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Spiritual experiences in temporal lobe epilepsy: a literature review

Niall McCrae and Samantha Elliott

Abstract

Profound spiritual experiences have been observed as a trait of temporal lobe epilepsy (TLE), as described in the Geschwind syndrome. This systematic review considers the evidence for ictal and interictal religiosity, and the neurological, psychiatric and cultural factors. Research in this area is at an early stage of development, with indications that a temporal focus is an important factor in spiritual experiences of epilepsy, albeit as a relatively rare and nebulous trait. The literature indicates that spiritual feelings may arise from a reciprocity of biological and psychosocial factors, but nurses should afford the possibility of a genuinely transcendent experience. Further research may help to explain whether the complex, partial seizures of TLE are a cause of abnormal religiosity or an accessory to spiritual enlightenment.

Key Words Epilepsy, religion, seizures, neurology, psychiatry, psychology

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An intriguing phenomenon in temporal lobe epilepsy (TLE) is the occurrence of mystical experiences around the time of seizure. Common to this form of epilepsy are partial, complex seizures entailing altered states of consciousness. Often described as 'absences', such fits typically last 2 or 3 minutes; the person remains awake but may become detached from reality. Russian novelist Fyodor Dostoyevsky described the aura that preceded his seizures as the pinnacle of ecstasy, with visions of heavenly perfection. Recurring ictal phenomena of divine content may lead to interictal personality changes. Transient images or voices of angels or a supreme being can have profound and enduring impact, in some cases spurring messianic zeal.

On observing pronounced religious expression in the afflicted, ancient Greek and Hebrew physicians declared epilepsy 'the sacred disease'. Hippocrates asserted pathological causation, but religious associations with epilepsy have persisted. Although such diagnoses cannot be confirmed, medico-psychological retrospect has attributed the intense spiritual experiences of various prophets, saints and gurus to seizures of temporal focus, including those of Buddha, Mohammed, Teresa of Avila and Mormon founder Joseph Smith. Other cases suspected of TLE include father of existentialist philosophy Søren Kierkegaard, and scientist and latterly Christian visionary Emmanuel Swedenborg (Temkin, 1971). A clear pattern to these cases may be discerned.

In the nineteenth century, religiosity was observed in asylum inmates labelled with epileptic insanity; Howden (1872) contrasted their piety and proclivity for unprovoked violence. After the introduction of electroencephalography (EEG), it was found that a disproportionate number of epileptic patients in mental hospitals had seizures of temporal lobe origin. A combination of temporal lobe focus, mental disturbance and religiosity was illustrated in psychiatric case reports (Bartlet, 1957). Slater and Beard (1963) reported mystical delusions in 26 of 69 epileptic patients with psychoses of schizophrenic presentation; in 6 of these cases, sudden religious conversion occurred, as in this 33-year-old dropout from medical training (Dewhurst and Beard, 1970, p500):

> **'He stopped taking his anticonvulsants; within six weeks he was having fits every few hours; he had become confused and forgetful. At this point he suddenly realised that he was the Son of God; he possessed special powers of healing and could abolish cancer from the world … "It was a beautiful morning and God was with me … God isn't something hard looking down on us, God is trees and flowers and beauty and love. God was telling me to carry on and help the doctors here."'**

Three years later this patient still believed that he was under the influence of a strange, possibly electrical power, through which God was revealing a virtuous path. The most legendary conversion was on the road to Damascus, where Paul, hitherto tormentor of Christians, was arrested by a vision; medical historians have explained this as a hallucinatory event of partial, complex seizure.

Alongside the adjacent limbic structures of the amygdala and hippocampus, the inner temporal lobe has been implicated in our sense of self. Building on

the seminal work of neurosurgeon Wilder Penfield, experiments by Michael Persinger indicated that most people are amenable to mystical experiences through micro-seizures induced by transcranial magnetic stimulation. Persinger (1987) saw this as evidence that God resides not in heaven but in neural networks. Encouraged by such findings, a specialism of neurotheology emerged. However, 'God helmet' effects appear superficial compared with spontaneous mystical occurrences, and the validity of Persinger's results was challenged by Granqvist et al (2005), who suspected suggestibility.

