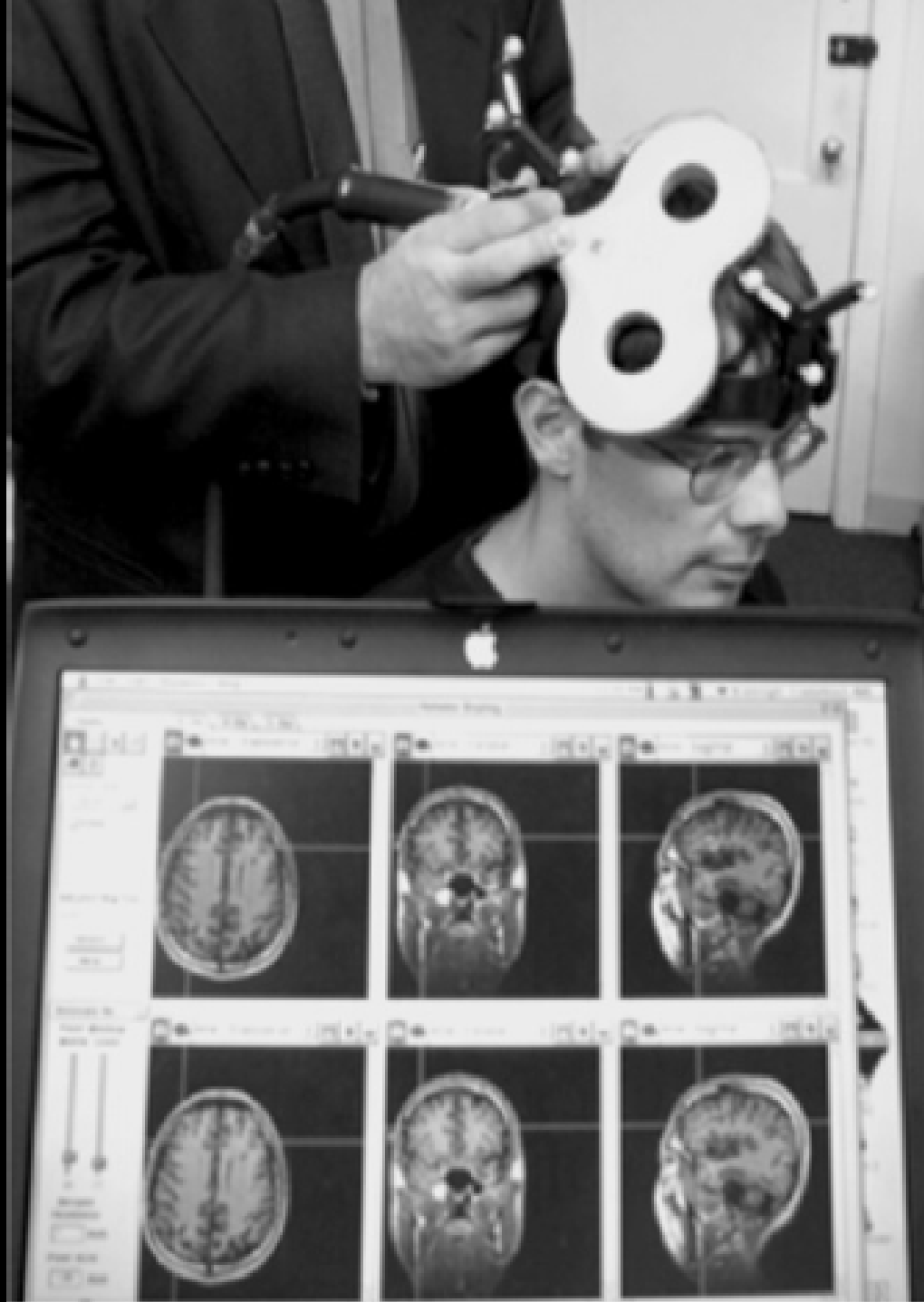
emisfero destro



Brain and Language  
93: 95–105, 2005

Improved picture naming  
in chronic aphasia  
after TMS  
to part of right Brocas area

Margaret A Naeser,  
PI Martin, M Nicholas,  
EH Baker, H Seekins,  
M Kobayashi, H Theoret,  
F Fregni, J Maria-Tormos,  
J Kurland, KW Dorona,  
A Pascual-Leone



# Dynamics of language reorganization after stroke

Dorothee Saur, Rüdiger Lange, Annette Baumgaertner, Valeska Schraknepper, Klaus Willmes, Michel Rijntjes and Cornelius Weiller (Aachen, Germany)

