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Is Our Brain Hardwired to Produce God, or is Our Brain Hardwired to Perceive God? A Systematic Review on the Role of the Brain in Mediating Religious Experience

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Abstract: To figure out whether the main empirical question "Is our brain hardwired to believe in and produce God, or is our brain hardwired to perceive and experience God?" is answered, this paper presents systematic critical review of the positions, arguments and controversies of each side of the neuroscientific-theological debate and puts forward an integral view where the human is seen as a psycho-somatic entity consisting of the multiple levels and dimensions of human existence (physical, biological, psychological, and spiritual reality), allowing consciousness/mind/spirit and brain/body/matter to be seen as different sides of the same phenomenon, neither reducible to each other. The emergence of a form of causation distinctive from physics where mental/conscious agency (a) is neither identical with nor reducible to brain processes and (b) does exert "downward" causal influence on brain plasticity and the various levels of brain functioning is discussed. This manuscript also discusses the role of cognitive processes in religious experience and outlines what can neuroscience offer for study of religious experience and what is the significance of this study for neuroscience, clinicians, theology and philosophy. A methodological shift from "explanation" to "description" of religious experience is suggested. This paper contributes to the ongoing discussion between theologians, cognitive psychologists and neuroscientists.

Keywords: Neuroscience; EEG; Brain; Cognitive processes; Consciousness; Mind; Soul; Spirit; Religious experience; God; Theology.

Canst thou by searching find out God?
Job 11:7.

1. Introduction

The numerous studies in the fields of theology, cognitive psychology and neuroscience on the nature of religious experience (see reference list of this article) have lead some researchers to claim that religious experience is explained (Persinger 1984, 1991, 1993; Proudfoot 1985; Wuthnow 1992; d'Aquili and Newberg 1993, 1999; Boyer 2001, 2003; Atran 2002). Does this mean that the main empirical question "*Is our brain hardwired to believe in and produce God, or is our brain hardwired to perceive God?*" is answered?

In order to figure out this we will provide systematic critical review of the positions, arguments and controversies of each side of the neuroscientific-theological debate and will offer our point of view on the matter. The review will include mostly practical/experimental/sociological studies, whereas broad theoretical/philosophical works will mostly be left out, as the works that greatly exceed its evidential grasp. The aim of this review is to critically examine the extent to which neuroscientific data of religious experience can be used to explain it. Additionally, biological framework of religious experience will be established and concrete research program will be offered. We will also outline main benefits of the research on religious experience and its importance to the fields of neuroscience, clinical studies, theology and philosophy. In this context we propose that this article be considered as a contribution to the ongoing discussion between theologians and neuroscientists.

2. Definition of religious experience

In order to undertake an adequate study of religious experience we need to define what religious experience is. Unfortunately, the terms used to define the religious experience differ across studies and researchers, and researchers have focused on different levels of its description.

Considering that *religious experience* is one of the three major components of religious activity, the other two components - *belief* and *practice* (James 1902; Previc 2006) - should be left out of the definition of the religious experience. However, religious belief and practice are often included explicitly or implicitly in the definition of the religious experience (Barrett and Keil 1996; Boyer 2003)[1]. This creates confusion in subsequent conceptualisations and dilutes the term religious experience in much wider phenomenon such as religious activity (see Runehov 2004).

Considering that religious experience is deeply subjective, we need to give a modern understanding what subjective experience is and how it differs from perception. According to the contemporary agreement in the professional community *subjective experience* is a phenomenal world inside the brain (so called "world-for-me") that is the collection of simultaneously present phenomena (such as seeing, hearing, touching, feeling, embodiment, moving, and thinking) that happen to a person right now (Revonsuo 2006). "*Perception* is a causal chain establishing systematic covariance between distal external states and the experiential states at the phenomenal level in the brain (as effect). […] The

[1] See also a consensus conference of scientists interested in studying spirituality and religiousness which created the criteria for each definition (Larson et al. 1998).

last link in the causal chain establishing accurate perception is the phenomenal level, bringing about or rather, *being* or *constituting* perceptual *experience*" (Revonsuo 2006; p. 129).

What is important here is the following: "Neither the phenomenal level as a whole nor any of its parts are somehow "perceived" themselves. That is, they do not serve as *objects* of perception in anything like the manner that external physical objects do. […] The phenomenal level incarnates the ultimate *realizer* and *presence* of perceptual experience, not the objects of some further perceptual process or the modulator of some further state which could still be regarded as perceptual" (Revonsuo 2006; p. 129). This means that we do not perceive phenomenal objects at all; we simply experience patterns of activation at the phenomenal level of brain organization. In other words, phenomenal objects are self-presenting, – they do not exist without being experienced; they are constitutive of the experience (Revonsuo 2006).

Now, let us look closely at religious experience per se. Phenomenologically religious experience consists of both explicit components (e.g., "visions," "voices", etc.) and vague (numinous) components that often have an emotional flavour (Previc 2006). According to Hardy (1979, as cited by Saver and Rabin 1997), Beauregard and Paquette (2006), and Cahn and Polich (2006) the most prevalent numinous experiences include: (1) a sense of special patterning of events in a person's life by a divine being; (2) an awareness of the presence of a divine being; (3) a sense of union with a divine being or the divine universe; (4) an awareness of receiving help in answer to a prayer; (5) an awareness of being looked after or guided by a presence of God; (6) an awareness of a divine presence in nature; (7) experiencing in an extraordinary way that all things are "One" with a divine being; (8) the sense of having touched the ultimate ground of divine reality; (9) the experience of timelessness and spacelessness; (10) feelings of positive affect, peace, joy and unconditional love; (11) a metacognitive[2] shift in the relationship between thoughts and feelings – they come to be observed as arising phenomena instead of occupying full attention; and (12) blissful absorption into the present moment.

Together these explicit and numinous components can be present in a religious experience in any combination. Together they address all known cultural expressions of religion experience. Here we would like to stress that religious experience is not the result of person's observations and reflection, rather it comes to the mind's eye at once in complete internal integrity. Often religious experience arises (a) spontaneously in the most prosaic of circumstances, outside any tradition of religious doctrine and

[2] *Metacognition* refers to thinking about cognition (memory, perception, calculation, association, etc.) itself or to thinking/reasoning about one's own thinking (Metcalfe and Shimamura 1994).

practice and (b) involuntary, where individual does not feel that he/she is the agent or cause of his/her own experience (Taves 2005).

Moreover, religious experience has two common yet very important characteristics: (a) it is invariably experienced as being *real*, even more real than the baseline reality[3] of every day life (for an extensive discussion on the reality issue, see Newberg and Lee 2005) and (b) it is characterised by the intense memorability.

Thus, based on the reasoning set out above, we can construct the following definition of religious experience: *religious experience is the very moment of experiencing of ultimate divine reality or ultimate divine truth, a transcendence of events or universe, timelessness, spacelessness, and divine being and/or union with it in any combination with an accompanied memorable feeling of reality, emotions and thoughts with a religious content*.

We use the word "religious" instead of "mystic" or "spiritual", because "religious" in our opinion is a narrower concept and also adds a cultural dimension. The cultural dimension is important because any experience is always subjective and personal, and each individual is inserted in a particular cultural environment. In the mystical experience, all 'otherness' disappears and the person becomes one with the transcendent. The person discovers that he or she is not distinct from the cosmos or the other reality but one with it. Here God or divine evaporates into abstract Ideality. Spiritual experience concerns experience of or communion with supernatural beings (the spirit(s)) or phenomena. Here, besides God a wide range of supernatural beings can be experienced: spirits of dead relatives, spirits of plants and animals and so on. Religious experience, however, relates to or consists of transcendent God or divine realm.

Taken together above mentioned reasoning, we have a narrow definition of religious experience which leaves out such components of religious activity as belief and practice, does not include such supernatural beings and/or phenomena as spirits of dead relatives, plants or animals and does not include extrovertive experiences (Marshall 2005) where features such as unity, knowledge, reality, love, luminosity and so forth, characterize experience of the natural world, but not the experience of something beyond the natural world such as a transcendent God or divine realm. At the same time, this definition is broad enough to pick out all known characteristics of religious experience and it permits culturally flavoured expression of God or divine.

[3] *Baseline reality* is the reality that comprises our everyday perceptions and behaviours.

Since we have a definition of religious experience which clearly distinguishes it from other phenomena, we now need a proper conceptualisation of religious experience on the basis of what is known about it from practical/experimental and sociological studies.

3. History of religious experience

There is indirect evidence that the history of religious experience spans over 40,000 years. Indeed, it has been well established that Neanderthals (Trinkaus and Shipman 1993) and other homo sapiens of the Middle Paleolithic (e.g. 150,000 to 35,000 B.P.[4]) and Upper Paleolithic (35,000 B.P. to 10,000 B.P.) engaged in complex religious rituals (Joseph 2001). Moreover, primitive religious concepts (such as the concept of death) were already present in Neanderthals while the first clear evidence of mythical creatures in cave drawings (e.g., half-man, half-god) appeared approximately 40,000 years ago (Mithen 1996, 1999).

Religious rituals and drawings by themselves are not evidence of religious experience but one can suppose that it is a religious experience that drives the development of religious rituals and the establishment of religious drawings. Such an assumption is supported by the fact that all higher vertebrate forms (including humans) demonstrate experience-dependent behaviour (along with other types of behaviour), i.e. an adaptive change of behaviour as a result of experience. Additionally, Lewis-Williams and Dowson (1988) have shown that cave bizarre drawings bear a close association with the entopic visual experiences.

Several aspects are important for our conceptualization in this brief review:

(1) Religious experience has a very long history (over 40,000 years). Thus, it is not a transient or temporary phenomenon in human history.

(2) Available (even though limited) data suggests that religious experience appeared much later than the modern human being came onto the scene. Thus, the gap that exists between the development of anatomically modern humans (≈ 200,000 years ago, McDougall et al. 2005) and the appearance of religious experience (over 40,000 years ago) raises the possibility that other factors besides the brain anatomy or morphology (size and shape) may have played a role in the emergence of mind or mental properties.

[4] Raw, i.e. uncalibrated, radiocarbon ages are usually reported in radiocarbon years "Before Present" (*BP*).

(3) At the same time, available (but limited) data suggests that religious experience appeared almost simultaneously with such pre-cultural phenomena as language, drawings and rituals (Logan 2006). However, it is only much earlier the time when culture starts to exert its own strong influence on the way the individual perceives his/her environment and shapes his/her experience. Thus, we *cannot* conceptualise religious experience as a by-product of culture.

4. Universality of religious experience

It seems that religious experience was and is a world-wide phenomenon. According to Burkert (1996) in prehistoric times no groups of people lived which had no religious experience (judging by the existence of religion). At the same time, groups existed which have no demonstrated such attributes of human culture as agriculture, clothing, money, laws and writing.

