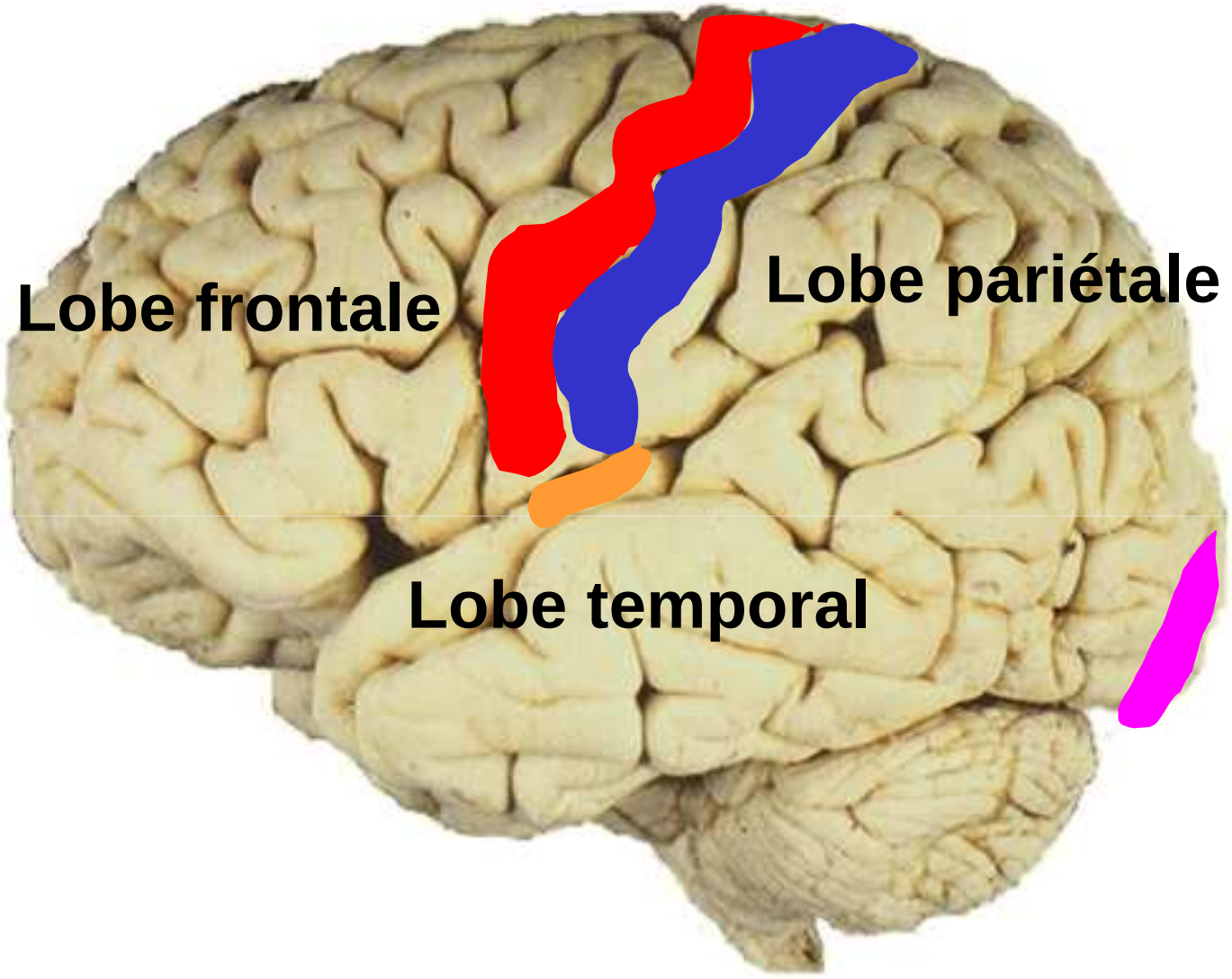
Cerveau, conscience et spiritualité

- Expérience consciente et le cerveau
  - Plaisir, perception de soi, récompense
- Esprit versus cerveau
  - Expérience religieuse a-t-elle un fondement cérébral?
  - Y a-t-il des configurations cérébrales qui facilitent la pratique religieuse?
  - Notre cerveau est-il changé par la pratique religieuse?
  - Notre expérience religieuse est-elle changée par des lésions cérébrales?
- Qu'est-ce la foi?
- Notre cerveau nous prédestine-t-il à croire?

Une lésion cérébrale peut causer des déficits cognitifs spécifiques et perturber ainsi notre expérience consciente d'une façon très particulière

- 2e moitié du 19 siècle: démonstration par les effets des lésions cérébrales

- dès 1995: démonstration des réseaux neuronaux impliqués chez les sujets normaux par imagerie fonctionnelle



