



Dr Vincent Giampietro

Module:
Techniques in Neuroscience

Week 1:
Understanding the brain: Who we study, how and why?

Topic 1:
The living brain
Part 3 of 3

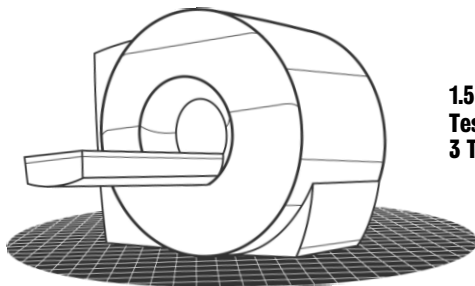
Part 3

Introduction to part 3

An introduction to
**Functional Magnetic Resonance Imaging
 (fMRI)**

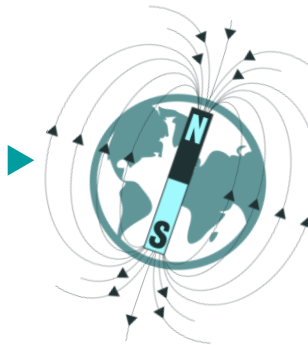


MRI – magnetic resonance imaging



1.5
 Tesla
 3 Tesla

The magnetic field is generated by a superconductive magnet that is always 'on' and that requires cooling by liquid helium.

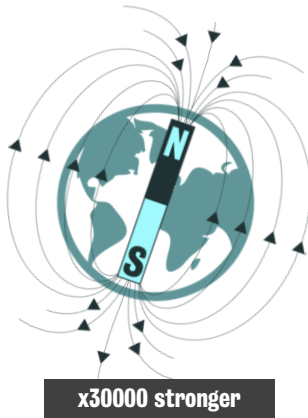


30000 times stronger than
 the earth's magnetic field



Participants and staff
 should be MR-compatible.

Junkyard electromagnet



The magnetic field generated by an MRI scanner is roughly equivalent to the one used in junkyards to lift cars.

fMRI - functional magnetic resonance imaging

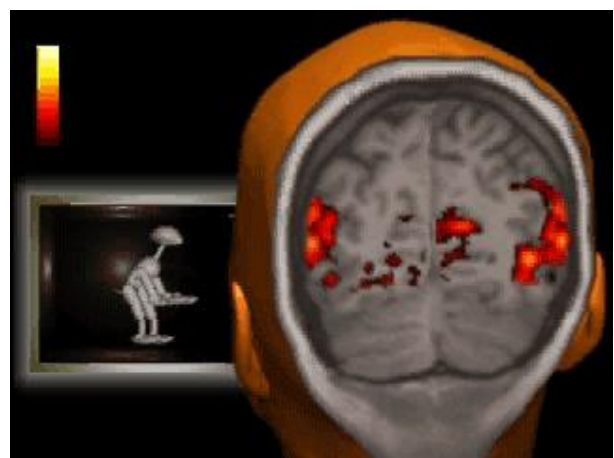


Functional MRI is not a quantitative technique, but rather works as a **contrast technique**.

fMRI is based on the principle of **cognitive subtraction**.



Different experimental conditions associated to different cognitive states are statistically contrasted to find out which parts of the brain respond to what is different between the conditions.



The fMRI experience



Click on video to play



Click on icon to play audio



Click on video to play

Click **Next** to continue

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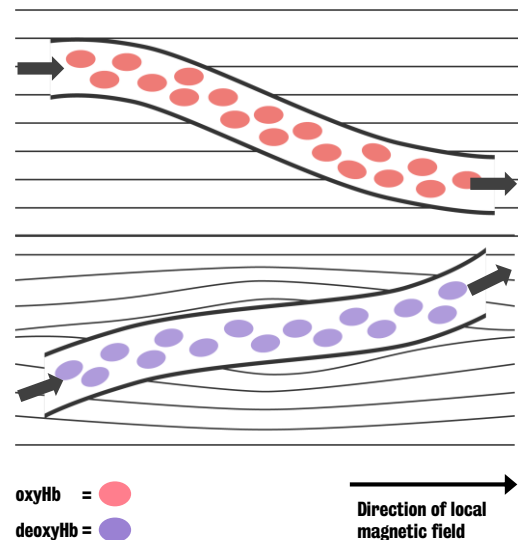
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fMRI measuring (1)

BOLD effect (**B**lood **O**xygenation **L**evel **D**ependent)

Oxyhaemoglobin [O₂Hb] is diamagnetic (not magnetic).

Deoxyhaemoglobin [HHb] is paramagnetic (magnetic).



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fMRI measuring (2)

Deoxyhaemoglobin perturbs the local magnetic field.

The brightness in an fMRI image is linked to the level of local magnetic perturbation.

