

Second Edition

The COGNITIVE NEUROSCIENCE OF RELIGIOUS EXPERIENCE

Decentering and the Self



Patrick McNamara

THE COGNITIVE NEUROSCIENCE OF RELIGIOUS EXPERIENCE

The Cognitive Neuroscience of Religious Experience, now updated and expanded in a new edition, updates key topics covered in the first edition including: decentering and self-transformation, supernatural agent cognitions, mystical states, religious language, ritualization and religious group agency. It expands upon the first edition to include major findings on the brain and religious experience over the past decade, focusing on methodology, future thinking and psychedelics. It provides an up-to-date review of brain-based accounts of religious experiences, and systematically examines the rationale for utilizing neuroscience approaches to religion. While it is primarily intended for religious studies scholars, people interested in comparative religion, philosophy of religion, cultural evolution and personal self-transformation will find an account of how such transformation is accomplished within religious contexts.

PATRICK MCNAMARA is Distinguished Professor of Psychology at Northcentral University, California. For twenty years he was based at Boston University School of Medicine where he was Associate Professor of Neurology. He has published extensively on the topics of neurology and psychology of religion, including *Religion, Neuroscience and the Self: A New Personalism* (2020). He is a founding editor of *Religion, Brain and Behavior* and co-founder of the Institute for the Bio-cultural Study of Religion.

THE COGNITIVE
NEUROSCIENCE OF
RELIGIOUS EXPERIENCE

Decentering and the Self

SECOND EDITION

PATRICK McNAMARA

Boston University and Northcentral University



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre,
New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781108833172

DOI: [10.1017/9781108973496](https://doi.org/10.1017/9781108973496)

© Patrick McNamara 2009, 2022

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published as *The Neuroscience of Religious Experience* 2009
Second edition 2022

A catalogue record for this publication is available from the British Library.

ISBN 978-1-108-83317-2 Hardback

ISBN 978-1-108-97789-0 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

To Ina Livia McNamara

Contents

<i>Preface to Second Edition</i>	<i>page</i> ix
<i>Acknowledgments</i>	xxvi
1 Introduction: Assumptions and Reasons	1
2 On Decentering	23
3 On the Self and the Divided Self	54
4 The Cultural and Evolutionary Background to the Neuroscience of Religion	74
5 Neurology of Religious Experiences	94
6 Psychedelics and Religious Experiences	125
7 Mystical Experiences	145
8 Religious Experiences and Transformative Experiences	159
9 Supernatural Agents and God Concepts	178
10 Ritual	190
11 Religious Language	209
12 Group Effects and Religion	223
<i>References</i>	238
<i>Index</i>	255

Preface to Second Edition

This second edition of my *Neuroscience of Religious Experience* is practically a whole new book. It is rightfully called a second edition, however, because it is based upon, and updates, all the key topics covered in the first edition. But it does more than mere updating:

- It provides an up-to-date review of the neurology of religious experiences.
- It reviews latest findings on religious experiences associated with psychedelics.
- It reviews empirical examinations of the decentering mechanism presented in the first edition and updates neuroscience findings on decentering.
- It applies predictive processing and free energy principles to every key topic treated in the book.
- It provides a consistent evolutionary biology grounding for all the key religion and brain topics covered in the volume.
- It provides a new neurobiology and theoretical treatment of ritual and the ritualization process.
- It systematically examines implications of evolutionary genetic and sexual conflict for all key religion and brain topics examined in the volume.
- It systematically examines the psychology, neurobiology and phenomenology of mystical states and experiences.
- It presents a systematic theoretical neurobiology of the self, the divided self and relations of these to religion and religious experiences.
- It presents a systematic psychology, philosophy and neurobiology of self-transformation in relation to religious practices.
- It provides a new theory of religious group effects rooted in evolutionary neurobiology and examines its relevance for functions of religion.
- It provides evidence for, relevance to religion of, and an exposition of the new “Theory of Group Mind” (ToGM), which stipulates that humans (and brains) aim to cognize both individual and group minds.

- It updates empirical and theoretical work as well as neural correlates of religious language.
- It systematically examines the evolutionary background, clinical neurology and philosophical phenomenology of the relation of schizophrenia to religion and brain topic areas.
- It incorporates insights of cultural evolutionary models to religion and brain topics.
- It incorporates insights of the embedded, extended, enacted and embodied (4E) paradigm to examine the extent to which religion and brain processes are embedded, extended, enacted and embodied.
- It systematically reviews work on, and incorporates the effects of, supernatural agent (SA) cognitions and “encounters” with respect to all key topics in religion and brain.
- It systematically incorporates rapid eye movement (REM) sleep neurobiology and dreams into topics on religion and brain.
- It attempts to bring religious studies insights to bear on selected religion and brain topics.
- It evaluates the value and significance, as well as the limitations, of neuroscience approaches and neuroscience data on religion.

I tried to write each chapter in such a way as it could, as much as possible, stand on its own without having to have read all the rest of the chapters. That commitment to standalone chapters inevitably entailed some amount of repetition across chapters. I managed, however, to keep that repetition to a minimum. But to get the full treatment on any single topic, say schizophrenia, you would need to read all chapters. For example, the chapter on evolution of religion and brain treats evolutionary approaches to schizophrenia while the chapter on neurology of religious experience treats the neuropsychiatric aspects of the disorder and the chapter on the divided self treats its phenomenology and so on.

In Chapter 1 I examine why neuroscience is not only desirable but a necessary approach to use for understanding religion. The central role of the brain in religious phenomena follows from its central role in human life history. Briefly put, a key (and perhaps *the* key) life history trait among human beings, that is, the trait that influences all other life history variables in the standard catalog of life history traits (e.g., average lifespan, body size, length of juvenile period, gestational period, interbirth intervals, fertility rates) is brain size and complexity. The greater the brain complexity the greater its metabolic demands and the more behavioral resources are organized around those metabolic demands. I also assume and show in this book that the best way to understand the role of the brain in religious experiences is to view the brain as a product of natural selection and

cultural evolution. Within the evolutionary sciences, the most applicable selective force that influences a range of religion and brain topics is, I argue, sexual conflict theory. Sexual conflict occurs when the genetic interests of males and females diverge. I add to the sexual conflict framework Dunbar's evolutionarily informed social brain hypothesis to understand religion and brain data. I also adopt and assume some, but not all, of the claims of "4E cognitive science" (suitably modified to take into account relevant brain functioning and constraints), namely that the mind, and the religious mind in particular, is embodied, enacted, embedded and extended. A final background framework I assume and adopt in this book (and introduce in Chapter 1) is the so-called predictive processing framework (PPF).

In Chapter 2 I systematically reexamine and update empirical work on "decentering." Religion, I insisted in the first edition, could profitably be seen as a neurotechnology for personal transformation in service to potentially positive or negative cultural outcomes depending on socioecological contextual factors. But it all hinged upon this decentering mechanism or process. Decentering includes (1) taking offline the self-concept, or disengaging executive control systems such that the sense of self or agency is transiently diminished and the individual is more open to sensory input and to cultural influences; (2) then the self-concept or structure is placed into a suppositional space or possible-worlds box where it can be edited or worked-upon using available cultural materials; (3) then a search in memory and semantic stores ensues, looking for materials to update the self-structure and guided by existing cultural scripts or narratives, until a more computationally efficient self (given current environmental challenges) is found, or failing identification of adequate self-concept match in semantic stores, construction of a new self-concept is cobbled-together out of available cultural scripts or from entirely new experiential materials; and finally (4) instantiating or binding the new self-concept into a position of executive control in the neural system that is matched to some extent to a culturally appropriate or ideal cultural script, resulting hopefully in a wider, better-adapted sense of self than the old self. Steps 2 and 3 are typically experienced phenomenologically as a kind of liminal or in-between space with high uncertainty and anxious affect.

In updating this schema, I treat decentering as a special case of Bayesian "surprise," where the surprise event in question exhibits special properties because the mismatch between expected and obtained data is large enough that it effectively calls into question the accuracy of the modeling strategy itself, its "Bayesian" priors. Therefore, the individual's sense of self becomes the object of the updating process. When this happens, the likelihood that the experience will be deemed religious or spiritual by the individual and

his or her cultural surround, increases. In Chapter 2 I systematically review what is known about decentering and related cognitive processes as well as their neurologic correlates. In the case of “surprise” and decentering I also show that the surprise event and error signal is extreme enough to trigger so-called pontine-geniculo-occipital (PGO) waves and REM intrusion as part of its “stop and reorient” or orientation reaction. In other words, normal cognitive processes are not strong enough to cognize the information delivered by the surprising event and thus REM sleep is recruited to help. REM then intrudes into waking consciousness, and presumably later that night REM intensity indices are stronger in an attempt to more effectively integrate the surprising information. This REM-based integration process is accompanied by cognitive events we call dreams. It is in these dreams that the cognitive materials for production of SAs emerge. In REM sleep, dreaming perception is decoupled from action as the dreamer is motorically paralyzed and incoming sensory information is blocked. Thus, belief updating and model reparameterization can proceed without interference. PPF requires an offline model reparameterization process and that process is REM. The mind is free to edit and update models during REM free of the necessity of responding to ongoing sensory feedback. Bottom-up sensory input and top-down prediction are decoupled. Dreaming embodies *counterfactual simulation* or *virtual reality generation*; that is, *predictive simulations*. Chapter 2 concludes with a consideration of recent data which suggests that genes acquired from matings with Neanderthals significantly enhanced the evolutionary role of REM sleep in the neurobiology of anatomically modern humans (AMH).

In Chapter 3 I examine new empirical and theoretical work on the so-called divided self and its relation to the religious mind/brain. I show that a sense of a divided self necessarily flows directly from the principles of the PPF. Generation of predictive simulations and error minimization operate at all levels of the neural hierarchy. Simulations at one level can sometimes not be fully convolved with, and may in fact be actively opposed to, simulations at another level. This is one source of the sense that the self is riddled with competing and conflicting desires and motivations. Each level of the hierarchy aims to predict the input of the level below, and violations of expectancies between predictions and the input (i.e., prediction errors) are propagated up the hierarchy, presumably producing conflicting impulses within consciousness. The endless generation of counterfactual scenarios about self and world may also generate conflicting impulses when they deliver information about hard choices or impossible situations. Another important driver of divided consciousness is evolutionary

genetic conflict between the sexes. I review recent evidence that neocortical brain networks, and specifically social brain networks, are largely built by/regulated by maternal line genes while limbic system networks were built by/regulated by paternal line genes. Thus, neurodevelopmental disorders that are influenced by these imprinted genes display symptom profiles that tracked evolutionary interests of maternal vs paternal line genes. I review Crespi and Badcock's suggestion that psychosis spectrum disorders (especially some forms of schizophrenia) and autism spectrum disorders represent two extremes on a cognitive spectrum with normality at its center. There is a form of hypofunctioning of the social brain in autism, and conversely a form of hyperfunctional social brain activity in psychosis. The autistic brain is said to manifest an extreme version of the systematizing style and a preference for reasoning in terms of mechanical forces associated with inanimate objects, whereas the schizophrenic brain tends to see agency and minds everywhere; it exhibits a hypermentalizing bias. I then review data that shows distinct religious expressions and interests as a function of these two sex-differentiated cognitive styles. I next review the theory of the "dialogical self" as it gives us a good model within which to understand the divided self and the ways in which the religious brain heals divided consciousness. In addition, a pluralistic, dialogic self also gives us a principled way to link the individual up with cultural forces and religious groups. Both the first edition and this updated chapter emphasize the role of the subjective sense of agency in unifying internally conflicted subselves. Agency is a target for the religious mind as large-scale cultural, legal and economic models are built upon assumptions concerning agency. If we assume, as some religious traditions do, that the individual is an autonomous and sovereign agent with a large scope for agency, then it is a threat to the cultural foundations of such a system when individuals report brain-related lapses in agency or significant changes in scope for their agency. The final topic for Chapter 3 is the theory of "possible selves." These are images of what people hope to become, expect to become, or fear becoming in the future. The ideal self is special in that it is crucial for agency, self-regulation and resolution of conflicts in the divided self.

In Chapter 4 I examine data and theory concerning evolutionary accounts of the religious brain. I evaluate several possibilities, including: the physiologic process of self-domestication, heterochronic shifts in ontogeny (i.e., pedomorphism or neoteny), *hypermorphosis* or the extension of growth times, the social brain hypothesis, the links between evolution of language, religion and brain, the accented development of executive control networks in the brain related to tool use and other capacities, the

development of new forms of behavioral plasticity utilized by cumulative cultural creation, the development of special social learning capacities, ultra-sociality, and the special development of REM sleep neurobiology among AMH during the upper Paleolithic. Recent evidence suggests that among the Neanderthal genes preserved in AMH populations are genes (e.g., ASB1, EXOC6) that enhanced REM sleep processes in several ways but also resulted in a higher risk for narcolepsy – a disorder wherein REM neurobiology is dramatically disinhibited, resulting in REM processes seeping into daily waking consciousness. REM neurobiology therefore became available in a new way for AMH peoples of the upper Paleolithic – indeed, it is likely that REM became an intrusive presence for some persons predisposed to dissociative states. This new access to REM neurobiology and states then allowed development of a new form of creativity and religiousness that relied on manipulation of an array of visionary states of consciousness we today call shamanism. I next review the evidence that shamanism was and is a root source for certain forms of religiosity and argue that REM neurobiology contributes to visionary forms of religiosity such as shamanism and mystical experiences. I conclude the chapter with a review of the evidence and the claims that schizophrenia, and its neurobiology, is related to visionary forms of religious experience.

In Chapter 5 I systematically examine the evidence on brain correlates of religious experiences. I begin the chapter with a short history of the first studies on brain correlates of religiosity. I then systematically examine those brain disorders that are associated with *increased* or hyperreligiosity. Some forms of temporal lobe epilepsy (TLE) are associated with hyperreligiosity. I lay out the interesting case of Kumagusu Minakata (1867–1941), a Japanese genius devoted to natural history and folklore. He kept meticulous diaries and, unusually, his postmortem brain was preserved for scientific study. In the 1990s, both his extensive diaries and his brain were studied, revealing extensive evidence of lifelong TLE. In his diaries there were detailed accounts of seizures, auras, déjà vu experiences, premonitions and headaches. His diaries and other written works also contained reams of material on spiritual, religious and mystical themes. He specialized in the study of slime molds, fungi and mushrooms, discovering several new species and reflecting on the difficulties of classifying these entities as plants, animals or some other form of being that exhibited extraordinary forms of intelligence. His religious and spiritual writings are studied intensively today, especially his long letter detailing his spiritual views that he wrote to a Buddhist monk in 1903. The “letter” filled a roll of paper more than 10 meters long by the time it was finished. He expounded at length on the Buddhist doctrine of

pratitya-samutpada – known as *engi* in Japanese – which refers to the well-known doctrine of codependent origination wherein everything is implicated in and dependent upon everything else. Minakata used higher-order logic, and extraordinarily dense arguments, pictograms and drawings including the “Minakata mandala,” to make the case for a new spirituality and science. He exhibited extraordinary productivity, publishing on a variety of subjects: fifty articles in *Nature*, 324 articles in *Notes and Queries*, and 1,142 Japanese articles. He was fluent in many languages and had a working knowledge of many others including Latin, Greek, Arabic, Persian and classical Chinese. Murai et al. (1998) performed a volumetric analysis of his brain and found evidence of significant right hippocampal atrophy. Survey studies of TLE patients suggests that the increased religiosity is rare but when it occurs it is often associated with ictal activity in right temporal lobe along with hippocampal atrophy. There has been at least one case where the hyperreligiosity disappeared after right temporal lobectomy. Right temporal loci are also occasionally associated with ecstatic seizures but these also implicate right anterior insula pathology. Interestingly, right-sided anterior temporal and frontal degeneration is sometimes associated with the frontotemporal dementing (FTD) process. About 15 percent of right-sided FTD patients express hyperreligiosity. Even in apparently normal aging, greater (both right- and left-sided) hippocampal atrophy over time was predicted by baseline identification as born-again Protestants, Catholics or no religious affiliation, compared with Protestants who were not born again. Greater hippocampal atrophy was also predicted by reports at baseline of having had life-changing religious experiences. Both right and left hippocampal atrophy significantly predicted religiosity in aging subjects. Some patients with schizophrenia evidence persisting religious delusions and other changes in religiosity. Neuroimaging studies of schizophrenia demonstrate aberrant connectivity patterns between three large-scale brain networks: the default mode network (DMN), the frontal-parietal central executive network (FPN) and the salience network (SN). Between 10 and 30 percent of patients with obsessive-compulsive disorder (OCD) also evidence religious delusions such as scrupulosity. From a PPF point of view, scrupulosity is fascinating because whereas most people according to PPF are looking for the levels of uncertainty that will maximize information in the error signal (uncertainty is good), people with scrupulosity are characterized by an intolerance of uncertainty. Their uncertainty tends to trigger aversive responses only. They need certainty to function. So the belief updating system must be tuned to look for absolute precision in sensory sampling and must be set on absolutely rigid priors.

Neuroimaging studies suggest abnormally increased activity in orbito-frontal cortex, in right temporal cortex and in subcortical basal ganglia (particularly in the caudate) and limbic circuits in OCD. There are other disorders associated with increased forms of religiosity. Decreased function of the right parietal lobe (RPL) was associated with increased sense of closeness to a transcendent being. In addition, alterations in the inferior parietal lobe, usually on the right, is also associated with self-transcendence. Disorders that decrease religiosity or access to religious concepts, such as left-onset Parkinson's disease, are less well studied. Neuroimaging studies of various aspects of religious behaviors or tasks tend also to recruit those three major brain networks that are implicated in schizophrenia, the FPN, DMN and the SN. It is interesting that very few or no functional imaging studies have simply compared the resting state, task-free brains of highly religious people to atheists.

In Chapter 6 I begin to engage with the flood of new data emerging on religion and brain topics from the renaissance of work on psychedelics. After reviewing brain and experiential effects of serotonergic psychedelics, I argue that psychedelics can indeed induce genuine religious experiences. I then systematically review neuroimaging studies of psychedelics, looking specifically for brain correlates of mystical experiences and encounters with SAs. In addition to the consistent findings of reduced DMN functionality, SA encounters and mystical experiences are associated with decreased functional connectivity between the hippocampus and both the SN and the FPN. I then evaluate three theoretical accounts of psychedelic effects on brain functioning: the REBUS model, the cortico-striato-thalamo-cortical (CSTC) model and the claustrum model, and find that all carry some truth but are weak in accounting for appearance of SAs in mystical experiences. I next argue for an "epistemic account" of the brain-based psychedelic experience which suggests that real knowledge is gained from religious experiences on psychedelics. The psychedelic experience is so richly detailed and so complexly structured, its cognitive structure and content implies some amount of real knowledge acquisition secondary to the experience. I build on work by Benny Shanon, and Andrés Gómez Emilsson, who detailed various forms of knowledge gained via psychedelic experiences. I focus specifically on religious content of psychedelic experiences – namely entity or SA encounters. These are typically explained away as defective attributions of agency. But the entities encountered in both "ordinary" mystical and psychedelically inspired mystical experiences do not merely mirror the individual's mind, desires or movements. Instead, the entities operate independent of, and often

against the will of, the individual. They often know things about the world that the individual does not know. There are also commonalities of entity characteristics across individuals – even individuals who do not or did not know one another. We cannot build a complete naturalistic account of entity encounters on the idea of agency misattributions alone – the mere decision that an action originated outside of me.

In Chapter 7 I focus specifically on brain bases of mystical experiences. I take a Wittgensteinian family resemblance approach to the problem of defining mystical experiences, thus avoiding the claim that there is a common core of mystical experiences that are always and everywhere present when people claim these experiences; or conversely avoiding the claim that there is no consistent unity at all within this family of experiences. Several alterations of brain network connectivity have been associated with various elements of mystical experiences. For example, individuals with damage to the dorsolateral prefrontal cortex (dlPFC), with diminished executive functioning, report more mystical experiences than individuals with damage elsewhere in the brain. Selective lesions to left and right inferior posterior parietal regions specifically *increase* reports of self-transcendence. Within the predictive promising framework, what may promote mystical experiences is that a mismatch signal or degree of surprise becomes sharp or extreme enough that it triggers an entire dismantling of existing priors associated with the executive self and construction of a new set of priors to support the agentic self and its active inferencing activities. However, the dislodging of the executive self is not yet enough to produce a mystical experience. Instead the construction of the updated beliefs and sense of self has to perfectly hit that sweet spot between resilient but flexible “priors” *and* then a sense of control over the noise or uncertainty/precision levels experienced during sensory sampling during active inferencing. I conclude the chapter with a review of mystical and brain correlates of near death experiences (NDE). Candidate brain mechanisms for NDEs include electrical spikes in the temporal lobes, intrusion of REM sleep into wakefulness, endogenous release of internal opiates and global demodulation of serotonergic transmission as seen after ingestion of psychedelics such as DMT. Existing data strongly support the REM intrusion theory of NDEs. The prevalence of substantial REM sleep intrusion is at least 60 percent among people with a history of NDEs and 24 percent in controls. A crowdsourcing study of >1000 unprimed laypeople from thirty-five countries found that people with REM intrusion were much more likely to report NDEs than those without (OR 2.85, $P < 0.0001$). A brain model of mystical states suggests disruption of DMN along with disinhibition

on medial temporal lobe (MTL) activity. Similarly, atrophy of right hippocampus would also have disinhibitory effects on the SN and on MTL and medial prefrontal cortex (mPFC). MTL activity is also enhanced in humans during REM sleep and pathological increases in MTL activity due to TLE can result in hyperreligiosity. Finally, dreamlike experiences can be elicited by direct electrical stimulation of the MTL/hippocampus. The brain, dreaming, mystical states relationships run quite deep.

In Chapter 8 I look at transformative experiences as a crucial part of the equation between religion, brain and the self. In self-transformational experiences it is not at all clear what self undergoes the transformational religious experience. “I” am not a single unified self with one consistent set of preferences and values. “I” hold inconsistent beliefs, values, motivations, urges, desires, thoughts and information and therefore my decisions reflect this disunity. Religion-assisted, self-transformative experiences can create or restore a sense of unity. The sense of unified self that transcends the dialogic self is related to activity in the network of midline structures including the DMN, the mPFC, the anterior cingulate cortex (ACC), the anterior insular cortex (AIC) and the precuneus – all regions mentioned in previous chapters concerning brain correlates of religious experience. As in PPF, dialogic self-theory assumes that the brain/mind is a hierarchically organized network of simulations or agents that together function like a society or task-oriented group. To facilitate self-transformation toward a sense of unity, so-called promoter positions within the dialogic self hierarchy function to arrange the subordinate self/agents within a small world network that then allows for a central hub that becomes an “I” with a unified sense of agency. The dialogic self tends to have a monological vs. a disorganized and cacophonous organization in people with schizophrenia. Only transformative experiences can dislodge these aberrant self positions.

A transformative self optimizes the balance between the self positions in an individual psyche. It does so by aiming for an “ideal” self. In dialogic self theory terms the “I” position decenters itself by refusing to own its current position and attempts to own a position of the ideal, imagined or simulated self. Thus, it places all other positions within the psyche in small-world network hierarchical relationships relative to the *ideal self position*. Culture directly shapes intrapsychic functioning via the insertion and subtraction of self positions with the individual plural/dialogic psyche. Inserted self positions obviously begin to interact with other self positions and thus alter the dialogue within the psyche, ultimately influencing decisions taken by the individual. Religion, when it is operating normatively, that is, to buttress existing societal norms, constrains the self

positions inserted into the individual to positions that are promoters of an “I” that adjusts itself to those norms, thus making cooperation within and without possible. I next discuss the neurology of the conversion experience. In terms of the dialogic self theory, what is occurring is the gradual introduction of new voices or positions as habits into the economy of the plural psyche, with these new voices becoming orchestrators of the overall consensus among voices in the psyche. I conclude the chapter with a discussion of the neurology of death as a transformative experience orchestrated via REM dreaming.

In Chapter 9 we examine the psychology and neurology of SAs—supernatural agents. Under PPF, mental states are represented higher in the cortical hierarchy than lower-level causal effects like sensory features of the environment features. When we model/simulate a mind causing an event we presumably start with the physical sensory features of the event and ask what forces could have produced it and then infer what kinds of motor outputs and motor commands could have had those effects and then infer the kinds of intentions that could have created those motor commands and so on. To reason about other minds we have to depend on this hierarchy of inferred causes. But that is not all. When reasoning about other intelligent agents we have to factor in the fact that they know that we are thinking about them and that they will adjust their actions accordingly and so we must do the same and so on. In addition, the 3D theory of mind (ToM) model argues that when people think about others’ mental states, they consider three key features: the rationality, social impact and valence of each state.

In short, in reasoning about other minds/agents arms races quickly start spiraling out to levels of complexity that defeat even the most astute strategic thinkers. It is within the complexities associated with this mentalizing realm that we encounter SAs. SAs are one of the things that make religious cognition a unique form of cognition. Unlike ordinary agents, SAs have all kinds of counterintuitive properties and superhuman powers. They also tend to demand intense levels of commitment or sacrifice from us ordinary humans. Naturalistic theories of SAs tend to dismiss them as compensatory fictions for anxious psyches. There is indeed empirical evidence that SAs do sometimes reduce anxiety. But as we all know they can also induce intense levels of anxiety.

Another psychological theory of SAs is built upon attachment theory. It too suggests a “compensation” hypothesis such that individuals with insecure relationships may use to SAs compensate for poor relationships with ordinary people. Another theory concerning the emergence of SAs is

that the cognitive materials for SAs come out of REM dreams. There is a growing body of evidence that systematically catalogs the steps in productions of SA within dreams or via use of dream images.

In Chapter 10 I focus on brain correlates of religious rituals. Rituals too can be said to be a source of construction of SAs. I take a different tack in my coverage of rituals than do other students of ritual. To properly develop a neurology of ritual I argue that the focus needs to be on the process of ritualization. Ritualization is the process by which selected behavioral processes are pulled out (by natural selection, repeated reinforcement learning or cultural selection) from the background of other physiologic and behavioral processes and then stylized into repetitive and sequentially ordered behavioral and motor stereotypies, and then made to perform certain functions or to signal certain messages to conspecifics or adversaries. Dissanayake argued that ritualization involved: formalization (stereotypy), repetition, exaggeration and elaborations of behavioral displays of various kinds. During the course of ritualization, particular changes occur in the original behavior pattern so that the resulting signal becomes prominent, distinctive and unambiguous, and consequently is not confused with its precursor or opposing behaviors. The ritual behavior then functions as an honest display or signal that can unambiguously communicate a message to an adversary. In terms of the neurology of ritualization I use the still viable model of the emergence of stereotypies involving a “contention scheduling system” (CSS), mediated by basal ganglia pathways, that selects and sequences behaviors on the basis of external reinforcing stimuli, and a “supervisory attentional system” (SAS) mediated by striatal-anterior caudate-prefrontal dopaminergic circuits. These interacting systems modulate the action of the CSS on the basis of internal context.

I review Liénard and Boyer’s argument that religious rituals are at least partially rooted in activation of human threat detection psychology. I find more empirical evidence to support Whitehouse’s classification of religious rituals into two broad cultural subgroups: high-arousal, intensely imagistic but low-frequency rituals vs. the high-frequency, more verbal-centric, doctrinal rituals. The former are characterized by dysphoric experiences (e.g., via painful or terrifying initiation experiences), while the latter doctrinal rituals, by contrast, are very frequent and are less emotionally intense and may even be quite tedious. I argue that these two broad families of rituals are driven by sexual conflict and ritualization. Men and women typically build different kinds of group alliances and this fact may help to explain the two different modes of ritualization. A majority of ancestral human populations exhibited female bias in dispersal – that is,

females left the local group at reproductive age. They then sought out new groups with which to live and to create families. But that dispersal pattern meant that until they had children they lived among low-trust strangers who were genetically unrelated to them. Given the low-trust environment, the female's interests would dictate group and coalitional structures that emphasized direct and indirect reciprocity, lots of verbal negotiating and mind-reading, surveillance of, and harsh strictures against free-riders, supernatural punishment of free-riders by moralizing gods and similar norm-enforcing mechanisms. Thus, female ritualization strategies would promote these kinds of doctrinally based religious rituals. Males, however, who stayed within the local group came of age among genetic relatives. The groups they formed would be high-trust "enterprise associations" or coalitions – that is, task-oriented groups that would form and dissolve based on tasks at hand. Although their within-group situation was stable and high trust, the situation with respect to outgroups was different. There was a lot of intergroup conflict and outright warfare among early human groups. Therefore, the types of groups males had to form had to do with the tasks imposed on them by ancestral conditions of intergroup conflict and the hunt; that is, the ability to plan strategically to outfight and outwit adversaries and competitors. Therefore, the ritualization process favored by male groups would likely be shamanistic and visionary forms of ritual. These forms can enhance out-of-the-box thinking that is so crucial for the instrumental goals of task-oriented groups like war parties and hunting teams. These differing ritualization and sex-related group strategies are reflected to some extent in the brains of males and females. Females are better at verbal tasks than men. They have proportionally larger Wernicke and Broca regions compared to males. They have larger corpus callosums than males and they exhibit less cerebral lateralization than males (more bilateral representation of language and other functions). They are better at learning second languages. This makes sense if they had to disperse out of their natal groups, find and be accepted into a foreign group and learn their languages and customs.

Rituals are intimately related to religious myths and cosmologies. One major myth-ritualist theory was exemplified in the several volume compendium of worldwide mythology called *The Golden Bough* (1890/1959) by James George Frazer. I discuss some of the evidence concerning the Neolithic successors to the Paleolithic shamans: the divine kings. These are essentially SAs who could be seen with the naked eye. The divine kings inherit the shaman's myriad roles of diviner, healer, master of ceremonies, visionary, leader and so forth. As societies became more complex, the kings in turn delegated

some of these healing, religious and leadership functions over the course of centuries to priests and prophets. Divine kingship lasted, arguably, right up to the modern age. Interestingly, human sacrifice may have begun in earnest with the divine kings as victims. According to Frazer, the sacrifice of the divine kings was aimed at unifying the tribe and renewing resources associated with the spring resurrection. But if we base our approach to human and other forms of sacrifice on male ritualization processes then the function of sacrifice very likely had something to do with signaling something concerning aggressive intentions to outgroups, that is, to groups with whom one was at war with in the past. Peter Leeson points out that human sacrifice can be construed as a form of ritualized wealth destruction. There is no need for the enemy to attack you if you had no wealth to lose.

In Chapter 11 we take the study of mystical experiences one step further but now view it from within the realm of religious language more generally. Religious language can be defined as the language that occurs in religious contexts and is found in religious texts, sermons and discourse. Religion both shapes language and is shaped by language. Both language and the decentering mechanism (which I argue is key to religious cognition) described in this book highlight agency as a structuring linchpin for its major elements and operating principles. Agency roughly is the personal sense that I, a subject, can initiate actions and can cause things to happen in the world. Within language the basic structural unit – the sentence or phrase – pivots on the role of the agent. Actions are cognized in terms of what happens to the agent and what the agent causes to happen. The agent is theorized linguistically in terms of what has been called a thematic role: an agent, who does something to a patient, via an instrument and object. These roles capture most of the meanings typically expressed in religious sentences. Decentering as well depends upon what happens to the agent. All known languages display a variety of grammatical devices for representing agency and the ways in which agency operates in the real world. Indexicality, for example, would be impossible without a conception of agency. It requires fitting speech to context, through appropriate use of deictics like pronouns and demonstratives. I discuss implications for religious language and decentering of Chilton's deictic space theory to model how agents/speakers position various entities (other people, objects, events, SAs etc.) in relation to themselves – a deictic origin. Speech acts are another linguistic form that is ubiquitous in religious language. A speech act is often defined as a linguistic utterance that accomplishes some action. Brain systems' support of speech act comprehension and production can only be partially sketched at this point. Empirical studies with patients

suffering from Parkinson's and Huntington's disease point to the role of basal ganglia, left-sided perisylvian and right-sided prefrontal regions as crucial for speech act processing. Religious language also uses metaphor. "Conceptual metaphor theory" or CMT has been used to model metaphorical expressions that express religious content. Conceptual elements or representations in one semantic domain are related to or mapped into another conceptual domain. The source domain may concern physical objects for example while the target domain may involve something more abstract. All of religious language's tools, metaphor, deitic operations, speech acts, CMT and so on are required to understand mystical language or texts. Mystical utterances, more than most other parts of language, obey the 4E principles. Mystical utterances do not merely *refer* to the mystical, but *embody* and *enact* it. The utterances and mystical states are *extended* beyond the human frame. The mystic literally kneels or lies face down or opens his arms wide and chants incessantly or speaks in tongues and so forth. Other enactments of the mystical include silence or the use of paradox, or using only negations to "refer" to the divine. Because the mystic is pointing beyond existing language elements this pointing is also identification of the limits of the linguistic world the mystic inhabits. Mystical language therefore acts to cancel or supersede or overcome existing linguistic constraints on what is permitted to say or think. It moves beyond and therefore ends or overthrows existing cultural norms and breakthroughs to some new world where the "unknown unknowns" lie.

In Chapter 12 I examine recent evidence and theories concerning the groupishness of religion. People who worship the same gods tend to form cooperative groups. Members direct their prosocial and altruistic behaviors toward other members of their religious group and their hostility toward competing outgroups. Some theorists of religion have argued that moralizing high gods have made cooperation among large groups of people possible. It is very likely also the case that "religion" as defined in this book also played a central role in formation and evolution of particular types of small group formations that are uniquely culturally innovative and distinctive to humans. The modern ethnographic record testifies to the near universal occurrence among hunter-gatherer and small-scale horticultural societies of the all-male secret societies within which lore about the hunt, weapons, initiation rituals and SAs was the order of the day. In small-scale hunter-gatherer societies these all-male groups within the tribes were organized around the purpose of optimizing the hunt by creating specific interdependent relations among group members based on skill-sets of each member in the group. Some members were good at tracking animals, others

at spearing them, others at chasing them, others at planning large-scale stampedes and so forth. These all-male groups virtually created the class of groups known as “enterprise associations” characterized by internal division of labor, interdependent relationships among members, long-range strategic planning, regular methods for generating creative associations among disparate ideas and subordination of all within the group to the overriding group purpose. Importantly, you typically could only become a member of a male secret society/group via an initiation ritual. These primary male-specific groups tended to evolve into task-oriented groups of enterprise associations. It was these enterprise associations that decisively shaped key aspects of religious cognition. Enterprise association/groups are formed around a task or purpose for the group, while civil associations are not organized around a single purpose. Instead, they are held together by common recognition of all members of the association of locally prevailing norms, customs, agreements and laws that govern interactions between members of the civil association. Enterprise or task-associated associations, however, are animated by purpose and teleologic aims. That teleologic structure then has downward effects on the internal structure of the within-group relationships among members of the group. These enterprise groups fostered interdependent decision procedures that promote group goals and the striking phenomenon of group agency or group mind. Group agency/mind decisively influenced religious forms of cognition. These group forms facilitated the rise of *distributed forms of cognition* where individual members draw upon the pool of expertise and shared information across group members to expand their cognitive capacity into an extended mind. This is also what occurs in religious rituals. Members are forced to acquire some metaknowledge about the team (i.e. knowing who knows what) and when that separate knowledge is to be deployed to solve the task at hand. Team members also form a kind of identity around their shared destiny or endpoint when the problem gets solved. Each member must acquire *shared task representations* in order to fulfill their roles on the team. By creating shared mental models within the team, the coordination of unique expertise afforded by team members is further enhanced. In addition, it is within the early enterprise associations and secret male societies where *leadership* and charismatic forms of leadership emerged. Given that decision-making procedures are organized around action plans that undergo systematic evaluation via presentation and evaluation of counterfactual scenarios they are strategic *and rational*. Reasons can be cited for any given action plan adopted by the group, thus making group mind possible. The rise of enterprise associations among

ancestral populations also promoted a new religious form of the so-called ToM capacity – namely the theory of the group mind capacities – that is, the ability to read the mind of these enterprise groups or ToGM.

After completing the book, after systematically reviewing recent work in the evolutionary, cognitive and neuroscience approaches to religion, my overall conclusions with regard to the phenomenon of brain and religious consciousness or mind are that the religious brain/mind is structured or functions in such a way as to seek out the “unknown unknowns” or those so-called ineffable experiences that extend beyond everyday human consciousness by creatively accessing previously unused or unexplored combos of brain networks and brain states in order to discover the most information-rich events available to it. It is particularly interested in information-rich events related to the self. It uses the “self” structure or process to both seek out these information-rich events and to enrich self and others, including its local group. Its neurocognitive tool in these efforts is the decentering mechanism (which overlaps with the neurocognitive systems underlying “surprise”). The decentering mechanism is unique to religious cognition and is used to update self-models while looping in the REM sleep/dreaming system to integrate its findings concerning the self and the ineffable into long-term memory systems.

Acknowledgments

I would like to thank Stephen Acerra from Cambridge University Press for his advocacy and support of this project. I would also like to thank my colleagues Jordan Grafman, John Balch, Wesley Wildman, Nick Gibson, Bettina Shapira and James Billings for all kinds of intellectual and moral support that made this project possible.

CHAPTER I

Introduction

Assumptions and Reasons

Why Use Neuroscience to Study Religion?

