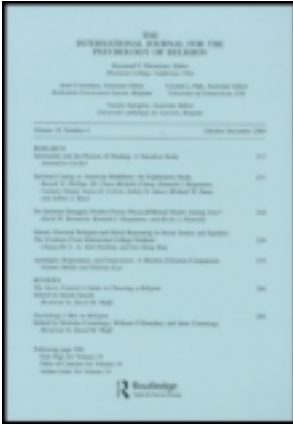


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### Right Parietal Lobe-Related “Selflessness” as the Neuropsychological Basis of Spiritual Transcendence

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# Right Parietal Lobe-Related “Selflessness” as the Neuropsychological Basis of Spiritual Transcendence

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The purpose of this study is to replicate studies that suggest that a frontal-parietal circuit is related to spiritual-religious experiences, and specifically that a decreased focus on the self (i.e., selflessness), associated with decreased right parietal lobe (RPL) functioning, serves as the primary neuropsychological foundation for spiritual transcendence. Participants included 20 outpatients with brain injury referred for neuropsychological assessment. Outcome variables included measures of spirituality (Inspirit: Kass, Friedman, Lesserman, Zuttermeister, & Benson, 1991; Brief Multidimensional Measure of Religiousness/Spirituality [BMMRS]: Fetzer Institute & National Institute on Aging Working Group, 1999) and neuropsychological abilities (i.e., bilateral parietal, temporal, and frontal lobes). Consistent with previous research, Pearson correlations indicated that decreased RPL functioning is significantly associated with increased spiritual transcendence as measured by the Inspirit (and BMMRS spirituality subscales to a lesser degree); and increased frontal lobe functioning is significantly associated with more frequent religious practices. Spiritual transcendence (i.e., emotional connection with the numinous/mystical) is a specific spiritual dimension that appears to be primarily related to increased selflessness associated with decreased RPL functioning. Increased frontal lobe functioning also appears to be related to more frequent religious practices (and spiritual experiences to a lesser extent), although the specific neuropsychological process/mechanism remains uncertain.

There is an increased interest in determining the neurological basis of spiritual experiences (see Johnstone & Glass, 2008; Newberg & Newberg, 2005; Schjoedt, 2009), partly due to the recognition that spirituality may be best conceptualized as a multidimensional emotional-cognitive construct that is primarily neurologically based versus religion, which may be best conceptualized as socially learned behaviors/rituals that are primarily influenced by cultural and faith traditions (Johnstone, Yoon, Frankin, Schopp, & Hinkebein, 2009). Newberg (2006) has stated that future neuroscientific studies of spiritual experiences will benefit from using participants with brain dysfunction to more clearly delineate the relationships that exist between cerebral structures/systems and specific spiritual experiences. In essence, just as the field of neuropsychology has determined the “behavioral geography” of the brain (i.e., which parts of the brain are associated with specific cognitive and behavioral abilities), the need exists to similarly determine the “spiritual geography” of the brain (i.e., which specific cerebral structures and neuropsychological abilities are related to specific spiritual traits/abilities).

However, the majority of research conducted to date regarding the neurological basis of spirituality has not adequately differentiated between spiritual and religious constructs, has generally investigated spirituality as a global rather than multidimensional construct, and has generally been exploratory in nature (i.e., not hypothesis driven). As a result, the neurologic basis of specific spiritual experiences remains uncertain, and no clear models exist to explain how neuroanatomical structures, or equally important neuropsychological processes, are related to specific spiritual constructs. In addition, it may be appropriate and necessary to study spirituality as both traits (i.e., consistent manner in which one relates to the environment; Piedmont, 1999) that are best measured through self-report surveys and specific mental/emotional activities that are best measured during religious practices (i.e., meditation, prayer) or experimental tasks (Azari et al., 2001; Butler, McNamara, & Durso, 2010, 2011).

## RIGHT PARIETAL FUNCTIONING AND SELFLESSNESS

In general, neurological studies of spirituality have identified a frontal-parietal circuit as being consistently involved in spiritual and religious experiences. Specifically, increased frontal lobe activity has been associated with advanced meditative/prayer states and increased activation of “religious concepts,” whereas decreased right parietal lobe (RPL) activity has been associated with increased spiritual transcendence. However, further replication of these studies is needed to determine the specific nature of these relationships, with specific attention to differentiating between the relationships that exist among the frontal and parietal lobes and specific (vs. general) aspects of religiosity and spirituality.

In one of the first studies of the neuropsychology of spirituality using persons with traumatic brain injury (TBI), Johnstone and Glass (2008), using neuropsychological tests to evaluate the functional integrity of different cerebral structures, indicated that decreased RPL function (as measured by the Judgment of Line Orientation Test; Benton, Hamsher, Varney, & Spreen, 1983) was significantly correlated with increased spiritual transcendence ( $r = -.56, p < .004$ ; Index of Core Spiritual Experiences, or Inspirit; Kass, Friedman, Lesserman, Zuttermeister, & Benson, 1991), although measures of frontal and temporal lobe functioning were not. Additional studies with persons with brain tumors generally supported these findings by indicating that “selective

damage to the left and right inferior posterior parietal regions induced a specific increase of self-transcendence" (Urgesi, Aglioti, Skrap, & Fabbro, 2010, p. 309).

