

SUPPORT FOR A NEUROPSYCHOLOGICAL MODEL OF SPIRITUALITY IN PERSONS WITH TRAUMATIC BRAIN INJURY

by Brick Johnstone and Bret A. Glass

Abstract. Recent research suggests that spiritual experiences are related to increased physiological activity of the frontal and temporal lobes and decreased activity of the right parietal lobe. The current study determined if similar relationships exist between self-reported spirituality and neuropsychological abilities associated with those cerebral structures for persons with traumatic brain injury (TBI). Participants included 26 adults with TBI referred for neuropsychological assessment. Measures included the Core Index of Spirituality (IN-SPiRiT); neuropsychological indices of cerebral structures: temporal lobes (Wechsler Memory Scale-III), right parietal lobe (Judgment of Line Orientation), and frontal lobes (Trail Making Test, Controlled Oral Word Association Test). As hypothesized, spirituality was significantly negatively correlated with a measure of right parietal lobe functioning and positively correlated (nonsignificantly) with measures of left temporal lobe functioning. Contrary to hypotheses, correlations between spirituality and measures of frontal lobe functioning were zero or negative (and nonsignificant). The data support a neuropsychological model that proposes that spiritual experiences are related to decreased activity of the right parietal lobe, which may be associated with decreased awareness of the self (transcendence) and increased activity of the left temporal lobe, which may be associated with the experience of specific religious archetypes (religious figures and symbols).

Keywords: neuropsychology; spirituality; traumatic brain injury

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[*Zygon*, vol. 43, no. 4 (December 2008)]

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NEUROIMAGING AND SPIRITUALITY

The neurological basis of spiritual experience is a topic of increased interest to both neuroscientists and religious scholars, as several recent studies suggest that different brain structures interact differentially to allow for the experience of spiritual phenomena. Recent review articles (Fenwick 2003; Newberg and Iversen 2003) summarize neuroimaging studies that suggest that regular spiritual experiences (such as reading religious texts), intense spiritual experiences (those related to religious conversions and psychiatric delusions), and meditative practices and prayer all are mediated by differential neurophysiologic activity of the frontal lobes, temporal lobes, parietal lobes, thalamus, and limbic system.

Spirituality and Frontal-Parietal Lobe Circuits. Several studies show that frontal-parietal lobe circuits play a key role in the experience of spiritual phenomena. For example, L. I. Aftanas and S. A. Golocheikine (2001) demonstrated the role of the frontal lobe in the experience of spiritual phenomena in an EEG study that indicated a positive relationship between frontal lobe theta activity and feelings of bliss for individuals engaged in meditation. Nina P. Azari and colleagues (2001) used PET scans to evaluate the cerebral blood flow of six religious individuals during three conditions: reading a psalm, reading a nursery rhyme, and reading a telephone book. Findings indicated that the religious-based condition, reading a psalm, was associated with activation of a frontal-parietal circuit, including the dorsolateral prefrontal cortex, dorsomedial frontal cortex, and medial parietal cortex.

Andrew Newberg and colleagues completed a series of neuroradiologic studies of Tibetan monks and Franciscan nuns that show that, in addition to increased neurophysiologic activity in the frontal lobes observed during spiritual experiences, the parietal lobes have associated changes in neurophysiologic activity. Newberg and colleagues (1997) used SPECT imaging to study proficient meditators and reported significant increases in brain activity in the prefrontal cortex and posterior superior parietal lobe but significant decreases in the blood flow of the nondominant inferior (right) parietal lobe. In a follow-up SPECT study (2001) they reported that the monks, while meditating, had significantly increased blood flow in the cingulate gyrus, inferior and orbital frontal cortex, dorsolateral prefrontal cortex, and thalamus. Of note, increased blood flow in the left prefrontal cortex was correlated with decreased blood flow in the left superior parietal lobe. Newberg, Michael Pourdehnad, and colleagues (2003) performed a similar SPECT study on Franciscan nuns engaged in verbal meditation (repetition of a particular phrase), with results showing increased blood flow to the prefrontal cortex, inferior parietal lobes, and inferior frontal lobes during the meditation. A strong inverse relation was reported be-

tween increased blood flow to the prefrontal cortex and decreased blood flow to the ipsilateral parietal lobe.

