

Introduction to consciousness

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- **Definitions**

Consciousness: cognitive process that enable us to *experience* the world around us

Distinct from automatic behaviours that occur in a rather unconscious manner:

Consciousness is not equal to be alert or attentive:

Are you conscious of the change?









Consciousness:

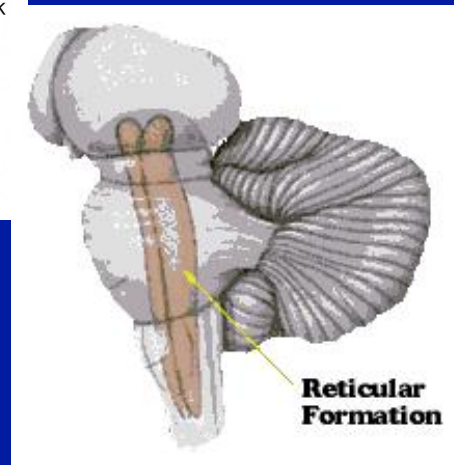
Levels vs. Contents

Alertness vs. Subjective
experience

Levels of consciousness: Alertness



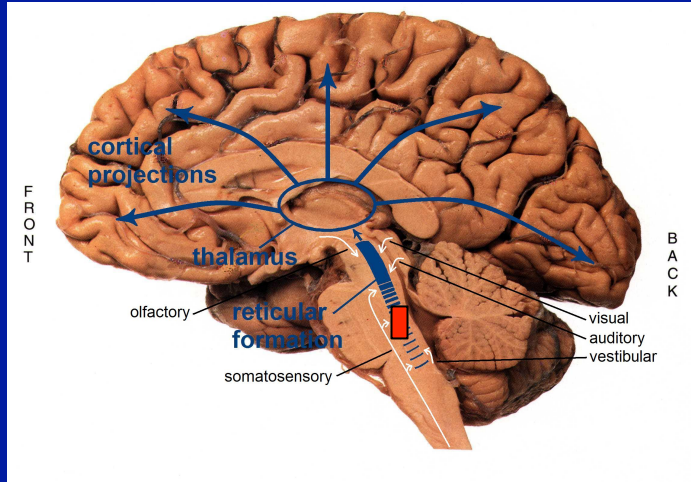
Reticular formation



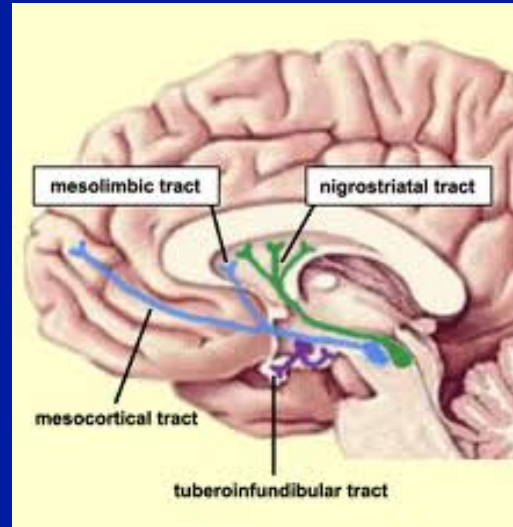
Regulates many vital functions. It projects to the thalamus and the cortex, allowing it to 'control' whether or not sensory signals reach cortical sites of conscious awareness such as the posterior parietal cortex

Reticular Activating System

The degree of activity in the reticular system is associated with alertness/levels of consciousness

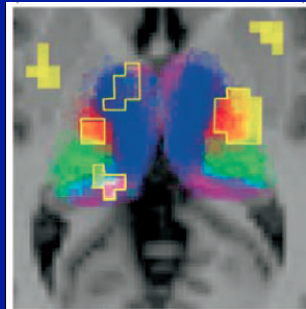
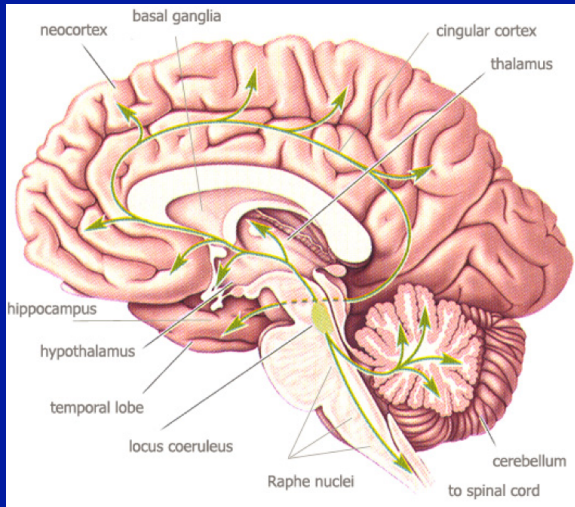