Cx visuel I

Cx auditif I

Cx moteur

Cx somatos

Vue latérale de l ’hémisphère gauche

Reconnaître

S’orienter

Faire attention

En parler

Comprendre

Se souvenir

Planifier,
organiser,
gérer

Aimer

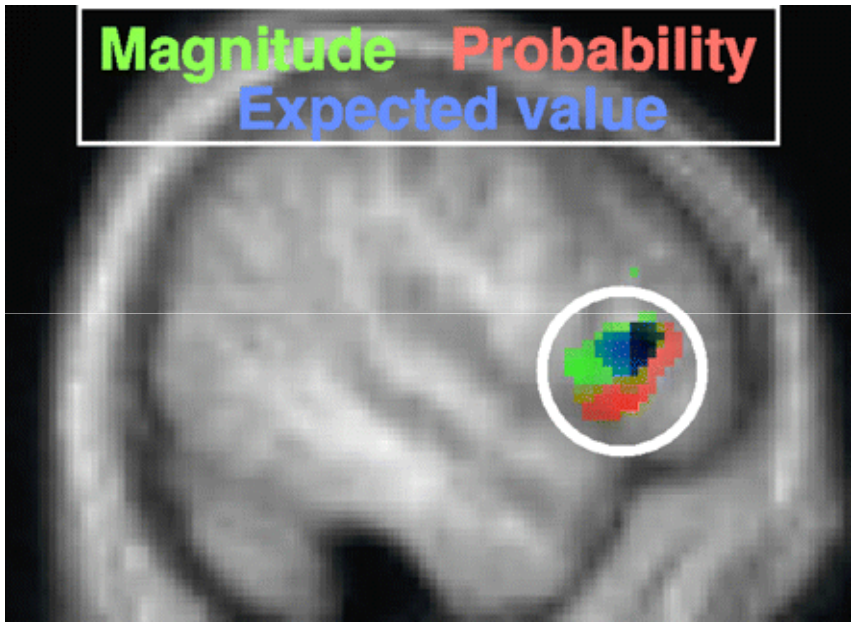
Interagir
avec les autres

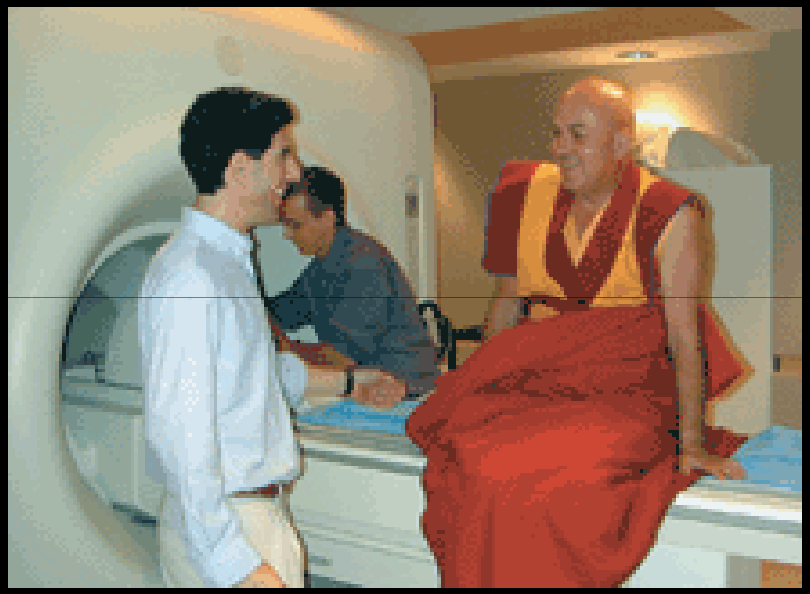
Tobler et al. 2007: Reward value coding distinct from risk attitude-related uncertainty coding in human reward system

Economic decision making
-Expected value
-Risk
-Probability

Reward game with a specific probability and magnitude of reward

Different conditioned stimuli were associated with different reward magnitudes and probabilities (and their expected value as their product)

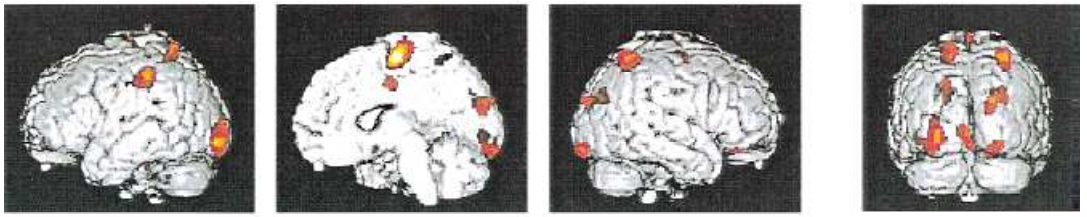




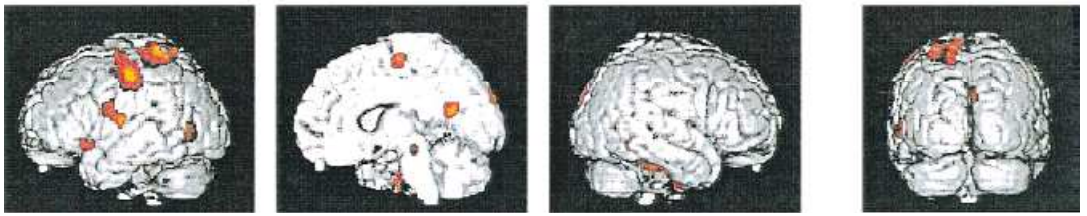
Buddhism and Neuroscience
Science, 3 Oct 2003

Lou et al. 1999: PET activation study of 4 stages of meditation (Yoga Nidra) vs normal consciousness