Hans Herzog and colleagues (1990–91) used PET scans to show that meditators demonstrated increased physiologic activity in the frontal lobes but decreased activity in the parietal lobes during meditation. These studies clearly reveal that, at least for persons engaged in meditation or prayer, spiritual experiences are related to increased frontal lobe activity in conjunction with decreased parietal lobe activity.

A Neurophysiologic Model of Spirituality. Based on their research, Newberg, Eugene d'Aquili, and their colleagues have developed variations of a general neurophysiologic model of spiritual experience (d'Aquili and Newberg 1993a, b; 1998; 2000; Newberg and d'Aquili 1998; Newberg and Iversen 2003; Newberg and Newberg 2005) based on the interaction of different cerebral structures and the excitatory and inhibitory processes associated with the autonomic nervous system (that is, sympathetic and parasympathetic). In simple terms, they propose that spiritual experiences are based on a process that generally involves increased physiologic activity of the prefrontal cortex and posterior superior parietal lobe as well as decreased activity of the nondominant (right hemisphere) inferior parietal lobe. In fact, this model is consistent with neuropsychological research that indicates that diminished activity of one hemisphere may be accompanied by increased activity of the other hemisphere when released from the inhibitory or competitive constraints of normal hemisphere interactions (Novelly et al. 1984; Shimuzi et al. 2000; Starkstein and Robinson 1997).

The researchers hypothesize that these coordinated neurophysiologic activities lead to the experience of spiritual phenomena, which they describe as an increasing sense of a universal connectedness, a greater sense of unity over diversity, and a decreasing awareness of the self. They suggest that these spiritual experiences can be experienced along a "unitary" continuum, ranging from general aesthetic experiences (such as a sense of connectedness with art or music), to romantic love (a sense of unity and connectedness with another person), to an experience they label Absolute Unitary Being (AUB), which is described as "a total breakdown of discrete boundaries between objects, an absence of a sense of time, and elimination of the self-other dichotomy" (Newberg and d'Aquili 1998, 81). They hypothesize that neurophysiologic activity associated with spiritual experiences may be perceived differently based on one's culture and background; individuals from monotheistic religions may experience these phenomena as numinous feelings of connectedness to a god, whereas Buddhists may experience them as mystical (such as the "Void" associated with nirvana).

Spirituality and Temporal Lobe Functions. Although Newberg and d'Aquili's general model explains how individuals may experience the transcendence that is reported by many individuals who attain deep spiritual

states, they do not account for the religious archetypes (religious figures and symbols) that permeate all cultures or the hyperreligious experiences reported by individuals with temporal lobe epilepsy or some psychiatric disorders. However, several studies suggest that increased activation of the temporal lobes and parts of the limbic system are associated with the experience of these spiritual phenomena and/or religious archetypes. Basant K. Puri and colleagues (2001) published a case study of a schizophrenic with religious delusions and reported that PET imaging indicated an increase in left temporal blood flow at the time of the religious delusions, with an associated decrease in occipital blood flow (particularly on the left). J. Wuerfel and colleagues (2004) evaluated thirty-three individuals with epilepsy using MRI and indicated that increased religious psychopathology (abnormal religious experiences) is related to smaller right hippocampi. This finding points to the possibility that either relatively larger left hippocampi or smaller right hippocampi (or both) are related to increased religious psychopathology. These findings are generally consistent with research and clinical observations that temporal lobe epilepsy is frequently associated with hyperreligiosity and religious conversions (Bear 1979; Bear and Fedio 1977).

According to these studies, the left temporal lobe/limbic system may be associated with the normal experience of religious archetypes (religious figures/symbols common to all cultures), and hyperstimulation (seizures, for example) or abnormal functioning (psychiatric disorders) of these cerebral areas may lead to abnormal hyperreligious experiences. Similarities between hyperreligious experiences associated with the temporal lobes and hippocampus are not unexpected, given the close proximity of and numerous connections between the temporal lobes and limbic system (Joseph 1990; Kandel and Schwartz 1993; Saver and Rabin 1997).

Basis for Current Study. Considered together, these neurophysiologic studies reveal that certain parts of the brain are differentially activated or inhibited during meditation, prayer, and religious experiences, although the specific pattern of interaction is not clear. Some of the discrepancies in the literature may be related to the different neuroradiological procedures used (PET, SPECT, MRI), the different types of meditation evaluated (yoga, tantric yoga, Kundalini), the different cognitive processes used during different meditative practices (verbal recitations, visual imagery), and the different times at which participants were evaluated (scanning before, during, or after the meditation). In addition, the preliminary research on the neurophysiologic basis of spiritual experience has been conducted primarily with nonclinical populations such as individuals engaged in meditation and prayer.