Based on their findings, Johnstone and Glass (2008) proposed a model that suggested that the RPL is related to spiritual transcendence in the following manner. The RPL is associated with defining/perceiving the self (Decety & Sommerville, 2003; Uddin, Kaplan, Molnar-Szakacs, Zaidel, & Iacoboni, 2005), self-related cognition (Platek, Keenan, Gallup, & Mohamed, 2004), own-body perception (Blanke et al., 2005), and autobiographical memory (Lou et al., 2004). Research has further indicated that the right inferior parietal cortex (along with the prefrontal area and the insula) "may be critical in distinguishing the self from the other" (Decety & Moriguchi, 2007, p. 9) and that repetitive transcranial magnetic stimulation to the right inferior parietal lobe (RIPL), but not the left IPL, "selectively disrupts performance on a self-other discrimination task" (Uddin, Molnar-Szakacs, Zaidel, & Iacoboni, 2006, p. 65). Given that *increased* activity in the RIPL has been associated with the tendency to focus on the self, it is logical to deduce that *decreased* functioning of the RIPL leads to a decreased tendency to focus on the self (i.e., increased selflessness) and a diminished capability to distinguish the self from others. According to the model proposed by Johnstone and Glass (2008), this RPL-based selflessness can subsequently lead to spiritual transcendence (i.e., the emotional connection with things beyond the self) that is experienced in terms of numinous or mystical states, depending on the environmental context and one's cultural and religious background.

These experimental research findings regarding the relationship between the RPL and selflessness are also generally consistent with neuropsychological anecdotes regarding clinical populations that indicate that injury to the RPL is associated with "disorders of the self" (Feinberg & Keenan, 2005), including impairments in self-awareness (e.g., anosognosia; McGlynn & Schacter, 1989), difficulties identifying the "self" in space (i.e., left-sided spatial neglect; Mesulam, 2000), and impairments in understanding how the "self" is perceived by others (Brozgold et al., 1998).

### RIGHT PARIETAL FUNCTIONING, SELFLESSNESS, AND MEDITATION/PRAYER

Studies of religious practitioners also suggest that selflessness is associated with decreased RPL functioning and related spiritual transcendence. Specifically, neurophysiologic studies of Buddhist monks and Franciscan nuns suggest that decreased activation of the RIPL is related to a decreased sense of the self reported during deep states of meditation and prayer. Newberg, Alavi, Baime, Mozley, and d'Aquila (1997) used single-photon emission computed tomography (SPECT) imaging to study proficient Buddhist meditators and reported significant increases in blood flow (a correlate of brain activity) in the prefrontal cortex and posterior superior parietal lobe but significant *decreases* in the blood flow to the RIPL. Newberg, Pourdehnad, Alava, and d'Aquila (2003) performed a similar SPECT study on Franciscan nuns engaged in verbal meditation with results indicating a strong inverse relation between increased blood flow to the prefrontal cortex and *decreased* blood flow to the RIPL. Study participants, despite coming from different faith traditions, generally reported an increasing sense of a universal connectedness, a greater sense of unity over diversity, and a decreasing awareness of the self. Similarly, fMRI studies (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007) reported that

deactivation of the RIPL occurs during a specific type of meditation (i.e., Loving-Kindness Compassion) practiced by Tibetan Buddhist monks.

## FRONTAL LOBE FUNCTIONING AND ACTIVATION OF RELIGIOUS CONCEPTS

Just as decreased RPL functioning has been shown to be related to increased spiritual transcendence, numerous studies have also indicated that increased frontal lobe activity, often in association with decreased parietal lobe activity, is associated with similar spiritual/religious experiences. For instance, Aftanas and Golocheikine (2001) reported an association between increased frontal lobe EEG theta activity and feelings of bliss for individuals engaged in meditation. Azari and colleagues (2001) used PET scans to evaluate brain physiology and reported that reading a psalm (i.e., a religious-based condition), compared to two nonreligious control activities, was associated with activation of a frontal-parietal circuit. Similarly, Herzog and colleagues (1990) used PET scans to demonstrate that meditation and prayer are associated with increased physiological activity in the frontal lobes but decreased activity in the parietal lobes. A series of more recent studies by Butler and colleagues (2010, 2011) suggest that individuals with Parkinson's disease demonstrate reduced ability to activate "religious concepts" associated with frontal lobe activity compared to control conditions. They specifically demonstrated that right forebrain pathways selectively mediate the time constant of gain to actuate "religious concept" representation, whereas left-forebrain pathways dictate rates of signal decay. Although the activation of "religious concepts" is apparently related to frontal lobe activity, the specific nature of these relationships remains unclear. For example, increased frontal lobe activity in the meditation/prayer studies may be related to the intense attention required for such practices, or to a neuropsychological ability associated with the activation of "religious concepts" as shown in the experimental tasks completed with individuals with Parkinson's disease (Butler et al., 2010, 2011). As a result, the specific nature of the relationships that exist among frontal lobe activity and religious and spiritual experiences remains unclear.

