

Neurotheology is the scientific study of religious or spiritual experiences and feelings. By using psychology and neuroscience, scientists explore the biological basis of religious experiences and are beginning to uncover the capabilities of the human mind. Neurologists have found evidence in the mechanics of the human brain that facilitates the capacity for spiritual, religious, or mystical experience and leads to an intermingling of science and religion. Neurotheology claims that the hardwiring of the human brain not only makes religion possible, but also makes it capable of being passed on through the genes as a physically distinct mechanism of cultural transmission, allowing religion to be selected as an adaptive behavior.

Religion has contributed to human evolution and continues to be a universal behavior even in apparently scientific times. In fact, statistics show that 70% of the world's population affiliate themselves with some religious or spiritual practice, whether they engage regularly or not.

It is important to understand what is meant by religious, mystical, or spiritual experience. It is the universal, transcendental state described by many as a feeling of being at one with the world, their God, everyone, or themselves, depending on the vocabulary of the religion with which they are affiliated. It often involves a period of deep concentration that is termed meditation or prayer by some religions, but also has been known to happen spontaneously to those without conventional religious belief. This would lead one to believe that it is in the potential of all human brains to have a mystical experience, not just those using religious vocabulary to describe it. Studies show that the potential of each person lies in his or her willingness to let the experience happen.

To understand how the human brain could possibly be wired for the internal mystical experiences of religion, we must first understand how our brain works to interpret our surrounding environment. The brain has several association areas in the cerebral cortex that are designed to put together all of the perceptions our other sensory organs experience. The ultimate goal of these areas is to help us understand the world around us and decide on specific responses.

Andrew Newberg and Eugene D'Aquili believe that four association areas play an important part in

producing the potential for religious perception. The visual association area aids in our ability to visually recognize people, places, and things, allowing our memories to hold a visual composition of events or perceived events. The verbal conceptual association area allows us to generate abstract concepts and describe them with words; it is located in the temporal, parietal, and occipital lobes of the brain.

The orientation association area (OAA) and the attention association area (AAA) are the most important to religious experience. The OAA is in the posterior section of the parietal lobe and receives sensory input that creates the three-dimensional sense of body and orients the body in its surrounding space. There are two OAAs in each hemisphere of the brain that function in related but distinct fashions. The left OAA creates the sensation of a limited, physically defined body. The right OAA generates spatial coordinates that provide the body with the limits of its surroundings. The two OAAs intermingle information to create a defined body that has a definite space around it in which it can move. Because spiritual experiences involve an altered sense of the time and space in which the body or the "self" exists, the OAAs are important to the reality of the experience.

The AAA is referred to as the seat of the will and is in the prefrontal cortex of the brain. It is involved in the complex choreography of integrating bodily movements and behaviors associated with reaching goals. From the seemingly simple task of reaching for an object to the laborious thought process involved in deep concentration or focus, function is therefore a main factor in the experience of transcendental states of being.

To test their claims, Newberg and D'Aquili's research involved the study of deep meditation. For the experiment, a Buddhist sits in a dark room setting up his ritual meditation scene. Candles, incense, and a picture of his deity are all important to the mood and thus important to the experience that the subject will have. Newberg and D'Aquili state that the acts of rituals themselves are the first steps in preparing the brain to be open to a transcendental experience.

The subject sits in meditation position, and a piece of string stretches into another room, where the doctors wait for a signal, a tug on the string that the "peak" state of meditation has been achieved. When the string is tugged, the doctors inject a radioactive tracer solution into an I.V. that has been placed in the subject's left arm. Because the solution goes directly

into the bloodstream, it “locks” onto the brain cells almost immediately and will stay there for hours.

The meditation session is quickly ended, and the doctors move the subject to another area of the hospital where a single emission computed tomography (SPECT) camera is located. The SPECT is an imaging tool that will detect the radioactive tracer in order to photograph the peak of the meditation experience. The imaging will give the doctors a freeze-frame of the brain.

Because increased blood flow to an area of the brain represents higher activity levels, this photograph will show what areas of the brain are active during meditation. What shows up is unusual activity in the posterior superior parietal lobe, or OAA. Remember that this is the area that helps us to determine which end is up and the physical limits of the self. People who suffer injuries to this area would have difficulty maneuvering in their physical surroundings. They are unable to tell where things begin and end, particularly because they cannot conceive of their own physical limits.

A brain scan taken before meditation showed normal, furious activity all over the subject’s brain, which shows up in vibrant bursts of reds and yellows. The peak scan, however, shows markedly reduced activity in the area of the OAA, which shows up as cool blues and greens. Normally, this area never rests. Newberg and D’Aquili have come to the conclusion that the OAA is working as hard as ever. What has changed is the sensory perception of the outside environment. The incoming flow of sensory information essentially has been blocked by a deep state of concentration inward. The OAA has no incoming information with which to define the limits of the self, and while continuing to search for this information, the brain perceives no distinctions between the limits of the self and the physical boundaries of the outside world. The brain perceives the self as endless. To the subject, this experience is unquestionably real.