However, Newberg (2005) suggests the need to examine spiritual experiences in populations with neuropathological conditions (brain injury, for example), which may lead to the identification of the neurobehavioral

systems that subserve “normal” spiritual experience. Only minimal research has been conducted with clinical populations such as individuals with schizophrenia (Puri et al. 2001) and epilepsy (Wuerfel et al. 2004).

The field of neuropsychology developed by ascertaining the “behavioral geography” of the brain by comparing the neuropsychological test performance of individuals with known brain damage to nonclinical (normal) samples. In this manner it was possible to determine the specific neuropsychological abilities associated with the different cerebral structures (left temporal lobe injuries were associated with verbal memory deficits, frontal lobe injuries were associated with behavioral disinhibition, and so on [Lezak, Howieson, and Loring 2004]). Similarly, the “spiritual geography” of the brain may be more clearly delineated by determining how the experience of spiritual phenomena is affected when different parts of the brain are injured.

In addition to using neuroradiologic techniques to identify cerebral structures and physiologic processes associated with spirituality, it is possible to use neuropsychological tests to identify the integrity of these same cerebral structures. For example, it is commonly accepted that the temporal lobes are associated with memory—verbal memory with the left temporal lobe, visual-spatial memory with the right (Tranel and Damasio 2002); the right parietal lobe is associated with spatial perception (Benton and Hacaen 1970) and the frontal lobes with divided attention and the ability to generate words (Johnstone et al. 1995). If Newberg and d’Aquili’s general neurophysiologic model of spirituality is accurate, it can be expected that measures of spirituality will be positively correlated with neuropsychological measures of frontal lobe abilities (divided attention, word generation) and negatively with neuropsychological measures of right parietal lobe functions (spatial perception). Similarly, based on the findings of other researchers (Puri et al. 2001; Wuerfel et al. 2004), it can be expected that spirituality will be positively correlated with neuropsychological measures of left temporal lobe functions (verbal memory).

We conducted the present study to determine whether a general measure of spirituality is associated with specific neuropsychological abilities, and specific cerebral structures by implication, for a group of individuals with traumatic brain injury (TBI). Based on previous research, we hypothesized that spirituality would be (1) negatively correlated with neuropsychological indices of right parietal functioning, (2) positively correlated with neuropsychological indices of frontal lobe functioning, and (3) positively correlated with neuropsychological indices of left temporal lobe functioning.

METHODS

Participants. The data were collected from a clinical sample of 26 adults as part of their neuropsychological evaluation for TBI at a Midwestern

university. All patients were evaluated as outpatients, indicating that their injuries were not acute. The average age of this sample was 34.3 years (sd [standard deviation] = 11.1; range = 18–53), with a mean education level of 13.0 years (sd = 2.3; range = 7–16). Males (n [number] = 18) made up 69 percent of the sample, and 31 percent were female (n = 8). The ethnic composition was 96 percent Caucasian (n = 25) and 4 percent Hispanic (n = 1). The average time since injury was 42.6 months (sd = 67.9). Ten participants (39 percent) reported experiencing an average loss of consciousness at time of injury of 55.8 hours (sd = 158.2), and twelve (46 percent) reported experiencing an average post-traumatic amnesia of 320.9 hours (sd = 830.9).

Procedures. All participants were referred for neuropsychological testing by physicians or vocational rehabilitation counselors for clinical purposes. Participants were administered comprehensive neuropsychological evaluations by trained psychometrists. The total number and types of measures varied depending on the individual and referral question, but all evaluations included measures of intelligence, memory, language, visual-spatial skills, and divided attention. After consenting to participate in the study, participants also completed a questionnaire regarding spirituality (INSPIRIT) for which they were compensated \$10.

Measures. The Index of Core Spiritual Experiences (INSPIRIT, Kass et al. 1991) is a measure that reflects intrinsic spirituality and subjective beliefs. The INSPIRIT includes nineteen questions about personal spiritual experiences, the amount of time devoted to spiritual and religious practices, and the degree of closeness experienced to a self-defined transcendental entity. The scores for each INSPIRIT item range from 1 (low) to 4 (high), with higher scores indicating higher intensity of spiritual experience. The INSPIRIT score used in the analyses was the mean rating of all answered questions (range = 1–4).

