


## Neural correlates of meditation states and traits



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# Mind & Life Institute




**Mind and Life XIX**  
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In a well known discourse, the Buddha declared:

*'All phenomena are preceded by the mind. When the mind is comprehended, all phenomena are comprehended.'*

The **mind** and **awareness** itself are therefore the fundamental subjects for introspective investigation within the Buddhist tradition.





- The unaided human vision is an inadequate instrument to investigate planets and stars.
  - Then, Galileo improved and used the telescope to observe these astronomical objects.
- The undisciplined mind is an unreliable instrument for the introspective examination of mental objects, processes and the nature of consciousness.
  - Then, the Buddha refined mental practices of meditation to stabilize and refine attention and awareness for this examination.





## Samatha Buddhist meditation

- Telescope analogy (Wallace, 1999).
  - development of attentional stability in Samatha meditation as mounting a telescope on a firm platform;
  - development of attentional vividness (acuity) in Samatha meditation as polishing the lenses and bringing the telescope into clear focus.
- Tsongkhapa (1357–1419), eminent Tibetan Buddhist contemplative
  - to examine a hanging tapestry at night, if one lights an oil-lamp that is both *radiant* and *unflickering*, one can vividly observe the depicted forms; by contrast, if the lamp is either *dim*, or - even if it is bright — *flickers* due to wind, one would not clearly see those images.



## Importance of *Vipassana* and contemplative insight

- *Vipassana* is a method of wisdom that searches for truth and peace in diverse ways by observing, inquiring into and penetrating the nature, the essence, the ultimate reality of mind and matter.
- The term '*Insight Meditation*' (*Samatha-Vipassana*) refers to mental practices that develop calm (*Samatha*) through sustained attention, and insight (*Vipassana*) through *reflection* (“direct seeing” or “intuitive awareness”).
- “*Samatha-Vipassana*” (insight meditation) classically based on attention to the body (including breath sensations) and body-awareness.
- Alternative “*Samatha-Vipassana*” practice based on the “sound of silence” (Ajahn Sumedho, 2004).



## **Focused Attention (FA) meditation**

(Lutz, Slagter, Dunne & Davidson, in press)

Sustaining selective attention moment by moment on a intended object (e.g. breath-related sensations).

- To sustain the attentional focus, the ongoing monitoring of attention is needed.
- If attention wanders away from the intended object, wandering has to be recognized and attention brought back to the chosen object.
- Then, “release” of attention from the distraction source is demanded.

Direct sustained focused attention (*Samatha*) skills:

- 1) Stability of focus
- 2) Vividness (“acuity”)

Attention regulative skills:

- 1) Distraction monitoring
- 2) Distraction disengagement
- 3) Attention focus redirecting



## **Focused Attention (FA) meditation**

(Lutz, Slagter, Dunne & Davidson, in press)

- FA meditation expertise reflected in degree of effort to sustain the intended focus.
- In experts in FA meditation, attention rests more readily and stably on the chosen focus, with sharp noticing of arising distraction, with less effort required.
- FA meditation has been related to reduced emotional reactivity.
- In advanced practitioners, a sense of physical lightness and vigor may be experienced, with reduced sleep demand.





## Focused Attention (FA) meditation

Brefczynski-Lewis et al. (2007) fMRI study

In FA meditation, attention was focused on an external point (small fixation dot on a screen)

- Activation in a network of brain regions typically involved in sustained attention showed an inverted u-shaped curve
  - in which expert meditators (EMs) with an average of 19,000 h of practice had more activation than novices
  - but EMs with an average of 44,000 h had less activation.
- In response to distracter sounds used to probe the meditation
  - EMs vs. novices had less brain activation in regions related to discursive thoughts and emotions
  - and more activation in regions related to response inhibition and attention.

Correlation with hours of practice suggests possible plasticity in these mechanisms.