Locus coeruleus – noradrenergic neurones

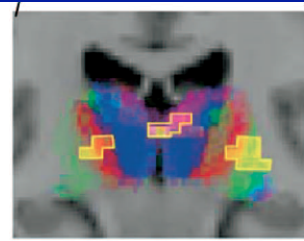


Ventral tegmental Area
Dopaminergic neurones

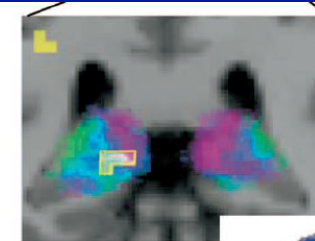
Cholinergic neurons in the reticular formation boost the level of activity in cerebral cortex via the thalamus



Z = 4



Y = -21



Y = -33.5



Damage to the reticular formation/thalamus can lead to coma - state of unconsciousness

- **Persistent vegetative state**

(due to disconnection of cortex from brainstem or widespread cortical damage)

- **Brain death**

(due to brainstem death)

Other causes of coma

- Metabolic

Eg. hypoxia, hypoglycaemia, intoxication

Glasgow Coma Scale:

(score of 3: severe brain injury and brain death)

Eyes open

| | |
|-----------------------|---|
| none | 1 |
| in response to pain | 2 |
| in response to speech | 3 |
| spontaneous | 4 |

Verbal responses

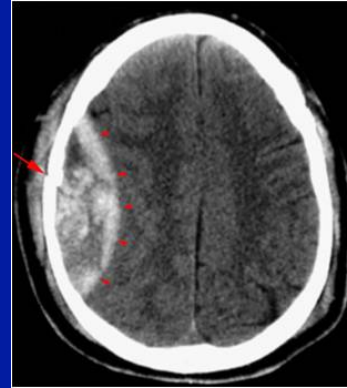
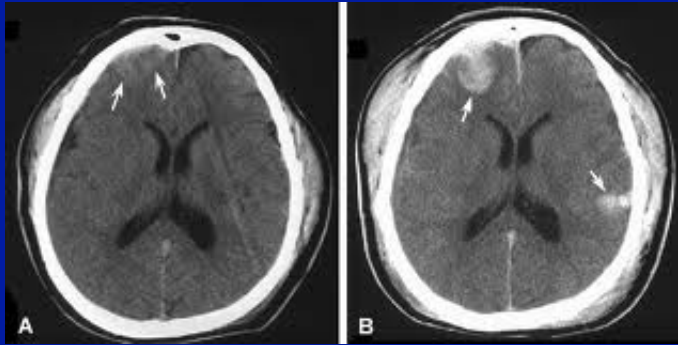
| | |
|-------------------------|---|
| none | 1 |
| incomprehensible sounds | 2 |
| inappropriate words | 3 |
| disoriented speech | 4 |
| oriented speech | 5 |

Motor responses

| | |
|---------------------------|---|
| none | 1 |
| extensor response to pain | 2 |
| flexor response to pain | 3 |
| withdrawal to pain | 4 |
| localisation of pain | 5 |
| obeys commands | 6 |

Altered states of consciousness

- Contusion , concussion



- Acute Confusion or delirium (dementias)
- Stupor

Monitoring level of arousal...