Well ... we need all the help we can get to understand religion. Religion is complex. Neuroscience is one tool in the toolbox. I also think and this book will demonstrate, I believe, that neuroscience can give us some particularly important information about religion that you simply cannot get from other tools or methods. But this latter argument depends on whether or not religious experience turns out to be reliably associated with a consistent set of neural changes (activations and deactivations) that reliably alter from resting patterns in association with some reasonably well-defined religious act. It seems to me that the evidence (to be reviewed in later chapters) accruing from standard neuroscience studies and from studies of serotonergic psychedelics strongly supports this contention. On average, if an individual with some spiritual background ingests a serotonergic psychedelic of sufficient dose, that person will, again on average, report that they experienced mystical religious and spiritual states, often involving encounters with supernatural agents (SAs). The mystical experiences the individual undergoes, furthermore, appear to be dose-dependent: the stronger the dose (up to a point) the more intense and elaborate the experiences. Psychedelic agents are known to produce a relatively consistent set of changes in brain activity that, in turn, is reliably associated with those mystical experiences. The physiologic changes the agents produce in other parts of the anatomy are not associated with the mystical states. Nor are the changes the agents produce in the environment (if any), or the culture or any other relevant entities associated with the reports of mystical experiences. Culture appears to shape the expression of the experiences but its rate of change is slow relative to the appearance of the mystical experience. The thing that reliably changes in close temporal association with the experience is the brain. Clearly, the most proximate causal contributing factor to the mystical experiences are the measurable alterations

we document on functional magnetic resonance imaging (fMRI) scans for all to see (Johnson et al., 2019; Preller & Vollenweider, 2018).

But these kinds of data, concerning the importance of the brain to religious experience, are not good enough for some scholars. I call them the “new Gnostics.” The old, ancient Gnostics hated human flesh and refused to ascribe anything of value to human flesh, including the brain. Human flesh was not spiritual enough for them. Interestingly, some nonneuroscientist scholars apparently see the brain as some kind of inert, dead matter that cannot produce anything of enduring value – again is not spiritual enough. They pay lip service to the idea that religion must be “embodied.” But strangely, embodiment does not appear to include the brain for them. For them, the brain, at most, is a kind of filtering device that merely allows information to be transmitted in greater or lesser amounts, from one disembodied, ill-defined entity to another. They argue against the idea that religious beliefs, behaviors or experience might be associated with a consistent set of activation patterns of brain regions and networks. They refer to this idea derisively as a search for a “religion circuit” or a “God spot” in the brain. They, rightly it seems to me, point out that religion is too vast and complex a phenomenon to be dependent on any one region of the brain – no matter how complex. But that sweeping assessment of the search for religion–brain correlations as futile throws the baby out with the bathwater. Obviously, no domain of human experience is associated with a single brain region. All forms of human cognition and experience call upon widely distributed neural networks for their realization and religious experience is no different in that regard. The point, however, is that we can reasonably assume that many domains of human experience and cognition are associated with distinct neural signatures, if we remember that the term “neural signatures” is shorthand for complex networks of brain sites exhibiting roughly consistent patterns of activation and deactivation in association with relatively consistent patterns of behavior. In short, some areas of behavior and cognition are probabilistically – not deterministically – associated with consistent brain activation patterns and some aspects of religious cognition are likely to be no different.

If we accept the common sense claim that complex forms of human experience/cognition are mediated by complex networks of brain activity of one kind or another, then *every* domain of human experience very likely has its own specific set of neural networks that probabilistically activate in particular patterns. We call these unique brain activation patterns things like “the neural signature,” “brain circuit” and the like to save time and to refer to some pattern of brain activity that reliably engages when that

domain of cognition manifests. Now in most of these cases the circuits in question can also be used for a host of other functions, but when that occurs the overlap is not complete. The pattern and set of networks activated are typically unique to the cognitive domain in question. Evidence for that claim is that if a preferred set of neural networks is damaged, the associated functional domain is degraded to varying degrees in relation to the severity of damage. Other related networks may over time take up some of the slack and restore some functionality in the affected domain, but the domain will typically not attain full functionality.

For example, language function X (e.g., grammar) draws upon a host of brain networks in order to realize its operations. For the function in question to be language function X, no other cognitive capacity but language function X utilizes the same pattern of brain networks and activity. It is impossible for language function X and visual function Y to utilize exactly the same pattern. There may be some overlap, such that they utilize some of the same hardware of course, but they cannot utilize exactly the same spatiotemporal pattern of brain activation. If they did, they would yield the same cognitive content and no longer be distinct cognitive phenomena. Most, and probably all, forms of distinctive cognitive content require some level of brain activity to manifest. Differing patterns of brain activity probabilistically produce distinct qualia and cognitive phenomenologies. The relation is probabilistic and dynamic; most of the time the brain activation pattern in question induces or facilitates the cognitive phenomenology – but not always and not deterministically. In addition, cognitive content feeds back on the brain itself to shape it in ways to make it more responsive to the kind of cognitive content that the environment seems to require.

Religious cognition is distinctive cognitive content – even though it calls upon a host of other cognitive domains. It is both produced by the brain and shapes the brain in myriad ways. Mathematics is another example of distinct cognitive domain. Even though it calls upon a host of other cognitive domains (like language, spatial processing, pattern matching etc.), it clearly has its own content and phenomenology and it clearly, over time, shapes brain structure and function. The distinctive phenomenology associated with the supraordinate cognitive domain must have its own distinct neural signature – inclusive of, but over and above the contribution of the host of other cognitive systems that contribute to the overall domain. This is a version of the binding problem in neuroscience. How do we get unity of a particular type of conscious experience despite a host of differing brain subcomponents contributing to the overall experience and its associated

brain activity? I therefore propose the neural version of Leibniz's Law of the *Indiscernibility of Identicals*, call it the converse of Leibniz's Law or the *Discernibility of Nonidenticals*: if cognitive contents x and y are distinct then there is at least one property that x has and y does not, or vice versa. That one property at some point in the analysis must involve a distinct brain activity pattern as understood in the terms noted.

Even if (in the very, very unlikely possibility that) language function Y and visual function X utilized the same exact brain hardware or networks, those networks would be used, orchestrated and activated in temporally differing ways in order to realize differing cognitive phenomenologies. Some scientists, for example, have pointed to various forms of brain activity in the gamma band range that index synchronous firing or at least correlated functional activity across regions of the brain. The spatial and temporal patterning of the neuronal firing and brain oscillatory patterns of these selected brain sites would be different for the two differing cognitive functions and thus there would be a corresponding difference in terms of their experiential and cognitive phenomenology. Each domain of human experience will call upon and draw from the array of fundamental computational capacities the brain offers and the cognitive capacities that support the domain in question. So the brain networks that support each of these fundamental cognitive processes will likely play a role in realization of the domain in question. But the domain in question will utilize that array of networks in a way that surpasses what occurs within any single subdomain and manifests as an overarching unity that is specific to, and for, that domain. There will be a brain signature peculiar to that domain of experience or there would be no such domain in the first place. The alternative view would be that human experience is not produced or mediated by the brain, or that the brain is infinitely plastic. In that case there would be no correlation between cognitive phenomenology and the computational capacities or structure of the brain.

Thus, the claim that religious experience has its specific associated brain signature is a trivial claim – not a bold or unusual claim. Perhaps the investigators who indignantly repudiate the search for a God spot in the brain simply mean to say that there is no one region dedicated exclusively to religion stuff. Who could disagree? But there may be one *pattern* of brain activity distributed across several brain networks, rather than one *region* of brain, that is probabilistically but roughly consistently associated with one type of religious experience – say some elements of mystical experience such as “ego dissolution,” or the encounter with SAs, or the ritualization of behavior and then all of religion's subcomponents combined.

Most neuroscientists agree that most functional brain networks contain one or two central nodes in the network, that if damaged, create downstream effects that dramatically alter the functionality of that network. For example, while language production is not reducible to Broca's area, Broca's area is nevertheless a crucial node in the network for language production for most right-handers. In this analogy, if examination of the data on brain and religion point to a single region as crucial for that domain of experience, we would assume that the region in question can be provisionally conceived as a potential key node in a larger network or set of networks that mediate various aspects of religious experience. In summary, if we assume that religious experience is like any other domain of human experience then it is reasonable to assume that religious experience, like any other complex domain of human experience, is probabilistically associated with relatively specific brain activity patterns – a brain signature that is realized in turn as dynamically ongoing recruitment of a relatively consistent set of neural networks, with critical and less critical operational nodes and that operate in unison to realize what we call religious experience.

This brings us to another assumption concerning brain and religion. I assume that the brain is not infinitely plastic. Religious experience cannot be realized with just any old part of the brain or set of networks. Religious cognition has its own computational requirements and peculiarities just like any other domain of human cognition. There is a line of thought coming mostly from investigators who are rightly impressed with both the abundance of evidence for brain plasticity even in the adult, as well as with the power of culture to shape brain response and functions. Here is not the place to address these issues in detail. Suffice it to say that despite the impressive plasticity displayed by the brain, that plasticity has limits. The brain exhibits relatively stable structure and an array of existing functional networks. It observes some population norms, consistent processing preferences and general operating principles. For nonhuman primates and human beings, the prefrontal lobes, for example, tend to support executive control, planning, working memory and related functions while the somatosensory strip supports bodily sensory processing and so forth. These evolutionarily shaped brain localization patterns are relatively stable functional configurations that give culture something to operate with when shaping contextually appropriate behaviors. In effect, culture does not have to “reinvent the wheel” each time it selects a configuration of brain networks to work with when shaping the brain and behavioral repertoire of individual human beings.

Religion Definition

Now given that our fundamental assumptions concerning brain and religion issues are explicit, let us turn to the more fundamental problem of just what religion is. As every student of religion knows there is no universally agreed-upon definition of religion. Religious activities are too multifarious and varied to be reduced to a single set of classificatory criteria. Religion should not be “essentialized” into one set of things and only that set of things. Rather I treat religion as a flexible class of things (artifacts, group effects, practices, cultural events, beliefs, cognitions, behaviors and experiences, etc.) held loosely together by Wittgensteinian “family resemblances.” This is also consistent with attributional theories of religious phenomena. There is no set of characteristics that is present in all and only members of the class of religious things. Instead, each of the flexible class of characteristics that are associated with the family of religious things occurs in a majority of religiously defined phenomena. This once again is adopting a probabilistic approach to the phenomena in question. What are those family characteristics of religion that are typical of the majority but not all of the phenomena deemed religious? These are things like SAs, rituals, distinctions between sacred and profane places, sacrificial altars, temples, churches, mosques, highly entitative groups, pilgrimages, afterlife beliefs and so on. For the purposes of this book, however, I focus on a restricted subclass of the family of religious things – namely psychological phenomena associated with religious behaviors, cognitions and experiences that refer to, or involve, ritualistic elements relating to SAs.

The justification for this focus is that SAs appear in virtually all religions (even in those that officially eschew the “gods” as illusions), in all places and across all epochs. When Murdock chose a sample of 168 societies to represent the full range of human experience in various types of societies, “religious rituals” and “beliefs in supernatural agents” occurred in almost all of them (Murdock & White, 1969). Thus, I will tend to treat religion in this book as rituals, cognitions and experiences concerning SAs and SA-imputed reactions, concerns and associated mythologies. I will emphasize experiences on the “mystical” end of the spectrum as the brain-related data are more clear concerning mystical-type experiences. Now obviously not all of the authors of the studies I review in this book adhere to this kind of restrictive definition of religion. So some of the neuroscience data reviewed in this book must be understood to refer to religious phenomena that surpass my restrictive definition of religion as ritual practices directed toward SAs and SA reactions thereto. I acknowledge that this definition

excludes spiritual experiences that do not involve reference to any deities or SAs, but I note that even so-called atheistic religions, such as Theravada Buddhism, which posit no ultimate supernatural agency or agencies, will often nevertheless include adherents who in fact do believe in SAs. For example, many of these nontheistic Buddhists imagine, understand and relate to the figure of the Buddha as a kind of moralizing SA who can be invoked to help, intercede or facilitate individual enlightenment goals, and then dispenses help, makes adherents aware of concerns, blessings, insights and so forth.

In my estimation, reference to interactions with religious SAs as opposed to ordinary agents or to magical beings like Santa Claus makes religious cognition unique from all other forms of cognition. When we relate to religious SAs we do so ritualistically. That ritual relation puts us in a kind of reduced, deferential, petitionary mode in terms of our agentic powers. It simultaneously elevates the SA as due sacrifices from us – or at least social honors, fear and some degree of reverence or awe, if not reverence. The SA then reacts to our ritual deference and exhibits special cognitive powers and concerns that help define the ritual relation as religious. We (adults at least) do not relate to Santa Claus via rituals, but we do require rituals to relate to beings like demons, angels and gods. To the extent to which we direct ritualistic behaviors toward SAs or magical beings or dead ancestors and so on we tend to have religious experiences. In addition, the extent to which we direct ritualistic behaviors toward powerful human beings like kings or presidents, we invest these individuals with supernatural auras and powers. Think of the “divine kings” that ruled most human polities for many thousands of years. Rituals plus SAs then establish a minimal example of religious cognition/experience. Given that representations of SAs are distinct from representations of other social agents, religious cognition cannot be easily reduced to, or explained by, social cognition alone. I therefore assume that religious cognition, insofar as it includes references to religious SAs, will be associated with a unique neural signature (in the sense of neural signature described).

Religious beliefs involving SAs are distinguished from all other beliefs by their epistemic properties. They often appear intuitive, noninferential, and when operating as ultimate regress blockers they may discourage reflection. But they also very often arise as a product of sustained reflection upon experiences of various kinds (Yilmaz & Isler, 2019). More importantly, we humans tend to want to relate to these SAs in ways that we do not relate to other human beings; that is, ritualistically. Other unique properties of SAs include:

- 1) the SA is nonphysical though visualizable;
- 2) the SA often has unusual and bizarre visual characteristics and features (e.g., haloes, therianthropic features, extra appendages like wings);
- 3) the SA has unusual powers and capacities (e.g., pass through barriers, become invisible, metamorphosis, like Proteus);
- 4) the SA makes unusual demands on the individual (e.g., requires sacrificial offerings);
- 5) in the case of moralizing SAs the extra demands put on the individual involve restrictions on certain behaviors and even thoughts, thus promoting a future-oriented motivational state within the individual to realize a desired or ideal self;
- 6) the SA often (though not invariably) elicits intense emotional reactions and demands an unusual level of emotional commitment from the individual;
- 7) the SA often, especially in the case of moralizing SAs, has “full strategic access” to the mind of the individual thus precluding deceptive interactions with the SA.

The associated neurobiology of SA cognition overlaps to some extent with networks involved in normal forms of social cognition, but the overlap is not at all perfect. We will see that it deviates in interesting ways that underscores the uniqueness of religious cognition.

In addition, when thinking about the minds of SAs we use the neurobiology associated with theory of mind (ToM) attributions differently than when we reason about human agents. For example, Epley et al. (2009) found that when individuals were asked to reason about God’s beliefs the parts of the brain involved in self-referential processing (dubbed cortical mid-line structures by Northoff et al. [2006]) were activated in addition to ToM networks. This did not and does not occur to the same extent when reasoning about minds of other people. For some reason when we think about SAs we involve a reference to our sense of self in a way that does not occur for thinking about ordinary human agents. I assume that what occurs when we think about SAs is that we prefer to think about those SAs that can give us something we need or want (e.g., help, healing, transformation, power). We therefore most often see ourselves as less powerful than the SA we prefer to think about. The sense of self therefore appears in this context in a kind of formal but diminished petitionary role or stance, whereas this is typically not the case when we think of other people.

Assumptions Concerning Evolution of Religion, Brain and Culture

I also assume in this book that the best way to understand the role of the brain in religious experiences is to view the brain as a product of natural selection *and* cultural evolution. Therefore, to illuminate brain and religion topics I adopt standard Darwinian frames of reference using cultural evolutionary models, evolutionary anthropology and neuroscience to probe religion.

In cultural evolution, individuals often acquire and recombine their cultural traits via social learning processes involving imitation of prestige models like charismatic teachers or gurus.

Cultural processes often favor different behavioral outcomes when, for example, cultural processes interfere with or inhibit expression of genetic traits. Conversely, cultural processes can amplify genetic traits.

Most students of religion, including the neuroscientists who study religion, when considering evolutionary accounts of religion assume that religion must in some way be adaptive. The typical function assigned to religion is support for social cooperation. But evolution does not necessarily always produce optimal adaptations to an environment. Therefore, the search for adaptive functions of religion should be supplemented to include the ways in which evolutionary factors produce things like costly arms races instead of nicely functioning adaptations or “spandrels” associated with the adaptations. In this book I suggest (as in its first edition) that one very potent evolutionary force that shapes religious cognition and experience is genetic conflict or sexual conflict.

Sexual Conflict

As Moon (2021) and many others have noted, most religions seem to be specially concerned with sexuality and sexual morality. Moon proposes something he calls the “reproductive-religiosity model,” which posits that religion serves to promote what life history theorists call k-selected reproductive strategies. In human terms these are individuals who pursue committed, highly invested and long-term mating strategies. Religions doctrinally and ritually support these k-selected strategies and impose costs on behavior inconsistent with these mating strategies. As I argued in the first edition of this book, I think there is a lot of truth in the idea that religion promotes k strategists – especially in the form of promoting morally “ideal selves” that exhibit strong executive functions, future orientation,

self-control of impulses, long-term planning and so on. However, religion and all of its associated practices can also be a kind of flexible cultural facultative process that can flexibly switch to promoting *r* strategists when appropriate to do so – as in cases of chaotic environments with high local mortality rates. In addition, even among the modernized religions that specialize in promotion of *k* strategists there are all kinds of exceptions to the rule like celibates, costly rituals, mystical experiences that care not a whit for long-term plans, and visionary forms of religiously ecstatic practices that blast apart all kinds of *k*-selected behaviors.

Taking into account sexual conflict theory can help us understand a broader range of religious phenomena than relying on life history theory only. Sexual conflict occurs when the genetic interests of males and females diverge (Gavrilets & Rice, 2014). Such conflict can result in arms races where adaptations in one sex are harmful for the other sex. These coevolutionary arms races are now recognized as one of the key evolutionary processes shaping life history parameters.

Sexual conflict in humans stems from some unusual reproductive biology in humans relative to other primates. Women's effort in gestating and raising offspring is significantly greater than men's, lasting at a minimum at least nine months. In comparison, men's obligatory investment can end with a single copulation. Thus for *r*-selected strategists men's mating strategy can be more short-term oriented (or *r*-selected: live fast, reproduce early, die young) unless cultural or other pressures promote *k*-selected strategies (develop slowly, reproduce later, live longer) among men. In short, men (relative to women) on average would benefit more from short-term, low investment in parenting strategies, while women would benefit more, on average, from long-term, high-investment strategies.

In addition, human females do not visibly advertise when they are sexually receptive or most fertile as do other female primates. Indeed, due to internal fertilization and gestation, ancestral men could not have been certain that their children were, in fact, genetically their own. This is known as paternity uncertainty. Paternity uncertainty in turn triggers all kinds of male adaptations to counter this female innovation. Females may have developed the innovation to prevent male primates from killing infants/ juveniles given that they could not tell that the juveniles were their own. This reduction in aggression then made it possible to form longer-term bonds between parents and offspring. In addition, new male innovations to overcome paternity uncertainty emerged at every level, from sperm competition inside the female reproductive tract to behavioral displays by males seeking to mate.

There are reliable sex differences in psychological functioning. On the one hand, men are higher risk-takers, more prone to systemizing in their thinking processes, and are more easily drawn to mechanical things and objects. Women, on the other hand, are better on average at language-related processing tasks, they more easily empathize with others and evidence more fluent ToM abilities. Males, on average, are also more aggressive than women. Males have for many tens of thousands of years been involved in recurring violent activities including the hunt and intergroup conflict. But those sources of violent conflict were not the only sources of violence in men's lives. Another source more directly derived from sexual conflict: men violently competed against one another for access to females within the group. Unlike females, males are much more likely to engage in defending territory, mate-guarding, male-male competition and exhibiting elaborate courtship displays.

A key element of male reproductive strategy in response to female innovations like paternity uncertainty is male-specific hormone secretion. Hormones induce the expression of sexual traits including masculinization of the somatic tissue – including the brain. Testosterone mediates the development of secondary sexual behaviors like territoriality, aggressiveness, in-group loyalties and outgroup aggression, courtship displays and male versus male combat for access to females, physiologic weapons and social dominance traits.

Testosterone and related steroid hormones help to regulate development of the human brain. Masculinization of the brain also results in differences in incidence rates and severity profiles for a number of neuropsychiatric disorders, the most conspicuous of which are autism (male biased) and anxiety disorders (female biased). Dyslexia, attention-deficit hyperactivity disorder (ADHD), autism, sleep apnea and Tourette's syndrome are all more prevalent among males.

Reliable sex differences have also been identified in the brain transcriptomes of individuals with multiple brain disorders, including depression, posttraumatic stress disorder and autism. The brain transcriptome includes all of the messenger RNA as well as the nonprotein-coding RNA molecules expressed in brain tissue and thus represents gene activity (NASEM, 2021).

There are several key sex differences in brain structure and function that contribute to behavioral and clinical differences between the sexes. Functional connectivity of the human brain is organized into segregated prenatal brain networks, and that prenatal functional connectivity varies with regard to fetal sex and gestational age. Once the brain develops there

are documented sex differences in serotonergic 5HT_{2A} receptor distribution in the prefrontal cortex. These are the receptor systems responsible for psychedelic effects. There are marked sex differences in striatal-prefrontal dopaminergic anatomy, regulation and function, with greater activity here among females.

Overall, male brains are on average 10–15 percent larger than female brains even after adjusting for body height (Ritchie et al., 2018). Ritchie et al. showed that after adjusting for brain size, female brains had smaller volumes than males in the amygdala, pallidum and putamen, while males had smaller nucleus accumbens. Functional imaging studies of brain activity patterns also find robust sex differences. For example, core default mode network (DMN) regions, such as the medial prefrontal cortex (mPFC) and posterior cingulate cortex (PCC), show greater activity in men versus women during exposure to rewarding stimuli. In addition, women exhibit increased suppression of the DMN and greater activation of the dorsal attention network during exposure to reward and punishment.

Sexual conflict not only has effects on brain and behavior, but it also has powerful effects on large-scale population trends. Under conditions of serial monogamy, and because women carry the greater reproductive burden, women tend to want fewer births and children. When women control cultural pressures fertility rates decline and the resulting overall decline in large families has downstream effects on moralizing religions, which as we noted generally prefer to promote k-selected strategies. Women then begin to come into conflict with moralizing religions.

The phenomenon of genomic imprinting (discussed in the first edition) also promotes sexual conflict as genetic interests diverge along paternal versus maternal gene lines. This makes the battle of the sexes a generational matter as well. Retention of sexually antagonistic alleles in a population can occur, for example, if it, or they, benefit one generational line versus the other. For example, the rate of homosexuality in a population is predicted to increase under sexual conflict if the average fecundity of the female relatives is higher in the maternal but not the paternal line of homosexuals. This turns out, in fact, to be the case (Iemmola & Camperio Ciani, 2009). But why would a greater number of homosexuals increase the overall fitness of any generational line? One proposed answer has been that homosexuals can devote their time to altruistic actions for the generational line. However, many homosexuals have their own children (despite the same sex orientation) and there is no evidence that they differentially contribute altruistically to relatives. Thus, both homosexuality and celibacy remain evolutionary mysteries. One clue to the solution of these mysteries may be

that religiosity is higher among both homosexuals and voluntary celibates than suitable controls. Thus, the contribution of these individuals may be related to religiously defined group fitness.

Biocultural Approach

Another background assumption I make in this book is that religion needs to be understood within an overall life history and biocultural theoretical framework. That same framework implies that the brain will be central to religiousness. Life history theory and biocultural approaches intersect to a great extent. A biocultural approach assumes that religion is influenced by both biological and cultural factors, and that any theory of religion that leaves out biology or culture will be partial at best and possibly misleading at worst. Life history theory concerns itself with life cycle traits such as gestation length, size and number of offspring, age at first reproduction, lactation/weaning period, ongoing reproductive strategy and length of life. These life history variables are all influenced by local cultural, ecologic and social contexts and contribute to reproductive fitness. We need to know how religion addresses each of these life cycle threshold points. I will refer to some of these in this book but cannot review them in depth. Individuals develop mechanisms or biobehavioral strategies that help them solve problems of infant survival, childhood growth, adult development and reproduction across the lifespan. They likely use religion to help in solving these problems.

According to life history theory, tradeoffs have to be made between time and energy devoted to “somatic effort” (i.e., investing in growth and development of the body) versus time and energy devoted to “reproductive effort” (i.e., funneling effort toward producing and raising offspring). Reproductive effort has two further components: mating effort (locating, courting and retaining a suitable mate) and parenting effort (i.e., gestating, giving birth and engaging in postnatal care). On the face of it, religion, at least those forms of religion involving moralizing high gods and developed after the Neolithic revolution, concerns itself largely with processes related to reproductive effort. However, more ancient forms of religion such as shamanistic practices appear to be concerned with both somatic and reproductive effort. Of course, I am not arguing that this is *all* that religion is concerned with. Far from it. Religion far surpasses anything having to do with life history schedules. The point here is to merely notice what parts of the life history cycle religion concerns itself with so as to better understand religion’s functional roles across the lifespan.

Those tradeoffs and investment decisions concerning developmental schedules very likely rest on an intuitive grasp of one's own genetic inheritance as well as one's current experience of the cultural context and social environment. For the neonate and the juvenile, making a bet on future social-ecologic conditions must be based on their inherited genetic profile and on their current experience of the harshness of the local environments (indicating local mortality rates), and the quality of care received from caregivers. If the caregivers invest only minimal resources in the child, then the child concludes that local social and ecologic conditions are adverse and he sets developmental schedules accordingly: "Grow up fast, do not invest in the future and sire many kids as you will be dead soon." If, however, caregivers invest quality time and resources into the child then the child gets the message that the social and ecologic context is favorable; whereupon the child will opt for a slower developmental schedule, longer time horizons and a longer lifespan: "Grow up slowly, invest heavily into one or two kids and live longer." Relative to other primates, humans have a longer period of juvenile growth, slower rates of reproduction and substantially higher investments in parental care. However, these life history strategies vary considerably within human populations with some individuals and groups adopting faster strategies relative to the norm. These life history strategies have been correlated with various religious behaviors, but the picture is complex. At first glance one might predict that some slow strategists would prefer forms of religion invoking moralizing high gods while fast strategists would prefer the more archaic visionary shamanistic forms of religion, but it turns out that beliefs about moralizing, punitive high gods are more widespread when local ecological conditions are harsh. Does that indicate that fast strategists prefer moralizing high gods? If moralizing, punishing high gods help to enforce rules in coalitional alliances and it is these rules that the fast strategists need to get ahead then perhaps it is not surprising that they prefer these moralizing forms of religion.

The central role of the brain in religious phenomena follows from its central role in human life history. Briefly put, a key (and perhaps *the* key) life history trait among human beings, that is, the trait that influences all other life history variables in the standard catalog of life history traits (e.g., average lifespan, body size, length of juvenile period, gestational period, interbirth intervals, fertility rates) is brain size and complexity. The greater the brain complexity the greater its metabolic demands. Gestational period, dependency period and interbirth intervals are all substantially influenced by the need to invest disproportionately huge metabolic resources into brain development, maintenance and functioning. Among humans, for

example, the great bulk of resting energetic expenditure is used to support the maintenance and growth of the brain in the first year of life. Similar amounts of energy are required for brain maintenance in the adult years. Conversely, large brain size/complexity, in turn, makes possible effective cultural learning strategies that feedback on human life history traits with sometimes unpredictable results. So the brain both makes culture possible and is in turn influenced and shaped by culture.

The 4E Framework

The product of brain–culture nexus is the mind. But to understand the mind I adopt and assume some, not all of the claims of “4E cognitive science” (suitably modified to take into account relevant brain functioning and constraints), namely that the mind is embodied, enacted, embedded and extended. It is embodied insofar as it reflects and expresses bodily needs and aims. Mind does not float out there in some nebulous cultural ether untethered to body and brain. Our basic cognitive capacities and categories are grounded in bodily sensorimotor experiences and elaborated via metaphor. Many computations performed by the brain begin with internal or interoceptive messages or information. These bodily computations scaffold more complex representations such as the sense of self. The mind, furthermore, is enacted. It is built for action, for grasping and manipulating the objects and things in the world. It is not some passive information processing device. It is always operating in a world. Its models of the world are oriented toward actionable goals. But this does not imply or mean that the brain does not process computations, content or representations. There is abundant evidence that the brain does indeed perform computations on what can be construed as very rich cognitive content/representations. Mind, however, is indeed embedded in the world. Mind manifests only when interacting with the world or particular contexts. No context – no mind. Finally, mind is therefore extended. It does not end at the skin of the thinker/doer. It extends into the context, the environment. Our tools are extensions of our minds and mind, in turn, are shaped and extended by the tools. The tools themselves are extensions of the culture. I interpret the evidence on religion and therefore treat religious cognition in this text as much like a *tool*. The technology in this case is a technology designed to transform the sense of self or the self-structure. Why self-transformation is so crucial for religion is an interesting question which also gets discussed later (as it was in the first edition as well). The upshot of these 4E considerations is that the brain does not “contain” the mind.

The mind is not reducible without remainder to the brain. The brain is absolutely necessary for manifestation of mind (no brain – no mind) but the mind itself has to be thought of as larger than the physical brain. It may be partially coextensive with the culture, but it interacts with culture which then operates on the brain eliciting some mental capacities and shutting down others. These capacities then articulate with the cultural processes of other minds and artifacts to produce “my mind.” Without culture there would be no mind, but without brain there would be no culture.

In this revised edition I therefore attempt to more fully embed the neuroscience findings within the current understandings on the evolution of mind and culture. Religion both uses and helps to generate culture, including its basic building blocks such as “shared intentionality” mindreading, and imitative social learning abilities. Religion utilized these preexisting cognitive capacities in order to promote cumulative cultural evolution and to facilitate human cooperation and group success via conflict between religiously defined out-groups. Cumulative cultural evolution is arguably one of the distinctive markers of our species and religion is one of its key drivers, products and constituents (Bulbulia et al., 2013).

Social Brain

But what processes of cultural and brain evolution have most influenced religious experiences and cognition more specifically? I discuss this issue more fully in the chapters that follow. As a first approximation the full array of religious phenomena tend to have been influenced by social forces. Dunbar (2009) has articulated the “social brain hypothesis,” which states that primates have larger than expected neocortical volumes (given body size) because they need to deal with the complexities of group or social life. Given neocortical volume in humans, Dunbar theorized that the average human social network should top out at about 150 individuals. Ethnographic and social evidence support this prediction. For example, it is the typical size of a hunter-gatherer group; of a company in a military organization, of a personal network (number of individuals a person knows directly), of a church congregation, of a small business company and so on. Within this large personal network there are hierarchically organized subgroups, alliances, coalitions and cliques, that reflect differing degrees of familiarity with the individual at the center of the network. These coalitional alliances need to be maintained, updated and renegotiated on a semiconstant basis by members of the alliance, all of which requires substantial cognitive resources.

Men and women form distinct kinds of groups, but both sexes need to cooperate within groups. Human groups succeed to the extent that problems can be solved cooperatively. Cooperation is based on trust, and trust can only be earned over time and after many social interactions have taken place between the parties involved. Those social interactions have to be remembered, archived and recalled repeatedly when evaluating current trustworthiness of one's potential partner in an enterprise. Maintaining the stability of relationships over time requires constant renegotiation of the terms of the cooperative agreement. People are capable of deception, and thus that capacity needs to be taken into account when weighing evidence of trustworthiness. It requires that individuals learn how to read the intentions or minds of others via ToM capacities in the group so as to manage conflict; anticipate strategic moves of the other, repair strained relationships and so on.

First order ToM involves having knowledge of one's own mental states ("I believe that ..."). Second order intentionality or ToM involves knowledge of another person's mental states ("I believe that you understand that ..."). Third order intentionality involves individual A thinking about what individual B is thinking about A's thinking ("I intend that you think that I think that we are going to ..."). Most scholars working in the area of social cognition think that human beings are capable of perhaps five orders of intentionality but no more. The computational demands on the brain for this kind of social cognition are considerable. Dunbar and many other theorists argue that mentalizing capacity is central to religious cognition. People who have difficulty with mentalizing tend also to have difficulty with religious experiences, while people with an overabundance of mentalizing tend to be more religious, and in cases of positive-symptom and cases of paranoid schizophrenia experience outright religious delusions.

Neurohormones important in social interactions such as oxytocin and vasopressin are crucial to the social brain hypothesis and to other theories that place religion within the overall idea that humans are an ultrasocial species and that it was social forces that largely drove the brain's recent evolution. Oxytocin has been called the trust molecule as it enhances level of trust and emotional closeness between people. Its receptors and actions differ profoundly by sex. It also helps to prepare the brain for out-group hostilities, particularly in men. Vasopressin appears to be crucial for social memories – especially in males. Its activity levels fluctuate in relation to testosterone activity. These neurohormones exert modulatory effects and actions on neuronal sites that are part of the loose collections of neural networks referred to above as the "social brain." For example, the

fusiform gyrus supports rapid recognition and processing of faces. Face-to-face contact and interaction of course was the basis for social interactions throughout human evolutionary history. Facial expressions function to convey complex social signals that facilitate communication and cooperative enterprises. The ventromedial and dorsomedial prefrontal regions are known to support processing of self-related information as well as understanding the mental states of others (i.e., ToM tasks). The frontopolar region (BA 10) evidences a uniquely complex structure in humans and is one of the evolutionarily most recent regions of the brain in primates. It is involved in multitasking, working memory and cognitive branching and therefore may support processing of third and fourth (etc.) orders of intentionality. The superior temporal sulcus contains mirror neurons that support social imitation behaviors and possibly emotional empathy. We will see later that imitative learning is crucial for cultural evolutionary models of brain evolution. The temporalparietal junction supports ToM tasks and language processing. The insula supports empathetic responses as well as moral emotions and the precuneus is involved in a range of activities from mental simulation to self-awareness. Finally the hippocampus is involved in memory functions. Now of course all of these structures support a myriad of other brain processes, and all are involved in extensive neural networks with multiple functional capacities. Thus, while it is clear they are involved in social cognition they are not exclusively devoted to social cognition.

Many neuroscientists have noted that this network of structures called the social brain overlaps to a significant extent with the so-called DMN, which is a central hub network in the human brain and has been a target of evolutionary innovations in brain function. The DMN activates in a resting state when the mind is free to wander and not performing any particular task. It appears that what most people daydream about are social interactions and future goals and desires. The DMN also repeatedly is engaged with forms of religious cognition and with some experiences of the self.

To be a bit more precise concerning the anatomy of this network consists of the ventromedial prefrontal cortex (vmPFC), posterior cingulate/retrosplenial cortex, inferior parietal lobe, anterior insula, precuneus, lateral temporal cortex, dorsal medial prefrontal cortex and the hippocampal formation (hippocampus, entorhinal cortex, and parahippocampus). All of these structures participate in the DMN and in other networks. They will also repeatedly appear in association with “sense of self” and with religious experience.

As the neuroscience findings summarized in this volume will make clear, it is becoming increasingly clear that ToM and mentalizing processes are also one of the core systems of religious cognition. But, in addition to mentalizing networks, religious cognition appears to vitally engage networks involved in self versus other-processing, which can be seen by the frequent observations of activity in the vmPFC, temporal-parietal junction, the precuneus and related DMN structures which are thought to be vital for self-processing. This indicates that when religious believers reflect on the mind of an SA or engage in interactive processes such as prayer, something about self-concept in relation to an SA has to be engaged as well to make the religious cognition religious. This idea is similar to what is proposed with internal working models of self and other in the attachment literature. These IWMs guide relationships between people and they may also be suitably altered to guide relationships with SAs.

The Predictive Processing Framework

Another background framework I will assume is the so-called predictive processing framework (PPF). Several researchers have turned to the PPF of cognition to explain the interplay between perceptions of agency and religious frameworks (Andersen, 2019; Schjoedt & Andersen, 2017; Van Elk & Aleman, 2017; Van Leeuwen & Van Elk, 2019). The version of PPF I prefer for this book is rooted in the “free-energy” interpretation of biological systems formalized in Friston (2010). The Free Energy Principle asserts that living systems are compelled to resist the entropic dissolution entailed by the second law of thermodynamics, and that they achieve this goal by seeking to minimize surprise within their environment. A computation or series of computations must be performed by the brain to minimize surprise and bind more free energy. Perception is consequently reconceptualized as a form of active inference, in which organisms try to engage in patterns of action that will enable them to remain within a set of states that guarantee survival. When applied to the brain, predictive processing offers an alternative to models of the brain that view it as a passive receiver of sensory signals. Instead, cognition is depicted as actively unfolding in hierarchically nested sets of Bayesian networks that are continuously generating hypotheses tested against inputs coming from the levels below them, all the way down to the level of sensory input (Clark, 2015; Hohwy, 2013). Predictive processing and active inference of conceptual information as well as foresight are likely to be crucially mediated at the top of the hierarchy by the prefrontal cortex (PFC), which is implicated in a

number of processes controlling event-planning, task representations and goal-directed behavior.

In the case of supernatural agency, religious narratives and concepts provide the “priors” (our prior assumptions and beliefs about expectancies and the world) through which individuals can interpret stimuli in uncertain situations with low perceptual information (Andersen, 2019; Van Leeuwen & Van Elk, 2019). The general idea with respect to PPF and religious cognition comes from work on psychedelics. Serotonergic psychedelics exert their effects via agonism at 5HT_{2A} receptors. These 5HT_{2A} receptors are densely expressed on deep pyramidal neurons in the PFC which are presumed to encode religious prior beliefs. Agonism at the 5HT_{2A} receptors will cause (via glutamate neurons) a general loosening of interconnected PFC networks encoding prior beliefs. Incoming sensory feedback carrying the error signal will thereby be more optimally resolved, minimizing a state of surprise.