## RATIONALE FOR THE CURRENT STUDY

To date, no clear neuropsychological models of distinct spiritual constructs have emerged, likely due in part to the fact that most research in this area has focused on spirituality as a global construct, that there has been a lack of theory-driven studies (i.e., relationships have been explored but models have not been tested) and that there has been a focus on neuroanatomical structures rather than neuropsychological abilities that may serve as the basis of specific spiritual traits. With these weaknesses in mind, the current study used a sample with TBI to (a) replicate a proposed model of spirituality that suggests that decreased functioning of the RPL is associated with increased transcendence, (b) determine if decreased RPL functioning is related to other measures of spiritual transcendence, and (c) confirm studies that suggest that increased frontal lobe functioning is associated with religious and spiritual experiences.

It was hypothesized that (a) decreased RPL functioning would be associated with increased spiritual transcendence as measured by both the Inspirit and the Brief Multidimensional Mea-

sure of Religiousness/Spirituality (BMMRS) spirituality subscales, and (b) increased frontal lobe functioning would be associated with increased BMMRS spirituality and religiosity scales.

## METHODS

### Participants

The data were collected from a convenience sample of 20 individuals with TBI who were referred for clinical neuropsychological evaluations at a midwestern university. Demographic characteristics of the participants are presented in Table 1. The sample was of average intelligence (i.e., Wechsler Adult Intelligence Scale–III Verbal IQ = 95.25 [11.62]; Performance IQ = 95.90 [12.34]; Wechsler, 1997a). All patients were evaluated as outpatients, indicating that their injuries were not acute.

The sample's TBIs were relatively significant as 95% reported losing consciousness, at least 40% experienced retrograde amnesia, and at least 65% experienced anterograde amnesia. Ninety-five percent had some type of neuroradiological evaluation of which at least 40% of the findings were abnormal. In the absence of available neuroradiological evaluations, the present study used neuropsychological tests as indices of the functional integrity of the cerebral lobes.

### Procedure

All participants were administered comprehensive neuropsychological evaluations by trained psychometrists, including measures of intelligence, memory, language, visual-spatial skills, attention, and sensori-motor skills (Table 2). After consenting to participate in the study, participants also completed self-report measures of spirituality and religion (Table 3) for which they were compensated \$25. The present study was approved by the university's Institutional Research Review Board.

### Measures

#### *Inspirit (Kass et al., 1991)*

The *Inspirit* is a 19-question measure that assesses 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 increasing spirituality. The *Inspirit* score is the average rating of all answered questions (range = 1–4).

#### *BMMRS (Fetzer Institute & National Institute on Aging Working Group, 1999)*

The BMMRS is a 38-item self-report survey with Likert-scale formats. Any reference to "God" in the original BMMRS items was changed to "higher power" for this study to make the measure more suitable for individuals of varied faith traditions. Lower scores are indicative of a higher degree of the measured trait.

TABLE 1  
Sample Demographics

	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SD</i>
Age	18	78	40.50	20.54
	<i>N</i>	<i>%</i>		
Gender				
Male	10	50.0		
Female	10	50.0		
Handedness				
Right	19	95.0		
Left	1	5.0		
Ethnicity				
Caucasian	18	90.0		
African American	1	5.0		
Middle-Eastern	1	5.0		
Marital Status				
Married	8	40.0		
Divorced	3	15.0		
Widowed	1	5.0		
Single	8	40.0		
Education				
Some HS	1	5.0		
HS Diploma	6	30.0		
Some College	8	40.0		
Bachelor's Degree	4	20.0		
Master's Degree	1	5.0		
Employment Status				
Currently Employed	9	45.0		
Student	1	5.0		
Unemployed, not on disability	4	20.0		
Unemployed, on disability	3	15.0		
Retired	2	10.0		
Annual Income				
<\$20,000	14	70.0		
\$20,001–\$40,000	2	10.0		
\$40,001–\$60,000	3	15.0		
Missing	1	5.0		
Religious Affiliation				
Protestant	6	30.0		
Catholic	1	5.0		
Muslim	1	5.0		
Other	10	50.0		
Missing	2	10.0		

TABLE 2  
Neuropsychological Measure Descriptive Statistics

	<i>N</i>	<i>Min.</i>	<i>Max.</i>	<i>M</i>	<i>SD</i>
Frontal Lobe					
Trails B (Scaled Score)	20	-11.48	0.31	-2.86	3.60
Left Temporal Lobe					
WMS-3 LM I (Scaled Score)	20	2.00	13.00	8.05	3.24
Right Temporal Lobe					
BVMTR Total ( <i>t</i> Score)	20	20.00	60.00	40.05	13.40
Right Parietal Lobe					
JOLO (Raw Score)	20	16.00	30.00	22.65	3.91
Agnosia Left-Hand Errors (Raw Score)	20	0	2	0.30	0.66
Left Frontal Lobe					
DKEFS Letter Fluency (Scaled Score)	20	3.00	13.00	8.10	2.53
Left Parietal Lobe					
Agnosia Right-Hand Errors (Raw Score)	20	0	3	0.65	1.04

*Note.* WMS-3 = Wechsler Memory Scale-III; BVMTR = Benton Visual Memory Test Revised; JOLO = Judgment of Line Orientation; DKEFS = Delis Kaplan Executive Function System Letter Fluency Test.