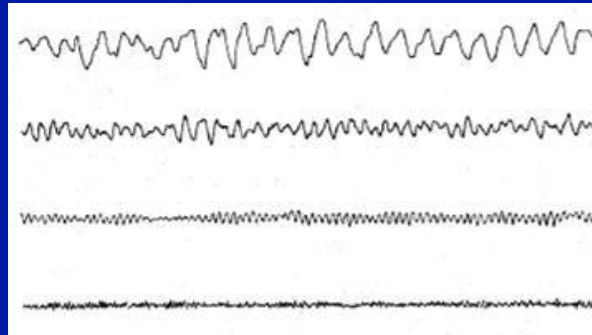
EEG rhythms: assessing alertness

Delta: Waves up to 4 Hz

Theta: 4-8 Hz

Alpha: 8-13 Hz

Beta; 13-30Hz



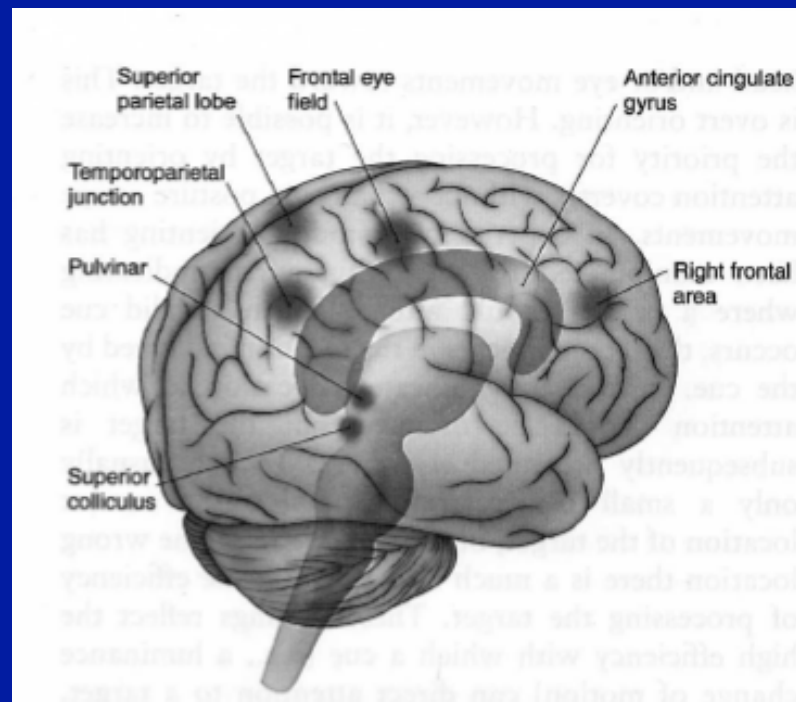
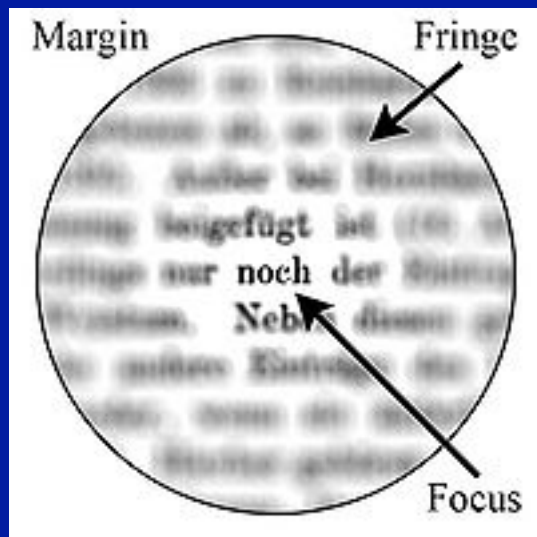
Sleep

Normal waking
consciousness

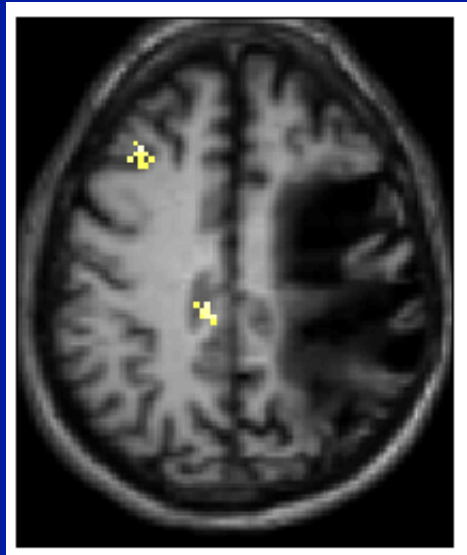
Higher frequency neural oscillations (gamma range: ~ 40 Hz associated with the creation of conscious contents in the focus of the mind's eye, **via thalamo-cortical feedback loops**).

Consciousness: the role of attention in selecting the contents of awareness.