It is not uncommon for people to have a religious experience. All surveys since the 1960s indicated that 30-40% of respondents have had at least one or two religious experiences (Spilka et al. 1984); Gallop polls in the 1990s found that 53% of American adults had had religious experience (Gallup and Castelli 1990). In general, about 20–53% of all religious persons actually claim to have had such an experience (Saver and Rabin 1997). The National Survey of Youth and Religion found that 80% of teens reported having at least one type of religious experience (Smith and Denton, 2005). These values are especially interesting if one considers the number of atheists[5] + agnostics[6]. According to Harris Interactive poll (2006) the number of atheists + agnostics is 18% (United States), 52 % (Great Britain), 64% (France), 45% (Germany), 41% (Spain) and 27% (Italy). According to Eurostat survey (Eurobarometer poll 2005) the number of non-believers[7] is 23% (Sweden), 22% (Luxemburg), 27% (Belgium), 27% (Netherland), 30% (Czech Republic), 26% (Estonia) and 18% in average for 25 countries of Europe.

It is striking that people from different religions (and cultures) experience certain *common* religious phenomena, for example the feeling of timelessness, divine love and being at one with the divine universe or divine being (Runions 1979; Hay 1990; Runehov 2004). Such commonality of experience Jung and von Franz (1964) described as "archetypal" – inborn tendencies to produce, create and respond in a similar and particular manner to specific images and stimuli.

[5] *Atheist* - one who denies the existence of God.
[6] *Agnostic* - one who is sceptical about the existence of God but not an atheist.
[7] *Non-believer* - one who does not believe neither in any sort of spirit, God, or life force.

It is also important to note that besides the fact that common religious experiences exist in all religions and cultures, religious experience exists also in all stages of individual development: from infancy through adolescence and into adulthood (Fowler 1981; Oser 1991; Tamminen 1994). Indeed, the literature in this field attests to the existence of profound religious experiences in children (see Robinson 1983; Armstrong 1985; Coles 1990; Stower and Ryan 1998). This experience in children may be conditioned by children's "intuitive theism" (default theory of the world) which is independent on cultural-environmental input such as parents' religiosity (atheism/theism), storybooks and family conversations (Evans 2000, 2001; Barrett and Richert 2003; Bering 2004; Kelemen 2004; Kelemen et al. 2005; Richert and Barrett 2006; Bloom 2007).

S*ummarising, we can note that*:

(1) The common phenomenon of 'religious experience' exists in all religions and cultures. This suggests that there should be a reason for such commonality; otherwise this religious experience cannot survive through evolution. Indeed, why would the brain have evolved the systems that enable the humans to experience something that does not exist?

(2) Religious experience exists in all stages of individual development starting from infancy and may happen in children whose parents are atheists. The pressure of culture is not strong in infancy (if nonexistent at all); therefore religious experience should not be conceptualised as a consequence of cultural influence.

(3) The above facts highlight that religious experience is a fundamental and universal characteristic of human being.

5. Variations of one religious experience versus a continuum of many religious experiences

It is well known that religious experience can appear either naturally (in healthy people and without chemical interventions), either during psychiatric diseases (temporal lobe epilepsy, mania, obsessive-compulsive disorder and schizophrenia; for the references, see Table 1), or under the influence of psychotropic agents (phencyclidine, ketamine, amphetamines, LSD, psilocybin, mescaline and salvatorin A; for the references, see Table 2) and brain stimulation (Makarec and Persinger 1985).

Table 1. Summary of studies on religious experience during psychopathologies.

References	Temporal lobe epilepsy	Schizophrenia/ schizotypy	Bipolar disorder (mania/hypomania)	Obsessive-compulsive-disorder
review by Joseph, 2001	+			
Waxman & Geschwind, 1975	+			
Bear & Fedio, 1977	+			
Bear, 1979	+			
Bear et al., 1982	+			
review by Csernansky et al., 1990	+			
review by Saver & Rabin, 1997	+			
Wuerfel et al., 2004	+			
MacDonald & Holland, 2002	+			
Morneau et al., 1996	+			
Persinger, 1984	+			
Diduca & Joseph, 1997		+		
White et al., 1995		+		
Feldman & Rust, 1989		+		
Peters et al., 1999		+		
Spencer, 1975		+		
Fenwick et al., 1985		+		
Cothran & Harvey, 1986		+		
Getz et al., 2001		+		
Buckley, 1981		+		
review by Previc, 2006	+	+	+	+
Brewerton, 1994		+	+	
Kroll & Sheehan, 1989		+	+	
Gallemore et al., 1969			+	
review by Lewis, 1994				+
Tek & Ulug, 2001				+
Tolin et al., 2001				+
Fiske & Haslam, 1997				+

Table 2. Psychotropic drugs and religious experience.

	glutamate system		dopamine system	serotonine system					opioid system
References	Phencyclidine	Ketamine	Amphetamines	LSD	Psilocybin	N,N-dimethyl-tryptamine	Mescaline	3,4-methyl-enedioxy-methamphetamine	Salvatorin A
Hansen et al., 1988	+	+							
Rosse et al., 1994	+	+							
Mandell, 1980			+	+					
Wright, 1989			+	+					
Unger, 1963				+	+		+		
Aghajanian & Marek, 1999				+	+	+	+	+	
Glennon, 1990					+	+	+	+	
Freese et al., 2002					+	+	+	+	
Roth et al., 2002									+

This raises another important issue: are there many variations of a single religious experience or is there a continuum of many different religious experiences. Several converging lines of evidence suggested that there is a state of religious experience (a naturally occurring state in healthy people and without chemical interventions) and there are several altered states with a religious content (appearing during psychiatric diseases or under the influence of drugs). Let us look at these pieces of evidence more closely:

(a) Although many people with psychopathological disorders may have religious experience, religious experience does not always occur in a pathological state in a previously healthy person.

(b) Not all people with psychopathological disorders have religious experience.

(c) Religious experience in the general population is negatively associated with psychoticism[8], depression and other mental illnesses (Batson and Ventis 1982; Francis and Wilcox 1996; Maltby

[8] *Psychoticism* is one of the three traits of personality. High levels of this trait are believed to be linked to increased vulnerability to psychoses such as schizophrenia (Eysenck and Eysenck 1976).

1997; Roman and Lester 1999) so that religious experience in the vast majority of individuals is associated with non-pathological brain activity.

(d) Patients with religious obsessions do not fundamentally differ from those with non-religious obsessions in terms of their religious practice and obsessive-compulsive-disorder symptoms (e.g., severity, frequency and type) (Tek and Ulug 2001).

(e) Cultural and other factors determine to a great extent whether schizophrenic delusions take on a religious flavour or not. For example, grandiosity delusions may be supplanted with religious ones as the patient ages (Verdoux et al. 1998), religious delusions may give way to non-religious ones as a particular society becomes less religious (Klaf and Hamilton 1961): preoccupations and delusions of a religious nature in British schizophrenics decreased strongly between the mid-19th century and the mid-20th century, while those of a sexual character increased. Additionally, religious delusions seem to be much more common in more religious or magical societies (e.g., religious delusions are low in China but are higher in Korea and Jamaica and are significantly more prevalent among Protestants than Catholics) (Getz et al. 2001; Kim et al. 2001; Ndetei and Vadher 1985).

(f) Not all subjects who consumed psychedelic drugs[9] reported religious experience; only about a third of all subjects had such an experience (Leary 1964; Leary and Clark 1963; Clark 1969).

(g) It has been shown that meditation produces no effect on brain electrical activity when subjects have been given either an opiate or benzodiazepine antagonist[10] (Sim and Tsoi 1992).

(h) Periods of religious experience for healthy people are rather brief, while persons with psychopathology have some kind of 'constant' intruder. Moreover, whereas the healthy person can conceptualise about the universe or God and remain intact, the patient with psychopathology is lost into confusion and is ultimately deprived of his concept of boundaries (Runehov 2004).

(i) 'Normal' people have reported that their religious experience is more real than baseline reality, even when they are recalled from within baseline reality (Bucke 1961; Newberg and d'Aquili 1994; Newberg et al. 2001; for an extensive discussion on the reality issue, see Newberg and Lee 2005). At the same time, 'normal' individuals almost always refer to dreams as inferior to baseline reality

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[9] *Psychedelics* are psychoactive drugs whose primary action is to alter the thought processes of the brain. They induce intense and distorted sensory perceptions, hallucinations, feelings of euphoria or sometimes despair, and altered states of awareness or sometimes states resembling psychosis.

[10] In medicine, the term *opiate* describes any of the narcotic substances (alkaloids) found in opium. The *benzodiazepines* are a class of psychoactive drugs considered as minor tranquilizers with varying hypnotic, sedative, anxiolytic, anticonvulsant, muscle relaxant and amnesic properties, which are brought about slowing down the central nervous system. In pharmacology an *antagonist* is a binding partner of a receptor that inhibits the function of an agonist (a substance that binds to a specific receptor and triggers a response in the cell).

when they are recalled and discussed within baseline reality. The same inferior feeling is true for psychotic hallucinations – after they are cured by psychotropic medications. A person having emerged from such a psychotic state will recall it as psychotic (Newberg and Lee 2005).

(j) Healthy adolescents reported a greater frequency of religious experiences than did their inpatient peers (Grossoehme et al. 2007).

Thus, there appears to be a clear distinction between spiritual pathology, pharmacologically induced spirituality and non-pathological religious experience.

6. Heredity and religious experience

Studies of identical versus fraternal twins have suggested a genetic contribution to the tendency of a human to have a religious experience (Waller et al. 1990; D'Onofrio et al. 1999a,b; Eaves et al. 1990; Eaves 2004). For example, in study by Truett et al. (1992) who used 3.810 pairs of twins found that about 16% of the variance in their religiosity was due to heredity. Using mostly very large samples of twins (3.000-14.000 pairs of twins), behaviour geneticists have shown that genetic factors manifest a moderate degree of influence on religious devotion and conservatism (D'Onofrio et al. 1999a,b).

A twins and adoption study has reported that genetic variation contributes to about 50% of individual variation in religiosity (Bouchard et al. 1990). This research is in line with Waller et al. (1990) who studied the relationship between heredity and environment on the religiosity in 53 pairs of monozygotic twins (identical) and 31 pairs of dizygotic twins (fraternal) who had been reared apart and 458 pairs of identical and 363 pairs of fraternal twins who were raised together and found that about 50% of the variation in the religiosity was a function of genetic influences. Their analyses suggested that familial-environmental factors played at most a minor role in their religiosity dimensions.

More recently, Kirk et al. (1999) confirmed that genetic makeup is responsible for approximately 50% of the variation in religiousness – including spiritual feelings and beliefs – from within twin siblings. They also reported that the heritability of self-transcendence was estimated to be approximately 41% in women and 37% in men. Recent research on twins has generally confirmed this conclusion (Olson et al. 2001). Additionally, it was shown that religiosity appears to be influenced by heredity to about the same degree as intelligence (Previc 2006).

Thus, on the basis of these studies, there is reason to believe that religious experience has a biological basis. In another words, an *appropriate biological basis is needed* for a religious experience to occur.

Based on this short review, we can conclude that religious experience is not determined by environmental and cultural factors, rather it is modulated by them. Here we stress that social and cultural contexts are heavily influenced and even limited by the human's biological nature. Any cultural characteristic takes as a given, a starting point, the innate biological characteristics of the human. However, many of these characteristics exist as potential and can be realised only in interaction with the environment.