## Open Monitoring (OM) meditation

(Lutz, Slagter, Dunne & Davidson, in press)

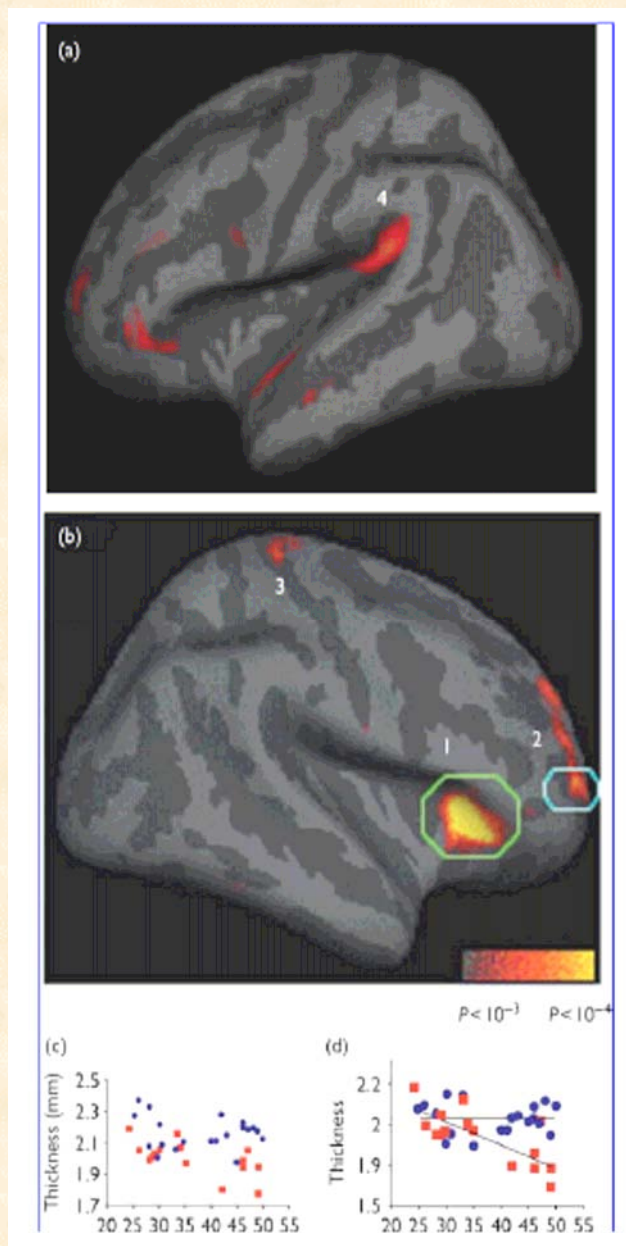
- Initial use of FA meditation training to calm the mind and reduce distractions.
- As FA advances, the *monitoring skill* becomes the main point of transition into OM practice.
- In OM meditation (e.g. in Buddhist *Vipassana* or in *Zazen*), the aim is to remain only in the monitoring state, attentive moment by moment to anything that occurs in experience, without focusing on any explicit object.
- The practitioner gradually reduces the focus on an explicit object in FA (e.g. breath-related sensations), and the monitoring faculty is correspondingly emphasized.
- Often also emphasis on cultivating a *'reflexive' awareness* that grants one greater access to the rich features of each experience.
- Although the enhancement of the monitoring awareness continues until no explicit focus is maintained, the monitoring itself does not create any new explicit focus.

OM meditation would lead to:

- Transformation of cognitive and emotional habits;
- Heightened sensitivity to body and environment;
- Decrease in the forms of reactivity creating mental distress.



