The Blissful Brain: Neuroscience and the Proof of the Power of Meditation

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From dying brains to living brains – this article summarises the latest research in neuroscience and health studies showing considerable implications at both personal and social levels for a better understanding and more extensive practice of meditation.

THE HUMAN BRAIN is a mind-boggling feat of neural engineering; a biosupercomputer. Over the last couple of decades, as the experimental tools at our disposal have become more complex and more successful at probing the inner workings of the brain, we have been able to define the brain's involvement in everyday tasks, such as object recognition, the expression of consciousness through language, and even sexual attraction. However, the less tangible aspects of what it means to be human have largely resisted our scientific scrutiny. Not only are we are still trying to define the neural basis of human characteristics, such as creativity and inspiration, but we are also still far from understanding the exact nature of the relationship between the brain and consciousness.

Mystical or religious experiences have historically been seen to lie within the domain of Religion, or spirituality, and scientists have shied away from trying to explain why and how they occur and, even in many cases, have challenged their validity. However, groundbreaking research around the turn of the century revealed the brain's involvement in mystical experiences, and this has prompted a growing interest in investigating these phenomena in the confines of the laboratory.

Neurotheology Reveals Humans are Hard-wired to have Mystical Experiences

Mystical experiences can be defined as short-lived experiences associated with a different mode of thinking and perceiving from that of our everyday existence. Because of this, mystical experiences defy explanation in terms that can be understood by individuals who have not themselves had an experience. However, generally speaking, they are associated with a sense of optimism and unboundedness. The isolated ego, 'I', is perceived to be both restricting and a fabrication of our minds, and this insight brings about an expansion of awareness in which the individual loses the sense of time and space, and the boundary between self and non-self. Although mystical experiences can occur spontaneously, particularly during and after a life crisis, regular meditation*, as practiced within countless different disciplines, can also increase the frequency with which these experiences occur.

Mystical experiences were first found to correlate with specific patterns of brain activity through the study of patients with temporal lobe epilepsy. The researcher Vilayanur Ramachandran and his colleagues investigated brain activity in these patients, and found that many experienced bursts of activity in their temporal lobe, referred to as microseizures. Patients who frequently reported mystical experiences, or who were known to express religious fanaticism, were more likely to have these microseizures than those that did not.[1]

Taking this research one step further, Michael Persinger, designed a device that would become popularly known as the 'God machine'. This simple device – a series of small electromagnets attached to a motorcycle helmet – delivers a weak electromagnetic field that can be used to selectively activate distinct regions of the brain. Persinger reported that stimulation of the temporal lobe elicited a mystical experience in about 80% of subjects; stimulation of the right temporal lobe tended to elicit more pleasurable experiences than stimulation of the left temporal lobe. Although some subjects failed to have an experience when wearing the helmet – most notably Richard Dawkins, the self-proclaimed atheist – these observations suggest that the large majority of subjects tested had the innate neural wiring necessary for them to have a mystical experience. This led Persinger to suggest that an individual's propensity to have mystical experiences depends on the lability of their temporal lobe (i.e. how prone it is to change). Individuals with a high lability were seen to be more likely to have microseizures, and therefore more likely to have mystical experiences. Persinger's early results have been confirmed in a more recent analysis of more than 400 additional subjects.[2]

For some, this research provided the proof that mystical experiences, and even the experience of God, were the result of aberrant neural circuitry, an artefact of brain function. However, this view is flawed. Our brains are designed to receive information about our experiences, whether that be the experience of biting into an apple or a mystical experience. Hypothetically, if we were capable of experimentally stimulating the specific areas of the brain involved in the perception of an apple, the subject would likely report that they had experienced an apple. The perceived apple would not real; it would be, quite rightly, an artefact of brain function. Does the replication of the neural

*There are many different types of meditation; however, the generic term "meditation" is used throughout to represent any meditative practice that meets the following criteria: it must involve a specific technique that is both clearly defined and taught; it must involve, at some stage, progressive muscle relaxation; it must involve, at some stage, a reduction in logical processing; it must be self-induced; and it must involve a tool, referred to as an anchor, that allows effective focus of the mind.

impression of an apple in the laboratory call into question whether apples actually exist in our world? Similarly, the observation that mystical experiences can be artificially evoked merely reveals that the neural circuitry of the human brain has evolved to allow it to process the full range of experiences, including mystical experiences. Like a radio receives and transmits music, our brain receives information about all of our experiences, including mystical experiences, and, in doing so, gives rise to our conscious awareness of these experiences. This research therefore merely suggests that most of us possess the innate neural circuitry, or hard-wiring, allowing us to perceive and make sense of mystical experiences when they occur.