The existence of a biological basis for religious experience suggests the significance of biological knowledge for theology (for discussion, see Clayton 2000). Here we need to understand whether biological peculiarities reflect the divine influences or ultimately physical influences. Clayton (2000) offered the following logic: "If biological explanations are ultimately nomological (law-based) in the strong way that physical explanations are, then there will be no room for divine influence; if they exhibit causal influences analogous to the way that one thought can (non-nomologically) influence another, then there will be room in principle" for divine influence.

7. Evolution and religious experience

Speaking about biology and religious experience, Joseph (2001) asks the following question: if there is no divine entity in the world then why has our brain become adapted for perceiving and experiencing what supposedly does not exist? Here the issue of evolution is raised[11]. Joseph suggested that we are able to hear and see because there were and are vital auditory and visual stimuli in the surrounding environment; and in order to perceive and analyse this information, the human brain possessed specialised structures or circuits capable of doing so. According to Joseph (2001) the same evolutionary principles should be applied to religious experience.

Therefore, from an evolutionary point of view, religious experience must contribute to the survival of those capable of experiencing it. In another words it should be adaptive. The adaptationist view is supported by the fact that the religious communities were far more likely to outlast their non-religious counterparts – four times as likely in any given year (Sosis 2000; Sosis and Bressler 2003). Joseph speculates that those who evolved a religious-moral conscience capable of redirecting and controlling the dangerous limbic[12] impulses, were more likely to survive, and, presumably, more likely

[11] The quest for an evolutionary basis of religious experience is not new (see Walter 1995).
[12] The *limbic system* includes the structures in the human brain involved in emotion, motivation, and emotional association with memory.

to successfully breed (Joseph 2001). This idea is in line with the fact that religious experience has some protection against certain types of mental and physical ill-health (see reviews in Koenig and Cohen 2002; Marks 2005) and this "power" of religious experience has very likely contributed to its evolutionary success.

Another point of view is that religious cognition is a by-product of the evolved mind and as such, religious experience has no adaptive value per se. Selection may preserve religious tendencies because it preserves the more broadly functional design that produces them (for general overviews see Barrett 2000; Boyer 2001, 2003). For example, Previc (2006) suggested that religious experience co-evolved with an expansion of the dopaminergic (DA) brain system and with such DA-mediated phenomena as abstract reasoning. See Table 3 for a list of the known functions of DA and other neurotransmitter brain systems involved in religious experience.

Table 3 . Known functions of the neuronmediator's systems which have been reported to be involved/modulated/(de)activated during religious experience.

Neuronmediator's systems	Functions	References
Dopaminergic	Speeds up the internal clock; promotes internal noise and loosened associations; mediates abstract reasoning; reduces perceptual sensitivity; involved in brain reward function and appetitive motivation processes; dopamine neurons participate in the modulation of expectation, memory, activity, attention, drives, and mood; plays role in emotional tone	Meck, 1996; Shaner, 1999; review by Previc, 2006; Krummenacher et al., 2002; Bozarth, 1991; Cohen & Carlezon, 2007
Acetylcholinergic	Elevated during dreaming and decreased during most hallucinations; is involved in behavioural inhibition; controls the learning rate, which determines when to learn something new and when to retain what has been memorized;	review by Previc, 2006; Carlton, 1963; Doya, 2000
Serotoninergic	Decreased during dreaming and hallucinations; includes inhibition of sensory stimuli and arousal; play an important part of the biochemistry of depression, bipolar disorder and anxiety	review by Previc, 2006; Borg et al., 2003
Glutamatergic	The interaction with the dopamine plays an essential role in mediating loss of consciousness; is implicated in epileptic seizures and in the acquisition of conditioned fear and anxiety; participates in the pathophysiology of schizophrenia and major depression; plays an "endocrine-like" role as part of a larger homeostatic system; is involved in most aspects of normal brain function including cognition, memory and learning	Smythies, J. 1999a,b; review by Tsapakis & Travis, 2002; review by Moghaddam, 2003; Fernstrom & Garattini, 1998; Danbolt, 2001

Even though different authors have emphasised different aspects of the evolutionary process in relation to the religious experience, one can derive a common denominator: as organisms become organised in more and more complicated ways, new properties emerge. Although the manifestation of new properties is dependent on the laws of physics, their behaviour is irreducible to any of the underlying levels (emergence principle[13]). At each level of emergence, new structures are created and new causal forces are at work (Clayton 2006). In this sense, according to Clayton (2007), divine entity "could guide the process of emergence through the introduction of new information (formal causality)

[13] *Emergence* refers to the way a complex system and pattern arises out of a multiplicity of relatively simple interactions and the complexity of this system makes possible types of phenomena which could not be generated by the components alone or summed together (Kim 1992).

and by holding out an ideal or image that could influence development without altering the mechanical mechanisms of evolution or adding energy from outside (final causality)."

Indeed, during the course of evolution there emerged a level at which entities within the universe became capable of acting according to explicit conscious purposes. At that point conscious persons emerged capable of being affected by and affecting other conscious beings, in a manner fully consistent with, though also going beyond, the laws of physics (Clayton 2000). Here, one can speak about a totally new level of experience, behaviour and causal forces which are different from physical ones: human thoughts, human intentions, human decision-making and human symbolic interactions including language, culture and art and senses of truth and justice. Thus, in humans nature becomes aware of itself (Fingelkurts and Fingelkurts 2004). In this context and following the logic of Clayton (2000, see also Section 6), there might be a room for divine influences in biological evolution.

Two different points of view have emerged from this brief review: one treats the religious experience as a by-product of human evolution and another explains the origin of religious experience as the result of the divine influences in biological evolution.

8. Review of arguments

This section does not provide a thorough review of research, but rather it simply presents an overview of the main arguments on whether our brain is hardwired to believe in and to produce God, or whether our brain is hardwired to perceive and experience God? It will become apparent that there are substantial theoretical disagreements between these two points of view.

8.1. Arguments for the "producing" point of view

A "producing" point of view (sometimes it is referred as neuroscientific and/or cognitive) is a reductionistic one and can be summarised as follows: our brain is structured so as to provide us with experiences that make us believe there is a God, but this belief may merely be the result of internal brain activity and our interpretation of it.

The followings are the main arguments for such position:

Argument 1: It has been reported that the intense activation of the frontal and temporal cortices and limbic system, as well as (de)activation of the parietal cortex give rise to religious experience (for the full list of brain areas and structures and for the references, see Table 4).

Table 4. Summary of studies on the involvement/modulation/(de)activation of brain areas/structures during religious experience.

	d'Aquili & Newberg, 1993	review by d'Aquili, 1993	review by Previc, 2006	Newberg et al., 2001	review by Newberg & Lee, 2005	Cahn & Polich, 2006	Newberg et al., 2003	Muramoto, 2004	review by Raine & Yang, 2006	Beauregard & Paquette, 2006	review by Boyer, 2003	review by Joseph, 2001	Azari et al., 2001a	Takahashi et al., 2005	Ruby & Decety, 2003	Waxman & Geschwind, 1975	Saxe et al., 2004, 2005	Bear et al., 1982	Bear & Fedio, 1977	Britton & Bootzin, 2004	Persinger & Makarec, 1987, 1993	Lehmann, et al., 2001	Aftanas & Golocheikine, 2001	Wuerfel et al., 2004	Brugger & Graves, 1997	Fenwick et al., 1985	MacDonald & Holland, 2002	Morneau et al., 1996	Persinger, 1984, 1991
Frontal cortex			I		I	I								I															
Right frontal cortex	I											A										A							
Inferior frontal cortex				A			A																						
Right medial orbitofrontal cortex (MOFC)				A						A	A																		
Prefrontal cortex (PFC)	A	I	I				A																						
Lateral PFC			I																										
Dorsolateral PFC				A		I							A																
Polar/medial/ventral PFC			A					I	A		A		A																
Left PFC				A																			A						
Left medial prefrontal cortex (MPFC)										A																			
Temporal cortex			A						A		A	A				A		I	I										
Ventromedial temporal lobe			I					I												I					I	I	I	I	I
Inferior temporal lobe (ITL)		I																											
Right middle temporal cortex (MTC)										A											A								
Left temporal cortex																			I	I									
Superior-temporal cortex											I																		
Left insula										A	A																		
Limbic system					I																								
Anterior cingulate cortex (ACC)			A			I					A																		
Left ACC										A																			
Left dorsal ACC										A																			
Posterior cingulate cortex (PCC)									A																				
Amygdala									A		A	A																	
Rigth amygdala	I, M																												
Hippocampus												A												I					
Hypothalamus		A																											
Thalamus				A	I						A																		
Caudate nucleus											A																		
Right caudate										A																			
Left caudate										A																			
Temporo-parietal junction																	I												
Parietal cortex											A																		
Posterior superior parietal lobule (PSPL)		DA	DA	DA	I					A																			
Right PSPL		DA								A																			
Left PSPL		DA																											
Medial parietal cortex													A																
Ipsilateral superior parietal lobule (SPL)							A																						
Inferior parietal lobule (IPL)		I					A																						
Left IPL										A																			
Right IPL										A					A														
Angular gyrus									A																				
Occipital cortex																													
Extra-striate visual cortex (MOC and LG)										A																			
Left brainstem										A																			

I = Involvement; M = modulation; A = activation; DA = deactivation

Comments:

(a) As one can see, the list of brain areas and structures involved in religious experience is quite extensive. A probable explanation for this is that different researchers used different techniques and methods to induce a religious experience. Most results perhaps, reflect not a religious experience per se (which is more or less homogeneous, see above) but rather diverse phenomena such as: *activity* - religious practice or execution of the ritual (meditation or prayer) and related cognitive activity; *beliefs* - reasoning about the truth of religious ideology; *moral reasoning* etc. A detailed and accurate inspection of the known functions of the brain areas and structures which have been reported to be involved/modulated/(de)activated during religious experience (Table 5) supports this position.

Table 5. Summary of known functions of the brain areas which have been reported to be involved/modulated/(de)activated during religious experience.