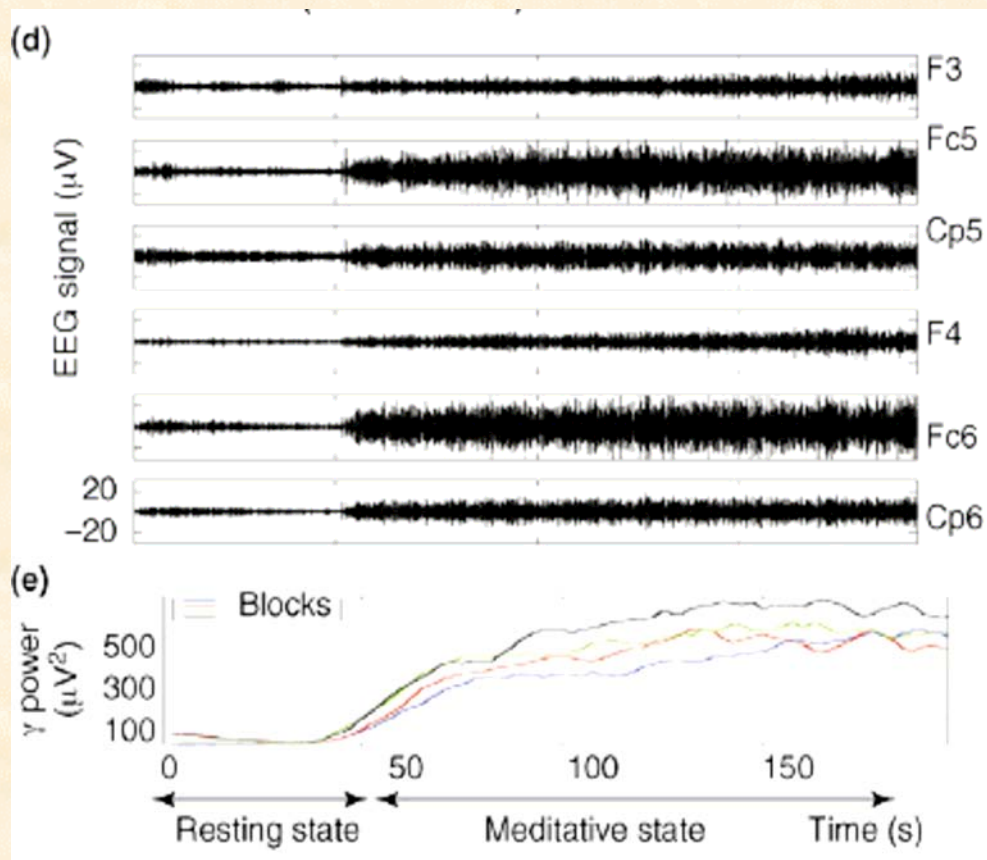
Meditation experience  
is associated  
with  
increased cortical thickness



Lazar et al. (2005)



## Importance of neuroscientific investigations of meditation with high-temporal resolution



Large-scale high-frequency oscillations and synchrony during OM compassion meditation

*Lutz et al. (2004) EEG study*



## Functional Magnetic Resonance Imaging (fMRI) study (Raffone, Manna, Perrucci, Nardo, Ferretti, Londei, Ferretti, Del Gratta, Olivetti Belardinelli & Romani, *submitted*)

To contrast directly brain activity in FA and OM meditation forms

With **8 Theravada Buddhist monks** (males, mean age 40.9 years, ages 25-58 years, SD 11.6 years), from the Santacittarama monastery, in central Italy, following a Thai Forest Tradition (the order was funded by Ajahn Chah in Thailand).

Meditation experience including regular intensive meditation retreats (with a 3-month long winter retreat); typically practice *Samatha-Vipassana* (insight) meditation two hours per day with the monastery community. Individual meditation practice is also emphasized.

Expertise in the sample: 17.0 years as mean number of years of *Samatha* (FA) and *Vipassana* (OM) meditation practice in Theravada monasteries (SD 9.7 years).





