

The Neurobiology, Genetics and Evolution of Human Spirituality

The Central Role of the Temporal Lobes

David E. Comings

Abstract

Spirituality is defined as a sense of being connected with something greater than oneself. That something can be a supernatural entity, nature, a social group or a family. Different studies show that a wide range of factors that influence temporal lobe function can produce hallucinations, paranormal, spiritual, mystical, and religious experiences. These factors include the electrical stimulation of the temporal lobes; spontaneous temporal lobe epilepsy; trauma; psychedelic drugs; and the severe anoxia of near death, G-forces and carbon dioxide inhalation. Studies of the very short acting psychedelic drug DMT, which exerts its effect by binding to serotonin receptors in the temporal lobes, show that even highly rational subjects can be absolutely convinced that their induced experiences of being in contact with non-humans beings were absolutely real. This suggests that hippocampal memory cannot always distinguish between external real experiences and internally induced spiritual experiences. Twin studies show there is a significant genetic component to spirituality while religion and church going are more cultural. It is likely that the genes for spirituality were selected because the social cohesiveness that spiritually fosters has a strong survival value. The neurobiology of spirituality suggests that our rational brain occasionally needs to step back and give the spiritual brain some space to have beliefs and feelings that do not always make rational sense.

Key Words: neurobiology, genetic, spirituality, evaluation

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Introduction

As a physician and molecular biologist I profess to a lifetime of disbelief in supernatural beings. That then removes from my belief system God, angels, life-after-death, heaven, hell, and all related entities, which I believe are created by man rather than the other way around. I have presented the detailed scientific support for why I

believe this way in a book entitled *Did Man Create God? Hope Press* (Comings, 2008).

One of the problems I have always had with this belief system is the fact that the majority of humans believe in these supernatural entities and are affiliated with some type of religious organization. While the percentage of non-believers is apparently on the rise, it still leaves unanswered the question, "Why do so many people believe in the supernatural?" For many years I have been satisfied with the answer that working in medicine and science left me with a

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skeptical approach to the world that requires scientific evidence before belief.

I started writing *Did Man Create God?* to provide intelligent answers to the Intelligent Design movement. When those pages were completed I felt it was time to look for a more satisfactory answer to the question, “Why do so many humans believe in God?”

As a first step I felt it was necessary to separate God and religion from spirituality. I define spirituality as *a sense of belonging to something greater than one’s self*. That greater entity can be something religious such as God, or Jesus, or Allah, or others. However, it can also be a non-religious entity such as family, friends, community or simply the endless wonders of nature. Thus, I proposed to examine the question, “Is there a region of the brain that attends to our sense of spirituality?” The following suggests the answer is ‘yes’ and that the region is the temporal lobes.

Role of the Temporal Lobes in Spirituality Wilder Penfield’s Open Brain Stimulation Studies

A good place to start is the open brain stimulation studies of Wilder Penfield performed in the 1930’s to the 1950’s. Penfield was a Canadian Neurosurgeon who surgically treated epilepsy including Temporal Lobe Epilepsy by removing lesions that were serving as seizure generating foci.

He took advantage of the fact that there are no pain receptors on the brain. This allowed the brain to be opened under local anesthesia and the surface of the brain to be stimulated in subjects who are awake and can relate what they feel.

As these studies progressed Penfield discovered what he termed *psychical* effects (Penfield, 1955). This was not referring to psychotic effects. Rather it was derived from a term used by Hughlings Jackson referring to complicated mental phenomena that involve the complex integration of many different neurons.

One subject stated, “I feel as though I were in the bathroom at school.” A few minutes later, when the electrode was re-applied near the same area, he said something about a “street corner.” When asked where, he said, “South Bend, Indiana, corner of Jacob and Washington.” A subsequent stimulation produced “music from Guys and Dolls.”

“Oh God! I am leaving my body”

“I am spiritually” speaking to an unknown woman.

“I am going to die.” When asked if he saw anything, he said, “No, God said I am going to die”

Of great interest was the location of the sites that when simulated produced these psychical responses. This is shown in Figure 1.

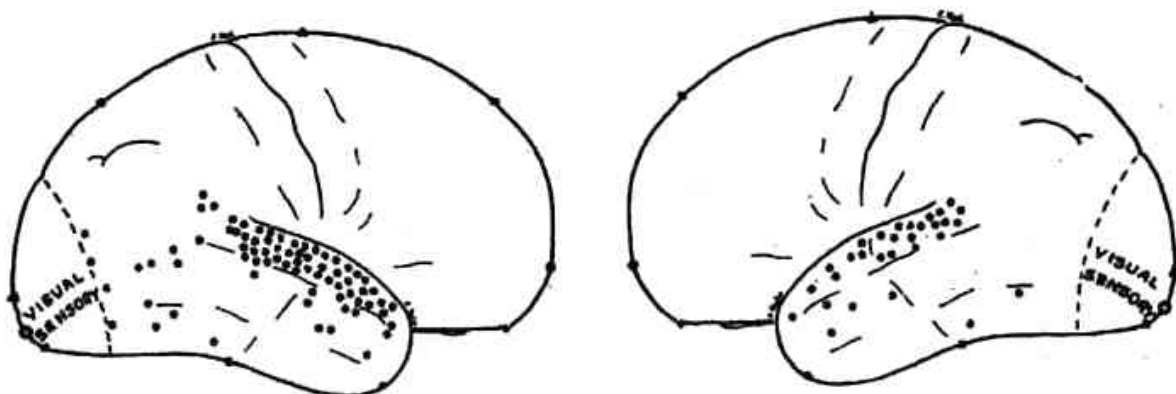


Figure 1. A summary of the brain sites where electrical stimulation produced psychical responses in awake subjects. from Penfield and Perot, 1963 by permission.

The sites were almost exclusively in the right and left temporal lobe. The area of the sites is smaller on the left temporal lobe because they avoid the areas for speech and language.

All subjects agreed that the psychological response was more vivid than anything they could voluntarily recall from memory. They “never looked upon the experiential response as remembering. Instead it was a hearing – and seeing – again, a living through moments of past time.”

The production of out-of-body experiences is not surprising since studies by Blanke et al (2002) have shown that stimulation of the right angular gyrus, a part of the temporal lobe, produces out-of-body experiences.

Many of Penfield’s studies involved the stimulation of the surface of the temporal lobes. However, an additional important part of the temporal lobes are the deeper structures consisting of the hippocampus, important in factual memory, and the amygdala, important in emotional response and memory.