*BMMRS Spiritual Experience Subscales.* *Daily Spiritual Experience* measures the individual's connection with a higher power in daily life (e.g., "I desire to be closer to or in union with a higher power"). This subscale consists of six items rated on a 6-point response format, ranging from 1 (*many times a day*) to 6 (*never*).

*Meaning* measures a sense of purpose or meaning in life (e.g., "The events in my life unfold according to a divine or greater plan"). This subscale is composed of two items with a 4-point response format, ranging from 1 (*strongly agree*) to 4 (*strongly disagree*).

*Values/Beliefs* measures religious values and beliefs (e.g., "I believe in a God who watches over me"). This subscale is composed of two items with a 4-point response format, ranging from 1 (*strongly agree*) to 4 (*strongly disagree*).

TABLE 3  
Spirituality/Religiosity Measure Descriptive Statistics

	<i>N</i>	<i>Min.</i>	<i>Max.</i>	<i>M</i>	<i>SD</i>
BMMRS					
Daily Spiritual Experiences	20	7	36	21.80	8.38
Meaning	19	2	7	4.16	1.43
Values/Beliefs	20	2	6	3.80	1.20
Forgiveness	20	3	11	6.25	2.25
Religious/Spiritual Coping	20	7	24	15.70	4.49
Private Religious Practices	19	6	37	24.21	9.78
Organizational Religiousness	20	2	12	8.35	2.91
Inspirit	20	1.43	4.00	2.95	0.68

*Note.* BMMRS = Brief Multidimensional Measure of Religiousness/Spirituality; Inspirit = Index of Core Spiritual Experiences.



*Forgiveness* measures the degree to which individuals are willing to forgive others and a belief in the forgiveness of a higher power (e.g., “I know that I am forgiven by a higher power.”). The subscale consists of three items rated on a 4-point response format, ranging from 1 (*always*) to 4 (*never*).

*Religious/Spiritual Coping* purportedly measures spiritual coping strategies (e.g., “I look to a higher power for strength, support, and guidance.”). This subscale consists of seven items with a 4-point response format, ranging from 1 (*a great deal*) to 4 (*not at all*).

**BMMRS Religious Practices Subscales.** *Private Religious Practices* measures the frequency of religious activities (e.g., “How often do you watch or listen to religious programs on TV or radio?”). This subscale is composed of five items with an 8-point response format, ranging from 1 (*more than once a day*) to 8 (*never*).

*Organizational Religiousness* measures the frequency of involvement in formal public religious institutions (e.g., “How often do you go to religious service?”). This subscale consists of two items with a 6-point response format, ranging from 1 (*more than once a week*) to 6 (*never*).

It is noted that the BMMRS Religious Support subscale was not included in the analyses given that only 13 participants completed this scale (participants are informed they do not have to answer this item if they do not attend religious services with fellow congregants).

### *Neuropsychological Tests*

The following neuropsychological tests were administered as general indices of each of the following cerebral lobes. For all tests higher raw scores indicate more intact ability, other than for the Trail Making and finger agnosia tests (i.e., higher scores equal worse performance).

**Left temporal lobe.** The Wechsler Memory Scale-3 Logical Memory I subtest (Wechsler, 1997b) is a measure of verbal memory that has been associated with left temporal functioning (Tranel & Damasio, 2002). It involves reading two narrative stories to the participant that they are asked to remember and repeat immediately after presentation. The score is the standard score according to age related norms (i.e.,  $M = 10$ ,  $SD = 3$ ).

**Right temporal lobe.** The Benton Visual Memory Test–Revised (Benedict, 1997) is a test of visual memory that has been associated with right temporal lobe functioning (Tranel & Damasio, 2002). It involves presenting the participant with three trials during which they are visually exposed to six geometric figures for 10 s, after which they are asked to draw the figures from memory. The score is the total number of details recalled for all three trials, which is presented as a  $t$  score based on age related normative data (average  $t$  score = 50,  $SD = 10$ ).

**Left frontal lobe.** The Delis Kaplan Executive Function System Letter Fluency Test (DKEFS; Delis & Kaplan, 2001) is a measure of verbal fluency that has been associated with left frontal functioning (Johnstone, Leach, Hickey, Frank, & Rupright, 1995). On this measure participants state as many words as they can in a 1-min period for three different letters. The total score is the total number of words generated over the three trials, which is expressed as a scaled score based on age-related normative data ( $M = 10$ ,  $SD = 3$ ).

*Frontal lobe.* The Trail Making Test Part B (Reitan, 1992) has been associated with frontal lobe functioning (Johnstone et al., 1995). It is a measure of divided attention that involves the participant completing a connect-the-dot test, alternating between a series of numbers and letters (i.e., 1 to A, A to 2, 2 to B, B to 3, etc.). The result is based on time to complete the measure. For this study the score is presented as a  $z$  score according to normative data (Heaton, Miller, Taylor, & Grant, 2004), with higher  $z$  scores indicative of better performance.

