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Challenges Facing the Neurological Study of Religious Behavior, Belief, and Experience

Wesley J. Wildman
Boston University, School of Theology,
745 Commonwealth Avenue, Boston, MA 02215
wwildman@bu.edu
Patrick McNamara
Department of Neurology (127), Boston University School of Medicine,
Boston, MA, and VA Boston Healthcare System,
150 South Huntington Avenue, Boston, MA
mcnamar@bu.edu

Abstract
The neurological study of religious behavior, belief, and experience faces many challenges related to research conception, experimental design, and interpretation of results. Some of these problems are common to other types of neurological study of behavioral and cognitive phenomena. Others are distinctive to the specifically religious domain of behavior, belief, and experience. This paper discusses eight of these problems and three key strategic principles for mitigating them. It then proposes an eight-step framework for research into the neurology of religious behavior, belief, and experience that implements the three strategic principles and addresses all eight of the problems.

Keywords
evolution, neuroscience, religious belief, religious behavior, religious experience

Researchers studying the neural embedding of religious behavior, belief, and experience (RBBE) know all too well that their work faces acute conceptual, design, and interpretation challenges. Some of these problems are common to other types of neurological study of behavioral and cognitive phenomena. Others are distinctive to the domain of RBBE. One or more of these problems is commonly mentioned in studies of the neural embedding of RBBE. Sometimes allied fields cast light on relevant aspects of the neurological study of RBBE (from the domain of consciousness studies, for example, see Revonsuo 2005). Life must go on, however, so research often proceeds without a full appreciation of how these problems influence experimental design and interpretation of results, and usually without an adequate strategy for managing

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such influences. The neurological study of RBBE enjoys an uncertain academic reputation, partly as a result of these problems.

The aim of this paper is to sketch some of the sharpest problems facing the neurological study of RBBE and to present a strategic framework for the multidisciplinary study of the neural embedding of RBBE that mitigates them. The chief virtues of this approach are that it takes the challenges with complete seriousness, that it integrates creative insights from several disciplinary sources, and that it resists every kind of malodorous oversimplification of the phenomena under study.

I. Eight Problems

Of the many challenges facing the neurological study of RBBE, we name the eight to be discussed below the point, complexity, modularity, reporting, semantic, evolution, ontology, and analogy problems. Each is multidisciplinary in character because the neurological study of RBBE necessarily takes its rise in a multidisciplinary context of study. To forget this is immediately to fall into the trap of underestimating how complex the phenomena of RBBE are and how difficult it is to specify what it is whose neurological embedding we seek to study. So we must refer extensively to other disciplines in our description of these problems.

1.1 *The Point Problem*

A particularly controverted problem is identifying the point of the neurological study of RBBE. For most investigators in this emerging field of study, it is probably fair to say that a fundamental aim of the neurological study of RBBE is to test the hypothesis that there are reliable brain-RBBE activity correlations. But even if such correlations are eventually identified, how will it matter? What will it tell us? Why are such correlations significant? In short, so what if there are brain-RBBE correlations?

We contend that the identification of reliable RBBE-brain activity correlations will trigger significant social effects and that investigators must be aware of this fact. If it can be reliably established, for example, that RBBEs occur only in the presence of specific brain activity patterns and cease to occur when those patterns of activity cease, then many of the ancient philosophical debates over RBBE will, arguably, have been settled. Spiritual experiences either co-occur with material events or are reducible to them. In either case, material events are crucial for RBBE. If reliable brain signatures of RBBEs can be established then it becomes easier to argue that human beings need a material substrate, the brain, consciously to experience religious cognitions. They may even need very selective *patterns* of neural activity consciously to experience RBBEs.

Once such reliable brain-RBBE correlations are established it may even be possible to produce RBBEs on demand, simply by stimulating the relevant neural networks. Does spiritual intoxication on demand raise any ethical issues? Does the putatively tight link between RBBEs and selective neural activation imply or prove that RBBEs are entirely natural phenomena? Does reference need be made to supposed supernatural entities that have hitherto been thought to cause RBBEs? Does the establishment of a reliable brain signature for RBBE render hypotheses about God or nirvana or the Dao unnecessary or incorrect? Or perhaps the specialization of neural circuits in support of RBBEs should be construed as evidence that God has designed human beings with the capacity to engage divine realities (Ashbrook & Albright 1997). The brain, in this view, is a biological machine that allows human beings to connect and communicate with ultimate reality, among many other activities.

RBBE-brain correlations carry important clinical consequences as well. For example, clinicians may find the data on RBBE-brain activity correlations very useful for helping patients who report that they are religious to better access their under-used religious coping strategies. The use of religious coping strategies may improve health outcomes for people who call themselves religious (Benson 1975, 1996; Koenig 2001, 2002; Pargament 1997; but see challenges to such research in Sloan et al. 2000; Sloan & Bagiella 2002). Clinicians equipped with knowledge of reliable brain-RBBE relationships might also be better able to help patients with religiously-tinted mental symptomology such as persecutory delusions or obsessional religious scruples to rein in such unwelcome compulsions.

Whatever the theoretical or practical payoffs of religion and brain research, our point is that investigators in this area will need to be unusually aware of the social implications of their research, given both the social policy questions and the more practical clinical implications. It is possible to limit neurological inquiry to satisfying pure curiosity about the neurological expression of particular types of RBBE, answering questions about the extent to which people differ in capacity for the various kinds of RBBE along the way. Pure research of this kind is never completely innocent. Even if researchers possess no pro-religion or anti-religion agendas—and that is definitely not always the case—the research itself occurs in a social context. The results of even the most ideologically neutral research can be potentially explosive in significance for social policy questions and for the existential self-understanding of ordinary people, both religious and non-religious. Whether we like it or not, therefore, neurological research into RBBE serves many purposes, some anticipated and some perhaps not. Researchers must recognize the linkages and implications and handle them responsibly.

1.2 *The Complexity Problem*

The diversity and complexity of RBBE resists convenient study. Recent decades have seen a number of research forays into brain function and elements of religiousness (see reviews in Andresen & Forman 2001; Atran 2002; Boyer 2001; Persinger 1987; Pyysiäinen 2001). It has become abundantly clear that RBBE refers to an enormously diverse range of phenomena and that this vast array of behaviors, beliefs and experiences must implicate virtually every brain function. But that makes it an awkward object for neurological study. That is why investigators choose to focus on a single paradigmatic religious belief, practice, or experience. This simplification strategy, in turn, generates its own problems.

For example, functional imaging of trained meditators yields fascinating results about one uncommon aspect of RBBE (D'Aquili & Newberg 1993; Newberg et al. 1997; Newberg et al. 2001). Similarly, neuroimaging studies of self-described religious people engaged in prayer (Azari et al. 2001; Beauregard et al. 2006; 2007) yield relatively consistent and circumscribed patterns of neural activation. But the results of such studies cannot be safely generalized to the entire suite of RBBE phenomena. Such research, while necessary and even invaluable is, nevertheless, almost irrelevant to the full range of RBBE in ordinary, untrained people, including even those who meditate or pray regularly but are not experts.

