

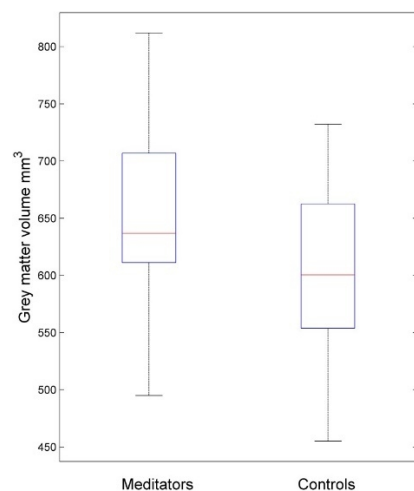
Brain effects



Several neuroimaging studies have shown that SYM is associated with changes in the structure and the function of the brain.

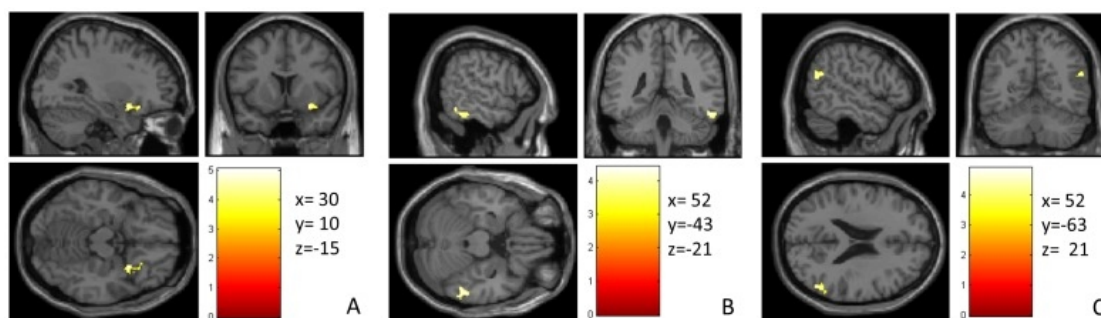
Brain structure

A structural MRI study conducted at La Laguna University, Spain in collaboration with King's College London, UK, showed that 23 adult long-term practitioners of SYM who had been meditating between 5 and 28 years compared to 23 healthy volunteers that were matched on age, gender, education level, height, and weight, had overall 7% more grey matter volume (Hernandez et al., 2016).



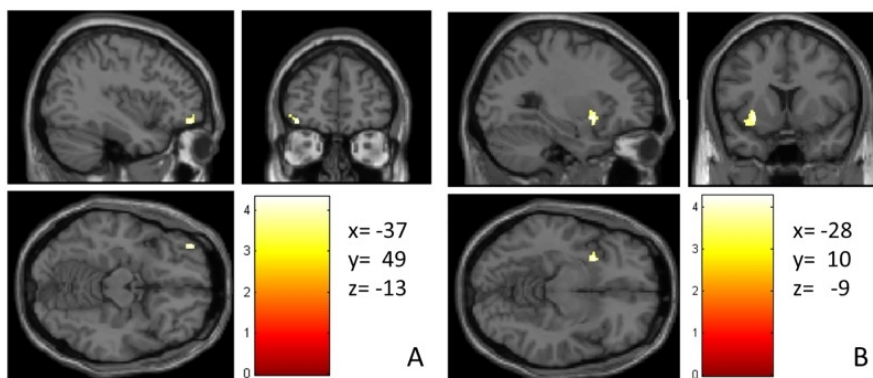
Meditators had 7% more grey matter than non-Meditators overall. Grey matter typically decreases with age and larger grey matter is associated with better brain functioning.

The brain regions that were particularly larger in Meditators were mostly in the right hemisphere and included areas of body self-awareness and emotion control (insula and ventromedial orbitofrontal cortex, respectively), and areas of empathy and social and emotional processes (inferior temporal lobe). Other regions that were enlarged were left inferior frontal cortex and insula which are areas that are crucial for concentration and inhibitory control (Hernandez et al., 2016).