Brain areas	Functions	References
Frontal cortex	Plays a major role in attention, working memory, creative and critical thinking, planning, decision making, inhibitory control and emotional regulation	Shallice & Evans, 1978; Stuss & Benson, 1984; Rueckert & Grafman, 1996; Miotto et al., 1996
Right frontal cortex	Is associated with the recall of affect-laden autobiographical memory	Calabrese et al., 1996; Fink et al., 1996
Inferior frontal cortex	Controls the impact of distracting emotions on cognitive performance (left hemisphere) and the subjective feeling of being distracted (right hemisphere)	Dolcos et al., 2006
Right medial orbitofrontal cortex (MOFC)	Codes for subjective pleasantness of the taste or smell of stimuli or music; associated with ethical, social or emotionally related behaviour; adaptation to complex changing environments; regulation of socio-emotional behaviour in settings involving social affiliation and social judgment, self-awareness, inhibition, and the self-guidance of behaviour through judgments and decisions about one's actions; exerts an inhibitory control to protect goal-directed behaviour from interference; encodes the values that subjects assign to different items on a common value scale;	Kringelbach et al., 2003; de Araujo et al., 2003; Rolls et al., 2003; Blood & Zatorre, 2001; Eslinger, 1999; Bechara et al., 1994; Cummings, 1993; Damasio, 1995; Damasio et al., 1990; Dolan, 1999; Elliott, 1990; Fuster, 1997, 1999; Giancola and Zeichner, 1994; Grafman et al., 1996; Grafman and Litvan, 1999; Lapierre et al., 1995; Mesulam, 1986; Zald and Kim, 1996; Roberts and Wallis, 2000; Padoa-Schioppa & Assad, 2006
Prefrontal cortex (PFC)	Responsible for selective attention to stimuli, perception of temporal contingent sequences, intention and will; regulates negative affect and emotional distress; temporal organization of actions towards biological or cognitive goals;	Beauregard, 2007; d'Aquili, 1993; Filley, 1995; Godefroy et al., 1999; Badgaiyan, 2000; Collette & Van der Linden, 2002; Luria, 1966; Pribram, 1973; Knight and Grabowecky, 1995
Lateral PFC	Supports processes related to the successful resolution of ambiguity in decision making; is involved in metacognitive/ executive top-down processes, which refer to the ability to monitor and control the information processing necessary to produce voluntary action; selection and control of behavioural strategies and action; the inhibition of inherent response tendency; plays a crucial role in willed actions and with the holding in mind of information on which an action is to be based;	Flavell, 1979; Fuster, 1999; Damasio, 1995; Frith and Dolan, 1996; Fuster, 1997; Goldman-Rakic, 1987; Frith and Dolan, 1996; Fuster, 1999; Goldman-Rakic, 1987; Roberts and Wallis, 2000
Dorsolateral PFC	Plays a profound role in sustaining reflexive evaluation of thought; reflects working memory expectation of the location of the target; cognitive control;	Azari et al., 2001a; Watanabe, 1996
Polar/medial/ventral PFC	Is activated in moral judgment tasks; is involved in the development of moral reasoning; is involed in moral decision-making and in the regulation of moral emotions; plays a profound role in sustaining reflexive evaluation of thought; is activated during self-referential judgments; is involved in monitoring performance	review by Raine & Yang, 2006; Azari et al., 2001a; Gusnard et al., 2001; Kelley et al., 2002; Ito et al., 2003
Left PFC	Helps to inhibit the negative emotions generated by limbic structures; reflect a domain-specific semantic working memory capacity; guides controlled semantic retrieval; is involved in episodic encoding into long-term memory	Gemar et al., 1996; Lane et al., 1997a,b; Gabrieli et al.,1998; Wagner et al., 2001; Shallice et al., 1994; Tulving et al., 1994
Left medial prefrontal cortex (MPFC)	Is linked with conscious awareness of feelings; involved in the metacognitive representation of one's own emotional state; integration of the visceromotor aspects of emotional processing with information gathered from the internal and external environments; is involved in the metacognitive representation of one's own emotional state; activated during evaluation of statements with respect to people themselves and during moral judgments; plays a role in the ability to attribute mental states to oneself or others in order to explain behaviour; involves monitoring or reporting one's own mental state, such as self-generated thoughts, intended speech, and emotions; involved in attributing mental states to others; is associated with explicit representations of states of the "self"; performs continuous "simulation of behaviour", "an inner rehearsal" and "an optimization of cognitive and behavioural serial programs"; plays an important role in conscious and voluntary regulation of emotion processes;	Beauregard & Paquette, 2006; Lane & Nadel, 2000; Beauregard, 2007; Johnson et al., 2002; Greene et al., 2001; Castelli et al., 2000; Fletcher et al., 1995; Gallagher et al., 2000; Lane et al., 1997a,b; McGuire, et al., 1996a,b; Gusnard et al., 2001; Pardo et al., 1993; Reiman et al., 1997; George et al., 1996; Goel et al., 1998; Frith & Frith, 1999; Ingvar, 1985, 1991;
Temporal cortex	Is involed in moral dilemmas; plays a role in "self-recognition" or "self-image"; store memories of life-events;	review by Raine & Yang, 2006
Ventromedial temporal lobe	Provides the action-extrapersonal system and mediates related extrapersonally dominated brain functions such as dreaming and hallucinations;	review by Previc, 2006
Inferior temporal lobe (ITL)	Attaches complex associations to the stimulus; alerting of the organism to the objects of interest or motivational importance	review by d'Aquili, 1993
Right middle temporal cortex (MTC)	Is associated with learning and memory;	Adcock et al., 2006
Left temporal cortex	Contributes to the composition of sentence meaning	Vandenberghe et al., 2002
Superior-temporal cortex	Is the seat of spatial awareness; plays a role in auditory processing; subserves language processes	review by Karnath H-O, 2001
Left insula	Integrates representations of external sensory experience and internal somatic state	Augustine, 1996; Critchley et al., 2004

Table 5. *(Continuation).*

Brain areas	Functions	References
Limbic system		
Anterior cingulate cortex (ACC)	Is involved in motivation control; monitors the consequences of actions; is involved in the regulation of autonomic processes; encodes cognitive and emotional demands	Ito et al., 2003; Luu & Posner, 2003; Davis et al., 2005
Left ACC	Reflects goal-relevant control demand	Fincham & Anderson, 2006
Left dorsal ACC	Reflects emotional awareness associated with the interoceptive detection of emotional signals;	Lane et al., 1997a,b, 1998
Posterior cingulate cortex (PCC)	Is activated during moral judgment tasks; implicated in the processing of positive and negative emotionally; has the evaluative functions which include the monitoring of sensory events and of the organism's own behaviour in the service of spatial orientation and memory; is involved in visuospatial processing (orientation within and interpretation) of the environment; is associated with the representation (monitoring) of the world around, and possibly within, us;	review by Raine & Yang, 2006; Maddock et al., 2003; Maddock, 1999; Vogt et al., 1992
Amygdala	Is activated during moral judgment tasks; performs a primary role in the processing and memory of emotional reactions; associates sensation with reward or punishment;	review by Raine & Yang, 2006
Right amygdala	Is activated during the unconscious processing of emotionally (negative) expressive stimuli	Morris et al., 1999
Hippocampus	Plays a role in memory and spatial navigation; and in the acquisition and recall of declarative memories and recalling affect-related information; processes recent memory;	Eichenbaum, 2000; Markowitsch et al., 2003
Hypothalamus	Is the source of many of the most elemental emotions: hunger, thirst, chills, etc. -- ultimately pleasure & pain	
Thalamus	Plays a critical role in perceptual processing; provides a behaviourally relevant, dynamic control over the nature of information relayed, and also plays a key role in basic cortico–cortical communication	Sherman & Guillery, 2005; Sherman, 2005
Caudate nucleus	Is associated with positive emotions such as happiness, romantic love, and maternal love; active during reward-related tasks and motivation-dependent responses	Damasio et al., 2000; Bartels & Zeki, 2000, 2004; Delgado et al. 2000, 2003
Right caudate	Is activated in the object working memory task	Levy et al., 1997
Left caudate	Is activated in the spatial working memory task; plays a universal role in monitoring and controlling the language in use	Levy et al., 1997; Crinion et al., 2006
Temporo-parietal junction	Plays a critical role in false belief attribution; is involed in a semantic processing; and specifically in reasoning about the contents of another person's mind	Saxe et al., 2004; Saxe & Wexler, 2005; Saxe & Kanwisher, 2003
Parietal cortex	Is involved in the perception of spatial relations which are of a holistic or gestalt nature; stores long-term memory;	Newberg et al., 2001
Posterior superior parietal lobule (PSPL)	Allows us to orient ourselves in space, that gives us a sense of boundary between ourselves and the rest of the world; involved in higher order visual, auditory, somatosensory information;	Newberg et al., 2001; d'Aquili, 1993
Right PSPL	Is associated with the absence of a sense of self	Newberg et al., 2001
Left PSPL	Exerts influences in regard to objects that may be directly grasped and manipulated	Newberg & d'Aquili, 2000;
Medial parietal cortex	Plays a profound role in sustaining reflexive evaluation of thought; in "perspectivity," bodily processes contributing to ones point of view; in action planning;	Azari et al., 2001; Taylor, 2001; Ruby et al., 2002
Ipsilateral superior parietal lobule (SPL)	Is involved in the spatial perception of self;	Neggers et al., 2006
Inferior parietal lobule (IPL)	Plays an important role in motor imagery; is responsible for generating abstract concepts and relating them to words; is involved in conceptual comparison;	Decety, 1996; d'Aquili, 1993
Left IPL	Is implicated in the processing of visuospatial representation of bodies;	Felician et al., 2003
Right IPL	Is crucial in the process of self/other distinction;	Ruby & Decety, 2003
Angular gyrus	Activated in moral judgment tasks; in the level of abstractness/concreteness of 1st person reflection (personality traits versus physical traits); pays role in "perspectivity," bodily processes contributing to ones point of view; in action; planning;	review by Raine & Yang, 2006; Taylor, 2001; Kjaer, et al., 2001; Ruby et al., 2002
Occipital cortex		
Extra-striate visual cortex (MOC and LG)	Is implicated in visual mental imagery	Ganis et al., 2004
Left brainstem	Maps the organism's internal state during emotion;	Damasio, 1999

Even though the analysis of Table 4 has revealed that the prefrontal cortex (especially polar/medial/ventral prefrontal cortex) and temporal cortex (especially ventromedial temporal cortex) are more likely to be activated during religious experience, and the parietal cortex (especially posterior superior parietal lobule) is more likely to be deactivated during religious experience, there is no evidence whatsoever that specific brain regions or mechanisms are devoted to religious experience per se. If we draw on the schematic brain all brain areas or structures which have been ever reported to be involved in religious experience, then we can see that virtually all the brain is involved in (Fig. 1).