*RPL.* The Judgment of Line Orientation (JOLO) and left-hand finger agnosia tests were used to assess RPL functioning. The JOLO (Benton et al., 1983) and left-hand finger agnosia test have been associated with RPL functioning (Lezak, Howieson, & Loring, 2004). The JOLO is a measure of spatial perception with the total score equaling the number correct of the 30 total items. The scores used in the analyses were presented as a  $z$  score calculated according to normative data published in the test manual (Benton et al., 1983). Left-sided finger agnosia is a measure of sensory perception associated with the RPL on which each of the five fingers is touched four times and identified by the participant, with the score equaling the total number of errors.

*Left parietal lobe.* Right-sided finger agnosia is a measure of sensory perception associated with the left parietal lobe (Lezak et al., 2004) in which each of the five fingers is touched four times and identified by the participant, with the score equaling the total number of errors.

### Statistical Analyses

Pearson product-moment correlations were conducted among the neuropsychological measures and the Inspirit (Table 4) and BMMRS (Table 5). For all measures higher scores are suggestive of relatively stronger abilities, other than the BMMRS and finger agnosia tests. Therefore, to ease interpretation of the results, correlations were reverse scored for these measures. Therefore, in Tables 4 and 5 all positive correlations suggest that stronger neuropsychological abilities are associated with greater degrees of spiritual transcendence and religiosity. Given

TABLE 4  
Pearson Product Correlations Between Neuropsychological Indices and Inspirit

<i>Brain Structure</i>	<i>Test</i>	<i>Inspirit</i>
Right Parietal Lobe	JOLO	-0.60**
	Left-hand finger agnosia	-0.34
Left Parietal Lobe	Right-hand finger agnosia	0.12
Right Temporal Lobe	BVMTR	-0.23
Left Temporal Lobe	WMS-III LM	0.21
Frontal Lobe	Trails B	0.43
Left Frontal Lobe	DKEFS Letter Fluency	0.13

*Note.* JOLO = Judgment of Line Orientation; BVMTR = Benton Visual Memory Test-Revised; WMS-III = Wechsler Memory Scale-III; LM = Logical Memory scale; DKEFS = Delis Kaplan Executive Functions System.

\*\* $p < .01$ .

TABLE 5  
Correlation Analysis Between Neuropsychological Indices and BMMRS

<i>BMMRS Variable</i>	<i>Spiritual</i>					<i>Religious</i>	
	<i>DSE</i>	<i>M</i>	<i>V/B</i>	<i>F</i>	<i>SC</i>	<i>PRP</i>	<i>OR</i>
Right Parietal							
JOLO	−0.34	−0.02	−0.38	−0.44*	−0.30	−0.35	−0.43
Left-Hand Agnosia	−0.29	−0.35	−0.32	−0.30	−0.15	−0.36	−0.11
Left Parietal							
Right-Hand Agnosia	0.13	0.00	0.20	0.27	0.29	−0.09	0.06
Left Temporal							
WMS−3 LM	0.41	0.30	0.23	0.21	0.28	0.27	0.17
Right Temporal							
BVMTR Total	−0.04	0.02	−0.03	−0.13	0.12	−0.06	−0.07
Left Frontal							
DKEFS Letter Fluency	0.17	−0.11	0.17	0.26	0.14	0.00	0.06
Frontal							
Trail Making Test	0.40	0.20	0.18	0.21	0.29	0.49*	0.42

*Note.* BMMRS = Brief Multidimensional Measure of Spirituality/Religiousness; DSE = Daily Spiritual Experiences; M = Meaning; V/B = Values/Beliefs; F = Forgiveness; SC = Spiritual Coping; PRP = Private Religious Practices; OR = Organizational Religiousness; JOLO = Judgment of Line Orientation; WMS−III LM = Wechsler Memory Scale−III Logical Memory; BVMTR = Benton Visual Memory Test−Revised; DKEFS = Delis Kaplan Executive Function System.

\*  $p < .01$ .

all neuropsychological tests were demographically corrected, other than for finger agnosia scores, differences in demographics such as age were accounted for in the analyses. Bonferroni corrections were not included as part of the analyses given the desire to replicate and extend a previous study with a small sample size. As a result, interpretation of significant results should be made with caution, acknowledging that the following results may reflect false positive correlations.

## RESULTS

### RPL and Spiritual Transcendence

As hypothesized, the results of the current study were consistent with the previous Johnstone and Glass (2008) study, as the JOLO was significantly correlated with the Inspirit ( $r = -.60$ ,  $p < .01$  in present study;  $r = -.56$ ,  $p < .004$ , in the original study). In general, relatively weaker RPL functioning was significantly correlated with greater spiritual transcendence. The Inspirit was not significantly correlated with any neuropsychological indices of other cerebral structures in either the previous or current studies.

Nonsignificant statistical trends also indicated that the JOLO was consistently and negatively correlated with the BMMRS spiritual subscales. Specifically, the JOLO was significantly and negatively correlated with the BMMRS Forgiveness scale ( $r = -.44$ ,  $p < .05$ ), and

approached significance with three others (i.e., Daily Spiritual Experiences:  $r = -.34$ ,  $p < .15$ ; Values/Beliefs:  $r = -.38$ ,  $p < .10$ ; Religious/Spiritual Coping:  $r = -.30$ ,  $p < .19$ ). As hypothesized, worse JOLO performance (suggestive of increased RPL dysfunction) was associated with increased spiritual transcendence as measured by the BMMRS spiritual subscales.

