Neurotheology: Neuroscience of the Soul

Paul Cooke \(^1\) and Mirari Elcoro\(^1\)

Neurotheology encompasses areas of research that investigate the neurological factors involved in religious conviction and sensations (religiosity). Since the 1970s case studies of patients with temporal lobe epilepsy have offered insights into religiosity and have sparked interest in the pursuit of neurological correlates for religiosity. Following the theory that the temporal lobes play important roles in religiosity, attempts were made to induce religious sensations by stimulating these areas of the brain, however the results proved unreliable. More recent research has focused on the usage of neuroimaging equipment to identify areas of the brain that presumably mediate feelings of religiosity. Brain scans of religious devotees engaging in verbal prayer and meditation have led researchers to conclude that religiosity is not as localized in the brain as was previously understood with research. Inzlicht, McGregor, Hirsh and Nash (2009) offer an evolutionary approach to the subject by analyzing the possible purpose of religiosity as a defense mechanism against stress. The results from these data indicate that religiosity can be attributed to specific areas of the brain and that religiosity as a whole appears to be far more complex and less compartmentalized than previously believed. By critically reviewing the current literature the argument is made for the necessity of neurotheology as a separate discipline with the goal of providing a wide breadth of information about the psychological and neurological underpinnings of religiosity.

INTRODUCTION

The purpose of this article is to critically review a collection of some of the most promising studies within neurotheology and to assist in consolidating the available data into one specific field within neuropsychology. In modern day neuroscience the term neuropsychology has come to envelop a robust field of research into the physiological basis of religious and spiritual experiences. The term neurotheology was coined by Aldous Huxley in his book Island in 1962. In it he describes a neurotheologian 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 described it in his book, describes the field almost as a blending of philosophy and science. Although empirical research into religious experiences has grown in popularity over the past few decades it wasn't until Lawrence McKinney's (1994) book Neurotheology: Virtual Religion in the 21st Century that the field was given the name. In his book McKinney attempted to define the field and create a name to work under. 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 the name neurotheology, the research itself promises to be informative and offers crucial insight into the neurological underpinnings of religiosity and the evolutionary function thereof. Bringing this research together under one name however is necessary to create an environment more conducive to achieving the goal of describing the many neurological facets of religiosity because it would allow easier communication and discussion between researchers as well as it would make future studies more accessible to those interested.

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). The key to this research is the theory that behaviors, feelings and thoughts are modulated by electrical activity in different, specific areas of the brain. One common means by which to study different areas of the brain in humans is to examine the physiology and behaviors of patients who have neurological disorders. In regard to neurotheology, it has been found useful to study the brains of patients who exhibit extreme religiosity coupled with observable neurological disorders. Research into the neurological basis of religiosity often focuses on epilepsy, a neurological disorder characterized by abnormal synchrony of discharges in groups of neurons in the brain that are often manifested behaviorally by jerking movements, disorientation, convulsions and loss of consciousness (Martin, 1991). Research with epileptic patients formed the basis for neurotheological research since the mid-nineteenth century. The earliest studies on epilepsy as a cause of religiosity can be traced back to early French researchers who provided detailed descriptions of the behaviors and symptoms exhibited by epileptic patients under their care (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. Esquirol (1838), a century ahead of his time, even drew comparisons between ancient religious figures and modern day mental disease patients. Though they didn't utilize what would presently be considered reliable scientific experimentation to come to their conclusions, these early researchers provided the necessary foundation by which to base contemporary research into epilepsy
on through their usage of case studies.

A book of interest is titled *Clinical Lectures on Mental Diseases* which was used as learning material for students studying epilepsy (Clouston & Edin, 1884). The authors of the book include lengthy discussions of case studies involving epileptic patients including one patient who suffers from what they describe as “religious emotionalism”, a predisposition to religious outbreaks and/or sensitivity. Although contemporary studies would require empirical research, a brief summary of a hospitalized subject with epilepsy was used as anecdotal evidence that religious (along with sexual and violent) tendencies were often times characteristic of epileptics. The patient who is discussed found that he was deeply engrossed in religious studies and would wander through the halls of the ward proclaiming his religious fidelity to anyone 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 for 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 under-researched phenomenon among neuroscientists until adequate imaging techniques could be developed to link specific areas of the brain in epilepsy patients to religiosity. The motivation and inspiration on future generations of neuroscientists to pursue empirical research into the realm of religiosity was perhaps a far greater asset than the data provided by these earlier researchers.