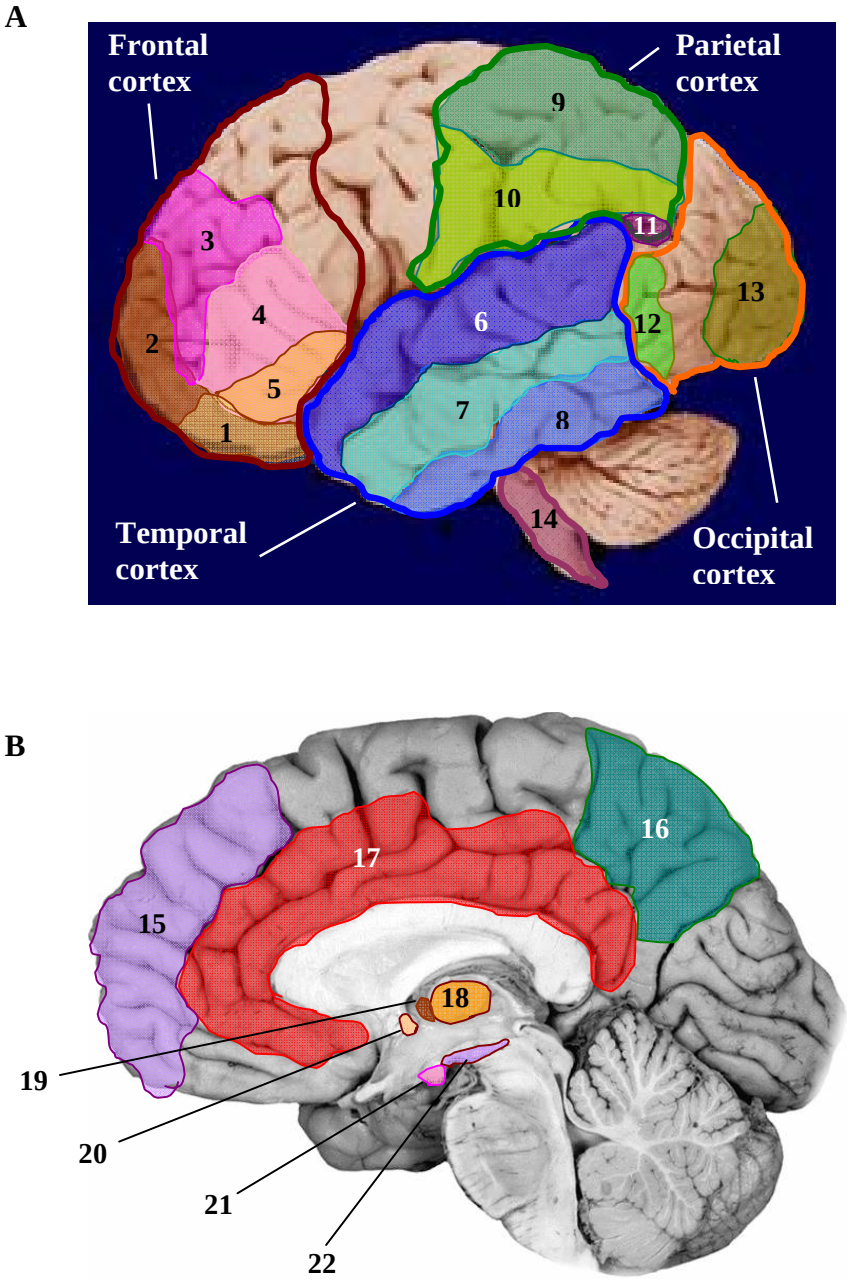

Figure 1. Schematic presentation of brain cortex areas and other structures which were reported to be involved/(de)activated during religious/spiritual/mystical experiences.

(A) Lateral surface. Frontal cortex (brawn outline): 1. Medial orbitofrontal cortex (MOFC); 2. Prefrontal cortex (PFC); 3. Dorsolateral PFC; 4. Ventrolateral PFC; 5. Inferior frontal cortex. Temporal cortex (blue outline): 6. Superior-temporal cortex; 7. Middle temporal cortex (MTC); 8. Inferior temporal lobe (ITL). Parietal cortex (green outline): 9. Posterior superior parietal lobule (PSPL); 10. Inferior parietal lobule (IPL); 11. Angular gyrus; 12. Temporo-parietal junction; 13. Occipital cortex (orange outline): Extra-striate visual cortex (MOC and LG). 14. Brainstem.
(B) Medial surface: 15. Medial prefrontal cortex (MPFC); 16. Medial parietal cortex, 17. Cingulate cortex (anterior and posterior); 18. Thalamus; 19. Hypothalamus; 20. Caudate nucleus; 21. Amygdala; 22. Hyppocampus.
Not shown: Ventromedial temporal lobe and insula.

Thus, *religious experience does not involve a specific neural system and probably requires joint activation of a family of systems each of which is usually involved in non-religious contexts*. This conclusion is in line with the work of Azari et al. (2001b). It is also consistent with the work of Fingelkurts and Fingelkurts (2001, 2005, 2006) who advocate that phenomenal experiences are reflected in meta-stable patterns of neuronal interconnectivity among brain areas and systems.

(b) The formulation of argument (1) is weak because the findings on which it is based are correlative in nature, and as such, they tell us nothing about the cause-consequence relationships. Thus, if brain activity changes during religious experience, it is not clear whether the brain activity caused that experience or responded to that experience (Newberg and Lee 2005).

Argument 2: The right hemisphere is involved more than the left in the reception and production of religious experience (for the references, see Table 6). For known functions of the brain hemispheres see Table 7.

Table 6. Survey of brain laterality during religious experience.

References	Involvement/ dominance of the RIGHT hemisphere	Involvement/ dominance of the LEFT hemisphere	NO laterality
Runehov, 2004	+		
Fenwick, 1987	+		
Ehrlichman & Wiener, 1980	+		
West, 1987	+		
Ornstein, 1972	+		
Persinger, 1993	+		
d'Aquili & Newberg, 1993	+		
review by Joseph, 2001	+		
Lehmann, et al., 2001	+		
Persinger & Makarec, 1987	+		
Persinger, 1993	+		
Ruby & Decety, 2003	+		
review by d'Aquili, 1993	+	+	
Newberg et al., 2001	+	+	
review by Boyer, 2003	+	+	
Beauregard & Paquette, 2006	+	+	
Bear & Fedio, 1977		+	
Aftanas & Golocheikine, 2001		+	
Kohlmetz et al., 2003		+	
Britton & Bootzin, 2004		+	
Gazzaniga, 2005		+	
Bennett & Trinder, 1977			+
Pagano & Warrenburg, 1983			+
Schuman, 1980			+

Table 7. Known functions of the brain hemispheres.

Brain hemispheres	Functions	References
Left-hemisferic (LH) predominance	The prepositional, verbal left hemisphere associates with the rational "I"; contributes to dreaming and some hallucinations; creates beliefs; is connected to verbal material, signs, symbols, and writing stereotypes, all of which provide verbal communication; contains metrical space of visual images organized as their "alphabet" equally in different people; built isolated elements of integrative structures of the human activity; has the consecutive analysis of information, whether verbal or nonverbal	review by Previc, 2006; Fischer, 1971; Gazzaniga, 2005; Sperry et al., 1969; Gazzaniga, 1970; Nevskaja & Leushina, 1990; Gribov, 1988; 1992; Gordon, 1978
Right-hemisferic (RH) predominance	The intuitive non-verbal right hemisphere associates with the "self"; easier than the LH, elaborates associations between images of different objects, differentiated by the exterior form or by the structure; is connected to nonverbal material, namely: perception of nonverbal images; melodies, intonations; space and body position orientation; visual field dependence; identification of complicated patterns (such as human faces); performance of kinesthetic functions etc; stores the characteristics of complete images – comparison standards, and retains individual structural information on them; integrats isolated elements – connects them into adequate "right now" working configurations; simultaneously processes of many elements of information	Fischer, 1971; Gazzaniga, 1970; Levy & Trevarthen, 1976; Sperry et al., 1969 Nevskaja & Leushina, 1990; Gribov, 1988; 1992; Gordon, 1978

Comments:

A detailed analysis of the literature available (see Table 4) has revealed *no consistent inter-hemisphere prevalence of one particular brain area during religious experience*. This is consistent with the comments on argument (1). Taken together, our commentary on arguments (1) and (2) indicate that religious experience is not *determined* by but rather is *accompanied* by changes in particular brain areas and systems depending on the practice and situation which give rise to this experience.

Argument 3: Electrical brain activity is altered during religious experience: research has shown large amounts of high amplitude alpha and theta waves[14] during the religious experience especially in the prefrontal and parietal areas (Corby 1978; Lobusov et al. 2001; Takahashi et al. 2005; for the review, see Cahn and Polich 2006). Moreover, increased alpha-theta range coherence[15] among recording sites has been observed intra- and inter-hemispherically during religious experience (Dillbeck and Bronson 1981; Badawi et al. 1984; Gaylord et al. 1989; Travis and Wallace 1999; Aftanas and Golocheikine 2001; Travis 2001; Faber et al. 2004; Hebert et al. 2005).

Comments:

In spite of almost 50 years of electroencephalographic (EEG) studies of religious experience, *no clear consensus about the underlying neurophysiologic substratum of religious experience has emerged*. Also see the last comment for the argument (1).

[14] *Alpha* (the frequency range of 8–12 Hz) and *theta* (the frequency range of 4–8 Hz) waves are electromagnetic oscillations arising from synchronous and coherent (in phase) electrical activity in the human brain.
[15] *Coherence* is a measure of the dependence of two random variables.

Argument 4: Chronic hyper-stimulation of particular brain areas can induce an individual to become hyper-religious or visualise and experience a divine being (Makarec and Persinger 1985; for the review, see Joseph 2001).

Comments:

This argument lacks an explanation why such stimulation should necessary induce religious experience. To our knowledge *stimulation of brain areas may evoke experiences with different contents (not necessary religious) as well as brief flashes of previous ordinary experience* (Jasper and Penfield 1954).

Argument 5: Often religious experience is a manifestation of such psychopathological disorders as temporal-lobe epilepsy, schizophrenia, bipolar disorder and obsessive-compulsive-disorder (for the references, see Table 1).

Comments:

There is enough *evidence to rule out psychopathology as an adequate explanation of religious experience* (Mandell 1980; Wright 1989). See Section 5 for a clear distinction between spiritual pathology and non-pathological religious experience.

Argument 6: It has been reported that activation or deactivation of the neuromediator's systems of the brain such as the dopaminergic, acetylcholinergic, serotoninergic, glutamatergic, and opioid systems gives rise to religious experience (for the references, see Tables 2, 8). The known functions of neuromediator's systems of the brain can be found in Table 3.

Table 8. Neurochemestry and religious experience.

	Dopaminergic system	Serotonergic system	Acetylcholinergic system	Opioid system
Kjaer et al., 2002	A			
Comings et al., 2000	A			
Krummenacher et al., 2002	A			
Shaner, 1999	A			
Previc, 2006	A	DA		
Borg et al., 2003		DA		
Fallon et al., 1990		DA		
Perry & Perry, 1995			A, DA	
Sarter & Bruno, 1998			A, DA	
Roth et al., 2002				I

I = Involvement; A = activation; DA = deactivation

Comments:

It seems that all the main neuromediator's systems in the brain are involved (except the noradrenalinergic system) in religious experience. It means that *religious experience does not involve a specific neuromediator's system and probably requires joint activation of a family of systems each of which is usually involved in non-religious contexts*.

Argument 7: Several psychotropic drugs (for a list of drugs and references, see Table 2) can lead to religious experience.

Comments:

There is enough *evidence to rule out psychopharmacology as an adequate explanation for religious experience*. See Section 5 for a clear distinction between pharmacologically induced spirituality and non-pharmacological religious experience.

Argument 8: Religious experience is just the brain's interpretation of its own residual or random activity (d'Aquli 1993; Sperber 1996; Boyer 2001). In another words, inadequate activation of different brain areas or structures causes different and unusual sensations and consequently unusual experiences. The failure to anchor these perceptions with feedback from the external world can lead to bizarre consequences which are interpreted as religious experience.

Comments:

This is the most common and 'favourite' argument used by neuroscientists. In our opinion this argument is weak for the following reasons:

Why should the interpretation be of a religious nature in the first place?

(a) For example, similar or the same unusual (bizarre)[16] experiences in the dreams are very rarely interpreted as being of a religious nature. On the contrary, they are considered natural and without any religious content.