Although nonsignificant, as hypothesized increased left-sided finger agnosia errors, reflective of decreased RPL functioning, were associated with increased ratings of transcendence on the Inspirit ( $r = -.34$ ,  $p < .14$ ) and all BMMRS spiritual subscales (correlation range =  $-0.15$  to  $-0.35$ ).

### Frontal Lobe Functioning and BMMRS Scales

Increased frontal lobe functioning, as measured by the Trail Making Test, was significantly and positively correlated with the BMMRS Private Religious Practices subscale ( $r = .49$ ,  $p < .05$ ) and approached significance with the Organizational Religiousness subscale ( $r = .42$ ,  $p < .08$ ). In general, stronger frontal lobe functioning was associated with increased frequency of prayer and service attendance. BMMRS religious subscales were not significantly associated with the DKEFS Letter Fluency Test, the other measure used to assess frontal lobe functioning.

Although nonsignificant, it is noted that nine of the 10 correlations between measures of frontal lobe function (i.e., Trail Making Test, DKEFS Letter Fluency Test) were positively correlated with BMMRS spirituality scales, suggesting increased frontal lobe activity is associated with increased spiritual transcendence.

## CONCLUSIONS

This replication and extension of the original Johnstone and Glass (2008) study further suggests that one spiritual dimension (i.e., transcendence) is primarily related to one specific neuropsychological process (i.e., selflessness), that is associated with one specific cerebral structure (i.e., RPL). Such a relationship has now been confirmed with clinical and nonclinical samples, including persons with TBI (current study; Johnstone & Glass, 2008), individuals having surgery for parietal lobe brain tumors (Urgesi et al., 2010), and Buddhist monks and Franciscan nuns engaged in religious practices (Brefczynski-Lewis et al., 2007; Newberg et al., 1997; Newberg et al., 2003). In addition, the current results support others studies that indicate that increased frontal lobe functioning is associated with increased religiosity (Aftanas & Golocheikine, 2001; Azari et al., 2001; Butler et al., 2010, 2011; Herzog et al., 1990), further supporting the existence of a frontal-parietal circuit in spiritual-religious experiences.

### RPL and Spiritual Transcendence

The results confirm previous research that indicates that decreased RPL functioning is associated with increased spiritual transcendence as measured by the Inspirit (Johnstone & Glass, 2008). Specifically, in the previous study the JOLO and Inspirit were significantly correlated at  $-0.56$ , whereas in the current study they were significantly correlated at  $-0.60$ . It is noted that the Inspirit was not significantly correlated with indices of any other cerebral

structures (i.e., frontal, temporal, left parietal) in either study, suggesting that the RPL serves as the *primary* neurologic foundation for spiritual transcendence. However, given the complex nature of spiritual transcendence, it is acknowledged that other cerebral structures/networks and cultural/faith tradition factors are likely related to transcendence.

The current study also aimed to determine if decreased RPL functioning was related to measures of spiritual transcendence other than the Inspirit, which was partially confirmed. Performance on the JOLO was significantly correlated with only one of the five BMMRS Spiritual subscales (i.e., Forgiveness). However, statistical trends suggest that decreased RPL functioning is related to increased spiritual transcendence as measured by other BMMRS spiritual subscales (i.e., Daily Spiritual Experiences, Values/Beliefs, Religious/Spiritual Coping). The fact that the BMMRS Forgiveness scale was significantly correlated with the JOLO may be related to the fact that the act of forgiving is often considered to be an act of selflessness. In essence, individuals selflessly let go of any perceived wrong that others have committed against them in order to release the offending individual, or themselves, from any ongoing responsibility for the perceived transgression.

Review of the face validity of specific questions of the other three BMMRS Spiritual scales that approached statistical significance with the JOLO indicate that these items also generally measure a construct that can be considered to be consistent with spiritual transcendence (i.e., emotional connection to a higher power). This hypothesis is consistent with a recent factor analysis of the BMMRS (Johnstone et al., 2009) that reported that the Daily Spiritual Experiences, Values/Beliefs, and Religious/Spiritual Coping scales (but not the Forgiveness scale, which was a separate factor) all loaded on a factor that was labeled “positive spiritual experiences.” Examples of questions related to spiritual transcendence from the BMMRS Daily Spiritual Experiences subscale include “I feel the presence of a higher power”; “I desire to be closer to or in union with a higher power”; “I feel the love of a higher power for me, directly or through others.” An example of transcendence from the Values/Beliefs subscale includes the following item: “I believe in a higher power who watches over me.” The BMMRS Religious/Spiritual Coping scale includes the following items which are also suggestive of a transcendent quality: “I work together with a higher power as partners”; “I look to a higher power for strength, support, and guidance.”

In contrast, it is noted that the Meaning subscale, although hypothesized to be a spiritual construct by the creators of the BMMRS, did not approach statistical significance with the JOLO ( $r = -.02$ ). This may be due to the fact that the questions on the Meaning scale do not assess a construct suggestive of a transcendent (i.e., selfless), emotional connection with a higher power, but instead focus on more existential and nonspiritual matters (e.g., “The events in my life unfold according to a divine or greater plan”).