Areas that were larger in Meditators than in non-Meditators:

- A. The right insula/ventromedial frontal cortex (emotion control)
- B. The right inferior temporal lobe (empathy)
- C. The right parietal lobe (attention)



- A. Left inferior frontal lobe (attention; self-control)
- B. Left insula (self-awareness)

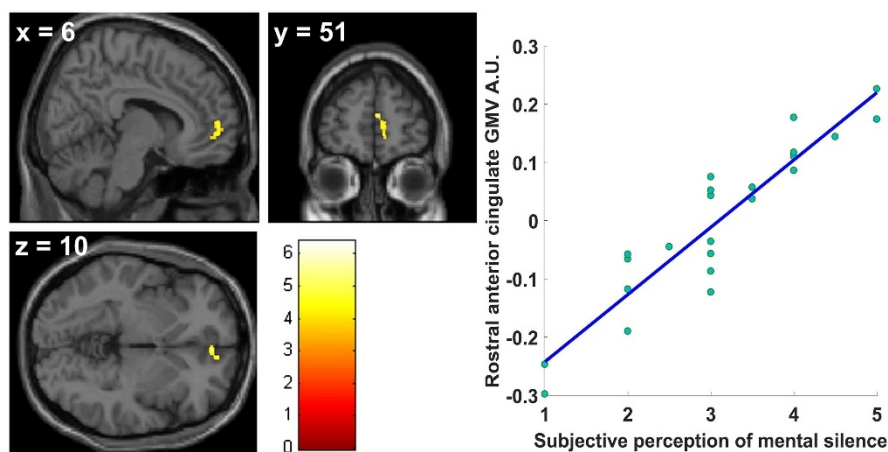
The larger volumes in these regions is likely a neuroplastic effect due to the long-term training of enhanced self-awareness, alertness and attention during the Meditation practice. Larger structure of the insula has been associated with better emotional intelligence, better self-acceptance and is a predictor of good health. The ventromedial orbitofrontal cortex is a key region of emotion regulation, in particular of control of negative emotions. Given that meditation is associated with feelings of happiness, greater emotional detachment and a detached witness state, it is likely that the long-term practice of Meditation leads to better control of emotions and in particular of negative emotions.

Grey matter decreases with age due to the normal ageing process. Larger grey matter overall in Meditators relative to non-Meditators hence suggests that there is a delay in the normal ageing process of grey matter loss due to Meditation. The larger grey matter furthermore is in regions that are typically activated during Meditation such as regions of attention, emotional self-control, bodily self-awareness and feelings of compassion and empathy.

Another study from the same group tested directly the association between brain structure and the state of thoughtless awareness achieved during the Meditation in the same 23 long-term Meditators of SYM. They found that a region that is crucial for emotion and attention control, the anterior

cingulate and medial prefrontal cortex was associated with the state of mental silence. The anterior cingulate is a key area of top-down control of attention and of emotions. This region is typically smaller in volume in people with mental disorders such as schizophrenia, obsessive-compulsive disorder, Attention-Deficit/Hyperactivity-Disorder, depression and anxiety. Grey matter in this region is associated with happiness and better emotion control. This region is likely larger due to the long-term practice of Meditation that has shown to activate this region in order to achieve the control of thoughts and emotions that leads to the state of mental silence.

Furthermore, the anterior cingulate showed better connectivity with areas of attention and less connectivity with areas of mind-wandering. Mind-wandering, which refers to task-irrelevant thoughts and which needs to be inhibited in order to concentrate, is associated with worse attention and is enhanced in all mental disorders. Meditators have shown to have better attention skills and less mind-wandering, presumably due to the daily practice of controlling their thoughts in the Meditation practice. This practice of reducing irrelevant thoughts in the Meditation is likely to extend to daily life and this could be the reason why Meditators have less mind-wandering.



The stronger the subjective perception of mental silence during the Meditation in the scanner, the larger the grey matter in the anterior cingulate.