Penfield and a number of other investigators have shown that deep temporal lobe stimulation in the area around the amygdala and hippocampus of the limbic system produces feelings of intense meaningfulness, of depersonalization, of a connection with God, of cosmic connectedness, of out-of-body experiences, a feeling of not being in this world, *déjà vu*, *jamais vu* (a feeling something is happening for the first time even though it has been experienced before), fear and hallucinations.

Penfield felt that the psychological responses were not hallucinations in the sense of psychotic or schizophrenic hallucinations because in all cases the subjects always talked to me, “the doctor” and never to the voices, and they were not afraid of the voices as is often the case in psychotic hallucinations.

In conclusion, Wilder Penfield’s brain mapping studies clearly placed both temporal lobes front and center as the site for many examples of spiritual intrusions, feelings of déjà vu, out-of-body sensation, trances, hearing music, hearing angelic voices, feelings of intense meaningfulness, of

being connected to some force greater than themselves, and of talking to God.

Temporal lobe epilepsy

Studies of temporal lobe epilepsy (TLE) provide further evidence that both the right and left temporal lobes are involved in sensations of spirituality in the human brain. Hippocampal sclerosis resulting in a small hippocampus is a common finding in TLE. Many studies have reported on the spiritual and religious feelings that occur in individuals during these seizures and on the personality changes that occur between seizures in individuals with TLE. The following are some examples.

Werfel et al (2004) examined the MRI scans on 33 subjects with refractory TLE. All subjects completed a religiosity scale. The religiosity scores were highest in those with the smallest right hippocampus, consistent with hippocampal sclerosis.

MacDonald and Holland (2002) studied a *normal population* of 262 undergraduate students. Spirituality was assessed in five different dimensions. They were also assessed for symptoms of complex partial epileptic-like seizures. The more spiritual the students were the more likely it was that they had some type of TLE episode. This is consistent with Persinger (1987) relating religious experiences to temporal lobe transients.

In some cases the spiritual and pleasurable content of TLE seizures is so dramatic that they have been called “ecstatic” seizures. Two types of ecstatic seizures have been described. The first is an emotional seizure of deep pleasure. The second is primarily a cognitive experience of insight into the unity, harmony, joy, and divinity of all reality, usually with pleasurable affect.

Of 11 patients with ecstatic seizures studies by Asheim Hansen and Brodtkorb (2003), eight had sensory hallucinations, four had erotic sensations, and five had a religious or spiritual experience. The authors felt that ecstatic seizures associated with TLE have had a substantial impact on our cultural and religious history.

This is consistent with the report of Dewhurst and Beard (2002). They provided

a large list of Saints and mystics who probably had TLE. They had periodic attacks which included trembling of the whole body, transient aphasia or paralysis, loss of consciousness, automatisms, feelings of passivity and childish regression, dissociations, hallucinations, ecstasies, and increased suggestibility. These stories suggest that TLE and its multiple spiritual manifestations have played a major role in the development of many religious people in history and of the religions themselves.

TLE interictal period

In addition to religious and spiritual experiences during TLE seizures, there are numerous reports of religious personality changes between seizures, the so-called *interictal period*. Saver and Rabin (1997) reported that during the interictal period individuals with TLE may undergo a sudden religious awakening or conversion and often report abruptly perceiving their ordinary, unenlightened selves as hollow, empty, and unreal (depersonalization). This was a prelude to their finding a truer, more authentic, religiously grounded self. A sense of suddenly developing a deeper, supernatural, genuine reality is a frequent aspect of mystical-spiritual experiences.

Dewhurst and Beard (1970) described a 37-year-old Jewish male brought up in a strictly Jewish orthodox faith. His first religious conversion occurred after photic stimulation. He had a vision he was in the cockpit of an airplane, flying over a mountainous region. As it brought him into a different land he felt at peace and felt that the power of God was upon him and was changing him for the better. In the years afterward he became intensely interested in following the teachings of Jesus Christ and became a member of the Pentecostal Church. He often walked the streets carrying a sign "Be prepared to meet thy God."

They reported another case of a 33 year-old male who stopped taking his medications at age 33 and was soon having frequent temporal lobe seizures. During this time he suddenly realized that he was the Son of God; he possessed special powers of healing and could abolish cancer from the world and had visions. "It was a beautiful morning and God was with me and I was

thanking God. I was talking to God. I was with God. God isn't something hard looking down on us, God is trees and flowers and beauty and love."

The God Module

Ramachandram (1998) observed that one of the effects of the TLE seizures was to strengthen involuntary responses to religious words as tested by changes in galvanic skin response. One subject with TLE felt a rapturous "Oneness with the Creator" that carried over into the rest of his life. When asked if he believed in God, he replied, "But what else is there?" Ramachandram suggested that the temporal lobes were the God Module. I prefer identifying them as the Spirituality Module. It was suggested that such a module could evolve if it fostered tribal loyalty or reinforced kinship ties. This is analogous to my thoughts about the evolution of spirituality (see below).

The 4-H Syndrome

Religious conversions have been reported in individuals with TLE of either the right or left temporal lobes. In some cases the conversions are permanent. A rare 4-H syndrome has been described by Wasman and Geschwind (1975) sometimes referred to as *Geschwind syndrome*. It consists of *Hyperreligiosity*, *Hyposexuality*, *Humorlessness* and *Hypergraphia* with increased concern with philosophical, moral and religious issues, and extensive writing on religious or philosophical themes. Other features include aggression, pedantic speech, a "sticky" or compulsive personality, and psychosis (Geschwind, 1985). The personality structure included increased concern with philosophical, moral, and religious issues, and extensive writing on religious or philosophical themes, lengthy letters, diaries, and poetry. Some of the most religious people in history may have had the 4-H syndrome, including Ezekiel, St. Paul, Theresa of Jesus, Joan of Arc, Joseph Smith (founder of Mormons), Ellen White (founder of Seventh-day Adventists), Ann Lee (founder of the Shakers) and Mohammed. The details of these cases are presented elsewhere (Comings, 2008). The following are summaries of two examples.

Ezekiel

Altschuler (2002) proposed that the biblical figure Ezekiel possessed some of the characteristics of the 4-H syndrome placing him as the oldest known case of TLE dating to approximately 2,600 years ago. These features included hyperreligiosity, a compulsive personality, and repetitive hypergraphia. In addition he was aggressive, pedantic, and critical of many women, of whom he referred to as harlots. He also had other symptoms of epilepsy in general, including “fainting” spells and episodes of mutism.