The more magnetic perturbation, the darker the image.

fMRI measuring (3)



A local increase in brain activity triggers:

initial use of the local pool of oxygen:

more
deoxyhaemoglobin
than at rest

more magnetic
perturbation
than at rest

image darker
than at rest
(initial dip in BOLD
signal)

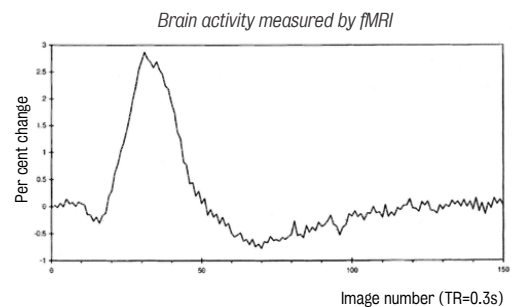
followed by a larger increase in regional oxygen delivery than what is needed:

local area
flooded by
oxyhaemoglobin

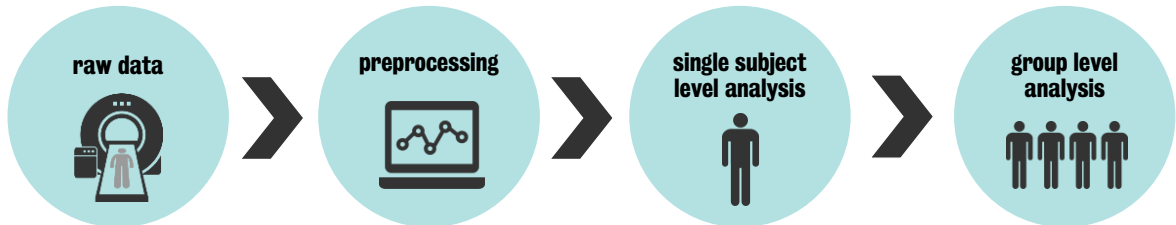
less regional
deoxyhaemoglobin
than at rest

less magnetic
perturbation
than at rest

image brighter
than at rest



fMRI processing stream



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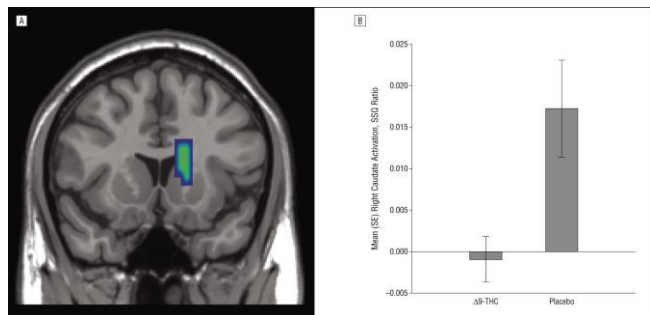
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Statistical analysis

**Most fMRI papers include:**

- brain maps
- result tables
- illustrative plots



Examples of how fMRI data are presented for publication



Induction of psychosis by Δ^9 -tetrahydrocannabinol reflects modulation of prefrontal and striatal function during attentional salience processing

Bhattacharyya et al. (2012)

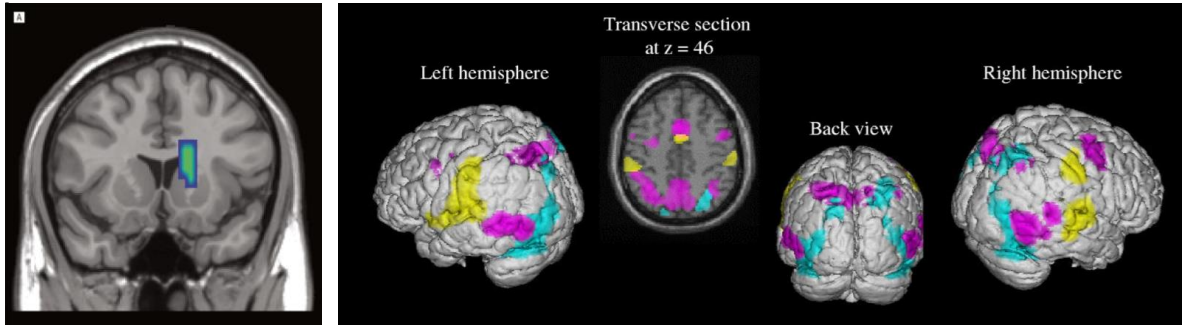
Bhattacharyya et al. (2012)

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Prettification of the results



Bhattacharyya et al. (2012); Macaluso et al. (2007)

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What do we study at IoPPN?



**Scanning
since 1995**



**~70 research
projects going
on at any time**



**Four clinical MRI
scanners scanning six
days a week, 8am –
7pm**

**Two pre-clinical MRI
scanner scanning
seven days a week**



**~100,000
subjects/patients
scanned**

So the question should be:
what have we NOT studied at the IoPPN?

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End of topic