# Experimental design



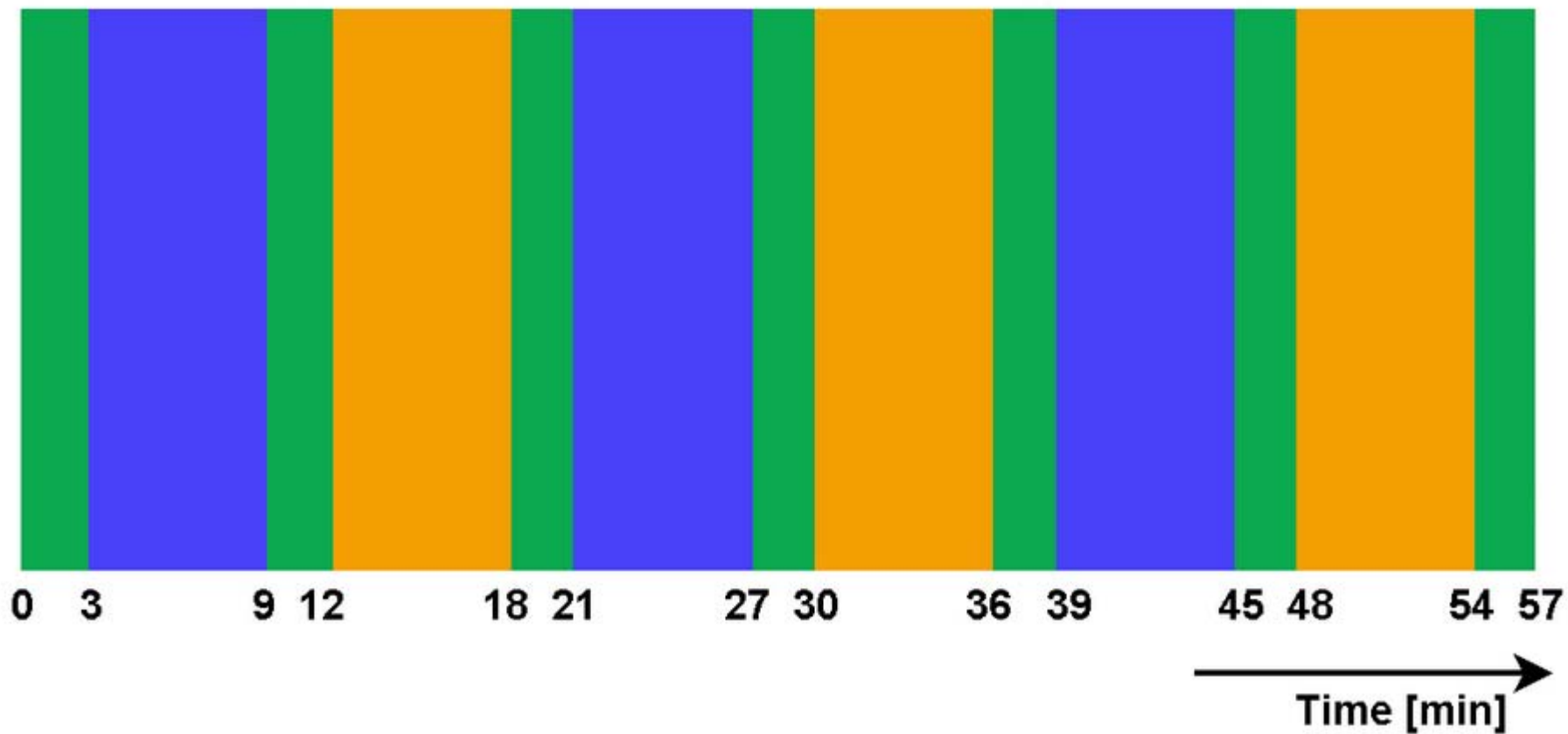
Rest



FA



OM





## Instructions

### **FA meditation:**

“Gently engage in sustaining the focus of your attention on breath sensations, such as at the nostrils, noticing with acceptance and tolerance any arising distraction, as toward stimuli or thoughts, and return gently to focus attention on the breath sensations after having noticed the distraction source”.

### **OM meditation:**

“Observe and recognize any experiential or mental content as it arises from moment to moment, without restrictions and judgement, including breath and body sensations, external stimuli, arising thoughts and feelings”.

