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Neurotheology: Neuroscience of the soul

Stephen P. Cooke

Armstrong Atlantic State University

Abstract

Neurotheology encompasses areas of research that investigate the neurological factors involved in religious conviction (religiosity). Case studies of patients with temporal lobe epilepsy offer insight into religiosity (Dewurst & Beard, 1973). Successful attempts to induce religious sensations using weak magnetic waves (St. Pierre & Persinger, 2006) caused controversy when similar results were unattainable when the experiment was replicated (Granqvist et al., 2005). Neuroimaging studies have also focused on other portions of the brain during religious practices such as meditation and verbal prayer (Newberg, Pourdehnad, Alavi and d'Aquili, 2003; Beauregard & Vincent, 2006). Inzlich, McGregor, Hirsh and Nash (2006) offer an evolutionary approach to the subject by analyzing the possible purpose of religiosity. All of these studies point to a neurological basis for religiosity.

In his 1962 book *Island*, Aldous Huxley coined the term neurotheology. In it he describes a neuro-theologian as “somebody who thinks about people in terms, simultaneously, of the Clear Light of the Void and the vegetative nervous system”(p. 112). Neurotheology, as Huxley used the term in his book, describes the field almost as a blending of philosophy and science. A staunch humanist, Huxley sought to stimulate an intellectual movement through science-fiction literature in the same vein as George Orwell's *Nineteen Eighty-Four* (1949). Although Huxley most likely never intended for his idea to gain any sort of mass following (indeed, his use of the word was a bit satirical at heart) the term neurotheology has come to envelop a robust field of research into the physiological basis of religious or cosmic experiences. The research that encompasses what is affectionately called neurotheology is also commonly known as biotheology and spiritual neuroscience. Although empirical research into religious experiences has grown in popularity over the past few decades it wasn't until Lawrence McKinney's book *Neurotheology: Virtual Religion in the 21st Century* (1994), that the field was given the name. In his book McKinney attempted to define the field and create a name to work under. The term neurotheology is still a new one and simple searches through peer-reviewed journal databases (e.g. PsycInfo) for articles with neurotheology in the title returned no results. Articles pertaining to the field of neurotheology often times omit the term and are more easily identified by the research presented, primarily containing titles reflecting reviews of brain-imaging studies on religiosity and patients suffering from epilepsy. Despite a current lack of cohesion under one name the research itself promises to be informative and offers crucial insight into the neurological underpinnings of religiosity and the evolutionary function thereof. By understanding these neurological functions we may one day learn how to manipulate them and use them to our advantage.

Early History of Neurotheology

The core purpose of neurotheological research is to identify whether or not a specific 'God spot' exists within the brain or rather what areas of the brain are active during religious/spiritual/mystical experiences (RSMEs; termed by Beauregard & Paquette, 2006). Early research into RSMEs presented evidence that the temporal lobe might be the source of the sensations. Research with epileptic patients formed the basis for neurotheological research since the mid 19th century. The earliest research on epilepsy as a cause of religiosity can be traced back to early French psychologists who researched epileptics and some of the symptoms and causes of their disorders (Esquirol, 1838; Morel, 1860). Early research conducted by such psychologists did not attribute epilepsy to specific portions of the brain and considered religiosity to be a by-product of epileptic symptoms as opposed to a direct effect of the condition itself.

Of particular interest is one specific book that was used in the Harvard psychology department (Clouston & Edin, 1884) as learning material for students studying epilepsy. The authors of the book include a lengthy discussion of epileptic patients, however they briefly discuss what they call *religious emotionalism*, a predisposition to religious outbreaks and/or sensitivity. A brief summary of a hospitalized subject with epilepsy was used as evidence that religious (along with sexual and violent) tendencies were characteristic of epileptics. The patient who is discussed finds himself deeply engrossed in religious studies during his epileptic seizures. He would wander through the halls of the ward proclaiming his religious fidelity to any who spoke to him. If approached by anyone, he would often assault them and ask to be left alone. All of these behaviors were considered products of his seizures. Because techniques to studying the brain were primitive at best, often times quite invasive and resulting in irreparable damage to the

patient, the specific origin of epilepsy was a mystery to the authors. For this reason it remained an understood, under-researched phenomenon among psychologists.