Final Assumption: Religion as a Transformational Technology

My study of the neuroscience literature on religion has led me to believe that in terms of the ways in which religious phenomena engage the brain it can be profitably understood as a cultural tool for transformation of the self. Religion promotes the cognitive process we call “imaginative simulation of other possible worlds.” The ability to imagine other worlds relativizes our own world and gives us ways to see how things could be run differently. Imaginative simulations are sometimes useless daydreams but are also occasionally strikingly useful as when conventional approaches and conventional reason fail to meet environmental challenges, as they very likely did during climatic changes of the upper paleolithic. Religion is that power that can thrive and win in these kinds of impossible situations ... when all the facts, reasons and givens of a situation stand against you. “Reason” looks at the situation and pronounces it impossible. But then imaginative faith looks at it and claims there is hope. That hope can and may be delusory but at least it leads to action when reason yields only indecision and paralysis. Religion is the creativity we find in other-worldly fantasies and simulations that, when sifted by reason, can sometimes yield the way out or at least the way through. It can defeat catastrophe, superhuman challenges or even the pedestrian, everyday mysteries of the “unknown unknowns.” Reason works best when facing the “known knowns” and “known unknowns” and it can even get us to the threshold of the “unknown unknowns.” But it can’t get us through the “unknown

unknowns” without help from an upheaval in thought, emotion and spirit known as religious consciousness and creativity supported and promoted by a process I called decentering in the first edition. I return to a discussion of decentering in Chapter 2. Nevertheless, even when grappling with the “unknown unknowns” religious consciousness can do no good without the help of reason. We can never dispense with reason, but in situations of extreme transformation and crisis, reason becomes a mere assistant to the process of mental upheaval and transformation that is religious consciousness. Radically chaotic situations and even mildly unpredictable situations as our ancestors encountered in the upper paleolithic require us to place our priors, our preexisting assumptions, in temporary abeyance so that we can better see the situation before us.

Decentering provides a mechanism for accomplishing this adaptive task or transformation. Religious consciousness allows for and even promotes a radical decentering of priors, and after assumptions and conventional rationality are discarded it can move or guide you through the process of fundamental transformation required to see the world anew. Religion, however, does not merely have you undergo transformation for transformation’s sake. It has an end in view. It aims to link you up to an updated version of your priors or a whole new set of beliefs that can meet the challenge of the new situation. Religion, in short, is a technology that transforms an identity, a well-established set of personal priors, world assumptions and norms – it detaches “you” from one set of beliefs/commitments, forces you to explore irrational and distant connections in other-worldly simulations all in service to finding better beliefs, and then finally links you up to another, newer, stronger set of beliefs/commitments (based on the new connections discovered in the exploratory phase) that can meet the challenge you are facing. In times of relative stability only mild updating of belief systems are required, and therefore daily ritual, practice and doctrinal forms of religion guide the updating process. When the inevitable return to chaos and suffering occurs, however, more fundamental experiential forms of religion return, along with the radical transformational process that that entails. When that transformational process is guided by ancient religious traditions with their hard-earned, hands-on knowledge and wisdom concerning transformational crises and practices, it generally has positive life-affirming properties. When however, that transformational process is guided by fads, cults, conspiracies, clubs, small groups, ideologies and in the modern age state power and political institutional structures, the transformational process serves ends other than the individual’s flourishing. In those cases we see the tell-tale signs of servile, antirational religious fanaticism and groupthink.

As we as a species have over the centuries been able to cobble together occasional islands of fragile and transient stability amid the chaos that is nature and history, religious transformational consciousness fades into the background. It is replaced with conventional norm-centered social-regulatory forms of religion. But this fading-away process is temporary as nature and our own failings (history) will always and inevitably return. When reality once again intervenes with instabilities, terrors, nightmares, chaos, strife and suffering, the need for innovative forms of thinking and creativity come to the fore again and – transformational religious consciousness reasserts itself and with it decentering.

It is to decentering we turn in Chapter 2.

On Decentering

Introduction

In the first edition of this book, I argued that a brain-based, cognitive process that promoted culturally shaped personal transformation was central to and characteristic of religious experience. I called it “decentering.” Religion, I insisted, could profitably be seen as a neurotechnology for personal transformation in service to potentially positive or negative cultural outcomes depending on socioecological contextual factors. But it all hinged upon this decentering mechanism. Decentering involves: (1) taking off-line the self-concept, or disengaging executive control systems such that the sense of self or agency is transiently diminished and the individual is more open to sensory input and to cultural influences, (2) then the self-concept or structure is placed into a suppositional space or possible-worlds box where it can be edited or worked upon using available cultural materials, (3) then a search in memory and semantic stores ensues, looking for materials to update the self-structure, guided by existing cultural scripts or narratives, until a more computationally efficient self (given current environmental challenges) is found, or failing identification of adequate self-concept match in semantic stores, construction of a new self-concept is cobbled together out of available cultural scripts or from entirely new experiential materials, and finally (4) instantiating or binding the new self-concept into a position of executive control in the neural system; this is matched to some extent to a culturally appropriate or ideal cultural script resulting hopefully in a wider, better adapted sense of self than the old self. Steps 2 and 3 are typically experienced phenomenologically as a kind of liminal or in-between space with high uncertainty and anxious affect. In neurological terms, the end result of this four-step process is a more computationally efficient set of small-world neural networks optimally balanced between circuit segregation and integration which could then support deeper cultural engagement or opposition depending on context

and a different, hopefully wider, more enriched sense of self and executive control. The central role that the “self” concept plays in this scheme demands greater explanation of exactly what I mean by the self. I will discuss that issue in-depth in Chapter 3. For present purposes it is enough to link the self with the sense of agency – the intentionality or world-directedness and care at the center of the personality and mind; that is, intentionality.

The evidence for decentering has accumulated rapidly since the first edition. In particular, I believe it is supported by or at least consistent with the imperative of the predictive processing framework (PPF) to minimize “surprise” paradoxically by seeking out high information or surprising events. In essence decentering is triggered by a certain kind of “surprise” – a surprise signal that cannot be handled by simple updating of beliefs. Instead, the surprise signal is intense or salient enough to indicate that major revision of priors is required in reference to group norms.

Decentering and Surprise

According to PPF a primary tool the brain/mind uses to update its models of itself and the world is “surprise.” Numerous accounts have been proposed to explain the experience of surprise (for review see Reizenzein et al., 2019), but all agree that the surprise mechanism is a brain-based information-processing system or series of operations that operate at an unconscious level of processing, where it continuously and automatically compares what it expects against what actually happens. It is a cognitive-schema discrepancy detector. When things violate expectations, surprise results and a cascade of brain and physiologic events follow.

According to Reizenzein et al.’s (2019) “cognitive evolutionary model of surprise,”

surprise is evoked by unexpected (schema-discrepant) events and its intensity is determined by the degree of schema-discrepancy, whereas the novelty and the valence of the eliciting events probably do not have an independent effect. Unexpected events cause an automatic interruption of ongoing mental processes that is followed by an attentional shift and attentional binding to the events, which is often followed by causal and other event analysis processes and by schema revision. A physiological orienting response marked by skin conductance increase, heart rate deceleration, and pupil dilation has been observed to occur regularly in the standard version of the repetition-change paradigm of surprise induction, but the specificity of these reactions as indicators of surprise is controversial. (p. 50)

Reisenzein et al.'s triggering event of surprise detection with its automatic interruption of ongoing mental processes is roughly equivalent to the first step (agency reduction) in my decentering process. The difference is that the interruption is strong enough to cause a transient decrease in the sense of agency, executive control and self-control we normally have. Reisenzein et al.'s second step of causal and event analysis is roughly equivalent to the third step in my decentering process (editing the old self and search in memory stores and cultural scripts). Reisenzein et al.'s "physiological orienting response marked by skin conductance increase, heart rate deceleration, and pupil dilation" occurs in the second step of my decentering process where the old self-concept is put into a suppositional space for editing and updating. This is subjectively experienced as a liminal space for the individual. The physiological orienting response in the decentering process in my view is a triggering of the orientating reaction (OR) we call pontine-geniculo-occipital (PGO) waves typically associated with rapid eye movement (REM) sleep, and thus the OR signals an intrusion of REM sleep neurobiology into waking consciousness. That is what gives the experience its liminal quality, and it is also another factor that makes the individual more willing to call the experience "religious." Both Reisenzein et al.'s surprise process and my decentering process end in belief updating processes. In the case of decentering the belief updating concerns the very sense of self resulting in a more ideal self relevant to individual or cultural ideals and norms.

Thus, decentering can be considered a special case of surprise, where the surprise event in question exhibits special properties because the mismatch between expected and obtained data is large enough that it effectively calls into question the accuracy of the modeling strategy itself. Its "Bayesian priors" which for our purposes here we can assume informs the individual's sense of self, becomes the object of the updating process. The surprise event and error signal are extreme enough to trigger PGO waves and REM intrusion as part of its orientation reaction. In other words, normal cognitive processes are not strong enough to cognize the information delivered by the surprising event and thus REM sleep is recruited to help. REM then intrudes into waking consciousness, and presumably later that night REM intensity indices are stronger in an attempt to more effectively integrate the surprising information. This REM-based integration process is accompanied by cognitive events we call dreams. It is in these dreams that additional cognitive materials for the production of supernatural agents (SAs) emerge (to be discussed in following chapters).

In Reisenzein et al.'s account of surprise, expectancies are the currently activated cognitive schemas, "priors" or beliefs that summarize predictions about the world. As long as the schema-discrepancy detector registers congruence between schema and sensory feedback or input, the person's predictive simulations about expected events are supported by the evidence, and there is no need to revise them. In contrast, if the surprise mechanism detects a discrepancy between the activated schemas and sensory feedback, the error or mismatch indicates that the prior schema or simulation is non-reliable to some degree. Then the system generates an orienting reaction to gather more information to assist in updating predictive models. The error signal or the trigger for a decentering event has to encode that there is a schema discrepancy, the degree of the schema discrepancy, the level in the neural hierarchy at which the discrepancy occurs, its valence and its physiologic significance or intensity.

If the schema-discrepancy signal exceeds a certain threshold, then ongoing information processing is automatically (unintentionally) and inevitably interrupted. Central executive systems are transiently taken off-line and central resources are reallocated to (i.e., attention is shifted to) the unexpected event. If the unexpected event or surprise signal indicates that prior schemas were significantly or radically nonreliable then the initial feeling of surprise and the reallocation of resources will not be adequate to end the surprise and adequately update priors. Instead, reallocation of attentional/executive resources will continue until the surprising event can be adequately cognized. If it becomes clear that it cannot be adequately cognized no matter what new cognitive resources are dedicated to the task, then emotions like dread, terror or awe and bliss become possible emotions. The liminal phase of the decentering process will be prolonged and mystical experiences may occur.

For run of the mill decentering/surprise events, however, reallocation of central executive resources leads to a transient reduction in agency as central executive systems are stopped/interrupted and decentering enters the liminal phase associated with a reduction in agency and the formatting of the sense of self into a possible worlds space where cognitive editing can occur and where priors are updated.

In normal everyday cognition, these processes – interruption, attentional shift, the occurrence of the feeling of surprise, then the production of a physiologic orientation reaction – set up the next step of event analysis plus an updating of the beliefs or schemas so as to resolve the schema discrepancy. But success and effectiveness of belief updating (search through memory stores and cultural scripts in the decentering framework) depends

on the estimated costs and benefits of information search, the difficulty of the event analysis and the available time. In short, the belief updating process depends on the severity of the problem uncovered by the surprise event. In the case of religious cognitions and experiences, I am hypothesizing that the surprise event is intense enough to call into question the individual's sense of self. That is why the orienting reaction triggers REM sleep neurobiologic resources. REM specializes in the consolidation of emotional memories, and these resources can facilitate the processing of the difficult to cognize event. In short, the surprise event is tagged as containing information of existential importance to the individual. My claim is that all experiences deemed religious by an individual (among modernized populations) will contain this existential dimension stemming from the intensity of the surprise signal.

How should the decentering framework understand the intensity of the surprise signal? Clearly traumatic events will be intensely surprising and some of these will also trigger religious experiences. But certainly most religious experiences are not traumatic. So the severity of surprise or adversiveness of surprise is not the critical factor predicting an event that will eventuate in religious cognition. The simplest quantitative surprise model assumes that the intensity of surprise about an event is proportional to its improbability, where, for example, the unexpected event disconfirms a single belief (e.g., the person expects to see a red square, but a green square appears instead). But to account for religious cognition we need models where the unexpected event disconfirms several beliefs about the modeler her/himself *and* the world as well, either simultaneously or sequentially.

One reason why religious cognition requires that the surprising event disconfirms beliefs about the self and world is that that sort of surprising event is supremely informative for the organism. It is especially valuable information to know that your "priors" or models are not adequate to the world. When that surprising event, in particular, detects pattern in the noise when only noise was expected, the information undermines the assumption of statistically independent outcomes in the sensory feedback data and suggests the presence of some alternative (to the expected) mechanism at work. If the deviations of a model's predictions *lack expected randomness*, it implies that a superior predictive model is available. The religious mind, in this special sense, is seeking randomness – not so much meaning or patterns in noise. It is seeking randomness so that it will be surprised when it notices patterns in the noise, as that is the gold standard in novel knowledge acquisition.

In the decentering account, after a surprising event, the self experiences a reduction in agency or control, as well as a more or less prolonged period of liminality precisely because the individual discovered randomness where the pattern was expected, and that randomness could not be processed adequately by normal cognitive means. It required the recruitment of REM neurobiology to do so. Surprises that lead to religious cognition are not merely improbable events; instead, they indicate a breakdown in the model being used to quantify probability. The decentering account predicts that religious people when in religious mode will experience their greatest or happiest experience of surprise when they identify patterns where their model implies there should only be random noise. What makes us postulate minds/agents with supernatural powers who apparently can also read our minds and intentions? As mentioned earlier, one element that pushes us to entertain supernormal minds is the *degree and type of surprise* we experience when we encounter something unexpected. When something totally unexpected occurs we need to infer something that has the power to account for that unexpected set of events. When we spill coffee on a tablecloth we expect a complex distribution of the coffee stain. If, instead, we find that the coffee spill either spells out something extraordinarily meaningful or conversely is completely random relative to expectations, then our brain-mind is more likely to infer that only a super-human mind could have done that.

Friston's free energy formulation of the Bayesian predictive coding process maintains that the brain's main aim is to minimize "surprise" but we need to understand this aim in practical terms. What is the best way to minimize surprise? It is to seek out the kind of surprise that maximizes life-relevant information for us – all within certain bounds. If our priors (predictive beliefs) are too rigid we will be ruling out too many sources of surprise. Conversely, if our prior beliefs are too loose and unstructured we will be aimless and not be able to fulfill any of our goals. We want to generate models that find that sweet spot between fixedness and flexibility that maximizes our chances to flourish in the kind of environments we face. To find that sweet spot we can use the generation of counterfactuals to evaluate the significance of the event as well as imaginative exploration of possibilities when confronted with surprise. Counterfactuals compare what occurred to what might have occurred in an ever-increasing "distance" to what actually occurred. The counterfactual comparison process makes possible the evaluation of the significance of the surprise event and the most practicable way to update beliefs to meet such events in the future.

Model Parameter Updating Via REM and Dreams

The difficulty or fluency with which generation of counterfactuals occurs relative to the surprising event may be one way the brain judges significance of the surprise signal. The more unexpected something is, the more information it likely has; and that information is the kind of information the brain needs to build adequate models of anticipated challenges. In particular, surprise-related information points to how much work we have to do to update our models; our beliefs and expectations. The work involved in belief updating involves counterfactual generations – endless scenario spinning and evaluation. The degree of surprise I experience encodes the information about how well my current self is adapted to coming challenges and how much work I will need to do to transform myself to meet those upcoming challenges. Will I need to completely scrap my “priors” and then build a whole new self from scratch? Or will simple editing procedures suffice? Given that surprise encodes this kind of information – information absolutely crucial for the sense of self and model updating – it follows that my sense of self is necessarily anchored in estimations of the surprisingness of the things I encounter in the world. But surprisingness in turn may be measured by the ease with which counterfactuals are triggered by the surprising event or their number. These counterfactuals can occur anytime but they most vividly and most often occur in dreams (McNamara, 2000).

In REM sleep dreaming perception is decoupled from action as the dreamer is motorically paralyzed and incoming sensory information is blocked. The mind is free to edit and update models free of the necessity of responding to ongoing sensory feedback. Bottom-up sensory input and top-down prediction are decoupled. Dreams or the simulations we generate during REM sleep depict scenarios where the balance between uncertainty and surprise is constantly being adjusted and optimized. From a phenomenological perspective, surprise is an organism’s response to an unexpected change in its environment. These unexpected events occur regularly in dreams and are indexed by the appearance of hippocampal sharp wave ripples, then REM theta and PGO waves. The kinds of unexpected events in dreams are embodied in bizarre images and lead to a surprise. The surprise then leads to the generation of simulations counterfactual to the surprising event, and these are the dream stories we encounter in dreams.

The fluency with which the counterfactual generation and comparison process occurs after surprise yields information on how significant that event is for the truth value of prior beliefs. If priors cannot account for the

surprising event then that fact leads to an information gain and thus can be formally measured as a Kullback–Leibler divergence between prior and posterior beliefs. In the brain, surprise as expectation violation correlates with functional magnetic resonance imaging (fMRI) blood oxygen level dependent (BOLD) responses in the salience network, including the hippocampus, anterior cingulate cortex and anterior insula. These same brain regions (among others) are modulated during REM.

If we use old-fashioned semantic network analyses to model surprise, then beliefs are represented as propositional nodes in a network, connected by excitatory and inhibitory connections depending on semantic closeness and whether propositions support or contradict each other. Adding new propositions triggers spreading activation, and a coherence metric can then be computed, based on the fit between new propositions and existing propositions. As such, a coherence score is low when surprise is high – that is, when new propositions are difficult to integrate into the network. Integration of new information into long-term semantic memory is accomplished during REM, which specializes in processing distant semantic associates.

In summary, I have discussed some potential ways in which the decentering framework (for religious cognition) might intersect with the process of minimization of surprise within the PPF. I will have more to say about PPF and religious cognition in the pages to follow. But for now, we need to dig more deeply into the phenomenology and neurocognitive detail of the decentering process.

The Four-Step Process

Back in 2009, I described decentering as a four-step process that always occurred sequentially. Its time course varied from minutes to longer periods of time and I claimed it characterized all religious experiences. Decentering cannot be understood in the absence of reference to its brain mechanisms because it crucially involves this four-step process whose steps are united not by any inherent logic but rather by the brain processes that mediate them. Decentering involves a sequential disengagement of executive control/diminution in personal agency *and* a subsequent entry (step 2) of the disengaged self into a liminal state (what I called in 2009 a “suppositional space or possible worlds box”). During this liminal phase, we are still identified with the old self-concept, except that it has no agency. Only the sense of ownership of experiences or qualia remains. We experience the state initially as

powerlessness. We are floating, drifting as it were, in this in-between state of self-awareness (without agency). If the liminal state persists, the prospects for more complete dismantling or dissolution of the ego increase. The greater the ego dissolution the wider the scope for cultural input during the reconstruction of the ego or sense of self. In an effort to end the liminal state and remedy the lack of executive control or top-down inhibitory and regulatory processes due to loss of the self-concept and associated downregulation of central hubs in the default mode network (DMN) and executive control networks of the brain, the brain initiates repair routines which bring us to step 3. In step 3, a culturally constrained search for an optimal self occurs and takes whatever time and brain resources are required to “locate” or settle on a “new self,” which then facilitates step 4 or integration of the old into a new self that reasserts executive control. Each step in the process invites psychic danger given that the derailment of agency or of entry of the diminished self into a liminal state or selection of, or integration into a new self could lead to adverse outcomes for both the individual and the local culture. For example, prolonged times spent in the liminal state could lead to dissociative phenomena, while the integration of the old self into a less than ideal new self could eventuate in identification with a fanatical group leader or highly entitatively defined and insular cultish group and so forth. Because of these sorts of dangers inherent to the decentering process, religions everywhere created rituals to regulate the outcomes of the decentering process.

Decentering is arguably unique to religious cognition as it naturally leads to the generation or postulation of SAs or superhuman minds/agents. It also differs from related states like trance, dreaming, or altered states of consciousness because each of these similar phenomenological states appears to be parasitic upon some portion of the decentering process itself. They are truncated versions of decentering, and in this sense, the evolution of religion made possible all these other forms of consciousness. Decentering surely contributes to the phenomenology of dreams, trance, altered states of consciousness, creativity and so forth, but these other experiential states exhibit only one or two steps of decentering’s four-step process. They are either triggering states for decentering, exhibiting only the lapse in executive agency/control, or they are products of the liminal phase of decentering (dissociation, hallucinations, trance, etc.). They typically begin the decentering process (involving reduced agency or sense of self and entering the liminal phase) but do not follow it to its natural conclusion in terms of the reconstruction of a wider sense of self or reassertion

of executive control. They represent aborted decentering events. An exception to this rule may be the case of music. The philosopher Stephen Asma in his recent text (Asma, 2017) “The evolution of imagination” discusses the creativity in musical performance and improvisation in terms remarkably like the decentering process I described back in 2009. He even refers to it as a “decentering”:

We recognize that creative activity decenters the ego What’s happening during this muse-like loss of agency, however, is rarely explored. We tend to equate this loss of executive control with a pseudo-religious ecstasy and give up any further analytical approach When we are in this decentered muse state, for example, we are engaged in a highly associative process – what William James might call the “stream of consciousness” ... Much of this is unconscious which is why the muse simile is so powerful, but this phase is followed by a *reentry* phase, where the free associations or stream of consciousness is brought back under executive control and integrated into the more focused projects of the person. (Asma, 2017, p. 27)

I think most scientific investigators of the process of creativity would agree with Asma and this stage or phase model of the creative process. It has obvious affinities with my model of religious decentering. As to Asma’s claim that the free association phase has not been investigated analytically I entirely agree, but offer here and in my 2009 book a beginning of investigation of decentering insofar as it illuminates religious experience.

In healthy decentering, the self itself undergoes an extensive deconstructive and then reconstructive process, again because of the brain dynamics involved – the process begins with the inhibition of precuneus and ventromedial prefrontal cortex, regions that mediate the sense of agency, awareness and self. This self-diminishment also occurs in REM dreams, trance, flow states and other altered states of consciousness (Vaitl et al., 2005). But in these related states the reconstructive process is not initiated or completed. This is the striking thing about religious cognition – that even in the most mundane everyday forms of religious cognition, one’s very self is brought into focus, suspended – even if transiently and then worked upon and reinstated into some sort of executive control. Without this sense of agentic control, normative conceptions of moral responsibility for one’s actions would be problematic. The Abrahamic religions emphasize the last step in the decentering process to ensure moral responsibility for one’s actions occurs, while some of the eastern religions such as Buddhism and Hinduism emphasize steps 1 and 2, which highlight the downregulation of ego and valorization of the liminal states.

Pivotal Mental States and Decentering

Brouwer and Carhart-Harris (2021) introduced a new construct that referred to a brain/mind state they called the “pivotal mental state,” which is a lot like the process I called decentering in 2009. They define pivotal mental state as a “hyper-plastic state aiding rapid and deep learning that can mediate psychological transformation” (Brouwer and Carhart-Harris, 2021, p. 319). They argued that pivotal mental states serve an important evolutionary function, that is, to aid psychological transformation in cases of extreme environmental demands or stressors. As in the case of decentering, pivotal mental states are theorized to be regulated by 5HT_{2A} receptor signaling. Serotonergic psychedelics trigger engagement with the brain system designed to mediate rapid and deep learning via hyperplastic brain and mind states, enhanced rate of associative learning and the potential mediation of a psychological transformation. Again all of this sounds a lot like decentering except that the last step in the process, reasserting executive control via an enriched sense of self, is not described, though it is inherent in the logic of the idea of pivotal mental states. After all, why engage enhanced hyperplastic brain and mind states unless they are to mediate knowledge gain and personal transformation? The authors also fail to note that the brain system that mediates this kind of personal transformation does not need stress to engage it. It occurs on a smaller scale every night during REM. Pivotal mind states are not a rare thing; they occur nightly in service to creativity and personal transformation. The intensity of the state of course varies dramatically. The greater the intensity, the greater the personal transformation. But transformation can be a daily/nightly incremental process as well. The combination of occasionally intense transformational experiences with slow incremental changes is made possible by decentering, and that is what we call religion.

Decentering Steps 1 and 2 and Generation of SAs

Returning to my 2009 account of decentering and with regard to steps 1 and 2 these appear to be one source of ideas concerning properties of the supernatural – including SAs. There would be no exalted SAs without a corresponding set of diminished human egos and selves striving to overcome and transform these diminished selves. The transformational process of old selves into new selves is typically transient, brief and almost unnoticeable in routine, everyday forms of religious cognition, but it does occur. In mystical states, however, the phenomenology of the decentering

process is much more obvious and pronounced. You can clearly see that agency is diminished in mystical states, while interactions (via the imagination) with SAs and realms are enhanced and brought to imaginative pitch. Note that I am not dismissing mystical experiences as nothing but imagination. I conceive imagination as intrinsic to decentering. It is not mere reproduction of memory images. Rather it involves a perceptual and creative moment in addition to an initial recombinatory process involving memory elements. There is no way to understand this kind of intense experience mediated by the decentering process without reference to the brain mechanisms which sustain it whenever it occurs. Its logic is dictated by the ways in which the relevant brain processes operate and the brain regions in which they operate. Thus, religious phenomenology is intimately tied to and to some extent produced by brain mechanisms. The brain shapes religious experience and, as we will see below, religious experience in turn shapes brain functionality. The neurophysiologic and neurochemical mechanisms that give rise to each step in the process can only be suggested at this point, given that careful investigation of decentering has only just begun. I turn next to a discussion of the neurology of decentering.

Step 1 Diminution in Sense of Agency/Self

The trigger for a decentering process is a surprising event or an inhibition or down regulation of executive control systems and the self-concept. Many different events can impair the sense of agency in an individual. Everything from sleep deprivation to social stressors can inhibit the sense of agency. To have the kind of transformational religious experience I emphasize in this book, however, you need a special kind of surprise and you need all four steps in the process. With regard to step 1, given that the self-concept and the subjective sense of self are mediated by cortical mid-line structures including the central hub of the DMN (David et al., 2008; Feinberg and Keenan, 2005; Keenan et al., 2001; Seth, 2013; Vogeley and Fink, 2003) – that is, the precuneus and the anterior insula, it is reasonable to suggest that step 1 of the decentering process involves downregulation or inhibition of activity in the DMN and precuneus particularly. Both the precuneus, anterior insula (and the DMN), particularly the precuneus' connections with medial prefrontal cortex via the superior longitudinal fasciculus and other tracts, support (among other functions) the sense of self and agency.

The brain mediates the subjective experience of the sense of self via summation of a million bodily cues reporting from all sectors of the sensory

system up to the frontal lobes and to the anterior insula. An extraordinary morphological characteristic of the anterior insular cortex (AIC) and the anterior cingulate cortex (ACC – an error detecting site) in hominoid primates is the unique concentration of clusters of large spindle-shaped neurons among the pyramidal neurons in layer 5, called von Economo neurons (VENs) after an early neuroanatomist. Their connections are not known, but VENs according to Craig (2009) may be the substrate for fast interconnections between the physically separated advanced limbic sensory (the AIC) and motor (the ACC) cortices. The loss of emotional awareness and self-conscious behaviors in patients with frontotemporal dementia that correlates with the degeneration of VENs directly supports this notion. Patients with borderline personality disorder and patients with autism spectrum disorder evidence reduced activation in the AIC. Patients with frontotemporal dementia display a selective loss of VENs and of self-conscious behaviors, and a loss of emotional awareness of self and others.

Downregulation of DMN, AIC and medial prefrontal and precuneus structures are probably facilitated by the activation of 5HT_{2A} receptor signaling systems via stress, pharmacologic agents, internal biologic signals, cultural pressures/ information, or religious practices. Administration of 5HT_{2A} receptor agonists like LSD reliably reduces activity in the DMN, AIC and in the posterior cingulate cortex, precuneus and medial prefrontal cortex, all structures central to self-processing. In psychedelic experiences, the degree of subjectively experienced self-diminution or ego dissolution is significantly correlated with the degree of downregulation of DMN and precuneus (Carhart-Harris et al., 2012; Tagliazucchi et al., 2016). These LSD-induced effects of ego dissolution, furthermore, can be blocked by the serotonin 2A receptor (5HT_{2A}) antagonists like ketanserin, indicating that effects of LSD on the sense of self are attributable to 5HT_{2A} stimulation. 5-HT_{2A} agonists induce a *reduction* in functional connectivity within higher-order cortical modules including the DMN. On the other hand, these agents also *increase* functional connectivity between lower and higher-order cortical networks. Lower-order sensori-motor and sensory association cortex transiently develop robust functional connectivity with higher-order secondary association cortex. In summary, it seems that the activation of 5HT_{2A} signaling systems induces a cascade of effects such that DMN, precuneus and medial prefrontal sites are downregulated, while processing centers in the secondary association cortex are upregulated and intensely connected with and receiving information from, primary sensory processing centers. In short, you get a flood of sensory information coming into a system that has a diminished sense of self (due to decreased DMN/precuneus/medial

prefrontal cortex activity) but no loss of the ownership sense of self (due to the hyperactivation of primary sensory-motor centers).

To understand the significance of these brain effects it is necessary to pause here to consider the data gathered from studies of psychedelics in terms of network structures. A network architecture particularly relevant for the brain is the so-called “small world” architecture. It refers to a type of network that combines high clustering of connections with a short overall path length thus facilitating optimal information flows within the network and with other outside networks. Clustering refers to the extent to which connected nodes share common neighbors. The path length of the network is computed as the average length of the shortest path between any two nodes. In the brain, small-world architectures perfectly capture neural wiring of functional circuits, which typically involve dense interconnections between hubs that coordinate functional communications between sites (sometimes called modules) that specialize in a small array of functions.

Hagmann et al. (2008) used diffusion spectrum imaging, high-resolution cortical connection matrices and applied network analytic techniques to identify core functional circuits of the human brain. By mapping network indices, such as node degree, strength and centrality, and by performing core decomposition, retrieving network modules and classifying hub nodes, they were able to identify several core and executive control networks. They identified eight anatomical subregions as members of a structural core of brain functionality. These are the posterior cingulate cortex, the precuneus, the cuneus, the paracentral lobule, the isthmus of the cingulate, the banks of the superior temporal sulcus and the inferior and superior parietal cortex, all of them cortical midline structures along with the ventral medial prefrontal cortex. Among these structures, the precuneus was found to exhibit short path length, low clustering and high centrality. As noted earlier, activation of the precuneus and of other cortical midline structures dubbed the “structural core,” has been linked to self-referential processing and consciousness. The structural core also includes key elements of the human DMN. Key components of the default network are the posterior cingulate cortex, the precuneus, the lateral and medial parietal cortex and the medial prefrontal cortex.

The DMN and the elements of the structural core identified here satisfy criteria for small-world networks with the precuneus and or the AIC as the key hub in the core. The combination of high clustering and short path lengths exhibited in these small-world brain networks allows for the ideal balance between and coexistence of segregation and integration of

neural information which supports very efficient functional capacities. High segregation involves the existence of many specialized capacities represented in separate neural groups, while high integration among groups allows for the efficient flow of information between all elements of the network. These small-world networks also promote redundancy in circuits. Functional signals can be transmitted along more than one route in a small-world network if the routes share fundamental information on theoretic and network properties.

The balance between randomness and order captured in these small-world brain networks tilts toward creativity when it tilts toward randomness, but obviously too much tilt toward randomness would produce disorder and collapse, and conversely too much tilt toward regularity and order would create stasis, stereotypies, perseveration and inability to adapt to the new. Hyperconnectivity within the DMN appears to be associated with the delusional paranoid phenomenology of a sense of self under attack. If the hyperconnected nature of the DMN in patients with paranoid or extreme defensive self-structures could be relaxed back into a small-world network configuration, perhaps symptoms would improve for these patients.

What this excursion into the small-world network structure of the human brain tells us is that both decentering and psychedelics operate to transiently disrupt the hyperconnected nature of the DMN and rebalance the small-world properties of the network via downregulation or inhibition of the central hub of the network – the precuneus, anterior insula and medial prefrontal cortex. Both decentering and psychedelics appear to utilize the activation of 5HT_{2A} signaling systems to initiate the process. Once the trigger occurs the process plays itself out, with a diminished ego being flooded with sensory impressions experienced as imaginative events and hallucinations and then – at least in the case of decentering – a reconstruction of the agentic aspects of the self and reassertion of executive control.

The DMN and its central hub the precuneus/AIC also appears to be uniquely influenced by the evolution of the modern human brain. Unlike in other primates, the evolution of the modern human brain is characterized by directional and gradual changes resulting in the typical globular modern human shape established at some point about 100,000 years ago. Now at that time some anatomically modern humans (AMH) had left Africa and had begun to interact and interbreed with Neanderthal populations in Europe. According to Bruner et al. (2018) two features of brain evolution in these AMH populations stand out: parietal and cerebellar bulging. Unlike our primate and Neanderthal cousins, AMH populations

developed over evolutionary time a globular head shape as well as parietal and cerebellar bulging. Parietal areas of the human brain include the precuneus and are involved in orientation, attention, visuospatial integration, imagery, imagination, self-awareness, working and long-term memory, numerical processing and tool use. The superior longitudinal fasciculus courses from the parietal lobes to the prefrontal cortex, creating a parietal-frontal attentional control and regulatory network that also becomes crucially important for human cognitive abilities. In humans, the first branch of the superior longitudinal fasciculus (SLF-I) connects the superior parietal lobule and precuneus (BA 5 and 7) with the superior frontal gyrus (BA 8, 9 and 32), while a second branch (SLF-II) originates in the anterior intraparietal sulcus and the angular gyrus (BA 39) and terminates in the posterior regions of the superior and middle frontal gyrus (BA 6, 8, 9). The third branch (SLF-III) connects the intraparietal sulcus and inferior parietal lobule to the inferior frontal gyrus (BA 44, 45, 47). The precuneus is hidden in the interhemispheric fissure; this is larger in humans than in chimpanzees and is probably responsible for the parietal bulging that characterizes the human brain. Bruner et al. (2018), therefore, concluded that precuneus expansion in *Homo sapiens* is related to our extraordinary cognitive specializations. As mentioned earlier, the precuneus is involved in self-referential processing, imagery and memory. Basically, the sense of self is supported by the AIC and precuneus and its interconnected functional circuits including DMN and cortical midline structures and the ventromedial prefrontal cortex. What this excursus on the evolution of the human brain tells us is that our provisional neurology of the decentering process can be reasonably situated within what is known of the paleoneurology of the human brain.

To return to our discussion of the neurology of decentering, let us first remind ourselves that as noted earlier in terms of a Bayesian or predictive processing theoretical framework the brain generates our experience of reality through predictive representations of the self and environment. We are emphasizing the self-structure because both religion and the PPF assign central importance to some aspects of the self-structure. In simplified terms, the self-concept encapsulates or represents our “priors.” Our selves or our priors or expectancies are constantly compared with what actually occurs in the sensory environment based on somatic and exteroceptive sensory input, which are called posteriors. When the priors do not match up with the posteriors, an updating and adjustment process is initiated to bring the priors or self-structure more in alignment with the posteriors. From a Bayesian point of view, things can go wrong in

two broad ways: First, unduly rigid priors (mediated by hyperconnected networks within the DMN where the balance between segregation and integration of networks is too tightly constrained) would make it difficult to update priors based on posteriors and you would, in the extreme, get a very rigid, impermeable and paranoid sense of self somewhat impervious to cultural shaping pressures as in the case of the positive symptoms of schizophrenia and obsessive-compulsive disorder. A less extreme case might in some instances be exemplified by the aging brain in an individual “stuck in their ways” and so forth. Conversely, if the priors are too weak and ill-defined (and mediated by reduced activity and poor connectivity within DMN, where the balance between segregation and integration of networks is loosely constrained) you would get a fragile psyche and poor sense of self too easily influenced and shaped by cultural trends. In its extreme, this profile might be exemplified by negative symptoms of schizophrenia. Within the normal spectrum, it would to some extent be exemplified by the teenage brain.

The decentering mechanism, when it is functioning correctly, keeps the neural circuits poised within that sweet spot between neural segregation and integration where the priors are not too tight and not too weak, and the individual is not too open to cultural scripts but not closed off either. But decentering only works properly with traditional forms of religion.

Step 2 Self-Concept Transferred into Suppositional Liminal Space

We have seen that in step 1, 5HT_{2A} signaling activation down regulates serotonergic activity and thus essentially shuts down the central hub, the precuneus, in the DMN. The Bayesian “priors” are, therefore, relaxed, subjectively the agent ego dissolves and the ownership ego is placed into a liminal suppositional space – the possible world’s box. When the ownership ego drifts in suppositional space the associated phenomenology appears to be that one is flooded with sensory impressions. While 5-HT_{2A} agonists shut down DMN activity they increase global brain connectivity by increasing functional connectivity between lower and higher-order cortical processing centers (Carhart-Harris et al., 2016; Tagliazucchi et al., 2016). Thus, the fragile ego and associated higher order association cortex is flooded with incoming sensory impulses. We experience this as imaginative scenarios of all kinds and in the extreme case of psychiatric disorder or administration of psychedelics as hallucinations.

Once the agency is brought off-line via inhibition of the DMN and precuneus, the logical next step would be to get it back on-line as soon as

possible in order to respond optimally to any environmental dangers or opportunities. This sort of immediate cognitive correction does not occur, however, because of step 2, wherein the diminished self enters a liminal state. This step inevitably happens because of the degree of inhibition of DMN and prefrontal networks associated with step 1. That diminished agency in turn is due to the intensity of the surprise event that triggers the decentering process in the first place. Diminished agency and 5HT_{2A} activation result in an overall reduction in serotonergic activity, which keeps the central hub inhibited but then subsequently results in release from the inhibition of subcortical sites such as the limbic cortex and mesolimbic dopaminergic activity. The normal top-down inhibition exerted on these sites via DMN and medial prefrontal cortex is removed due to their down-regulation. Thus, the tonic inhibition placed on limbic sites is removed and their activity increases. The mind is flooded with affect-laden images. In addition, as mentioned earlier, the increased connectivity between primary sensory processing centers and secondary association areas in cortical sites results in a massive flooding of these centers and the fragile ego or self-concept with sensory impressions which we experience as imaginative phenomena, including everything from visual changes to outright hallucinations. But because of the release from the inhibition of subcortical dopaminergic mechanisms, step 3 then occurs which involves brain attempts to reassert top-down regulatory and inhibitory processes. The way that this is done, however, is that the brain begins a search for a self-concept that can be utilized to activate the central hub of the core (precuneus). The search for a more computationally adequate “self” that can restore the proper inhibitory balance between DMN/prefrontal and subcortical sites and serotonergic and dopaminergic activity levels proceeds until an appropriate self-concept is found or constructed that can reassert executive control.