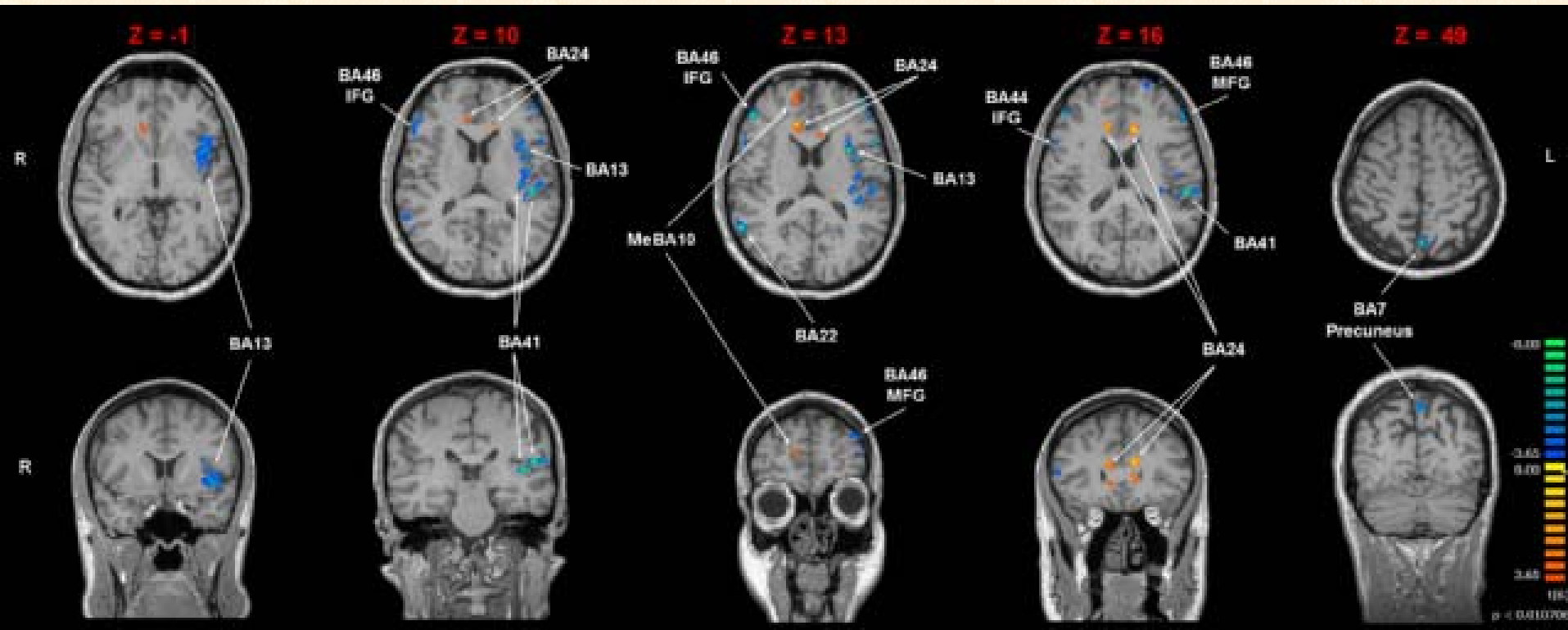
### **Rest:**

“Rest in a relaxed awake state”.

During all the conditions, the participants kept eyes closed.



# FA versus Rest



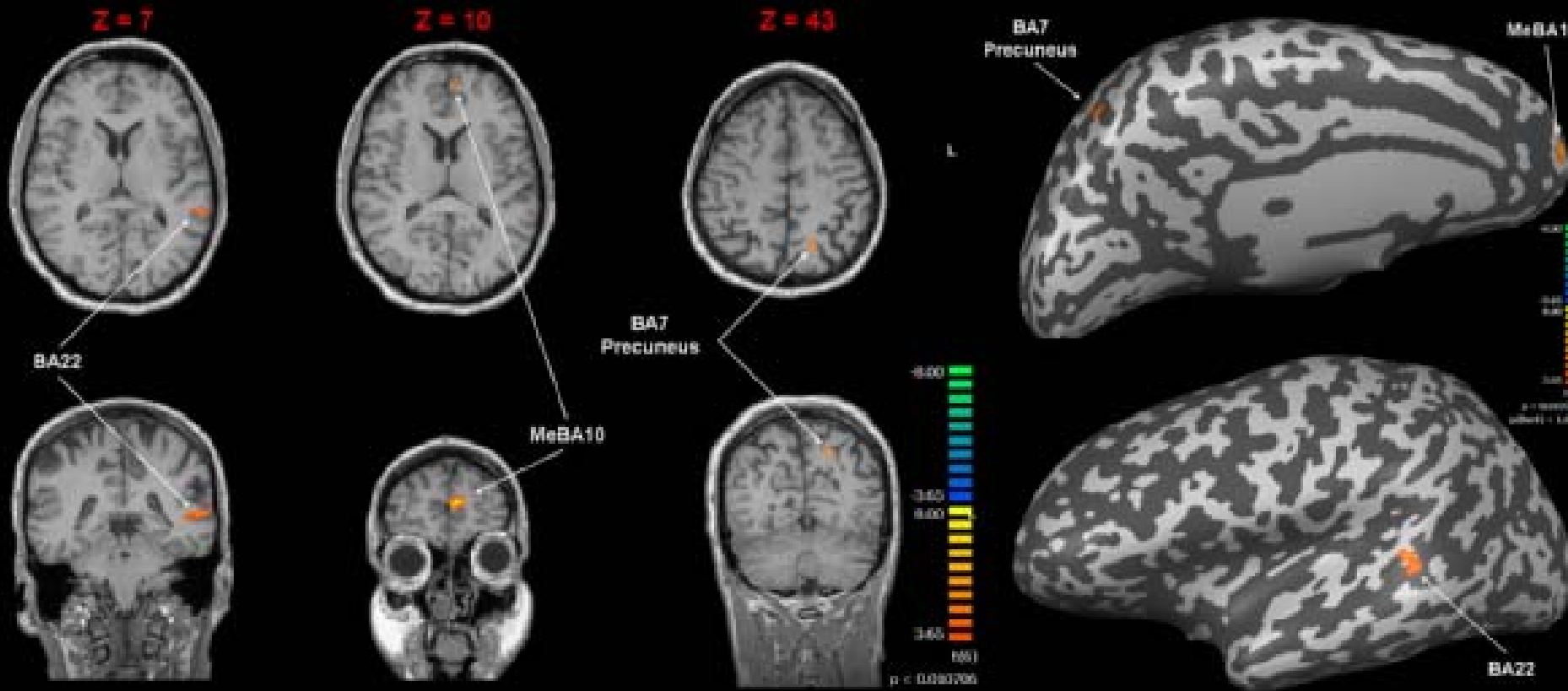
BA7 Precuneus  
BA10 Anterior Prefrontal Cortex  
BA13 Insula  
BA22 Superior Temporal Gyrus