Research With Temporal Lobe Epilepsy Patients

The theory of the the temporal lobe as the origin of RSMEs pervaded the psychological community for almost a century. Case studies of epileptic patients with severe religiosity (i.e., extremely salient feelings of religious conviction) can be found readily and are relatively abundant. An exemplary review of such case studies was written by Dewhurst and Beard in 1973. Their article focuses on six patients who suffered from epileptic seizures at different points in their lives. Among various other emotional distresses, each of these patients noted significant religious experiences at some point during their seizures as well as spontaneous conversions to and, in one case, away from Christianity. Most of the conversion stories involved a sudden novel feeling or experience of elation or clarity. Following their experiences, each patient gained a strong religious fervor. In these studies the researchers investigated the condition of the patients' brains by way of x-rays of the skull and air- and electroencephalograms. Through these methods of imaging the researchers evidence of temporal lobe epilepsy (TLE) was found in all six patients. Signs of a right-side-temporal protrusion was found in one patient, left side protrusions in two patients, anterior medial protrusions in one patient, and both right and left side protrusions in two patients. These protrusions indicate excess growth in their respective brain regions. These data support the hypothesis that religiosity is moderated to some extent by regions of the temporal lobe if not controlled primarily by it.

In their discussion Dewhurst and Beard (1973) review different approaches to the issue of sudden religious conversion in epileptic patients. Of note is the empirical explanation of these

conversions as an effect of TLE in their citation of Jackson (1876) who explained that the many effects of TLE, including conversions, are results of the electrical discharge causing both a loss of function in the higher regions of the brain such as the cortices and hyperactivity in the lower regions such as the limbic system. This two-sided effect diminishes the level of consciousness while at the same time agitating lower functions of the brain. Although this theory would seemingly imply that religion is a lower psychological function of the brain it is better described as an inability of the higher levels of the brain to interpret information from the lower regions. This confusion within the brain, fostered by past experiences of religion, creates the perfect psychological environment for a rationalization of perceptions by way of spiritual conversion and religiosity.

The Temporal Lobe as the God Spot

Another explanation is offered by V.S. Ramachandran in his book *Phantoms in the Brain* (1998). Ramachandran believes that repeated electrical stimulation within the brain as is characteristic of epilepsy facilitates pathways between neurons or opens new ones. This process, called kindling, was first identified by Goddard in 1969. Kindling was developed as a model to explain how it is that repeated stimulation of a specific area in the brain would cause the onset of epileptic seizures even after controlled stimulation ended in some cases. After repeated electrical stimulations to specific parts of the brain Goddard et al. found that the threshold for activation of an epileptic seizure lowered. In this same manner it can be inferred that repeated stimulation of other parts of the brain can effect behaviors other than seizures. Ramachandran's theory therefore insists that religiosity is one such behavior that can be attributed to a kindling effect.

Ramachandran (1998) proposes that the temporal lobe, namely the amygdala, may be the

source of religious experiences. The amygdala, as he explains it, serves the function of attributing significance to sensory information gathered from the environment by relying on emotional memories. Evidence has been found that damage to the amygdala results in an inability to retain information in conditioned emotional response (CER) tests (Goddard, 1969). Conditioned emotional response procedures generally involve the conditioned suppression of activity at the onset of an aversive stimulus (Mazur, 2002). If a CER is absent due to damage to a particular region of the brain (in this case the amygdala), the effect would be continued normal activity despite repeated aversive stimuli. The experiment by Goddard illustrates the importance of the amygdala in emotional memory and its function in identifying the significance of activities and stimuli in the environment. If the amygdala is stimulated, the opposite effect might be found in a sense of inflated significance attributed to sensory stimuli that would elicit little to no response in a normal brain. This could explain the situation by which patients suffering from TLE become overwhelmed by profound moments of perceived clarity and elation.