Seizures of temporal focus may be a naturalistic facilitator of spiritual phenomena. In the 1970s neurologist Norman Geschwind described a personality disorder in TLE comprising religiosity, compulsive writing and low sexual drive; patients display 'increased concern with philosophical, moral or religious issues, often in striking contrast to [their] educational background' (Geschwind, 1979, p217). The Geschwind syndrome links historical ideas about religious sentiment in epilepsy with current knowledge of the functioning of the temporal lobe and adjacent limbic structures. Trimble (1991) estimated its incidence at 7% of people with TLE, but the religiosity trait could be more common as neurologists do not routinely enquire into such beliefs or experiences. In their secular empiricism and standardised diagnostic practices, the disciplines of neurology and psychiatry are likely to pathologise or overlook unusual religious or quasi-religious experiences. While functional magnetic resonance imaging reveals neural correlates of intense spiritual feelings, it neither conveys the meaning for the patient nor refutes the ontological basis of faith.

In recent decades there has been much growth in the literature on spirituality in health care, but evidence of practitioners attending to this aspect of patients' lives is sparse. According to Paley (2007, p182), nurses rarely provide spiritual care, and when they do 'it is infrequent, inconsistent, unsystematic, and apparently uncomfortable'. Consequently, patients' spiritual world remains a private domain, and opportunities to understand the dynamics of mind, body and spirit are missed.

Enquiring into mystical experiences may not be a priority for nurses working with epileptic patients. Practical intervention is necessary to control seizures and maintain safety. However, nursing is not exclusively focused on physical needs. Queally and Lailey (2012) urged nurses to assess how patients felt before, during and after seizures, taking the opportunity to consider spiritual sensations beyond the confines of symptomology. Better knowledge of the infrequent but significant mystical phenomena of TLE would enhance nurses' understanding of patients' experiences, potentially informing developments in practice.

Aims

To systematically review empirical evidence of the relationship between TLE and spiritual experiences, and to discuss the implications for nursing.

Method

Studies of spiritual experiences in TLE were sought by electronic search of the databases Medline, PsychInfo, ATLA Religion and Cumulative Index to Nursing and Allied Health. Search terms were combined as follows: epilep* or seizure* or ictal or convuls* and delusion* or hallucinat* or psycho* and religio* or spiritual* or faith.

Inclusion criteria were reports of primary research on samples or multiple cases in English language, published in peer-reviewed journals in the period since the Geschwind syndrome was described (Waxman and Geschwind, 1975). Excluded were single case studies and reviews. Although the focus was on TLE, papers were included if samples of mixed types of epilepsy presented results specifically for temporal lobe cases. As spirituality and religion were not always mentioned in abstracts, papers were also examined that used other terms for metaphysical experiences during or following seizures (e.g. ecstasy), on the condition that spiritual phenomena were specifically investigated. Manual searching was performed in relevant journals, reference lists and authors' publication lists. Critique of the design and conduct of the studies was followed by thematic analysis.

Results

Of 288 papers found by electronic search, on examining abstracts only six papers were found to fulfil the criteria. Four additional studies were found by manual search, producing ten papers in total. The papers are summarised in *Table 1*.

Methodology

Most of the studies had small samples, inhibiting statistical analysis and generalisation. There was wide methodological variation with little attempt at replication. Some studies were specifically of TLE only (Bear and Fedio, 1977; Mungas, 1982; Tucker et al, 1987; Trimble and Freeman, 2006; Lin et al, 2008), others were of partial seizures (Ogata and Miyakawa, 1998; Åsheim Hansen and Brodtkorb, 2003; Wuerfel et al, 2004; Dolgoff-Kasper et al, 2011), and another was of epilepsy generally (Khwaja et al, 2007). All of the studies used neurological examination to confirm the type of epilepsy and localisation of seizures, either from existing clinical data or as a research procedure. One study (Tucker et al, 1987) recorded EEG during seizures. Bear and Fedio (1977) developed an instrument for measuring the behavioural disturbances of TLE, and this was used in three other studies (Mungas, 1982; Wuerfel et al, 2004; Trimble and Freeman, 2006). In three studies, data on spiritual