Step 3 Cultural Scripts and Reconstruction of the Ego

While step 2 involved *hypo*connectivity within the central core and DMN, it conversely involves *hyper*connectivity between primary sensory and limbic emotional centers and secondary association areas. In step 3, some processing of all that sensory and emotional information delivered to those secondary association areas of the cortex begins, in service to finding a new more computationally adequate self-concept. Appropriate selves must necessarily be taken from the cultural surround as the individual needs a self-concept that is more complex than the one he had, and he needs to rebalance those segregation and integration circuits within the DMN.

The new self-concept, furthermore, must fit in with the local social group. Given that cultural scripts and semantic memory fields are being searched for materials that can be used to reconstruct the ego or self-concept, it follows (given typical memory integration dynamics) that interactions between hippocampus and association areas in the cortex will occur during step 3. When social ritual or private religious practices support the reconstruction process, balance can be restored via the integration of old self properties into a more complex new self. Unfortunately, equilibrium can be, at least transiently, restored via other routes as well. For example, a more fanatical self can transiently restore the balance and reassert agentic control for a while. This may be one reason why religion can lead to cultish groups and sometimes great violence.

In any case, to see how beliefs are updated, the old self is edited, repaired, or transformed in interaction with cultural scripts and norms, we need to once again momentarily set aside the current discussion of the decentering process itself to examine constituent elements of the updating/editing process. That updating requires creativity, so we begin there.

Creativity is inherent to the decentering process and may even be considered a product of it. The search for a computationally adaptive self-structure or for materials to reassert executive control must involve a search beyond close semantic associates. The search needs to be as wide as possible, and therefore the search must use outside-the-box search and repair/rebuild strategies. Religion is used by people to find ways out of impossible or otherwise hopeless situations. It specializes in the generation of outside-the-box search strategies. When reason fails, faith steps in. That is what faith sometimes is. It allows for hope despite the evidence that the situation is hopeless. Fundamentally radical creativity occurs in that boundary line between chaos and stability that the small-world network properties of the human brain exhibit. We need radical creativity in otherwise hopeless situations. The human brain can utilize random search strategies as well as the generation of random signals, firings and behaviors when searching for ways through an impossible fitness landscape. We know that the one strategy that predators of all kinds cannot defeat is the generation of randomness or random behaviors. Artificially intelligent machines are now incorporating stochastic defense mechanisms to protect against hackers and catastrophic attack and collapse. The idea behind stochastic defense is to introduce randomness to the behavior of neural networks. Simply adding noise to the weights and activation functions and the inputs and outputs of the neural network can increase randomness in the operations of the networks but at great cost to operating efficiency. Therefore, it is better to

add randomizing elements at access points or at central nodes or hubs of the networks. It follows, therefore, that a randomizing element would occur at the center of the decentering mechanisms and its associated central hub – the precuneus–AIC–ventromedial prefrontal network. That randomizing element must either be REM sleep or involve REM sleep and dreams.

Consider the many anecdotal reports of musical, artistic and scientific innovations made while dreaming. REM sleep appears to promote memory consolidation and creativity by taking randomly accessed memory fragments and then recombining them with existing memory complexes such that novel and unusual pairings occur, and these pairings are often experienced in dreams. Discontinuities and shifts in dream scenes also occur frequently in dreams, thus allowing greater opportunities for novel combinations of cognitive elements. REM sleep physiology of high cholinergic and low serotonergic activity facilitates the disruption of existing semantic associative networks and therefore an expansion of the search space for semantic associates. Stickgold et al. (1999) showed that participants awakened from REM sleep (vs. non-REM sleep) were faster at recognizing target words when they were preceded by a weakly related prime (e.g., thief–wrong) than a strongly related prime (e.g., hot–cold). People with lots of REM sleep and dreams tend to be more creative than their matched controls. For example, people with narcolepsy exhibit remarkable forms and levels of creativity relative to controls. Narcolepsy is a disorder where REM physiology is essentially disinhibited such that it tends to invade daytime consciousness. Subjects with narcolepsy experience excessive daytime sleepiness often accompanied by direct transitions from wakefulness to REM sleep, named sleep onset in REM periods. Dissociated REM in these patients also sometimes manifests in cataplexy (sudden paralysis which appears to be related to the atonia associated with REM physiology), hypnagogic hallucinations and lucid dreaming during REM sleep. Lacaux et al. (2019) assessed 185 narcoleptics on a range of tests of originality and creativity. They found that subjects with narcolepsy scored higher on average on all creativity tests, divergent, convergent, verbal, graphic, abstract and concrete, compared with controls. The authors suggested that greatest levels of creativity were linked with greater dream recall and complexity; that is, the creativity in these subjects was being driven by their dreams. The ability to recall dreams with chaotic transitions, bizarre imagery, novel settings, unusual memory juxtapositions and the like may thus constitute a resource from which to draw inspiration and raw materials for creative projects.

Dreams are also characterized by startling transformations of the self or the dream ego. The dreamer may experience himself as himself but

with features that belong to some other person the dreamer knows. Self-transformations may occur multiple times in dreams.

If chaotic and randomizing elements in brain activity are generated via REM and subjectively experienced as dreams, the aim is always to find that sweet spot between randomness and ordered activity. REM's ability to generate chaotic activity patterns that are subjectively experienced as "novel" ideas indicate that both deterministic mechanisms of brain activity, as well as chaotic neural patterns, are important for brain functioning and creativity.

Virtually all animals with central nervous systems have added random elements to their behavior repertoire. For example, insects, fishes, birds and mammals, including humans, exhibit a special class of random walks, called Lévy walks, that confuse potential predators. The addition of unpredictable and indeed random behavioral displays to the brain's functional repertoire has been called Proteanism – after the Greek god Proteus, who could repeatedly undergo identity transformations to escape capture. The brain can produce various protean behaviors (erratic, unpredictable and confusing) that may serve to confuse predators or help the individual find a way to escape apparently impossible situations. Protean behaviors include a range of seemingly disparate actions such as the inking discharge of cephalopods and the apparent difficulty associated with trying to pursue individuals in a group (swarm effect). Likewise, protean strategies include random brain discharges resulting in convulsions, erratic behaviors, manic thinking and flight of ideas, locomotion that involves fast turns and unpredictable trajectories and so forth. Protean displays may also be related to the ritualizing behaviors in animals, as both send messages to potential predators or mates concerning the status of the sender. The decentering process and creativity are rooted in these ancient pressures to create neural circuits that support randomizing and ritualizing processes. Thus, in step 3, decentering can facilitate unusually creative search processes that can occasionally include randomizing elements in order to promote fundamental personal transformational and culturally informed updating of beliefs and identity.

Step 4 Reconstruction of Self-Concept and Reassertion of Executive Control

The computational reservoir of neural resources noted earlier that is a side-effect of the small-world network properties of the DMN, precuneus, AIC and medial prefrontal networks, can be used in steps 3 and 4

to search through and select appropriate cultural scripts that can be used by the brain to reshape and rebalance neural circuits to find that sweet spot between degrees of segregation and integration of circuits. To accomplish this rebalancing, however, the cultural scripts need to be integrated into information processing systems of the brain. The decentering process, alone of brain mechanisms, allows for the entry of identity-relevant cultural information into key hubs of the brain networks supporting the sense of agency. Agency is the main target of cultural interventions as it is most relevant for what people actually plan and do – that is, for social practices. These include everything from shared intentionality to coalitional behaviors and larger scale cooperative endeavors. Cultural scripts on possible identities available to individuals within a given culture can be inserted into these small-world brain networks discussed earlier with the aim of rebalancing degrees of segregation and integration of these information processing circuits. Cultural scripts concerning possible identities theoretically should not violate this rebalancing rule. This is one way that brain shapes culture.

The decentering-induced diminished sense of the agentic self allows for greater disinhibition of sensory centers, which then can pick up a wider array of information from the sensory and cultural surround. Sensory filters are downregulated. Critical and reflective thinking centers are also downregulated. Thus, more information gets in, which of course allows for both positive and negative cultural outcomes. The relevant cultural scripts concerning role, powers and experiences afforded by existing cultural scripts need to be compared against the needs and capacities of the self-concept under repair and of the local cultural group. Under conditions of low social conflict, religion guides this comparison and repair process into generally healthy channels.

The nature of the self as a cultural construct or a social process that is nevertheless articulated with specific brain networks, but embodied, enacted, socially constructed and extended in the world beyond the brain, clearly emerges here in steps 3 and 4. While it is not merely the imposition of new “software” on existing “hardware,” the process of selection of cultural identity scripts is perceived that way by many scholars. It is not a question of merely inserting a script or card into a computing system. Instead, it is a matter of acquiring informational materials that can be incrementally cobbled together to rebalance, on the fly, small-world neural networks in the brain, which in turn, once rebalanced optimally, can support greater loads of cultural information and cultural fine-tuning and so on. The self (and religion for that matter) very obviously is not located

merely in the brain per se, but is located more precisely in a biologic niche composed of the brain and the ecologic context that surrounds it, most especially the human social interactions and practices that comprise the culture. Culture, mind and brain continually coconstruct one another, with religious culture playing the central role up until the modern era in constructing cultural scripts for social roles and selves.

Interestingly, 5HT_{2A} receptor signaling systems, which we argued earlier are key to triggering and regulating the decentering mechanism, seem to play a key role in articulating the links between brain mechanisms and cultural scripts and social practices. Dressler et al. (2009) demonstrated that the presence of a 5HT_{2A} receptor polymorphism in individuals renders those individuals (with the A/A variant) more susceptible to the reception of cultural information. “Cultural consonance” or the degree to which the individual endorses cultural ideals on a given cultural practice varies significantly as a function of the presence of the 5HT_{2A} receptor variant. In one study (Dressler et al. 2009) the cultural consonance at issue concerned the individual’s estimation of whether his or her family matched the local cultural ideal. When cultural consonance in family type or practice declines, depressive symptoms increase more for persons with the A/A variant relative to other genetic variants or for persons without the 5HT_{2A} polymorphism. These data are consistent with the idea that decentering mediates the articulation of cultural scripts with DMN and related neural networks. Distress due to cultural mismatch will trigger 5HT_{2A} signaling systems (which in turn triggers decentering) until the individual estimations of his practice match that of the cultural ideal. In the case of searching for appropriate social identities, similar mechanisms likely apply.

We have seen how decentering might operate phenomenologically as well as in terms of brain mechanisms as well as its articulation with local cultural practices. Decentering shows us just how the brain shapes religious consciousness, and conversely how religious consciousness and experience shapes the brain. Decentering sharply limits the range of cultural scripts that are practicable and usable for an individual, given that they must respect the rule that balance between segregation and integration in small-world network properties of the brain must be optimized. Cultural scripts cannot promote an imbalance in DMN network properties. Conversely, religion shapes those very circuits because religious identities at least up to the modern era ideally optimized small-world properties of DMN and related networks, such that the information processing capacities, as well as the computational reservoir (discussed earlier) of these networks, are

significantly increased. In that way, religion promotes optimal brain function, growth and complexity.

It is important to note that the logic of the decentering process is due to the ways in which the brain mechanisms involved operate and the regions in which they operate (the DMN, right-sided precuneus and prefrontotemporal sites) – as described in my 2009 account. You cannot predict or understand the steps involved in religious phenomenology or decentering without reference to the relevant brain mechanisms. Furthermore, understanding the brain mechanisms leads to predictions that would be impossible to make if brain mechanisms were not understood. For example, entheogens that bind to serotonergic receptors in right-sided precuneus and prefrontal regions will more likely produce religious experiences than drugs, which do not bind these receptors and so forth. Phenomenologic analyses, furthermore, of narratives of everyday religious experiences have been found to be entirely consistent with the decentering account of religious experiences (McNamara et al., 2015; Wildman and McNamara, 2010).

Note that this account of a brain-dependent process like decentering does not necessarily involve a commitment to a reductionistic stance with respect to mind–brain relations. Although the sequential logic of the decentering process is dictated by brain mechanisms, its content emerges from an interaction between the sequence of brain mechanisms involved and social and cultural context as explicated earlier. Rebalancing of brain systems is radically contingent on context. That is one reason why religious cognition is so vulnerable to negative social influences. This seamless interactive process between the sequential logic set by operations of interacting brain systems and local social context is also one of the reasons why cognitive neuroscience should be interested in religious experiences. They provide very clear examples of cultural shaping of outcomes of sequential brain operations involving the sense of self – itself a culturally shaped brain construct. At this point the reader might well protest “OK, Let us suppose that the something special in religious experiences that make these things religious is decentering *and* that decentering requires reference to brain mechanisms to understand its dynamics and effects, how does all of this help illuminate the phenomenology of religious experiences? How can your account, or any neuroscience account for that matter, help me understand the most basic forms of religious cognition like belief in supernatural agents?”

Belief in SAs cannot be due to a simple misfiring of an agency detection device as humans can routinely correct for such misfirings and in any case

SAs, especially religious SAs (rather than mere ghosts, etc.) exhibit many more properties than mere agency. For example, religious SAs tend to be more powerful than us and we tend to relate to them from a subordinate role. In addition, religious SAs also tend to have full strategic access to our cognitions and mind states, and we tend to ascribe ultimate values to them. Indeed, many SAs demand or require a response from us or full commitment or binding of ourselves to them. In short, in addition to the enhanced agency attributed to SAs, we also ascribe to them inherent or even ultimate value, and we tend to relate to, placate, sacrifice to or bind ourselves to them. The asymmetric relations between us and them put us in a subordinate role and therefore imply a diminution in agency in us when we relate to them. All of these properties require a decentering process in us for them to occur. Recall the phenomenology here: Our agency is diminished while theirs is enhanced; our selves are devalued while ultimate value is placed in them – the SAs.

To gain their favor and attain to the value we see as inherent in them, we seek them, and while seeking them we place our diminished selves in a liminal state of seeking until yoking (*religio*) or binding of ourselves to them occurs – a quintessential decentering process. We can see decentering occurring in religious experiences, even in ancient religious texts describing religious experiences. See the special issue on decentering in ancient religious texts (McNamara, 2015).

Decentering in the original 2009 account reflects the capacity to shift experiential perspective – instead of identifying ourselves with past or passing experiences we (1) dissolve that old sense of self and then (2) shift our perspective away from the old self and passing phenomena to embrace a new more free sense of self. An old self dies and a new more capacious self is born. I realize that some Buddhist ideologies aim at the extinction of self altogether, but I treat the illusory self that must be relinquished as the current, clinging, impulse-ridden self rather than a new ideal future self. The future self, paradoxically, is less of an illusion than the impulse-driven current self. We get to the future ideal self via decentering – the brain process of decentering. Bernstein et al. (2015), in their studies on mindfulness phenomena, have noticed a process that they too have called, in a happy coincidence, “decentering.” According to Bernstein et al., the key cognitive elements of decentering are meta-awareness, disidentification from internal experience and reduced reactivity to thought content. Bernstein et al.’s concept of decentering appears to only describe the first step in my decentering model. As noted earlier, for me decentering is a brain-driven, sequential process. In the first step, there is “disidentification

from internal experience” – that is, the inhibition of executive control networks with resultant reduction in the sense of agency, ownership and self. There necessarily follows reduced reactivity to thought content and meta-awareness. These latter may be assimilated to my step 2, involving a liminal state where the loss of old self creates a sense of no-self given that the updating to a new self has not yet occurred. Typically, the decentering process is an automatic process that plays out once the first step is triggered. But in mindfulness and other meditative processes, it all occurs semiconsciously, so these related phenomena like meta-awareness are mapped out pretty clearly. What I am concerned with here is explicating decentering phenomena only to the extent to which it helps us to understand brain mechanisms driving the whole process. To further understand those mechanisms, we need to look a little deeper than we did earlier at the evolutionary background of decentering. My argument will be that decentering evolved in tandem with the evolution of REM sleep and dreaming in AMH populations. It is, therefore, a recent innovation – perhaps only 50,000 years old.

Evolution of Decentering

It is not mere hyperbole to classify human beings as *Homo religiosus* rather than *Homo sapiens* given that religion defines us as a species better than does “knowing.” We are transformational beings steeped in imaginative worlds more than we are rational beings. Reason without imagination is mere guessing while imagination without reason is mere delusion. Religion and imagination are particularly crucial when we face chaotic and unpredictable environments. In occasionally unpredictable and chaotic environments, that is, the kind of environments we evolved in and that we still regularly face today, standard forms of reasoning, “knowing” and “awareness” are not enough. You need to supplement reason with a radical kind of creativity that involves reason but surpasses it. This kind of creativity always involves personal transformation and is able to produce solutions we previously had never dreamed possible. It is capable of searching not only previously successful solutions to upcoming challenges but also more distant or disparate connections to problems. In evolutionary terms, there are some fitness landscapes that are near impossible for human beings to traverse and survive. Their parameters of landscape ruggedness and of peak number, height, separation and cluster are nearly uncharacterizable. In these kinds of situations where the challenge appears insurmountable, you need radical forms of creativity and transformation that only the human

imaginative capacity (allied to reason) can supply. Decentering as explicated earlier can supply this kind of imaginative creativity.

As noted earlier, although AMH populations had developed the characteristically globular shape of the modern human brain, with its precuneus-induced parietal bulge in Africa before the time of the Upper Paleolithic-related migration into Europe, they did not display full signs of behavioral modernity until they interacted with Neanderthal populations in Europe. Among the genes transferred to AMH populations via interbreeding with Neanderthals are genes that affected the sleep architecture of AMH peoples. Currently, scientists find that the genomes of modern human groups that originated outside Africa hold between 1.8 and 2.6 percent Neanderthal DNA. DNA from Neanderthals influences modern humans' hair color, skin color, mood and sleep biology. Many of these traits are linked to the level of sunlight people receive. Depigmentation affects both skin and pigmented neural nuclei within the brain, and that is why sleep biology and mood are directly influenced by Neanderthal genes. Whether or not gene transfer from Neanderthal populations was the biologic trigger to change sleep biology of AMH populations, change they did. Other possible causes of these changes in sleep biology after the migration into Europe was the change in climate at the time. There was a new cooling period in Europe at the time causing loss of forests and proliferation of frozen steppeland. The Campanian Ignimbrite Eruption in Italy about 40,000 years ago produced further 2–4 °C cooling for at least a year and several years of acidic rainfall thereafter. This general cooling process, as well as the overall reduced exposure to sunlight time, would have put a premium on reducing time spent sleeping so as to increase time on daytime food and tool production. An overall decrease in time spent asleep would have to be compensated by increasing sleep intensity (i.e., REM time), so that one could obtain brain benefits of sleep at lowest possible time and opportunity costs. And that is precisely what evolutionary anthropologists of human sleep evolution have found.

Sleep of AMH populations are markedly different compared to all other primate species. We sleep much less than our primate relatives. While humans average seven hours of sleep per night, other primates range from just under nine hours (blue-eyed black lemurs) to seventeen (owl monkeys). Most importantly we spend a hugely disproportionate amount of our sleep time in REM relative to all other primates. With respect to REM time, humans are significant “evolutionary outliers” (Nunn and Samson, 2018). We spend about 10 percent *more* of our total sleep time in REM than expected for a primate of our body size. In short,

we have increased sleep intensity at the expense of overall sleep duration. Even more interesting with respect to the evolution of the decentering mechanisms is that during REM sleep, we humans selectively inhibit the precuneus. It is transiently down regulated or switched off in association with REM atonia, downregulation of prefrontal cortex and initiation of vivid dreaming.

Why did human evolution devise a mechanism for shutting down, each night, the executive control and self-networks associated with precuneus and prefrontal cortex? There are probably several reasons for this evolutionary innovation among *Homo sapiens*. As alluded to earlier, sleep in the *sapiens* lineage was associated with reduction in nonrapid eye movement (NREM) sleep and increased REM sleep intensity. REM is crucial for the normal development of the brain and for synaptic plasticity and homeostasis. Optimal brain functioning, therefore, depends on REM–NREM cycling and the chemical environment created by REM. Therefore, the increased investment in REM likely has to do with the increased *sapiens* investment in the brain. In addition, REM promotes creativity for reasons adumbrated earlier. The reduced serotonergic and increased cholinergic activity associated with REM along with increased associativity (e.g., the linking up of distant semantic associates in memory and dreams) and the juxtaposition of significant but decontextualized images during dreaming appears to promote significant creativity. Thus, the increased investment in optimizing brain functions appears to be related to an increased need for enhanced creativity. Another often overlooked reason for the increased investment in brain function and in REM, in particular, has to do with pressures our ancestors faced on a near-daily basis, namely intergroup violence, aggression and primitive forms of warfare.

Aside from REM promoting brain development, brain plasticity and cognitive creativity, REM is also associated with increased activation of those brain circuits that facilitate aggression. As noted earlier, REM is associated with a shut down in executive control networks such as the precuneus and prefrontal cortex. That downregulation of executive control networks results in or is associated with a disinhibition subcortical circuit centered on the amygdala in the limbic system. Neurochemically, REM sleep demonstrates high activation levels in dopaminergic and cholinergic circuits as well as the cessation of activation in the noradrenergic locus coeruleus and the serotonergic raphe nucleus. Note that this pattern of activation and deactivation strikingly replicates the pattern associated with impulsive aggression in the waking state. Reduced levels of serotonin activity in the context of relaxed inhibitory control via dorsal-prefrontal cortex

along with intense activation of the amygdala is a recipe for the induction of impulsive aggression.

Not surprisingly, therefore, you see a lot of aggression in dreams. Dreamer-involved aggression (adjusted for the number of all social interactions except sexual interactions) is present in 60 percent of male dreams and half (51 percent) of female dreams. The dreamer is an aggressor in 40 percent of male dreams and a third of all female dreams. One out of every three characters in male dreams and one out of every four characters in female dreams is involved in some kind of aggressive interaction. About 50 percent of characters in dreams are strangers to the dreamer. In some dream series, up to 80 percent of characters are unknown to the dreamer. Strangers in dreams are most often male, and these unknown males appear more often in dreams of males than females. When male strangers appear in a dream, the likelihood that physical aggression will occur in that dream far exceeds what would be expected on the basis of chance. In short, male strangers signal physical aggression (McNamara, 2019).

Interestingly, in REM Behavior Disorder (RBD), the normal motor inhibition that occurs in tandem with REM sleep is abolished. Thus, when people with RBD go into REM sleep, they tend to act out their dreams. This disorder, therefore, allows us to literally see what REM neurobiology produces in terms of mentation and what REM dreams are about. Common behaviors include screaming, punching, grasping, kicking or jumping out of the bed in pursuit of or in flight from a foe. Dreams of these patients include high levels of aggression, including a higher percentage of “Dreams with at least one aggression” (66 percent vs. 15 percent), an increased Aggression/Friendliness interactions’ ratio (86 percent vs. 44 percent) and an increased Aggressions/Characters (A/C) ratio (0.81 vs. 0.12). In short, dreams of RBD patients dramatically confirm the very high levels of aggression associated with REM dreaming. Therefore, in addition to maintaining brain plasticity and mental creativity, REM also promotes readiness for extreme aggressiveness and violence.

Thus, one reason for the greater investment in REM (and brain development) at the time of the Upper Paleolithic was its ability to increase aggressiveness, creativity and personal transformation. Now what ecological circumstances did our ancestors, entering Europe from out of Africa some 100,000 years ago, encounter that required the ability to undergo personal transformations, greater brain complexity, intelligence, creativity and aggressiveness? As mentioned earlier, climatic changes were surely part of the picture, but the most obvious challenge AMH populations faced when exiting Africa and moving into Europe at that time was

violent opposition from populations already living in Europe – namely Neanderthals.

Our ancestors were very likely not always peaceful, nonviolent groups. Some violence accompanied the evolution of *Homo sapiens*. Our chimpanzee ancestors were for the most part extremely violent creatures. Even today groups of male chimps routinely raid other groups, killing males in the rival group to gain access to their territory, resources and especially females. Skeletons of *Homo sapiens*, particularly young males, entering Europe in the Upper Paleolithic frequently show the kind of trauma (e.g., broken arms, head injury) associated with violent conflict rather than mere hunting injuries; the same with Neanderthals. At this time the two groups also either invented or began to widely use new weapons such as the bow and arrow, atlatls or spear throwers, tipped spears and throwing clubs. It is not rare to find evidence that corpses were mutilated and that cannibalism was widely practiced. AMH populations in Upper Paleolithic Europe had to rapidly develop weapons, strategic creativity, new tool-making skills, the ability to transform one's consciousness to model the consciousness of a superior enemy, and high levels of within-group cooperative aggression to defend against and ultimately wipe out the Neanderthals. Thus, religion was born.

The mechanism Mother Nature used for the birth of religion and its associated skillset may have been what I am calling decentering here but what the PPF might call additional upgrade to the process of minimization of surprise, such that we became able to perceive or detect extremely high informational events via surprise when it had recourse to REM sleep, PGO waves as orientating reaction and REM neurobiology to update priors. It may be that behavioral modernity flourished in the Upper Paleolithic in Europe when AMH populations acquired this new form of informational detection and REM dreaming, due perhaps to the acquisition of Neanderthal sleep genes, intergroup violent conflict with Neanderthals and the extreme climatic pressures of the Upper Paleolithic. I also suggest that the anterior insula/precuneus off switch during REM is the brain basis for the process of triggering decentering (and therefore religious experience). If I am correct, then religion was born when AMH populations acquired this new form of sleep in the Upper Paleolithic.

It was at this time of the Upper Paleolithic that the human mind under the new form of REM it was experiencing developed regular access to imaginative other worlds, counterfactual to our own. Religion's cognitive prerequisites such as embryonic predictive simulations, mind reading, affective commitments/bonding and communal group identities were

developed by our ancestors the great apes, and within the *sapiens* lineage by *erectus* who also made the first attempts to tame fire. But the real work in bringing to fruition the full imaginative abilities of *Homo religiosus* happened later when the trajectory of increasing brain size and brain power fully started to take off when the Neanderthals attempted to fight off *sapiens* in Europe between 100,000 and 50,000 years ago. At that time religion began to shape the human brain itself so much so that it is not ridiculous to consider the brain itself as shaped by the rise of religion during this period. Religion's primary characteristic of running imaginative simulations of other worlds, as well as its capacity to handle the dynamics of personal transformation of the "priors" or fundamental identity of the individual in the sense described earlier, all began during this time of the Upper Paleolithic. The rise of religion implies that the human brain had to become unusually plastic, constantly remaking itself as it meets the human cognitive and cultural demands of incessantly casting off current "priors" or identities or worlds and then fashioning whole new cultural forms, new tools, new weapons, new creativity and new identities. Paraphrasing Nietzsche, we might say that a human brain is that which must always overcome itself. This kind of brain was made possible by decentering and developed during the period of the Upper Paleolithic.

Right at the birth of religion (due to decentering and the emergence of human version of REM) we also get the birth of self-consciousness. It is to self-consciousness that we turn in Chapter 3.

On the Self and the Divided Self

Introduction

In the first edition of this book I argued that the divided self is the problem religion addresses and solves. But what is a “self” and what is a “divided self” and why does the divided self matter for religion and brain issues?

The Self

Most experts on the psychology and neurology of the self distinguish at least three differing aspects of the self or three differing types of self: 1) the *minimal self* that reflects basic bodily integrity and multisystem sensory integration. It is generally thought to be linked primarily with the salience network (SN) and related connections. 2) the *narrative self* which involves the sense of ownership of conscious contents and a sense of identity and persistence over time in its autobiographical memories and its future-oriented aims and goals. The narrative self is generally thought to be mediated by the default mode network (DMN) and its related connections. 3) the *executive or social self* which is involved in high level planning, deliberating, reflective processing and social interactions. This social-facing self is generally associated with the frontal parietal (FPN) executive control network and its related connections. Now all three of these “selves” are actually elements of one unified self that carries the sense of “I” will and agency. In addition, all three subselves call upon far wider brain networks to realize their functions. The assignment of selves with their primary brain networks is just shorthand and a heuristic for remembering their primary functions and brain correlations. In fact, it appears that all three subselves require one another to realize their own preferred modes of operation. For example, the narrative self likely requires the SN to help evaluate the significance of life episodes for its narrative identity formation processes, and the social/executive self likely calls upon the mentalizing functions

associated with the DMN to optimally interact with other minds and so on. I do not have any special name to assign the overall “I” – that transient entity that rides atop the others and occasionally expresses the combined wishes and intentions of the three sub-entities that it is tied to. Perhaps it should be called the *agentic self*. Although I called the agentic self “the executive self” in the first edition, I think agentic self more accurately captures the ways in which agency unifies the subselves and creates a future-oriented stance that religion seems particularly interested in.

With respect to the 4E paradigm, we can conceive the overall “I” or agentic self as enacted or achieved rather than as some structural entity. It is embodied, enactive, embedded and extended as it emerges as a function of the body’s active movement toward goals within the sociocultural and ecological environment it moves within, including social, and it is extended across past, present and future as well as the minds of other individuals it interacts with. The “I” constructs, simulates and then actively enacts a world–self relation via dynamically ongoing feedback loops with the social and physical environment. While it is unlikely that a single brain region supports the agentic self that unified all of the subselves within the individual, it appears that cortical midline structures, including the DMN, precuneus and AIC as well as temporoparietal junction, angular gyrus, inferior parietal lobe and the right prefrontal region play major cortical roles in the emergence of the sense of self-awareness and agency. There are also many subcortical structures important for the sense of agency. Those details will be mentioned as appropriate but will not be reviewed here.

If we take the predictive processing framework (PPF) as our guide to an initial understanding of the self, then it follows logically from the principles of the PPF that religion, brain and self will be intimately bound up together. There would be no understanding of religion without an accounting of the self and vice versa. To see why this is the case, recall that the fundamental idea of the PPF is that the brain/mind is a prediction machine. It is constantly generating predictive simulations or hypotheses to account for the internal and external sensory feedback it receives each day. They are predictions or expectations about how the world is and will be. But the world must include the individual “simulator” in it to be complete or accurate. The self therefore must essentially be a simulation, built out of hierarchical models like any other brain-based simulation. That is why Søren Kierkegaard could write over a century ago that:

A human being is spirit. But what is spirit? Spirit is the self. But what is the self? The self is a relation that relates itself to itself or is the relation’s relating itself to itself in the relation; the self is not the relation but is the relations’

relating itself to itself. A human being is a synthesis of the infinite and the finite, of the temporal and the eternal, of freedom and necessity, in short, a synthesis (Kierkegaard, 1846/1989, p. 13).

In PPF terms, the self is a simulation that is generated by another simulation, and thus a simulation relating to another simulation ... but the key elements here are the generation of the simulations and the content of each simulation. The generation of simulations is composed of layers with progressively more complex ones at the top. The simulations are built one on top of another from very low level concrete sensory feedback-based simulations at the bottom to simulations that are abstract, temporally thick models of the self at the top of the neural hierarchy. The self must therefore also be hierarchically organized or structured with multiple layers underpinning it.

Given that one cannot predict the sensory outcomes of future actions without representing oneself in those actions as a hidden cause of changes in sensory input, it follows that the self we simulate is a kind of explanation or confabulation or best guess picture of what “we” think or what some lower level simulations guess about what kind of thing or entity or process is causing the kind of sensory feedback it is, in fact, receiving. So the predictive simulations generated by the brain/mind are not simulations of the world alone. Instead, they are simulations about both the “I” and world – about self-world. To make these predictive simulations as accurate as possible, many hundreds, perhaps thousands, of simulations are generated constantly until one best fits the data to be accounted for. To accurately simulate the world the brain/mind has also to include itself, and this simulation of a simulating machine is part of what we call the self. To produce the most accurate simulations/predictions of the self-world, thousands of counterfactual simulations need to be run until one scenario fits the data to be explained. These counterfactual projections or models extend forward and backward in time, and therefore have temporal depth or thickness. The greater the temporal thickness the more accurate the simulation – all other things considered. These counterfactuals are always running in the background of our minds, probably supported by the DMN. They compare what is with what can be expected. They also eventually compare what is with what might be and with what could be and with what *ought* to be. In short, they implicitly hold up the self and the world to question and they let us know that both self and world are contingent. The self and world are things that could have been otherwise, and indeed they could have not been at all. Not to put too fine a point on it, the counterfactual simulations, in short, are the basis for consciousness/awareness and

self-reflection; they raise the question of *being itself*, and thus they point to alternative worlds including the supernatural realm. Because both the self and these supernatural realms come directly out of the imperative to constantly generate counterfactual scenarios about the self-world in order to minimize surprise (or free energy within the free energy framework), it follows that the roots of both the idea of the supernatural realm and the idea of the self are born from the same materials, arise from the same materials and grow into potent forces in our lives from within the same counterfactual materials.

The Divided Self

Interestingly, the experience of the divided self also flows directly from the principles of the PPF. The generation of predictive simulations and error minimization operates at all levels of the neural hierarchy. Simulations at one level can sometimes not be fully convolved with, and may in fact be actively opposed to simulations at another. This is one source of the sense that the self is riddled with competing and conflicting desires and motivations. Each level of the hierarchy aims to predict the input of the level below, and violations of expectancies between predictions and the input (i.e., prediction errors) are propagated up the hierarchy, presumably producing conflicting impulses within consciousness. The endless generation of counterfactual scenarios about self-world may also generate conflicting impulses when they deliver information about hard choices or impossible situations. It is entirely possible, for example, that humans became aware of the possibility of death due to the accuracy of our counterfactual prediction machine. There are whole theoretical programs of research that find the origins of religion in our awareness of death or mortality salience. Whether or not that is the case, the more proximate origins of religion come out of these conflicting impulses inevitably generated by the hierarchical nature of the brain and of the self. That nature is itself rooted partially in the evolutionary forces and genetics of sexual conflict.

Genetics of the Divided Self

The fundamental driver of the divided consciousness in human beings comes primarily from evolutionary genetic conflict between the sexes. Sexual conflict also fundamentally shapes brain evolution and behavior (Gavrilets and Rice, 2014). It also shapes, I will argue, many facets of religious experience. Diverging genetic interests among the sexes is due to the

fact that females produce just a few eggs over their reproductive life, while males can produce practically limitless amounts of sperm over their lifetime reproductive efforts. In addition, unlike females, males face “paternity uncertainty” and thus seek and require all kinds of reassurances that offspring are his before investing in that offspring. There are many other issues over which the sexes battle, but they cannot be discussed here (see Gavrillets and Rice, 2014 for review). Suffice it to say that genetic sexual conflict helps to shape the very structure and function of all brain systems, and thus it is a primary factor in understanding human behavior including the divided mind or self. We will see in later chapters how sexual conflict has also influenced human evolution and religion.

Genetic complexes help to build brain networks that then represent internal “agents” that differ among themselves over ultimate behavioral goals. These agents reflect differing sets of genes whose strategic “interests” are opposed and in conflict with one another. This genetic conflict is reflected in the consciousness of the individual in whom the genes reside. One of the best available discussions of the natural history or biological roots of the divided self comes from David Haig (2006) – an expert on genetic conflict. Haig points out:

[T]here are subtle ways in which genes can have distinct interests and these can be the source of contradictory adaptations within the genome. Transposable genetic elements replicate at a faster rate than the rest of the genome. Nuclear genes are transmitted via eggs and sperm, whereas mitochondrial genes are transmitted only via eggs. If different genes have different rules of transmission, then an adaptation of one gene that promotes its own long-term propagation may not promote the transmission of the other genes with which it is temporarily associated. (Haig, 2006, pp. 15–16)

Different transmission patterns by sex of genes to offspring create the context for conflict or negative fitness covariance between two associated or antagonistic genes. For example, genes that are normally passed on by only one sex, such as mitochondrial genes inherited through the female line, differ in their transmission patterns from Y chromosome genes inherited through the male line, and can therefore enter into conflict with them. If maternal line genes, for example, can increase their likelihood of transmission by decreasing transmission probabilities of paternal line genes, then they will do so.

Genetic conflict can often result in the spread of apparently maladaptive physiologic phenotypes. An allele harmful to male fitness, for example, could spread if it was beneficial to female-line mitochondrial genes. The resultant male phenotypes would be vulnerable physiologically, and thus

natural selection would act to create suppressors of the harmful allele in males. Suppression, however, may be only partial (“dose sensitive”), and thus increased expression of the harmful allele may reoccur, creating an evolving cycle of measures and reactive countermeasures by the harmful allele and its suppressors. Effects of the harmful allele on male phenotypes reduces the numbers of males in the population who compete for resources with carrier females, thus increasing the fitness of carriers of the allele (females).

Similarly, sexual conflict between the sexes can often involve or recruit the genes of parasites and their hosts. Some parasites, such as certain microsporidians in mosquitoes, are only transmitted through females (in the egg cytoplasm). When these parasites find themselves in males, they kill the host and try to get to an alternative host (typically a copepod). In females (daughters) the parasites are harmless. Similarly, in some crustaceans, cytoplasmic bacteria called *Wolbachia* turn males into females and exploit the “female” to find new hosts to infect.

Another form of genetic conflict called meiotic drive occurs when a gene obtains, during meiosis, a transmission advantage. Meiotic drive can involve both the sex chromosomes and the autosomes. Segregation distortion is a form of autosomal meiotic drive that has been intensively studied in the fruit fly, *Drosophila melanogaster*. A similar driving system characterizes the *t* locus on chromosome 17 in mice. The products of the genes encoded at the *t* locus are necessary for normal spermatogenesis, and thus when the males mature they are sterile.