The following neuropsychological tests were administered as general indices of each of the following cerebral lobes. For all tests other than the Trail Making Test, higher scores indicate greater ability, so Trail Making Test scores were reverse-scored to simplify discussion of results.

1. The *left temporal lobe* has been shown to be associated with individuals' memory for what they hear (Tranel and Damasio 2002). The Wechsler Memory Scale-III Logical Memory (LM) I and II subtests (WMS-III; Wechsler 1997b) were used as measures of left temporal lobe functioning. The subtests involve the examiner reading aloud two narrative stories, which the participant is asked to remember and repeat immediately after presentation (LM I) and again after a thirty-minute delay (LM II). The score is the total number of details recalled.

2. The *right temporal lobe* has been shown to be associated with individuals' memory for what they see (Tranel and Damasio 2002). The WMS-

III Visual Reproduction (VR) I and II subtests were used as measures of right temporal lobe functioning. The subtests involve presenting participants with pictures of linear designs of increasing complexity and then having them draw these designs immediately after presentation (VR I) and again after a thirty-minute delay (VR II). The score is the total number of details recalled.

3. The *frontal lobes* have been shown to be associated with several neuropsychological abilities, including the ability to generate words and divide one's attention between two tasks (Johnstone et al. 1995). The following were used as measures of frontal lobe functioning: Controlled Oral Word Association Test (COWAT; Benton and Hamsher 1989) and Trail Making Test (Reitan 1992). The COWAT has individuals state as many words as they can in a one-minute period for each of the letters F, A, and S. The total score is the total number of words generated over the three trials. The Trail Making Test Part B is a visual scanning test that involves the participant completing a connect-the-dots task, alternating between a series of numbers and letters (1 to A, A to 2, 2 to B, B to 3, and so on). The score is the number of seconds needed to complete the test.

4. The *right parietal lobe* has been shown to be associated with visual-spatial perception (Benton and Hacaen 1970). The Judgment of Line Orientation Test (JOLO; Benton, Hannay, and Varney 1975) was used as a measure of right parietal lobe functioning. When completing the JOLO the participant is asked to estimate angular relationships between two line segments for thirty drawings of increasing complexity. The score is the total number correct of the thirty items.

5. In order to determine whether *general intelligence* is related to spirituality, the Wechsler Adult Intelligence Scale-III (WAIS-III; Wechsler 1997a) was administered to participants, with the total score having a mean of 100 and standard deviation of 15.

Analyses. Given the relatively normal distribution of the data, Pearson product moment correlations were conducted among the INSPIRIT and neuropsychological test mean scores. Descriptive statistics for all variables are listed in Table 1. Pearson correlations are presented in Table 2.

RESULTS

TBI and Neuropsychological Abilities. As hypothesized, the INSPIRIT was significantly negatively correlated with a measure of right parietal lobe functioning (JOLO; $r = -.56, p < .004$).

Contrary to hypotheses, correlations were zero or negative (and nonsignificant) between the INSPIRIT and measures of frontal lobe functioning (Trails B; COWAT).

As hypothesized, the INSPIRIT was positively correlated (although nonsignificantly) with neuropsychological measures associated with left

temporal lobe functioning (WMS-III LM I and LM II subtests). In contrast, the INSPIRIT was negatively correlated (nonsignificantly) with measures associated with right temporal lobe functioning (WMS-III VR I and VR II).

DISCUSSION

Overall, our results generally support previous neurophysiologic findings that different cerebral structures interact differentially to allow for spiritual experiences. Specifically, the pattern of results lends general support to Newberg and d'Aquili's model that suggests that certain aspects of spirituality (such as transcendence) are related to decreased activity of the right parietal lobe, as well as to research suggesting that other aspects of spirituality (such as the cultural experience of religious archetypes) are related to increased left temporal lobe functioning. Taken together, the previous and current research suggests that such brain-spirituality relationships exist for both nonclinical (meditators) and clinical (TBI, epilepsy) samples, and in terms of both neurophysiologic and neuropsychological functioning.

Spiritual Experience and the Right Parietal Lobe. In the current study the INSPIRIT was significantly correlated (negatively) with only one neuropsychological test, the JOLO, which is a general measure of right parietal lobe functioning. This finding is consistent with previous research (Newberg et al. 1997; Herzog et al. 1990–91) as well as the model proposed by Newberg and d'Aquili (1998) and further confirms that decreased functioning of the right parietal lobe—whether by reduced blood flow during meditation for nonclinical samples, or by neurologic injury associated with TBI—is associated with certain aspects of spiritual experience (transcendence).