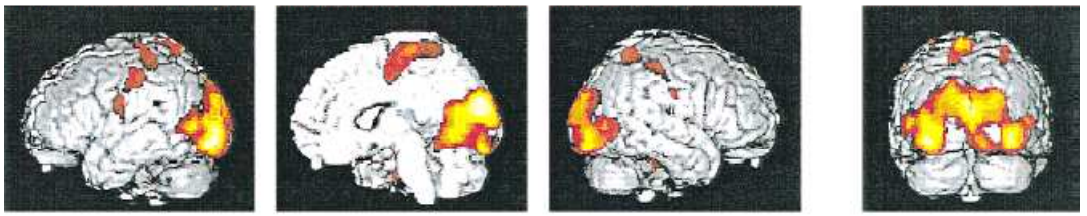
Weight of body parts



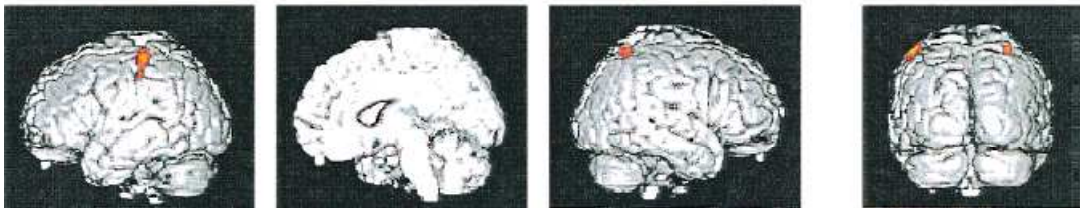
Abstract perception of joy



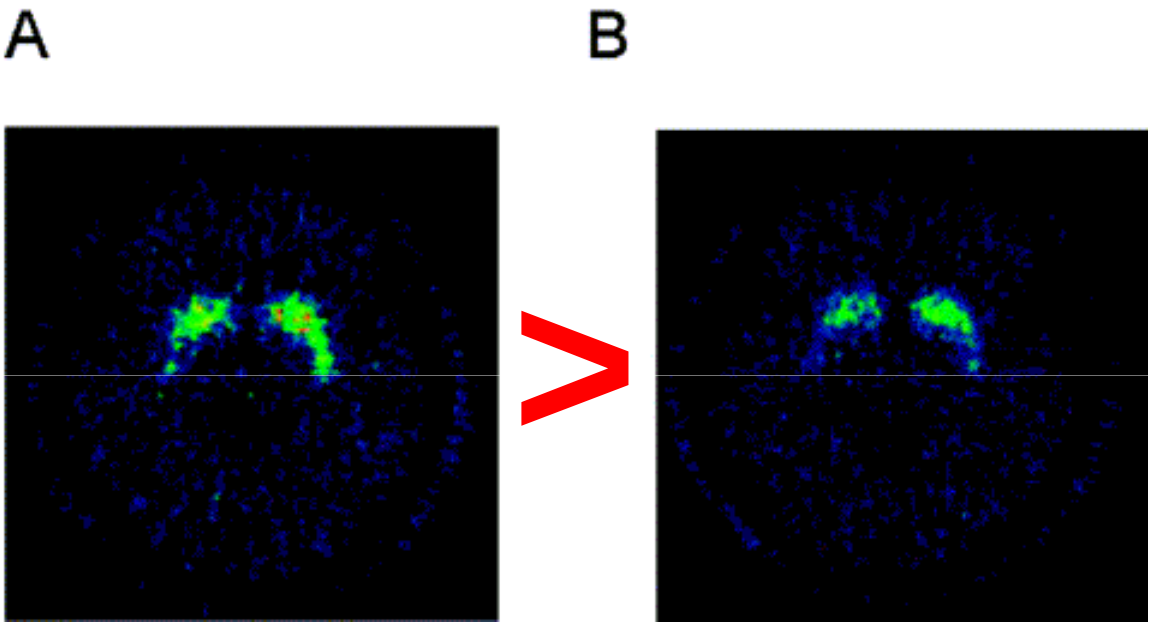
Visual imagery



Sympbolic representation of the self



Kjaer et al. 2002: Increase dopamine tone during meditation-induced change of consciousness



11C-raclopride binding at the level of the striatum during attention to speech (A) and meditation B; Yoga Nidra). Lower binding in B is evidence of increased endogenous dopamine release during meditation.

Kakigi et al. 2005: Intracerebral processingin a Yoga Master who claims not to feel pain during meditation

fMRI activation during noxious laser stimulation of left hand/foot

1. **Thalamus**
2. **SII-insula**
3. **Cingulate cortex**

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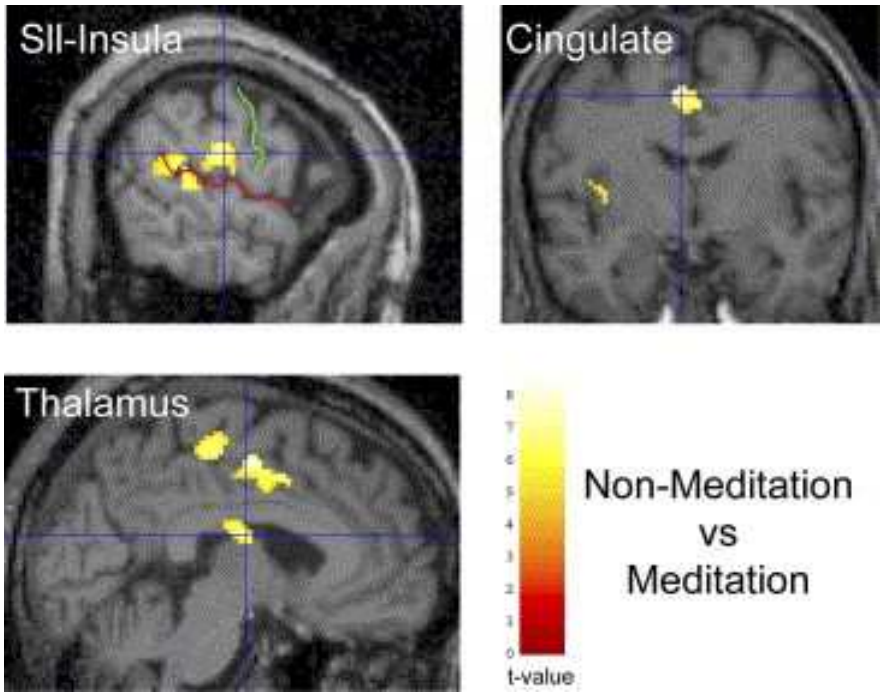
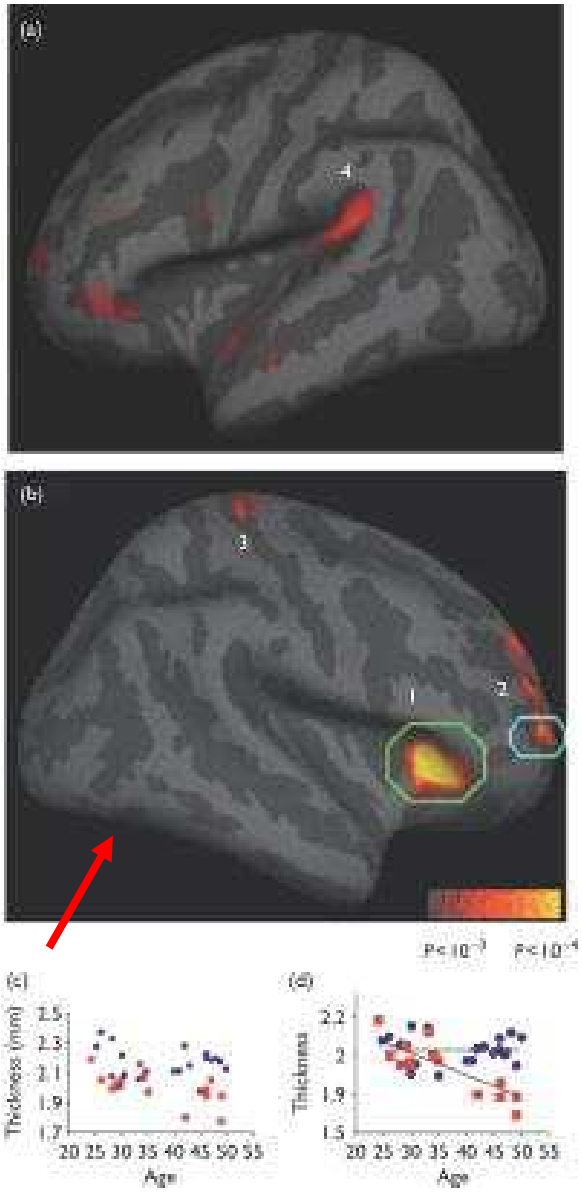


Lazar et al. 2005: Meditation experience is associated with increased cortical thickness

Buddhist insight meditation
-cultivation of attention
-« mindfulness » = non-judgmental awareness of present-moment stimuli without cognitive elaboration
-Practice = sustained mindful attention to internal and external sensory stimuli