Table 1 (part 1). Summary of the papers included in the review

Paper	Objective	Design	Findings	Strengths and weaknesses
Bear and Fedio (1977)	To determine whether distinct behavioural profiles exist in TLE of right and left laterality	Comparison of four groups: 15 patients with right-sided TLE, 12 with left-sided TLE, 9 with neuromuscular disorders, and 12 healthy volunteers. A scale developed by the authors measured 18 traits including religiosity	Consistent profile of changes in behaviour, thought (including religious and philosophical interest) and affect, apparently as specific consequence of temporal lobe seizures. Religiosity was particularly common in left laterality	Small sample. Cases of TLE may have had disproportionate rate of psychiatric disturbance
Mungas (1982)	There were two studies: the objective of the first was to compare behavioural traits between TLE and psychiatric illness; that of the second was to measure the influence of psychiatric illness on these traits	Study 1 included three groups of 14 patients: one group with TLE, one with concomitant neurological and behavioural disorders, and one with psychiatric disorder but no neurological abnormality. The Bear and Fedio Inventory was completed by each participant and a family informant. Study 2 used the same groups plus patients with neuromuscular disorders and healthy volunteers. It used a self-rated Bear and Fedio Inventory	Study 1 found no difference between TLE and comparators in Bear and Fedio Inventory scores. In study 2, in the TLE group, psychiatric disorder accounted for 40% of behavioural trait variance. The authors concluded that TLE is not a necessary condition for these traits	Small sample. Problem of differentiating epileptic psychosis from psychiatric disorder
Tucker et al (1987)	Investigate frequency of hyperreligiosity in TLE	Used three groups: 76 patients with complex, partial seizures of unilaterial temporal lobe focus; 31 with primary generalised seizures; and 27 with pseudoseizures but no epileptic seizures. Video EEG of ictal phase and observation of concurrent behaviour were conducted	No significant group differences were found	Only overt behaviour was measured
Ogata and Miyakawa (1998)	To examine the frequency of and contributory factors for ictal and postictal religious experiences	234 epileptic outpatients at a neuropsychiatric clinic in Japan were recruited from 1984–1997. Patients were routinely interviewed about ictal experiences	Three patients, all with TLE, had ictal religious experiences (1.3% of overall sample, 2.2% of TLE). These cases also had postictal psychosis and interictal religious experiences	Large sample, with 137 having TLE. No standardised assessment of spiritual experiences
Åsheim Hansen and Brodtkorb (2003)	To investigate ecstatic auras in partial epilepsy	Descriptive study at an epilepsy clinic in Norway. Interviews with 11 consecutive patients who had pleasant aura experiences	Five cases described spiritual or religious phenomena. Two felt that these experiences had a lasting impact	Small sample. No standardised instrument assessment of spiritual experiences
Wuerfel et al (2004)	To investigate the neurological basis of Geschwind syndrome (hyperreligiosity, hypergraphia, hyposexuality)	Analysis of correlation between Geschwind features and volumes of mesial temporal lobe structures. Included 33 patients with refractory focal seizures at an epilepsy treatment centre in the UK. The Neuro-Behavioral Inventory (an extended version of the Bear and Fedio Inventory) was completed by each participant and a family informant. MRI was also used	11 participants had hyperreligiosity. This group had a smaller right hippocampus on average than the group without religious interests, but no difference in the size of the left hippocampus or amygdala. No correlation was found between hypergraphia and hyposexuality and size of amygdala and hippocampus	Small sample. Researcher measuring hippocampus and amygdala volumes was blinded to psychological data
Trimble and Freeman (2006)	To compare religious experiences of people with epilepsy and regular church-goers	Comparison of three groups: 28 patients with TLE and religiosity, 22 patients with TLE and no religiosity, and 30 members of a Church of England congregation. INSPIRIT, Hood's Mysticism Scale, Bear and Fedio Inventory, Beck Depression Inventory, Hospital Anxiety and Depression Scale were all used	No significant difference was found in the frequency of religious experiences between the hyperreligious group and the church-goers, but hyperreligious participants had more intense experiences. There were significant personality and behavioural differences between the epileptic groups	Small sample. All epileptic participants from one neurology centre. Criterion for hyperreligiosity required prominent religious interests for at least 1 year