Again, the study of temporal-lobe abnormalities in the small group of persons with epilepsy establishes a link between one particular brain region and a few unusual aspects of RBBE, especially hyper-religiosity associated with interictal personality disorder (Bear & Fedio 1977, Dewhurst 1970; Geschwind 1983). But this link between interictal behavioral changes in a small group of patients (many of whom may have had significant neuropsychiatric symptomology as well; see Schachter 2006) says little about less peculiar types of RBBE, or about these same phenomena in other populations, or indeed why such phenomena occur in only a fraction of those with temporal-lobe epilepsy.

In short, most existing neurological research says less than everyone would like about the whole range of RBBE, from the ordinary to the anomalous, which is what matters for understanding religion in its most influential social and existential manifestations. To learn about the whole range of RBBE and the brain, we need to overcome this problem of scope and generalizability of findings.

We also need to overcome the dual tendency to exaggerate claims of the relevance to RBBE of a particular finding about neural embedding, and to treat RBBE as if it its essence were somehow captured in the tiny corner of its rambling territory that the latest neurological discovery helps us explore.

1.3 *The Modularity Problem*

The modular theory of brain organization and function (Fodor 1983; but see Fodor 2000) is too often taken for granted by many cognitive neuroscientists—indeed, it has to be in order to get very far in localization studies because of the coarseness of lesion-correlation techniques and existing imaging techniques. The role of the modularity hypothesis in such research leads to colorful claims that a link has been discovered between an observable change in brain function and a phenomenological feature of the state of mind reported by the experimental subject. But such claims are inevitably strained, and we would feel much more comfortable with something other than gross regional correlations. A given region of the brain is potentially involved in many functions, and most interesting behaviors and states of consciousness have complex neural realizations. Thus, there is slender basis for unequivocally assigning an interesting phenomenological feature of an experience to one function in one brain region. The classic example of such hasty associations is talk of a God part of the brain (Alper 2001; and see the discussion in Ramachandran & Blakeslee 1999) or a God gene (Hamer 2005)—as if all religious people are interested in God, and as if the neural embedding of the vast variety of RBBEs can be localized to a single brain region. Neither premise is remotely sound.

More importantly, the modular theory of the brain itself is deeply flawed. There is neurological structure and specialization of function, to be sure; functional imaging clearly establishes that, particularly for highly focused, isolable activities. But there are also overlaps of different functions in any given region, and all functions operate within an overarching integrating process of global electro-chemical signaling. The neural representation of a state of consciousness with any degree of cognitive or behavioral richness is extraordinarily complex. The more we recognize this, the more we come to see neuroimaging and lesion-correlation techniques as useful only for highly circumscribed purposes. Neuroimaging techniques may be useful for identifying the suite of key nodes in a neural network that often, though not invariably, gets recruited for a specific and very well-defined task. Lesion-correlation techniques conversely are most useful for identifying the essential nodes in a network that mediates a given behavioral competence. But both are potentially unreliable or misleading guides to discovering correlations between neural processes and most of the ordinary RBBE phenomena that matter to ordinary people.

1.4 *The Reporting Problem*

A far-reaching challenge that has thwarted rapid advance in both consciousness studies and the neurological study of RBBE is the inevitable reliance on subjective reporting. Many battles over this have already been fought in the methodological literature, with behaviorists resisting introspection and subjective reporting (Watson 1913, 1929; Skinner 1974), and phenomenologists of various stripes eventually reasserting the value of such modes of data collection (see Kukla 1983; Lieberman 1979; Pekala 1991; Revonsuo 2005).

The problem is not so much the possibility of deliberate deception by subjects; except in special circumstances, this possibility can be minimized through careful experimental design. Rather, the problem is the complexity of brain processes and the likelihood that subjective reports of states of consciousness do not accurately reflect all of the relevant factors. This is most difficult when research turns on the smaller details of the contents of consciousness, such as a subject's report of the order of conscious processing. There is also the problem of interference, whereby the experimental subject's report materially alters the state of consciousness under study. There is the problem of selection bias, whereby the experimental subject unintentionally emphasizes particular aspects of a state of consciousness in order to answer a question framed in a particular way or to please the questioner. There is the problem that experimental subjects may not be able to access or produce the relevant states of consciousness under study simply because they have no control over the relevant links between cognitive prompts and neural production of particular states, because these links vary from person to person, or because these links vary with age and experience. There is the problem that experimental attempts to abstract particular states of consciousness from their natural contexts might effectively destroy some of their salient features. For example, remembering is not the same as directly experiencing, both because of its second-order character, and because of the selective processing involved in memory recording.

Each of these problematic factors, and a range of others, complicates experimental design in the neurological study of consciousness, including RBBE. Other reporting problems are more commonly found in association specifically with the study of RBBE. For example, intense conversion experiences routinely produce powerful convictions around novel and untested beliefs, despite their sometimes dramatic lack of coherence with existing beliefs (Ullman 1989). We can speculate that this phenomenon is probably due to the intense swamping of ordinary semantic matching processes that typically govern whether a candidate belief is accepted into the network of working beliefs (Brothers speculates along these lines in Wildman & Brothers 1999). Regardless of how we neurologically explain convictions around new and untested beliefs, this cognitive process makes it difficult to gain access to a subject's reasons for a holding a belief. Again, conceptual frameworks are such potent factors in RBBE that it is difficult to discern when subjects are offering different descriptions of experiences with neurologically similar expressions and when they are describing states with quite different neurological expressions. This is a difficult factor in crosscultural comparative research of every kind (see Neville 2001) but nowhere more so than in the neurological study of RBBE.

1.5 *The Semantic Problem*

Access to the contents of consciousness is, at least initially, at the semantic level of concepts and ideas. Experimental subjects can communicate these contents directly to the investigator and priming techniques can be used to access some of these contents as well (Wenger 2004). Yet the neural embedding of RBBE is at the level of brain regions, neurotransmitter functions, and specific neurological processes. What is the relationship between the semantic level and the neural level of brain functions? This potentially vast problem is well known because it is so obvious. Yet its intractability constitutes a systematic weakness in the neurological study of RBBE. This intractability derives from the dependence of such studies on subject reports of states of consciousness, and the inevitable complexity of the relationship between the semantic and neural networks within the human brain. Researchers have to contend with individual differences in neural-semantic network mapping, with neural plasticity and the effects of training, and with the possibility of multiple realizations of phenomenologically similar cognitive states within a single person.

More than anywhere, this is where a breakthrough is needed in the neurological study of consciousness in general, and of RBBE in particular. We will argue that this is the area where a breakthrough is within reach.

1.6 *The Evolution Problem*

Evolutionary psychology and cognitive science have jointly sponsored some of the most spectacular interpretations of RBBE in recent years (for example, see

Atran 2002; Boyer 2001; Dennett 2006; Dawkins 2006). The promise of the evolutionary framework for understanding the emergence of human brain functions, including those associated with RBBE, is superficially obvious. Knowing how humans developed the neural capacities for the variety of RBBE phenomena is supposed to help us understand, predict, regulate, and evaluate such phenomena. This is correct, as far as it goes, but dangerously incomplete. In fact, the most careful research into the evolutionary significance of RBBE produces a wide variety of interpretations and evaluations (see papers in McNamara 2006). The connection between RBBE and evolution is crucial but it is currently so flexible a connection that dramatically conflicting interpretations are possible even with regard to whether the traits underlying RBBE are selected for that function, for other unrelated functions, or not selected at all.