Ellen White

Based on the presence of a clear history of head injury, paroxysmal loss of consciousness, upward staring of the eyes, hundreds of visual hallucinations, mood and personality changes, automatisms, and hypergraphia, Hodder and Holmes (1981) concluded that Ellen White had TLE. Her hypergraphia was prodigious, consisting of 5,000 periodical articles and 40 books totaling over 100,000 pages of text.

Persinger (1987) has proposed that temporal lobe transients (TLTs), play a major role in peoples’ most intense God Experiences and that the God Experience is a phenomenon that is associated with the construction of the temporal lobes. He does not view TLTs as the equivalent to the seizures of temporal lobe epilepsy but rather as “a normal and more organized pattern of temporal lobe activity.”

Trauma to the Temporal Lobe

In addition to epilepsy, trauma to the temporal lobes can be associated with religious delusions. Assal and Bindschaedler (1992) reported the presence of religious delusions 13 years after injury to the temporal lobe.

Fenwick and colleagues (1985) compared the TLE symptoms of 17 ‘sensitives’ from the College of Psychic studies to 17 church-going controls. The ‘sensitives’ experienced more head injuries and serious illness than controls. Sixty-one percent showed evidence of right hemispheres and right temporal lobe dysfunction.

Schizophrenia hallucinations and the temporal lobe

Ecstatic communications with God are common in individuals with schizophrenia. This raises the question of the role of the temporal lobes in these symptoms. In one study SPECT imaging of schizophrenics with religious delusions showed increased activity of the left temporal lobe and decreased activity of the left occipital lobe. In another study direct electrical stimulation of the temporal lobe was performed on individuals with schizophrenia. Their visual hallucinations were reproduced by deep temporal lobe stimulation (Puri *et al.*, 2001).

A feeling of a presence

Arzy and coworkers (2006) in Switzerland reported that the stimulation of the left temporal-parietal junction repeatedly produced a creepy feeling of the presence of another person in their extra-personal space and that somebody was close by. An epileptic focus in this area could contribute to the sensation of being close to a supernatural being.

Near Death Experiences

Individuals with near-death experiences (NDE) have many features with a strong spiritual content including a feeling of great peace, depersonalization or out of body sensations, changes in visual perception interpreted as passing down a dark tunnel and coming out into a bright light, a review of one’s life, and a feeling of seeing God and being in heaven.

As with other forms of spiritual awakening, NDEs are often associated with a *permanent decrease* in an individual’s susceptibility to depression and fear of death, improved overall mental health, increased tolerance of stress, and a greater appreciation for the spiritual aspects of life.

Morse (1992) interviewed elderly people who had an NDE as children. He noted that nearly all of the people who had a NDE, no matter if it was 10 years ago or 50, were still absolutely convinced their lives had more meaning and there was a universal, unifying thread of love which provided that meaning. Matched against a control group, they scored much higher on life-attitude tests, significantly lower on fear-of-death

tests, gave more money to charity, and took fewer medications. There's no other way to look at the data. *These people were just transformed by the experience.* In addition, these adults had less depression, lower rates of drug and alcohol abuse, spent more time meditating, ate more fresh fruits and vegetables, did more exercise, spent more time with family members, and had increased scores relevant to good mental health and spiritual well-being. These symptoms are similar to the long-term features of individuals who have experienced a religious conversions and "found God" or "found Jesus."

As much as some would like to use NDEs as proof that God, heaven and a life-after-death exists, NDEs are most likely due to severe lack of oxygen to the brain with the release of endogenous hallucinogens. Anoxic loss of consciousness in human centrifuges can also produce NDEs. Anoxia, in combination with the release of endorphins, produces a pain free state of peaceful bliss. Support for the role of anoxia in the production of NDEs comes from the observation that prolonged exposure to carbon dioxide is one of the very few other things to produce symptoms of NDEs. This was used to treat nervous diseases in the 1950s. (Medune, 1950) Since it produced severe anoxia and risked brain damage, it was discontinued. This biological explanation in no way detracts from the power of NDEs to produce lifelong spiritual changes.

Just as examples were given above concerning the role of TLE in religious history, Morse (1990) listed a number of examples where NDEs with the light shaped individuals' life-long religious and spiritual affiliation. In one case, one of his patients experienced a light that totally engulfed him after a NDE at age 15. After that he knew he wanted to become a minister, and 30 years later was a successful mainstream Protestant minister. The Indian guru Paramahansa Yogananda (1998) author of *Autobiography of a Yogi*, had a NDE at age eight. He states, "There was a blinding light, enveloping my body and the entire room. My nausea and other uncontrollable symptoms disappeared; I was well." This light then stayed with him the rest of his life allowing him to illuminate

others.

Since many of the features of NDEs suggest temporal lobe involvement, is there any evidence that NDEs involve the temporal lobe? Acute and moderate-to severe anoxia produces abnormal nervous activity in the temporal lobes (Gastaut and Meyer, 1961) and especially the hippocampus. (Benveniste *et al.*, 1984; Schiff and Somjen, 1985; Aitken *et al.*, 1991). These factors suggested to Britton and Bootzin (2004) that altered temporal lobe functioning may be involved in individuals who reported having transcendental NDEs during life-threatening events. To test this they examined 43 individuals who had a significant life-threatening event, had NDE symptoms, and had a minimum score of seven on Greyson's (1983) *Near-Death Experience Scale*. They also examined 20 controls who had a life-threatening experience but scored less than seven on Greyson's scale. Administering the Complex Partial Epileptic Signs and the Temporal Lobe Symptoms sub-scales of the Personal Philosophy Inventory assessed the presence of general symptoms of epilepsy and specific symptoms of TLE. The subjects were also given an EEG during sleep and monitored for the timing of onset of rapid eye movement or REM sleep. Paroxysmal EEG activity was found in 22 percent of the NDE subjects compared to five percent of the controls. In all NDE subjects this activity emanated from the left temporal lobe, while in the controls it emanated from the right temporal lobe. As shown in Figure 2 the NDE subjects had significantly higher scores on both the *Complex Partial Epileptic Signs* and the *Temporal Lobe Symptoms* tests. The scores on both tests were significantly higher in the subjects with NDEs.