EEG, electroencephalogram; INSPIRIT, Index of Core Spiritual Experiences; MRI, magnetic resonance imaging; TLE, temporal lobe epilepsy

Table 1 (part 2). Summary of the papers included in the review

Paper	Objective	Design	Findings	Strengths and weaknesses
Khwaja et al (2007)	To examine religious temperament and practices before and after onset of epilepsy	100 sequential patients with epilepsy (aged 15–84 years) in an Indian neurology centre were enrolled. CT was used to differentiate idiopathic from symptomatic epilepsy. Interviews explored family history, beliefs, practices, and mystical experiences before and after diagnosis	29% of the participants became more religious after onset of epilepsy. There were two cases of mystical experiences but neither had TLE. Religiosity was found in all types of epilepsy. 80% stated that religion helped them to cope with epilepsy, but some saw epilepsy as punishment	No standardised assessment of spiritual experiences. CT scan in 80 participants, with few cases of temporal lobe focus determined, but around a third had partial seizures or absences
Lin et al (2008)	To evaluate the ictal significance of the sign of the cross	Cases identified from video records of 530 patients monitored at an epilepsy centre in Brazil. Participants who made the sign of the cross during a seizure were interviewed. Spiritual experiences were assessed by INSPIRIT	All four participants who made the sign of the cross had localised seizure activity in the right temporal lobe and atrophy of the right hippocampus. Two participants also had interictal religiosity. EEG results suggested ictal automatism, with participants having no recollection of making the action	Small number of cases. Video recording. Sign of the cross not transferable beyond Christian culture
Dolgoff-Kaspar et al (2011)	To investigate hyperreligiosity in people with supernatural experiences in partial seizures	38 US adults with partial epilepsy were enrolled. Seizures were localised by EEG. Participants were divided into high and low frequency of experiencing divine or spiritual auras, as reported on an aura checklist. Expressions of Spirituality Inventory (Revised) were completed for ictal and interictal experiences	High frequency group (12 participants) had more metaphysical experiences ictally and interictally. No participants reported overtly religious experiences. High frequency group had more paranormal beliefs	Small sample. Eligibility criteria not stated. Only six participants in the high frequency group had seizures of temporal focus

CT, computerised tomography; EEG, electroencephalogram; INSPIRIT, Index of Core Spiritual Experiences; TLE, temporal lobe epilepsy

experiences were collected by interviews rather than by standardised instrument (Åsheim Hansen and Brodtkorb, 2003; Ogata and Miyakawa, 1998; Khwaja et al, 2007). One study used video recording of ictal behaviour (Lin et al, 2008).

Neuropsychiatric factors

A variety of ictal experiences, postictal psychosis and interictal beliefs were observed. Trimble and Freeman (2006) found higher frequency of postictal psychosis in their hyperreligious group than in epileptic participants without religious interest. The validity of the religiosity trait in TLE was supported by Bear and Fedio (1977), who speculated that high emotional intensity (as displayed in irritability, sorrow and elation) is due to kindling, whereby limbic–cortical connections become hypersensitive as a result of previous aura experiences. However, the studies by Mungas (1982) and Tucker et al (1987) indicated that spiritual phenomena result from psychiatric comorbidity, although the Mungas study had a small sample and the Tucker study only measured overt behaviour. In study samples with mixed types of epilepsy, spiritual phenomena were generally more frequent in TLE. The three cases of spiritual experience observed in the Ogata and Miyakawa (1998) study all had TLE. Magnetic resonance imaging by Wuerfal et al (2004) showed an abnormally small right hippocampus in hyperreligious cases, implying that this structure has a critical role in spiritual delusions.