Exploring Mystical Experiences Elicited by Meditation

The investigation of artificially evoked brain events is clearly far from ideal. This fact led the researchers Andrew Newberg and Eugene d'Aquili to attempt to study mystical experiences elicited by meditation in the laboratory. Experienced Buddhist meditators were asked to meditate and, when they felt they were accessing an altered or mystical state of awareness – sometimes referred to as the transcendent or peak moment of meditation – they were asked to pull on a string. Radioactive tracer was then injected into the meditator, through an in-dwelling catheter, and the binding of this tracer in the brain visualised using SPECT (single photon emission computed tomography). Active regions of the brain have a greater blood supply and can therefore be expected to bind more of the radioactive tracer. In this manner, information about the activity in the meditator's brain at this transcendent moment was captured and visualised.

From these pivotal experiments, Newberg and d'Aquili demonstrated that meditation triggered two important changes in brain activity. Firstly, there is an increase in activity in the frontal cortex, in the area of the brain known to be involved in sustained attention – referred to as the attention association cortex. Increased activity in this association cortex leads to decreased activity in the surrounding regions of the brain that are responsible for complex cognitive processing. This is the consequence of innate circuitry that filters out redundant information in order to maintain sustained attention in the face of continual distractions. The more attention is held on a single focus, the easier it becomes to sustain that attention. The key feature of this first step is a shift in brain activity from the left to the right hemisphere, as attention is predominately a right-hemisphere function. The implications of this are discussed below. Secondly, the increase in activity in the frontal cortex drives a decrease in activity in the parietal cortex. This houses two important association cortices; the orientation association cortex and the verbal-conceptual cortex. The former gives rise to our sense of orientation in space and time, and contains the neural circuitry that defines the boundary between self and non-self, whereas the latter confers the ability to relay our experience in words. A decrease in activity in the parietal cortex therefore leads to a decreased awareness of space and time, as well as an inability to describe the experience using language.[3]

The findings of this research therefore mirror our current subjective understanding of the mystical experiences elicited by meditation. Sustained attention is pivotal to all types of meditation, and these experimental results confirm that sustained attention elicits defined changes in the activity of the frontal cortex that trigger the unfolding of the meditative experience. Many meditators also report a dissolving of the boundary between self and non-self and an expansion of awareness that brings a sense of unboundedness and transcendence. This so-called mystical experience can also be understood in terms of changes in brain activity, with meditation switching off the circuitry in the parietal lobe involved in generating our perception of time and space, and our position within it, as well as the self/non-self boundary. Furthermore, the indescribability of mystical experiences can also be explained by the reduced activity in the parietal lobe, as this part of the brain also houses the neural circuitry that confers the ability to express our experiences in language.

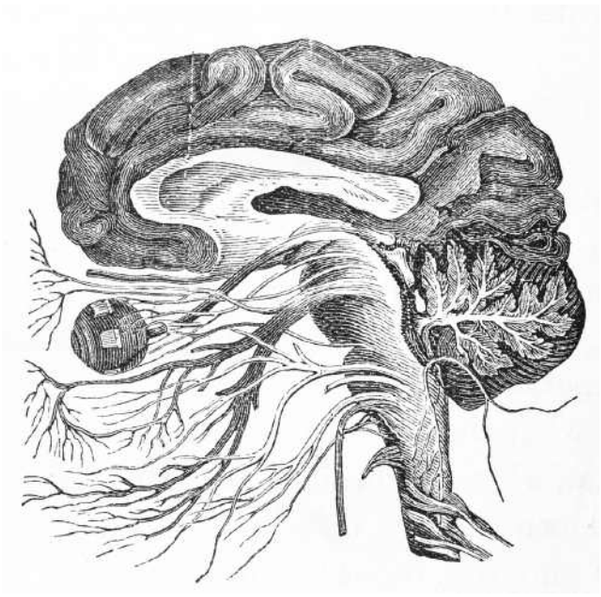
Meditation as a Neural Process Designed to Unlock the Innate Potential of our Brains