Evolutionary theory has several fascinating but problematic lines of connection specifically with the neurological study of RBBE, of which we mention three here.

First, experimental designs in the neurological study of RBBE are often forced to make assumptions about evolutionarily stabilized features of the brain (the structural features that are shared across individuals) and their significance for behavior. Such assumptions are made necessary by experimental reliance on semantic-level subject reports to detect presumed neural-level activations, as described in the previous section. Of course, it may be that individuals offer similar reports of experiences that are neurologically quite different. Indeed, this would be quite likely given neural plasticity, social conditioning, and individual variations. But neurological investigation of RBBE requires the assumption that, at least in most cases, semantic-level reports are signals that the same neural processes are at work. This assumption is credible only if the neural-semantic link has been evolutionarily stabilized, either through selection or as a recurring byproduct of neural processes selected for some other reason. But a great deal of work is required to support the assumption of evolutionarily stabilized semantic-neural correlations, and it is not always clear that such work is even feasible within evolutionary psychology.

Experimentalists rarely have the luxury to slow down to ask whether these correlational assumptions are sound from an evolutionary point of view. In some respects there is no problem with forging ahead with an assumption that may prove mistaken in the long run. Large experimental populations mitigate this problem, as they help researchers pick out cases of exceptional neural wiring. But small populations make it impossible to decide whether the features detected in neural imaging are the result of specific conditioning rather than being native brain structures. This makes it difficult to interpret the discovery of a specialized neural process in response to certain meditative states that experts can achieve, for example. These neural processes may be the result of the meditative state achieved, the fruit of training required to induce that meditative state, or an exhibition of individual variations in brain structure whereby only certain people could produce the meditative state anyway. These possibilities haunt many studies in this area, making the significance of the results genuinely difficult to interpret.

Second, the functions of RBBE crucially depend on interpreting them in evolutionary perspective. Particular functions of particular types of RBBE in particular contexts may be wholly circumstantial and say nothing at all about evolutionary adaptations and side-effects. But the evolutionary framework does shed light on potential this-worldly functions of RBBE by showing which are adaptive in which settings, which are side-effects of adapted traits, how changing environments might make maladaptive some functions of RBBE that spring from traits that were adaptive in another context, and a host of similar issues. This knowledge is vital for assessing the negative and positive value of RBBE, for establishing and evaluating strategies for optimizing the positive effects and regulating the negative effects of religious experiences, and for deepening our understanding of human social life.

Third, an evolutionary approach to studying RBBE can help the investigator develop concrete and partially testable hypotheses. Analyzing RBBE into neurological components allows researchers to identify potential design specifications for the phenomenon in question—that is, the cognitive architecture underlying a type of experience, a type of social behavior, or a process of religious belief formation. With such design specifications in place, it is possible to ask relatively precise questions about evolutionary selective pressures. Evolutionary forces, including selective forces, operate in part by preserving and promoting functional design and eliminating non-functional characteristics over time. The evolutionarily most salient aspect of a functional characteristic is its design—design, that is, in the technical sense of the exhibition of structural and operational elements that implement some process that accomplishes some important function or solves some important problem faced by our ancestral forebears. Focusing research on the identification of potential design specifications of the various experiential, behavioral, and cognitive capacities associated with RBBE facilitates identification of potential functions of the trait in question and thereby helps both to reconstruct the process of human evolution in the ancestral environment and to evaluate claims about the evolutionary origins of RBBE phenomena.

These three examples make clear how important an evolutionary framework is for the neurological study of RBBE. The possibilities for interpretation are unconstrained in a most unsatisfactory way when the evolutionary framework is absent. Even when an evolutionary framework is present, however, the evolutionary explanation of the neurology of RBBE faces all of the challenges familiar from evolutionary psychology (see Atran 2004; Barkow et al. 1992).

1.7 *The Ontology Problem*

Attempting to answer ontological questions (alluded to above) about RBBE strikes some ivory-tower intellectuals as futile. They might be right in the final analysis. But there is no question that the ontological interpretation of RBBE is among the most pressing issues for ordinary people and for the religious and anti-religious communities which they revere and serve, or ridicule and shun, as the case may be. Is there a supernatural realm or not? Are there supernatural beings with which human beings can communicate? Is the world of experience fundamentally illusory? Is the soul exclusively embodied in the brain so that the dissolution of neural organization destroys the soul as well? Are there other realms of reality into which people can travel and from which they can gain information? Are there flows of power that we can tap for the purposes of wisdom, healing, and control? Do religious practices such as petitionary prayer change merely the attitude of those who pray or also the wider world?

From a philosophical point of view, most of the major classical ontological theories of human cultures and religions can be affirmed with only minor modifications in the face of our contemporary knowledge about the neural and social embedding of RBBE. That includes body-soul dualism—brain damage can destroy the soul, or it can merely destroy the antenna-like means by which the indestructible soul connects efficaciously to the body. It includes shamanic travel through other-worldly realms—experiences of such journeys may be misunderstandings of unusual brain phenomena or the mind's best way of comprehending the soul's actual journey. It includes demon possession—who really knows how putative demons would interact with human bodies and brains?

This apparent philosophical neutrality of the neurological study of RBBE to ontological questions in the history of religions is roundly rejected by many neurologists. They operate within a naturalistic framework because nothing else keeps them looking for causal processes that are tractable for neurological study. And because this framework is compelling on a daily basis, it understandably tends to dominate the ontological imaginations of most neurologists. So pointing out philosophical methods for preserving alternative ontological frameworks tends not to be persuasive. But investigators of RBBE-brain correlations cannot allow the functional naturalism of scientific work to become a full-blown naturalistic ontology without due consideration. And the consideration that is due turns out to be extremely complex and not terribly interesting to most working neurologists. This is how popular books slip so quickly from “RBBE is realized in the brain” to “a naturalistic ontology is correct and supernaturalistic religious belief is delusion.” This kind of sloppy reasoning must be resisted for the sake of a responsible interpretation of RBBE—and we say this as thinkers who actually do defend naturalistic ontologies.

So the pressing problem becomes precisely how the neurological study of RBBE can produce the kinds of traction necessary for resolving these ontological questions. In fact, despite the possibility of saving a wide range of ontological hypotheses in face of the neural and social embedding of RBBE, it may still be the case that certain ontologies may achieve greater overall coherence with neurology than others. This sort of traction between neurology and philosophy won’t be at the course level of proofs and refutations, but rather at the subtle level of cumulative weight of empirical evidence joined with integrative interpretation. Assessments of this kind require the patience and perspective of the philosopher and the neurological study of RBBE must squarely face this difficulty.

