

# NEUROIMAGING

MICROSCOPIC )  
CELLULAR )  
SYSTEMS )

functional & structural  
spatially resolved  
temporally resolved



Richard Frackowiak  
FIL, Queen Square, UCL

**BRAIN RESEARCH**  
knowing how the brain works:  
from perception to language,  
cognition & consciousness

**FIL, ICN, ENS, SISSA...**

**MEDICINE**  
aging,  
drug addiction, pain,  
neurological & psychiatric  
disease...  
30% medical budgets

**Insurances, social security...**

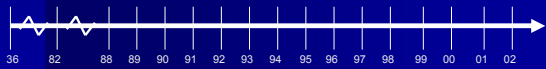
**SOCIETY**  
education,  
oral & written  
language learning,  
social behavior &  
its disorders

**Education, literacy...**

**INDUSTRY**  
biotechnologies,  
man-machine  
interface &  
prostheses,  
Information  
technologies,  
robotics,  
medical  
Instrumentation

**Siemens, Bruker, Magnex...**

<b>Technology</b>	1.5T, 3T, 4T EPI Local Human Head Gradient Coils BOLD ASL Spiral EPI Multi-shot MRI	EPI on Clin. Syst. Nav. pulses Quant. ASL Dynamic IV volume Simultaneous ASL and BOLD	Diff. tensor Real time fMRI Z-shim Baseline Susceptibility Current Imaging?	Magn Venography TT >8 channels SENSE
<b>Methodology</b>	Baseline Volume IVIM	Correlation Analysis Parametric Design Phase Mapping Linear Regression Event-related Deconvolution Fuzzy Clustering Multi-variate Mapping	Motion Correction Surface Mapping ICA Mental Chronometry Deconvolution Fuzzy Clustering Multi-variate Mapping	CO <sub>2</sub> Calibration Mixed ER and Blocked Multi-Modal Mapping Free-behavior Designs Free-behavior Designs Free-behavior Designs Free-behavior Designs Free-behavior Designs
<b>Interpretation</b>	Blood T2 Hemoglobin	BOLD models B <sub>2</sub> dep TE dep SE vs GE NIRS Correlation Vents Inflow	IV vs EV Pre-undershoot Resolution Dep Post-undershoot CO <sub>2</sub> effect Fluctuations Balloon Model Optical Im. Correlation Electrophys. correlation	PET correlation Mixed ER and Blocked PSF of BOLD Linearity mapping Extended Stim. Linearity Metab. Correlation Optical Im. Correlation Electrophys. correlation
<b>Applications</b>	Volume - Stroke A Volume-V1	Complex motor Language Motor learning Presurgical V1, V2, mapping Plasticity	Imagery Children Attention Pressing/Learning Face recognition Performance prediction	Emotion Tumor vasc. Ocular Dominance Clinical Populations Performance prediction


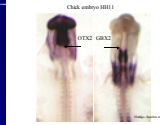

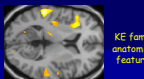
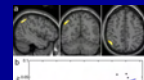
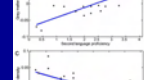



## GENE NETWORKS IN BRAIN DEVELOPMENT & EVOLUTION

cell lineage in *Caenorhabditis*  
Sulston et al 1983

secondary organisers in the chick  
Hidalgo-Sanchez et al 1999

from the human genome to  
the human brain

molecular evolution of FOXP2:  
a gene involved in speech & language  
Monaco, Paabo et al 2002

Innate and environmentally  
driven intellectual capacities  
Mechelli et al 2004

## NEURAL NETWORKS OF COGNITIVE FUNCTIONS

example of reading

pure alexia  
Dejerine 1901

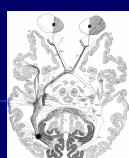


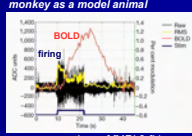
conscious vs non-conscious  
words processing  
Dehaene 2001

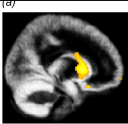
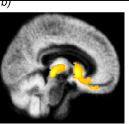
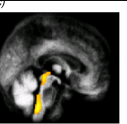
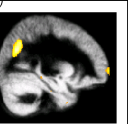
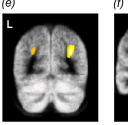
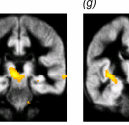
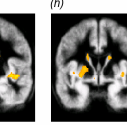
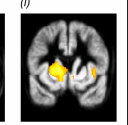
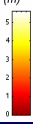
toward an integration of anatomy, functional imaging,  
electrophysiology & cognitive behavior

regional Cerebral Blood Flow  
Lassen & Ingvar 1975

monkey as a model animal

comparison of fMRI & firing  
Logothetis 2001

**Preclinical diagnosis of debilitating diseases of ageing**