**Research with Temporal Lobe Epilepsy Patients**

Dewhurst and Beard (1970) expanded upon earlier research into the link between religiosity and epilepsy by analyzing brain scans from six patients who suffered from 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. Based on x-rays and air encephalograms evidence of right-side-temporal lesions (i.e., excess growth of scar tissue in the respective brain region) was found in two patients and left-side temporal lesions in two different patients. Electroencephalograms (EEGs) showed spiked discharges of electrical activity in the right-side temporal lobe in two patients, the left-side temporal lobe in two other patients, and activity in both sides in the remaining two patients. This increase in activity within the temporal lobe coupled with the physical deformities observed in four of the patients provides a correlation between the temporal lobe and religiosity. This theory of the temporal lobe as the origin of RSMEs continued to pervade the scientific community throughout the late nineteenth century and into the twentieth.

In their discussion of the data, Dewhurst and Beard (1970) reviewed different approaches to the issue of sudden religious conversion in epileptic patients. Worthy of noting is the explanation of these conversions as an effect of temporal lobe epilepsy (TLE) in their reference of Jackson (1876), who theorized that the many effects of epilepsy, 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 cognitive processes such as reasoning 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. Although Jackson lacked the technology to empirically test his theory, it is possible for scientists like Dewhurst and Beard to use modern day technology to form and test hypotheses based on Jackson’s work and to substantiate or discredit his claims.

**The Temporal Lobe as the God Spot**

Another explanation of how religiosity occurs is offered by Ramachandran (1998) in his book *Phantoms in the Brain*. Ramachandran believes that repeated electrical stimulation within the brain 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 repeated stimulation of a specific area in the brain would cause the onset of seizures even after controlled stimulation ended in some cases. After repeated electrical stimulations to specific parts of the brain Goddard et al. (1969) found that the threshold for activation of a seizure lowered. In this same manner it can be inferred that repeated stimulation of other parts of the brain can affect behaviors other than seizures. Ramachandran therefore insists that religiosity is one such behavior that can be attributed to a kindling effect and that the structure in the brain responsible for this effect is the amygdala.

Ramachandran (1998) proposes that the amygdala, a group of nuclei located within the medial temporal lobes, may be the source of religious experiences. The amygdala, as he explains, serves the function of attributing significance to sensory information gathered from the environment by relying on emotional memories. Evidence has shown 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 the amygdala is damaged or lesioned the CER is therefore abolished. Conversely, it can be hypothesized that if the amygdala is stimulated the effect would be an exaggerated sense of significance being attributed to sensory stimuli that would otherwise elicit little to no response in
a healthy brain. This could explain the situation by which patients suffering from TLE become overwhelmed by profound moments of perceived clarity and elation. The evidence found by Goddard illustrates the importance of the amygdala in emotional memory and its function in identifying the significance of stimuli in the environment.

In 1997 Ramachandran et al. conducted research that involved determining the importance attributed to different objects in patients suffering from TLE by testing their galvanic skin response. Compared to results obtained from a control group of participants that were not screened for religiosity and a test group of highly religious participants, TLE patients 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 perceived less importance in statements pertaining to sex. This negative correlation between sex drive and religiosity could possibly account for why chastity and celibacy are important traits to many religions. These results could also contribute to evolutionary psychology and sexual selection. The results from this experiment reveal the perceived significance of sex in the form of galvanic skin responses rather than the actual sexual behavior of the individuals. In practice religiosity could have a positive correlation with sex. The implication of this research however, is that highly religious individuals, applying little significance to sex, would likely find themselves more attracted to other highly religious individuals who they would most likely perceive as less sexual. In this regard religiosity could possibly serve an important role in sexual selection.

The Controversial God Helmet

Using the available knowledge of TLE and its correlation with religiosity, Dr. Michael 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 (St. Pierre & Persinger, 2006). In a series of double-blind studies 201 participants were isolated in a room where they were required to sit blindfolded in a chair for 30-min sessions of electrical brain stimulation in which they were not informed of the purpose of the study. After the sessions ended they were asked to complete a questionnaire identifying the feelings they experienced during the session including the sensed presence of figures or objects in the room during exposure. During the sessions a percentage of the participants that reported various experiences often described them as religious or mystical. St. Pierre and Persinger interpreted these results as evidence that the temporal lobes are the source of RSMEs. Additionally, neuroscientist Todd Murphy (n.d.) 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. Interpretation of the results obtained from use of the God helmet by the aforementioned researchers proves to be difficult due to an abundance of previously untested independent variables (magnitude, length and areas of electrical stimulation). More concerning is the inclusion of questions regarding sensed presences and feelings in the room during the experiment. Including questions like these may have produced the undesired effect of suggesting specific, retrospective interpretations of memories that otherwise would not have been reported. Perhaps a more appropriate methodology would have been to openly inquire what, if anything, was felt or sensed in the room.