A form of sexual conflict that Haig (2006) suggests impacts the feel of “within brain” or intrapersonal conflict is called genomic imprinting. This refers to the silencing of one allele of a gene according to its parental origin. The silencing or tagging of the DNA probably involves methylation of CpG-rich domains. Thus, each cell in the progeny recognizes and expresses only one allele of a gene locus, namely either the paternally derived or the maternally derived allele. The pattern-specific monoallelic expression of imprinted genes results in a bias in the inheritance of traits, with some traits inherited down the matriline and others down the patriline. Most of the genes identified to date as imprinted code for proteins that influence early growth, with paternally imprinted or silenced genes tending to inhibit growth and maternally imprinted genes enhancing growth. Interestingly, knock out models in mice suggest that maternal line genes shaped some elements of the so-called social brain, while paternal line genes shaped subcortical limbic and motivational networks as well as the FPN and agency network connections and structures. At a metabolic level

paternally expressed loci increase, and maternally expressed loci restrain allocation of resources by the mother to offspring. This is because it is in the mother's genetic interests to divide resources among offspring while the father's interest is to direct the bulk of resources into the offspring he knows is his. Future offspring of the mother may be due to other fathers (i.e., extra-pair copulations or cuckoldry).

Haig (2000, 2004) provided formal, game-theoretic models of imprinting effects in terms of the opposing effects of patriline and matriline genomes on growth and development. He conceptualized the evolution of genomic imprinting in terms of a process of genetic conflict between the maternal and paternal genomes that obtains whenever there is uncertainty about paternity of offspring (which is considered to be the case for human biology). Because a paternal gene in one offspring is unlikely to be in its siblings or its mother, the paternal gene can increase its chances of getting into the next generation (i.e., its fitness) if it promotes extraction of resources from the mother regardless of costs to the mother or its siblings who, in the context of paternity uncertainty, may carry genes of another male parent. The maternal gene, by contrast, is in all the siblings, and thus its fitness is increased by favoring cooperation and sharing of resources.

As Haig says in the essay on intrapersonal conflict:

A gene that a daughter inherits from her mother has one chance in two of having an indirect copy in the younger sibling and one chance in two of having an indirect copy in the daughter's own offspring. The two routes of achieving fitness remain equivalent for genes of maternal origin. However, a gene that the daughter inherits from her father is absent from the younger sibling but has one chance in two of having an indirect copy transmitted to the daughter's own offspring. The two routes are not equivalent for genes of paternal origin. That is, maternal genes of the daughter are "indifferent" as to whether an offspring or a maternal half-sib receives a benefit, but the daughter's paternal genes would "prefer" her own offspring to receive a benefit instead of a maternal half-sib. (Haig, 2006, p. 17)

Thus, paternal-line genes are more likely to foster aggressive prenatal and postnatal growth schedules, while maternal-line genes are more likely to modulate, restrain or inhibit aggressive rates of growth and development. Because these maternal and paternal genomes act antagonistically with respect to allocation of maternal resources and control of growth schedules, they also tend to promote internal brain and biobehavioral systems that function antagonistically around growth, reproductive behaviors and adult behavioral repertoires more generally. Things likely get more complicated after the period of juvenile growth is over as genetic interests

of each genetic line change depending on the social context when mating and reproduction occurs.

These genetic data substantially verify the claim that the default state of most organisms, including human beings, is internal conflict. We are a conglomeration of conflicting sets of genes all of whom are in competition with one another to pass copies of themselves down the generations. They build physiologic systems that assist them in that process, and among these systems are systems of the brain.

Crespi and Badcock (CB; 2008) building on Haig's work and on work on imprinted gene's effects on brain structure and function, argued that neocortical brain networks and specifically social brain networks were largely regulated by maternal line genes while limbic system networks were regulated by paternal line genes. Thus, neurodevelopmental disorders that are influenced by these imprinted genes displayed symptom profiles that tracked evolutionary interests of maternal versus paternal line genes. CB argued that psychosis spectrum disorders (especially some forms of schizophrenia) and autism spectrum disorders (ASDs) represent two extremes on a cognitive spectrum with normality at its center. There is a form of hypofunctioning of the social brain in autism, and conversely a form of hyperfunctional social brain activity in psychosis. The autistic brain is said to manifest an extreme version of the systematizing style and a preference for reasoning in terms of mechanical forces associated with inanimate objects, whereas the schizophrenic brain tends to see agency and minds everywhere; it is a hypermentalizing device. Reasoning in the hypermentalizing brain involves a preference for distant semantic associates and loose associations between external stimuli and between components of thought. The positive symptoms of schizophrenia often involve delusions centered around the self, such as persecution and grandiosity, whereas in autism there appears to be a reduction in the sense of self. There is in autism, for example, a reduction in inner speech or self-talk, while in schizophrenia auditory hallucinations (due to misattribution of internal for external voices) can sometimes be prominent.

There is creativity in both states: the hypermentalizing brain specializes in associating distant or loose associations, while the hypomentalizing brain specializes in systematizing and mechanical reasoning. The human race obviously needs both to arrive at science, technology, religion or other forms of creativity. The question is one of balance and synthesis.

CB's theory suggests that schizophrenics, who are hypermentalistic, may be predisposed to be more religious in the traditional sense – that is, more prone to cognizing supernatural agents everywhere – while autistics

should be less religious in the traditional sense because of their hypomen-
talizing. In addition, women on average have better theory of mind skills
than men so they should be, and are, more religious in the traditional
sense on average than men. In such a case the hypermentalizing schizo-
phrenic profile represents the extreme female brain while the hypomen-
talizing autistic brain represents the extreme male brain, so it is not at
all surprising, according to this line of argument, that women are more
religious in the traditional sense than men, given religiosity is somehow
dependent upon mentalizing or the anthropomorphic tendency of people
to see agency and minds behind everything. It is not that autistics are
predicted to be irreligious. Rather, their religiosity would be predicted to
be colored by their preference for mechanistic cognition. Impersonal con-
cepts of God might be preferred, for example, among people with autistic
spectrum disorder. The available evidence regarding these predictions is
sparse. However, schizophrenics do tend to be as religious in the tradi-
tional sense and sometimes more so than suitable controls. In addition,
when they have auditory delusions, the voices they hear often refer to reli-
gious issues or content. In the few surveys available on religiousness among
ASD individuals there does seem to be evidence for a different religious
profile than suitable controls. The data on ASD and schizophrenia seem to
point to a role of mentalizing in generations of supernatural agent cogni-
tions. In their review of the general hypothesis that mentalizing capacities
drive religious intuitions about supernatural agents and levels of religios-
ity in general, McCauley and Graham (2019) concluded that the avail-
able empirical evidence provides significant support for the idea. In short,
although mentalizing is not the whole story when it comes to religion,
it appears to be a key neurocognitive factor in facilitation of religiosity
because our perceptions of supernatural agents are colored or shaped by
our mentalizing abilities and because they are central to religion. But just
what is mentalizing ability?

Mentalizing is the capacity to understand ourselves and others in terms
of intentional mental states, such as feelings, desires, wishes, attitudes and
goals. Luyten et al. (2020) argue that mentalizing is acquired developmen-
tally during the attachment process in the context of interactions with
significant others. A fully developed mentalizing capacity according to
Luyten and Fonagy is organized around four behavioral polarities. These
are 1) automatic versus controlled mentalizing, 2) mentalizing with regard
to self and to others, 3) mentalizing based on external or internal features
of self and others, and 4) cognitive versus affective mentalizing. There is
a fast, automatic sizing up of others in the social realm provided by the

automatic, other-orientated, externally focused and emotional appraisal of other's intentions. Conversely, at the other extreme there is a slow, more reflective mentalizing focused on imaginatively modeling of inward cognitive states of self and others. Luyten and Fonagy argue that the myriad different combinations of each of the four polarities are heightened or down regulated in various psychological disorders. The four mentalizing polarities are out of balance in psychological disorder.

Full and healthy mentalizing is thus all about the balance between the systems underlying these four dimensions. Imbalances such as being overly attuned to the emotional states of others at the expense of reflective awareness of one's own state of mind lead to eventual emotional or psychic dysfunction. We have seen that with the psychopathology of autistic spectrum disorders there is an imbalance in mentalizing functions which manifests as reduced thinking about inner states of self or others, while in schizophrenia there is the opposite imbalance. There is too much thinking about intentional states of self and others in schizophrenia, particularly of course in paranoid forms of schizophrenia. Good mentalizing thus balances the various systems that are responsible for being attentive to intentional states within and without.

The sense of agency we all feel when formulating intentional states is at the center of this balancing act because we gauge our own inner intentional states and those of others by the strength of that sense of agency. If we feel or sense little or no agency we have no standard or material with which to evaluate our inner states and thus no rule of thumb by which to gauge other's intentional states. Conversely, if our sense of agency is abnormally enhanced we then judge other's inner states erroneously as well. Thus, agency appears to be key to mentalizing and thus to religiosity itself.

Dialogic Self and the Emergence of Agency

I have found that a helpful way to understand the nature of the divided self and the imperative to experience a united sense of self via agency is to utilize the theory of the "dialogical self" (Hermans et al., 1992; Hermans and Kempen, 1993) The dialogic self takes the genetically shaped contrasting motives of the individual as almost literal subselves of the individual – little "I"s that compete and conflict with one another in an incessant internal dialog. Unification of self requires cooperation among these little selves rather than one dominant self commanding all other subselves. How to achieve that cooperation that leads to unity? Hermans and Kempen (1993) suggest that there are distinct "I" positions capable of becoming

the authorial voice that can elicit cooperation and transient forms of unity among each of the “me’s” or subselves. An “I” becomes a unifier with help from so-called “promoter positions.” An “I” achieves promoter status when it finds itself mediated by or near a neural network that functions as a kind of hub for the topmost levels of the neural hierarchy. In that hub position it is able to receive and transmit traffic or information from more diverse “I” positions and therefore can serve as a unifier force. It is, in short, an information broker to the extent that it handles valuable information. A special feature of a promoter position is that it stimulates the development of a broader range of more specific internal and external positions of the self and moves them to a higher level of integration. Thus, promoter positions have the overall effect of organizing the overall dialogic self into something that approximates a small world network. In terms of groups it could be called an enterprise association (a task-oriented, intentional group) when it becomes a small world network, given that the overall dialogic self, the complete set of positions within the network, are all oriented and pushed by promoter positions into serving the aims promoted by the authorial “I.” In addition, each subself within the information network that is the dialogic self becomes specialized in terms of transmitting forms of information graded or evaluated/curated by promoter positions along a line/metric of value for the overall “I” or network. At that point the sense of agency emerges. We will return in a later chapter to the issue of small groups becoming enterprise associations that then exhibit real intentional states and agency, as these groups were important for the evolution of religion and brain and are still important today for self and religion.

Agency as a Culturally Shaped but Intrapsychic Unifying Force

What is agency? What is this sense of agency that I argue is so crucial to religiousness? From within the PPF, agency can be construed as arising from active inference – the process by which we actively seek out information and data that can add precision to predictions and in the short term surprise us (ultimately minimize surprise). The modeling or simulating of one’s own self and actions leads inevitably to awareness of one’s plans, intentions and goals, thus agency.

At a basic level agency is the awareness of one’s own and others’ intentional states. It is the awareness that one is the originator and author of one’s own actions and that others are also originators and authors of their own actions; and finally this awareness of self and others implies that originators of actions bear some responsibility for those actions. This awareness

of one's authorship and responsibility for actions is facilitated, promoted, saturated, shaped and constrained by the surrounding social group and culture. The local culture provides scripts concerning the possible strength, range or scope of agency an individual might feel and yield. Culture sets the bounds in terms of scope of agency permitted for local agents. People can therefore report dramatic variations in sense of agency depending on context or the extent to which they feel controlled by agencies more powerful than themselves. Stromberg (2012) noted that given Western investments in legal and economic models of the completely free individual as an autonomous and sovereign agent with a large scope for agency, it is a threat to the cultural foundations of this system when individuals report lapses or changes in agency. Reductions or expansions in individual agency are therefore sites for political conflict in western societies. Obviously if you can manipulate agency you can control the behavior of the individual. In some traditional premodern societies and in some nonwestern societies, agency is conceived in more communal terms. The default condition in these societies emphasizes "we agency" rather than individual agency. Of course, individual agency remains. We are simply highlighting emphases here to illustrate the fact that agency itself is literally culturally informed. For example, if a culture valorizes the self like the West does as a sovereign entity with a large scope for agency, then the individual's actions are more likely to be understood in terms of self-determination. By contrast, if a culture sees the self as less autonomous and more connected and interdependent with others then the individual's actions are evaluated against its effects on others. Most cultures contain a mix of the individual as sovereign versus the individual as communally obligated.

The personal sense of agency is the experience of control over one's own action and its consequent outcomes. The neural mechanisms underpinning sense of agency are poorly understood. A model has been proposed that both predictive and postdictive mechanisms are involved in formation of sense of agency (Synofzik et al., 2013). Predictive processes involve internal forward models in which a copy of motor command will be compared with the actual results of a movement. The mismatch between the planned and actual action (i.e., prediction error) will be used to update the internal agentic model. On the other hand, postdictive processes act during and after a movement, and a sense of agency will be consciously felt if some agency-related criteria are met such as temporal compression or closeness in time between deciding to act and the motor output. Optimal integration and balance of predictive and postdictive cues seems to be crucial for a normal experience of agency. If the reliability of either of these cues

reduces due to internal (e.g., agency-disturbing disorders like schizophrenia) or external (lack of reliable sensory input) factors, the other cue type receives a higher weight and aberrations in agentic experience follow.

The cultural factors that shape the phenomenology of agency include 1) authorship and ownership of actions, 2) choice and ability to withhold agency, 3) purposiveness or goal – directedness of actions, 4) public rationale or reasons for actions, 5) responsibility for action, 6) unintended consequences of actions.

With regard to numbers 1 and 2, authorship/ownership of actions and choice every culture stipulates that some powers can override and even crush personal agency. These powers include supernatural agents, individuals and groups with legal rights to coerce you and individuals and groups with economic or social power to coerce you. When agency is crushed and crushed indefinitely the individual experiences what Simone Weil (1942) called “affliction.” The opposite case of giving free rein to agency is also tyrannous as social life becomes a war of all against all. Most of the time, however, a healthy culture will find a way to provide as wide a scope to personal agency as possible without creating a chaos of warring wills. With regard to the teleological and rational structure of intentionality (number 3) the local culture provides a range of permissible goals and public reasons for those goals that speak to the needs of the local group. With regard to 4 and 5, responsibility for and unintended consequences of actions create local norms, customs and manners that assign responsibility, while more complex societies enact legal codes that define responsibility. The last item, unintended consequences of actions, refers to the ways in which culture breaks down when regulating the scope of personal agency. Only religion can speak to the complexity of the downstream actions and ripple effects of our intentional states and actions. Those unintended consequences are sometimes harmful to the interests of the individual author of the action and sometimes harmful as well to the local group. When you place the individual who is given a relatively wide scope for his agency within a complex society and then follow the intended and unintended consequences of his actions, you will inevitably find among those consequences some reversal of expected outcomes, some irony and occasionally tragedy.

Given then that agency inherently breeds complexity, uncertainty and occasionally tragedy, even though it is a fundamental requirement of our freedom, it is not surprising that personal agency is the special target of both the local religious cult and the political cult. When culture is healthy it facilitates the flourishing of the individual via supporting and assisting the individual in expanding the scope of his/her agentic capacities. This

expansion of agency assists the individual's efforts to overcome inner conflict and divisions so that there is unity of purpose and integrity of the will. Commitment to personal and group values and goals becomes possible and social cooperation flourishes. The expanded sense of agency builds up a healthy communal sense of self. Haig (2006) says "The Self can be viewed as the arbiter that mediates among the conflicting parties and then decides. We are free actors at least in the limited sense that no single set of interests exclusively determines our choices" (p. 22). I agree with Haig's assessment of how unity is achieved except I would emphasize the element of agency – especially an expansion in the scope of agency as the event that unifies consciousness in service to social cooperation. The agentic self, in cooperation with others in the local culture, arrives at or computes or imposes a decision that at least temporarily imposes unity. There are many theories as to how that unity is achieved. Is the expanded sense of agency achieved via simple democratic vote among the internal agents seeking control over the executive power? Can we apply something like Arrow's theorem concerning an aggregation function that computes a plurality of agents who then rule? Or is there instead a tyrant who temporarily grabs the executive control networks in the brain and imposes a rule? Or is there some strategic manipulation scheme developed among interacting agents as in game theory dynamics that results in eventual collaboration of a group that then runs things? It is likely all of these and more. Agency requires some commitment to a value or goals in a hierarchy of goals. Thus, only an ideal for all warring parties can unify these competing factions. In terms of the self only an ideal self can unify internal warring factions. The choice of an ideal hoped-for self to commit to as a long-term distal goal confers some unity of purpose on the individual and his internal conflicts. This unification results in generation of long range distal intentions deep within prefrontal (BA 10) regions that then propagates up to a readiness potential in the supplementary motor cortex, where plans to implement distal intentions are packaged and formatted into proximate intentions and then sent into the primary motor cortex, where motor programs are programmed and then implemented so that the distal intentions are carried out.

Theory of the Ideal Future Self

In the recent empirical psychological literature two theories of the self are particularly well supported by the data: the self as a collection of schemas and the self as a story. We can conceive of these in terms of Bayesian priors to some extent or predictive simulations of self and world as described

earlier. Because PPF requires that the self be essentially a hierarchy of simulations or predictions about the expected future, it is not unreasonable to see the essence of the self as a simulation of the future – a possible future self. Religion promotes ideal or normative or moral possible selves so it is necessary to discuss possible selves.

According to Markus and Nurius (1986), possible selves are images of what people hope to become, expect to become, or fear becoming in the future. Though not every possible self-theorist would agree, I count as a special possible self the “ideal self.” The ideal self is special in that it is crucial for self-regulation and resolution of conflicts in the divided self.

Possible selves appear to be elaborated out of imaginary narratives involving the self both in childhood and in adulthood. Possible selves consist of a description of a set of behavioral actions aimed at some goal designed to overcome some conflict, along with causes and consequences of those imaginary actions, with an end state that is described as an event. Cultural narratives about future selves provide interpretations about what we see as possible. Here is another example of how the local culture both promotes and restricts or regulates the scope of agency given to an individual. As stories, the narratives the local culture provides to the individual help to integrate material about conflict involving the present self into a resolution of that conflict – a resolution involving a higher, more complete and more complex self.

Empirical work has supported this narrative-related integrative function of possible selves. We evaluate our current and past selves with reference to possible selves (Markus and Nurius, 1986). Thus, for instance, a current representation of the self as “non-practicing Hindu” would be evaluated more severely by an individual with a salient “saint” possible self compared with an individual with a “banker” possible self. The discrepancy between the possible self as saint and the current self as nonpracticing is large and has been demonstrated to be motivational. Interestingly when the positive possible self “saint” is combined with a feared possible self such as “sinner,” the motivational strength of possible selves increases substantially because both approach and avoidance systems are activated under the regulatory control of the possible hoped for and feared possible selves.

Possible selves become relevant for self-regulation when they are recruited into the subset of self-knowledge that is active in working memory. Obviously when a possible self is periodically or chronically activated it becomes particularly important for evaluation of current representations of the self as

well as discrepancy reduction behaviors or engagement of approach and/or avoidance behaviors. For example, frequent attendance at religious services or performance of religious rituals will periodically activate a number of possible selves, including an ideal self. The chronically activated ideal self is then in a position to contribute to self-regulation by providing a standard by which to evaluate progress toward a goal and resolution of internal and social conflicts (Oyserman et al., 2004). Because the ideal self allows for resolution of conflict, it is experienced as a relatively conflict-free unified self.

That people use possible selves as behavioral standards to guide conflict resolution and self-regulation more generally has been remarked upon repeatedly (Oyserman et al., 2004 for review). Just as PPF predicts, behavioral reference points or standards are organized in these models of self-regulation in a hierarchical fashion from abstract and general to concrete and specific. A particular behavioral standard derives from the level above it. The highest level of standards are global ideals. In the context of religious ritual, these global standards are the ideal selves that the current self is urged to become or desires to become. The highest global standard is the god toward which the entire religious service is oriented. Participants in religious services often actively attempt to take on the identity of the god – to become “spirit possessed.” In any case, in everyday religious contexts, such as in daily ritual practices, the individual is reminded that an ideal self is possible and even required of him or her and that the ideal self then serves as a behavioral standard against which the current self is evaluated. Discrepancies between the two can then motivate corrective goal directed behaviors. Discrepancies between a behavioral standard and the current self, however, also contribute to the subjective experience of a “divided self” and, as discussed earlier, it is the divided self that religion promises to heal.

Breakdowns in the Self

Psychiatry and clinical psychology have largely concerned themselves with charting and studying breakdown patterns of the unified person into the divided self. Take, for example, the phenomena of *akrasia* or weakness of will, displayed by most of us on a daily basis and in an extreme fashion by the addict with regard to her drug. *Akrasia* has been modeled as conflict between two subselves: a current self and the future self. People have a tendency to identify with the impulsive current self – even though doing so will adversely affect the individual in the future. For example, people will choose the chocolate cake NOW even though they know they will regret

the choice when they put on more pounds in the future. People have a tendency to think of the future self as a different self in conflict with the present self, making working toward future goals difficult. The conflict between current and future selves has been studied with many methods. A key finding is that to the extent to which you perceive your present self to be continuous with a future self, you will save more money. If you do not identify with a future ideal self at all, you are less likely to save for retirement or anything else. Higher present/future self-continuity predicts reduced discounting of future rewards in a laboratory task, and greater lifetime accumulation of financial assets (even after controlling for age and education). The more individuals resolve the conflict between current and future self, the better the ability to plan and save for the future. The decentering process helps us to get closer to the future ideal self.

Apparent breakdown in the sense of unity occurs in many neuropsychiatric disorders. Bipolar disorder involves two contrasting personalities and thought patterns. Dissociative identity disorder involves two contrasting personalities vying for control over the behavior of the individual. There are several personality disorders (e.g., borderline, narcissistic, sociopathic) that involve an absence of some elements of the personal in the context of fully functional cognitive capacities. One of the most intensively studied breakdowns in the sense of self and one that has implications for religion and brain topics is schizophrenia.

Schizophrenia, Divided Self and Religion

Sass (2014) has presented a compelling model of schizophrenia as essentially a disorder of the self. He argues that basic or minimal self-awareness, of the normal, first-person quality of experience – that is, of ipseity, is the root problem in schizophrenia. Ipseity includes the sense of existing as the subject of one's own experience and agent of one's own actions. It is grounded in the lived body and inner time-consciousness, and is sometimes called the "intentional arc" of one's life.

The foundational disorder of core self or ipseity is understood from a phenomenological standpoint as having three interrelated aspects that, taken together, can account for all the major symptoms of schizophrenia. The three aspects are: 1) hyperreflexivity – which refers to an exaggerated self-consciousness; 2) diminished self-presence, which refers to a decline in the experienced sense of existing as a subject of awareness or agent of action; and 3) disturbed "grip" or "hold" on the cognitive-perceptual world – which refers to disturbances of simulation or structuring of the world.

The idea appears to be that genetic, epigenetic and environmental insults lead ultimately to a disturbance first at the level of the minimal self and SN. This disturbance of the minimal self then leads to inability to experience first person subjectivity normally. Then the self-world connection is lost, and either in reaction to the loss of, or disturbances in subjectivity, or as downstream effects of that deficit in subjectivity, the individual becomes either hyperflexive or reduces self-presence. The hyperreflexive individuals become paranoid as all the focus is on the unstable self-structure in order to make it stable. The “reduced presence” individuals attempt the opposite strategy to stabilize the self-structure. They minimize it in a vain attempt to make it more manageable. Presumably the degeneration of the SN (minimal self) is then followed by dysfunction in DMN (narrative self) and finally FPN (social executive self). Once these three stools of the overall agentic self get wobbly, so too does the overall “I” and the sense of agency itself dissolves. The individual feels as if the ontological ground of reality itself begins to wobble as well.

What does all this have to do with religion? When the sense of agency begins to be undermined by the disorder there sometimes arises the tendency to overattribute mind to agencies outside the impoverished self. These agencies are often clothed in supernatural dress. They are either seen visually but are more often heard via auditory hallucinations or voices. One explanation of this promiscuous attribution of minds to disembodied spirits is the idea that with loss of the ability to sense agency or ownership of one’s own actions, one nevertheless still needs explanations for why thoughts and actions keep happening despite the absence of any awareness at some level of the neural hierarchy of persisting intentional states. Thus, every time one produces a significant impulse, thought, desire or wish there is no awareness of that fact given the ipseity disorder. Nevertheless, another part of the brain/mind higher in the hierarchy than that at which the impulse was generated is aware of the impulse. Therefore, that part of the brain/mind feels obliged to generate an explanation for the impulse. So the brain/mind infers that the impulse was produced by some mind somewhere. Since the individual cannot see the mind the individual concludes that it is supernatural.

The Divided Self and Social Cooperation

One major trend in the evolution of religion and the brain is the trend toward making us and our ancestors more socially cooperative with one another. The ways in which Mother Nature accomplished this task may

have involved an expansion of the scope of cultural evolution in human evolution or via a process of self-domestication or via some other process. The bottom line, however, is that there has been a trend in human evolution towards increasing the ability of humans to form social bonds, relationships and alliances with one another to further individual and group interests and success. This general evolutionary trend involved the development of the so-called social brain. This is a loosely defined set of interconnected brain regions that often handle or mediate all of the thinking and emotional work we have to do to keep track of and regulate our social interactions with others. Central to the network is the brain's DMN, which includes at a minimum many of the structures that support the sense of self such as the medial prefrontal cortex, posterior cingulate cortex, ventral anterior cingulate cortex, and precuneus. To permit social bonding into small groups and to later evolve larger social groups and social cooperation, individuals need to be able to commit themselves to the group's aims, goals and long-term strategic objectives. Individuals cannot constantly signal wavering commitment due to conflicting desires. If they did so they would be seen as free riders or unreliable partners and thus would be excluded socially. Therefore, the divided self needed to give way as much as possible to moments of unity and consistent commitment. Religion solves the problem of the divided self by enlarging the sense of self, expanding the sense of agency that results from forging a temporary intrapsychic truce between warring factions within the self. Expanding the sense of agency and making agency more flexible was also important in creating targeted and effective group actions, particularly coordinated group actions required for the hunt or intergroup conflict and war.

The Self, PPF and Rapid Eye Movement Sleep

One other aspect of the self that turns out to be important for religion flows directly from the principles of PPF – namely the central role rapid eye movement (REM) sleep plays in optimizing simulations at every level of the neural hierarchy, but particularly at the topmost level involving the DMN and related networks. Once the brain/mind generates a series of simulations, schemas, models, counterfactual scenarios and then tests them against surprise and reality, it presumably holds them until disconfirmed by reality. Over time, in fact eons of time for some models, models and beliefs that work well are compressed and then stored (the brain can be seen as built up over time as information compression proceeded). Existing models with strong priors may also need to be fine-tuned, updated and so on.

Since the self is a model at the top of the hierarchy and is in constant use, it must constantly undergo editing and updating. Model refinement and compression can entail finding computationally simpler and more parsimonious models using only prior beliefs or sparingly using internal bodily feedback only. The system is taken “off-line” so that current sensory feedback does not interfere with the editing/updating process. These model refinement and compression processes are part of the decentering process where the self-model is edited and updated in order to better match the ideal self. They are also best accomplished offline during REM sleep. Non-REM slow wave sleep would not be suitable for updating beliefs as most areas of the brain are down regulated. But REM sleep specifically involves systematic DMN activation and deactivation. The neurochemical environment of REM (high cholinergic/dopaminergic with low serotonergic activity) also lends itself to recalibration of redundant (synaptic) model parameters to minimize model complexity. In short, REM sleep has to be part of the picture concerning brain/mind construction of the self because predictive models, particularly those generated at topmost points in the hierarchy require constant off-line updating and REM sleep is the best candidate system to accomplish that task.

REM sleep and its primary product, dreams, will reappear throughout the story of religion, self and brain topics, but in Chapter 4 we examine in detail the evolutionary background of religion and brain, and then we examine what has been learned about brain mediation of religiousness since the first edition of this book was published.

The Cultural and Evolutionary Background to the Neuroscience of Religion

In previous chapters we discussed some potential evolutionary antecedents to decentering and religious cognition. We emphasized social forces, pressures for social cooperation, the social brain, the default mode network (DMN) and rapid eye movement (REM) sleep biology. In this chapter we go into more detail concerning the evolutionary (cultural and biologic) background to religious cognition and experience. The aim is to set up what we need to know in order to better appreciate emerging knowledge concerning neurologic correlates of religious cognition and experiences.

While it is certainly true that pressures for social cooperation shaped brain evolution in significant ways, they were not the only drivers of human brain evolution. Larger cultural forces also played a role. Cooperation requires some control over individual free-riders and aggression. Thus, for social cooperation to stabilize, reactive forms of aggression had to be reined in and controlled. Brain mechanisms for control of reactive aggression thus needed to be developed and supported. Note that this enhanced control over reactive aggression would then allow for more controlled and perhaps more lethal forms of strategic aggression. Similar control mechanisms, however, were also required to support innovations in toolmaking capacities. Tool and weapon use and development are simply impossible without exquisite levels of control over attentional processes and eye-motor coordination among other capacities. Executive control processes were also required to meet new challenges posed by the new colder and darker climates anatomically modern human (AMH) populations were facing as they moved into Europe. Not only did these populations interact with existing hominin populations, the Neanderthals and Denisovans, but they also likely needed to deal with new diseases encountered when meeting new populations and new environments. All of these matters, larger social groups requiring greater cooperation, more complex tool kits, new environmental and climate challenges and new diseases, all required new

levels of cognitive control and were certainly significant drivers of human brain evolution regardless of social pressures. Evolution of brain systems of executive control likely involved expansion of inhibitory powers of pre-frontal and parietal cortex. But once these inhibitory and executive control powers are enhanced a whole series of neural consequences follow therefrom. These downstream consequences of the development of executive control networks in the brain can be partially understood within the theoretical framework of “self-domestication” of the human species. But they can also be understood within other theoretical frameworks emphasizing the need for highly developed executive control networks in the brain.

When the physiologic process of self-domestication begins, certain consequences follow for brain physiology. We learn from study of brain and behavior changes in domesticated lineages that domesticated animals tend to show the following traits: reduced brain sizes; less lateralized brains, reduced reactive aggression, docile behavior; reduced sexual dimorphism; reduced prognathism; smaller teeth; skeletal gracility; altered estrus cycles and fertility; floppy ears; elevated vocal communication; and altered skin and hair pigmentation (Wilkins et al., 2014). Many of these features are known to appear rapidly, as heterochronic shifts in ontogeny (i.e., paedomorphism or neoteny), rather than as isolated and adaptive mutations. McNamara (1997) noted that *hypermorphosis* or the extension of growth times (relative to our primate ancestors) within each normal phase of development (infancy, childhood, adolescence and maturity, etc.) captures the unique character of human evolutionary change and individual development across the lifespan. We have long-drawn-out growth phases *within* each of the classical periods of primate lifespan development. This means that the brain grows larger during infancy and childhood simply because it grows for a longer period of time within the infancy and childhood phases (again relative to our nearest evolutionary relatives). Because hypermorphosis characterizes human developmental phases, we can expect that human life history schedules will necessarily be affected. For example, if moralizing forms of religion function in part to promote reproductive effort, then religious beliefs/practices may operate more intensely during the period of life where most reproductive effort occurs.

In any case, once the domestication process begins via some form of retention of juvenile traits/paedamorphosis, the neural crest, which produces developmental assembly and guidance elements for many developing neural structures and bodily tissues, alters its activity levels to accommodate the new developmental lags and operations, and therefore neural development processes are systematically altered, ultimately producing less

lateralized neural systems. This may be one major result of a self-domestication process. People with neural crest-related disorders tend to be left-handed or at least evidence reduced right-handedness. Thus there is reduced laterality of function which may manifest as reduced volume of corpus callosum, and more bilateral representation of language and attentional functions.

While the self-domestication hypothesis appears to account for some evolutionary forces shaping human brain evolution, its fundamental premise that aggression was and had to be curtailed among humans may be only partially true. In hunter gatherer societies of the Upper Paleolithic AMH populations did not necessarily need to become more docile and less aggressive – after all they were facing Neanderthals and very dangerous animals in the hunt. Instead of docility, people needed more nuanced executive control over behavioral repertoires and responses.

There is strong evidence that human brain evolution accented development of executive control networks in the brain rather than a drive toward docility. As mentioned already, there were strong evolutionary pressures on AMH populations to develop powerful central control cognitive systems. Brain mechanisms of both emotional and executive control are necessary for creation of the kinds of behavioral plasticity utilized by cumulative cultural creation. The production of complex stone tool kits and the social transmission of symbolic knowledge and local culture requires exquisitely precise and detailed inhibitory efferents running from prefrontal and parietal executive control networks to every other region of the brain. Parietal-prefrontal networks and the DMN appear to answer to these evolutionary pressures for self-control.

In support of the evolutionary development of executive control systems there were also neuroanatomical changes associated with the parietal precuneus, intraparietal sulcus, supramarginal gyrus, anterior insula and visuospatial association cortex (Bruner et al., 2018). Instead of a reduction in size, these sites are larger in AMH populations relative to Neanderthals. These regions, especially in their interactions with the prefrontal cortex are involved in executive control and attentional networks as well as integration of bodily representations with vision, eye–hand coordination and very complex experiences like self-awareness. Bruner argues that these are the brain systems that facilitate integrating tools into cognitive schemes of the body.

Whether it was the need for social cooperation, a reduction in reactive aggression or an increase in self-control capacities that propelled evolution of brain structure and function in AMH populations, the phenomenon

we now call religion found itself centrally embedded within the overall cultural evolutionary forces that were now fueling evolution of the human race itself.

We need to pause here and consider how the brain supports and makes possible cumulative cultural evolution and innovation. We are interested in what role, if any, religion plays in cumulative cultural evolution.

Cultural evolution depends upon social learning behaviors. Individuals, especially children, selectively learn or adopt others' beliefs, practices, techniques or rituals when these beliefs are widely shared (conformist cultural learning) or modeled by high prestige individuals (prestige-biased cultural learning) and backed up by credibility-enhancing displays – when these prestige models or teachers also practice what they preach.

In a comprehensive review of cumulative cultural evolution and the evolutionary uniqueness of the human species, Marean (2015) argued that the basis for behavioral modernity and the cumulative cultural evolution that uniquely characterized our species was highly advanced cognition operating in a symbolic framework, hyperprosocial proclivities and a dependence on social learning. If we call these three capacities the “learnability” capacities that underlie cumulative cultural evolution, then we can ask what brain processes underlie learnability.

Very likely multiple cognitive and brain processes allow for or facilitate learnability. “Highly advanced cognition operating in a symbolic framework” must refer to cognitive processes like attentional control, salience tagging/discernment and complex mental simulation abilities. Understanding symbols requires the ability to take one mental image and let it stand for another that is displaced spatially or temporally from the individual. The executive control networks operating upon and selectively accessing mental tokens within semantic memory systems would be capable of supporting symbolic cognition. Attentional and executive control is generally supported by parietal–prefrontal networks anchored on the anterior cingulate cortex. Salience tagging is supported by dopaminergic striatal–prefrontal networks as well as limbic networks deep to the temporal lobes. Complex mental simulation abilities are supported by several brain networks, but the DMN centered on the precuneus appears to be key. I will provide more nuanced discussions of all of these rather simplistic pronouncements later in the book. The aim here is merely to suggest that the capacities underlying cumulative cultural evolution that makes us uniquely successful can be tentatively but nontrivially associated with brain systems and networks. In addition to these well-studied networks, I would like to consider a functional network that is not given the attention

it deserves in discussions of cumulative cultural evolution as it turns out to be crucially important for religion as well. That functional network or brain state is REM sleep. We learned when discussing decentering, the predictive processing framework's emphasis on surprise minimization led us to considering REM sleep because REM sleep is characterized by pontine-geniculo-occipital (PGO) waves that function physiologically as an orienting reflex or system that helps to select beliefs slated for update and emotional memories slated for integration into long-term memory.

REM Sleep and Dreams as Critical for Cumulative Cultural Evolution

Cumulative cultural evolution took off in the Upper Paleolithic in the Eurasian ecologic context. AMH populations dispersing out of Africa between 75,000 and 50,000 years ago and meeting other human populations such as the Neanderthals had to adapt to these new populations, new diseases and colder climates. Recent analyses of Neanderthal DNA have demonstrated that migrating AMH peoples mated with some Neanderthals. Among the Neanderthal genes preserved in AMH populations are genes (e.g., *ASB1*, *EXOC6*) that enhanced REM sleep processes in several ways, but also resulted in a higher risk for narcolepsy – a disorder wherein REM neurobiology is dramatically disinhibited, resulting in REM processes seeping into daily waking consciousness. REM neurobiology therefore thrust itself upon or became available in a new way for AMH peoples of the Upper Paleolithic – indeed it likely became an intrusive presence for some persons predisposed to dissociative states. Some AMH peoples whose preexisting neurologies made them vulnerable to the new disorder of narcolepsy developed the ability to easily access REM-based visionary states, thereby more easily transitioning into altered or dissociative states of consciousness. This new access to REM neurobiology and states then allowed development of a new form of religiousness that relied on manipulation of an array of visionary states of consciousness we would refer to today as shamanism. If elements of shamanism existed prior to the interaction of populations in the Upper Paleolithic, then these elements were enhanced and made more powerful via the enhanced access to REM. Easy access to REM neurobiology also allowed better access to and employment of all the things REM neurobiology makes available, including enhanced emotional learning and consolidation of emotional memories, enhanced neuroplasticity, enhanced creativity, enhanced linking of disparate ideas or connections, dreamy visionary states, advanced mental

simulations of significant social interactions, appearance of numinous or supernatural beings/figures, and so on.

I next present a summary of the evidence for each of these claims.