The results from the sleep studies provided some insight into why individuals with NDEs are more centered and resistant to stress. The NDE subjects had altered sleep patterns with a longer interval between the onset of sleep and rapid eye movements or REM, relative to the control group. Individuals with depression characteristically have a short sleep to REM interval averaging 60 minutes or less. A short sleep to REM interval has, in fact, proven to be an excellent predictor of the risk of developing a major depression. The

average interval is 90 minutes. In the controls without an NDE it averaged 77 minutes, while in those with NDE it averaged 109 minutes.

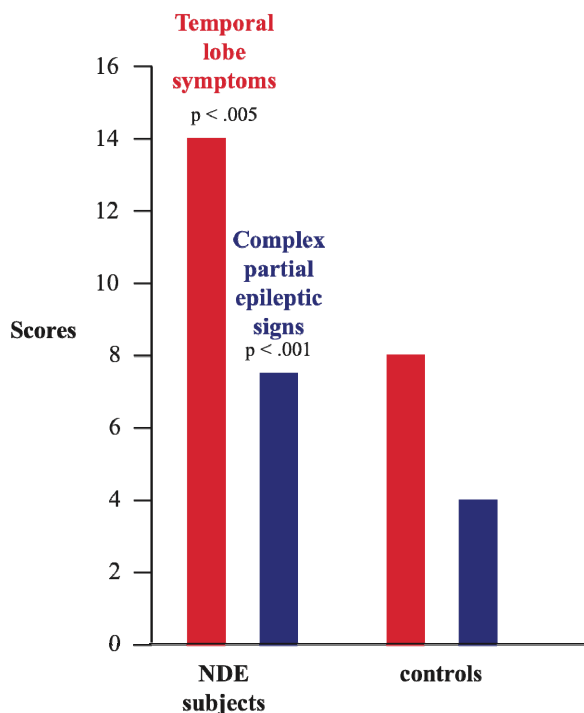


Figure 2. Scores on the Temporal Lobe Symptoms and Complex Partial Epileptic Signs scales in the subjects with NDE and controls. From Britton and Bootzin (2004). By permission from Blackwell Publishing.

The positive effect of near-death experiences on sleep and REM latency raises the question, “What part of the brain is activated by REM versus non-REM dreams?” EEG recordings show that the right hemisphere becomes highly active during REM sleep, while the left hemisphere is more active during non-REM sleep. (Goldstein *et al.*, 172; Hodoba *et al.*, 1981). Brain imaging studies also support this and show greatly increased blood flow in the right temporal and parietal regions during REM sleep and in subjects who upon awakening report visual and auditory dreaming. (Joseph, 2002; Meyer *et al.*, 1987)

EEG activity during a spiritual seizure

Persinger (2002) described an event that occurred in his laboratory. In 1983 during a routine EEG study to monitor the effects of transcendental meditation, an experienced instructor of that technique displayed an

electrical anomaly over her right temporal lobe. During an “electrical seizure,” she reported she was “filled with the spirit” and felt the presence of God with her in the laboratory. The duration of the electrical transient was about 20 seconds. To my knowledge this is the only record of a TLE-related “God Experience” that actually occurred during EEG monitoring.

LSD, the Temporal Lobes, and Spirituality

In addition to TLE and schizophrenia, psychotropic drugs such as LSD represent an additional cause of hallucinations. The following is an example of an LSD trip with strong religious overtones.

This subject was a housewife in her early thirties (Masters & Houston, 1966). The guide who stayed with her for her trip took her into a garden.

“I felt I was there with God on the day of the Creation. Everything was so fresh and new. Every plant and tree and fern and bush has its own particular holiness. As I walked al on the ground the smells of nature rose to greet me — they were sweeter and more sacred than any incense. Around me bees hummed and birds sang and crickets chirped a ravishing hymn to Creation. Between the trees I could see the sun sending down rays of warming benediction upon this Eden, this forest paradise. I continued to wander through these woods in a state of puzzled rapture, wondering how it could have been that I lived only a few steps from this place, walked in it several times a week, and yet had never really seen it before.”

Later she stated that,

“Since that day I had brewing in me a sense of the relevance of that forest for the other areas of my life and the life of my family. For I have come to realize that my way of seeing and hearing and smelling the forest that way was greater than any way I had ever seen and heard and smelled before.”

Are temporal lobe structures also involved in LSD-induced hallucinations? What is the mechanism of such powerful imagery? The LSD molecule is structurally similar to serotonin, a major neurotransmitter implicated in a range of behavioral disorders. It and other

psychedelic drugs bind to serotonin 1A, 2A and 2C receptors (Burris *et al.*, 1991; Delgado & Moreon, 1998; Riba *et al.*, 2004). Serotonin is an inhibitory neurotransmitter that normally inhibits the neurons of the amygdala and thus filters its sensory input so that we are not constantly bombarded by all the emotionally laden sounds, visions, memories and images stored there. LSD interferes with this action of serotonin by binding to the serotonin receptors in the amygdala and hippocampus. This interaction breaks down the filters and releases all the visual, auditory and emotional imagery as illustrated by the description of the above LSD trip.

The central role of serotonin in spiritual experiences was supported by a PET scan study of a series of 15 normal males. (Borg *et al.*, 2003). The PET scan utilized a radioactive compound that, like LSD, also binds to serotonin 1A receptors. The hippocampus and the brain stem nuclei enriched in serotonin (raphe nuclei) were examined. The subjects were administered the *Temperament and Character Inventory (TCI)*. There was an inverse association between the amount of binding to the serotonin 1A receptor and the self-transcendence scale, a measure of spirituality. It is of note that over time the self-transcendence subscale is the most stable and at the same time one of the most variable of the TCI scales. (Forsgren *et al.*, 1998) None of the six other subscales showed such a relationship. Thus, *lower levels of the serotonin receptor were associated with higher spirituality scores*. The authors speculated that *the several-fold variability in serotonin 1A receptor density may explain why people vary greatly in spiritual zeal*. A role of the temporal lobes in LSD hallucinations is indicated by studies where subjects slated for temporal lobectomy were given LSD before and after the surgery. There was a decrease in the richness of perceptual changes after the removal of the temporal lobe (Serafetinides, 1965).