Controversy later arose from the publication of a paper by Granqvist et al. (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 hypothesis by Ramachandran et al. (1997)) namely that the usage of the God helmet requires a blind-fold to work. In Persinger's experiments participants are required to wear a blind-fold because it “enhanced the occurrence of a sensed presence” (St. Pierre & Persinger, 2006). 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 since the amygdala requires stimuli, especially visual, to activate. Perhaps the most public opposition to the results 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.

In addition to the weakness of the design, Murphy's helmet is available for purchase on his website (www.shaktitechnology.com). Although the website is owned and operated by Murphy, there is a letter of acknowledgment and recommendation signed by Persinger is posted. The website proposes pseudoscientific and metaphysical applications of the helmet as a catalyst for psychic abilities and paranormal activity. For example, the website has a product called the Shiva Neural Stimulation helmet (listed as Psychic Technology) that can, “allow psychic perceptions to appear” by “dampening the binding factor for consciousness” as well as links to research on reincarnation, telepathy, out of body experiences and various other pseudosciences. These unsubstantiated claims are a detriment to neurotheology and science in general as they perpetuate unscientific theories and applications to the public. The lack of replicability and evidence contradictory to established theories such as that of Ramachandran indicate that the God helmet may be a novelty item and the results from such experiments are insubstantial. Failure to replicate the RSMEs produced by the God helmet in Persinger's research does not however diminish the possibility that such a device could be produced. Further research into the specific mechanisms
governing RSMEs may provide information to develop such a device at some point in the future.

**Examining 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. These results offer a descriptive look at other potential areas of the brain that would be researched in future studies.

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 cannot summon God at will. Due to this, they were asked 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 asked to meditate on a point at which they felt very close to a person lacking divine or spiritual qualities. Compared to baseline there were more than ten areas of increased activity in the brain during prayer. 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 makes sense that multiple areas of the brain, in contrast to one, would be active. One of the areas of activation worth mentioning is the right middle temporal lobe which supports the importance of the temporal lobe in RSMEs 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 may underlie the powerful emotions sometimes experienced during RSMEs.

Another important aspect of neurotheology rests within the role of having such RSMEs and religious convictions. Inzlicht, McGregor, Hirsh and Nash (2009) suggest that religious conviction serves an adaptive function as a barrier against anxiety and frustration in one’s environment, most notably when making errors. The experimenters monitored the brain waves of patients performing a color Stroop task using an EEG, focusing their attention on the anterior cingulate cortex (ACC). The ACC is a portion of the brain 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 RSMEs and religiosity, their impact on society is staggering. In many civilizations religion has been a deciding factor in the fates of countless people and nations. This fact alone should merit the research conducted within neurotheology. The data gathered over the course of the past century and the selection of research within this review have revealed numerous scientific underpinnings to what has largely been considered a field outside the realm of science. Based on the current research utilizing neuroimaging techniques it is likely that more than one area of the brain plays a crucial role in what we generally consider to be RSMEs. Determining an origin of these experiences will be difficult because of the complexity of the sensations as well as the complexity of the brain itself, however we have already made great strides towards this goal. Through the study of neurotheology we have already learned that there is a two-way function between RSMEs and our brains. On the one hand there is an obvious neurological correlate for religion; on the other hand we cannot definitively state that one is the precursor to the other. Further research into the field will help us to determine empirically whether RSMEs are the products of our brains. 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 a fourth blow to humanity's self-esteem will be manifested in neurotheology and the systematic deconstruction of religiosity. Understanding the neurological and psychological bases of religion will help us understand what was once thought to be an external force guiding our actions and beliefs. This understanding extends beyond the realm of religion and spirituality and into what internal mechanisms drive us to attribute significance to beliefs, objects and behaviors in our lives. In turn, this will help us to better understand how it is that the brain develops mechanisms to motivate us to perform goal oriented tasks. The research from neurotheology should also be disseminated to other fields of science as well. As mentioned...
within this review the study of religion can have a direct impact on evolutionary psychology. In a similar vein it can also have a direct impact on evolutionary biology. If a specific neurological mechanism can be identified that facilitates RSMEs, then this mechanism must have an evolutionarily beneficial function. By bringing together research from numerous scientific fields such as neuroscience and evolutionary psychology under the one umbrella of neurotheology it will be possible to more quickly and efficiently attain the aforementioned goals and to use the information reciprocally to aid them in their respective goals as well. As such, it is necessary that the term neurotheology becomes a convention accepted within the scientific community in order to establish more fruitful cross-disciplinary communication.

REFERENCES


St. Pierre, L. S. & Persinger, M. A. (2006). Experimental facilitation of the sensed presence is predicted by the specific patterns of the applied magnetic fields, not by
suggestibility: Re-analysis of 19 experiments.  