In the discussion above, we saw that meditation, through sustained attention, elicits a switch between left- and right-hemisphere activity. This switch is a crucial component of the process leading to the mystical state of awareness often experienced as a result of meditation. In order to understand the implications of this, it is important to first examine the functions of the two hemispheres. Our understanding of the different roles of the two hemispheres largely stems from split-brain surgeries performed in the 1960s in patients suffering from particularly severe epilepsy. By severing the connections between the two hemispheres, the two sides of the brain can be essentially isolated from each other. Following one of these surgeries, a split-brain patient was blindfolded and given a toothbrush to hold in their left hand. As the right hemisphere controls the left-hand side of the body, the toothbrush was sensed by the right hemisphere. The patient was therefore able to mime what a toothbrush would be used for (i.e. they understood the toothbrush's purpose); however, they were unable to name the object. Both the term 'toothbrush' and the ability to vocalise this term lie within the left hemisphere. Observations in these split-brain patients prompted the neuroscientists, Jerre Levy and the now Nobel prize winning Roger Sperry, to suggest that the two hemispheres have inbuilt, qualitatively different, and mutually antagonist modes of cognitive processing.[4]

The left hemisphere houses the neural circuitry that mediates verbal and written language, as well as being home to many of the cognitive processors that give rise to

the intellectual functioning of the human mind (i.e. our ego). Accordingly, the left hemisphere is often considered to be the dominant hemisphere, and many of us spend much of our existence cultivating and using the left-brain mode of cognitive processing. During meditation, the practitioner accesses the functioning of the right hemisphere, and therefore can gain insight from the right-brained mode of cognitive processing. Experiments suggest that the right hemisphere captures a much more truthful representation of an experience. Our left hemisphere has a tendency to filter our experiences so that they fit into our established perception of ourselves and the world. Experiences that fit our worldview and 'boost our ego' are captured, whereas those that challenge our worldview and 'undermine our ego' are ignored. The right hemisphere, on the other hand, captures the whole experience and therefore, during meditation, when the practitioner has access to the right hemisphere, often long-forgotten memories can surface in full Technicolor or solutions to unsolved problems or dilemmas can emerge.

Meditation therefore provides the practitioner with a method through which to switch between the two modes of thinking and perceiving conferred by the two hemispheres. We have seen that the expansion of awareness often reported during mystical experiences elicited by meditation



can be partially explained by decreased activity in the neural circuitry conferring our sense of orientation in space–time, as well as our self/non-self boundary. This expansion of awareness can also, however, be partially explained by the fact that meditation triggers a shift from left-hemisphere activity to right-hemisphere activity, and thus a shift towards a more holistic, abstract mode of cognitive processing that reveals the interrelatedness of all things, as well as the restrictions of the ego-centred mode of cognitive processing.