Religious and cultural factors

Although the incidence of spiritual experiences was generally low, the intensity and impact were often highly significant for those affected. As described by Waxman and Geschwind (1975), religious phenomena in TLE tend to deviate from the prevailing beliefs and practices. In the Trimble and Freeman (2006) study, 18 of the 28 hyperreligious cases were affiliated to denominations other than Anglican or Roman Catholic. In addition, in some cases the spiritual presence was malign, provoking morbid and overwhelming fear. The instances of religious experience reported by Ogata and Miyakawa (1998) differed from social norms in Japan, where a nominally Buddhist populace lacks a tradition of overt religious practice. In a devout Buddhist and two converts to Christian sects, ictal experiences appeared to amplify existing beliefs. In 12 patients with a high frequency of spiritual auras, the Dolgoff-Kaspar et al (2011) study found no instances of overt religious experience but instead a sense of cosmic consciousness was expressed; paranormal beliefs were disproportionately common in this group. The researchers suggested that the hyperreligiosity feature be renamed ‘cosmic spirituality’. By contrast, the Lin et al (2008) study in Brazil

produced video evidence of a religious automatism in partial seizures, with four patients making the sign of the cross with their hand; all were Catholic but did not attend church regularly. In the Khwaja et al (2007) study the participants were mostly Hindu (77%), with 18 Muslims, 4 Sikhs and 1 Christian. Religion and family background were major factors in beliefs and experiences, with lingering traditional beliefs about divine retribution (6% attributed their epilepsy to a curse of God and 14% to bad karma). Khwaja et al (2007) suggested that religiosity arises not from ictal stimulus but from feelings of fear or guilt; almost a third of the participants reported becoming more religious after the onset of epilepsy.

Discussion

Religiosity in TLE should be considered in the context of contrasting ideas on the relationship between the brain and spirituality. From the materialist stance, epitomised by Gilbert Ryle's 'ghost in the machine', the mind is an illusion, with all thoughts and feelings products of neural processes (Tallis, 2011). As the brain is the physical medium of experience, it is reasonable to hypothesise organic causes of abnormal emotions. Neurotheology is predicated on a biological explanation for religion. From functional brain scans on Tibetan monks, who signalled when their meditations reached a peak of intensity, Newberg and d'Aquili (2000) found that spiritual elation related directly to neurological changes including increased blood flow in the frontal cortex, midbrain, cingulate gyri and thalamus. Coles (2008, p1956) argued that 'without careful interpretation, this contributes as much to the study of religious experience as a Chicago city plan does to an analysis of American culture', yet Newberg and d'Aquili (2000) inferred evolutionary programming of faith. The true scientific attitude is doubt. Fingelkurts and Fingelkurts (2009) asked 'is our brain hardwired to produce God, or is our brain hardwired to perceive God?', but it seems unlikely that spirituality, being strongly influenced by personal and social factors, can be pinpointed to a single structure.

A second explanation for religiosity is a dysfunction of mind. As religious delusions are common in schizophrenia and in transient psychotic states, psychiatrists and psychologists may be inclined to interpret extreme or culturally-divergent expression as symptomatic. Outspoken critic of psychiatry Thomas Szasz (1974, p113) remarked: 'if you talk to God, you are praying; if God talks to you, you have schizophrenia'.

A third view is to critically accept the authenticity of experience. Clinicians are expected to be sensitive to the beliefs and values of patients, but the spiritual concept of the soul is anathema to scientific episteme (Walach, 2007). Humanistic psychologist Abraham Maslow regarded spiritual events not as supernatural but 'within the jurisdiction of a suitably enlarged science' (1964, p19), with religious ecstasy as a variety of 'peak experience' in which ultimate fulfilment is attained. Refining his hierarchy of needs, Maslow placed transcendence atop the pyramid. The current enthusiasm for mindfulness in psychology is a secularised form of Buddhist meditative practice that pursues a higher plane of consciousness. Cosmic enlightenment was taken seriously by pioneering psychologist William James (1902/2002, p195):

> **'If there be higher spiritual agencies that can directly touch us, the psychological condition of their doing so might be our possession of a subconscious region which alone should yield access to them. The hubbub of the waking life might close a door which in the dreamy subliminal might remain ajar.'**

James was an early proponent of phenomenology, now an established paradigm in the human sciences. While the patient's perspective is valued in medical and psychological research, generalisability of experiential data is problematic amidst the Western dualism of mind and matter. Adding to the challenge of understanding spiritual events in epilepsy, 'spiritual and religious experiences are deeply personal and verbally inexpressible' (Devinsky and Lai, 2008, p636). Yet without the personal account there would be little to investigate. For all its flaws, mind trumps brain as informant.