Psychedelic drugs are clearly potent hallucinogens. Great spiritual properties have been attributed to them, especially by the “new age” culture. In one study of 206 observed sessions of psychedelic drug use,

chiefly LSD and peyote, 96 percent of the subjects experienced religious imagery of some kind, 91 percent saw religious buildings, and 58 percent encountered religious figures (Masters and Houston, 1966).

DMT and Spirituality

The effects of the psychedelic drug, DMT (dimethyl tryptamine) provide great insights into my original questions of why do so many people believe in supernatural entities. In his book *DMT: The Spirit Molecule* Dr. Rich Strassman (2001) describes his experiments with the intravenous use of DMT. The structure of DMT is very similar to serotonin.

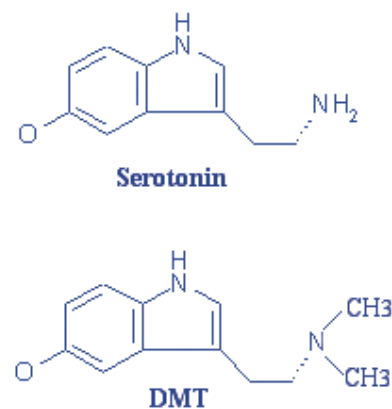


Figure 3. Comparison of the structure of serotonin and DMT.

DMT has *psychedelic properties and is normally present in the human brain*. It is synthesized in the pineal gland and is actively transported into the brain. Compounds do not have mechanisms to actively transport them across membranes unless they have some function in the brain. These properties indicated to Strassman that DMT it was an endogenous psychedelic compound (Barker *et al.*, 1981). He wondered, “What was DMT doing in the human brain?” One intriguing possibility was that it was released during intense meditation or severe stress and was responsible for the feelings of spiritual transformations that can occur during meditation and with NDEs.

After a two-year effort Strassman

obtained FDA approval to examine the effects of intravenous DMT. Given by this route it is very short acting with effects lasting about 5 minutes. To avoid being criticized for having subjects become dependent on psychedelic drugs, he only involved individuals who had previously used psychedelic drugs many times. This also avoided some of the “bad trip” problems of new psychedelic drug users.

Intravenous use of the drug allowed Strassman to determine the precise dose administered. The peak effect occurred in two minutes. The effects were usually noticed even before the injection was completed. Subjects felt they were coming down after five minutes. They could describe their experiences after 12 to 15 minutes and felt relatively normal after 30 minutes. The following are some of the experiences related by the subjects receiving DMT (Strassman, 2001).

In addition to the usual sensations experienced after taking a psychedelic drug, including visual and auditory hallucinations the remarkable aspects of these studies was the frequent report of subjects having made “contact” with non-human beings.

“Something took my hand and yanked me. It seemed to say, ‘Let’s go!’ Then I started flying through an intense circus-like environment. I’ve never been that out of my body before. We went through a maze at an incredible fast pace. I say ‘we’ because it seemed like I was accompanied.”

“If I could only hold onto this feeling. If everyone did this every day the world would be a much better place. Life would be a lot better. The potential for good was great. Feeling good within yourself. I guess meditation is supposed to get you to the same place.”

“There was a moment of color. The colors were words. I heard them saying ‘God is in every cell of my body.’”

“These experiences are like the height of meditation, accessing inner power and inner strength. I am in contact with something deeper and inside.”

“I felt a tremendous energy, brilliant pink light with white edges, building on my left side. I knew it was spiritual energy and love.”

“I feel very loved. It was a feeling in my

chest. It was warm. My whole chest felt inflated. It was a really good feeling. I was loved by the entities or whatever they are. It was very pleasant and comforting.” (In later conversations this person said it helped her by demonstrating that she could lose control, particularly around a powerful man, and be safe and loved at the same time.)

One of the most remarkable aspects of these DMT-induced contact experiences was *how real they felt*. The subjects knew these were drug-induced. However, if an individual had a spontaneous contact experience, triggered by personal crisis, trauma or loss, the realness of it could be overwhelming. This sense of realness was described by Strassman (2001) as follows:

The research subjects tenaciously resisted biological explanations because such explanations reduced the enormity, consistency, and undeniability of their encounters. How could anyone believe there were chunks of brain tissue that, when activated, flashed encounters with the beings, experimentation, and reprogramming? Neither did suggesting that it was a waking dream satisfy the volunteers’ need for a model that made sense and fit their experience. One said, “This was not a dream or a hallucination. It was real. I can tell the difference. I couldn’t have made it up if I wanted to.”

The same powerful sense of realness has been reported for NDEs (Ring, 1980); hallucinations induced by the drugs ketamine and PCP (Jansen, 1990) and by hallucinations in general. The American Psychiatric Association notes that “a hallucination has the immediate sense of reality and true perception” and that “transient hallucinatory experiences are common in individuals without mental disorder” (DSM, 1980). These observations have clear implications for spiritual experiences in general and *provide insight into their power because they feel so real*. This relates to the issue of egocentricity (Persinger, 1987) namely, “Since I experienced it, it was real.” How can we make sense of this intense sense of this false “realness?” The following diagram suggests how.

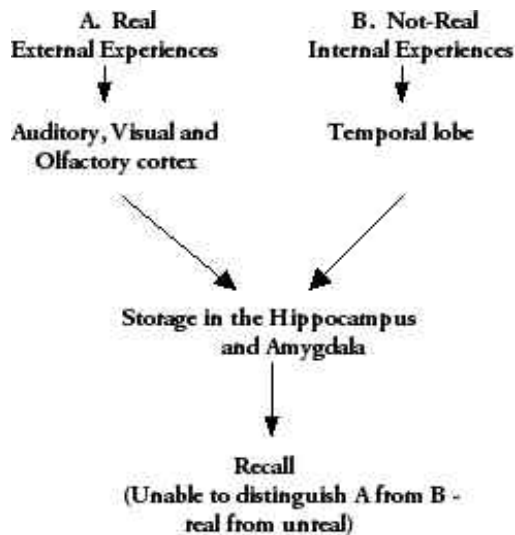


Figure 4. Diagram of how internally generated experiences might seem totally real.

The many similarities between DMT experiences, religious conversions, out-of-body experiences, NDEs, and alien abductions illustrate how all of these spiritual experiences can be generated by neurochemical events taking place inside the temporal lobes. It is little wonder that Strassman referred to DMT as the *Spirit Molecule*. It is also little wonder that psychedelic drugs have also been called *entheogens*, meaning *God-containing* (Horgan, 2003). The extensive role of psychedelic mushrooms and other plants in the religions of the world have been reviewed elsewhere (Comings, 2008).