Brain 129: 1371-1384, 2006

*In the **acute phase***

*[mean: 1.8 days post-stroke (dps)]  
patients' group analysis showed  
little early activation  
of non-infarcted left-hemispheric  
language structures*

*in the **subacute phase***

*(mean: 12.1 dps)  
a large increase of activation  
in the bilateral language network with peak activation in  
the right Broca-homologue (BHo) and supplementary motor area (SMA)*

*in the **chronic phase** (mean: 321 dps)*

*a normalization of activation with a re-shift of peak activation to left-hemispheric language areas*

Studies of speech production suggest that **recovery depends on slowly evolving activation changes in the left hemisphere.**

## A fMRI study of word retrieval in aphasia

D. Perani,<sup>a,b,\*</sup> S.F. Cappa,<sup>b</sup> M. Tettamanti,<sup>c</sup> M. Rosa,<sup>d</sup> P. Scifo,<sup>c</sup> A. Miozzo,<sup>e</sup>  
A. Basso,<sup>f</sup> and F. Fazio<sup>a,c</sup>

<sup>a</sup> *Institute of Neuroscience and Bioimaging-CNR, Via Olgettina 60, 20132 Milan, Italy*

<sup>b</sup> *University Vita-Salute HSR, Milan, Italy*

<sup>c</sup> *IRCCS H San Raffaele, Milan, Italy*

<sup>d</sup> *Centre de Estudos de Linguagem, Egas Moniz, Hospital de Santa Maria, Lisbon, Portugal*

<sup>e</sup> *Department of Neurology, University of Brescia, Brescia, Italy*

<sup>f</sup> *Institute of Neurology, University of Milan, Milan, Italy*

Accepted 10 September 2002

### Abstract

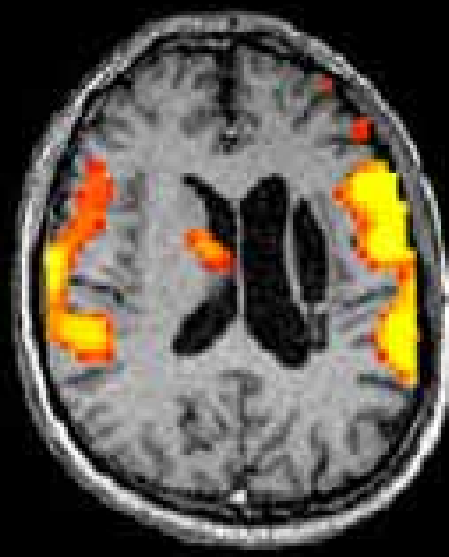
The neural mechanisms underlying recovery of cognitive functions are incompletely understood. Aim of this study was to assess, using functional magnetic resonance (fMRI), the pattern of brain activity during covert word retrieval to letter and semantic cues in five aphasic patients after stroke, in order to assess the modifications of brain function which may be related to recovery. Four out of five patients had undergone language recovery, according to standard testing, after at least 6 months of rehabilitation. The cerebral activation of each patient was evaluated and compared with the activation pattern of normal controls studied with the same fMRI paradigm. In the patients, the pattern of brain activation was influenced by the site and extent of the lesion, by the degree of recovery of language, as reflected by task performance outside the scanner, and by task requirements. In the case of word retrieval to letter cues, a good performance was directly related to the activation in Broca's area, or in the right-sided homologue. On the other hand, in the case of semantic fluency, the relationship between performance level and activation was less clear-cut, because of extensive recruitment of frontal areas in patients with defective performance. These findings suggest that the performance in letter fluency is dependent on the integrity of the left inferior frontal cortex, with the participation of the homologous right hemispheric region when the left inferior frontal cortex is entirely or partially damaged. Semantic fluency, which engages the distributed network of semantic memory, is also associated with more extensive patterns of cerebral activation, which however appear to reflect retrieval effort rather than retrieval success.