Humans Differentially Invested in REM in the Upper Paleolithic

Nunn and Samson (2018) analyzed a large dataset composed of a host of sleep, ecological, physiologic and life history characteristics of some thirty differing primate species including humans. Using phylogenetic methods including two different Bayesian methods, phylogenetic prediction based on phylogenetic generalized least squares and a multistate Ornstein-Uhlenbeck evolutionary model of random drift and stabilizing selection, the authors were able to identify what kind of sleep characteristics a primate like us should evidence given the physiologic, ecologic and life-history characteristics we possess. It turns out that humans sleep less than predicted for a primate of our body mass, predation risk, brain size, foraging needs, sexual selection and diet. Humans were predicted to spend 13.8 percent of their TST in REM. The observed value was 22.3 percent. Humans pack an unexpectedly higher proportion of REM sleep within a shorter overall sleep duration than other primates and do so by reducing nonrapid eye movement (NREM) sleep (rather than increasing REM). The authors themselves suggest that the evolutionary reduction in NREM and investment in REM produced new opportunities for learning, creating material objects and socializing. In my view it is reasonable to suppose that this new evolutionary opportunity for cultural learning, afforded by NREM reduction and REM enhancement, helped to fuel the extraordinary advances humans made in cultural accomplishments. However, Nunn and Samson were not able to date when AMH populations reduced NREM and enhanced REM, but I place it in the Upper Paleolithic when AMH populations entered colder climates of Europe and encountered new human populations. The reduction in daylight hours and the colder climate meant that AMH peoples had to adjust their sleep habits, and they did so by using REM more intensely. In any case, there is now good evidence that REM was altered and enhanced when AMH populations interbred with Neanderthals in the Upper Paleolithic.

Dannemann and Kelso (2017) reviewed Neanderthal genetic contributions to AMH populations. In addition to the well-known fact that we obtained (from Neanderthals) genes contributing to skin and hair traits, we also obtained genes that significantly altered AMH sleep patterns. One of the introgressed single nucleotide polymorphisms (SNPs) discussed

by Danemann and Kelso modifies the coding sequence of ASB1 (MIM: 605758; rs3191996, p.Ser37Lys). Archaic alleles near ASB1 (tag aSNP: rs75804782) and EXOC6 (MIM: 609672; tag aSNP rs71550011) are associated with a preference for being an “evening person” and an increased tendency for daytime napping and narcolepsy, respectively. As AMH populations met the challenges of reduced sunlight and colder climate in Europe, they acquired genes that helped them adapt to short day lengths and greater amounts of dark. Presumably, these factors also played a role in alterations in skin pigmentation and hair color. Dark skin is a liability in ecologic conditions with short daylight times. But these adaptations to shorter daylengths had the side effect of enhancing REM as well as risk for the disorder of REM, narcolepsy. To understand the significance of this enhanced risk for narcolepsy among Upper Paleolithic peoples, we will need to discuss narcolepsy a bit.

First a word on REM in the normal state. REM sleep accounts for about 22 percent of total sleep time in humans. It is that form of sleep associated with vivid dreaming and with rapid eye movements under the closed eyelids, thus the name. Brain activation levels within the limbic system (the emotional brain) can be higher than they are in the waking state. REM is composed of tonic and phasic events. REM’s tonic characteristics are a desynchronized electroencephalogram, sexual activation (penile erections/clitoral engorgement) and atonia of the antigravity muscles. Its phasic characteristics include bursts of rapid eye movements under the closed eyelids, myoclonic twitches of the facial and limb muscle groups, and increased variability in heart rate, respiration, blood pressure and autonomic nervous system discharges. The phasic aspects of REM tend to occur in association with bursts of PGO waves in the visual centers of the brain but propagate throughout limbic and related regions. In addition, some mammals also exhibit a theta rhythm in the hippocampal formation during REM. The hippocampus is an important structure for formation of memories. Other brain systems activated appear to overlap to a significant extent with networks supporting mental simulation. For example, the collection of structures activated and deactivated during REM overlap to a significant extent with the DMN. The DMN includes posterior cingulate, precuneus, retrosplenial cortex, inferior parietal, superior temporal, hippocampal formation and medial prefrontal cortex.

Now let’s discuss narcolepsy – the disorder that may have become a more insistent reality for some peoples of the Upper Paleolithic if the gene in question (EXOC6) was operating in the same manner then as it does for modern populations; that is, increasing risk for narcolepsy. Narcolepsy

is characterized by the irruption of REM neurobiology into daytime consciousness. Its symptoms are 1) excessive daytime sleepiness, 2) hypnagogic hallucinations, 3) “sleep attacks” or sudden paralysis (cataplexy) following a strong emotional stimulus like laughing or an intense emotion and 4) sleep paralysis or paralysis during the transition from sleep to wake or from wake to sleep. In the sleep to wake transition the paralysis normally associated with REM sleep has not yet ceased even though the patient is conscious or awake. They may see or hallucinate some residual dream imagery – typically frightening imagery. There is a sense of threat and of an evil being or presence in the room, yet the patient cannot move to protect him or herself. These threatening presences or beings are generally perceived as supernatural beings. In addition, patients with narcolepsy very frequently experience lucid dreams, meaning that they are more often conscious of dreaming when dreaming in REM sleep than controls. They also recall far more REM dreams than do healthy controls. In short, narcoleptics appear to be more or less often, if not constantly, immersed in REM neurobiology on a daily basis, and indeed cannot escape it effectively. To see mental or psychological effects of REM neurobiology we only need to look at narcoleptics.

Now because dreaming, especially lucid dreaming, has been associated with creativity (see below for greater discussion of links between dreams and creativity), Lacaux et al. (2019, p. 1998) formally assessed links between REM neurobiology and creativity in 185 narcoleptics and 126 healthy controls. They did indeed find that narcoleptics evidence higher levels of creativity than controls as assessed in multiple ways. They were more creative on tests of past achievement and in-lab objective creativity tests that tapped Imaginative, Innovative and Researcher modes of creativity as well as divergent, convergent, verbal, graphic, abstract and concrete modes of creative thinking. In addition, each of the classic symptoms (cataplexy, sleep paralysis, hypnagogic hallucinations, lucid dreaming and REM sleep behavior disorder) of narcolepsy that are directly responsible for dissolving the normal boundary between wakefulness and REM sleep were found to be significantly associated with higher creativity scores. Notably, 43 percent of the 185 subjects with narcolepsy were frequent lucid dreamers compared with 3 percent of the 126 normal controls, and these lucid dreamers were among the most creative of the group.

In summary, one brain network that likely contributed significantly to the rise of the capacity for cumulative cultural evolution among AMH peoples was that brain system associated with REM sleep. REM neurobiology became more accessible to AMH peoples due to the introgression

of relevant genes from Neanderthal peoples. Now I turn to additional evidence to indicate REM is important for cumulative cultural evolution.

Brain Mechanisms in REM Overlap with Social Learning Networks

In my 2019 book on the neuroscience of sleep and dreams (McNamara, 2019) I review special characteristics of REM. REM (relative to the waking state) is associated with high activation in extrastriate visual regions, limbic, limbic striatum, paralimbic, anterior insula, Brodmann's Area 10 in the prefrontal cortex, the ventromedial prefrontal cortex, and temporal regions and relative hypoactivation in the inferior and middle frontal gyrus and inferior parietal regions. In addition, the motor and premotor cortices are also very active during REM. Interestingly, the superior frontal gyrus, the medial frontal areas, the intraparietal sulcus and the superior parietal cortex are not less active in REM than during wakefulness. In addition, hippocampal outflow to the cortex is blocked during REM. Instead, the hippocampus receives information from cortical networks.

The collection of structures activated and deactivated during REM overlap to a significant extent with the DMN. The DMN includes posterior cingulate, precuneus, retrosplenial cortex, inferior parietal, superior temporal, hippocampal formation and medial prefrontal cortex. These brain regions collectively are always active when the individual is at rest and simply thinking, letting his/her mind wander or daydreaming. The DMN is sometimes conceptualized to be composed of at least two major subsystems, one centered on the medial temporal lobe and the hippocampus (the simulation system) and the other centered on the medial prefrontal cortex (the self-referential system). The simulation system is operative when we imagine future or past states of affairs, while the self-referential system computes or handles information about the self, including of course emotional information. Both are operative during dreaming. Social learning, which is crucial for cumulative cultural evolution, depends on the DMN – both its simulation system and the self-referential system. Imitative learning is impossible without reference to an imaginal simulation of to-be-learned procedures in reference to the current capacities of the self.

Social and generational transmission of information cannot proceed effectively unless there are mechanisms for deciding which information is significant enough to transmit. REM makes that choice and stabilizes that information. REM functions to consolidate various types of emotionally significant memories. REM times, for example, increase after intense learning episodes, particularly after emotional types of learning tasks.

Sleep-associated consolidation of information gathered during the wake state appears to depend on hippocampal–cortical interactions that are dependent on REM but that occur during both slow wave sleep (SWS) and REM and involve some sort of replay during REM sleep of learned associations acquired while awake (Buzsáki, 1996). That replay helps to stabilize the memories within long-term semantic memory stores. REM-rich sleep (but not three hours of early night SWS or three hours of wakefulness) facilitates memory for narratives with intensely negative emotional content. Most models of how sleep facilitates memory processes involves communication between the hippocampus, amygdala and the cerebral cortex, where long-term memories are stored and formatted for later use in cognitive processes. In these models, the hippocampus is considered a temporary repository for abstracting context from memories, the amygdala separates context from emotions and the cortex is the site where context-free memories are stored over long periods. Both the hippocampus and the amygdala (along with critical subcortical sites such as the dopaminergic “salience system” centered in the ventral striatum) act as selectors or gatekeepers or sieve for the information that ultimately gets encoded into long-term stores versus the information that gets discarded. During sleep, external input is reduced so memory consolidation processes can occur “off-line,” free of potentially interfering effects of ongoing incoming information from the external environment.

As the brain cycles between NREM SWS and REM across the night there occurs a complex interaction between activity patterns in the amygdala/hippocampus subcortically and the cortex. The communications between the hippocampus and cortex involve an interesting choreography of different brain waves. The slow waves of non-REM sleep, the sleep spindles, which originate in the circuits involving the thalamus and the cortex and the brief sharp-wave ripple events that originate in the hippocampus all appear to index key steps in the memory consolidation process. Sleep spindles index activation of the thalamus and cortex while the slow-wave oscillations index synchronizing activity in the hippocampus, so that hippocampal activity also occurs in frames synced up with the spindling activity in the thalamus and cortex. As a result, sleep spindles and sharp-wave ripple events in the hippocampus occur together. It is believed that these spindle–ripple events reflect communication of information between the hippocampus and the cortex. In short, during non-REM and REM sleep cycles there is a dialogue between the hippocampus and the cortex that is coordinated by slow waves, sleep spindles and sharp-wave ripples.

While information appears to flow from hippocampus to cortex during NREM SWS and is indexed by sleep spindles and sharp-wave ripple activity, theta rhythms are thought to support transfer of information in the opposite direction during REM sleep. Theta waves enhance hippocampal long-term potentiation, a candidate mechanism for memory formation. Interestingly, this synchronization with theta wave activity during REM sleep appears to shift from in-phase (i.e., correlating with the peak activity of the theta wave) to out-of-phase (correlated with the troughs of inactivity) over four to seven days of daily exposure to a new learning environment. This suggests that there is a certain amount of time required for hippocampally dependent memories to be transferred to the neocortex for long-term storage and social learning to stabilize.

As discussed previously, REM is associated with vivid dreaming and with creativity. REM's neurochemical environment of low aminergic activity and high cholinergic activity levels in the context of down-regulated prefrontal and up regulated limbic system activity levels all conduce to intense stimulation of hyperconnectivity or disparate ideas and images. There are many anecdotal reports of artists deriving creative inspiration from dreams. The entire surrealist movement in the visual arts of the early and mid-twentieth century took their creative cues from dreams. Semantic priming techniques have revealed that we are faster in accessing disparate associations after a bout of REM sleep than we are in accessing strong associations. That is the opposite of the normal case: we normally access strongly associated semantic items automatically during waking consciousness. Something about REM enhances our abilities to access more distant semantic associations to a given stimulus. That enhanced ability to cognitively reach for the more distant association is fundamental to thinking outside the box and arriving at novel insights. Indeed, it seems clear now that after a good night's dream-rich sleep we have improved "insight" – the ability to suddenly "see" the solution to a difficult problem that eluded us before we engaged in the sleep (Walker et al., 2002). In summary, the available data suggests REM sleep and dreams are fundamental to the mind's creative abilities and thus to cumulative cultural evolution.

Recent advances in neuroplasticity research has demonstrated that one of the areas of the brain that can generate new neurons even in the adult state (neurogenesis) is the hippocampus. The hippocampus is constantly in play during REM. REM sleep deprivation can impede neurogenesis in the hippocampus (Mueller et al., 2015). REM sleep activity promotes neurogenesis and neuroplasticity. In early life it promotes brain development

by facilitating release of a kinase critical for neuronal plasticity, so-called extracellular signal-regulated kinase (ERK). Kinase phosphorylation in the primary visual area of the cortex, area V₁, requires REM sleep, because it will not occur in sleep-deprived animals. REM-induced ERK phosphorylation is essential for plasticity changes in the visual region of the brain. REM sleep deprivation after monocular deprivation (suturing one eye shut) profoundly and selectively inhibited ERK phosphorylation in V₁ in kittens. Preventing REM sleep after monocular deprivation reduced ocular dominance plasticity (normal visual development) and inhibited activation of ERK, the kinase critical for this plasticity.

Formation of new neuronal circuits in the brain is accomplished by experience-dependent selective pruning and elimination of an initial exuberant overgrowth of synapses during development. REM deprivation prevents selective pruning and elimination of neuronal synapses. Li et al. (2017) have shown that REM sleep promotes pruning of newly formed postsynaptic dendritic spines of layer 5 pyramidal neurons in the mouse motor cortex during development and motor learning. Dendritic calcium spikes arising during REM sleep are important for this pruning and strengthening new spines. (Li et al., 2017). Cumulative cultural evolution works more easily with some degree of behavioral plasticity; that is, the use of existing circuits to develop new capacities or the generation of new circuits to support new cognitive-behavioral capacities.

REM dreams, furthermore, support social imitative social interactions by simulating significant social interactions. Hundreds of controlled studies on the content of dreams has demonstrated that they are essentially simulations of social interactions between persons familiar and unfamiliar to the dreamer. The stuff learned in daily social interactions is rehearsed and practiced during REM sleep simulations and some of this simulation activity is reflected in dream content. For example, the learning of a second language or a musical instrument or various psychomotor tasks is facilitated by simulations of the activity during dreams. The typical REM dream contains between two and three characters in addition to the dreamer. These familiars are people like family members and emotionally significant friends and acquaintances to whom some special value is attached (e.g., a teacher). The people we learn from in daily life appear in these dreams, and thus the things we learn from them are replayed in these dreams. This replay improves learning obtained from these social interactions.

In addition, about 50 percent of characters in dreams are strangers to the dreamer. These unfamiliar or undefined character lines in dreams turn

out to be one of the sources of great creativity. They are often used by the dream narrative to innovate new activities or characters important to the dreamer. In addition, it is at least partially out of these strangers that the supernatural agents who populate many dreams emerge.

In summary, REM neurobiology is certainly not the only brain basis of cumulative cultural evolution. It may not even be the most important brain support for cumulative cultural evolution. But the evidence presented here, including REM's facilitation of social learning processes, creativity and visionary states, suggests that it is a significant contributor to cumulative cultural evolution. Most importantly for this book, it is surely likely that REM neurobiology contributes to visionary forms of religiosity such as shamanism and mystical experiences. These are the forms of religiosity that will be emphasized here, as they powerfully predict, support and promote individual and social transformation and, age after age, have generated new forms of religiosity.

The Evolution of Visionary Mystical Religion and Shamanism

Whether or not the enhancement of REM sleep processes among AMH populations that I claimed occurred in the Upper Paleolithic was the basis for the birth of shamanistic religion in the Upper Paleolithic, REM certainly was and is a crucial element in visionary forms of religious experience. I now suggest that it is a crucial part of the brain basis for shamanistic and mystical forms of religious experience. Since these types of religious experiences are crucial to the topic of this book, I discuss shamanistic forms of religious experience more fully here. After discussing shamanism's evolutionary and cultural history I will discuss its formal and experiential elements and then its brain correlates. We will find that those brain correlates repeatedly turn up in mystical forms of religious experience in the modern period.

Shamanism

Peoples et al. (2016) investigated the evolutionary emergence of shamanism by reconstructing ancestral states for seven religious ideas/practices (called characters in the analysis) describing religious beliefs and behaviors in a global sample of thirty-three hunter-gatherer societies. Using a time-calibrated supertree based on published genetic and linguistic phylogenetic trees associated with the languages of these hunter gatherer societies, they reconstructed the temporal emergence of ancestral character

states and tested for correlated evolution between the characters and for the direction of cultural change. The key character states were animism, belief in an afterlife, shamanism and ancestor worship. Animism refers to the belief that most or all things in a life-world were/are alive or had minds. Supernatural agents appear first as a part of animism and they are conceived as inhabiting all of nature. Belief in an afterlife is defined as belief in survival beyond death. The authors defined shamanism as the presence in a society of a “shaman,” a ritual specialist, healer and problem-solver who used spirit helpers during performances involving altered states of consciousness to benefit individuals and the group as a whole. Ancestor worship is defined as belief that the spirits of dead kin remain active in another realm and if ritually invoked or propitiated may influence the living. The emergence of “High gods” was also analyzed by the authors: they were coded as all-powerful creator deities who may be interested in human affairs and generally are interested in human morality. After performing their phylogenetic analyses the authors found that animism with supernatural agents was the earliest and most basic trait of religion. It was universally present in all societies studied. Belief in an afterlife came next, and may have generated a sense of “being watched” by the spirits of the dead. Shamanism then evolved in the presence of belief in a realm of spirits of the dead. If belief in an afterlife is lost, shamanism is also likely to be lost. As humans migrated out of Africa more than 60,000 years ago, the shaman’s curing skills and ability to access altered states of consciousness would have yielded individual and group benefits in the challenging environments of Upper Paleolithic Europe.

Given that shamanism appears to have been the “religion” most often practiced by our hunter-gatherer ancestors, it was also very likely the generative cultural matrix out of which modern religious traditions emerged. It certainly is the root source of mystical forms of religious experience which is a key focus of this work. What, then, is (and was) Shamanism?

In an intensive study of archaeological artifacts associated with the prehistoric religion of the Ohio Hopewell culture, Romain (2009) provides the following definition of shamanism: “a complex of beliefs and practice based in the notion that spirits pervade the cosmos and that these spirits can be contacted for specific purposes, through altered states of consciousness” (Romain, 2009, p. 7). The Hopewell culture refers to a broad interconnected network of native American culture groups who flourished between 200 BC and 500 AD in what is now southern Ohio. They built large earthwork burial mounds in this region that contained a wealth of artifacts which allow archaeologists to recover much of the culture and

lifeways of these ancient hunter gatherers and horticulturists. Romain provides the following summary of the shamanistic worldview as manifested within the Hopewell culture:

1. The shamanic universe is holistic and dualistic. All things are interconnected and part of a greater reality...
2. The shamanic universe is multi-layered ... including ... an upperworld, this world and lowerworld...
3. the layers or realms of the shamanic universe are connected by a central axis or axis mundi that extends vertically.... As the axis mundi serves to connect the cosmic realms, it is often used by the shaman to soul travel to these other worlds. The axis mundi can be symbolized by a tree, a column of smoke, a ladder, a ray of sunlight, a rainbow, or in many other ways.
4. The shamanic universe also extends on the horizontal plane. Often this plane is divided into four basic directions...
5. The center of the shamanic universe is located on the axis mundi at the intersection of the cardinal directions, or world quarters.
6. Time in the shamanic universe is oriented to periodic events that include solar and lunar cycles, seasons and life cycles.
7. The shamanic universe has hidden dimensions or realms not normally visible or accessible.
8. The shamanic universe is animistic.... In some sense all things are alive, including humans, animals, plants, rocks, rivers, mountains, tools, weapons, pottery vessels, figurines and so on.
9. The shamanic universe is one of metamorphosis and transformation ... people, animals and spirits can assume each other's forms ... shamans are often believed to have the ability to change their form, often assuming the shape of an animal.
10. The shamanic worldview is concerned with the relationship between predators and prey ... between humans and the plants and animals we eat ... the concept of reciprocity and the idea that plants and animals have spirit masters ... plants and animals willingly give up their lives so that humans can eat their flesh...
11. In the shamanic worldview it is possible for humans to experientially engage and interact with the spirit world and spirit entities. Engagement occurs through altered states of consciousness ... dreaming can be considered an altered state ... two forms of shamanic altered states of consciousness: soul flight and embodiment trances. During soul flight trance the shaman's soul or spirit travels

to the otherworld. In embodiment trance an outside spirit is allowed to temporarily reside in the person of the shaman. (Romain, 2009, pp. 20–23)

Please note Romain provides a detailed analysis of hundreds of material artifacts unearthed from the mounds at Hopewell to substantiate these principles concerning Hopewell Shamanism. Among these artifacts are engraved stone and bone tubes used for sucking evil spirits or objects out of ill persons or to blow liquids, powders and smoke during ritual ceremonies. An array of divination paraphernalia was uncovered at Hopewell and used by the Hopewell shamans including deer astragali, engraved stone marbles, quartz crystals, mica mirrors, engraved elk antlers, bear teeth and claws, and worked copper plates containing designs depicting the shamanic multilayered cosmos. In addition, Romain discusses multiple artifacts from Hopewell that shamans used in their curing ceremonies such as rattles, tinklers, bells, whistles, panpipes and drums. All kinds of figurines were uncovered, typically depicting spirit animals (bears, deer, raptors, wolves, panthers) rather than animals actually hunted by the Hopewell people. The Hopewell shamans left us all kinds of stone carved pipes that were used in myriad ritual ceremonies. Many of these were so-called effigy pipes containing representations of spirit animals the shaman identified with and transformed into during special rituals. Tobacco and tobacco smoke was offered as a sacrifice or gift to spirit animals in exchange for favors or knowledge. It was also used as a purifying fumigant in the presence of an ill person and as a daily offering to the spirits of the four directions. The Hopewell shamans used a potent form of tobacco called *Nicotiana rustica*. The nicotine in this plant could be some eighteen times stronger than that found in cigarettes. There is also some evidence that the Hopewell shamans used *Amanita muscaria* mushrooms to attain altered states of consciousness. It was and is a common variety of mushroom in the Hopewell Ohio region. Romain (2009, pp. 182–183) discusses a unique object found in mound 7 at mound City. The object is known as the mushroom effigy wand. “Carved out of wood and covered with thin copper, the object is about 13 ½ inches in length. The effigy wand had been placed on a large sheet of mica and covered with cremated remains.” The shape of the cap on the top of the wand, the presence of an annulus on the stem and the copper coloring make Romain and several other experts confident that the wand was depicting the mushroom *muscaria*. This mushroom had negligible nutritional value, indeed was poisonous under most conditions, but it was a potent

hallucinogen – and therefore collected as part of the shaman's armamentarium to attain altered states of consciousness.

In summary, "shamanism" is that word we use to refer to a very ancient form of culturally sanctioned interactions with supernatural agents when in visionary or altered states of consciousness so as to propitiate or to attain various forms of knowledge and favors from these spirit entities. The work reviewed here is merely one documentary source of the shamanistic worldview as reconstructed from the material artifacts left behind at Hopewell. It may be a root source of many or most of the world's visionary religious traditions and of mystical religious experiences.

The Case of Schizophrenia

I have argued here that one factor that supported the rise of behavioral modernity among AMH populations of the European Upper Paleolithic was the heightened role that REM sleep began to play within AMH neurologies when they interacted with Neanderthal peoples and acquired from them genetic profiles that relaxed neural controls over REM sleep neurobiology. Thus, access to the visionary states produced by REM sleep suddenly became easier for these people, and the power and appeal of altered states of consciousness intruded into their waking realities. This new power they experienced with REM sleep and dreams and the relaxation of boundaries between waking consciousness and REM helped to reinvigorate the shamanic traditions they were familiar with, and the new flowering of shamanism helped to give birth to behavioral modernity – or at least a new religious consciousness among AMH populations.

Several authors have made similar arguments regarding the co-occurrence of the birth of behavioral modernity and shamanism, but in support of that claim they invoke the case of schizophrenia. So let's take a step back and look at the place of schizophrenia in the story of the evolution of the human brain and of religion.

Schizophrenia is a neurodevelopmental psychiatric disorder that typically emerges in late adolescence or early adulthood. We are most interested in the positive symptoms of schizophrenia which include delusions, hallucinations, and thought disorder and word salad dysphasia. The most common hallucinations involve hearing voices that are sometimes religious and persecutory. Delusions also often contain religious content. It is unclear if schizophrenics are more religious than others, as surveys return dramatically differing results depending on a host of disease-related factors. But there is no question that many of the delusions reported by

schizophrenics involve religious themes. Commonly these involve persecution (by the devil, demonic entities, etc.), or grandiose themes (“I am Jesus,” etc.). In addition to religious delusions, distortions of self-experience are also common. Patients often report that they do not know where they begin and end or that other persons can read their minds or that they can read another person’s mind. They often claim that someone else controls their thoughts and actions. When delusions turn grandiose, patients report that all kinds of events are imbued with special significance and are related to them in a special way.

How to explain such delusional beliefs? The standard cognitive explanation is that the patient’s reduced sense of self (which is related to negative symptoms of schizophrenia such as VMPFC dysfunction, poverty of thought and language, avolition, a-motivation, etc.) and agency leads to unawareness of intended actions. Since the patient does not know that they just intended/initiated a thought or action, they seek an explanation for that thought and action, and then go on to confabulate such an explanation. In short, internally generated voices are not ascribed to self because the self is impaired, and they are therefore ascribed to external voices.

This fundamental problem of schizophrenia – the disappearance of the sense of self – also leads to problems with “mentalizing” or properly ascribing mental content to self and others. As mentioned earlier, because patients with schizophrenia lack a robust sense of self they overascribe mental content to others. They have therefore been characterized as exhibiting a hypermentalizing tendency when they overattribute mind and agency to objects and the people they interact with.

Crespi and Badcock (2008) placed the apparent hypermentalizing behaviors of schizophrenics on a continuum of mentalizing disorders with autism at one end (hypomentalizing) and schizotypal thought/schizophrenics at the other end (hypermentalizing). They marshalled an array of evidence that suggested that this continuum of mentalizing disorders was due to altered development and function of the social brain. Since the social brain is traditionally thought to include neural networks that are also associated with supporting a sense of self, it makes sense that a fundamental neural deficit associated with schizophrenia would involve the multiple sites and networks of the social brain.

Now interestingly some forms of schizophrenia are also associated with high levels of creativity. The vast majority of schizophrenics cannot overcome the burden of the massive cognitive deficits associated with the disease. But when the disease is in a kind of remission some schizophrenics evidence high levels of creativity. Some family relatives of schizophrenics

also evidence high levels of creativity, specifically when they evidence schizotypal cognition. Schizotypic traits consist of tendencies to have abnormal perceptual or cognitive experiences. Often these family members with schizotypal traits have an intense interest in religion.

These enhanced levels of creativity in family members of schizophrenia patients has been used to explain the persistence of schizophrenia in the population. Given the disease burden there are very low fertility rates associated with the disease. Thus, natural selection should have eliminated the disease long ago. It may persist because it is associated with overproduction of schizotypal traits in relatives of patients, and these relatives are highly creative individuals (e.g. Horrobin date). Crow proposed schizophrenia as the price we paid for evolution of language (Crow, 1997). Crow (2002) argued that the evolutionary acquisition of language created a cerebral torque such that:

The anatomical disposition of the torque along the anteroposterior axis allows the motor and sensory engrams in Broca's and Wernicke's area respectively to interact with differing polarities with the corresponding areas of heteromodal association cortex in the nondominant hemisphere. Thus language is conceived as a bihemispheric phenomenon with a deictic focus in Broca's area and its relationship on the one hand to the internal word of thoughts in the right dorsolateral prefrontal cortex and on the other hand to the external world of perceived speech in Wernicke's area. In this way can be conceptualised the critical role of the self in the origin of language and the phenomena of psychosis. (Crow, 2002, p. 21)

Julian Jaynes (1978) likened the auditory hallucinations of some schizophrenics to the voices of the gods among ancient peoples – especially those with thin boundaries between mental states like those with schizotypal personality traits. Before the era of behavioral modernity, the human brain was organized in a bicameral fashion with the right hemisphere issuing commands to the left hemisphere, and these commands were experienced as voices of leaders and gods. Schizophrenic auditory hallucinations are then essentially a relic of the ancient bicameral mind. Stevens and Price (2015) assigned schizophrenics a visionary leadership role in expanding small-scale ancestral communities. Polimeni and Reiss (2003) placed schizophrenics as the original shamans and creators of the root religion shamanism.

But as ingenious as all these explanations of schizophrenia are, are they correct? On the question of why natural selection has not eliminated schizophrenia, some progress has been made. It appears that the latest genetic analyses suggests that genes associated with schizophrenia are slowly being eliminated from the population (Pardiñas et al., 2018). There may therefore

be no evolutionary paradox associated with schizophrenia because natural selection is slowly eliminating schizophrenic genes from the population. On the other hand we still have these interesting associations between brain evolution, creativity and religiousness seen in schizophrenia and schizotypal cognition that need to be explained. How to do so?

We have seen that one potential explanation has to do with evolution of the social brain. At the center of social cognition is the mentalizing capacity or “theory of mind” capacity. Development of the networks that compose the social brain can sometimes become aberrant (due to myriad accidents like perinatal infection or injury). These aberrant networks can increase connectivity in some regions and decrease connectivity in others. The pattern of aberrant connectivity that leads to schizophrenia yields enhanced mentalizing abilities but loss of function in other domains of social cognition. Schizophrenics tend to hypermentalize (due ultimately to a reduced sense of self). When you hypermentalize you see mind and agency everywhere, and thus schizophrenics are more prone to seeing supernatural agents everywhere and thus to religious delusions.

While this hypermentalizing capacity may provide an adequate explanation for things like religious delusions in schizophrenia it does not appear to account for the creativity sometimes associated with schizophrenia or in relatives of schizophrenia. Where does this creativity come from?

I suggest that it may come from the reduced boundaries between brain states (waking, REM, NREM) associated with the change in REM sleep intensities among the AMH populations already described. Indeed many of the symptoms associated with schizophrenia may in fact be attributed to significant dysfunction in sleep neurobiology in these patients. Significant disruptions in REM neurobiology during childhood significantly predict psychosis later in life and significantly predict risk for schizophrenia. In particular, significant periods of insomnia and/or frequent nightmares significantly increase risk for schizophrenia. For example, in a sample of 4,720 young people, nightmares at age twelve predicted psychotic-like experiences (PLE) at age eighteen (OR = 1.62, 95 percent CI 1.19–2.20) (Thompson et al., 2015). I am not arguing that REM dysfunction causes schizophrenia. But I am arguing that REM dysfunction significantly contributes to visual and auditory hallucinations and more specifically to delusional beliefs including religious delusions.

In Chapter 5 we will discuss the neurology and psychology of religious experiences.

*Neurology of Religious Experiences***Introduction**

In the ten years since the first edition of this book, there have been several advances in charting the ways in which the brain mediates religious experiences. As already discussed, one of those salutary advances in neuroscience that has significant relevance for the project of developing neurology of religious experience is the widespread adoption of the so-called predictive processing framework (PPF) to understand brain function. We will need to go into a little bit more detail on PPF to understand its benefits for the study of the neurologic correlates of religious experience.

As mentioned previously, PPF treats the brain as a prediction machine that uses principles of Bayesian inference to optimize its predictive models of the world. The basic premise is simple: The brain is not merely passively receiving sensory impulses from the world that are then faithfully reproduced and reflected in the mind. Instead, it is actively sampling sensory information and comparing it against its expectations, predictions or models of how the world will be. These models are constantly being built up, proposed, constructed and revised on the fly. They are continuously updated when expected data do not match with actual data. These mismatch signals between expected sensory information and actually obtained sensory information create error signals that are then used by the brain to adjust its models. The brain is not looking for sensory information per se; instead, it preferentially processes sensory information that can deliver the most valuable information relevant to current predictive models; that is, information that can disconfirm current predictive models. That kind of information is sometimes called “surprise” and is derived from these error signals, and utilizes them to update models and in order to minimize prediction error in the future (Clark, 2015; Friston et al., 2017).

PPF’s predictive simulations are theorized to occur at every level of the neuraxis from primary motor levels right up to the most cognitively

abstract levels subserved by most recently evolved areas of the prefrontal lobes. One possibility is that error signals that propagate up the neuraxis from distal sensory receptors to the prefrontal cortex are registered mostly via glutamatergic alpha-amino-3-hydroxy-5-methyl-4-isoxazole propionic acid receptors, while predictive signals may be sent downwards from higher hierarchical levels predominantly via glutamatergic N-methyl-D-aspartate receptor signaling. Glutamatergic signaling systems, in turn, are known to be modulated by dopaminergic cholinergic systems depending on the particular inferential hierarchy.

The mismatch error/surprise signal likely also triggers an orientating reaction to upregulate information gathering and processing relevant to the surprising event, and then an emotional change ensues in order to motivate corrective action and the updating of predictive internal models.

The link between error signals and motivational states raises the important issue of how emotion fits into the PPF. A long-standing tradition in psychology holds that emotions result from bodily reactions to external events, which was later updated by Damasio as the “somatic marker hypothesis” (Damasio, 1991). The neural networks that preferentially process incoming and internal (autonomic) bodily signals appeared to be centered on the insula with a viscerosensory (afferent) component in the posterior insula (for interoception processing) and a visceromotor (efferent) component in the anterior-ventral insula. The insula integrates the interoception of bodily states in the posterior insula progressively with cognitive and motivational information in the anterior insula. The PPF brain predicts not just expected sensory states; it also predicts emotional states and thus it is also continually comparing current emotions against expected emotions. As discussed previously, the anterior insula in fact has been suggested to play a central role in PPF models of emotion and motivational states by acting as the comparator/integration site of the predicted emotions versus the actual emotional states. In fact, the anterior insula activates in the anticipation of aversive events and encodes probabilistic risk predictions and prediction errors associated with gambling tasks.

With respect to approach learning or the anticipation of rewards (predicting awards, etc.) midbrain dopaminergic signaling appears to be crucial. When predictions or models are confirmed by sensory input, dopaminergic signaling is either unchanged or slightly downregulated. But if expectations are violated (there is a mismatch between predicted model and sensory feedback) then dopaminergic signaling is upregulated, thus activating glutamatergic signaling in the neural hierarchy facilitating the processing of the error signal as novel and therefore valuable information.

Novel signals are registered in the dopaminergic reward system, thus reinforcing learning and model updating.

The PPF has already been introduced into the emerging field of the neuroscience of religion (Andersen, 2019; Schjoedt, 2009; Van Elk & Aleman, 2017). For example, Schjoedt et al. interpret neuroimaging findings on intercessory prayer as evidence that religion decreases believers' ability to monitor for error, or perhaps increases their credulity. In short, religion operates on "priors" in such a way as to bias the model updating process. After prayer, the error monitoring systems are repurposed to elicit experiences that correspond with theologically correct religious teachings. In their review of the neuroscience of religion literature in 2016, Van Elk and Aleman (2017) used existing data at that time and the PPF to map out what each of several regional brain networks likely contributes to the overall religious experience as understood within the PPF: The default mode network (DMN) likely mediated self-transcendent experiences, the components of the so-called social brain network mediated conceptualizations of supernatural agent cognitions, the temporal cortex was associated with mystical and ecstatic experiences, and the anterior cingulate cortex and the medial prefrontal cortex were involved in error monitoring and reflective processing on religious and supernatural beliefs.

Like all theoretical frameworks in science, the PPF brings with it both benefits and challenges. The challenges with respect to understanding brain mediation of religious experience, however, are severe. Among the most prominent of these is how we might understand religious experience in a framework where the brain is theorized to preferentially look for and process error signals, and the purpose of cognition is the building up of and adjustment of predictive simulations of expected worlds. On the face of it, religion is about supernatural realms or counterfactual worlds. What are the sensory effects or consequences that are used to create error signals that can be used to update belief systems? What also might be the connection between the drive to minimize prediction error and the intensity of religious beliefs and experiences? In addition, as recent evaluations of the PPF have made clear, PPF can be quite difficult to falsify (Kogo & Trengove, 2015). If a function, property or dysfunction cannot be understood as a defect of priors or existing models, then it can be understood as a defect of posteriors, sampling error or the error signal itself. Anything and everything can be explained as an imbalance between priors and mismatch error signaling. In many instances, both defects will apply and thus the theory is capable of producing apparently contradictory predictions. Finally and perhaps most importantly for an understanding of religion, the brain is not

merely a prediction machine. It is also a moralizing and desiring machine. It considers what it desires and what “ought” to occur. How does it operate to fulfill wishes, appetites and desires if it only computes expectancies? PPF undoubtedly has some potentially excellent answers to that question, but there has not been enough work around how the brain/mind expects, models, simulates, fantasizes and plans around desires. When it comes to human beings, we should expect evidence of motivated belief, desire and goal-directed states and emotional extremes – not merely expectancies. Nevertheless, motivated belief certainly is not an insuperable obstacle to PPF. Within each domain of human experience, we can assume that the human brain/mind is looking to find the most informative data possible, and that kind of data invariably involves information that can falsify PPF-type schemas or models at the highest level of the neural hierarchy.

When we examine the available data on brain mediation of religious experience we will proceed descriptively. We are simply interested in presenting existing facts concerning brain mediation of religious experience. I will attempt wherever possible to interpret the data with reference to PPF as science builds by reference to theory, but it will soon become clear that most existing studies on religion and brain did not reference this framework. Indeed, most studies did not refer to or operate within any existing discernible theoretical framework. That is unfortunate, but just reminds us of the scientific immaturity of the field. But some religion and brain data do exist, however inadequate, and the student of religion must begin somewhere to build a science of religion.