References:

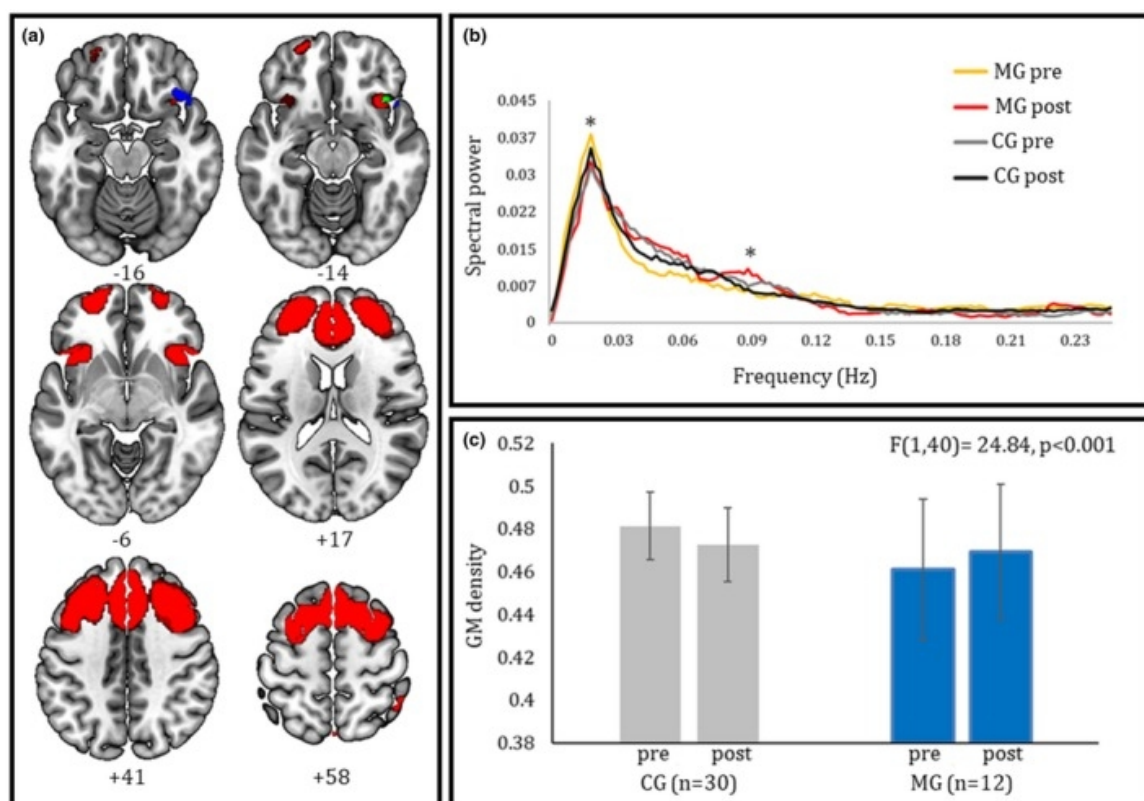
Hernandez, SE, Suero J, Barroso A, Rubia, K (2016) A voxel-based morphometry study on brain structural changes associated with long-term Sahaja Yoga Meditation. *PLOS ONE*, 11(3):e0150757.

Hernández SE, Barros-Loscertales A, Xiao Y, González-Mora JL, Rubia K. (2018) Gray Matter and Functional Connectivity in Anterior Cingulate Cortex are Associated with the State of Mental Silence During Sahaja Yoga Meditation. *Neuroscience* 371:395-406

Another study conducted by Bocconi University in Italy found that only 4 weeks of Meditation resulted in similar brain changes as those observed in long-term Meditators suggesting that even a short period of Meditation training leads to lasting changes in the brain.

They compared 4 weeks of Meditation training in 12 healthy adult students who had not meditated before with 4 weeks of a waiting period in 30 healthy people.

The students who received Sahaja Yoga Meditation for 4 weeks had larger grey matter in the right inferior frontal cortex, a key region of self-control and of concentration. Furthermore, the grey matter changes were associated with feelings of wellbeing after the meditation training. In addition, they also had better function in the right inferior frontal cortex and insula after the training than the non-Meditation group. The right inferior frontal cortex is a key region of self-control and of the control of attention. This region is also important to control mind-wandering which needs to be reduced in order to enter the state of mental silence. The region that was larger in structure and function is the same region that has been found to be larger in function and structure in long-term practitioners of Sahaja Yoga Meditation. The findings hence show that only 4 weeks of Meditation is sufficient to achieve larger structure and better function in a key region in the brain of attention and self-control.