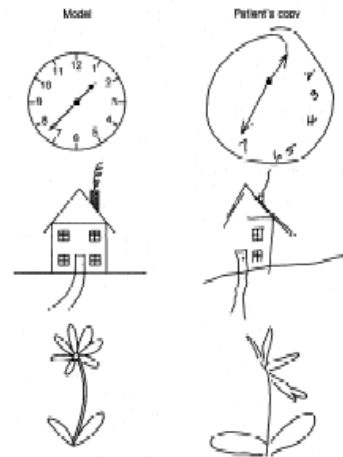
‘Orienting’ ‘Alerting’ & ‘Executive’ networks (Fan et al., 2000): moving the ‘spotlight’ of attention



Breakdown of conscious awareness after right brain damage.



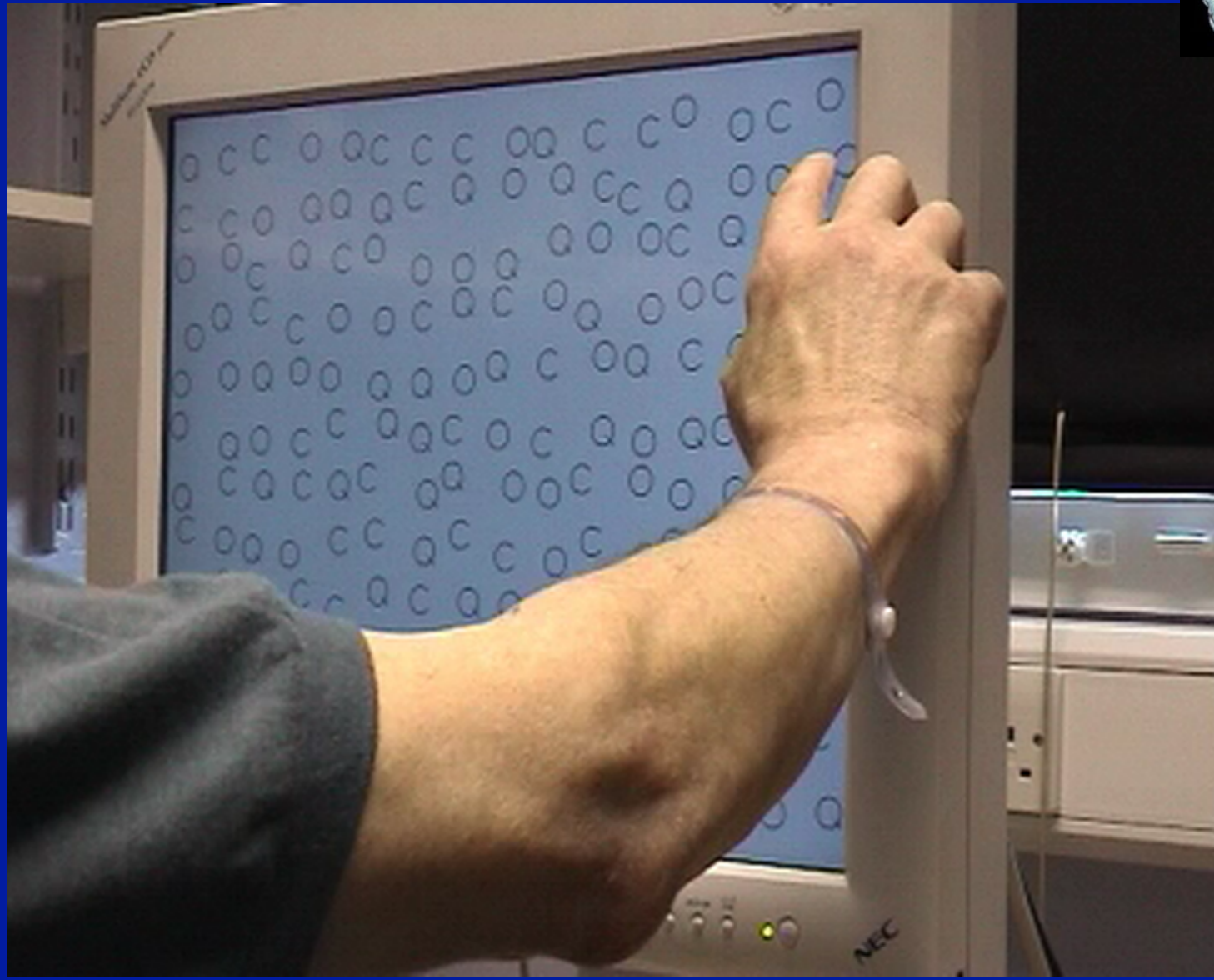
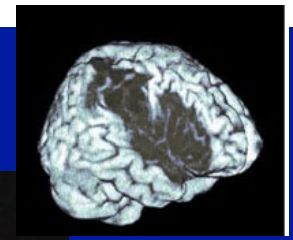
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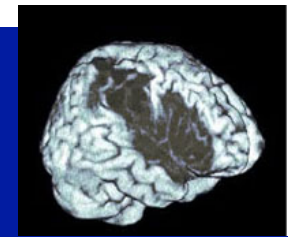
Spontaneous drawing:



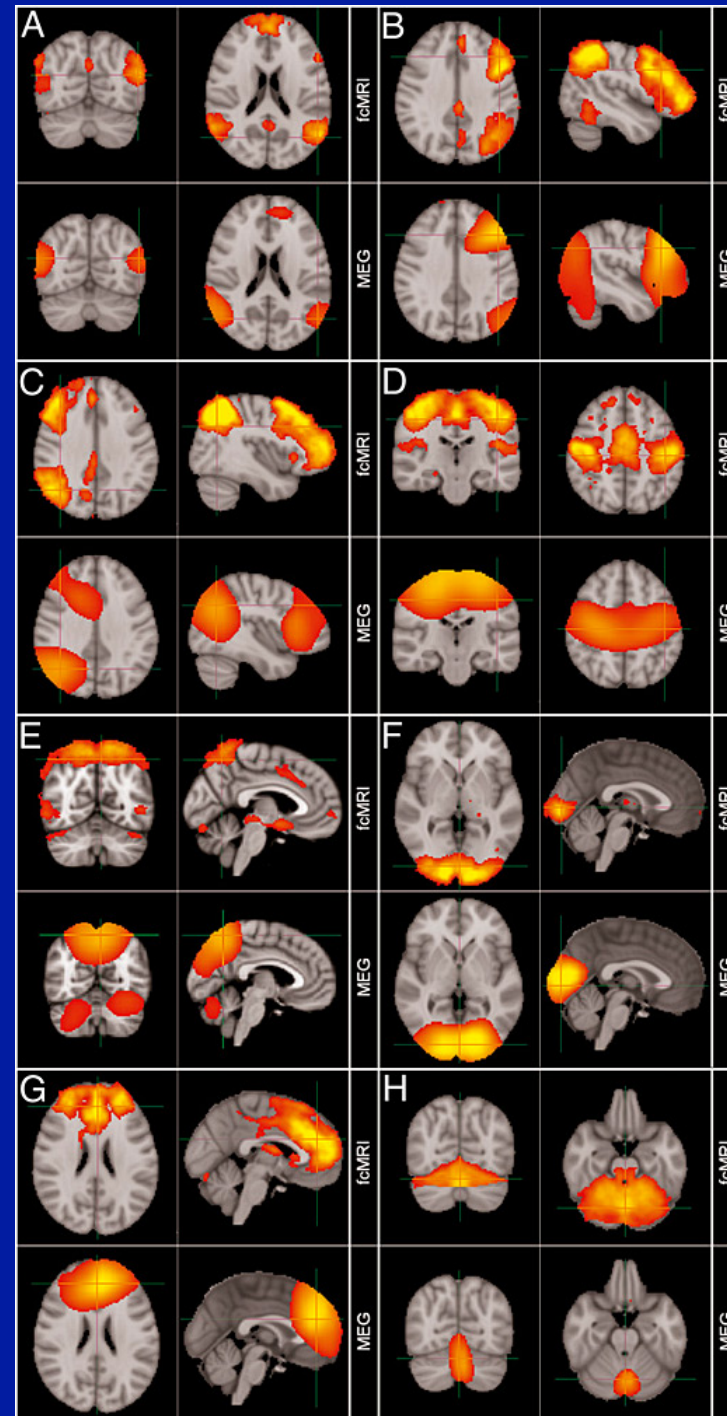
Cancellation test in patient with visual neglect