1.8 *The Analogy Problem*

As persuasive neurological interpretations of RBBE are put in place, religious and anti-religious intellectuals of various kinds press hard the question of the reliability of religious cognitions. One of the functions of a religious community, whether acknowledged or not, is to legitimate the “sacred canopy” of its own making (see Berger 1967). This involves trying to make the best sense possible of a religious community’s truth claims, interpreting this as an investment in the health and future of a group that matters to those mounting such inquiries. These people are usually theologians or philosophers of religion, and they are usually members of the group in question. Outsiders can also mount such theological inquiries, with the opposite aim of unmasking the falsity of religious beliefs (neutral inquiries in the name of sheer curiosity are possible but rare). Assessing the reliability of the cognitive elements of RBBE is of enormous importance for religious groups and for those who oppose them. It is also broadly valuable for gaining an understanding of the interactions between religious groups and the wider society and for the psychological processes of conversion, personality change, and achieving existential fulfillment or falling into despair.

Arguments about the reliability of RBBE have typically depended on analogies between the cognitive elements of RBBE and other brain systems about which we supposedly have more information. For example, some Christian philosophers have drawn an analogy between certain aspects of religious experience and ordinary sensory perception. On the basis of this analogy, we are asked to believe that the cognitions of religious experience are as reliable as ordinary perception. Indeed, the argument goes further: we should take for granted the reliability of religious experience until contrary evidence forces abandonment of religious beliefs, because that is how we operate in regard to sense perception. (The debate among philosophers over these questions has bloomed into a large literature with the analogy and its evidential force interpreted in diverse ways; seminal contributions include Swinburne 1979 together with the critique in Gale 1994a; and Alston 1991 together with the critique in Gale 1994b and the review of the ensuing debate in Byrne 2000).

Analogizing happens in other areas, also, as neurologists and cognitive scientists use an existing model (of vision, say) as a guide to another brain system. Sometimes such an analogy works well in the long run, and sometimes it doesn't, but in such cases the analogy is used as a guide for seeking out the actual causal processes involved in the process under investigation. Unfortunately, in relation to arguments over the cognitive reliability of RBBE, the basis for such analogies is typically weak. The analogy with successful sense perception and the analogy with perceptual illusion are not used to inspire a quest for the actual causation of religious cognitions so much as a way to achieve a preconceived ideological aim.

Thus, the problem in this case concerns how to use analogies among various neural processes to advance evaluation of the cognitive reliability of RBBE. Or, perhaps it is better to find ways get beyond analogies by replacing them with detailed causal accounts that allow us to assess the cognitive reliability of RBBE more directly.

II. Key Strategic Principles

There is no silver-bullet solution to these eight problems. It is in the nature of the case that research and experimental design should be as difficult as these problems suggest. The accumulated ingenuity of experimenters will make the largest difference in the long run. But it is crucial to understand the difficulties, to acknowledge them straightforwardly, and to indicate how experimental designs and interpretation of research addresses them. Beyond that general point, there are several key principles for guiding a research project on the neural embedding of RBBE through the conceptual maze defined by these eight problems.

2.1 *Leverage on Brain Correlations*

The first principle is that a research project must offer a way to get leverage on specific brain functions and a large range of the domain of RBBE simultaneously. The key here is to locate populations that facilitate study of connections between a well-defined and circumscribed group of brain functions and a wide range of types of RBBE. The right neurological population can help researchers isolate particular brain functions (note: this is not the same as brain regions, though there may be a connection) without narrowing the range of RBBE phenomena to the point of irrelevance. Then the question is whether it is feasible to study such populations.

Several tragic diseases produce sizable neurological populations that can be studied conveniently. A classic example is Parkinson's disease (PD). Most PD patients evidence a remarkable range of self-reported changes (relative to a pre-morbid baseline) in religious sentiment and practices. This is precisely what is needed to overcome the complexity problem (that is, the problem of scope and generalizability of research findings). Some undergo new and intense conversion experiences and others lose all interest in religious goals and practices. Their cognitive access to previously acquired religious knowledge such as ritual action scripts and God (or ultimacy) concepts can be dramatically altered as a function of disease and medication status. Their primary neurologic deficit involves dysfunction in striatal-prefrontal circuits. These circuits figure prominently in theoretical models of brain mediation of religious experience (see papers in McNamara, 2006) and thus PD patients represent an ideal population in which to assess the adequacy of these theoretical models. Moreover, the most common PD treatment is a medication (levodopa) that fairly decisively puts patients into a normal-functioning state for a period of time each day, which both indicates the brain functions affected (the dopamine system, especially in the frontal lobes) and makes studying PD patients particularly convenient.

Something similar, though with significant variations, can be said of other neurological conditions, such as temporal-lobe epilepsy, circumscribed stroke, schizophrenia, and obsessive-compulsive disorder.

2.2 *Multidisciplinary Cooperation*

The second principle is multidisciplinary cooperation. It is important to work closely with scholars of religion to make sure that the broad scope of RBBE is not reduced to serve the convenience of neurologists. Equally important is to work closely with theoretical neurologists to make sure that the demands for experimental convenience do not lead to the embrace of unsteady analogies, the over-simplification of brain processes, or the neglect of the sturdier connectionist models in the name of modular convenience.

It is also important to make use of cutting-edge, tested tools to minimize the problem of subjective reporting, on which there is now a sizable literature.

The evolutionary framing of this research is crucial; there needs to be assiduous review of experimental designs in search of the evolutionary assumptions being made, and collaborative relationships with the sorts of evolutionary psychologists who can help assess the reliability of such assumptions.

There must also be expert representatives of the disciplines for which the research promises to have implications, in order to evaluate whether the claimed implications are ephemeral or substantive. Neurologists and philosophers might have quite opposite opinions about how important a neurological finding might be for supporting one ontological hypothesis over another.

These lines of multidisciplinary cooperation can make all the difference in producing reliable interpretations and thereby adequately achieving the imagined point of the research. They mitigate all of the eight problems except the semantic problem.

2.3 *Translating between Neural And Semantic Networks*

The third principle concerns the semantic problem, which is possibly the most technically difficult issue. Yet it is also the issue that is most susceptible to a major breakthrough, as against merely mitigation through careful collaborative management. At the most basic level, merely recognizing the fact that there is a difference between semantic and neural levels of analysis defeats some experimental designs and limits the relevance of the results in others. But this kind of policing of design and interpretation does not get us very far.

The semantic problem actually has to be solved for research to move ahead efficiently. That requires a new level of analysis and a heightened degree of sophistication in both experimental design and theoretical vision. In particular, it requires constructing careful translations where possible between the evolutionarily stabilized parts of the semantic and neural brain networks. Then these translations can help researchers establish correlations between neural functions and the subjective reports of experimental subjects. This is easier to say than to do, but it is a vital guiding principle nonetheless.

III. Eight Steps to Mitigating the Problems

We sketch here the conceptual framework for careful neurological research into RBBE that squarely acknowledges the whole range of problems identified above and centralizes the three strategic principles just discussed. The result has the potential to restructure multidisciplinary research into the neural embedding of RBBE. We present the conceptual framework in eight steps, arcing from the details of neurology to ethics and philosophy. Though this proposal as it stands is not intended to be comprehensive, it is intended to be expandable to accommodate the wide variety of disciplinary perspectives and research efforts in the neurological study of RBBE that can profit from its approach.