Other, nonsignificant statistical trends between neuropsychological tests and spiritual transcendence suggest that decreased RPL functioning is associated with increased spiritual transcendence. For example, the association between left-sided finger agnosia errors, another measure of RPL function, were in the hypothesized direction with both the Inspirit ( $r = -.34$ ) and BMMRS spiritual subscales (correlation coefficient range =  $-.15$  to  $-.35$ ). In general, greater RPL dysfunction was associated with higher levels of spiritual transcendence. The left-sided finger agnosia test may not have reached statistical significance with measures of spiritual transcendence given the restricted range of errors (i.e., less than one error per 20 trials for the sample;  $M = 0.30$ ,  $SD = 0.66$ ).

### Frontal Lobe Functioning and Religiosity

In general, the findings were supportive of previous research that suggests that increased frontal lobe functioning is associated with increased religiosity (and spirituality to a lesser extent). For example, the Trail Making Test was significantly correlated with the BMMRS Private Religious Practices subscale ( $r = .49, p < .05$ ) and approached statistical significance with the Organizational Religiousness subscale ( $r = .42, p < .08$ ). These findings may be related to several possibilities (Schjoedt, 2009). Individuals who report being more spiritual are also likely to participate more frequently in religious practices, and, conversely, increased frontal lobe activity may be related to a specific neuropsychological ability (e.g., activation of “religious constructs”) based in the frontal lobes (Azari et al., 2001; Butler et al., 2010, 2011). However, it is noted that the current study only measured self-reported frequency of private and public religious practices and did not measure either specific attentional abilities that are evident during spiritual practices such as meditation or prayer, or to a neuropsychological ability related to activation of “religious concepts” measured during an experimental task. Regardless, the results clearly suggest that increased frontal lobe activity is related to increased religious/spiritual experiences.

It is also noted that the results indicated that the Trail Making Test approached statistical significance with the Inspirit ( $r = .43, p < .09$ ) and was positively correlated with all BMMRS spirituality scales (correlation range = 0.18–0.40). Consistent with previous studies, this suggests that increased frontal lobe activity is related to increased spiritual transcendence. Increased frontal lobe activation of “religious concepts” based on an individual’s cultural background may interact with RPL-based selflessness, which leads to the individual experience of spiritual transcendence. The specific mechanism, however, remains uncertain.

### Neurologic and Cultural Influences on the Expression of Spiritual Transcendence

RPL-related selflessness appears to provide the neuropsychological foundation for transcendent experiences as individuals who achieve the highest levels of transcendent states (with an associated decrease in RPL activation) have generally described a lack of sense of the self, the lack of experience of the self–other dichotomy, and a universal connectedness (Austin, 2000; Calabri et al., 2011). From a neuropsychological perspective, the RPL defines the self that is experienced in terms of time, space, and/or relationships (e.g., I am occupying this specific space at this particular time while I am relating to this person/place/event, etc.; Calabri, et al., 2011; Mesulam, 2000). Selflessness is experienced by decreasing or eliminating any personal reference to space, time, or relationships. If individuals focus less on time, space, and relationships, the concept of the self becomes less salient. If one has diminished awareness of the self in terms of time, space, and/or relationships, the question arises as to what one is aware of? We propose that this selflessness, which can be learned and achieved through meditative and prayerful practices, or experienced after brain injury or surgery to the RPL, allows individuals to focus on and emotionally connect with things beyond the self (i.e., the very definition of self-transcendence).

It is important to consider how this RPL-based selflessness is experienced as spiritual transcendence, rather than just a decreased focus on the self or the symptoms that are typically

associated with RPL dysfunction (i.e., anosagnosia, left-sided neglect). The answer appears to be partially related to the context in which the selflessness is experienced (e.g., in an artistic/musical context, personal relationships, religious/spiritual setting, etc.). Different theories have been proposed regarding the manner by which self-transcendence can be experienced along a continuum (d'Aquila & Newberg, 1993; Newberg & d'Aquila, 1998). This continuum ranges on one end as a sense of connection with the beauty of nature/art/music (e.g., losing a sense of self while listening to a favorite piece of music), to romantic love with others (e.g., becoming one with your soul mate), to an ultimate transcendence that has been described as a trance state that involves the complete breakdown between a sense of the self and a complete connection with God/the universe. Specifically, Newberg and d'Aquila (1998) suggested that the complete deafferentation of the RPL is associated with feelings of the total obliteration of the self–other dichotomy during which individuals can feel a sense of becoming absorbed into the object of focus/meditation (e.g., Unio Mystica with God in Christian faiths, absorption into the Void in Buddhism, etc.).