-Cortical thickness greater in practitioners

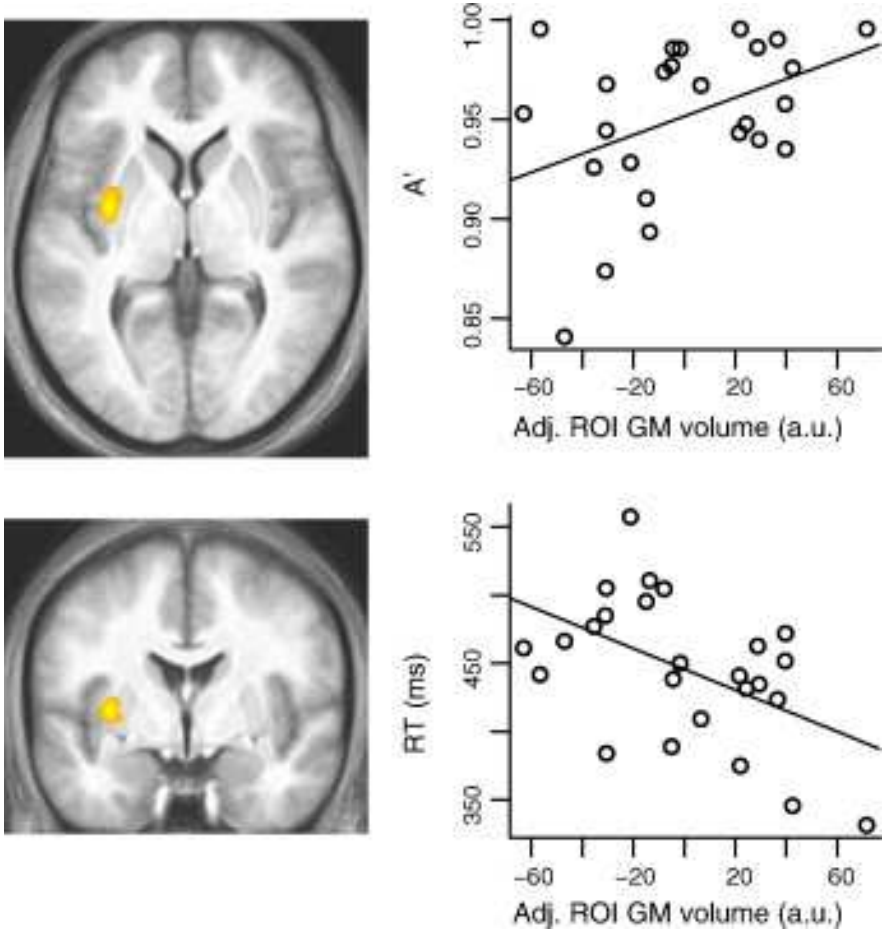


Pagnoni & Cekic 2007: Age effects on gray matter volume and attentional performance in Zen meditation

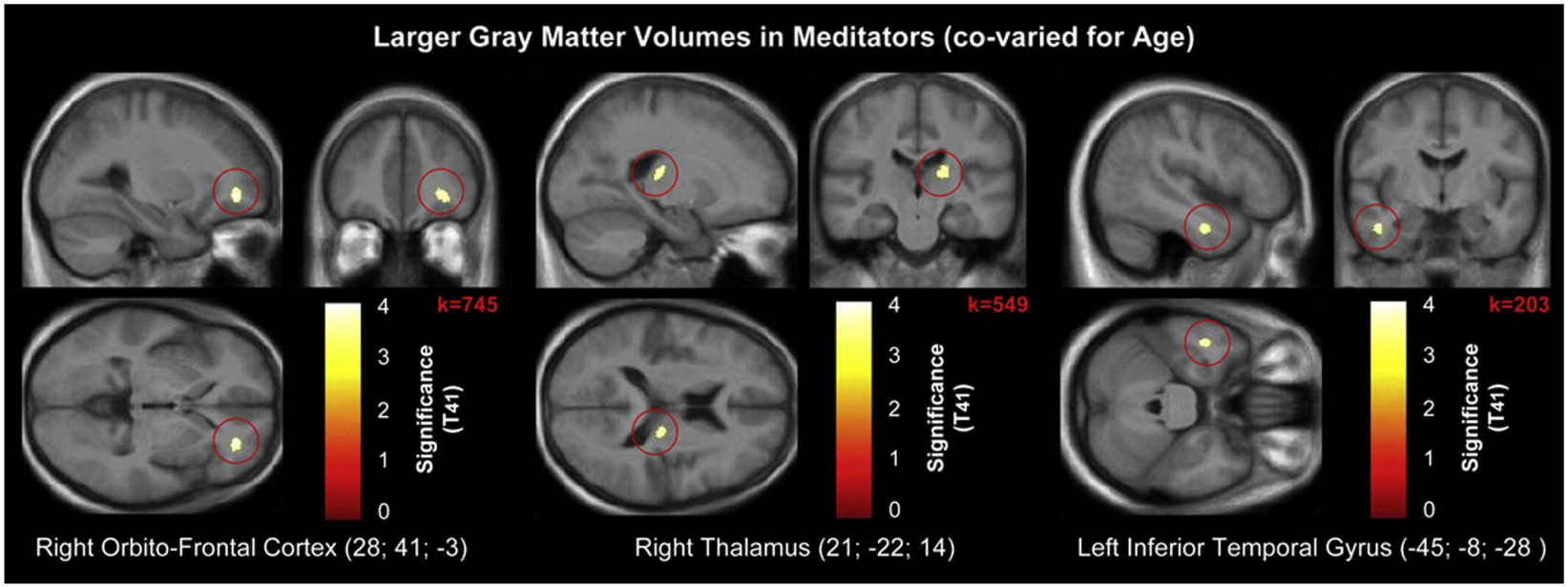
(Buddhist) Zen meditation

-Centred on attentional and postural self-regulation

-Regular practice was associated with significant absence of gray matter decrease in the putamen



Luders et al. 2009: The underlying anatomical correlates of long-term mediation: Larger hippocampal and frontal volumes of gray matter



22 meditators (practice of 5-46 years; Zazen, Samatha, Vipassana)
22 normal non meditators
1.5 T structural MRI

-Increased gray matter in right orbitofrontal cortex, right hippocampus and right thalamus
-Regions involved in emotional regulation and response control

Vestergaard-Poulsen et al. 2009: Long-term meditation is associated with increased gray matter density in the brain

10 meditators (Dzogchen tradition of Tibetan Buddhism; 14.31 years practice)

