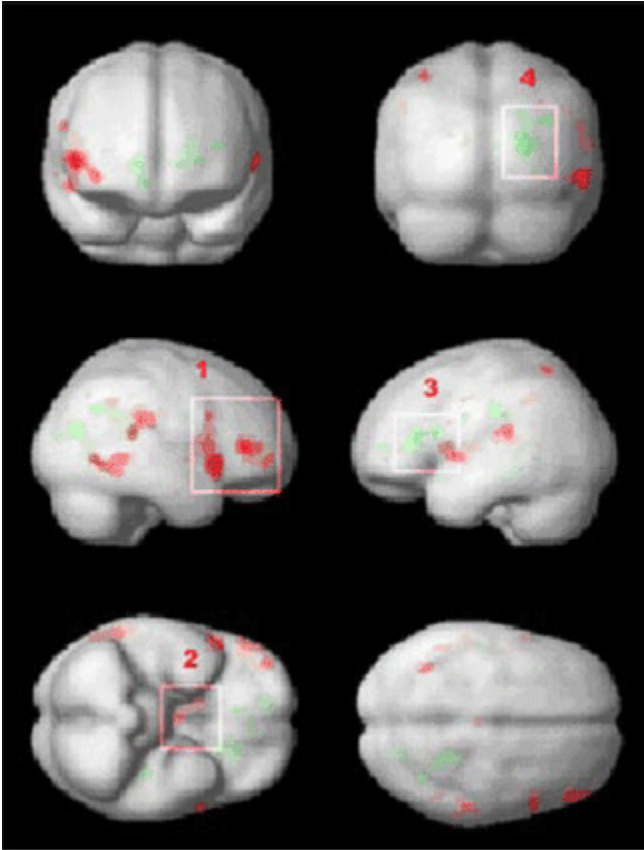


MRI Scanning during Zen Meditation: The Picture of Enlightenment



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A group of 11 (8 male and 3 female) experienced Zen meditation practitioners were scanned with fMRI during the conscious switch from normal consciousness to a meditative state of mind. This

switching has been hypothesized to be realized by a dedicated “neural switch”¹. In the literature increased activity is reported to occur in the prefrontal cortex and the basal ganglia during meditation². On the basis of other publications, deactivation in the gyrus occipitalis was expected⁴. The present study demonstrated a simultaneous occurrence of patterns of brain activation and deactivation in the aforementioned mentioned structures. Moreover, the present study showed a deactivation of the anterior cingulate, an area associated with our will. It is hypothesized that this combination of four events may reveal the neural basis of the experience of enlightenment in Zen.

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Methods

The group consisted of 8 males and 3 females. These subjects had on average 8 (range 15 –25)years of daily Zen-meditation experience. Participants were all right handed, with a mean age of 48 (range 32 – 62)). During fMRI scanning a blocked on-off design was used, in which 3 periods of 45 seconds meditation were alternated by 3 periods of 45 seconds of random thoughts. During the meditation blocks, all 11 subjects focussed on counting their breaths (silently counting from one to ten), as they were accustomed to doing during their daily Zen-meditation practice. All fMRI scans were made on a GE Signa MRI scanner, which one of the most technologically current fMRI systems available today. Data were analyzed with

Statistical Parametric Mapping Software (SPM99 –[http://](http://www.fil.ion.ucl.ac.uk/spm/)

www.fil.ion.ucl.ac.uk/spm/).

Results

Three periods of 45 seconds scanning during meditation were compared to 3 periods of 45 seconds of random thoughts (“on-off”). After the scanning period, all subjects reported that they had been able to meditate well in the lying position in the scan, and that it had been relatively easy to enter their normal meditative state of mind. These results are consistent with subject’s reports that they were able to shift their state of mind in this on/off experiment. The fMRI images show a significant increase in the activity of the prefrontal cortex (gyrus frontalis medius, right side, Brodman area 10) during Zen meditation (ill.1-1) and are consistent with similar findings by Hirai², who did EEG studies in Zen priests. Ryding⁵ has compared the effects of counting loud and silently using a PET scanning methodology, and also found an increased activity in the prefrontal cortex during silent counting. Additionally, the basal ganglia became more active during the meditation periods in our study (ill.1-2). Current conceptualizations of the role of the basal ganglia consider that their function is to facilitate behaviour and movements, which are required and considered appropriate in any particular context, and to inhibit unwanted or inappropriate behaviours or movements⁹.

Simultaneously, with the activation of the above-mentioned

areas, significantly less activity was found in two other areas: the gyrus occipitalis superior (ill.1-4)and the anterior cingulate (Brodman area 32)(ill.1-3). The gyrus occipitalis is related to general visual orientation and orientation ability, whereas the anterior cingulate, is associated with conscious activities that are directed by the will.

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Legend to figure:fMRI image of 11 subjects during the initial phase of Zen meditation as compared to random thoughts.

From top to bottom, left to right:

Cranial, caudal, right lateral, left lateral, central and dorsal view.

1 gyrus frontalis medius

2 anterior cingulate

3 basal ganglia

4 gyrus occipitalis superior

Figure 1

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Discussion

This study demonstrates, consistent with earlier findings, that a higher activity in the gyrus frontalis medius arises during the initial phase of Zen meditation. The gyrus frontalis medius is part of the frontal lobe;this area, sometimes called the Attention Association area, is held responsible for more

complex human feelings. Austin⁶ concludes, based on studies of people with frontal lobe lesions, that increased activity in this area is thought to be associated with enhanced insights and attentiveness, heightened interests, sharper mental focussing, and deepened emotional resonances. In the famous case report on Phineas Gage⁷, it is reported that the gyrus frontalis medius in the prefrontal cortex was damaged due to an accident. Consequently, he lost his personality, developed blunted emotions and lost social interest. Presumably, this outcome can be summarized as a loss of compassion. Other research has shown that electrical stimulation of the prefrontal cortex is associated with positive feelings⁸. This study reports that one-quarter of the group that received electrical stimulation of this area of the brain, reported positive changes in the mood as well. Additionally, a PET-study¹⁰ has demonstrated decreased frontal-lobe activity in murderers (there may after all have been a good scientific reason for the New York State prison to have started a Zen meditation group in 1984 -an example that is followed by many prisons world wide). Increased activity in the basal ganglia during meditation conforms to what one would expect during certain Zen practices. For example, the tea-ceremony and Zen-archery are just two examples of rituals that need optimal use of the main functions of the basal ganglia, namely the making of precisely controlled movements. Moreover, activation of the basal ganglia appears to be stimulated by counting the breadth,

thereby possibly resulting in improved control of movements by the conscious breathing process. Decreased activity in the gyrus occipitalis superior and the anterior cingulate suggests that, during meditation, there is less interference of our will and less awareness of where we are. In summary, current research is suggestive of a state of mind, which may have resemblances to the experience of an enlightenment state, where time and place limits have disappeared, and a great feeling of love/unity is experienced.

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You live and learn. At any rate, you live.

-Douglas Adams

Where is the knowledge that is lost in information?

Where is the wisdom that is lost in knowledge?

-T.S.Eliot