Initial Studies on Brain and Religion

Neurologic studies of religious experiences began in earnest just over 100 years ago when William James delivered his Gifford lectures. These lectures were published as “The varieties of religious experience” (1908/1958). James’ first lecture was entitled “Religion and Neurology,” in which he pointed out that if specific brain regions were found to participate in religious expression it would not mean that religion was nothing but a misfiring of neurons in that brain region. Similarly, if religious expression was more common among individuals with mental disorders it would not imply that religion was due to mental disorders. Instead, we can partially infer normal operations of the religious brain/mind by carefully documenting the ways in which the system breaks down. Breakdown patterns, it turns out, are not random and that allows us to use the information we have on the rule-governed process of breakdown to reconstruct the minimal cognitive

architecture that must have been obtained in the healthy state to give us the breakdown pattern we now observe.

While William James attempted a reconstruction of the cognitive operations of the healthy and unhealthy religious mind, he was never able to develop neurology of religious experience, as neurology itself was just emerging as science when James worked. Too little was known at the time to develop a real science of religion. Since James' pioneering studies other psychologists, anthropologists and sociologists have attempted to understand various facets of religious phenomena, but James' accent on neurology was largely dropped until the 1970s.

What revived neurologic studies of religious experience in the 1970s were reports of intense religious experiences in epileptics with seizure foci in the temporal lobes. Although links between epilepsy and religiousness had been noted for centuries, systematic observations of religiousness in epilepsy did not begin to appear until the nineteenth century, but these reports were not followed up by other investigators. Only sporadic reports appeared on the neurology of religious experiences between James' observations and the modern period, so no systematic growth in the field occurred until the 1970s.

In the 1960s and 1970s, a flurry of new reports (Bear & Fedio, 1977; Dewhurst & Beard, 1970; Geschwind, 1979; Waxman & Geschwind, 1975) reignited interest in brain–religion relationships. Slater and Beard (1963) reported religious delusions and unusual experiences in about a third of sixty-nine epileptic patients. Dewhurst and Beard (1970) reported that some patients with temporal lobe epilepsy (TLE –epilepsy where the seizure focus is in the temporal lobes, a region of the brain that is associated with memory, emotion and aspects of language) were prone to intense religious conversions (see also Waxman & Geschwind, 1975). Other patients described profound experiences of being chosen by God for a special mission and so on. Still, others filled notebooks with reams of material on religious and philosophic themes, often in the minuscule handwritten script (hypergraphia). In cases where pathology could be documented, the hyperreligiosity or religious delusions and conversions were associated with right-sided hippocampal atrophy or sclerotic changes.

TLE and Hyperreligiosity

Murai et al. (1998) described the interesting case of Kumagusu Minakata (1867–1941), a Japanese genius devoted to natural history and folklore. He kept meticulous diaries and unusually his postmortem brain was preserved

for scientific study. In the 1990s both his extensive diaries and his brain were studied revealing extensive evidence for lifelong temporal lobe epilepsy. In his diaries, there were detailed accounts of seizures, auras, déjà vu experiences, premonitions and headaches. His diaries and other written works also contained reams of material on spiritual, religious and mystical themes. He specialized in the study of slime molds, fungi and mushrooms, discovering several new species and reflecting on the difficulties of classifying these entities as plants, animals or some other form of being that exhibited extraordinary forms of intelligence. His religious and spiritual writings are studied intensively today, especially his long letter detailing his spiritual views that he wrote to a Buddhist monk in 1903. The “letter” filled a roll of paper more than 10 meters long by the time it was finished. The Buddhist doctrine of *pratitya-samutpada* – known as *engi* in Japanese – refers to the well-known doctrine of codependent origination wherein everything is implicated in and dependent upon everything else. If that is true, then simple cause-and-effect conceptions of science and reality could not work. Minakata used higher-order logic, and extraordinarily dense arguments, pictograms and drawings including the “Minakata mandala,” to make the case for a new spirituality and science. He exhibited extraordinary productivity publishing on a variety of subjects: 50 articles in *Nature*, 324 articles in *Notes and Queries* and 1,142 Japanese articles. He was fluent in many languages and had a working knowledge of many others including Latin, Greek, Arabic, Persian and classical Chinese. Murai et al. (1998) performed a volumetric analysis of his brain and found evidence of significant right hippocampal atrophy. They also noted, after studying his diaries, that he evidenced many features of the Geschwind syndrome. He evidenced hypergraphia involving the tremendous number of articles he wrote and his tendency to write minuscule letters page after page. Indeed, he copied out dozens of books by hand. Although he had two children, he apparently tended toward asexuality and developed complex metaphysical views on sexuality. He was also known to have a volatile personality and could become irritable and violent at times. And finally, as already noted, he had an extraordinary interest in religious matters. Now, of course, no one will or should claim that his extraordinary genius was due to atrophy of the right hippocampus. The point here is to note that atrophy of the right hippocampus is associated with *increased*, not decreased cognitive function. In addition, as Geschwind pointed out, it is interesting that there are several documented cases in the neurologic literature where right-sided hippocampal dysfunction is associated with increased religiosity and metaphysical interests.

Persinger (1983; 1987) hypothesized that forms of religiosity could be evoked by transient, electrical microseizures within deep structures of the temporal lobe. Norman Geschwind also called attention to the links between temporal lobe seizure activity and religiosity. Nevertheless, rates of heightened religiosity among TLE patients may not exceed 5 percent (Devinsky & Lai, 2008). Ogata & Miyakawa (1998) interviewed 234 Japanese patients with various forms of epilepsy, including 137 patients with TLE. Only three patients, all with TLE, reported significant religious interests.

Some authors have argued that the heightened religiosity found in the few TLE patients who report it does not stem so much from the anatomy of TLE as it does from the psychiatric effects of TLE. Tucker et al. (1987) evaluated seventy-six patients with TLE of unilateral onset for signs of heightened religiosity. They carefully screened out any patients with significant psychiatric histories. They compared TLE patients with a left-sided focus to TLE patients with right-sided focus and two other control groups consisting of patients with primary generalized seizures and patients with nonepileptic seizures. Tucker et al. (1987) found no significant group differences in religiosity between the left versus the right TLE groups, nor between patients with TLE and either control group. They argued that the reason why religiosity was not elevated in their TLE population was that none had significant psychiatric histories relative to the control groups.

To some extent, Tucker et al.'s results could have been due to the assessment instruments they were using. Roberts and Guberman (1989) developed an exhaustive inventory/checklist of religious and spiritual experiences and then asked fifty-seven TLE patients to indicate if they had ever experienced any of the events on the list. They found that 51 percent indicated that they had experienced a significant past spiritual event such as an intense religious conversion.

Trimble and Freeman (2006) looked at the clinical correlates of TLE patients with and without self-reported high interest in religion (these patients also scored higher than the other TLE group on three measures of religiosity) and compared these epileptic patients with a control group of regular churchgoers. They found that the hyperreligious TLE patients more frequently had bilateral seizure foci than unilateral (right or left) foci and more frequently reported episodes of postictal psychoses. Compared with the healthy churchgoer group, hyperreligious TLE patients more often reported actual experiences of some great spiritual figure or supernatural being – either an evil presence or a benign spiritual presence.

Lin et al. (2009) found that a rare TLE-related automatism that involved making the sign of the cross was associated with right temporal lobe seizure activity and atrophy of the right hippocampus. Dolgoff-Kaspar et al. (2011) found that twelve epileptic patients who often experienced spiritual and religious auras also reported greater paranormal experiences. Tedrus et al. (2015) administered the Duke Religion Index to 159 adult patients with epilepsy and 50 controls. While religiosity was higher in epileptics, being female and having mesial temporal lobe epilepsy with hippocampus sclerosis were the only predictors of high religiosity.

These survey studies as well as the earlier mentioned clinical cases of heightened religiosity in TLE raise the issue of just how seizure activity in the temporal lobe could give rise to religious experience. It appears that right-sided hippocampal atrophy or seizure activity is more predictive of hyperreligiosity than left-sided hippocampal atrophy. While bitemporal atrophy or bilateral hippocampal atrophy does predict some forms of religiosity, left-sided atrophy is less consistently associated with hyperreligiosity. Thus, the data suggest more consistent associations between hyperreligiosity and right-sided hippocampal atrophy and seizure activity.

Geschwind (1979) suggested that heightened interest in religious matters in TLE often occurred in association with hypergraphia (a tendency to highly detailed writing often of a religious or philosophical nature), hyposexuality (diminished sex drive) and emotional irritability of varying degrees. Gastaut (1954) pointed out that the major interictal behavioral symptoms of TLE, including (1) emotional intensity, (2) viscosity (excessive attention to detail and perseveration) and (3) hyposexuality, are the exact opposite of the behavioral manifestations of Kluver–Bucy syndrome, which involves bilateral removal of the temporal lobes. The classical symptoms of Kluver–Bucy syndrome are placidity (lack of aggression), fluctuating attention and hypersexuality. In TLE, overexcitation or hyperconnectivity between limbic and temporal sites leads to TLE behaviors where everything but sex is significant and requires attention. In many TLE patients, aggressive outbursts are not uncommon. How can we explain these opposite behavioral profiles?

One possibility is that in Kluver–Bucy syndrome prefrontal and whatever remaining temporal sites there are after resection are underactive, while limbic-related sexual drives are disinhibited and behavior is controlled by the posterior parietal cortex (thus the fluctuating attention). Conversely, in TLE prefrontal and temporal sites are released from inhibition while limbic sites are inhibited. But this scenario would not explain the emotional flatness in Kluver–Bucy and emotional intensity in TLE. If

the amygdala is the key site for aggression then it should be overactivated in TLE and underactivated in Kluver–Bucy. To the extent that the temporal lobe resection impacts the amygdala, it is not surprising to see placidity as part of the syndrome. In TLE, the amygdala is overstimulated, while in Kluver–Bucy it is absent or underactivated. Sexual drive depends on hypothalamic sites which are regulated in turn by the amygdala. Without any top-down influence from the amygdala onto hypothalamic sites you get hypersexuality. With the overstimulation of the amygdala you get the inhibition of hypothalamic sites and hyposexuality.

If we assume that the seizure activity runs throughout the amygdala and adjacent limbic regions, then a hyperstimulated amygdala would inhibit the hypothalamic functions associated with sexuality, thus accounting for hyposexuality in TLE-associated hyperreligiosity. But what accounts for the hyperreligiosity?

Bear and Fedio (1977) argued that heightened religiosity in some people with TLE was due to a greater number or density of connections between cortical sites handling the senses and the limbic system, including the amygdala, so that patients with TLE experienced a greater number of sensory events as “significant” relative to a healthy person with fewer such connections. Ramachandran and Blakeslee (1998) later assessed this theory by measuring subconscious reactions to religious, sexual and violent imagery via skin conductance responses (SCR) in temporal lobe epileptics with religious preoccupations, normal “very religious” people and normal “non-religious” people. For temporal lobe epileptics, SCRs were enhanced for religious words and images to about the level found in the religious controls. This result is consistent with Bear and Fedio’s model of hyperconnectivity.

Assuming the hyperconnectivity model is operative in hyperreligious TLE patients, how does hyperconnectivity result from seizure activity? An epileptic seizure results when an abnormal and excessive synchronization of firing of brain neurons spreads across brain regions. The most common part of the brain giving rise to TLE-related complex partial seizures is the mesial (inner) aspect of the temporal lobe, including structures deep to the temporal lobe and housed in the limbic lobe, the amygdala and the hippocampus. Hypersynchronized and discharging neurons in the amygdala would have the effect of chronically overstimulating the structure. Connections from the amygdala to the cortex would be excitatory, while impulses from the amygdala to the hypothalamus would be inhibitory. Increasing impulses from the amygdala to the cortex would then be interpreted at the cortical level as greater numbers and frequencies of significant

emotional events, while impulses from the amygdala to the hypothalamus would result in prolonged inhibitory pressure on the hypothalamus.

In their review of religious and spiritual experiences in epilepsy, Devinsky and Lai (2008) largely endorse the hyperconnection model for interictal hyperreligiosity, and they agree with Trimble and Freeman that interictal religiosity may be linked with bilateral temporal lobe seizure foci. During ictal experiences, however, they argue that religiosity is associated with right temporal lobe activity and point out that four of the five well-documented cases of “in the moment” ictal religious experiences were associated with right temporal or temporofrontal foci.

The link between right temporal-frontal foci and religiosity in both the ictal and interictal states is also supported by a case (case 1) described by Devinsky and Lai (2008), wherein heightened religiosity was associated with right temporal seizure activity and loss of religiosity was associated with removal of the right temporal lobe. I could find no instance where removal of the left temporal lobe, in the context of unilateral foci, resulted in the loss of religiosity.

The crucial role of the right temporal cortex is underlined by the rare phenomenon of ecstatic seizures. These are seizures that are associated with various forms of intense bliss and occasionally religious ecstasy. Dostoevsky may have experienced these sorts of seizures. But let us look at a case with verified right-sided temporal lobe seizure activity that has been studied more recently.

The patient is a 30-year-old unmarried man who had a normal birth and gives no history of familial epilepsy, severe illness, or cranial injury. He attended secondary school and is currently employed full-time. A self-contained, suspicious, unsociable person, he is prone to lonely meditation. His only intellectual concerns, music and travel, are in harmony with his need to establish rarefied contacts with the environment. He has a taciturn nature and expresses himself slowly and with difficulty. At the age of 13 he began to have attacks of short duration (20–30 sec) characterized by psychomotor arrest, slight lapse of consciousness, and, above all, an ineffable sensation of “joy.” The episodes had a frequency of 1 or 2 per month but have become almost daily in recent years. In January, 1979, he was referred to us after a tonic-clonic nocturnal seizure. He had never seen a physician before, as he did not consider his small attacks as negative events. Seizures generally come on when he is relaxed or drowsy. The subjective symptoms are defined by the patient himself as “indescribable,” words seeming to him inadequate to express what he perceives in those instants. However, he says that the pleasure he feels is so intense that he cannot find its match in reality. Qualitatively, these sensations can only be compared with those evoked

by music. All disagreeable feelings, emotions, and thoughts are absent during the attacks. His mind, his whole being is pervaded by a sense of total bliss. All attention to his surroundings is suspended: he almost feels as if this estrangement from the environment were a *sine qua non* for the onset of seizures. He insists that the only comparable pleasure is that conveyed by music. Sexual pleasure is completely different: once he happened to have an attack during sexual intercourse, which he carried on mechanically, being totally absorbed in his utterly mental enjoyment. (Picard, 2013, pp. 705, 709)

In their review of the neurology of ecstatic auras/seizures, Geschwind and Picard (2016) studied fifty-two published cases. They concluded that the ecstatic symptoms in these patients seem to localize to a functional network centered around the anterior insular cortex. Note that we earlier had cause to mention the anterior insula in reference to emotional and motivational states and in reference to its possible function as a comparator of expected to actually experienced emotional reactions. In ecstatic seizures what appears to be taking place is that the comparator no longer detects anomalies or errors or mismatches. Instead, there is a perfect coincidence between expected states and actuality. Geschwind and Picard note that patients with these kinds of seizures often report that “everything seems to be exactly in the right place, as it should be,” that perfect solutions have been arrived at, that all is and all will be right with the world and so on. The authors hypothesize that in ecstatic auras the PPF-like mechanisms of interoceptive prediction error detection are no longer functional. So the individual detects no error or mismatches, and the brain concludes that it has reached the promised land of perfect prediction and thus bliss follows.

Interestingly, ecstatic seizures are characterized by a heightened self-awareness and a feeling of union with the world. This is the opposite of the feeling of the transient loss of agency that occurs with decentering as described elsewhere in this book. The hypothesized mechanism with decentering is the transient inhibition of the precuneus and/or anterior insula, but there may also be an interaction between the precuneus and the anterior insula. The anterior insula partially mediates the sense of self, maintaining a coherent first-person perspective on the basis of its connections with viscerosensory internal impulses as well as the inferior parietal lobe (IPL), the temporoparietal junction and presumably the precuneus (Craig, 2009). Activation of the anterior insula would then give rise to heightened self-awareness and downstream effects on the precuneus. And conversely, if the precuneus is activated there would be downstream effects on the anterior insula.

All of the TLE-related data, including the striking phenomenon of ecstatic seizures, suggest that heightened religiosity is most consistently associated primarily with right-sided temporal lobe foci and perhaps right-sided hippocampal atrophy. Devinsky and Lai (2008) came to similar conclusions in their review of the literature. In addition, heightened spike activity in the hippocampus and amygdala, particularly on the right side stimulates both temporal and prefrontal sites such that these higher cortical centers attach heightened significance to everyday events and complex ideations occur in response to chronic emotional stimulation due to hippocampal/amygdala overactivity.

But overactivity cannot be the whole story, as we have cases where atrophy rather than overstimulation or hyperconnectivity is the main finding associated with hyperreligiosity. For example, Wuerfel et al. (2004) evaluated religiosity and brain volumes/activity in thirty-three patients with partial-onset epilepsy and found that religiosity significantly correlated with reduced right hippocampal volumes. As noted earlier, atrophy of the right hippocampus was also mentioned in the case of Manikata. Indeed, there are now additional such cases reported in the literature, but this time in association with another disorder known as frontotemporal dementia (FTD).

Frontotemporal Dementia and Hyperreligiosity

FTD is a neurodegenerative disorder that is localized primarily to the frontal lobes and the anterior portions of the temporal lobes. In its early stages, before individuals become demented, FTD is associated with early behavioral abnormalities, including apathy, disinhibition, obsessive and compulsive behaviors (Miller et al., 2001). In one anatomical subtype of FTD, the degeneration appears to involve selectively, and often asymmetrically, the amygdala, hippocampus and anterior temporal lobes, as well as the posterior/medial portion of the orbital frontal cortex. This subtype involves asymmetric, right- or left-sided degeneration of the orbitofrontal cortex, the anterior temporal lobe, hippocampus and amygdala. In one series of cases of the right-temporal lobe variant (RTLTV) of FTLD, 15 percent of cases were associated with hyperreligiosity (Chan et al., 2009). Veronelli et al. (2017) presented an in-depth nine-year study of a case of RTLTV of FTD. A woman “MS” was brought into a dementia clinic at age seventy-three with a three-year history of significant behavioral change. Her daughter was becoming concerned because of (1) an abnormally increased interest in religious matters (hyperreligiosity); (2) excessive and

compulsive writing on religious themes (hypergraphia) and (3) reduced emotional regulation (irritability, impulsivity, disinhibition, egocentric behavior). Interestingly these behavioral changes were the most prominent signs of impending dementia as all of her other cognitive functions initially tested within the normal range. Over time, however, cognitive and behavioral functions began to decline significantly. Seven years after her symptoms began, MS demonstrated deficits in several domains of verbal memory and on tasks tapping prefrontal function such set-shifting. High-resolution T1-weighted three-dimensional structural magnetic resonance (MR) images were obtained at four time points – when first seen in clinic and then at three-time points subsequently (ages seventy-three, seventy-four, seventy-five and seventy-seven). In addition, PET scans were apparently also obtained (PET scan images were presented in the paper though not described in methods). These neuroimaging assessments initially revealed mild atrophy in temporal lobes, right greater than left and then over time atrophy progressively affected the anterior temporal and frontal lobes and the hippocampus bilaterally with more prominent neurodegeneration on the right.

In 2020 Block and Miller discussed three more cases of religiosity changes in people with FTD. These religiosity changes were observed in the patients with classic behavioral variant FTD (bvFTD) and in the semantic variant of FTD (svPPA), which is often characterized by primary progressive aphasia. According to Block and Miller the changes in religiosity in these patients co-occur with profound changes in the sense of self:

[I]n patients with bvFTD due to asymmetric degeneration of the right frontal regions ... [they observed] a very different religious pattern ... apparently mechanistically driven by changes in a sense of self... there appears to be complex cognitive representations of the deity and of the self. From the study of FTD it appears that the most dramatic changes in religious behaviors occur in patients with either bvFTD or the svFTD – particularly patients with more severe right temporal involvement ... [and also] affecting frontal brain regions. These data from FTD provide evidence that frontal regions are involved. Disruption of networks in these areas can cause profound changes in religious behaviors. (Block & Miller, 2020; pp. 166–167)

The fact that cases of right-sided FTD with hyperreligiosity are similar in some respects to hyperreligiosity associated with TLE is interesting. In both syndromes the most prominent, but by no means the only, neurologic signs were atrophy, scarring or seizure foci in the right hippocampus deep to the temporal lobe.

Interestingly, even mild atrophy of the hippocampus associated with normal aging is associated with religiousness variables. Owen et al. (2011) studied prospective relationships between religious factors and hippocampal volume change using high-resolution MRI data of a sample of 268 healthy older adults. They found that greater (both right- and left-sided) hippocampal atrophy over time was predicted by baseline identification as born-again Protestants, Catholics or no religious affiliation, compared with Protestants who were not born again. Greater hippocampal atrophy was also predicted by reports at baseline of having had life-changing religious experiences. Both right and left hippocampal atrophy significantly predicted religiosity. But again these data concerned normal participants who were apparently healthy elderly where the neurologic signal is more difficult to discern. Note that even in these otherwise healthy people right-sided hippocampal atrophy was significantly associated with increased measures of religiosity.

Explanations of Hyperreligiosity

How might we understand *increased* religiosity associated with *decreased* cell volume and *decreased* hippocampal function? Both TLE and FTD are primarily associated with degeneration in or near brain networks associated with right-sided hippocampus including interconnected structures such as the amygdala, anterior insula, precuneus and the prefrontal cortex; and as we have seen the brain change that most significantly predicted hyperreligiosity was atrophy of the right-sided hippocampus. Why? One possibility is that the atrophy has downstream effects on a brain network that increases its functioning. If the network released from inhibition happened to normally mediate functions associated with the assessment of things like value, emotional significance and information content of a stimulus, then the brain would be inundated with information it assessed of supreme significance. The interpretative framework for that kind of information would be religion. Let us call this account “the salience hypothesis” for hyperreligiousness.

There is good evidence that the hippocampus operates within a network of brain structures that could fit the bill for the proposed salience network (SN). Both TLE and FTD are disorders that are in fact significantly associated with changes in this SN. FTD, in particular, is associated with the degeneration of so-called von Economo neurons (VENs), a variety of neurons that are especially important for an SN central to brain function. The largest number of these neurons are found in the

anterior insular cortex, anterior cingulate cortex and portions of the prefrontal cortex, especially Brodman areas 9 and 10 on the right side. VENs are atypically large and spindle-shaped pyramidal neurons. They preferentially appear in social animals such as elephants, cetaceans, macaques, great apes and humans, and in increasing numbers leading up to humans (Cauda et al., 2014). They are specifically located in layer Vb of the prefrontal cortex and in clusters of three to six neurons, mainly at the crown of the gyrus.

VEN-containing cortical areas are part of the SN in which information on the physiological states of the body reaches the anterior insula and is integrated into decision-making and value attribution processes in the anterior cingulate cortex (ACC) and prefrontal cortex (Craig, 2009). Disinhibition or overstimulation of this functional network might lead to inappropriate attribution of meaningfulness or salience to both interoceptive stimuli and external sensory feedback, thus leading the individual to ascribe ultimate significance to otherwise mundane and everyday events. The anterior insula, moreover, is heavily interconnected with both the amygdala and the orbitofrontal cortex, which have been consistently implicated in the attribution of emotional significance to internal processes as well as to external events. As discussed elsewhere in this book, the insular cortex along with the precuneus has been shown to constitute a kind of “hub of hubs” in the human brain, functioning as central functional links in the larger DMN and the frontal-parietal executive attentional and control networks (for review see Bullmore and Sporns, 2009; Hagman et al., 2008). VENs may function to relay information rapidly across remotely connected brain networks. VENs in the right-sided insular cortex might constitute the neuronal basis of global network switching processes. They allow the brain to call upon a global workspace within the brain where very highly processed information from disparate sources in the brain can be processed. If this is correct, then the neuroscience of religiosity is telling us something that models of the religious mind based solely on cognitive and psychological data could not: Intense forms of religiosity appear to call upon very highly processed forms of information derived from the most disparate brain networks possible to explore novel simulations of self and world on a regular basis. We will see more evidence for this claim in Chapter 7.

These considerations also underline the importance of SNs and related structures such as the hippocampus, the amygdala, the temporal lobes and the prefrontal lobes particularly on the right side, in the set of neural networks that likely participate in religious experiences. I will now turn to a

review of the literature on religiosity in other neurologic disorders to see if findings are consistent with the findings we have gathered from epilepsy and FTD literature.

Schizophrenia and Hyperreligiosity

Schizophrenia was partially discussed in previous chapters. It is a disorder of the self-involving psychotic delusions and hallucination that has its onset most typically during the adolescent period. There is a definite heightening of religiousness in many schizophrenic patients, particularly those with positive symptoms. Reports of religious experiences are more frequent among the schizophrenia population than the general population – especially in those patients with positive symptoms (Huguelet et al., 2006; Mohr et al., 2006).

Triveni et al. (2017) studied 100 Hindu patients with schizophrenia who were clinically stable on antipsychotics. The patients were assessed for religiosity on two standardized scales – the religiosity measure scale and the Duke University religion scale (DUREL). Religious coping was assessed using brief RCOPE. On DUREL, 75 percent of patients reported practicing private religious or spiritual activities at least a few times a month. In a separate sample of 193 patients admitted to a community hospital for schizophrenia, 24 percent had religious delusions (Siddle et al., 2002). Huguelet et al. (2006) found that 16 percent of their sample of schizophrenic patients had positive psychotic symptoms involving religious content but the majority of the patients reported that religion was an important aspect of their lives. Mohr et al. (2006) conducted semi-structured interviews about religious coping with a sample of 115 outpatient schizophrenics and found that 71 percent of patients reported that religion instilled hope, purpose and meaning in their lives, whereas for others, it induced spiritual despair (14 percent). Patients also reported that religion lessened (54 percent) or increased (10 percent) psychotic and general symptoms. Positive delusions with religious content appear to be linked with specific sites of neural dysfunction. Single photon emission computed tomography (SPECT) neuroimaging on an individual with schizophrenia who was actively experiencing religious delusions revealed increased uptake in the left temporal region, as well as reduced uptake in the occipital cortex especially on the left (Puri et al., 2001). The authors note, however, that these results in a single patient are difficult to interpret as increased uptake could mean either hyperfunction or dysfunction in the left temporal lobe.

The prevalence and content of religious delusions and symptoms vary between cultures and religions. For example, with regard to paranoid persecutory delusions, Christians, in contrast to Muslims and Buddhists, are more likely to view the persecutors as supernatural beings. Common themes of religious delusions are that of persecution by demons, being helplessly controlled by demons or conversely developing an inflated sense of self (e.g., being an incarnation of Christ). Religious delusions are also resistant to updating. There is inflexibility in these belief systems. Gearing et al. (2011) reviewed over seventy studies on the issue of whether religious factors helped or hindered recovery among patients with schizophrenia. They found that religion may act as both a risk and protective factor in regards to hallucinations and delusions. Thirty studies looked specifically at religious delusions in people with schizophrenia. They distinguished between religious versus supernatural delusions, with the latter referring to religious-based themes like sin, heaven and hell, and religious delusions referring to encounters with or identification with supernatural entities. The majority of studies (twenty-seven of thirty) found the evidence of religious-related delusions and hallucinations among patients, with twenty describing delusions to be primarily of a religious-based nature and fourteen of a supernatural nature.

A meta-analysis (Sullivan et al., 2003) of heritability of schizophrenia based on twelve twin studies found evidence for very large additive genetic effects with heritability estimates of 81 percent. Why would Mother Nature preserve the genes for such a devastating disorder? There is some evidence that schizophrenia is slowly undergoing purifying selection or elimination from the gene pool. But there is other evidence that genes for schizophrenia are being preserved for other reasons. Crespi et al. (2007) point out that schizophrenia or at least schizotypal cognition is associated with creativity and divergent thinking. Crespi et al. found that allelic variants of three genes associated with schizophrenia, *SLC6A4*, *TPH1* and *DRD2*, have been associated with measures of creativity and imagination in normal population while two others, *COMT* and *HTR2A*, are associated with schizotypal cognition. 5HT_{2A} receptor signaling systems are furthermore the systems responsible for the psychedelic experience, as blocking these receptors prevents the experience.

The link between religiousness and schizophrenia has been explained in evolutionary terms as follows. Stevens and Price (1996) argued that the genetic susceptibility to develop schizophrenia emerged as an adaptation to facilitate group splitting. In ancestral human groups, subgroups or cults

would form around charismatic leaders who had experienced religious insights and visions. These cult leaders would then split from the natal group and trek off to form new groups at some distance from the natal group. These cult leaders were likely schizotypal according to Stevens and Price. Even if we agree, however, that ancestral humans would follow leaders with schizotypal traits or full-blown schizophrenia, it does not seem plausible that all human groups were founded this way. Nor does it seem plausible that group splitting in itself was so important a human behavior as to be positively selected. It does not seem to outweigh the costs associated with schizophrenia.

Polimeni and Reiss (2003) proposed a similar scenario to that of Stevens and Price. Religious and healing powers conferred prestige and leadership status on individuals and thus increased fitness. These were the shamans. Shamans, in turn, develop trance and schizotypal traits/abilities in order to practice their religious inspirations/powers. Fitness-related benefits of these shamanistic capacities outweigh the costs associated with vulnerability to schizophrenic traits. McClenon (2006) proposed a similar theory in his ritual healing theory, but in this case, the fitness-related benefit had to do with healing capacities.

Crow (1993, 2008) has also offered an evolutionarily informed theory of the disorder that speaks to its neuroanatomical abnormalities. He argues that schizophrenia was the price we (*Homo sapiens*) paid for the acquisition of language. The acquisition of language in *Homo sapiens* required the introduction of a range of neuroanatomical asymmetries in the human brain. Grammatical components of language were housed in the left temporal regions while pragmatic aspects of language were housed in the right frontal regions. Cerebral asymmetry produced a “torque” effect on the brain such that right frontal regions were wider than homologous regions on the left and left occipital regions are wider than homologous regions on the right.

If you fail to develop this torque, this form of cerebral asymmetry, then you will evidence language and cognitive deficits proportional to the reduction in asymmetry, and you will become vulnerable to schizophrenia. There is a considerable amount of empirical evidence in support of Crow’s theory (Brüne, 2004). Schizophrenics, for example, do, in fact, suffer from a lack of normal anatomic asymmetry between the right and left hemispheres. On the other hand, many other brain disorders are associated with a reduction in asymmetry but are not associated with psychoses (e.g., developmental learning disabilities like dyslexia). Even normal aging is associated with a reduction in asymmetry, but again there is no psychosis.

Obviously, in addition to the reduction in asymmetry, you need an over-activated limbic system to get psychosis.

It is generally agreed that symptoms of the disorder can be divided into two broad categories. Positive symptoms include delusions and auditory hallucinations while negative symptoms include flattened affect, disorders of will and anhedonia. Schizophrenia has been associated with dysfunction in the dorsolateral prefrontal cortex (dlPFC) as well as the abnormal regulation of subcortical dopamine systems. Limbic dopaminergic activity is enhanced while dorsolateral prefrontal cortical activity is depressed.

Neuroimaging studies of schizophrenia demonstrate aberrant connectivity patterns between three large-scale brain networks (Keshavan et al., 2020): The DMN, described in other chapters of this book; the frontoparietal central executive network (FPN), involved in higher cognitive and executive functions, and the SN, involved in the evaluation of internal and external stimuli as significant. In physiological conditions, switching between DMN and FPN is thought to depend on the SN. Therefore, the crucial network dysfunction associated with schizophrenia appears to converge on the SN.

As mentioned earlier, the SN is characterized by two main hubs anchored in anterior insula, precuneus and ACC. Its interconnectivity patterns involve the prefrontal cortex at one end and the subcortical hippocampus, amygdala and paralimbic structures at the other. The aberrant saliency hypothesis of schizophrenia states that the delusions and hallucinations associated with the disorder are mostly due to the overascription of meaning/saliency to incoming internal and external stimuli. The overattribution of salience is due to the hyperdopaminergic state of the schizophrenic brain. Dopaminergic signaling continuously stimulates the SN which then relays erroneous information to other brain networks. This overattribution of meaning problem was also operative, I have argued, with respect to hyperreligiosity among TLE and FTD patients.

As I argued above and in other chapters, the most important kind of information available to an individual is information that confirms that our topmost models are deficient. In the case of human beings that means that our priors, our very sense of self, must come under suspicion for its salience to be exceptionally high. Our preexisting priors will only come under suspicion if the environment we are facing is especially unpredictable. Therefore, aberrant salience can be thought of as resulting from an abnormally high estimate of the rate at which the environment is changing/threatening. When change is rapid and threats are salient there is often rapid belief updating in changing environments. Consistent with

this interpretation of aberrant salience theory, some but not all patients with schizophrenia do, indeed, update beliefs more rapidly than control subjects. But unpredictable environments demand unusual learning strategies that can flexibly depend on the statistical context. If you sample only a thin slice of the data concerning the self–world relation your belief updating may be too constrained, and if you sample too wide a range of data your belief updates will miss the mark in being overgeneral and so forth. But how does such a belief updating aberration result in religious delusions? Religious delusions are certainly inflexible and rigid. The kinds of sensory sampling that schizophrenic patients are apparently capable of results in imprecise sampling with spotty data, contributing to the brain’s decision that it is dealing with a threatening environment, thus triggering sparse data sampling and rapid updating cycles.

Obsessive–Compulsive Disorder (OCD) and Hyperreligiosity

OCD is characterized by intrusive and unwanted ideas, thoughts, urges and images known as obsessions together with repetitive and ritualistic cognitive and physical activities comprising compulsions. The frequency of religious obsessions in OCD populations in the USA has been estimated to lie between 10 percent (Eisen et al., 1999) and about 30 percent (Mataix-Cols et al., 1999). The frequency of religious obsessions in OCD populations in countries of the Middle East runs much higher, with at least half of the patient population reporting religious obsessions (Tek & Ulug, 2001). Liénard and Boyer (2006) have offered a cognitive and evolutionary model of ritualistic behaviors in OCD, linking the ritualistic behaviors of OCD with an innate threat avoidance system.

The clinicopathological functional and structural imaging studies of OCD suggest a consistent finding: There is abnormally increased activity in the orbitofrontal cortex and in subcortical basal ganglia (particularly in the caudate) and limbic circuits, particularly the right-sided hippocampus.

One important symptom complex associated with OCD, “scrupulosity” is particularly relevant to hyperreligiosity. At least 5–20 percent of individuals with OCD report some religious obsession, especially obsessional thought. Findings from nonsecular societies indicate that as many as 50 percent and 60 percent of OCD patients in Saudi Arabia and Egypt (respectively) report religious obsessions.

Scrupulosity is the feeling that you really need to do the religious ritual correctly or God won’t respond or sin won’t be relieved. For more spiritual rather than religious persons the supernatural or magical formula needs

to be recited perfectly for its magic to work. Some behavioral forms of this interesting phenomena include checking, hoarding and making things symmetrical. Common religious compulsive rituals include excessive praying, repeating religious rituals and Bible verses until they are done or said “perfectly,” compulsive writing on religious themes, seeking unnecessary reassurance from clergy and so on. The most interesting thing about scrupulosity is that it tends to be focused on thoughts and feelings as triggers for ritualistic behaviors. The feeling or thought is that I cannot be certain that I did the ritual correctly or that I have not sinned and so on. It’s that feeling or evaluation that I have not reached certainty. There is a drive to minimize surprise and imprecision that never comes to resolution or completion.

From a PPF point of view scrupulosity is fascinating because whereas most people according to PPF are looking for the levels of uncertainty that will maximize information in the error signal (uncertainty is good), people with scrupulosity are characterized by an intolerance of uncertainty. Their uncertainty tends to trigger aversive responses only. They need certainty to function. So the belief updating system must be tuned to look for absolute precision in sensory sampling and must be set on absolutely rigid priors. Abramowitz and Jacoby (2014) propose that scrupulosity emerges from otherwise commonly occurring intrusive thoughts that are misinterpreted as significant based on exaggerated and maladaptive beliefs about the importance of thoughts themselves. In the context of intolerance of uncertainty, the mere possibility that one has sinned (and could be punished) provokes high levels of anxiety and distress. The ritualistic compulsive behaviors temporarily reduce the feeling of uncertainty, and this then reinforces the ritualistic behaviors and so the cycle continues.

It is worth citing a couple of cases of scrupulosity in order to get a feel for the kinds of unwanted thoughts that plague the patient in this condition. These cases are from Greenberg et al. (1987).

Benjamin

Thirty-three-year-old married man with three children. Following his marriage when 20, he became preoccupied with the thought that he had not had sufficient concentration during his wedding ceremony, rendering the marriage invalid. He went to see rabbis about it until a second ceremony was arranged. After this, he became preoccupied with his wife’s menstrual cleanliness. The thoughts filled his mind all day, although he tried to dismiss them. Although he was aware that this preoccupation was excessive,

he would question his wife many times a day as to whether she had become menstrually unclean. If she dismissed his question, he would decide that she was not taking the matter seriously and he would remain tense. He consulted rabbis very frequently as to whether – given his doubts – he was permitted to be with his wife, and they always permitted it. Nevertheless, he avoided touching his wife whenever possible, and intercourse was very infrequent. He only agreed to intercourse because of the commandment “Be fruitful and multiply,” but on occasion his wife “forced” intercourse on him.

In addition, he took a long time to complete the portions of daily prayer that are considered to be especially important and requiring particular devotion, every such line adding an extra 10 minutes to his prayer.

From an Eastern European ultra-orthodox background, Benjamin’s father is described as rigid and pedantic, never giving way to leniency, and making his religious practice a burden for the family. Benjamin was the third of nine children, and the first son. In the Jewish religion the duty of performing commandments is emphasized for men, and the duty of educating them is taken more seriously than for girls. From the age of three, Benjamin went to a separate-sex institution for teaching Jewish studies, with little emphasis on secular studies. He married at 20 and has three children. He has never felt a strong sexual desire, although it has always been heterosexual. He learns all day in an institution for Talmudic studies. Three years ago he became increasingly depressed, and responded to ECT. The intensive thoughts were unaffected until he was given clomipramine.