10 age-matched controls
Both groups native Danish

3 T structural MRI

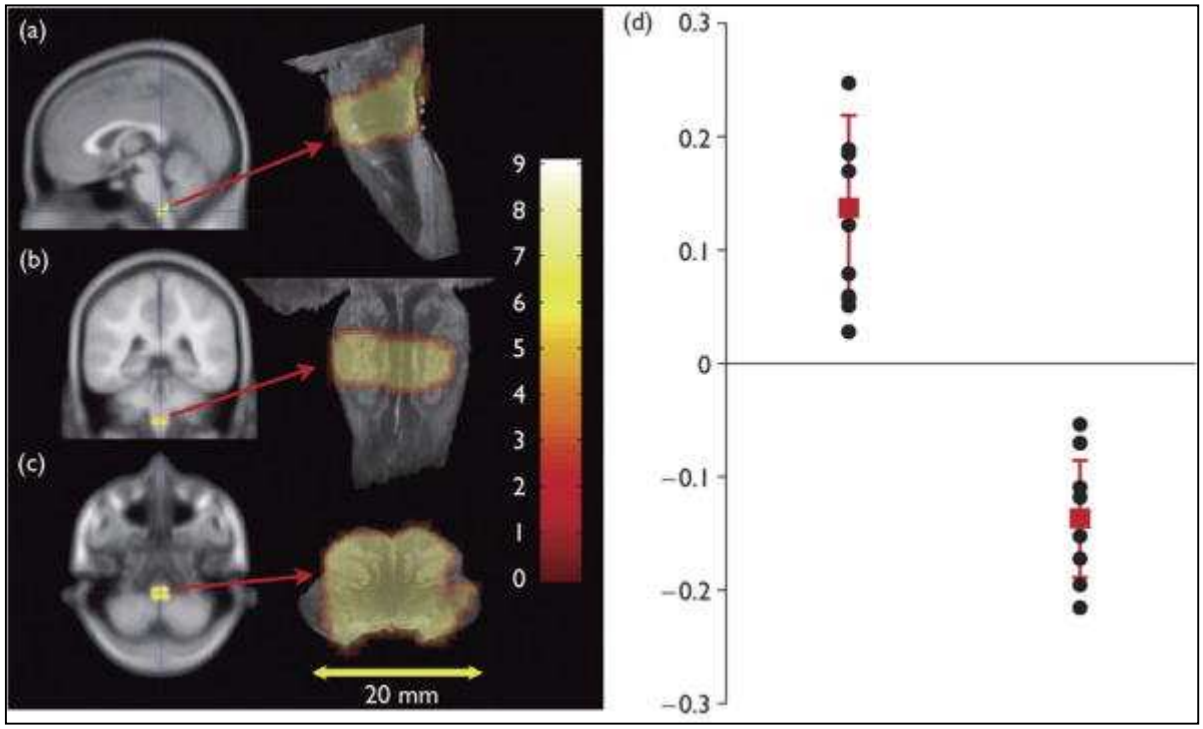


Fig. 1 Increased gray matter density in the brain stem of the meditators. All data were corrected for multiple comparisons, false-discovery rate (Pin vitro, which was coregistered to the stereotaxic space of all participants (Montreal Neurological Institute, Canada). Color scale indicates T-score. (d) Relative gray matter density difference in the peak voxel for the groups of meditators (left) and controls (right). Individual data are shown as well as the group mean and standard deviation.

Urgesi et al. 2010: The spiritual brain: Selective cortical lesions modulate human self-transcendence

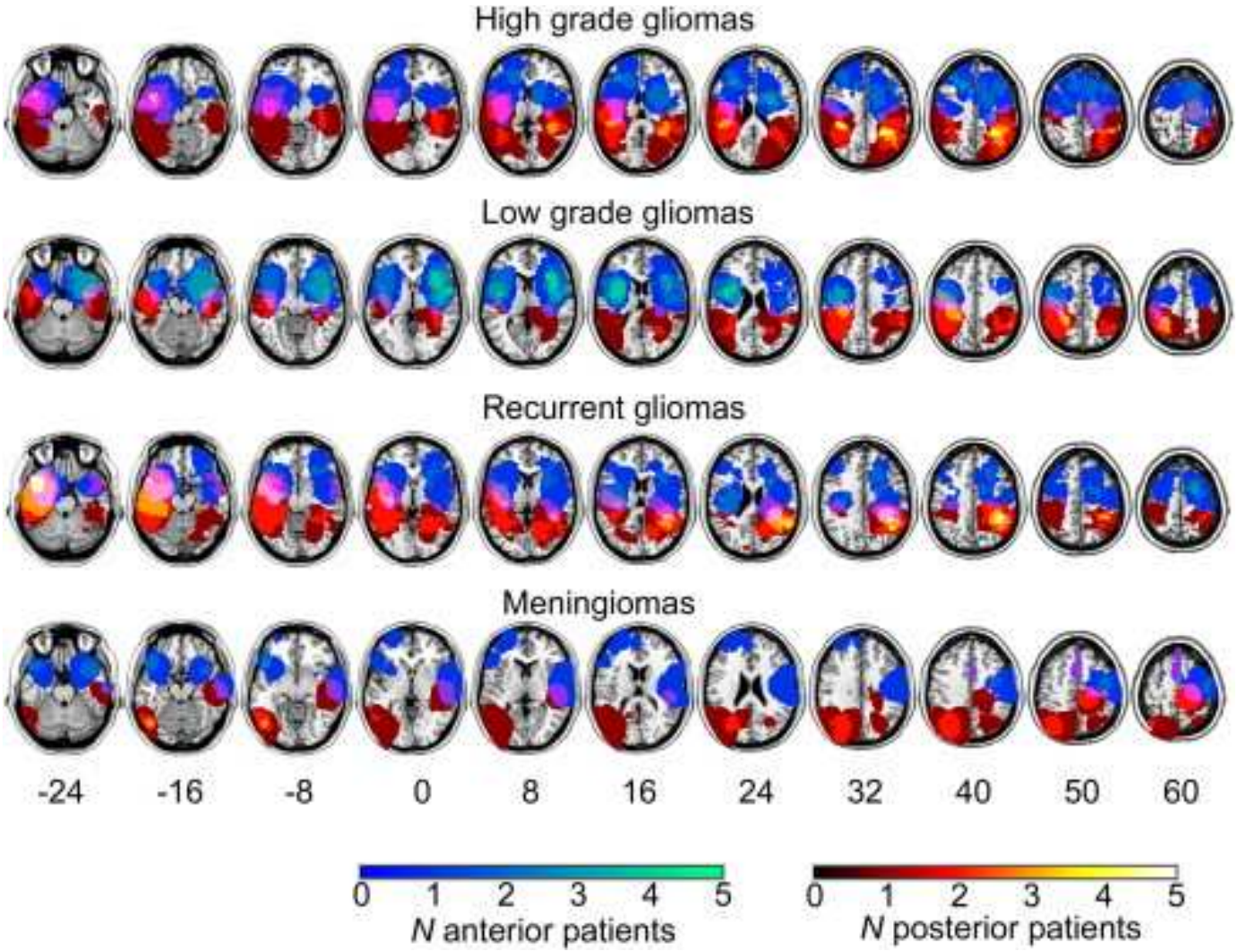
Patients with brain tumours
24 patients with high-grade glioma
24 patients with low-grade glioma
20 patients with recurrent gliomas
20 patients with brain meningiomas