In 1997 Ramachandran et al. conducted research that involved determining the significance that is applied to different objects in patients suffering from TLE by testing their galvanic skin response. Compared to results obtained from a control group of normal participants (not screened for religiosity) and highly religious people, the test group attributed higher significance to religious statements than that of the control group but comparable to the results from the highly religious group. Interestingly, the participants also exhibited a decrease in significance of other statements specifically those pertaining to sex. This negative correlation between sex drive and religiosity could possibly explain why chastity and celibacy are important traits to many religions.

The Controversial God Helmet

Using the available knowledge of TLE and its correlation with religiosity Persinger developed an apparatus known as the *God helmet* to stimulate the temporal lobes using low voltage electromagnets that generate a horizontally rotating electrical field (for an overview of some of Persinger's experiments see St. Pierre & Persinger, 2006). Participants were isolated in a room where they were required to sit blindfolded in a chair for 60-min sessions of electrical stimulation. During the sessions a percentage of the participants reported various experiences often described as religious or mystical. St. Pierre and Persinger translate these results as evidence that the temporal lobes are the source of RSMEs. Additionally, neuroscientist Todd Murphy (n.d.) has replicated the original design of Persinger's helmet. According to a study conducted by Tsang, Koren (the scientist who built the original helmet) and Persinger (2004), this new helmet, called the *Shakti helmet*, generated the same results as the original *God helmet* but was built to be more conventional and aesthetically pleasing.

Controversy later arose from the publication of a paper by Granqvist et al. in 2005. In an attempt to recreate the *God helmet* they were unable to replicate the findings by Persinger (St. Pierre & Persinger, 2006). Additionally they hypothesized that the patients' suggestibility may account for previous RSMEs during Persinger's studies. What also gives credence to Granqvist et al.'s claim is the fact that there has been no evidence of a successful replication of the study. There is also a fundamental inconsistency between Persinger's results and the previously mentioned hypotheses by Ramachandran and Beard and Fedio, namely that the usage of the *God helmet* requires a blind-fold to work. If the amygdala, as proposed by Ramachandran (1998), is

the source of RSMEs then it should be less likely that one would experience heightened senses while blind-folded and in a silent room alone. Additionally, to Persinger's discredit, Murphy's helmet was designed for commercial purposes and is available for purchase on his website (www.shaktitechnology.com). Although the website doesn't specify any direct affiliation with Persinger it does serve as negative publicity due to its proposed pseudoscientific and metaphysical applications of the helmet as a catalyst for psychic abilities and paranormal activity. Perhaps the most public opposition to the results found by Persinger came from evolutionary biologist and staunch atheist Richard Dawkins who participated in Persinger's experiment with the helmet and experienced no significant sensations that he considered spiritually moving (Persuad, 2003). Persinger explained this as a result of a low score on a temporal lobe sensitivity questionnaire completed by Dawkins before the test. The lack of replicability and evidence contradictory to established theories such as that of Ramachandran would indicate that the *God helmet* may be little more than a novelty item and the results from such experiments insubstantial at best.

Research Into Other Areas of the Brain

Research has recently taken a different approach to neurotheology in the form of neuroimaging studies which have revealed multiple areas of activation during religious moments as opposed to a specific *God spot*. In 2003 Newberg, Pourdehnad, Alavi and d'Aquili performed imaging studies on three Franciscan nuns. A single-photon-emission-computed-tomographic (SPECT) camera was used to analyze the brain waves during the experiment. The participants were scanned for a baseline prior to meditation. During the test, participants were required to meditate for 40 min. Meditation included the continuous repetition of a verbal prayer. Contrary

to the TLE theory there was no significant increase in blood flow to the temporal lobes during meditation. In contrast they found an increase of blood flow compared to baseline in the prefrontal cortex (7.1%), inferior parietal lobes (6.8%), and the inferior frontal lobes (9.0%). The research helped to establish a new way of studying RSMEs through neuroimaging and revealed a greater amount of complexity than was thought to exist from research with TLE.