Step 1: Quantitative Signatures of Extended States of Consciousness

Producing Quantitative Signatures

Quantitative, survey-based signatures of an extended state of consciousness help us deal with the problem of subjective reporting, the complexity problem, and the semantic problem. We must impose strict requirements on a quantitative signature if it is to prove useful for studying the neural embedding of RBBE. The wrong kind of quantitative signature will not pick out any interesting features of RBBE.

A candidate for the right kind of quantitative signature is the Personal Consciousness Inventory (PCI) of Ron Pekala and his associates (see Pekala 1991). The PCI gives a quantitative profile of the contents and qualities of personal consciousness along 26 measures, grouped into 12 major dimensions (positive affect, negative affect, altered experience, imagery, attention, self-awareness, altered state of awareness, internal dialogue, rationality, volitional control, memory, and arousal). In graphical terms, a signature is a bar graph with 26 vertical bars extending from a baseline of 0 as far up as 1. This quantitative signature is produced by triggering a memory using carefully designed prompts and then asking the experimental subject to fill out an inventory. It can also be used when someone is actually in the midst of an experience.

This approach involves asking the participant to recall an experience and then to reflect on that experience as they answer questions about it. More intrusive methods are available as well. It is possible to induce the type of experience under study using sensory deprivation techniques, virtual reality environments, and pharmacologic methods. All of these approaches give the experimenter slightly more control over the type of experience the participant undergoes but the price can be high. The greater the attempt to induce a religious experience the more artificial the experience will be and thus the ecological validity of the experience is called into question.

In any case, once an experience is produced (either by means of the participant's memory or through some induction technique) the experimenter must then choose a method for quantifying key features of that experience. Options for deriving quantitative signatures from verbal reports of RBBEs include narrative analysis (Herman & Vervaeck 2005), discourse analysis (Schiffrin et al. 2003), and linguistic analyses, including automated word category counts (Pennebaker et al. 2001). As in the case of the PCI, these involve applying techniques developed in another area to the domain of RBBE, and thus may require modification.

The existence of several methods for generating quantitative signatures promotes cross-checking that promises to increase confidence in the reliability of each method independently and also to guide modifications. Note that the different quantitative techniques produce different *types* of results. This complicates interpretation but helps to avoid oversimplifying RBBE phenomena.

General Quantitative Signatures

We can gather quantitative signatures for all kinds of extended states of consciousness, including religious behaviors, beliefs, and experiences (RBBEs) and experiences that do not appear to be religious at all. If we compare quantitative signatures for different kinds of RBBEs and different kinds of other experiences in a single person, the quantitative signatures display obvious variations. With the right kind of quantitative signature, it is also likely that we will notice consistent patterns of variation across individuals. If this is the case, then we have discovered individual-transcending quantitative signatures for particular extended states of consciousness. We call one of these a "general quantitative signature" (GQS). For example, deep grief may produce more or less the same quantitative signature for most people who experience it, and the same might be true of ironic enjoyment, peaceful prayer, high stress, or loyalty under pressure. Some experiences may not lead to a GQS. In such a case, we are led to ponder whether we are asking the right questions for detecting a GQS, or whether there is no evolutionarily stabilized, individual-transcending neural basis for a GQS in that instance.

Producing a GQS is a formidable task. To imagine what a GQS looks like, recall the PCI and its bar graph. In that context, a GQS takes the form not of a particular bar graph, but rather of a set of ratios that express the typical way that the PCI signature for the state of consciousness being characterized varies relative to a specified average of PCI signatures for each individual. This ratio approach makes systematic allowance for individual differences.

Producing a GQS for a specific experience is probably less illuminating than producing a GQS for a particular *type* of experience because these tools are not sensitive enough to pick out particular experiences. For example, qualitatively intense experiences may have a GQS regardless of other specific modalities of the experience. It is also likely that certain sub-classes of RBBE exhibit a GQS. For example, a subset of highly trained meditators in a particular state of consciousness produce similar fMRI scans (Newberg 1997, 2001), so it is likely that this state also has a GQS.

It is possible to imagine competing, testable hypotheses about these different types of GQS. For example, on the one hand, if intense experiences are evolutionary fundamental, then the GQS for intensity should appear in quantitative measures of intense experiences of all kinds, whether or not they are RBBEs, and any specifically religiousness-related GQS will be subordinate to the intensity GQS. On the other hand, one or more religiousness GQSs might be dominant, and the intensity GQS subordinate. If one of these conjectures turns out to be correct and the other mistaken, this would have important implications for interpreting RBBE in an evolutionary framework.

Step 2: Mapping States of Consciousness onto the Brain's Semantic Network

Neural Network Activation and Evolutionary Stabilization

A reasonable conjecture is that a GQS reflects particular, repeatable activation patterns in the brain's neural network. The consistency of activation patterns corresponding to the existence of a GQS is presumably due to evolutionary stabilization of those activation patterns.

The linkage that a GQS discloses between brain activation patterns and evolutionary stabilization requires careful analysis. Neural activation patterns that became stabilized over evolutionary time may (or may not!) be adapted traits or exapted side-effects of adapted traits, and they may (or may not!) say something about the survival value of the corresponding behaviors and states of mind. In both cases, however, they *probably do* say something important about the social functions and cognitive structure of the experiences corresponding to a GQS.

Without a detailed evolutionary framework, it would be easy to rush to unsteady conclusions about the role of RBBE in stabilizing brain functions in the ancestral environment, either centralizing and in a way authorizing them as adaptive traits, or delegitimizing them as cognitive delusions much like visual illusions or mental illness that are neither adapted nor useful exaptations. It is true that conclusions such as these are at stake in these discussions. But the evolutionary stabilization of neural activation patterns as detected in a GQS says very little by itself one way or another on these debates. Only a systematic evolutionary interpretation of human emergence in the ancestral era can hope to address such questions responsibly. GQSs serve as indispensable data points for such large-scale evolutionary interpretations of RBBE. At this point, speculative large-scale interpretations are well known and we need much more data to have a chance of sorting between them.

Studying the Neural Network via the Semantic Network

The neural network that underlies brain activation patterns has a definite structure but is famously difficult to study. A further conjecture, crucial for neurology, is that we can use the brain's semantic network to study the brain's neural network. A semantic network has meanings for nodes and relations of various kinds between meanings as network links. Each meaning node in the semantic network corresponds to a particular activation pattern in the neural network. Each link between nodes in the semantic network corresponds to a causal relationship between activation patterns in the neural network. Mapping the semantic network gives access to relevant functional properties of the neural network, even if the details of its physical structure remain out of reach for now.

Mapping the brain's semantic network has to focus strictly on the evolutionarily stabilized parts of the semantic network because these are the parts that transcend individual differences. What we know about evolutionarily stabilized parts of the semantic network comes mostly from cognitive psychology, backed up by evolutionary psychology. But every time we find a GQS we discover another evolutionarily stabilized aspect of the semantic network.

Mapping the brain's semantic network has to take account of all relevant data but not necessarily in the same way. For example, a simple story relating a conversation between two characters might be expressible in the map of the semantic network in terms of nodes for people and conversations and contextual features of the event, and it may have links expressing what is happening to whom and where and why it is happening. A GQS-feature of the story such as the intensity of the story's impact on the teller may not have a distinctive node or a distinctive link but rather may be expressible in terms of geometric features of the activated part of the semantic network, such as breadth of activation or approximation to a scale-free structure.