Normal real external experiences are seen and heard and smelled and these sensations enter the brain thorough the auditory (temporal lobe), visual (occipital) and smell (olfactory) cortexes. They are then passed to the hippocampus for factual memory and the amygdala for emotional memory. Unreal internal experiences can be generated in the temporal lobes by a wide variety of agents: temporal lobe epilepsy; trauma; anoxia from near death experiences, CO₂ inhalation and G-forces; psychedelic drugs; and intense emotional experiences such as death of a relative, an intense religious service, music, religious indoctrination; and others. These “experiences” are also stored in the hippocampus and amygdala. When recalled, the brain is unable to distinguish how they got there – the internally generated

experiences seem just as real as the externally generated ones. These experiments provide much insight into the question, “How can a rational, educated, thinking person believe so strongly in supernatural beings?”

This conviction and sense of realness in the face of clear evidence of non-realness goes to the heart of the conflict between science and faith. Edmond O. Wilson claimed that you cannot tread the path of spirituality and the path of reason; you must choose between them. The DMT studies suggest this is not necessarily true since they show that even the sophisticated, science-savvy volunteers in this study felt and believed that the “contact” they experienced under DMT was not a dream, not a hallucination, but real. Thus, while the rational and the spiritual brain would always seem to be in conflict, this is not necessarily true. *It is simply necessary for the rational brain to understand that one of the characteristics of the spiritual brain is to strongly believe in something and have faith in something, even when the rational brain says it is unreasonable or that it did not and could not have happened. The rational brain needs to recognize that the spiritual brain can sometimes confuse externally generated with internally generated reality. So long as it does not lead to truly irrational beliefs, such as death to anyone that does not believe as you do, or in the literal truth of the Bible, or that the earth was created in 6,000 years, etc, one could argue that there is little harm in allowing the rational brain to give the spiritual brain some space.*

The Genetics of Spirituality

Before entering into the subject of the genetics of spirituality it is necessary to introduce several terms. Twin and adoption studies are valuable methods for determining the relative role of genes versus the environment in human behavior. The three major types of human behavior are: *psychiatric disorders* such as major depression, manic-depressive disorder and conduct disorder; *personality traits* such as extraversion and neuroticism, and *cultural attitudes* such as sexual, political and religious beliefs.

Twin studies can dissect out not only the relative role of genes versus the

environment, they also divide the environmental factors into two types: *shared environment* versus *unique environment*. The shared environment includes such influences as general parenting, and the economic status, political orientation and religious upbringing of the parents and peers. Since both twins would be exposed to attendance at the same church, mosque or synagogue and be exposed to the same religious and political views, these are all part of a *shared environment*. By contrast, many times twins are placed in separate classes, have separate teachers and friends and attend different summer camps and colleges. These represent a *unique environment*.

A final term used in twin studies is *variance*. For any continuous trait such as height, or weight, or score on a given questionnaire, there will be a great deal of variation from individual to individual. This variation is called the *variance*. Different influences such as genes or environmental factors influence this variation. The proportion of the variance attributed to a specific factor is referred to the *percentage of the variance*. Thus, for a single gene disease such as Huntington's Disease, the gene accounts for 100 percent of the variance of Huntington's Disease. In the case of the flu, the influenza virus accounts for 100 percent of the variance of the flu.

One of the major tenets of psychology from the time of Freud was that the early shared environment was critical to later psychological development. However, twin studies of psychiatric disorders such as conduct disorder, clearly showed that the percent of the variance attributed to the shared environment was virtually zero. Forty to 90 percent of the variance was due to genes with the remainder being due to the unique environment. This was hard for psychologists to accept but this could be understood if we assumed that these more severe conditions were due to a disorder of brain chemistry rather than how individuals were raised.

When twin studies of personality traits were carried out, the results were the same (Eaves *et al.*, 1993). This really upset many psychologists and led behavioral geneticist David Rowe to state (Rowe, 1985):

Given the environmental emphasis in behavior science theories, the idea that the shared environment fails to impact on personality development is radical; but it is, nevertheless, supported by an extensive literature of twin and adoption data.

Twin Studies of Spirituality

Self-transcendence refers to the capacity to reach out and find meaning in life in dimensions beyond oneself. In 1993, Dr. Robert Cloninger, at Washington University in St. Louis, developed a personality inventory which included four scales for temperaments and three for character. This was called the Temperament and Character Inventory (TCI) (Cloninger *et al.*, 1993; Svrakic *et al.*, 1993). One of the character dimensions was self-transcendence – a measure of spirituality. This represented the first time that a questionnaire to assess personality traits had included a scale for spirituality.

Self-transcendence consisted of three subscales: self-forgetfulness, transpersonal identification, and spiritual acceptance. The questions relating to *self-forgetfulness* included losing oneself in thought, time or space. During such states individuals may experience flashes of insight or understanding. Creativity and originality may be enhanced in this state. The questions relating to *transpersonal identification* covered issues of feeling connected to others, to nature, to the universe, and a willingness to sacrifice oneself for the good of other people to make the world a better place. Ardent environmentalists would be likely to score high on this scale.

The questions indicating a capacity for *spiritual acceptance* included believing in miracles, believing that many things cannot be scientifically explained, having a spiritual connection to others, having meaningful religious experiences, having one's life directed by a spiritual force greater than any human being, and feeling in contact with a divine and wonderful spiritual power. The other end of this scale would include people who don't believe in things that cannot be explained scientifically. Based on these questions it can be seen that the subscore for spiritual acceptance is clearly the most relevant for estimating the degree to

which an individual may become involved in religious experiences and spirituality. Twin studies using the TCI could provide us with information of the role of genes in spirituality. There have been several such studies.

Kirk and colleagues (1999a) examined the self-transcendence scale as a measure of spirituality in 1,279 Australian twins 50 years of age or older. An age of 50 or more was important since the role of family environment diminishes after individuals leave home (Eaves, 1997). The self-transcendence scores varied significantly by gender and across different religions affiliations. The scores were higher for females and individuals identifying themselves as evangelical and fundamentalist. They were intermediate for other religious groups and lowest for those with no religious affiliation. There were small but significant correlations with optimism, extraversion, and good general health and for fatigue, anxiety and depression. The results for the involvement of genetic factors, common and unique environment for self-transcendence in male and female twins are shown in Figure 5.