BA24 Anterior Cingulate Cortex  
BA41 Primary Auditory Cortex  
BA44 Ventrolateral Prefrontal Cortex  
BA46 Dorsolateral Prefrontal Cortex





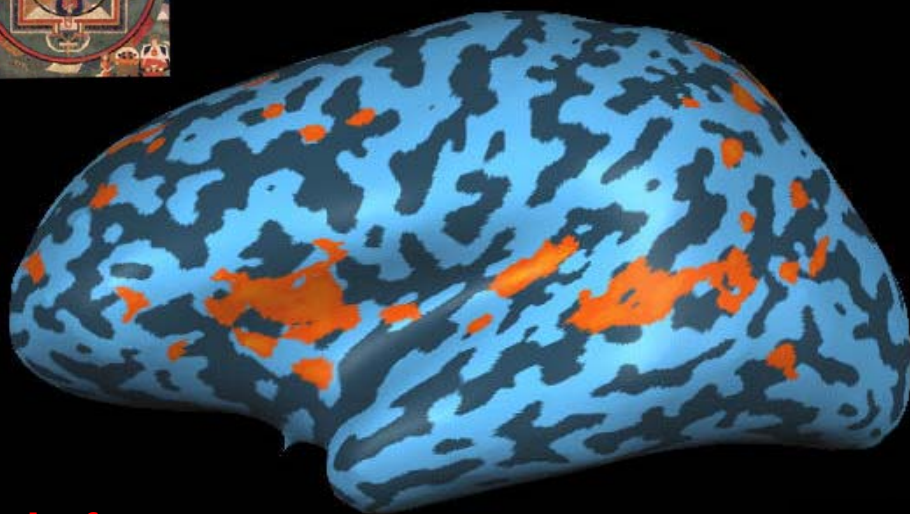
# OM versus Rest



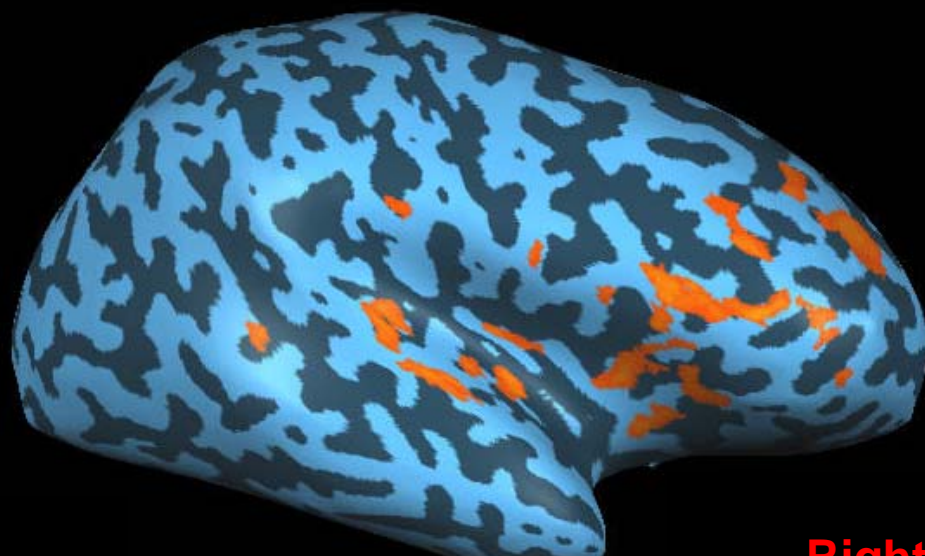
BA7 Precuneus  
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BA22 Superior Temporal Gyrus