For each group equally represented:
- **anterior lesions (fronto-temporal)**
- **posterior lesions (occipito-temporo-parietal)**

Self-transcendence
-**Stable personality dimension**
= to transcend contingent sensorimotor representations
= to identify the slef as an integral part of the universe as a whole

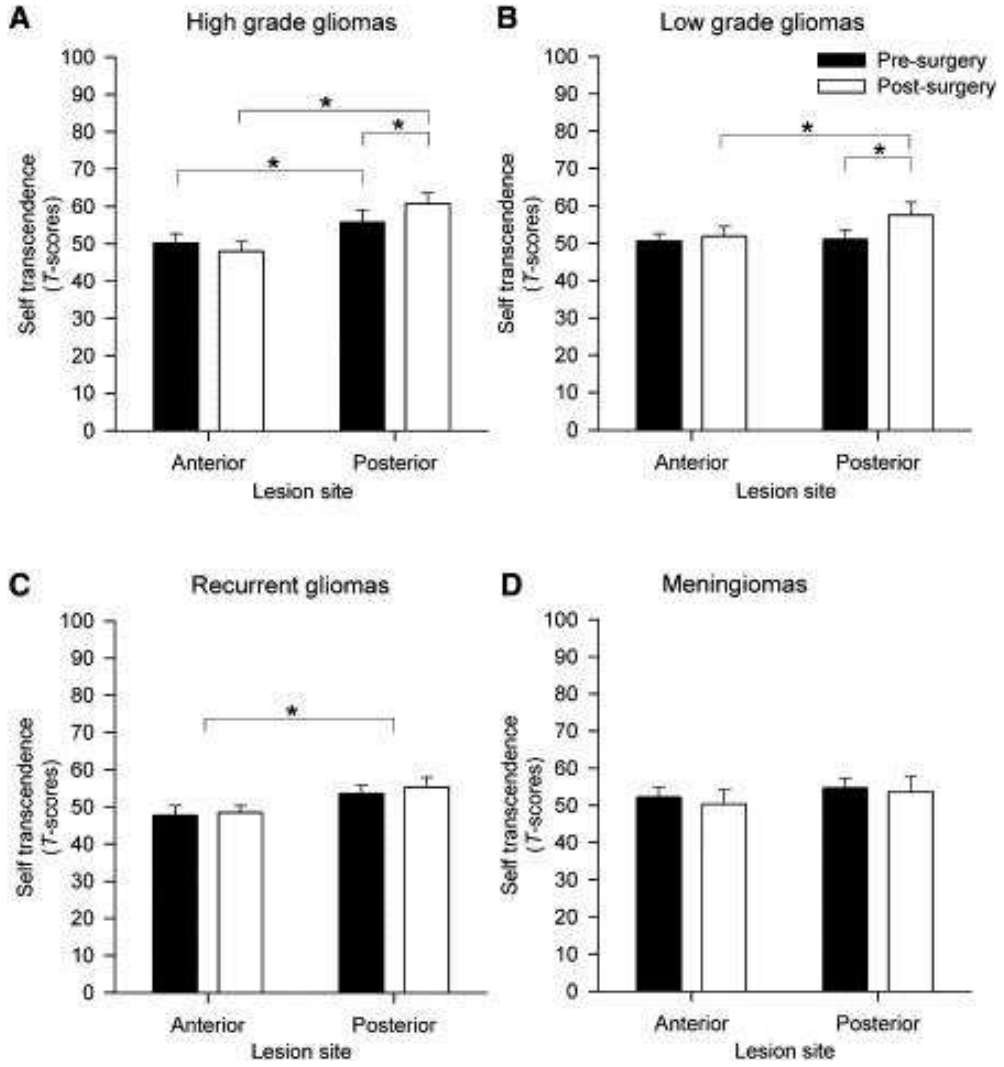
Self-transcendence evaluated before and after tumour resection

Urgesi et al. 2010: The spiritual brain: Selective cortical lesions modulate human self-transcendence



Distribution of anterior and posterior lesions

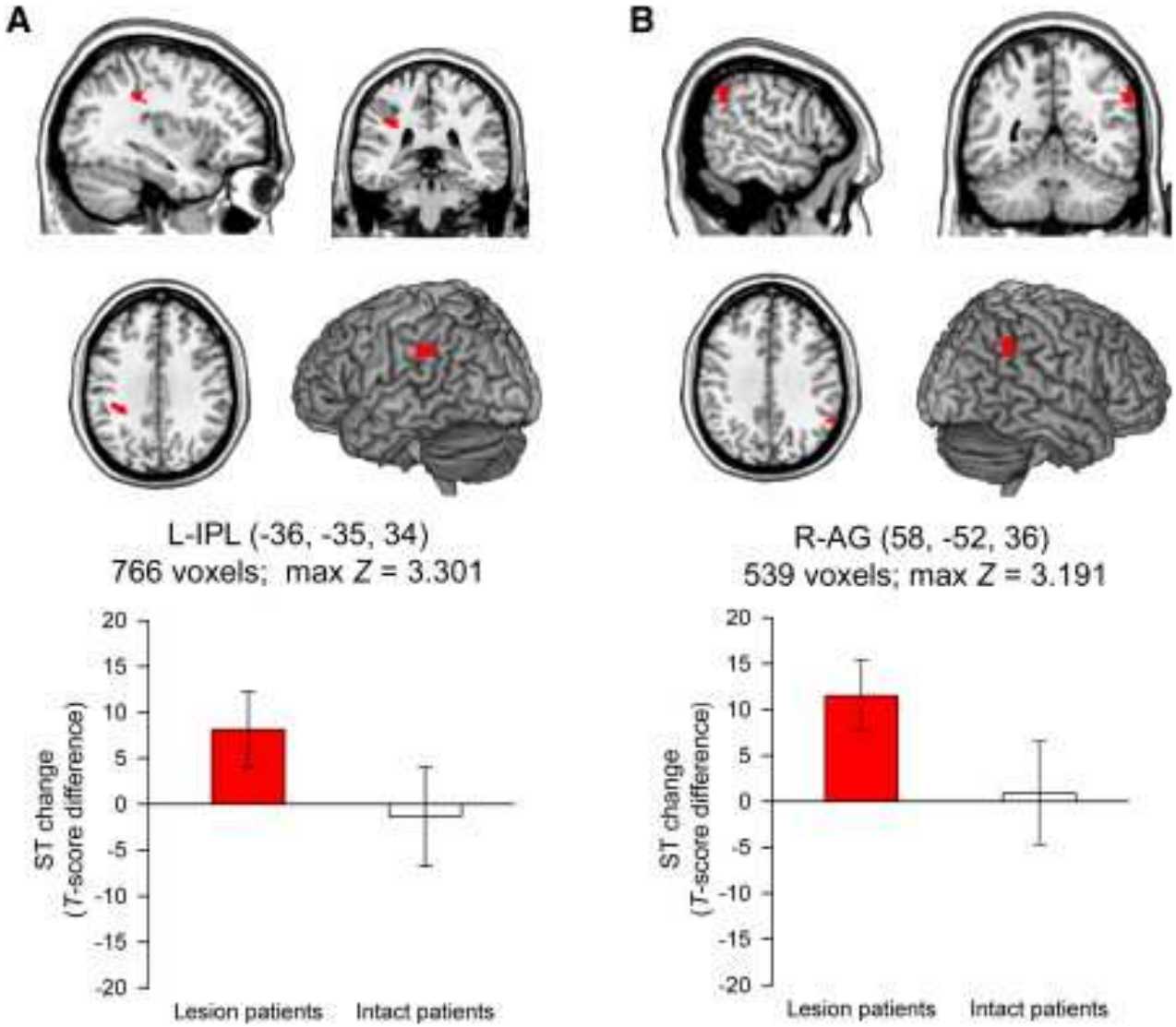
Urgesi et al. 2010: The spiritual brain: Selective cortical lesions modulate human self-transcendence