## Therapy-related reorganization of language in both hemispheres of patients with chronic aphasia

Friedemann Pulvermüller,<sup>a,\*</sup> Olaf Hauk,<sup>a</sup> Katrin Zohsel,<sup>b</sup>  
Bettina Neiningen,<sup>b</sup> and Bettina Mohr<sup>a,c</sup>



Patient 2



Patient 6



Patient 4

# 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>3</sup>Department of Electrical Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Korea; <sup>4</sup>Department of Biomedical Engineering;

<sup>5</sup>College of Communication, Boston University, Boston, MA, USA

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

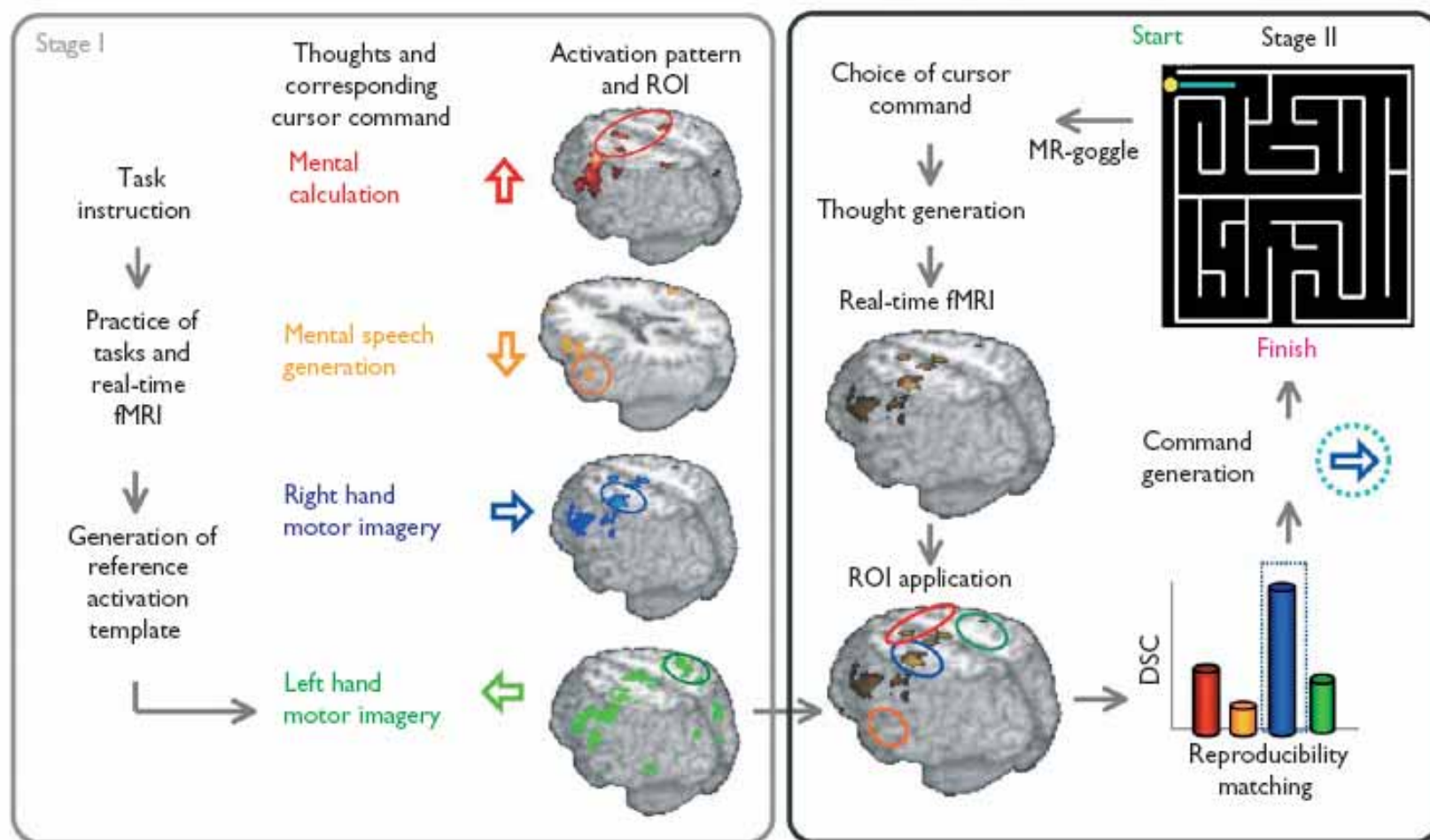
Received 8 April 2004; accepted 28 April 2004

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 (3T) 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.

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

La grande bellezza della scienza  
è che il progresso in essa,  
che sia grande o piccolo,  
invece di esaurire il soggetto di ricerca,  
apre la porta a conoscenze ulteriori e  
più abbondanti,  
straripanti di bellezza e utilità

Michel Faraday

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

grazie  
per  
l'attenzione