In the late 1970s, Maxwell Cade, a prominent psychophysiologist, proposed that there were five different levels of consciousness dreaming sleep; hypnogogic/ hypnopompic (i.e. between waking and dreaming); everyday waking; meditative; and lucid awareness, and that these different levels of consciousness correlate with specific patterns of electrical brain activity. During meditation – considered by Cade to elicit a higher level of consciousness than the normal, waking consciousness (equated to the aforementioned 'mystical' or 'meditative' state of awareness)– there is a prominence of alpha brain waves, associated with relaxed wakefulness, and theta brain waves, associated with the creative subconscious mind. Unsurprisingly perhaps, there is also a decrease in the beta brain waves that are associated with active thought. The highest level of consciousness – referred to as lucid awareness or the 'awakened mind' state – involves comparable levels of alpha and theta brain waves to the meditative level of consciousness, but also includes beta brain waves, indicating a return of higher cognitive functions. Unlike the beta brain waves seen during the everyday waking level of consciousness, which occur predominantly in the left hemisphere, the beta brain waves seen in the 'awakened mind' level of consciousness are balanced across the two hemisphere. Optimal brain functioning, and indeed higher states of consciousness, are thus seen to stem from balanced left- and right-hemisphere cognitive functioning.[5] In our left-hemisphere dominated society, in which achieving and succeeding are valued over being, meditation offers us a method of switching into the right-hemisphere mode of thinking, thereby re-addressing this imbalance. Meditation also elicits brain wave changes associated with higher states of consciousness than our everyday, waking state, and therefore provides the key to unlocking the innate potential of our brains. By observing the changes in brain activity underlying some of the main features of mystical experiences elicited through meditation, we have therefore not only gained a better understanding of the involvement of the brain in conveying mystical experiences and eliciting mystical states of awareness, but we have also gained a more complete picture of the role that meditation plays in eliciting these changes in brain activity, and indeed, the role it plays in optimising the performance of our brains.

Investigating the Effect of Meditation on Measurable Health Outcomes

The growing body of evidence supporting the role of meditation in triggering mystical experiences or mystical states of awareness, together with the evolving view of meditation as a potential method of optimising brain performance, have prompted researchers to explore the effects of meditation on the health and well-being of the practitioner. This research reveals that meditation may play an important role in modern healthcare.

Mindfulness-based stress reduction (MBSR) is a technique developed by Jon Kabat-Zinn for use in patients, including those with chronic pain, depression, cancer, heart disease and anxiety. Based on the Buddhist practice of mindfulness, but essentially independent of any esoteric tradition, MBSR trains the practitioner to become more aware of their moment-to-moment thoughts. Rather than modifying these thoughts, practitioners are taught to modify their attitude to these thoughts. MSBR also involves the practice of seated meditation, together with a body-scan relaxation technique and some yoga postures. A number of studies have shown that MBSR has a measurable impact on the well-being of patients suffering from chronic pain. In one of these studies, conducted by Kabat-Zinn, more than 65% of patient who had failed more conventional methods of pain management responded to a 10-week programme of MBSR. Patients not only reported an improvement in their level of pain, but also an improvement in the mood disturbances precipitated by chronic pain.[6] Furthermore, in cancer patients, particularly those with hormone-dependent

cancers such as breast and prostate cancer, MBSR can lead to significant improvements in quality of life. In a study conducted by Michael Speca and colleagues, MBSR was shown to elicit a 65% improvement in mood and a 35% improvement in symptoms of stress.[7] In a recent meta-analysis of studies of MBSR, Paul Grossman and colleagues concluded that MBSR was an effective stress-reduction method that was associated with clear benefits in terms of both overall health and the ability of patients to cope with their illness. The size of the effect seen is dependent on both the frequency and duration of practice.[8]

Meditation's impact on stress underlies many of its proven physical health benefits. In some patients, regular meditation is associated with a reduced risk of cardiovascular disease, as well as decreases in blood pressure, both of which are likely to result from better stress management. Regular meditation also confers psychological benefits, such as reducing anxiety and depression, improving coping mechanisms (both with disease and chronic pain), and addressing addictive behaviour, all of which are again, at least in part, manifestations of stress. In a world in which the levels of stress appear to be continually escalating, meditation appears to offer a therapeutic antidote that can, at least to a certain degree, lessen the impact of stress and stress-related disease on both the individual and our healthcare systems.