Indeed, a content analysis of 16,000 reports of dreams (Krippner et al. 2001) demonstrated that religious and spiritual elements are generally extremely infrequent in dreams: only up to 2% of the dreams reports mentioned religious places, denominations, concepts or objects. At the same time, bizarre elements occurred in the dreams much more often than religious and spiritual elements. Thus, content analysis of dreams revealed 14-84.2% occurrence for bizarre elements in dreams (Rechtschaffen et al. 1963a,b; Cicogna et al. 1998; Kahn et al. 2000).

[16] Bizarre objects/actions/persons etc. are defined as not existing or as impossible in waking-life reality (States, 2000)

Thus, the significant difference in the occurrence of religious (up to 2%) and bizarre (up to 84%) elements in the dreams suggest that bizarre elements in dreams are not usually interpreted by the brain as religious. Therefore, similarly *bizarre experiences in an awake state should not be necessarily interpreted by the brain as religious*.

(b) There are many experiences that are epistemologically similar to religious experience but nevertheless they do not give rise to religious interpretations. As one example let us look at extrovertive experiences (Marshall 2005). Like religious experience it tends to be characterised by one or more of the following: profound sense of unity, profound sense of knowledge or profound sense of contact with reality. However, this experience is distinguished from religious experience by its orientation towards the natural world. In extrovertive experience, such features as unity, knowledge, reality, love, luminosity and so forth, characterize experience of the natural world, but not the experience of something beyond the natural world such as a transcendent God, soul, or divine realm.

Comments (a) and (b) lead one to the conclusion that *"interpretation argument" for explanation of religious experience should not be considered as the main one*.

Argument 9: Fischer (1971) argues that religious experience results simply from the loss of cortical "freedom" to interpret subcortical activity.

Comments:

It is well known that subcortical activity in animals contributes to behaviour to a larger extend than in the humans. Considering this fact and Fischer's argument, one would expect much more religious experience and behaviour in animals. However, we do not have any evidence of religious experience or behaviour in animals (see also Rolston 2005).

Argument 10: Proudfoot (1985) claims that religious experience is not a result of "direct perception," because interpretation plays a role in it. For Proudfoot, religious experience is shaped by doctrine and belief. He argues that religious experience arises only through our cultural contexts. This is in line with the view of Wuthnow (1992). Proudfoot suggests that without religious language one could not have a religious experience (Proudfoot 1985). Thus, he posits that there is no experience that is prior to language.

Comments:

Even though cultural contexts do affect individual experiences, concerning religious experience this position fails to consider seriously the following:

(a) Why should the interpretation be exclusively of a religious nature? Within the same culture and religious doctrine such experiences (which are epistemologically similar to religious experience) as bizarre experience in the dreams and extrovertive experience (see above) are not interpreted as religious.

(b) Within the same culture and religious doctrine (i) not all religious persons claim to have had religious experiences (Saver and Rabin 1997); (ii) non-religious persons (atheists) have reported having religious experiences (Hood et al. 1996; Robinson 2000); (iii) religious experience may also arise spontaneously in the most prosaic of circumstances, outside any tradition of religious doctrine and practice; (iv) despite the fact that vast majority of people were raised and educated in absolutely atheistic environment in Soviet Union (which lasted 70 years), many people still had a religious experience (Katz 1971).

"Cultural interpretation" position also fails to account for empirical evidence indicating that:

(a) There is a genetic contribution to the tendency of a human to have a religious experience (Waller et al. 1990; D'Onofrio et al. 1999a,b; Eaves et al. 1990; Eaves 2004) and genetic variation contributes up to 50% of individual variation in religiosity (Bouchard et al. 1990);

(b) Young children whose parents are atheists may have religious experience (Evans 2000, 2001) and their religiosity may persist without any specific or robust cultural input (Kelemen 2004; Kelemen et al. 2005);

(c) If we consider the individual's first religious experience, then it is difficult to find something in the individual's past non-religious experience what can directly serves as an explanatory model;

(d) Available (but limited) data (see above) suggests that religious experience appeared almost simultaneously with such pre-cultural phenomena as language, drawings and rituals (Logan 2006). However, it is much earlier the time when culture starts to exert its own strong influence on the way the individual perceives his/her environment and shapes his/her experience.

In the light of these deficiencies, the "cultural interpretation" position suffers from limited phenomenological adequacy. Thus, one can conclude that *ones own religious experience is most likely not an interpretation conditioned by cultural/environmental pressure*.

Considering the comments on arguments (8), (9) and (10) the "interpretation argument" should not be included as the main explanation of religious experience.

Argument 11: Religious experience is a by-product of ordinary cognitive functions (Boyer 2001, 2003).

Comments:

(a) All basic cognitive functions of humans (perception, attention, memory and others) are the same (or are analogous) in non-human animals (Baars 2005; Watanabe and Huber 2006). Moreover, several cognitive universals are common for humans and animals (Norenzayan and Heine 2005). These cognitive universals are: (i) quantity estimation – it does not require culturally invented counting systems, it appears in early infancy, and it is shared by other non-linguistic higher primates; (ii) the exposure effect, or the tendency to experience increased positive affect towards familiar objects relative to unfamiliar ones – this robust affective phenomenon can emerge without any conscious awareness, it is impervious to reasoning processes, and it is evident across species; (iii) social facilitation, or the finding that the presence of others can facilitate performance of a dominant (well-learned) behaviour and inhibit performance of a nondominant (poorly learned) behaviour – this effect is mediated by physiological arousal and occurs widely in the animal kingdom.

Considering these facts and explanation of religious experience as a by-product of ordinary cognitive functions one should conclude that animals should have a religious experience too. However, we do not have any evidence of religious experience or activity in animals (see also Rolston 2005).

(b) It may be the case that 'religious representations' are not acquired in quite the way Boyer claims. It may turn out that the religious concepts that Boyer describes as 'acquired' are essentially innate. Recall innate intuitive theism of young children (see Section 4).

Thus, the *"by-product argument" cannot be considered as the principal explanation of religious experience*. However, complex cognitive processes are most likely involved in religious experience (Newberg et al. 2001a,b; Azari and Birnbacher 2004) in the same way as they are involved in any other subjective experience.

Argument 12: As cognitive mechanisms that support religious (as well as any other) experience are error-prone, they cannot be trusted to give us Truth (Boyer 2001; Atran 2002). As we cannot trust these aspects of our minds to give us Truth, we cannot trust most of our religious experience.

Comments:

The treatment of this argument we borrow from Barrett (2007): "The cognitive sciences have given us evidence that our minds – for the sake of survival – can be systematically fallible, trading survival and reproduction for accurate representations of reality. On what basis then do we trust our minds at all? Our minds cannot be trusted to tell us that gods exist, that other human minds exist,

that our memories are reliable, or that natural laws remain the same from moment to moment, or that cognitive science can produce accurate findings or that evolution is true. The Error-Prone Mind argument proves to be self-defeating – it has a Suicidal Tendency" (for detail treatment, see Barrett 2007).

Argument 13: People's actual religious concepts often diverge from what they believe they believe (Barrett and Keil 1996).

Comments:

Religious concepts and beliefs should be distinguished from religious experience (see Section 2). Several pieces of evidence support this position: (a) Non-religious persons have reported having religious experiences (Hood et al. 1996; Robinson 2000); (b) church attendance has proven to be unrelated to religious experience (Makarec and Persinger 1985) and finally (c) not all religious persons actually claim to have had religious experiences (Saver and Rabin 1997).

Argument 14: One of the main reasons for the existence of religious experience is innate people's search for causal explanations and organizing the world in a meaningful and consistent fashion to impose order and predictability on it.

Comments:

Because the same reasons also apply to scientific work, the explanatory power of this statement for religious experience is weak.

Argument 15: Viewed objectively and dispassionately, personal experience of God does not constitute appropriate scientific evidence of God's presence or existence.

Comments:

We agree with this argument. However, we would like to mention that realities that are independent of human existence but not embodied in physical form do exist (Ellis 2001): at least part of mathematics (e.g. prime numbers, Gödel's incompleteness theorem) was discovered, not invented.

8.1.1. Concluding remarks

It follows from this brief critical review of the arguments for a "producing" point of view that observed neuroscientific arguments tell us nothing about the true nature of religious experience or God. The reviewed results of neuroscience neither prove a "producing" point of view nor disprove a "perceiving" point of view. Therefore, the only conclusion from observed neuroscientific studies is that religious experience is *reflected* in brain activity and that the brain somehow *mediates* some aspects of religiosity.

Additionally, neuroscience may eventually help researchers to explain the human ability to express and understand God.

8.2. Arguments for a "perceiving" point of view

The "perceiving" position (sometimes it is referred as theological) can be summarised as follows: our brains have the capacity to perceive God, and since our brain is designed to attune us to reality, this points to the likelihood that there is a God.

The followings are the main arguments for this position:

Argument 1: If the human brain enables humans to have religious experience, to perceive and believe in God, then it should be a reason for this experience (Joseph 2001).

Comments:

Religious experience may co-evolve with any other human phenomenon (for example, DA-mediated abstract reasoning, Previc 2006) which increases the survival of the organism. On the other hand, religious experience and practice themselves may have a protective effect on human communities and thus may also increase their survival (see Section 7).

However, this reasoning tries to explain how religious experience has been preserved in human evolution but not the reason for the origin of religious experience. Clayton (2006) speculates that human perhaps have religious experience because we live in a universe that is open to transcendence, a universe that is the product of a cosmic order. Indeed, studies of modern primitive tribes have shown that *it is not a reflection and not a philosophy that drove the first people, but irrational intuition*: they saw world full of spirits not because they thought about this world and tried to interpret it, but because they perceived mysticism in nature (Menn 1997).

Argument 2: Religious experience in the general population is negatively associated with psychoticism, depression and other illness (Batson and Ventis 1982; Francis and Wilcox 1996; Maltby 1997; Roman and Lester 1999). Additionally, there does not appear to be a positive correlation between psychosis among religious practitioners in general (Spencer 1975).

Comments:

This argument stresses that *religious experience in the vast majority of individuals is associated with non-pathological brain activity*.

Argument 3: There is no evidence that specific brain regions or mechanisms are devoted to religious activity per se (see Section 8.1., comments for the argument (1)).

Comments:

This means that *religious experience cannot be reduced solely to particular brain activity*.

Argument 4: A religious experience is invariably perceived as being more real than the baseline reality of everyday life (for a discussion of this issue, see Newberg and Lee 2005).

Comments:

This means that *religious experience should be distinguished from other altered states of consciousness such as dreams, drug-induced states or psychotic hallucinations with religious content*.

Argument 5: Having consciousness (as an emergent property of a complex neurophysiological system; Revonsuo 1995, 2001) humans exercise a form of causation distinctive from physics: conscious agency which can be described by means of 'circular causality' (Varela and Thompson 2003).

Comments:

Indeed, humans are driven not only by survival and reproduction but also by complex sets of insights, goals and beliefs (Beauregard 2007). According to Clayton (2000) conscious agency would in principle allow *God to influence human thoughts and motives at the same mental level that other persons influence them*.

Argument 6: The mental level is dependent on, yet not reducible to, the physical level. In other words, there are mental causes that are not themselves a direct product of physical causes (Clayton 1999).

Comments:

This means that (a) mental level represents a type of property, not a new form of substance, (b) mental causation does not involve the addition of new energy into physical systems, and (c) mental causation is not supernatural, it is natural (see Clayton 1999).