Posterior tumours

1. **Associated with greater self transcendence scores in gliomas**
2. **Resection associated with an increase in ST scores in first diagnosed gliomas**

Urgesi et al. 2010: The spiritual brain: Selective cortical lesions modulate human self-transcendence



Critical regions for ST

When damaged, these regions are associated with higher ST scores than when preserved

L inferior parietal lobule

R angular gyrus

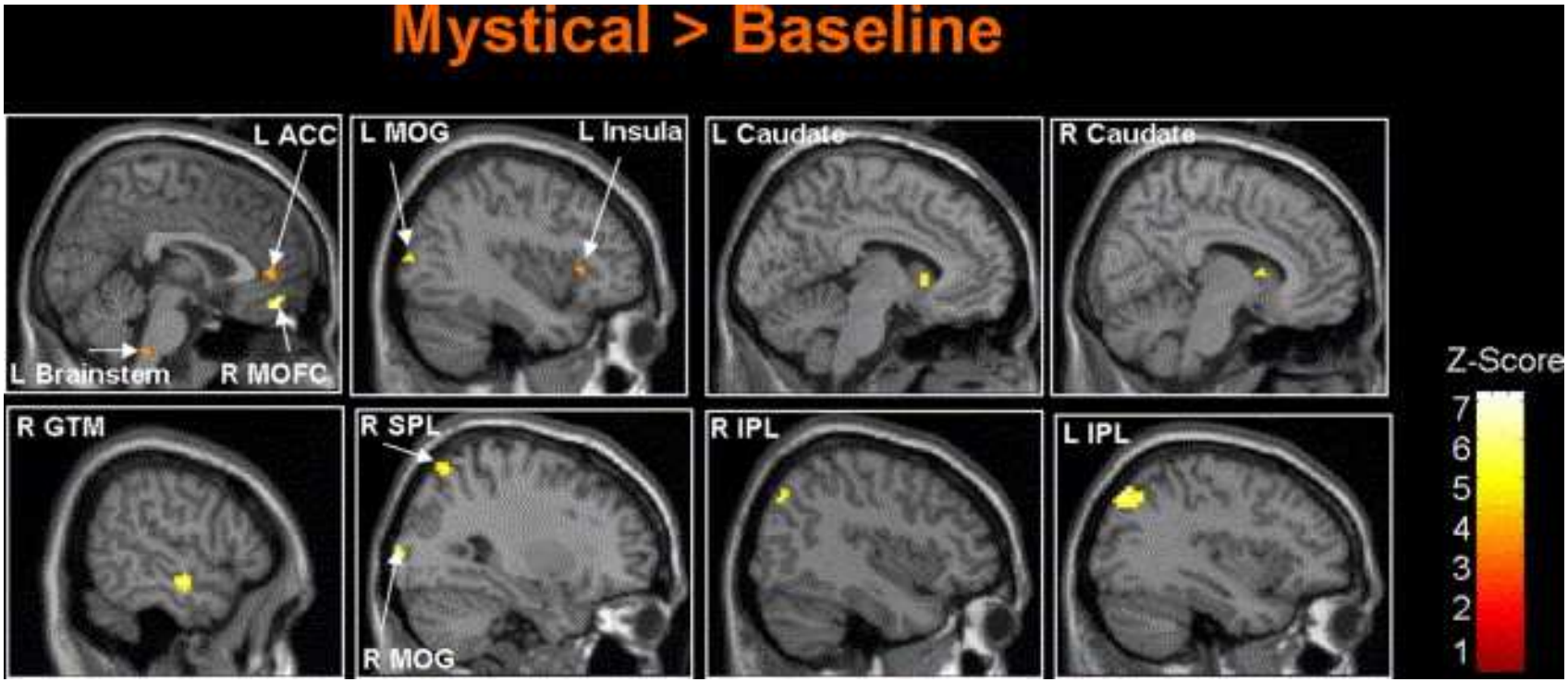
Known to be involved in different aspects of bodily knowledge

Qu'est-ce la foi / croire?

Contexte chrétien:

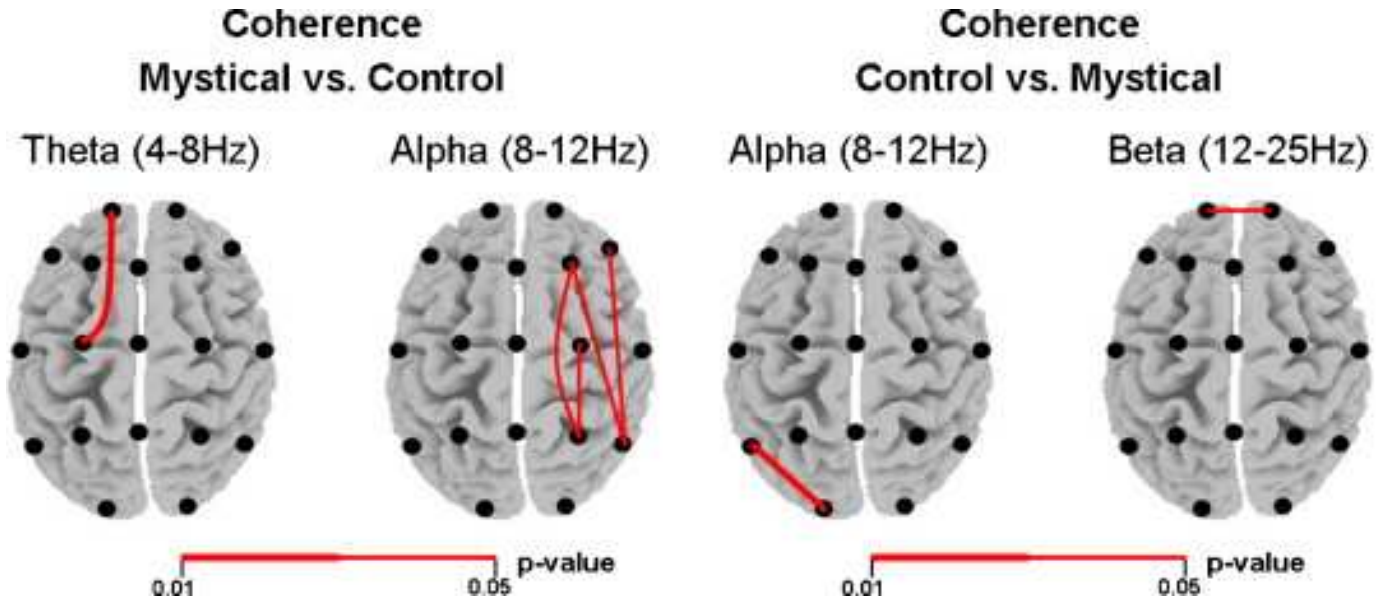
- Croire à un principe par une adhésion profonde de l'esprit et du cœur qui emporte la certitude
- Connaissance des textes bibliques
- Connaissances de doctrine et de préceptes
- Conviction profonde quant à l'objet de la foi
- Décision de suivre les préceptes et les pratiques religieuses associés
- Prière, louange
- Expression communautaire de la foi, église
- Se sentir « porté » par la foi
- Expériences spirituelles
- Souvenir des expériences vécues dans le cadre de la foi

Beauregard & Paquette 2006: Neural correlates of a mystical experience in Carmelite nuns



Mystical experience of union with God,
often including also sense of having touched the ultimate ground of reality, experience of timelessness and spacelessness, sense of union with humankind and the universe, feelings of positive affect, peace, joy and unconditional love.

Beauregard & Paquette 2008: EEG activity in Carmelite nuns during a mystical experience



Mystical experiences are mediated by marked changes in EEG power (not shown here) and coherence (figure; alpha, right hemisphere).

Kapagiannis et al. 2009: Cognitive and neural foundations of religious belief

Psychological structure of religious belief

The authors consider religious belief and behaviour as complex brain-based phenomena which are similar to social cognition

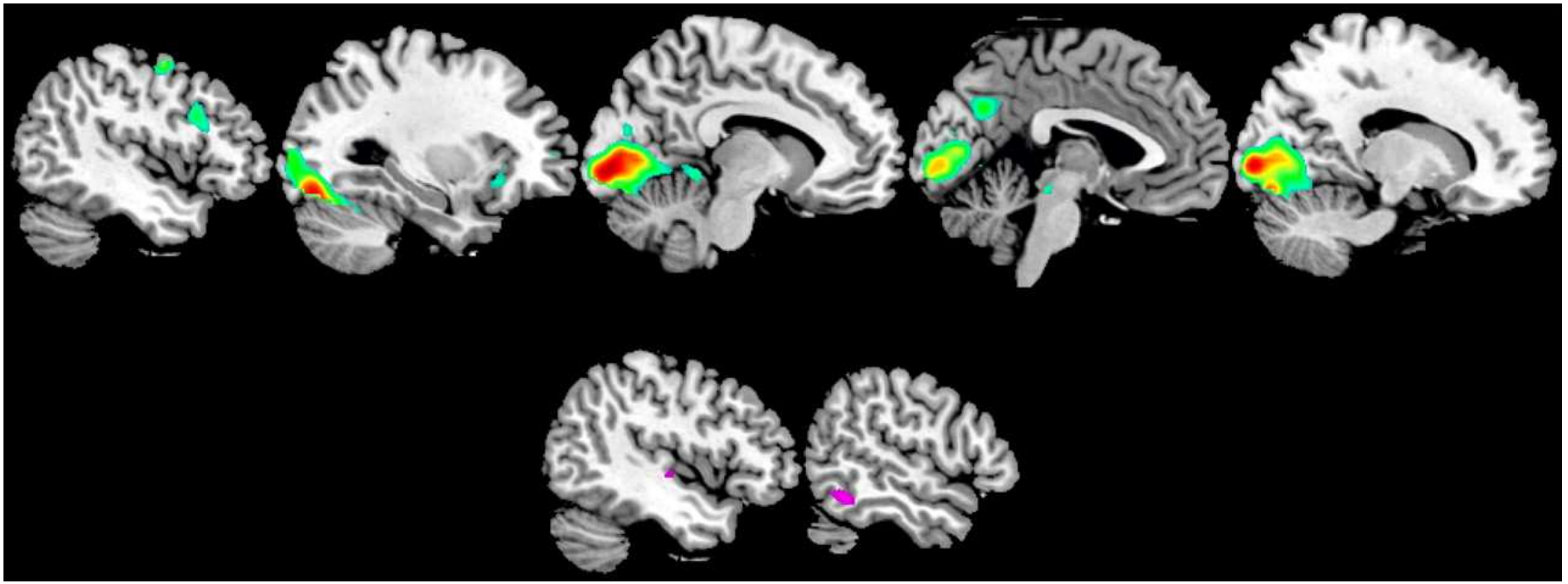
Supernatural agents – theory of mind

Doctrine – semantic knowledge

Personal religious experiences (prayer, participation in ritual) – event knowledge (memory retrieval and imagery)

Adoption and implementations of religious beliefs – emotion, motivation, goal-directed behaviour

Kapagiannis et al. 2009: Cognitive and neural foundations of religious belief



Effect of religious knowledge : Experiential (Above) vs. Doctrinal (Below). Activations are shown in purple for doctrinal knowledge and as a spectrum for experiential knowledge.

Threshold was set to P < 0.05, FDR corrected. Slices are oriented from L to R.

Notre cerveau nous prédestine-t-il à croire?

Etudes d'imageries cérébrales

- **Correlats neuronaux des experiences/pratiques religieuses**
- **De même pour les qualia non-religieux**

Notre cerveau nous permet de faire des choix, comprendre des fondements, vivre des pratiques, faire confiance, avoir une paix intérieure

Le choix reste personnel

Cerveau, conscience et spiritualité

Notre expérience consciente dépend du fonctionnement cérébral

L'expérience spirituelle influence le fonctionnement cérébral, mais en dépend aussi

La foi et sa pratique ont de nombreuses facettes qui impliquent différentes fonctions cognitives

Notre cerveau ne nous prédestine pas, mais nous permet de croire – le choix reste presonnel