Implications for nursing

Technological advances make an exciting environment for neurological nursing, but practitioners should not be blinded by science; the essence of nursing remains in individualised care (Woodward, 2011). A holistic approach is presented as a defining concept of nursing but, as Clarke (1999) explained, although this is construed as a triad of physical, psychological and social considerations, the philosophical idea of holism means integration of mind, body and spirit. Spiritual needs are emphasised by textbooks, but ambiguity is apparent. Frontline practitioners of no religious belief may lack confidence or inclination to engage in patients' spirituality. However, Paley (2007) discussed the apparent paradox of an agnostic society and a burgeoning interest in spirituality in nursing. While Christian worship declines, vague beliefs in a transcendental life force or ultimate reality appear in its place (Hay, 2006). Interest in Oriental spirituality is shown by the popularity of yoga, although arguably such dabbling in other belief systems is superficial, as a commodity rather than a life-changing commitment. In an increasingly multicultural society, awareness of heterogenous beliefs is vital in nursing. Instead of merely attributing an episode to culture, a nurse hearing of a patient having a profound aura experience should consult hospital chaplaincy, whose pastoral support does not impose any doctrine but

illuminates personal meanings in coping with illness. Through their interpersonal rapport with patients, nurses have an important role in developing the knowledge of mystical phenomena in epilepsy. Neuroscience nursing should be at the forefront of creative, interdisciplinary partnerships in this area.

Limitations

Systematic review and replication are constrained by imprecise definitions of spiritual experience, which demands subjective judgment in selection of papers. Included here were studies contributing to knowledge of the frequency and quality of spiritual phenomena in TLE, but wider criteria would have accommodated studies of elevated emotional states, which would inevitably include mystical experiences. The review only included papers in English; consequently, some Japanese literature was omitted, although most of these papers report single cases (Ogata and Miyakawa, 1998).

Conclusion

In summary, research in this area is at an early stage of development, with indications that a temporal focus is an important factor in spiritual experiences of epilepsy, albeit as a relatively rare and nebulous trait. Spiritual feelings may arise from reciprocity of biological and psychosocial factors, but nurses should afford the possibility of a genuinely transcendent experience. Whether transcendence is real or epiphenomenal, 'epilepsy may have influenced and formed our cultural and religious history to a degree that has not been fully acknowledged' (Åsheim Hansen and Brodtkorb, 2003). The impact on humanity is tremendous if the insights of some of the most prominent figures in history were indeed facilitated by ictal excitation. Further research may help to explain whether the complex, partial seizures of TLE are a cause of abnormal religiosity or an accessory to spiritual enlightenment. BJNN

Key Points

- Epilepsy has long been associated with spiritual phenomena
- Religiosity is a feature of the Geschwind syndrome, observed in some cases of temporal lobe epilepsy
- Evidence for disproportionate spiritual experiences in temporal lobe epilepsy is mixed, but sufficient to justify further research
- Whenever possible, nurses should engage in the ictal experiences of patients with epilepsy, both for individualised care and to contribute to broader understanding

Åsheim Hansen B, Brodtkorb E (2003) Partial epilepsy with 'ecstatic' seizures. *Epilepsy Behav* **4**(6): 667–73

Bartlet JEA (1957) Chronic psychosis following epilepsy. *Am J Psychiatry* **114**(4): 338

Bear DM, Fedio P (1977) Quantitative analysis of interictal behaviour in temporal lobe epilepsy. *Arch Neurol* **34**(8): 454–67

Clarke L (1999) *Challenging Ideas in Psychiatric Nursing.* Routledge, London

Coles A (2008) God, theologian and humble neurologist. *Brain* **131**(7): 1953–9

Devinsky O, Lai G (2008) Spirituality and religion in epilepsy. *Epilepsy Behav* **12**(4): 636–43