Argument 7: A recent review of neuroimaging studies (Beauregard 2007) has demonstrated that mental causation does exist: (a) The results of neuroimaging studies into the conscious and voluntary regulation of various emotional states (sexual arousal, sadness, negative emotion) show that metacognition and cognitive recontextualisation selectively alter the way the brain processes and reacts to emotional stimuli; (b) The results of neuroimaging studies into the effect of psychotherapy in patients suffering from diverse forms of psychopathology (obsessive-compulsive disorder, panic disorder, unipolar major depressive disorder, social phobia, arachnophobia, borderline personality) indicate that the mental functions and processes involved in diverse forms of psychotherapy exert a significant influence on brain activity; (c) The results of neuroimaging investigations into the

placebo (Beauregard 2007) and nocebo[17] (Dworkin et al. 1983; for the review, see Benedetti et al. 2007) effects in healthy individuals (placebo analgesia[18], psychostimulant expectation) and patients with Parkinson's disease or unipolar major depressive disorder demonstrate that beliefs and expectations can markedly modulate neurophysiological and neurochemical activity in brain regions involved in perception, movement, pain and various aspects of emotion processing.

For a review on mind-mind interaction effects and resent results, see the work of Wackermann (2004 and also see Seiter 2002); for mind-matter interaction, see Radin and Nelson (2002).

Comments:

Collectively, these findings strongly support the view that (a) the subjective nature and the intentional content (a first-person perspective) of *mental processes (e.g., thoughts, feelings, beliefs and volition) are neither identical with nor fully reducible to brain processes*; (b) that *mental processes or events do exert "downward" causal influence on brain plasticity and the various levels of brain functioning* (e.g., molecular, cellular and neural circuit) (Varela and Thompson 2003; Beauregard 2007; Benedetti et al. 2007); (c) *mind-matter interaction and mind-mind interaction effects may exist* (Wackermann 2004; Radin and Nelson 2002; need to be reproduced and investigated further). However, mental processing does not occur without concurrent physical activity in the brain.

Argument 8: There are evidences that the religious experience, religiousness and prayer are positively correlated with health (mental and physical) and self-actualisation (Byrd 1988; Kune et al. 1993; Matthews et al. 2000; Cha et al. 2001; Abdel-Khalek and Lester 2007; Liebovici 2001; for the reviews, see Braam et al. 2001; Koenig and Cohen 2002; Koenig et al. 2001; Marks 2005).

Comments:

Perhaps the *religious experience offers some protection ("downward" causal influence) against certain types of mental and physical illness* what provides additional support to the previous comments relating to argument (7).

[17] The *nocebo effect* is a phenomenon that is opposite to the placebo effect, whereby expectation of a negative outcome may lead to the worsening of a symptom.

[18] *Analgesia* is a loss of sensation of pain

8.2.1. Concluding remarks

It follows from this brief critical review of the arguments for the "perceiving" point of view that evolution managed to evolve an organ – the brain – capable not only of reflecting on itself but of experiencing something higher than itself (see Newberg et al. 2001a,b). This became possible due to the emergence of a form of causation distinctive from physics: mental/conscious agency which (a) is neither identical with nor reducible to brain processes, (b) which exerts "downward" causal influence on brain plasticity and the various levels of brain functioning. However, the presented review while not proving a "perceiving" point of view not disproves it either.

To progress further one needs to overcome conceptualisation problem and to establish methodologically adequate research program.

9. The problem of conceptualisation

As it follows from critical review of the arguments for both the "producing" and "perceiving" points of view *the main empirical question "Is our brain hardwired to believe in and produce God, or is our brain hardwired to perceive God?" remains unanswered*. Indeed, the previous two sub-sections have shown that both points of view on Brain-God problem are legitimate. Each offers some insight regarding this issue. However, neither one, by itself, simultaneously takes into account both sides (e.g., Brain-God), as they are unified in subjective experience (and brain processes that support it). Therefore, we argue that neither description, in isolation, is satisfactory. It seems that at least a part of the problem is based on wrongly chosen levels of description and explanation. We believe that the appropriate level should articulate integration of subjective experience, cognitive processes, and large-scale brain activity which relates to phenomenological level of subjective experience (Wildman and Brothers 1999; Fingelkurts and Fingelkurts 2001, 2005; Fingelkurts et al. 2009).

As is apparent from the previous sections, the problem of conceptualisation arises when researchers attempt to reduce religious experience solely to brain activity based on a misinterpretation of their own results. It is implicitly or explicitly assumed in such attempts that religious experience is a by-product of brain or cognitive processes. Theologians, on the other hand, often reject the importance and relevance of biology for explanation of religious experience. We do not agree with these views for several reasons (based on the reviews presented in the previous sections).

First, religious experience (a) is a real, natural, normal, world-wide, universal among cultures, permanent in human history, heritable (but not inherited) phenomenon, (b) is reflected in (or even partially instantiated by) brain activity, and (c) exists in all stages of individual development (from infancy through adolescence and into adulthood). Second, religious experience (a) does not depend directly on the brain anatomy or specific brain regions, on culture and environment, (b) is not the outcome of psychopathology or psychopharmacology, (c) is not a brain interpretation of its own states, and (d) is not a (sub)cortical activity or by-product of ordinary cognitive functions.

Moreover, religious experience exists only in humans (there are no any evidences of religious experience or activity in animals whatsoever) (see also Rolston 2005). At the same time, only humans have developed a form of causation distinctive from physics: conscious agency (see above). This means that humans are driven not only by survival and reproduction but also by complex sets of insights, motives, intentions, thoughts and beliefs. These mental processes and events do exert a "downward" causal influence on physical processes (brain plasticity and the various levels of brain functioning) but are not themselves a direct product of physical causes. This would in principle allow divine influences on human thoughts and motives at the same mental level that other persons influence them.

Generalising about the data described in this paper, it should be suggested that the potential for religious experience is an innate biological characteristic. Development of this characteristic is a biosocial issue, and the realisation of religious experience is a psychobiological issue. Thus, all this makes it suitable for "bridging" biology and theology to describe and later to explain religious experience.

Each of the descriptions of religious experience has usually been tackled separately, not simultaneously by the researchers. This is inherently implausible and requires significant over-simplification. What emerges in the human case is a particular psychosomatic unity, an organism that is capable of both mental and physical things (Clayton 1999). Therefore, an understanding of human nature in its *unity* (not just as a mixture of brain/body/matter and consciousness/mind/spirit) is of scientific and theological importance. Thus, perhaps the most promising research framework for the investigation of religious experience is an integrated one (within a single experimental study) that utilizes the reality of the multiple levels and dimensions of human existence (physical, biological, psychological and spiritual reality), allowing consciousness/mind/spirit and brain/body/matter to be seen as different sides of the same phenomenon, neither reducible to each other. Such a general theoretical framework may allow researchers to handle in a plausible manner an enormous amount of diverse observations related to the brain, mind and spiritual phenomena.

10. Integration of theological and neuroscientific points of view

Theological and neuroscientific views are two quite different ways of looking at and describing the world, and at first glance, there is no direct link or correspondence between them. This apparent barrier can only be traversed by developing an explanatory common framework (or reference). This requires an explanation using phenomena within the same conceptual continuum. In our opinion such a common conceptual framework could be found[19].

Let us start with a theological point of view.

Starting from ancient Egyptians (Fergus and Lothian 1997), early pre-Pythagoreans (Rohde 1925), Epicureans and Stoics, and also by Plato, Aristotle and Plotinus (King 2005) the body and soul were considered as complimentary parts of the same unified whole entity[20], – living human being (Klima 1984; King 2005). In Judaism (Youde 2003), Christianity (including present Christian Catechism[21]) and Islam (Muhammad Ali 2002) the human being is understood as a unified trinity of Spirit (God's breath), soul and flash/matter. From this trinity at least one ingredient – human matter (brain) – is obviously a natural/objective phenomenon in the physical world which has a biological nature; therefore it can be (and is) readily studied scientifically within neuroscience and has been given the least attention in theological literature. On the contrary, Spirit and soul are not at all scientific concepts, – their origins lie in a theological point of view.

Theology assumes that Spirit is not the reality of the physical universe, but rather is the reality of freedom, it is the world-*for-itself*. It is not an object, and therefore the reality of Spirit is not the reality of objects. Hence, theology concludes that in the physical universe there is no such object and/or objective reality which we could call Spirit (Berdyaev 1937). That seems to be a fundamental mystery. In the light of the above considerations, it is obvious that Spirit (as an ingredient of the human being) is inexplicable within the scientific paradigm, but nevertheless it can be perceived and cognised through the process of *objectification* when the Spirit is revealed in the subject[22].

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[19] However, we understand and accept that there may be some aspects of the relationship between spiritual (Divine) and brain (Physical) natures that will escape our understanding forever, but that should not stop us from trying still to understand it.

[20] Even though in the main stream Buddhism, Hinduism, Jainism and Chinese religious tradition there is similar understanding of body and soul interaction, generally these traditions contain many variant and inconsistent beliefs on the origin, purpose, and fate of the soul.

[21] A catechism is a summary or exposition of doctrine, traditionally used in Christian religious teaching from New Testament times to the present.

[22] In the other words, 'ideal' (as a subjective form) get realised in the matter as 'real' objective form.

In further discussion we will use the Genesis text as common scripture for three world religions (Judaism, Christianity and Islam). Considering the description in Genesis[23] (2:7), the following formula can be suggested (Gijsbers 2003): Body + God's breath (Spirit) = Living soul. Thus, the soul is the product of the Spirit-body interaction: Somehow, these two natures, although seemingly worlds apart, must be intimately connected. The human brain is that specific location in the physical universe where divine enters the human through a Spirit (Menn 1999) and manifests itself as a soul. More specifically, certain arrangements of physical matter in the brain (which have occurred in the course of evolution and ontogenesis) together with the Spirit (which is God's breath) cause the coming into being of something different – conscious soul.

Soul, according to majority of religious and philosophical traditions, is the self-aware essence unique to a particular human being, the unification of one's sense of identity, so called subjective world-*for-someone*. Ancient Greeks typically referred to the soul as psyche (Bremmer 1983), while ancient Muslim philosophers Avicenna and Ibn al-Nafis described the soul as a human self-awareness (Hossein Nasr and Leaman 1996). Buddhists also relate the ever-changing entity – mind or principle of "anatta" – with the cause of continuity of the human consciousness (Conze 1993). Hinduists and Jainists consider soul as either personality ("Jiva/Atman"), consciousness ("Jiva/Cetana") or knowledge/perception ("upoyoga"). Most Christians regard the soul as the seat or locus of human will, understanding and personality. In the same vein Richard Swinburne, a Christian philosopher of religion at Oxford University, states that soul is the subject of mental properties: it has sensations and thoughts, desires and beliefs, and performs intentional actions (Swinburne 1986). Indeed, the detail analysis of Western and Non-Western traditions (for the review, see Carter 2000) demonstrated that universally, and for as far back as we can trace (starting from the Hebraic and Greek terms), soul and consciousness have been closely associated[24].