Visual exploration in a patient with visual neglect

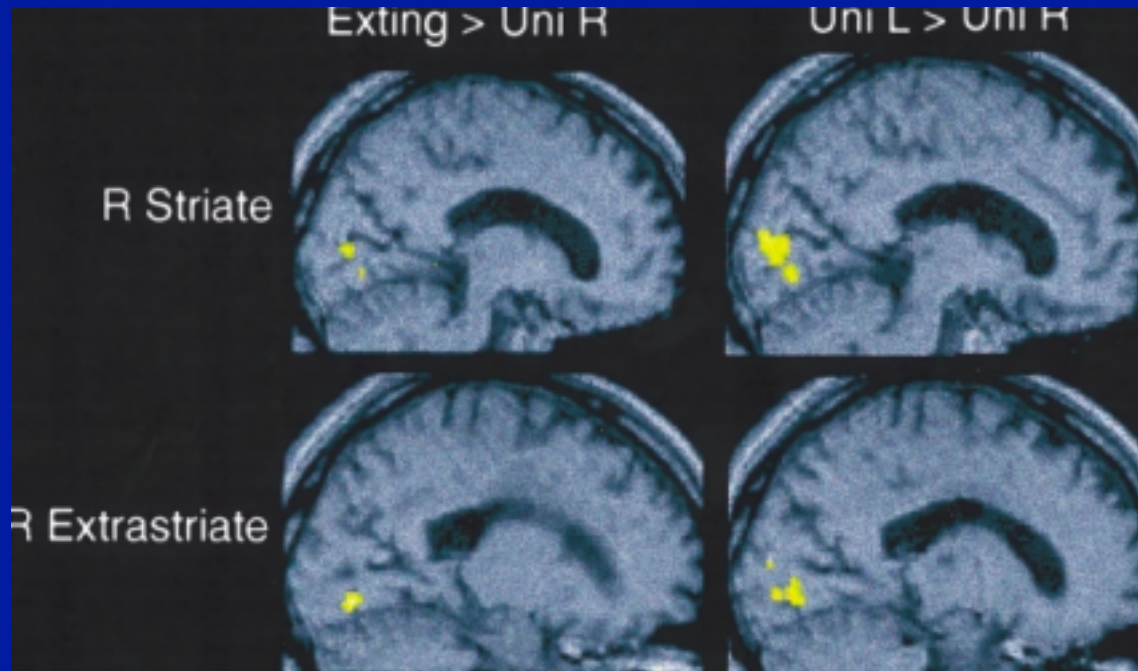


Using functional MRI to study consciousness in health and disease



Brain activation for unconscious information in patients with visual neglect (Rees et al., 1993, *Brain*)

Patient performed a Face/house detection task inside the fMRI scanner

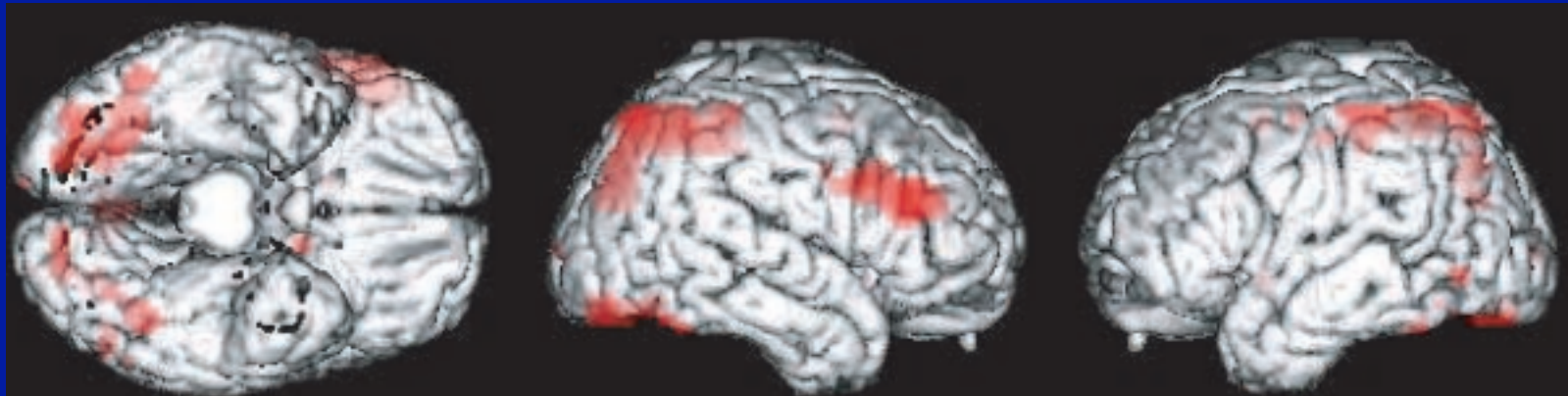


Activation of primary visual cortices may not be sufficient for consciousness -

'Blindsight': brain-damaged (occipital visual cortex) patients who are perceptually 'blind' of their visual field can however demonstrate some response to visual stimuli.