From a neuropsychological viewpoint, we hypothesize that decreased right parietal functioning allows for transcendental experiences, one aspect of spirituality, by minimizing basic right hemisphere abilities. Whereas Newberg and colleagues (2001) propose that this decreased right parietal activity may be related to the altered sense of space experienced by some meditators, we alternatively hypothesize that this diminished right parietal activity may actually be related to a decreasing awareness of the self, which subsequently allows for increasingly transcendental experiences (a sense of universal connectedness, greater sense of unity over diversity, and decreasing awareness of the self). From a neuropsychological perspective, the right hemisphere allows for individuals to define themselves in relation to the immediate environment, the here-and-now. The right parietal lobe is generally associated with awareness of the self relative to other objects in space, awareness of the self as perceived by others in social situations, and the ability to critically evaluate one's own strengths and weaknesses (such as insight). Disorders of the right hemisphere involve a diminished capacity

TABLE 1
Descriptive Statistics (*n* = 26)

Test	Mean (Standard Deviation)
INSPIRIT	2.70 (0.80)
WMS-III LM	9.73 (3.33)
WMS-III LM II	9.38 (2.32)
WMS-III VR I	9.00 (3.05)
WMS-III VR II	10.15 (3.79)
JOLO	24.12 (3.30)
Trails B	72.77 (26.54)
COWAT	30.00 (9.19)
WAIS-III FIQ	95.00 (9.95)

Wechsler Memory Scale-III (WMS-III); Logical Memory subtest (LM); Visual Reproduction subtest (VR); Judgment of Line Orientation (JOLO); Trail Making Test Part B (Trails B); Controlled Oral Word Association Test (COWAT); Wechsler Adult Intelligence Scale-III (WAIS-III).

TABLE 2
Pearson Product Correlations (*n* = 26)

BRAIN STRUCTURE	TEST	INSPIRIT
Left Temporal Lobe	WMS-III LM I	+ .13
	WMS-III LM II	+ .04
Right Temporal Lobe	WMS-III VR I	- .34
	WMS-III VR II	- .11
Right Parietal Lobe	JOLO	- .56*
Frontal Lobe	Trails B	- .09
	COWAT	.00
Intelligence	WAIS-III Full Scale IQ (n=24)	- .31

* *p* < .004

Wechsler Memory Scale – III (WMS-III), Logical Memory I and II subtests (LM), Visual Reproduction I & II subtests (VR); Judgment of Line Orientation (JOLO); Controlled Oral Word Association Test (COWAT); Wechsler Adult Intelligence Scale – III (WAIS-III)

in the ability of the self to function in the immediate environment, including difficulties localizing the body in space (left-sided neglect, as in Mesulam 2000), difficulties interacting socially based on problems comprehending social nuances (Brozgold et al. 1998), and difficulties in awareness of one's deficits (anosagnosia, as in McGlynn and Schacter 1989). Muriel D. Lezak and colleagues state, "Most cases of anosagnosia involve the inferior parietal cortex . . ." (2004, 73).

Spiritual Experience and the Frontal Lobes. Contrary to hypotheses, measures of frontal lobe functions were not significantly correlated with spirituality. This may reflect the fact that the previously cited neuroimaging studies indicating that increased frontal lobe functioning is related to increased spirituality were conducted while participants were actively engaged in spiritual practices or experiences, such as reading religious texts, meditation, or religious delusions (Azari et al. 2001; Puri et al. 2001; Newberg et al. 1997; 2001; 2003). It may be that the frontal lobes of these participants were increasingly active given that they were intensely focusing their attention and concentrating (frontal lobe abilities) during their spiritual experiences. The participants in our study were not engaged in a spiritual practice or actively attending to specific religious thoughts or objects. It may be that the frontal lobes are not directly related to a spiritual capacity per se, other than to help focus attention on spiritual thoughts, beliefs, and practices.

Spiritual Experience and the Left Temporal Lobe. The neuropsychological results in our study are generally supportive of some research findings (Puri et al. 2001; Wuerfel et al. 2004) that increased neurophysiologic functioning of the left temporal lobe, but not necessarily the right temporal lobe, is related to increased spiritual/religious experiences. It is noteworthy that of all the neuropsychological variables included in the current study, only the measures of left temporal lobe function (WMS-III verbal memory subtests) were positively correlated with spirituality.