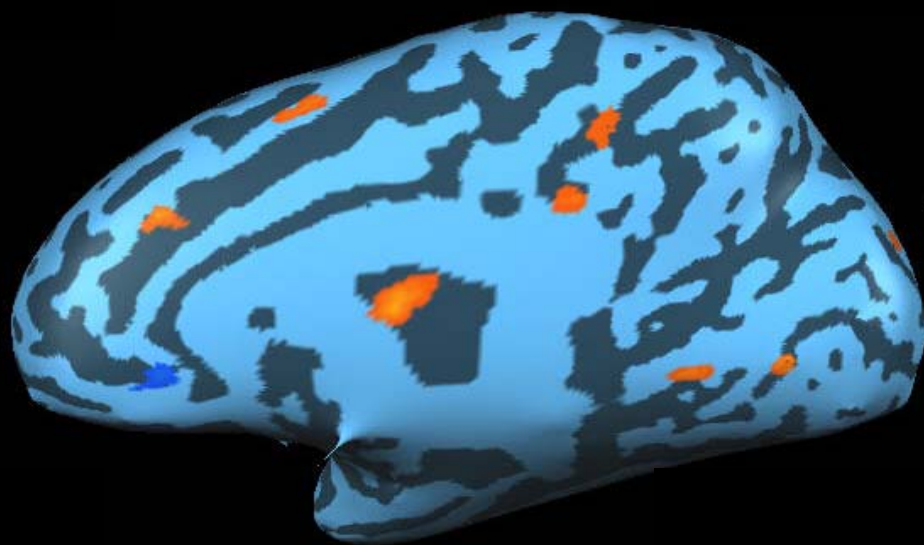
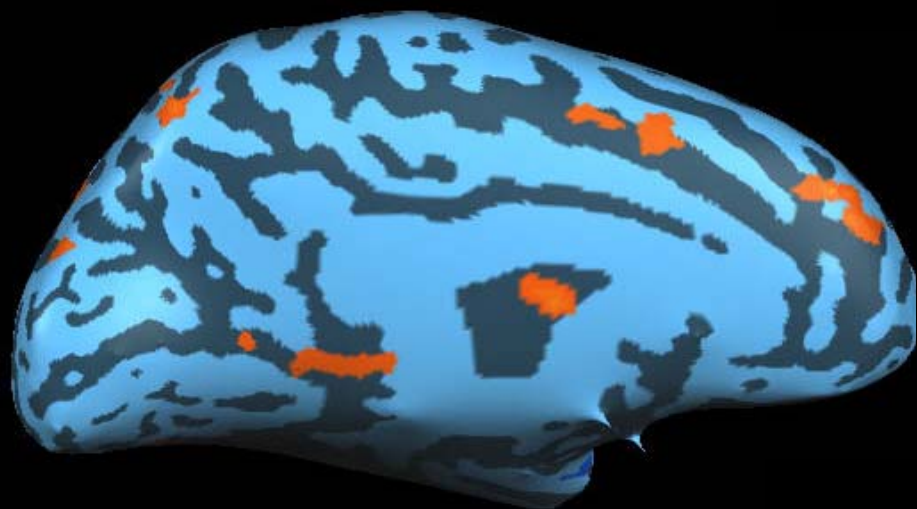
# OM versus FA



Left



Right





## SUMMARY

We studied brain activity patterns in **both** focused attention and open monitoring meditation in Theravada Buddhist monks and lay novices, by functional magnetic resonance imaging.

A **massive deactivation** of left brain activity during focused attention meditation, with special reference to the **insula**, was observed in the monks. Also, the activation of right midfrontal areas was also observed in the monks, in focused attention meditation.

By contrast, open monitoring meditation was associated to the activation of **left fronto-temporo-parietal areas**.

Brain activity in focused attention meditation sharply contrasted with rest and open monitoring states.

These highly differentiated brain activity patterns were not found in the novices.

Our study suggests that a **functional reorganization** and lateralization of brain activity patterns for phenomenal and access consciousness can take place with mental practice.

Thanks for your attention!