The Structure of the Semantic Network

The actual structure of the semantic network is an empirical question that has to be answered by careful analysis of categorization patterns, recurring features of experience, and typical assumptions about "what happens next" and "why she did that" of the sort that cognitive psychologists routinely study. The links to Jungian, myth-analysis, and other structuralist lines of thinking are potentially helpful here. Indeed, the semantic-mapping approach to such controversial structuralist insights may actually serve to rehabilitate them in the minds of cognitive scientists by providing a means to distinguish between genuine and merely apparent recurring structural features. There are many techniques that can be used to study the structure of the semantic network including word association tests, conceptual priming tasks, and network modeling procedures. It is important to capitalize on diverse existing work that attempts to isolate common cognitive features in human minds.

Investigation of the expression of GQSs in the semantic network is similarly an empirical matter, also involving especially the application of linguistic analysis tools to narratives that express the state of consciousness for which a GQS exists. But to the extent that a GQS refers to a particular quality of experience (such as intensity or religiousness in a particular aspect), its realization in the semantic network is probably geometric, as has been noted. This requires the tools of network analysis rather than node- and link-mapping. The mathematics of graph theory and network analysis is extremely complex but there are now software packages that mask a lot of the mathematical details and are immediately useful for analyzing particular networks (Barabisi 2003).

A plausible result of this line of semantic-mapping research might be the following. Suppose we have a map of the major nodes and links of the evolutionarily stabilized parts of the semantic network. The map is detailed enough to permit network analysis so that we can detect large-scale geometric properties. A GQS such as the signature for intensity or some other phenomenal state turns out (i) to be detectable in narratives (ii) that subjects report as subjectively clear and (iii) corresponds to (say) breadth of scale-free activation of the relevant portion of the semantic network. In that case, we would conclude that this GQS reliably picks out correlations between subjective features of experience and objective measures of narratives. This in turn demonstrates the extent to which subjective reports are reliable, at least in one dimension.

Step 3: Relating the Brain's Semantic Network to the Brain's Neural Network

Translating between Networks

A mapping of the brain's semantic network can be translated (in places at least) to a mapping of the brain's neural network. This is extraordinarily important because, to express it coarsely, whereas ideas affect the brain via the semantic network, ingested substances and diseases and medicines know nothing of ideas and affect the brain via the neural network. Because every cognitive experience involves both the neural and the semantic networks, every cognitive experience is potentially vulnerable to modification, stimulation, and inhibition by means of both networks. To the extent that we care about particular cognitive experiences (e.g. responsible behavior, clinical depression, or RBBEs) we need to pay attention to both networks and to both lines of influence and interference.

Once a hypothesis about a correlation between the semantic network and the neural network is in hand, it is important to evaluate its robustness and to attempt to correct or refine it. A number of methods are useful for testing semantic-neural correlational hypotheses. Neural-network models of a particular component process of a particular type of RBBE test how well a correlational hypothesis coheres with existing successful neural models. Evolutionary and genetic algorithms expose correlational hypotheses to plausibility tests related to the origins and development of the corresponding RBBE capacities. Multi-agent modeling techniques test a correlational hypothesis by extending it to the social contexts of group religious behaviors, and comparing the results with what is known observationally from anthropology and social psychology.

There are good methods for testing correlational hypotheses once we have them in hand, but how do we efficiently generate compelling hypotheses in the first place? Functional neural imaging techniques at this point are relatively unhelpful for establishing a reliable translation between the neural and semantic networks. Functional imaging focuses on brain activities that have localized neural expressions, in accordance with the modularity thesis of brain structure. But the neural activation patterns corresponding to nodes and links and geometric properties of the semantic network are highly unlikely to appear in particular modules. Even if they do there is no way that functional imaging could conveniently distinguish between activation patterns for different features of the semantic network. That is, two nodes in the semantic network might be expressed in the neural network as interpenetrating activation patterns, which would be indistinguishable in any functional imaging equipment that we currently have or can imagine.

The Role of Neurological Disease

The key to generating promising hypotheses about how to translate between the brain's semantic and neural networks given today's technology is disease—specifically, human disorders involving breakdown or impairment of the brain in relatively circumscribed functional domains. We have arguably learned more about the brain's support of language through study of the aphasias and the neurodevelopmental disorders affecting some aspect of grammar than we have through neuroimaging studies of highly restricted and ecologically suspect verbal tasks. Certain neurological conditions affect specific aspects of the brain's neural network and have significant impacts on the semantic network. This establishes a causal link that facilitates partial translation of one into the other. Of course, knowledge of the brain regions involved in RBBE gained in this way can only be partial because it depends on the particular diseases that create neurological populations. At this point, the complexity problem reminds us that it is important not to generalize too enthusiastically from discoveries about the role of a part of the neural network in RBBE. Precisely because RBBE is so complex and multi-faceted, it is very likely that many brain regions play crucial roles.

We have mentioned a number of neurological conditions that promise translations between neural and semantic networks: PD, temporal-lobe epilepsy, circumscribed stroke, schizophrenia, and obsessive-compulsive disorder. The key is to study a disease that selectively affects circumscribed regions or systems of the brain and that results in patterned breakdown of specialized cognitive systems.

The Role of Quantitative Signatures in Translation

Along with other domains of behavior, belief, and experience, our understanding of RBBE should be greatly enhanced by even a partial translation between semantic and neural brain networks. The GQS is one of the keys to making this translation count. To see how this works, consider the following speculative line of reasoning.

Suppose we have a partial translation between the semantic and neural brain networks. We know from PD patients that the dopamine system in the frontal lobes of the neural network is most directly affected by the disease (Agid et al. 1987). We discover from studying PD patients at the semantic level using interview instruments that access to the RBBE parts of the semantic network is easier to achieve when they are treated with dopaminergic medications (such as levodopa), and that untreated patients or patients treated in other ways or patients interviewed when the effects of levodopa have worn off display markedly less interest in RBBE or find it much more difficult to access RBBE concepts and beliefs (McNamara et al., 2006). We conclude that the dopamine system in the frontal lobes is crucial for producing strong interest in RBBE and for maintaining access to the RBBE parts of the semantic network. This is direct evidence of a causal link between a brain system and the qualities of a state of consciousness. This also leads us to a range of testable hypotheses about the effects of particular socialization techniques and particular ingested substances on interest in RBBE; we will hypothesize that the dopamine system in the frontal lobes is implicated.

Continuing this speculative line of reasoning, the particular way that RBBE is more and less pronounced in PD patients is quite important. This is where the GQS enters the picture. Survey data may indicate that the GQS for intensity is what is most obviously affected by treating (as against not treating) PD patients. Thus, the more precise conclusion is that the dopamine system in the frontal lobes is crucial for promoting the kinds of intensity that are necessary for sustaining strong interest in, or maintaining access to, RBBE. Other aspects of RBBE might be relatively unaffected, and other non-religious intense experiences might be profoundly affected. In this way, we avoid the careless reductionism of the complexity of RBBE that is an ever-present danger in its neurological study. We are also led to more refined testable hypotheses because we focus on a particular condition for RBBE (e.g. intensity) rather than on RBBE as a whole (which is too complex to be tractable).