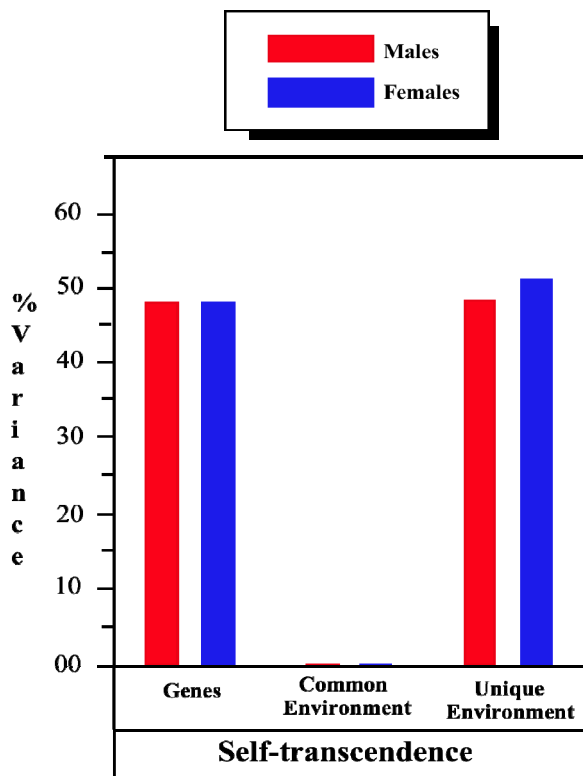


Figure 5. Estimates of the role of genes, common and unique environment for self-transcendence in 50+ year-old Australian twins. From Kirk et al., (1999a).

This showed that in both males and females about half of spiritual self-transcendence was the result of genetic factors and half was the result of the unique environment with no contribution from the common environment. This was an astonishing result. It showed that spirituality was unrelated to the common environment including religious upbringing. *This clearly indicates that spirituality is an intrinsic biological trait and is not transmitted by culture.* Most personality traits tend to share this remarkable characteristic. When all factors were considered together using a statistical tool called *multivariate analysis*, the genetic contribution to self-transcendence averaged 40 percent for both sexes. These results were unchanged by the time the size of this study had increased to 2,517 twins (Gillespie, 2003).

Ando and colleagues, (2002; 2004) reported twin studies for 617 pairs of adolescent and young adult twins in Japan. They examined the TCI traits and their subscales. The contribution of genes to the variance of all scales and subscales ranged from 22 to 49 percent. Specifically genes contributed to 41 percent of the variance of self-transcendence and 39 percent of the variance of spiritual acceptance. Unique environmental factors contributed the rest. As with the Australian twins, *the shared environment including religious upbringing, contributed nothing.* The high contribution of genes to spirituality and lack of contribution of the family environment is counter-intuitive and minimizes a role of cultural perspectives or social learning in spirituality.

Twin studies of spiritual well-being

Dr. Ming Tsuang and colleagues from Harvard Medical School used the Vietnam Era Twin Registry to examine the role of genetic and environmental factors for two evaluations of an individual's sense of well-being (Tsuang, 2002). Both were based on a Spiritual Well Being Scale (Paloutzian, 1982). This consisted of 10 questions for a "vertical dimension" relating to one's sense of well-being in relationship with God. An additional 10 questions related to a "horizontal dimension" for an existential sense of well-being related to one's

perception of their purpose and satisfaction in life, apart from any religious reference.

They also computed an Index of Spiritual Involvement based on a subset of the questions from Kass's Index of Core Spiritual Experiences (Kass, 1991). These questions sought to measure the strength of one's religious or spiritual orientation and the time spent on religious or spiritual practices. Other assessments included the Multidimensional Personality Questionnaire and an assessment of any psychiatric disorders. Genetic factors accounted for 37 percent of the variance in the religious well-being scores. The shared environment explained only 10 percent of the variance while the unique environment explained 53 percent. Genetic factors accounted for 23 percent of the variance of the Index of Spiritual Involvement. The common environment explained 32 percent and the unique environment explained 23 percent, indicating that cultural and religious upbringing did play a role in this scale. Genetic factors accounted for 36 percent of the existential scale with common environment contribution to zero percent of the variance and unique environment accounting for 64 percent.

An additional informative aspect of this study was the correlation between the religious well-being and the existential well-being scales and the different personality traits. The interesting result was that the religious well-being scale was significantly correlated only with the personality traits of traditionalism and constraint, perhaps best described as a conservative and rigid approach to life. This agreed with the results by Eaves and colleagues (Eaves, 1999) described above.

In contrast, the existential well-being scale, based on *meaningful but non-religious aspects of life*, was positively associated with many advantageous personality traits such as general sense of well-being, social closeness and communion, as well as constraint. It was negatively correlated with disadvantageous personality traits such as a poor reaction to stress, alienation, aggression, and negative emotion, and all the negative summary traits of

odd/eccentric, dramatic/erratic, and anxious/fearful. A negative correlation means that the higher the score on a well-being scale the lower the score on the personality trait.

These results suggest that individuals can attain a significant sense of well-being, satisfaction with life and a sense of purpose without turning to organized religion, and conversely, turning to religion does not necessarily bring the same level of positive and purposeful outlook on life and satisfaction as a non-religious, existential outlook. This existential outlook should not be construed as non-spiritual. This "horizontal" dimension is a measure of spirituality in relation to "a life purpose, satisfaction with life, and positive life experiences" (Bolvin, 1999). Individuals scoring high on the existential realm of spirituality and low on the religious realm could best be described as – spiritual but not religious.

Twin studies of Church attendance

In contrast to measures of intrinsic spirituality, church attendance taps the dimension of participation in active organized religion. Many psychologists felt that certainly this trait would be influenced by the shared environment, and this proved to be the case. Studies of genetic factors in church attendance have been carried out in both the United States and Australia. In 1999 Kirk and colleagues (1999b) compared the accumulated results for these two countries. In the United States this involved the Virginia 30,000 study while in Australia it involved the Australia Twin Registry.

Church attendance was more common in the United States than in Australia. For example, an average of 20 percent of subjects in the United States stated they rarely attended church while an average of 50 percent of subjects in Australia rarely attended church. In both countries attendance was greater for women than men and greater for individuals 50 year of age or greater than for younger subjects. Figure 6 compares the results for the analysis of the relative importance of genetic versus environmental factors for both countries.