Newberg and D’Aquili also researched several Franciscan nuns during prayer. The SPECT scans of the nuns revealed similar changes in brain activity. Unlike the Buddhist’s feelings of oneness with the world, however, the Sisters tended to describe their experience as closeness to God. The doctors describe both experiences as absorption of the self into something larger and conclude that the mystical experiences are scientifically observable, neurological events that are experientially and biologically real.

What Newberg and D’Aquili believe they have found is the core of neurotheology, the evolved biological link to spirituality that has the ability to be passed on through genes. We hold a physical memory of our past in our genes and an implicit and explicit heritage in our cultures, languages, and moral and religious traditions that are passed on by our brains and our books. To realize the co-evolution of culture and biology is important to the perpetuation of religion and availability to mystical interpretation of the transcendental experience. Newberg, D’Aquili, and others claim that humans are naturally equipped to induce effortless self-transcendence. They describe such everyday experiences as being moved by music or the feeling of being swept away by an inspirational speech as examples of everyone’s potential for transcendence.

Neurologists have previously found a connection between temporal lobe epilepsy and new interest in religion. It is during seizures involving this portion of the brain and those of the association areas that patients describe religious experiences occurring. When the electrical impulse of a seizure disturbs areas of the brain, hallucinations, voices, and feeling of a presence or infinite space occur, creating an imitation enlightenment.

In fact, with this discovery, it is believed that many religious and historically significant individuals actually suffered from temporal lobe epilepsy. For instance, Joan of Arc, a historic woman who led the French army against the English with her perceived voices and visions of God, is now believed to have suffered from temporal lobe epilepsy. The condition would have caused her to hear her own conscious thoughts as if they were coming from an outside entity. She also described bright lights and hallucinations, which are known to be symptoms of temporal lobe epilepsy.

It is also speculated that Moses, a prominent prophet in one of the world’s most popular religions, was afflicted with temporal lobe epilepsy. His visions of the Archangel Michael led the Israelites out of Egypt and are the basis for a portion of the Old Testament.

The affliction of imitated enlightenment is not seen only in historical accounts. Psychologist Dr. Oliver Sacks encountered a patient in the early 1970s named Greg F. Greg was in his early 20s when he joined the Hare Krishna, a religious group. Shortly after taking up residence in the main Krishna temple in New Orleans, Greg began to lose his vision and experience

a glazed-over feeling. The Krishna interpreted this as Greg's path toward spiritual enlightenment. However, when his parents came to visit him 3 years later, their once-healthy young man was now a bald, fat, 25-year-old man with a huge midline brain tumor. Greg was able to have surgery to remove the tumor, but he never recovered his vision and remained forever blissed out.

Richard Dawkins sees religion in terms of pathology. He considered the God-meme (a unit of culture) a virus that infects an organism and produces copies. Susan Blackmore, referring to religious laws about killing nonbelievers, describes religion as a way that "even evil and cruelty can be redefined as good." Religion itself and its practices are not always as beneficial. For example, being involved in a doomsday cult and participating in mass suicide would not improve anyone's inclusive fitness. There is also evidence of psychological damage wrought by dogmas of guilt and fear. And, some religions allow the blatant physical and psychological abuse of women, including genital mutilation. Historical accounts describe hundreds of years of Holy War and the persecution of people because of their faith or lack thereof. Even today, in a scientifically modern world, some religions justify the killing of people throughout the world. Religion has, however, persisted for thousands of years, and there must be adaptive benefits resulting from it.

One benefit that has long been known in the East is that meditation has health benefits. Physical benefits to the body include a reduced heart rate, lower blood pressure, and decreased levels of stress hormones that would inhibit the immune system. These benefits seem to transcend religious affiliation. Religion appears to generally increase longevity, which in turn increases relative fitness.

While some see religion's persistence as self-delusional superstition, others believe it still exists for healthier reasons. Studies suggest that people who are affiliated with and practice a religion have fewer strokes and heart attacks, and lower blood pressure. Newberg believes that religion bonds families and individuals, providing them with unifying beliefs. It encourages more peaceful and productive community settings. Clearly, the benefits of religion would give those inclined an advantage in the evolutionary struggle for survival.

However, the benefits of religion are not always outwardly apparent. What would the benefits of

religion have been to our ancestral cousins that would have allowed it to continue to be selected for? Even today, like in the past, religion brings people together with a sense of community. Within this community, it is less likely that you will go hungry or be without shelter or care when you are ill. There is evidence, though disputed in Neandertal burials, of osteoporosis and arthritis, suggesting that they took care of their elderly and enfeebled.