Despite the growing body of evidence supporting the effect of meditation on measurable health outcomes, orthodox medicine still largely approaches meditation with scepticism. This is largely the result of the failure of meditation to demonstrate statistically significant results in large-scale meta-analyses. In 2007, the authors of a technology assessment based on research conducted by the University of Alberta Evidence-based Practice Center (EPC) under contract to the Agency for Healthcare Research and Quality (AHRQ) stated that, 'firm conclusions on the effects of meditation practices in healthcare cannot be drawn based on the available evidence'. As acknowledged by the authors, this negative finding results from the low quality of the included studies and the diversity of types of meditation studied, methodology used and enrolled patient populations.[9] This example highlights a number of important issues. Firstly, there is a clear need to standardise the methodology used when studying meditation and to, wherever possible, conduct randomised controlled trials. Furthermore, researchers studying meditation should strive to adhere to the CONSORT guidelines for trial reporting to ensure that their data are viewed in the most favourable light. Secondly, it remains questionable whether studies of meditation should be forced to meet the rigorous standards devised for clinical trials of investigational drugs. Meditation is not a substitute for conventional treatment approaches; it is an alternative therapy that can, in some patients, provide added benefit. Whereas failure of an antihypertensive could lead to considerable patient morbidity and mortality, failure of meditation to improve a patient's clinical situation has few drawbacks.

The value of meditation as a healthcare intervention is perhaps best illustrated by the fact that, at an increasing number of medical institutions in the US and Europe, training courses in meditation are being offered to a diverse range of patients. More than 16,000 patients have undergone MBSR training at the Massachusetts Medical School, Center for Mindfulness since it was founded in 1995, and the feedback from healthcare professionals and patients involved is overwhelmingly positive. Furthermore, at the MD Anderson Cancer Center in Houston, Texas, patients are now routinely offered a variety of support programmes, including courses in meditation, to help them to better deal with their illness and its consequences. In the UK, the Centre for Mindfulness Research and Practice at Bangor University offers training courses in mindfulness to both healthcare professionals and patients, and strives to promote the use of mindfulness in the clinical setting within the National Health Service (NHS). In a climate in which our healthcare systems are struggling to cope with the ever-expanding pool of patients, this trend suggests that meditation can play a key role in effective patient management, and may well offer a much-needed solution to the growing healthcare crisis in the West.

Defining a Role for Meditation in our Modern, Everyday Lives

In the clinical setting, meditation can undoubtedly alleviate some of the burden currently placed on our healthcare systems, as well as empowering the individual patient to play a pivotal role in the management of their condition. Meditation's adoption into mainstream society, however, requires another substantial shift in thinking. Our fast-paced, adrenaline-filled lives draw our attention away from our health and well-being, and often promote unhealthy lifestyles. Western medicine is largely responsive rather than preventive; by the time most individuals seek medical help, they have established disease requiring active intervention. There are obvious benefits of diagnosing disease in its early stages, or even preventing it before it can develop. The achievement of this, however, depends on both the individual's awareness of their state of health and well-being and their motivation to instigate lifestyle changes that promote good health and well-being.

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Meditation offers a potential strategy through which an individual can cultivate and maintain a state of good health and well-being. Long-term stress can have damaging effects on the body long before these effects are manifest as poor health or disease. Not only does meditation reduce stress, but it may also prevent or delay the onset of stress-related diseases, as well as reducing risk prone behaviour triggered by stress, such as smoking and the use of recreational drugs. Furthermore, there is an abundance of anecdotal evidence suggesting that meditation can be associated with the following subjective benefits: a boost in energy levels and a decreased need for sleep; an increase in productivity and creativity; increased self-acceptance, which often

translates into an increased acceptance of other people and thus improved interpersonal relationships; a greater ability to express emotions; fewer bouts of irritability and impatience, or emotional or behavioural outbursts; an improved and expanded sense of identity; and a greater understanding of which situations, individuals and behaviour are constructive, and which are destructive. This evidence provides a strong rationale for the inclusion of meditation in our everyday lives.

In addition to conferring health benefits, the insights gained for our investigations into the effects of meditation on the brain reveal that meditation is also an important tool that allows us to access higher levels of consciousness. These higher levels of consciousness are associated with optimised brain functioning, and their attainment is conducive to personal growth. Through meditation, it is possible to harness the innate power of our both our left and right hemispheres, and reap the benefits afforded by using the complementary modes of cognitive processing offered by them. Meditation, and the mystical states associated with meditation, appear to be part and parcel of what it means to be human, and regular practice promises to allow us to fulfil more of our potential, both as individuals and a society as a whole.

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