Therefore, the 'soul' as it has been described formally from a theological point of view is the very same and precise description of the human mind with its consciousness as defined in cognitive neuroscience (and related scientific fields): Mind refers to the collective aspects of intellect and consciousness which are manifest in some combination of thought, perception, emotion, will and imagination. It is this subjective world-*for-someone* which would not have existed if this someone

[23] Genesis is the first book of the Bible used by Judaism and Christianity and to a large extend in Qur'an. It contains stories about the creation of the world and human being.

[24] Note that sometime the notions of "*soul*" and "*Spirit*" are used as synonyms. This may bring confusion and consequently may lead to a debate in the history of religions and in the history of the modern psychology. If the mentioned intermix is avoided, then rather a consensus, not a debate is present.

(matter) has not existed. As Revonsuo, a cognitive neuroscientist, writes "It is not a world of space-time, force fields, or subatomic particles we are talking about now, but a world of joys and sorrows, colours and sounds, thoughts and memories, embodiment and movement: a reality of lived experience and sensation. It is a world that, at the very least, senses its own existence, though it may not understand it or have the ability to conceptualise it as sensed existence" (Revonsuo 2006).

We would argue that soul (using the theological/religious terminology) and conscious mind (using the cognitive neuroscience terminology) are different descriptions of the very same phenomenon (for the review, see Carter 2000). Therefore, soul (read mind) can and should be studied scientifically within the cognitive neuroscience research program. We believe that it is the soul/mind phenomenon that is the shared (for the theological and neuroscientific points of view) fundamental reference which provides us with a starting point for a conceptual integration and unified research program.

Modern neuroscience no longer ignores the mind phenomenon and is progressively starting to address the mind-brain problem (for the review see Fingelkurts and Fingelkurts 2001): Physical ('objective') and mental ('subjective') processes are considered as two basic and complementary aspects of the same whole informational brain state (Fingelkurts et al. 2009). In this sense it is possible to come closer to understanding how something subjective has causal interactions with something objective.

Based on the above review of the existing literature and the proposed definition of religious experience, it is obvious that the human brain is the junction point of the material world and the world of ideas, the body and the mind, the objective and subjective (Fingelkurts and Fingelkurts 2004), the phenomenal organisation of the physical universe (Revonsuo 2006). The human mind (consciousness) is not just a reflection of physiological (internal) and physical (external) processes, but rather is a powerful active force: a mirror can not change creatively the object which it reflects, but the human mind is capable of this (see Section 8.2, argument (7) and comments on it).

In summary, the human mind appears as a partially isolated or partially independent pocket of thought and purpose, receiving its separate identity due to the constraining conditions of natural laws, the material composition of the individual brain, biological drive and genetics, and perhaps also through its own free agency (Clayton 2000). According to Clayton (2007) the emergence of the human mind in turn gives in principle the possibility for divine influences. In this scenario, no physical or natural laws are broken if there is an exchange of information between a divine source and conscious human agents: God could bring about changes in one's subjective thoughts, will and emotions the same way as the thoughts, will and emotions of other people do. Such influences do not require the addition of new causes or new energy into the system.

11. What can neuroscience offer?

It follows from this paper that religious experience is a complex subjective psycho-neuro-physiologic phenomenon. In order to understand and *explain* it fully we need to *describe* its physical, biological, psychological, sociological and spiritual dimensions. At the moment neuroscience can not provide a reliable *explanation* for religious experience (see above). However, already today cognitive neuroscience in a broad sense may contribute to an overall *description*[25] of religious experience with regards to biological and psychological dimensions. This is a very important task which needs to be performed before the reliable explanation for religious experience can be constructed. Therefore, currently there should be a methodological shift from "explanation" to "description." This will result in reduction of (a) misinterpretation of results, (b) desired logical speculations and (c) explanations which have limited phenomenological adequacy.

Considering "description" framework, neuroscience *can* specifically (a) identify neuropsychological components of the religious experience (describing what the brain is doing during a religious experience). By identifying the neuropsychological correlates of religious experience one can establish an objective, non-phenomenologically based but phenomenologically relevant definition of the religious experience; (b) demonstrate the reality of religious experience and show that religious experience is a complex state in its own right, which differs from other altered states of consciousness[26] such as dreams, or pathologically-, pharmacologically- or self- induced hallucinations; and (c) distinguish states and traits[27] components of religious experience.

In order to progress with a neuroscientific description of religious experience, several methodological issues should be addressed:

(1) It is important to find a way to register a true religious experience but not the other related phenomena such as religious practice or rituals, associated cognitive activity or pathologically or pharmacologically induced hallucinations. One possible solution may be to compare the state of

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[25] The terms "*description*" and "*explanation*" are used here according to a common sense: "Description" is about observable or empirical phenomena (it answers the question What?). "Explanation" – provides a mechanism of observable or empirical phenomena (it answers the question Why? – why the observable or empirical phenomena is like it is? It provides a mechanism).

[26] *Altered state of consciousness* - a changed overall pattern of experience coupled with a changed pattern at the neurophysiological level (Kallio and Revonsuo 2003).

[27] *State* refers to the altered sensory, cognitive and self-referential awareness that can arise during religious experience, whereas *trait* refers to the lasting changes in these dimensions that persist in the person irrespective of being actively engaged in religious experience (West 1987; Austin 1998).

a religious experience not to the subject's own baseline waking state but to a state which is induced by similar activity, however, without specific religious meaning (see, for example, Telles et al. 1998).

(2) It is important to choose appropriate level of neuroscientific description of religious experience. We believe that the appropriate level should articulate the phenomenal level of brain organization, and in particular, of cognition and consciousness (Revonsuo 2001). Recent work in different fields of cognitive neuroscience seems to support the idea that the "translation" from phenomenological/psychological constructs to brain activity should focus on the dynamic operations of large-scale cortical networks (see Edelman and Tononi 2000; Bressler and Kelso 2001; McIntosh et al. 2001; Revonsuo 2001; Varela et al. 2001; John 2002). Electroencephalography (EEG) is the correct measure to study the behaviour of large-scale neuronal networks, because it is a highly organized macro-level electrophysiological phenomenon in the brain, which captures the operations of large-scale cortical networks and which is remarkably correlated with behaviour, cognition and phenomenology (Nunez 2000; John 2001; Freeman 2003; see also recent detailed review Fingelkurts and Fingelkurts 2005; Fingelkurts et al. 2009). Behaviour, cognition and phenomenology in their turn have been supposed to be reflected in the temporal structure of EEG (see reviews Fingelkurts and Fingelkurts 2004; Kaplan et al. 2005). Moreover, among all non-invasive brain-imaging methods currently employed by Neuroscience EEG is (a) the method which measures brain activity directly in a millisecond time scale and (b) the most practical method with relatively simple, inexpensive and compact/portable equipment.

(3) It is important not only to correlate subjective (report on what was actually experienced by the individual) and objective (for example brain activity) measures, but also to use first-person reports to correlate internal experience with brain activity to guide EEG analysis (Varela 1996; Lutz et al. 2002).

(4) It is important to evaluate subjects on an individual basis because religious experience may vary phenomenologically across subjects. This permits researchers to reveal universal (common) and variable (individual) features of religious experience. Such findings may be important for science and be of interest to theology.

(5) Even though naturally occurring religious experience differs from a drug-induced one (see above), comparing drug-induced religious experience to naturally occurring religious phenomena

within one experimental paradigm may allow for a better distinction between pathological and non-pathological religious experiences.

(6) Considering that normal religious experience can occur in pathological and normal conditions and that pathologic religious phenomena can occur in individuals with or without psychopathological disorders (Newberg and Lee 2005), it is important to study religious experience in psychiatric and neurological disorders.

(7) Using a framework of the Operational Architectonics[28] of brain and mind functioning (Fingelkurts and Fingelkurts 2001, 2004, 2005, 2006; Fingelkurts et al 2009) and the phenomenon of functional isomorphism[29] (Fingelkurts and Fingelkurts 2001, 2004) as a base, it would be possible to study and systematically describe the phenomenal level of brain organisation which constitutes the mental phenomena associated with religious experience. As such, it would be possible to give a subjectively/phenomenalogically plausible neurophysiological description of mental phenomena which are so important for the description of religious experience.

We believe that fulfillment of these methodological requirements will result in adequate neuroscientific description of religious experience. Such neuroscientific description of religious experience together with biological, psychological, sociological, phenomenological and theological descriptions will bring us closer to explanation of religious experience (which should be the next phase in the understanding the religious experience) and to the answer on the question: "Is our brain hardwired to believe in and produce God, or is our brain hardwired to perceive God?"

12. The importance of the study of religious experience

Contrary to the immediate intuition, the study of religious experience has significant importance not only for theology and philosophy, but also for science and clinical practice.

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[28] *Operational Architectonics* defines the temporal structure of the information flow and the inter-area interactions within a spatial network of functional neuronal assemblies by examining topographic rapid transition processes (on the millisecond scale) in the scalp electroencephalogram (EEG) / magnetoencephalogram (MEG) and is a framework adequate to instantiate discrete conscious experiences without fundamentally violating the demand of its continuity (Fingelkurts and Fingelkurts 2006).

[29] *Isomorphism* is generally defined as a mapping of one entity into another having the same elemental structure, whereby the behaviours of the two entities are identically describable (Warfield 1977). A functional isomorphism on the other hand requires the functional connectivity between its component entities (Lehar, 2003). It is an extension to Müller's psychophysical postulate (Müller 1896), and Chalmers' principle of structural coherence (Chalmers 1995).

12.1. Importance for a scientific perspective

We agree with Newberg and colleagues that considering that religious experience is the only state where a person claims to have broken the bounds of his/her own human self-consciousness and come into intimate contact with ultimate reality, it is very important to study religious experience because that may be the only way of solving the problem of how to get outside the subjective mind (see Newberg and d'Aquili 2000; Newberg et al. 2001a,b). As such, the study of religious experience may shed new light on (a) mind, consciousness, self and reality, and (b) the relationship between phenomenological characteristics, brain states, body physiology and behaviour. Moreover, it will contribute to the development of (a) an appropriate definition of religious experience, (b) methodology and measurement techniques, and (c) methods of analysis in order to study subjective phenomena in general.

12.2. Importance for a clinical perspective

The results of a study into religious experience will help therapists to determine whether a patient is experiencing a normal religious phenomenon, a pathological one, or both. The therapist would benefit in having a clearer understanding of the neuropsychological processes involved in the religious experience in that he or she would be able to treat pathologies associated with the religious experience appropriately.

Moreover, considering similarities between religious experience and schizophrenic states with religious content (Buckley 1981), the state of religious experience is arguably the most valuable state for understanding the relationship between religious activity, extra-personal brain mechanisms and schizophrenia.

12.3. Importance for a theological perspective

The results of such studies may (a) help to gain a better and deeper understanding of religious experience, (b) to gain a better understanding of the doctrine of the image of God, and eventually (c) contribute to theological and philosophical conceptualisations. These studies will enhance human knowledge of how religious experience affects the mind, brain, body and behaviour (Newberg and Lee 2005).

12.4. Importance for a philosophical perspective

The results of a study into religious experience will provide evidence-based grounds for psycho-biologically relevant conceptualisations of religious experience and subjective phenomena in general (versus abstract ones).

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