In the past, environmental stress would have been difficult to understand. Indeed, it was in times of famine that ancient Native Americans created deities such as the Great Stag, to whom they prayed for increased deer populations. Newberg describes a speculative but interesting scenario in which a hunter is out searching for deer for days with no food or water and begins to hallucinate of a talking deer. After returning to the village and telling his story, some other hunters also return with an excellent amount of meat, which the Great Stag had foretold in the hallucination. Whether the benefits are coincidental or divine intervention, it is easy to see how the hardwiring of the human brain could have created and perpetuated the mystical experiences that led to the development of hundreds of religions and vast interpretations of transcendental episodes.

As far as Newberg and D'Aquili are concerned, religion has been around since before modern *Homo sapiens*. However, they do not think that the hardwiring used to genetically transmit potential for religious experience evolved specifically for this purpose. In fact, Newberg and D'Aquili have hypothesized that the potential for religion is actually a by-product, having risen from the circuitry involved in mating and sexual experience. They state the vocabulary of mystical experiences of the past as part of their evidence. Such words as *bliss*, *rapture*, *ecstasy*, and *exaltation* have been used to describe transcendental experiences and sexual experiences alike. "Mystics speak of losing themselves in a sublime sense of union, of melting into elation and of the total satisfaction of desires."

This theory is also based on the fact that many of the areas of the brain involved in transcendence are also involved in sexual arousal and the connection to the powerful sensation of orgasm. A similar blocking off of outside senses is experienced in both situations. They are not the same experience, just functioning on some of the same neural pathways. Falling in love involves the same sense of reception to the experience as the potential for a transcendental experience.

That religion is a by-product does not necessarily lessen the experience. Many of the brain's most sophisticated functions evolved from more humble beginnings. For instance, the ability to appreciate music and art developed from simple survival tasks. For religion, evolution stumbled in the right direction and took hold, continuing to allow the biological and cultural facets to co-evolve.

The way that we perceive our surrounding environment lays in the inner workings of the brain. The evolution of the concept of self led to the distinction between mind and brain, leading humans to contemplate more than where their next meal was coming from. Neurotheology does not claim to either support or deny the existence (now or in the past) of one all-knowing God, as believed in many religions. It does, however, thoroughly demonstrate the ability of the human brain to create and therefore experience religious, mystical, or spiritual experiences.

— Jackie L. Orcholl

Further Readings

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NGANDONG

Ngandong is an archaeological site located on the High Terrace deposits near the Solo River in eastern Java, Indonesia, that includes remains of early *Homo sapiens*. Excavations of the site were conducted between 1931 and 1933 by Eugene Dubois.

Originally called *Homo solonesis*, or “Solo Man,” the remains were thought to belong to a more advanced population than *Homo erectus*. Remains found at the site include 13 skull caps. Of the 13 crania or cranial fragments, nine are adults or at least

fully grown, and one is clearly a child. Additional finds include two fragmentary tibia bones. These indicate that one individual was 167 cm and the other 188 cm tall, which is larger than other finds of early *Homo sapiens* in Indonesia. The general impression of the Ngandong hominids is that they were a very powerful and muscular people. This is indicated by the bony evidence of muscle attachments, as well as in the form and thickness of the bones themselves. The specimens were not intentionally buried, and there are no archaeological associations found directly with these remains. Healed cranium wounds were common in the Ngandong specimens and are found more on presumed female than male crania.

Most of the crania were faceless and/or baseless, and it is uncertain whether this was the result of ritual treatment of the dead, taphonomical factors, or perhaps preferences of those who collected the specimens. Some even suggested that they were used as water bowls. The most probable explanation, however, is that the face and base contain the most fragile bones of the skull, and either the action of carnivores or natural damage through the process of fossilization led to the destruction of these parts.

Found near the broken crania was a fossil bed of 23,000 mammalian bones, mostly of extinct elephants, oxen, and hippos. Along with the mammal remains, an assortment of scrapers, borers, choppers, and stone balls for use as slings was found. Evidence that these early *H. sapiens* had social organization and used simple tools is supported by these findings.

Previously, it was thought that the Ngandong remains dated to about 100,000–250,000 years ago. But recently, teams have reexamined the Ngandong excavations using electron spin resonance and mass spectrometric uranium-series techniques to reach a date as recent as 43,000–27,000 years ago.

The Ngandong hominids are considered by most authorities to be ancestral to modern Australian Aborigines. The date of the earliest hominids in it is in dispute, but most authorities would agree that Australia has been occupied by humans for at least the past 120,000 years. If this is the case, then the Ngandong population cannot be ancestral to the Australian Aborigines.

— Donald E. Tyler

See also **Homo erectus; Indonesia; Java Man; Sangiran**