Note that this speculative line of thinking introduced the neurochemical level. Neurochemicals activate or deactivate neural networks and when they act in particular networks (e.g. selected regions of the prefrontal lobes, as shown in PD patients) they serve to facilitate access to information stored in those networks. The link to the neurochemical level therefore allows us to address semantic networks by means of the neural level. Attention to neurochemical correlates of RBBE also leverages understanding of the genetic contribution to RBBE. Genes code for the proteins that function in pathways for the production or regulation of neurochemicals. In short, using GQS data (and any other methods) to map between the neural and semantic brain networks opens research up to new possibilities by linking up worlds of information that often remain unconnected.

Step 4: The Evolutionary Substructure

RBBE is fundamental to the human experience, for better and worse, and it facilitates a number of key bio-cultural functions. But what precisely are the biological and cultural functions of RBBE? Informed public debate on the value of religion is impossible if the biological and cultural functions of RBBE are not known. Those functions cannot simply be read of by casual observation because of the subtlety of social embedding involved. Function is most effectively addressed within an evolutionary theoretical framework and in two ways.

First, experimental findings from the neurological study of RBBE can be assessed against current theoretical proposals concerning the evolution and function of RBBE. In this way, experimental data can be useful in adjudicating among competing theories of the evolution of RBBE. For example, if we find that dispositions to cooperate (on games or tests assessing cooperativeness) decline in tandem with RBBE scores in patients who are depleted of prefrontal dopamine, then the theory that religiousness evolved to support cooperativeness will be supported (not decisively, because of the usual caveats concerning common causation etc., but supported nonetheless). If, on the other hand RBBE scores or access to religious concepts change in tandem with disposition to seek out novel information sources, then the theory that religion evolved as a special knowledge-seeking faculty would be supported (again, with the usual caveats).

Second, it is also possible to use current advances in evolutionary theory to develop new approaches to RBBE phenomena, including its neurological study. For example, evolutionary theory could illuminate religion's effect on health (some beliefs appear to have privileged access to the autonomic nervous center regulatory controls), on religious obsessional behavior (selected patients with obsessive-compulsive disorder or schizophrenia develop persecutory delusions), ritual form (by means of costly signaling), distinctively religious emotions (awe and reverence are typically directed not to other humans but beyond human beings to nature or religious objects), and religiousness as a generator of cultural artifacts more generally. In short, an evolutionary focus yields greater experimental pay-offs by allowing a richer range of data to be assessed against theory.

Step 5: Ethical Considerations

The first four steps lay out the conceptual framework for research into the neurological embedding of RBBE made possible by carefully deduced quantitative signatures for extended states of consciousness, meticulous translation between the semantic and neural networks of the human brain, and thorough analysis in a robust evolutionary framework. The remaining four steps describe the forging of links to other disciplines. These links recognize the significance of the neurological study of RBBE beyond the realm of satisfying pure academic curiosity and implement the principle of multidisciplinary cooperation. The particular approach to the neurological study of RBBE outlined in the first four steps generates unusual detail and promises novel results, and so it offers unfamiliar kinds of leverage on the wider interpretative problems that arise in the last four steps. The influence of quantitative and mapping techniques in an evolutionary framework is felt at every level from the details of neurological research to the complexities of allied disciplinary connections.

Addressing the "point problem" described earlier requires recognizing the potential significance of neurological research into RBBE for a host of wider interpretative ventures in medicine, ethics, social policy, and philosophy. But it is equally important to acknowledge that just because neurologists believe there are such connections it does not follow that experts in the affected fields agree, and it would be embarrassing if neurologists overreached in claims about the ethical or political significance of a particular finding. Thus, it is crucial to test amateur intuitions about the wider relevance of neurological findings with experts in the relevant fields to see if the disciplinary connections are robust enough to support interpretation in the expected way.

We expect research into RBBE and brain correlations to have important implications for both the understanding and management of three target areas: (i) mental and physical health, (ii) political and social policy issues, and (iii) philosophical and theological questions. Each of these connections calls for two kinds of discourse, one less problematic and one more problematic. The less problematic kind of discourse is broadly *descriptive* in nature. The results of research about neural embedding of RBBE can enrich descriptions of each of these three target areas, and thereby deepen understanding. The more problematic kind of discourse is broadly *evaluative*. It requires establishing connections between neurology and valuational norms—norms for mental and spiritual health, for optimal political organization and social function, and for philosophical and theological adequacy.

Such criteriological discourse does not derive directly from the neurological research itself, but rather is brought to discussions by stakeholders. Sometimes the criteria or norms relevant to a particular application—say, the reliability of religious belief—diverge sharply. On other issues—say, physical health—there is wide consensus around norms and ideals, at least in a given era and culture. When there is conflict over criteria, it is vital to argue for value principles rather than simply taking them for granted or surrendering to the futility of relativistic despair, after which the forceful imposition of norms is the only alternative that remains. It is profoundly unwise to abandon the field of rational argument over criteria and norms even—especially—when it becomes frustrating. Those who care more about control than responsibility have always been quick to fill the void that such frustrated withdrawal produces.

Justification of the values expressed in such criteria is the domain of ethics. Thus, ethical reasoning is the key step in opening up neurological research to the other domains for which it has potential significance. For example, suppose we discover that the dopamine system of the frontal lobes is an essential component in generating enthusiasm for, and in maintaining access to the semantic network associated with, RBBE. Suppose further we discover that certain kinds of RBBE are implicated in both mental and physical health (in fact, there is already strong evidence for this). Finally, suppose we confirm that the kinds of RBBE that are linked to health are among those kinds of RBBE that the dopamine system of the frontal lobes supports. Then, we can draw one conclusion at the descriptive level, namely, that the dopamine system impacts mental and physical health, at least among people with a capacity for or openness to RBBE. Notice the lack of value terms.

To go further into the domain of management, as we would if we were in public health or medicine, we would need valuational categories of positive and negative health effects. This has been an extremely controversial issue over the years, particularly in regard to mental health, so ethical argument is indispensable, as are historical and cultural awareness. Nevertheless, so long as we remain committed to ethical justification of norms, we have evaluative categories tentatively at our disposal. The simplest of these categories may allow us to draw practical, correlational conclusions such as the following: a malfunctioning frontal-lobe dopamine system probably has *negative* physical and mental health effects, at least among the large majority of people for whom RBBE is a possibility. An even stronger conclusion, harder to justify ethically, bears on management and intervention: where negative mental and physical health is found in conjunction with a malfunctioning frontal-lobe dopamine system, prescribe medication to correct the dopamine malfunction and commend RBBE of the appropriate kinds (especially supportive group membership, generous helping activities, and simple meditation practices) to the patient; this will probably improve the patient's health.

This speculative example pertains to mental and physical health, which involves the least controversial kind of ethical reasoning about valuational criteria of the three target areas we have mentioned. In other areas, management and intervention are extremely controversial and potentially dangerous. The era when more extensive regulation of RBBE within individuals and groups is possible is fast approaching, whether we welcome it or fear it. How will human beings *minimize negative and maximize positive effects of RBBE, consistent with respecting the sanctity of individuals and the intrinsic value of cultural forms*? Assiduous ethical reasoning has to become more important in order to disrupt ideological structures of bias that would impose regulative measures without due consideration of all stakeholders and all relevant valuational considerations.