Dewhurst K, Beard AW (1970) Sudden religious conversions in temporal lobe epilepsy. *Br J Psychiatry* **117**(540): 497–507

Dolgoff-Kaspar R, Ettinger AB, Golub SA, Perrine K, Harden C, Croll SD (2011) Numinous-like auras and spirituality in persons with partial seizures. *Epilepsia* **52**(3): 640–4

Fingelkurts AA, Fingelkurts AA (2009) 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. *Cogn Process* **10**(4): 293–326

Geschwind N (1979) Behavioural changes in temporal lobe epilepsy. *Psychol Med* **9**(2): 217–9

Granqvist P, Fredrikson M, Unge P et al (2005) Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak complex magnetic fields. *Neurosci Lett* **379**(1): 1–6

Hay D (2006) *Something There: The Biology of the Human Spirit.* Darton, Longman and Todd, London

Howden JC (1872) The religious sentiment in epileptics. *J Ment Sci* **18**: 482–97

James W (1902/2002) *The Varieties of Religious Experience: A Study in Human Nature.* Routledge, London

Khwaja GA, Singh G, Chaudhry N (2007) Epilepsy and religion. *Ann Indian Acad Neurol* **10**(3): 165–8

Lin K, Marx C, Caboclo LO, Centeno RS, Sakamoto AC, Yacubian EM (2008) Sign of the Cross (Signum Crucis): observation of an uncommon ictal manifestation of mesial temporal lobe epilepsy. *Epilepsy Behav* **14**(2): 400–3

Maslow AH (1964) *Religion, Values and Peak-Experience.* Penguin, New York

Mungas D (1982) Interictal behaviour abnormality in temporal lobe epilepsy: a specific syndrome or nonspecific psychopathology? *Arch Gen Psychiatry* **39**(1): 108–11

Newberg AB, d'Aquili EG (2000) The neuropsychology of religious and spiritual experience. *J Conscious Stud* **7**(11–12): 251–66

Ogata A, Miyakawa T (1998) Religious experiences in epileptic patients with a focus on ictus-related episodes. *Psychiatry Clin Neurosci* **52**(3): 321–5

Paley J (2007) Spirituality and secularization: nursing and the sociology of religion. *J Clin Nurs* **17**(2): 175–86

Persinger MA (1987) *Neuropsychological Bases of God Beliefs.* Praeger, New York

Queally C, Lailey S (2012) Care of the person with epilepsy in the hospital environment – getting it right. *Br J Neurosci Nurs* **8**(1): 14–20

Slater E, Beard AW (1963) The schizophrenia-like psychoses of epilepsy. *Br J Psychiatry* **109**: 95–150

Szasz TS (1974) *The Second Sin.* Doubleday, Garden City

Tallis R (2011) *The Aping of Mankind: Neuromania, Darwinitis and the Misrepresentation of Humanity.* Acumen

Temkin O (1971) *The Falling Sickness: A History of Epilepsy from the Greeks to the Beginnings of Modern Neurology.* (2nd edn). Johns Hopkins University Press, Baltimore

Trimble M (1991) *The Psychoses of Epilepsy*. Raven, New York

Trimble M, Freeman A (2006) An investigation of religiosity and the Gastaut-Geschwind syndrome in patients with temporal lobe epilepsy. *Epilepsy Behav* **9**(3): 407–14

Tucker DM, Novelly RA, Walker PJ (1987) Hyperreligiosity in temporal lobe epilepsy: redefining the relationship. *J Nerv Mental Dis* **175**(3): 181–4

Walach H (2007) Mind-body-spirituality. *Mind Matter* **5**(2): 215–40

Waxman SG, Geschwind N (1975) The interictal behavior syndrome of temporal lobe epilepsy. *Arch Gen Psychiatry* **32**(12): 1580–6

Woodward S (2011) Technological advances: a help or a hindrance. *Br J Neurosci Nurs* **7**(3): 519

Wuerfel J, Krishnamoorthy E, Brown R et al (2004) Religiosity is associated with hippocampal but not amygdala volumes in patients with refractory epilepsy. *J Neurol Neurosurg Psychiatry* **75**(4): 640–2