The left temporal lobe therefore may be a primary location for the generation/experience of religious archetypes (figures and symbols). This is consistent with other hypotheses that point to a neurobiological basis for religious/mythical archetypes (d'Aquili 1978; 1986; Newberg and d'Aquili 1994). It is possible that the left temporal lobe, with its connections to the limbic system where experiences are provided with emotional valence, is the cerebral location for normal and common religious archetypes experienced across all cultures throughout history (god figures, savior/prophet figures, demonic figures, symbols). Religious archetypes provide a basis for all individuals to define theological, ethical, and moral constructs such as good/evil and sacred/secular, and help to provide existential meaning to our lives. These archetypes are subsequently interpreted by individuals on

the basis of their specific cultural experiences (interpretation of a god figure as Allah, Jehovah, Yahweh; interpretation of a prophet figure as Jesus, Mohammed, Moses; the experience of transcendence as a mystical or numinous experience, and so on).

Additional support for an association between specific religious archetypes and the temporal lobes is supported by research on individuals with temporal lobe epilepsy (Bear 1979; Bear and Fedio 1977). These individuals often experience intense religious experiences (delusions of religious persecution or grandiosity; abnormal experience of religious figures and symbols) without the associated decreased sense of the self and experience of bliss and unity that is reported by individuals who achieve advanced states of meditation (the transcendence that may be associated with diminished right parietal lobe functioning). For these individuals, it may be that "normal" universal religious archetypes are experienced abnormally secondary to neurologic injury or psychiatric dysfunction.

A NEUROPSYCHOLOGICAL MODEL OF SPIRITUAL EXPERIENCE

Based on our findings, we propose a neuropsychological model of spiritual experience that suggests that spirituality is a multifaceted construct related to the interaction of different cerebral structures that involve different neuropsychological processes. Specifically, we hypothesize that individuals may experience transcendence (feelings of universal unity, decreased sense of the self) by minimizing right parietal functions through conscious effort, as in meditation, or reduced ability, as in injury. This hypothesis is generally consistent with the report of persons engaged in transcendental experiences who often indicate that they "lose" themselves (their self) during prayer, mediation, or spiritual experience, without thoughts of person, place, or time. In addition, we hypothesize that increased activity of the left temporal lobe leads to the experience of universal religious archetypes, which are defined by cultural experiences. Furthermore, in this neuropsychological model of spirituality, we hypothesize that the frontal lobes may be primarily related to the intense concentration that is associated with deep spiritual states.

This neuropsychological model of spirituality also addresses questions regarding the impact of neurologic versus environmental factors on spiritual experience (nature versus nurture). It suggests that all individuals, regardless of cultural background or religion, experience the same neurophysiological/neuropsychological functions during spiritual experiences (nature). However, it also provides a rationale for how these similar brain activities are interpreted differently based on the manner in which religious archetypes are culturally defined (nurture).

LIMITATIONS AND FUTURE DIRECTIONS

The model proposed is simple, but it provides a basis from which future research can expand. For example, other cerebral structures have been shown to be related to spiritual experiences, such as the thalamus and limbic system structures. Their roles will need to be clarified, although the thalamus has been shown to be associated with attentional abilities (Portas et al. 1998), and the limbic system has been shown to be associated with the generation and modulation of feelings and emotions (Joseph 1990; Kandel and Schwartz 1993; Saver and Rabin 1997).

The findings are limited by the relatively small sample size ($n = 26$). By increasing sample size in future research it is possible that several of the correlational trends reported in this study may achieve statistical significance. The current study is also limited by the lack of neuroradiological indices of injury severity. As a result, it can lead only to speculation about how different brain structures may be related to spirituality.

Future research regarding the relationships between brain injury, neuropsychological impairments, and spiritual experience will benefit from including simultaneous measures of anatomical (CT, MRI), physiological (PET, SPECT), and neuroendocrinological variables to determine the impact of structural, physiological, and neuropsychological aspects on spirituality. Furthermore, it will benefit from more clearly delineating distinct aspects of spirituality (that is, in addition to transcendence and the experience of religious archetypes).

NOTE

This article was supported with funding from the Center for Religion and the Professions at the University of Missouri, funded by the Pew Charitable Trusts.

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