Environmental context and cultural practices also clearly influence the neurologically based experience of transcendence. Specifically, neurologically based spiritual transcendence can be experienced in terms of numinous (e.g., connection with God/higher power, etc.) or mystical states (e.g., connection with the universe, nirvana, etc.) depending on one's cultural and religious background. For instance, although Buddhist monks and Franciscan nuns demonstrated generally similar SPECT blood flow patterns during meditation versus prayer, respectively, they reported different spiritual experiences (i.e., connection with the Void vs. God, respectively). The manner in which individuals are conditioned to interpret such physiologically based, transcendent experiences is analogous to the manner in which humans develop language skills. Specifically, all individuals are genetically predisposed to develop language which is neurologically hardwired in the left hemisphere. The language they eventually speak is based on the culture in which they are raised (e.g., English if raised in the United States, French if raised in France, etc.). The development of spiritual transcendence is likely similar. Several studies have indicated that individuals are genetically predisposed to be spiritual (Hamer, 2004), with numerous previously cited studies indicating that the RPL serves as the neurologic structure responsible for the experience of selflessness. The manner in which this selflessness is experienced in transcendent terms is then likely based on environmental context and one's cultural and religious upbringing (e.g., numinous if raised in a monotheistic/polytheistic culture, mystical if raised in a Buddhist culture, etc.).

In fact, there is preliminary evidence that some neural aspects of defining the self may be influenced by cultural and religious background. Studies have shown that English-speaking Westerners (e.g., British, American, Australian, and Canadian) exhibit consistent neural differences in processing images of the self and of others compared to Chinese-speaking East Asians (Zhu, Zhang, Fan, & Han, 2007). It has been suggested that such differences in neurological processing may reflect the operation of different cultural values of individualism and collectivism, in which a Western independent "self" contrasts with an East Asian interdependent "self" (Chiao et al., 2009). In addition, neuroimaging studies comparing nonreligious Chinese with Chinese Christians have shown distinct neural substrates for self-related processing (Han et al., 2010; Han et al., 2008). Furthermore, Han Chinese participants showed stronger neural self-processing compared to other-processing, compared to the Tibetan participants who exhibited atypical neural self-reference patterns (Wu, Wang, He, Mao, & Zhang, 2010). These results

suggest that the influence of Tibetan culture and religion has shaped a minimal subjective sense of self or “I-ness” for the Tibetan participants, and reflects neurological functions in accord with the philosophical and religious views of the self (or lack thereof) enumerated in Tibetan Buddhism.

### Limitations and Future Directions

Although the results are generally supportive of the proposition that the RPL is the *primary* cerebral region associated with spiritual transcendence, and that a frontal-parietal circuit is related to spiritual-religious experiences, it is acknowledged that these experiences are likely very complex and related to multiple neuropsychological abilities, neuroanatomical structures/networks, and neurophysiological processes. The current study is simplistic in its design and conclusions by necessity but nonetheless provides a foundation for future research in this area.

The primary limitation of the current study relates to the relatively small size of the sample compared to the number of correlations. However, it is important to note that even with this limitation the results confirmed previous studies regarding the RPL and the Inspirit (Johnstone & Glass, 2008) and partially extended the results to another measure of spiritual transcendence (i.e., BMMRS). The fact that any statistical analyses were significant is notable given there were only 20 participants. The findings are also limited given the primary Caucasian and Christian nature of the sample, which limits its generalizability, with the need to replicate the findings with other faith traditions and ethnicities.

Another limitation relates to the lack of direct (e.g., neuroradiologic) evidence as to the location of the brain injury experienced by the participants. In the absence of such data, we presently relied on neuropsychological tests that are known to be sensitive to integrity of particular brain areas (e.g., JOLO and RPL). With that said, it is important to note that the specificity of the measures to damage in a particular brain region may be less precise such that poor performance may arise from injury to other, more ancillary brain regions. For example, whereas the RPL is known to play an important role in JOLO performance, at present we cannot rule out the possibility that damage to non-RPL regions may have given rise to poor performance on the JOLO for some patients. The incorporation of neuroradiologic (e.g., functional magnetic resonance imaging) evaluation into future studies would help to address this limitation.

Just as research is now differentiating between spirituality primarily as a neurologically based experience and religion primarily as a culturally based phenomenon, future research may also benefit from conceptualizing spirituality as multidimensional (i.e., that several, specific dimensions of spirituality exist, such as transcendence and “religious concepts”) rather than as unitary constructs (i.e., global spirituality or religious constructs). Such refined research on specific spiritual dimensions will likely lead to a clearer understanding of the manner in which different spiritual experiences are related to different neuropsychological processes, different neuroanatomical structures/networks, and different neurophysiological processes.

The results also clearly indicate that the frontal lobes play an important role in spiritual and religious experiences, but information regarding the specific nature of the “religious concepts” associated with frontal lobe functioning is lacking. Increased frontal lobe functioning may be related to the activation of “religious concepts” (Azari et al., 2001; Butler et al., 2010, 2011), the intense attentional processes required for meditation/prayer (Newberg et al., 1997; Newberg



et al., 2003), or a combination of both. Further study of the role of the frontal lobe in spiritual experiences is needed.

From a practical standpoint, previous studies suggest that regular participation in spiritual practices such as meditation or prayer may lead to consistent changes in brain functioning (Han et al., 2008; Han et al., 2010; Zhu et al., 2007) and associated improvement in immune system functioning (Davidson et al., 2003). This suggests that further research may warrant investigating the health benefits of repetitive spiritual practices focused on increasing transcendence (or selflessness).

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