In 2006 a similar study was performed by Beauregard and Vincent using functional magnetic resonance imaging (fMRI). The participants in the study were 14 Carmelite nuns. When asked to summon a mystical experience the nuns responded that one can not summon God at will. As such they were required to imagine significant moments in their life when they felt close to God or some other powerful religious experience. As a control they were also required to meditate on a point at which they felt very close to a normal person. Compared to baseline and control group there were more than ten areas of increased activity in the brain. Beauregard and Vincent note that there are multiple facets of the RSME including perception (mental imagery), cognition (representation of the self) and emotion (feelings of joy/love/importance). This being the case it would only make sense that multiple areas of the brain would be active. One of the areas of activation that is worth mentioning is the right middle temporal lobe. This offers support to the importance of the temporal lobe within RSMEs that has been proposed by previously mentioned studies. Also of relevance is the activation of the caudate nucleus and its role in feelings of love (Bartels & Zeki, 2000) which can explain the powerful emotions sometimes experienced during RSMEs.

Another important aspect of neurotheology rests within the purpose of having such RSMEs and religious convictions. Inzlicht, McGregor, Hirsh and Nash (2009) offer evidence in

their article suggesting that religious conviction serves an adaptive function as a barrier against anxiety and frustration in one's environment, most notably when met with error. The experimenters monitored the brain waves of patients performing a color Stroop task by way of EEG, focusing their attention on the anterior cingulate cortex (ACC). The ACC is a portion of the brain that is largely identified by its involvement in anxiety. The patients were divided into two groups: religious and non-religious. The results revealed that religious participants exhibited less activation in the ACC following errors during the Stroop task. Following the activation of the ACC non-religious participants were prone to making more errors. It can be inferred that the higher level of anxiety resulted in poorer choices made during the test. Religiosity may therefore be described as a functional deterrent to anxiety. These data support Inzlicht et al.'s hypothesis that religion diverts focus away from stress inducing events and decreases anxiety produced by levels of uncertainty. The ACC was also one of the regions of the brain that was activated during meditation in Beauregard and Vincent's (2006) study.

Conclusion

Regardless of the nature of RSMs and religious conviction, their impact on society is staggering. In many civilizations religion has been a deciding factor in the fates of countless people and nations. The data gathered over the course of the past century and contained within this review have revealed numerous scientific underpinnings to what has largely been considered a field outside the realm of science and nature. Sigmund Freud believed that three blows have been dealt to humanity's self-esteem (Hergenhahn & Olson, 2007). The initial blow was Copernicus's demonstration that the earth is not the center of the universe. Second, Charles Darwin's theory of evolution placed humans in the same category as animals at which point

Sigmund Freud dealt the third blow revealing that human nature is motivated largely by unconscious desires as opposed exclusively to free will. It is the opinion of this author that the fourth and final blow to humanity's self-esteem will be manifested in neurotheology and the irrefutable analyses of religiosity. Understanding the neurological and psychological bases of religion can help us understand the invisible hand that has been guiding humanity since the dawn of time and perhaps even expose it as an intricate evolutionary adaptation to conflicts met and overcome within our environment throughout our past. From the research we may also be able to learn techniques to manipulate RSMs. Controlling them could have therapeutic applications to the clinically depressed or those suffering from anxiety disorders because of the elated feelings that are often experienced. The process could also prove to be a powerful mechanism for suggestion as well since the process by which religiosity is generated is being stimulated and whatever is experienced during this process would be left up to the subjects interpretation and could be manipulated by the experimenter or whomever might be in control of the situation. Whatever path is taken with the research it will certainly prove to be a powerful guide in shaping humanity's subjective perception of reality, the self and various other existential ponderings.

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