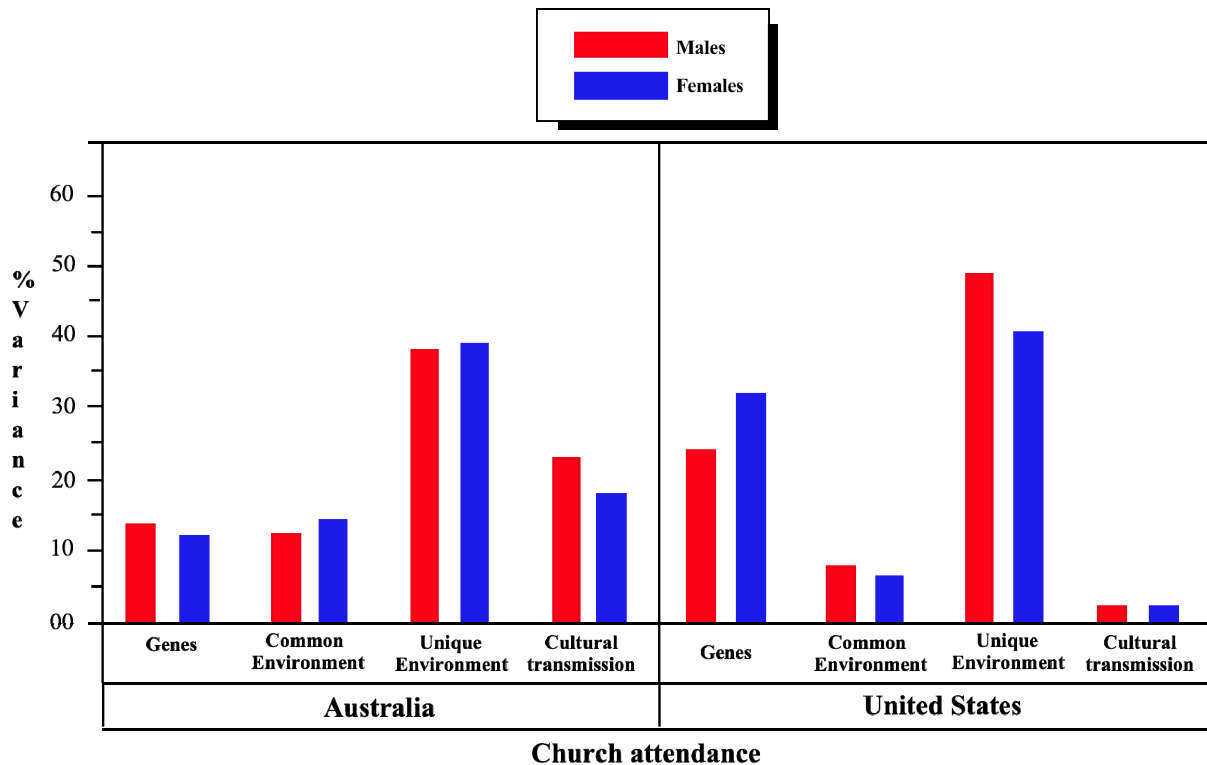


Figure 6. Twin studies of church attendance in Australia and the United States. From Kirk et al., (1999b).

Somewhat surprisingly, the unique environment still played the greatest role in both countries. Cultural transmission, measured as parent-to-offspring environmental transmission, was more important in the Australian sample, while genetic factors were more important in the United States sample. Church attendance was moderately associated with common family environment in both countries. These results indicate that religion and spirituality are separate entities. Spirituality comes from within. Religiousness, at least in the form of church attendance, comes from common and unique environmental factors and cultural influences. It is learned from parents, teachers, friends and church leaders.

In summary, both genes and the environment play a significant role in church attendance in both the United States and Australia. Common environment and cultural factors are far more important than they are for spirituality. Spirituality and religiousness are separate entities and involve separate sets of genes. Spirituality comes from the inside. Religiousness comes from the outside.

The Evolution of Spirituality

As shown above spirituality has a significant genetic component. For genes to be selected and retained in the population, they have to provide a selective advantage to the species. A number of factors may have been involved in the evolution of man's capacity for spirituality. These include a reduction in the fear of death, a feeling of being in better control over a hostile environment, a feeling of being monitored for moral behavior, improved social cohesiveness, and greater feelings of joy, happiness and optimism. These in turn may have had selective value by allowing spiritual individuals to more easily escape life-threatening circumstances, to make better hunters and warriors, to have greater resistance to stress and disease, to behave morally, to belong to a protective religious group, and to have greater appeal to a sexual partner. Details relating to these factors are reviewed elsewhere (Comings, 2008).

Of the above possible factors involved in the select of the genes for spirituality I believe the most important is *improved social cohesiveness*. As stated above, I believe the best definition of spirituality is a sense of being connected with something

greater than oneself, not necessarily something supernatural. As such an enhanced sense of spirituality would be an important factor in the evolution of humans as a social animals where working as a cohesive group provides more satisfaction and reward than working as individuals. This is especially likely to be the case when environmental factors become extreme, as during the ice ages. Division of labor with different individuals in the group being responsible for different survival skills, would provide considerable selective value.

On the first page of his beautifully illustrated book *World Religions*, John Bowker (1997) spoke of *Religion and Natural Selection*. He first pointed out that religion is derived from the word *religare*, meaning to bind things closely together. This was appropriate since religions bind people together in common practices and beliefs and this draw them together in a common goal of life. He went on to state:

Religions are the earliest protective systems we know about that enabled people to have children and to raise them to adulthood. The importance of this is obvious: natural selection and evolution

means that wherever the processes of birth and bringing up children (that is passing on genes and looking after children) are best protected, their human communities survive and flourish.

Culture [from the Latin word *cultus* meaning worship of the gods] is protective; religions, with their various patterns of belief and practice, are the earliest cultural system that we know about for the protection of gene replication and the nurture of children....religions have been the best systems that humans could devise to ensure survival.

While we might forgive Bowker for his enthusiasm for his favorite subject, these thoughts are supported by E. O. Wilson, (1978) who stated that "*religions, like other human institutions, evolve so as to further the welfare of their practitioners.*" This provides support for the concept that there has been selection for the genes associated with spirituality. Individuals with the greatest inherent spirituality are the ones most likely to join a religious group and thus the most likely to benefit from the protective effect of such a group.

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