The red areas are areas that are enlarged in their structure after 4 weeks of Meditation. The blue areas are regions that are larger in their function after 4 weeks of Meditation. The green area is a region that is overlapping and hence larger and at the same time more active after Meditation.

References

Dodich A, Zollo M,³ Crespi¹ C, Cappa SF^{4,5}, Laureiro D, Martinez, Falini A, Canessa N (2019) Short-term Sahaja Yoga Meditation Training Modulates Brain Structure and Spontaneous Activity in the Executive Control Network. *Brain Behav* 9, e01159.

Brain function

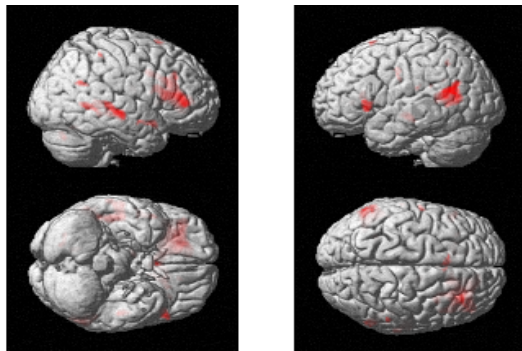
What happens in the Meditator when they enter the state of mental silence in their Meditation?

A study conducted at La Laguna University, Spain in collaboration with King's College London, UK, used functional magnetic resonance imaging (fMRI), which measures the brain in action while the person is doing something in the scanner and which is currently the imaging modality with the best spatial resolution.

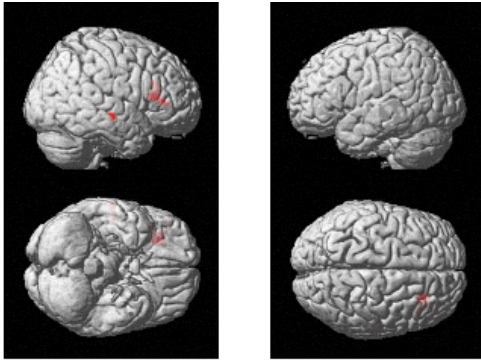
The study investigated 19 long-term meditators during 3 progressively deeper phases of Meditation compared to a relaxation period.

At the beginning of the meditation sessions there was a significant increase of activation in bilateral inferior frontal, anterior cingulate and temporal regions. The right inferior frontal cortex is a key region for concentration and inhibitory self-control, presumably activated in order to concentrate on the present moment and to reduce unwanted thought processes during the Meditation. The activation became progressively more reduced with deeper meditation stages and in the last meditation session it became localized to the right inferior frontal cortex/right insula and right middle/superior temporal cortex. Furthermore, right inferior frontal activation was directly associated with the subjective depth of the mental silence experience. The insula is a key region for self-perception and superior temporal lobe is also an important area of attention.

The findings suggest that Meditators appear to pass through an initial intense neural self-control process necessary to reduce their thoughts, focus their attention on the present moment, and to silence their mind. After this they experience relatively reduced brain activation while they deepen the state of mental silence, over right inferior frontal cortex, the key region for relaxed sustained attention, probably reflecting an effortless process of attentional contemplation associated with this state.



A. Activation during the first stage of meditation in the left and right inferior frontal cortex, anterior cingulate gyrus and the superior temporal lobe



- B. Activation during the deepest state of Meditation is reduced and focused over the right inferior frontal lobe.

Hernandez, SE, Suero J, Rubia K, and González-Mora JL (2015) Monitoring the Neural Activity of the State of Mental Silence While Practicing *Sahaja* Yoga Meditation. *The Journal of Alternative and Complementary Medicine* 21(3): 175-179.

Studies using electroencephalography (EEG)

As before. EEG studies etc etc etc