Step 6: Health Care Considerations

Any fair perusal of the religion and health literature will show that certain types of RBBE, when present, tend to contribute significantly to (both positive and negative) health outcomes. Unfortunately, the pathways mediating this effect are poorly understood. The most obvious candidate pathway for religion's effects on health, the brain, is only beginning to be thoroughly investigated as such. A reliable map of the brain regions associated with RBBE would foster reasonable hypotheses as to how religion impacts various physiologic systems known to regulate health.

For example, if certain religious cognitions are typically associated with activation in the central nucleus of the amygdala, then we can reasonably hypothesize that this nucleus' connections with the hypothalamus likely mediate, at least in part, health effects of religion. If, furthermore, we possessed reliable knowledge of brain-RBBE correlations, then potentially we could selectively (using either cognitive or pharmacologic techniques) activate or de-activate that region in order to enhance health in patients who wish to gain better access to their tried and true religious coping strategies. This is a controversial prospect, to say the least. Yet such powers are almost in our control, so our scientific understanding and our ethical argumentation need to be fully up to speed.

Step 7: Political and Social Considerations

RBBE is both problematic and valuable at all of the levels of its relevance: cultural expression, political power, economic practice, social change, worldview construction, communal identity, moral formation, existential orientation, mental health, and physical wellbeing, among others. This is because RBBE is profoundly rooted in human sociality just as it is intricately embedded in the human brain. The social and political ramifications of a religiously inspired and shrewdly calculated act of violence can beggar the imagination. Similarly, the implications of certain social or political policies for human health and existential contentment can be enormous. Wise educational practices can liberate people for creativity and cultural enhancement by freeing them from the bane of superstition; segregationist racial policies can leave a trail of destruction that rumbles forwards for centuries even after the policies are ended.

RBBE is implicated at every level of such policies, from motivation to articulation, from rationalization to implementation, and from causes to effects. For example, RBBE is enormously powerful in providing a release in the face of economically driven alienation that actually sustains oppression (Marx 2002), in establishing patterns of economic behavior (Weber 1930), in defining group identity (Durkheim 1954/1912), in legitimating the social construction of reality (Berger 1967), in replenishing economic and social attitudes that such systems cannot reproduce themselves (Bellah et al. 1991), in preserving superstitious beliefs and behaviors (Frazer 1900; Tyler 1874), and in powering the global clash of civilizations (Huntington 1996). RBBE is a vital driving force behind political change, from the establishment of new nations to the overthrow of governments, and behind social change movements from the civil rights movement to the various post-1960's liberation movements.

The bidirectional causation linking the neural embedding and the social embedding of RBBE is staggering in its historical significance and explosive in its continuing and potential future influence on virtually every domain of human life. It is striking to realize that the political effects of religious extremism might be traceable to a small group of neurological processes that permit a powerfully convincing religious response, which helps people under duress both cope and create meaning through violence. It is equally striking to understand how a consumerist economic culture or an unimaginative approach to education can condition people on a large scale to behave in ways that suppress valuable virtues such as creativity and curiosity and criticism.

In the presence of suitable forms of ethical reasoning and argumentation, there can be an enormously fruitful interaction between knowledge of the neurological embedding of RBBE, on the one hand, and understanding of the effects of the social embedding of RBBE, on the other hand. This interaction is made much more detailed and constructive by the robust correlations between states of consciousness and brain states that flow from the evolutionarily framed quantitative mapping techniques described above. Such correlations promise, for example, rough neurological diagnostic tools based solely on linguistic analysis of certain kinds of narratives. This may eventually yield a technique for gaining understanding of the neural dimensions of a social situation—a non-invasive technique that depends only on publicly accessible data.

Step 8: Philosophical and Theological Considerations

Most people depend on medical professionals for health-care expertise, and few are fully aware of the subtle yet potent connections between neurology and society. But many people are strongly invested in their religious beliefs (or their anti-religious beliefs, as the case may be), and in assuring themselves that they are not mistaken in these beliefs. For many people religious experience is one of the key authorizing powers for such beliefs. Not surprisingly, therefore, the philosophical and theological implications of RBBE are a hot topic. Parts of this domain of inquiry sometimes go by the name of "neurotheology"—a sexy new name surely is evidence that something significant for the general public is afoot.

But what precisely is knowledge about the neural correlations of RBBE supposed to yield in terms of a judgment of how reliable religious beliefs are?

There are diametrically opposed conclusions on this topic. Some delight in the neural embedding of religious beliefs because it shows that religious people make things up and don't know it, thereby confirming skepticism about religious beliefs. Others derive equal delight in discovering that the brain changes in meditating monks; this demonstrates that something is *really* happening and they are not making it up, thereby confirming their religious beliefs. Neither instinctive argument makes much sense. Instincts are useful for inspiring hypotheses, but hypotheses then require thorough articulation and rigorous testing. The missing link—or rather the hidden link—in instinctive chains of so-called reasoning is the valuational categories, and indeed the metaphysical theories, that connect the sheer fact of the neural embedding of RBBE to attitudes about religious and anti-religious worldviews. Systematic analysis of this linkage is necessary if neurotheology is to stay empirically grounded and to gain respect among philosophers.

Arguments that liken religious experience to sense perception are similarly complex to construct properly. As we saw when discussing the analogy problem, the strategy of such moves is to argue that we are rationally entitled to assume that cognitions deriving from religious experience are reliable until contrary evidence proves otherwise, just as we are so entitled in regard to ordinary perception. Similarly, the analogy between RBBE cognitions and visual illusions can be deployed with the aim of impugning the reliability of RBBE using a similar style of reasoning. In all cases, we require causal connections rather than mere conceptual analogies. Suppose we were to introduce a plausible causal basis for the link between perception and RBBE—say, along the lines of Gibson's theory of visual perception (see Gibson 1950, 1966, 1979), which might be generalizable to other hypothetical, exploratory activities such as processes of belief formation involved in social knowledge (Good 2007). Then we may have a basis for evaluating the reliability of the cognitive aspects of RBBE. We might conclude that some religious beliefs are functional, but probably false. Or we might conclude something else. But at least a framing hypothesis of this sort achieves enough specificity for neurological research to become relevant to epistemological questions.

We do well to remember that, no matter how detailed the neurological insights into the cognitive aspects of RBBE might become, there is a pronounced philosophical gap between usefulness (which neurology and evolutionary theory can help to establish) and truth (which is a key value issue that may not always line up closely with usefulness). But this does not necessarily make neurology irrelevant to philosophical and theological questions. The evaluation of conceptual hypotheses in philosophy and theology is a complex, drawn out process that depends on theoretical coherence as much as empirical adequacy. But information sufficient to support the empirical aspects of philosophical evaluation remains vital. The approach we describe in the fist four steps promises more robust correlations between states of consciousness and neural activations. This data set is potentially helpful for constraining competing philosophical and theological hypotheses about the epistemology of RBBE.

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