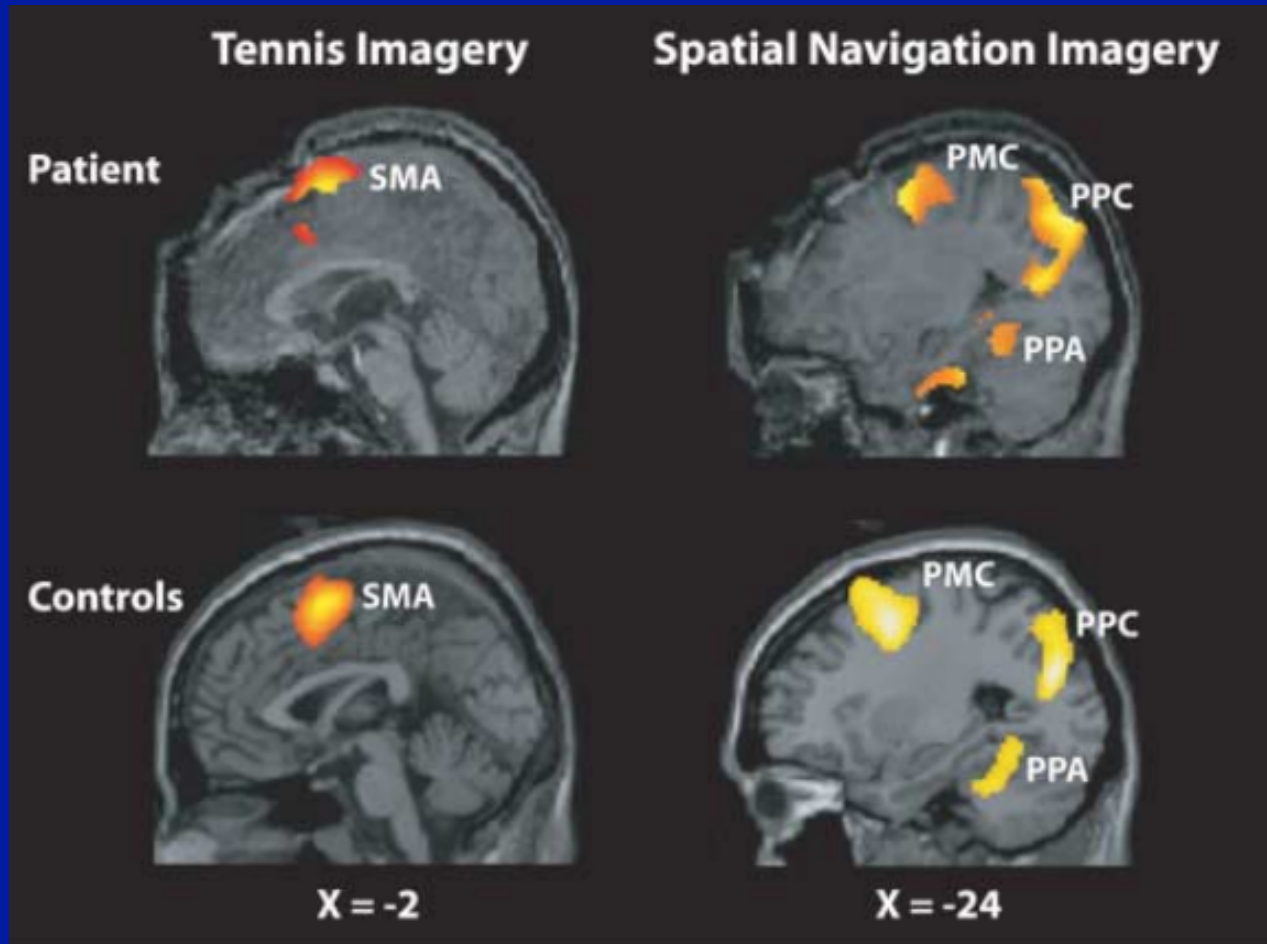


What is then the neural correlate of consciousness?



Beck et al (2001, *Nature Neurosci*)

Detecting Awareness in the Vegetative State (coma 'vigil')



Owen et al. (2006, *Science*)

Thank you for your attention!