Since then his mental state has been kept relatively stable on regular clomipramine (up to 200 mg).

At interview, he is tall and thin, with a long beard, dressed in the black long coat of ultra-orthodox Eastern European Jewry. He is quiet and withdrawn although he occasionally smiles. He describes his preoccupying thoughts, his weak resistance and partial insight. There are no psychotic features. (pp. 32–35)

Ephraim

Nineteen-year-old bachelor. At the age of 12, Ephraim developed fears of bears and wild animals. He became tearful and withdrawn and rejected food. Over the subsequent months his studies deteriorated, and he started praying excessively, often going back to the beginning as he thought he may have forgotten something. Shortly before his bar mitzvah, his father died. His fears receded, although he remains frightened of thieves or other intruders at night. His main problem now is over lengthy prayers. He says the words slowly in order to be exact, and goes back over sections he thinks he may have forgotten. His fears over saying his prayers dominate his day. Up at 6 a.m. In order to say some pre-prayer prayers, he completes his morning prayers at 11 a.m. After learning in the Talmudical academy with

a special tutor – willing to go at a very slow pace – he is home for lunch for two hours followed by two hours for the afternoon prayers (normally 10 minutes), immediately followed by another two hours of evening prayers (normally 10 minutes). His two-hour lunch break is mainly taken up by meticulous handwashing before the meal and slow recital of the benediction; grace after meals can take half an hour. A five-minute prayer recited before sleep takes another half an hour. In the time left over “I think about the prayers.” In addition, washing, dressing and all other activities are very slow, and any visit to the toilet takes half an hour.

Ephraim’s father was a Holocaust survivor, described as a depressive, who spent his days in the Talmudical academy, sleeping there usually, often not returning home for weeks and never showing any interest in his wife or children. His oldest son assumed responsibility for the children. Ephraim’s father only became religious after arriving in Israel from Europe; his oldest son became irreligious which upset the family. Ephraim was the youngest of five, being of normal development if a little bashful. He was very attached to his mother, and was very upset when he was sent to boarding school – a decision taken in order to prevent him following in his brother’s irreligious footsteps.

Over the years he had not benefitted from treatment by a series of anti-depressant medications.

At interview, Ephraim was a short, thin, pale young man, bowed over, dressed in the garb of the ultra-orthodox. He rarely established eye-contact and spoke with a lisp in a quiet voice. He said that his slowness caused him much pain and considered it excessive. When requested, he read a prayer Psalm slowly but steadily. He made it quite clear, however, that this did not count as prayer, and declined to pray alongside the assessor. There were no features of psychosis or depression. (pp. 60–61)

Other Disorders Associated with an Increase in Religiousness

Another neuropsychiatric disorder associated in some cases with hyper-religiosity is bipolar disease. In bipolar disease, religious delusions are much more likely in the manic than in the depressive phase of the illness, and that mania is associated with limbic, hippocampal, orbitofrontal and right-sided temporal overactivation. Obviously, the relation between bipolar illness and religiosity is in need of further research. The dramatic neurologic and behavioral changes that occur between the depressive and manic phases make it a potentially fascinating and informative case for deepening our understanding of brain–religion relationships.

Johnstone and his associates (2012; 2017) have also investigated religiosity in populations who have suffered a stroke or another type of brain injury. Johnstone et al. (2012) found that decreased function of the right parietal

lobe (RPL) was associated with increased senses of closeness to a transcendent being. They concluded that the RPL is an important region for mediating experiences of selflessness, which is an important factor in many types of religious and spiritual experiences. A follow-up study looked at 109 Christians, Muslims and Hindus with traumatic brain injuries (TBIs) and also found an association between decreased RPL functioning and spiritual transcendence. Johnstone and associates studied sixty-one individuals with TBIs in an outpatient clinic using the Brief Multidimensional Measure of Religiosity/Spirituality (BMMRS) and the Medical Outcomes Scale-Short Form 36. For persons with TBIs, hierarchical regressions indicated that the BMMRS Values/Beliefs and Forgiveness subscales accounted for 16 percent additional variance in health perception after controlling for demographic variables.

Crescentini et al. (2014) showed the influence on religiosity measures of reversible modulation of the IPL, but not the dlPFC. The authors targeted the IPL in line with previous studies that found an increased religiosity and spirituality associated with *decreased* activation of the parietal lobe (Newberg et al., 2001) and surgical ablation of the inferior IPL (Crescentini et al., 2014). We can add Johnstone's studies here as well. Crescentini et al. suggested that increased religiosity after IPL inhibition could be due to an altered sense of awareness of the self in space – a particularly relevant factor given the centrality of the sense of self in religiosity. They combined dual-pulse (10 Hz) transcranial magnetic stimulation (TMS) with a Religious/Spiritual Implicit Association Test and found enhanced religiosity/spirituality after IPL inhibition. In contrast, dlPFC inhibition had more widespread effects, reflecting its more general role in the acquisition or maintenance of task rules and in controlling the expression of other self-related representations not specific to religious/spiritual attitudes. We note that the causative relationship here may be complicated by the fact that downregulating the IPL may entail the release of the inhibition of the prefrontal cortex, which, therefore, would lead to the upregulation of the PFC. In addition, Crescentini et al. (2014) combined continuous, intermittent and sham theta burst stimulation (cTBS, iTBS and sham TBS) with implicit religiosity/spirituality measured using a modified version of the Implicit Association Test. The authors found a decrease of implicit religiosity/spirituality with increasing IPL excitability with iTBS. The authors argued that these findings showed the causative role of IPL in regulating implicit religiosity/spirituality. They also suggested that boosting IPL excitability reduced implicit religiosity/spirituality due to a decrease in extended self-awareness experience, where the self

is projected into dimensions that transcend body sensorimotor contingencies (in keeping with the known role of the parietal lobes in self and body representation. Urgesi et al. (2010) examined how neuropathological patients ($n = 88$) responded to the self-transcendence scale before and after neurosurgery. Urgesi et al. found that selective damage to the left and right inferior posterior parietal regions increased participants' scores on the self-transcendence scale. Farias et al. (2017), however, used transcranial direct current stimulation (tDCS) ($n = 44$) to explore the relationship between cognitive inhibition (stimulation of the right inferior frontal gyrus) and change in supernatural beliefs, but they found no association. If the authors had measured something like self-transcendence rather than cognitive beliefs they may have found relevant religiousness changes.

With the exception of the Farias et al. experiment, this series of experiments beginning with Newberg et al.'s observations on parietal lobe lesions and the sense of "absolute unitary being" and ending with these demonstrations that inhibition or disabling of IPL, especially on the right, is reliably associated with self-transcendence, suggests that just as the TLE, FTD and related data emphasize the role of the right hippocampus in religiosity, so too do these data suggest an important role of the IPL – especially right-sided parietal networks in some aspect of religiosity. Interestingly, both data sets suggest impairment in brain functioning leads to an increase in religiosity. The story we suggested to explain the role of the right hippocampus in religiosity involved its role in the SN, which was theorized to be upregulated, released from inhibition or overstimulated after right-sided hippocampal dysfunction. An overstimulated saliency function would lead to the overascription of significance and meaning to otherwise mundane events and thus the increase in religiousness. Can a similar story be told with respect to the role of the IPL? Is there any connection between IPL/ right-sided parietal lobe and the SN? There are certainly dense interconnections between the FPN discussed earlier and the SN. It is possible that disabling the FPN would upregulate or increase the functioning of the SN, but this is all speculation.

Some forms of hyperreligiosity or at least increases in certain measures of religiousness can occur after brain lesions as well. Zhong et al. (2017) found that individuals with dlPFC and vmPFC lesions have increased fundamentalist beliefs. The dlPFC lesions, in particular, had an effect on fundamentalism that was mediated by decreased cognitive flexibility and openness, suggesting that dlPFC functions to filter or critically evaluate noisy signals, and when this function is impaired greater noise is interpreted in magical and sometimes religious terms. Magical ideation was

also found to be positively correlated with religious experience, but only in patients with brain damage. PFC lesions were associated with increased magical ideation scores. In addition, Cristofori et al. (2016) demonstrated that executive functions (mediated by dlPFC) appeared to be engaged when the downregulation of mystical experiences occurred. Conversely, individuals with damage to the dlPFC, with diminished executive functioning, reported more mystical experiences than individuals with damage elsewhere in the brain. Holbrook et al. (2016) used TMS to downregulate posterior medial frontal cortex (pmMFC) functioning due to its crucial role in detecting discrepancies between desired and current conditions and then adjusting subsequent behavior during decision-making tasks. They reported that in a threatening context where participants were reminded of their own death, targeted downregulation of pmMFC activity modulated belief in God and other aspects of religious belief (as well as prejudice against members of an outgroup) in healthy volunteers. This suggests the pmMFC in addition to the right-sided temporal cortex plays a key role in adjusting commitment to and updating ideological beliefs under changing contexts; for example, considering the impending unavoidability of death can strengthen belief in God.

Neuroimaging of Religiosity

Let us turn now to the literature on the neuroimaging of religious practices in healthy people. Perhaps we can find more clues as to how the brain mediates religious experience/practices. We will first be looking for the disconfirmation of these ideas derived from the clinical data on the circuit that mediates religiosity in clinical populations. Then we will look for evidence of structures, brain networks that did not make an appearance in the clinical literature.

Newberg et al. (2001) pioneered use of functional imaging approaches to religion and brain issues. He and his colleagues have used PET and SPECT methods to study the brain states of experienced meditators during meditation and of nuns in prayer. They found in both cases decreased activation levels in the parietal lobes and increased activation levels in frontal lobes. There was also increased activation seen in the cingulate gyrus bilaterally and the thalami. They suggest that because the parietal region has been implicated in somesthesia, body schema disturbances and the sense of self, the hypoperfusion in the parietal regions result in a dissolution of the boundaries of the self, and a more intense religious experience. Note that this data on the face of it is consistent with the

clinical and experimental data summarized concerning the role of the IPL in enhanced religiousness.

Another important study that used functional imaging techniques to study religious experience was Azari et al. (2001). These investigators used positron emission tomography or PET to study a group of six self-identified religious subjects, who were Protestant Christians, and a group of six control subjects, who were self-identified as nonreligious. The two groups were matched on age, gender and level of education. The goal of Azari et al. (2001) was to image the brains of their volunteers while they were engaged in religious thoughts (e.g., recitation of the Psalms) as opposed to non-religious but equally “poetic”/happy thoughts – namely a learned poem from childhood like a nursery rhyme. They also asked their volunteers to indicate how they were feeling while they were engaged in these tasks. All subjects were able to recite from memory both the religious and happy texts at the time of the PET scanning. According to the self-assessment ratings, only the religious subjects achieved the religious state (while reciting the religious text). The PET images acquired from the religious subjects in the religious state showed peak blood flow activation in the right dlPFC as compared with the nonreligious subjects. Religious subjects, during the “religious” state, activated a frontal-parietal circuit involving the dorsolateral prefrontal, dorsomedial frontal and medial parietal cortex.

Newberg et al. (2006) measured regional cerebral blood flow using SPECT in a group of five Christian women who had practiced “glossolalia” for at least five years. Glossolalia is also known as “speaking in tongues” within Christian communities. There is a reduction in volitional control, and then the individual begins to emit vocalizations that sound like a different language. Both the target individual and his or her community attribute religious meanings to these vocalizations. The researchers observed decreased activity in the left caudate and in the prefrontal lobes and a trend towards increased activity in the right amygdala.

Beauregard and Paquette (2006) reported on two studies of Carmelite nuns in mystical states associated with their contemplative prayer practices (also see Beauregard and O’Leary [2007]). The first study involved functional magnetic resonance imaging (fMRI) scans of fifteen nuns in a baseline condition (a restful state), a control condition (most intense union with another human being) and a mystical condition (recalling and reliving their most significant mystical experience). Self-induction methods were used to produce the control and mystical conditions. The second study used quantitative EEG to measure brain waves of the same nuns in the same three conditions, with subjects sitting in an isolation chamber. The results

from the first study showed that many areas of the brain were involved in the nuns' recalling and reliving their most significant mystical experience, including especially the inferior parietal lobule, visual cortex, caudate nucleus and left brain stem. The results from the second study showed "significantly more theta activity ... in the mystical condition, relative to the baseline condition" in the insula, the right inferior parietal lobule and superior parietal lobule, and the right inferior and middle temporal cortices. "Moreover, there was significantly more theta activity in the mystical condition, compared to the control condition" in the anterior cingulate cortex and the medial prefrontal cortex (Beauregard & O'Leary, 2007, p. 275).

Schjødt et al. (2008) used fMRI to investigate brain activation patterns associated with overlearned forms of prayer like the Lord's Prayer and improvisatory forms of prayer (prayer made up on the spot). The participants were a group of Danish Christians. Recitation of the Lord's Prayer was associated with strong activation in the right caudate nucleus. Given that this nucleus is known to be a central node in an ascending network of dopaminergic systems that support reward and approach behaviors among other things, the authors hypothesized that religious prayer was capable of stimulating the dopaminergic system of the dorsal striatum in religious people. Improvised praying on the other hand elicited a strong response in the temporopolar region, the medial prefrontal cortex, the temporo-parietal junction and precuneus. All of these structures participate in the mediation of the sense of self. The authors pointed out that praying to God appeared to activate areas of the brain known to be involved in social cognition and theory of mind processing.

In a related study, Schjoedt et al. (2009) showed that personal prayer recruit areas associated with social cognition, suggesting that praying to God may be comparable with normal interpersonal interaction. This latter finding was later replicated in a study by Neubauer (2014), who also used fMRI to examine similar prayers and control conditions in an American Christian sample.

Ferguson et al. (2018) used fMRI with a sample of Mormons ($n = 19$) and found that ratings of "feeling the spirit" during various tasks with religious content were associated with activity in the striatal reward system as well as areas associated with social cognition.

Kapogiannis et al. (2009) recorded the blood oxygen level-dependent (BOLD) signal in forty participants who were asked to respond to statements about God in religious and nonreligious participants. They found that reflecting on particular dimensions of God beliefs (God's emotional states, God's involvement with the world, etc.) was associated with

different neural networks corresponding to the content of specific beliefs. For instance, reflecting on God's level of involvement with the world was associated with the activation of the medial prefrontal cortex and the precuneus – areas that have been associated with self-referential processing and mind wandering.

Kapogiannis et al. (2009) performed structural magnetic resonance imaging of participants who reported different patterns of religiosity ($n = 40$). Experiencing an intimate relationship with God and engaging in religious behavior was associated with an increased volume of the right middle temporal cortex, while experiencing fear of God was associated with a decreased volume of the left precuneus and left orbitofrontal cortex. The finding that intimacy with God was associated with increased volume of the right temporal lobe is possibly consistent with data from TLE and FTD patients in that both data sets implicate right-sided temporal lobe networks likely including hippocampus in enhanced religiousness. On the other hand, the FTD and TLE data involved impaired right temporal lobe functioning while the neuroimaging data here suggest increased volume and normally functioning temporal networks. But note we explained the TLE and FTD as enhanced brain functioning due to release from inhibition secondary to the disorder, so perhaps the neuroimaging data are consistent with the clinical data, but again this is all speculation.

Using fMRI Han et al. (2008) found that self-referential processing was associated with heightened activity in the ventral medial prefrontal cortex (MPFC) for nonreligious participants but in the dorsal MPFC for Christian participants. The authors suggest that the representation of stimulus self-relevance is mediated by the ventral MPFC while the evaluation of self-referential stimuli is mediated by dorsal MPFC.

Harris et al. (2009) looked at brain activity patterns of fifteen believers and fifteen nonbelievers, who evaluated religious and nonreligious statements. They found that when religious and nonreligious statements were compared, religious thinking was associated with greater activation in the anterior insula, the ventral striatum, the ACC and the posterior MPFC. These sites are nodes in the SN described earlier and are also crucial for detecting mismatches between expected versus obtained sensory experiences.

Epley et al. (2009) found that when individuals were asked to reason about God's beliefs they employed a significantly more egocentric framework than when they reasoned about other people. This distinction was supported through a neuroimaging experiment, in which they found that parts of the brain involved in self-referential processing were activated when reasoning

about God's beliefs, but not for other people. Ferguson and collaborators reported that in devout Mormons, religious experience elicited by ecological religious stimuli *and* practices activated reward, salience and attentional networks, including the nucleus accumbens, ventromedial prefrontal cortex, anterior cingulate and frontal attentional regions (Ferguson et al., 2018).

Disorders Involving Decreased Access to Religiousness Measure

Parkinson's Disease

In a series of publications, Butler et al. have demonstrated that access to religious concepts is reduced (relative to normal and control subjects) in left-onset patients with Parkinson's disease (PD; Butler et al., 2011a, b). These patients report fewer religious experiences and fewer religious interests/goals and engage in fewer religious practices (Butler et al., 2011a, b) than age-matched control individuals who are also coping with chronic disease – though some of the controls were not dealing with anything like PD. These findings, furthermore, have been replicated in relatively large samples of PD patients (N = 76; Butler et al., 2011a, b) (N = 83; Giaquinto et al., 2011; N = 35). Morgan et al. (2016) found that religious controls responded more quickly than patients with PD to intertemporal decisions under a religious priming condition versus neutral condition. Differences in response time were significantly associated with fMRI measured functional connectivity between the nucleus accumbens and various regions, including the left anterior cingulate cortex and Brodmann areas 10 and 46 in the right dlPFC. These results suggest that religious primes influence discounting behavior via dopaminergic mesolimbic and right dorsolateral prefrontal, supporting cognitive valuation and prospection processes.

In summary, the networks which on the face of it are most often associated with changes in religiousness involve the SN, the DMN and the frontal-parietal executive function network. The structures that appear in the literature are primarily limbic, temporal and frontal cortices on the right. This conclusion is congruent with those of other authors who have studied potential brain correlates of religiosity. d'Aquili and Newberg's (1993) early model of religiousness indicated that all the major association areas of the cortex generate some aspect of the total religious experience. They assume, for example, that the temporal lobes attach meaning and significance to events and thus are central to eliciting the profound adherence to religious frameworks. They argue that the parietal lobes undergo

a deactivation during profound religious experience and this deactivation is related to a diminution in sense of self or ego with subsequent experiences of unity with others or with being and so on. Their early model is consistent with Van Elk and Aleman's recent summary of the literature. Van Elk and Aleman (2017) argued that the existing data suggested that there were a consistent set of brain regions associated with various aspects of religious experience with the crucial caveat that the association was with various subcomponents of religious experience: The DMN likely mediated self-transcendent experiences, the components of the so-called social brain network mediated conceptualizations of supernatural agent cognitions, the temporal cortex was associated with mystical and ecstatic experiences, and the anterior cingulate cortex and the medial prefrontal cortex were involved in error monitoring and reflective processing on religious and supernatural beliefs.

All of these models of brain correlates of religious experience are helpful. In my estimation, however, we need additional data gathering efforts and model building efforts in this area. As the review of the literature in this chapter demonstrates, the data on religion and brain have been gathered in almost a secondhand manner. Astute clinicians noticed profound changes in religiousness after brain injury in some patients. They reported as faithfully as possible on these changes and these reports gave birth to the new brain-based approach to the study of religiosity. But the adventitious approach to data collection about brain and religion correlates means that no systematic efforts to document relationships between particular brain regions and particular aspects of religious cognition have yet been attempted or accomplished. We have no way of knowing, therefore, whether the clinical and neuroimaging data are giving us a biased picture of the true state of affairs with respect to the brain mediation of religiosity. Despite these shortcomings of the existing dataset on religion and brain, it is nevertheless striking, at least to this observer, that the picture is relatively consistent. There is a consistent set of networks or brain structures that modulate religiosity. I have named those structures and said something about their known functions. I have also argued that they are interconnected anatomically. This latter fact suggests that the structures in question may act as a single functional unit when handling religious material. If so, then chemically addressing that circuit should produce religious experiences. We will see in Chapter 6 that that is, indeed, the case when we evaluate psychedelics and religious experience.

*Psychedelics and Religious Experiences***Introduction**

Administration of psychedelic agents such as LSD (lysergic acid diethylamide), psilocybin (present in “magic mushrooms”) and DMT (dimethyltryptamine, present in ayahuasca and other preparations) have been reliably associated with production of experiences deemed “spiritual” or “religious” by many individuals. In addition, in the last ten years there has been an explosion of research on brain correlates of psychedelic experiences. It seems sensible, therefore, for us to look at the literature of the neuroscience of psychedelic experiences given that we are interested in developing a neuroscience of religious experiences. We will see that neuroscience evidence supports some aspects of the decentering model presented here, but more importantly raises some fundamental questions as to why the brain and mind seem to be wired in such a way as to facilitate religious and mystical experiences.

Existing anthropological and archaeological evidence suggests that plants containing compounds that produce effects similar to these psychedelic compounds have been used for many thousands of years by human populations in various parts of the world. For example, ayahuasca is a drink used ceremonially for over 5,000 years in South America. It is commonly made from a combination of the *Banisteriopsis caapi* vine with one of several DMT-containing plants (such as *Psychotria viridis*). Various species of mushrooms and fungi with psychedelic properties have been used by humans for centuries in the ancient Mediterranean world and among native North American peoples. The famous “sacramental” drink, soma, referred to in the ancient Vedic texts over 2,500 years ago, apparently used in sacrificial ceremonies for centuries in both India and Persia, very likely contained psilocybin mushrooms and other psychoactive plants. Similarly, the ancient Greeks used a sacramental drink, kykeon, within the Eleusinian mystery cult for millennia. It too may have contained psychedelic-inducing ergoline alkaloids.

Given that there are many other plant species that exhibit hallucinogenic properties that have been used by a variety of ancestral populations for many thousands of years, it is possible that what we call religious and spiritual experiences have been shaped, in part, by these sorts of chemically induced or enhanced experiences. If we want to know how brain systems mediate, facilitate, shape, limit, constrain, induce, inhibit or amplify religious and spiritual experiences, looking at the effects of psychedelics on brain systems is a good place to start.

On the other hand, an examination of psychedelics' effects on brain systems cannot and will not provide a complete story or understanding of brain and religion dynamics. After all, psychedelic effects are clouded with all kinds of unusual phenomenological experiences besides religious experiences, such that effects of psychedelics are not limited to the spiritual sphere. Indeed, many people who have taken psychedelics have never had a spiritual or religious experience when on the drug. Much depends on "set" and "setting." If we include personal history within the category of "set," then it is clear that personal dispositions and history of the individual taking the psychedelic matter a great deal with regard to who gets spiritual and religious experiences on psychedelics. Therefore, some investigators assert that psychedelics merely amplify or bring into awareness preexisting potentialities. By that account then only people with preexisting religious or mystical sensibilities would have spiritual and mystical experiences on psychedelics. But we know this is not the case. People who called themselves atheists before taking the drug can very often self-report intense mystical and spiritual experiences after taking the drug. Indeed, a substantial proportion of these individuals no longer wish to call themselves atheists after having had the experiences. In any case, even if psychedelics merely amplify preexisting potentialities, that in itself is remarkable and will be valuable to study for a neuroscience of religious experiences, as preexisting neural potentialities for religious experiences are easier to study when amplified.

Psychedelics Can Induce Genuine Religious Experiences

The fact that psychedelics can and do induce or facilitate religious and spiritual experiences in people open to such experiences is now indisputable. In two recent surveys involving fairly large *N*s (*N* = 561, Davis et al., 2020; *N* = 606, Griffiths et al., 2019) several spiritual and religious experiences were queried. For example, supernatural agent (SA) encounters are often a part of religious experiences. Existing reviews (Davis et al., 2020;

$N = 606$, Griffiths et al., 2019) report that on average greater than 80 percent of people who have taken a psychedelic at moderate to high dosage report encounters with nonnatural or supernatural entities. What are these encounters like? Survey results from the Davis et al. and Griffiths et al. studies revealed that people who had taken an agent with DMT described the SA encounters they experienced as being just as real as encounters with people when off psychedelics. The most commonly endorsed labels for the SAs they encountered when on DMT were “being” (60 percent), “guide” (43 percent), “spirit” (39 percent), “alien” (39 percent) and “helper” (34 percent). Virtually all respondents reported having had an emotional response to the experience including joy (65 percent), trust (63 percent), surprise (61 percent), love (59 percent), kindness (56 percent), friendship (48 percent) and fear (41 percent). The SA was considered to be a conscious being (96 percent), intelligent (96 percent), benevolent (78 percent), sacred (70 percent) and had agency in the world (54 percent). Most respondents believed that the SA was absolutely real, not hallucinated, with 72 percent believing that the entity continued to exist after their encounter. The SA encounter also produced dramatic psychic and spiritual effects in respondents. For example, approximately one-quarter of the sample reported that they were atheist (28 percent) or agnostic (27 percent) before taking the drug and the entity encounter, but there were only 10 percent of respondents who were atheist or 16 percent agnostic after the encounter.

In addition to and as part of the SA encounters, it is now very well established that psychedelics reliably produce mystical-like experiences. The first well-documented experimental study to investigate the effects of a serotonergic psychedelic on mystical experience was the so-called Good Friday experiment conducted by Walter Pahnke at Boston University’s Marsh Chapel in 1962. The study involved administration of either 30 mg psilocybin ($n = 10$) or 200 mg nicotinic acid ($n = 10$) to seminary students during the Good Friday religious service (Pahnke, 1967). After the experience, and at a six-month follow-up, participants were assessed for mystical experiences based on the model of mystical experience developed by Stace (1960). The Stace dimensions of mystical experience include sense of unity, sacredness, positive mood, transcendence of time and space, noetic quality, ineffability, paradoxicality, transiency and persisting positive changes in attitudes and behaviors. Four of the participants in the psilocybin conditions reported most or all of these dimensions while none in the control group did. Doblin (1991) tracked down sixteen of the original twenty participants twenty-five years later and confirmed that many of the positive benefits linked to the psychedelic experience remained!

In psychedelic studies mystical experiences are typically measured with the so-called Mystical Experience Questionnaire (MEQ30). The MEQ30 is a psychometrically validated retrospective measure of acute mystical experience (Barrett et al., 2015). The four factors of the questionnaire (as also utilized by Pahnke in the Marsh Chapel experiment, mystical, positive mood, transcendence and ineffability) are derived from a total of thirty items that probe seven dimensions of mystical experience that were identified in an exhaustive review of the literature on mystical religious experience by the philosopher Walter T. Stace (1960) and subsequently confirmed and emended by Ralph Hood and associates. The Mystical factor is composed of fifteen items probing four dimensions of the Stace model (internal unity, external unity, noetic quality and sacredness). Positive Mood (six items), Transcendence of Time and Space (six items) and Ineffability (three items) factors correspond to three separate dimensions of the Stace model.

In a now landmark psychedelic study (Griffiths et al., 2006) using the MEQ, the mean percentage of endorsed items was 78 percent immediately after psilocybin and 33 percent after the control substance methylphenidate. Follow-up some fourteen months later did not substantially change these numbers. In addition, the appearance and intensity of mystical experiences appears to be dose dependent (Barrett et al., 2015; Griffiths et al., 2011): volunteers received 5, 10, 20 and 30 mg/70 kg of psilocybin in separate sessions with at least one month between each session and a placebo session randomly placed within the sequence. The mean percentage of maximum total possible score on the MEQ30 on session days was 23 percent, 47 percent, 52 percent, 70 percent and 77 percent placebo and 5, 10, 20 and 30 mg/70 kg psilocybin. This score for 30 mg/70 kg at fourteen months was 81 percent. Hierarchical regression analysis demonstrated that MEQ30 scores significantly predicted various clinical, health and spiritual well-being outcomes.

There have now been well over a dozen such studies confirming these landmark findings wherein psychedelic use induces dramatic changes on the MEQ and full-blown mystical type experiences while control substances do not – despite identical set and settings. It is, in short, a remarkable fact that self-reported religious mystical experiences are now widely and reliably produced in the laboratory in association with administration of a psychedelic. If one reads accounts of mystical experiences from saints in virtually any religious tradition and then compares these accounts with descriptions of the mystical experiences induced by psychedelics, the overlap is substantial (Barrett and Griffiths, 2018; James et al., 2020; Johnson

et al., 2019). When the people who have them (1) describe the experiences as mystical, religious and spiritual, (2) when these experiences are associated with benign to excellent clinical outcomes, (3) when the phenomenology of the experiences are substantially similar and (4) when the mystical experiences are dose-dependent, I think we can conclude that these experiences are psychedelically induced and genuine religious mystical experiences.

But caution is in order here. When, for example, one compares phenomenologies of psychedelic experiences with classic religious mystical experiences, one can be just as impressed with their differences as with their similarities. The psychedelic experience furthermore may be quite different for a secularized rich, highly educated westerner than for an indigenous shaman living in the rainforests of Brazil. While both individuals (the westerner and the shaman) may interact with entities of the spirit world for purposes of healing, the shaman may experience no bliss or sense of unity or love as the westerner does. Instead, any given or particular shaman is simply acting instrumentally and attempting to manipulate powers to cause an effect. There may not be any empirically demonstrable “common core” of experiential qualities that is seen in self-reported religious and mystical experiences when examined across cultures or across social roles.

If on the other hand one looks at these experiences in terms of family resemblances, noting commonalities without dismissing clear differences, then it seems to me reasonable to conclude some commonalities exist between classical religious mystical experiences and modern psychedelic experiences whether reported by the indigenous shaman or the westernized and modernized individualist. If we were examining the cross-cultural phenomenologies of similar experiential states such as first-person perspective or subjective consciousness, we would likely discover the same sort of thing: there are family resemblances in the experiences across cultures. We would not be surprised that people report the experience of first-person perspective to consist of similar qualities no matter the reporter’s cultural context. We are not denying the dramatic and striking differences that likely occur in first-person perspective across cultures. These are real and scientifically important. But so are the commonalities. For now, therefore, we emphasize the commonalities. However, no full picture of the phenomenon can be obtained until both commonalities and differences are taken into account.

Given that some commonalities exist, what are the neuroscientific implications of this fact? If we emphasize commonalities (between psychedelic and classical mystical experiences) then it seems clear that at least for the western subjects who have called their experiences religious, spiritual or mystical, some of the psychedelic experiences must be

understood as genuine religious experiences. At a minimum then we can conclude that the brain, when given the right conditions, can facilitate, allow, mediate and undergo ecstatically blissful states that are subjectively understood in religious terms and often in supernaturalist terms. It is not just that subjects have intensely blissful experiences that they then ascribe significance to. They are not like other intensely blissful personal experiences or even “peak” experiences. They are this – but more. As mentioned earlier, these intensely blissful ecstatic states often occur in tandem with encounters with supernatural entities. These SAs are often understood in religious terms. They are experienced as real events and they occur within a sensorium that is aware there is an everyday reality and an extraordinary reality; that is, the encounter occurs in a nonpsychotic state. In short, these sorts of psychedelic experiences must be construed as genuine religious experiences.

These considerations suggest that the brain is either plastic enough to accommodate these mystical experiences or it comes equipped with innate circuitry that, when addressed properly, reliably leads to deeply significant religious experiences for some people. That does not mean that that circuitry produces ONLY those experiences. It merely indicates that religious and spiritual experiences are reliably associated with a specific, identifiable and reproducible set of neural events. A religious supernaturalist might take these facts to confirm that God gave us the equipment to contact and experience him and other supernatural entities reliably. A nonsupernaturalist would likely disagree with that claim but concede that the brain comes equipped with the necessary machinery to apprehend value of the highest significance and magnitude such that that apprehension induces transformational states and often bliss or positive mood as well as dramatic long-term behavioral changes in some individuals.

Brain Effects of Serotonergic Psychedelics

Obviously, data from psychedelic studies suggests that the serotonergic psychedelics apparently uniquely address the brain in such a way as to promote mystical experiences. What does this fact tell us about the brain’s capacity for religious experiences? To obtain a satisfactory understanding of the brain’s role in production of these mystical states we need to grapple a bit more with the nitty-gritty stuff of what is actually occurring in the brain when on a serotonergic psychedelic. Now the neurological effects of psychedelics are extraordinarily complex. But we are interested here in spiritual and mystical experiences associated with psychedelics. So we can make the

task of understanding psychedelic effects on brain more tractable by limiting the focus in several ways. First we limit our review of brain effects of psychedelics to those effects that have been empirically linked with spiritual and mystical experiences. These experiences include encounters with SAs. But even if we limit our focus to studies that directly address spiritual and mystical experiences there are still a number of decisions to be made, given the complexity of factors that influence drug effects on brain. Neuroimaging studies of acute effects of psychedelics are our primary source of how these agents affect the brain and “produce” mystical experiences. However, keep in mind that each substance (e.g., LSD, psilocybin, DMT) will affect the brain differently. So let us limit ourselves to serotonergic agents as these are most studied and most strongly linked to mystical experiences. But in addition there are numerous individual differences factors such as age, sex, medical history, set and setting, prior beliefs and expectations that also dramatically influence the drug’s effects on brain. Then there are the temporal factors that affect neuroimaging findings. Findings vary dramatically depending on when they attempt to image the brain during the psychedelic experience. Is it at peak effects or at some other time? Then there are complications due to dose and study designs – the extent to which adequate placebos were used and so on. Finally, there is the complication of what kind of neuroimaging procedure is used. Will it be looking at functional connectivity or positron emission tomography (PET) metabolic and neurochemical changes or something like electrocortical rhythms and so on?

Since we are interested in the self and in mystical experiences – and since we are interested in relatively large brain network changes in association with self and mystical experiences, and since we further know that these experiences are most often associated with peak effects at higher doses, then we will confine our examination to brain changes on high dose serotonergic agents measured via functional connectivity analyses with functional magnetic resonance imaging (fMRI) scans. Given the documented association of mystical experiences and entity encounters with the so-called ego dissolution experience at peak drug effect, studies that focused on these experiences will be examined.

Recall that classic psychedelics are direct agonists at the serotonin (5-hydroxytryptamine, or 5HT) 2A receptor (5HT_{2A}) subtype, and while all of the most popular psychedelics also have activity at other receptor subtypes, agonism at the 5HT_{2A} appears to be key to their main action (Nichols, 2016; Vollenweider & Preller, 2020) given that 5HT_{2A} antagonists can completely block phenomenologic effects of the drug. Activation of these 5HT_{2A} receptor signaling systems induces synchronized spiking of

single units (most strongly in layer V pyramidal cortical neurons) and also neuronal ensembles, a phenomenon known as wave oscillation synchronization. Activation of the 5HT_{2A} signaling systems in the prefrontal cortex (PFC, which is densely innervated with 5HT_{2A} receptors) enhances spontaneous excitatory postsynaptic potentials in neocortical layer V pyramidal cells through a Ca²⁺-dependent action in apical dendritic fields involving glutamate release. Some 5HT_{2A} receptors are co-localized 5HT_{1A} receptors (5HT_{1A}) on pyramidal neurons in the PFC. These two serotonin receptor types have opposing effects on glutamate-induced PFC neuronal firing and intracellular signaling. The two receptor types appear to work together to regulate high level executive functions of the PFC and thus the functioning of the frontal parietal executive function network (FPN). The 5HT_{2A} and 5HT_{1A} receptors together generate gamma oscillations in PFC through fast-spiking interneurons coexpressing the two serotonin receptor types in pyramidal networks. These receptors have opposite effects on the modulation of gamma wave power; whereas 5HT_{1A} antagonism *synchronizes* cortical gamma oscillations, 5HT_{2A} antagonism causes *desynchronization* of gamma waves (Aznar & Hervig, 2016). Although Lord et al. (2019) demonstrated a destabilization of frontoparietal subsystems under psilocybin, psychedelics appear to have complex effects on cortical gamma oscillations, so there is no clear picture emerging yet on the extent to which demodulation of gamma rhythms occurs or whether such demodulation is associated with the relaxation of top-down regulatory effects on subcortical systems that is typically associated with the psychedelic experience.

The key studies on brain effects related to ego dissolution and mystical experiences have been done with fMRI resting state functional connectivity paradigms. In an early landmark study that demonstrated clear dysregulating effects on the default mode network (DMN), Carhart-Harris et al. (2012) found that psilocybin decreased cerebral blood flow in several regions associated with the DMN, including the thalamus, putamen, hypothalamus, posterior cingulate cortex, precuneus, bilateral angular gyrus, supramarginal gyrus, anterior cingulate cortex, fronto-insular cortex and orbitofrontal cortex. Most fMRI studies subsequent to this landmark study replicated these basic results (i.e., some amount of dysregulation in the DMN), but also complicated the picture in interesting ways. Reanalyses of the data obtained in the 2012 study showed additional findings such as *increased* functional connectivity between DMN and the salience network and the executive function frontal-parietal network among others.

Tagliazucchi et al. (2016) utilized fMRI to investigate global and local brain connectivity changes from the resting state following intravenous injection of LSD versus placebo to fifteen healthy volunteers. They found that the DMN, salience and FPN or frontoparietal executive function network and the thalamus showed increased global connectivity under the drug but decreased within-network integrity. The increase in global connectivity observed under LSD correlated with subjective reports of ego dissolution. The authors suggested that increased cross talk between DMN, salience and FPN, when these individual networks are not functioning normally, could blur boundaries between self and world in such a way as to lead to ego dissolution and mystical experiences. Lebedev et al. (2015) studied brain functional connectivity correlates of ego dissolution and mystical experiences in fifteen volunteers given 2 mg of psilocybin. Analysis of within-network integrity revealed an association between decreased salience network integrity and ego dissolution. In addition, ego dissolution was also associated with decreased functional connectivity between the hippocampus and both the salience network and the FPN. The intensity of ego dissolution was found to be strongly anticorrelated to the density of connections in the anterior part of the para-hippocampal circuit (PHC). The PHC, in turn, mediates the connectivity of the hippocampus with the DMN. Thus, the final result of down regulation of the PHC is decoupling between structures in the medial temporal lobe (including hippocampus) and the DMN. Ego dissolution did not correlate with DMN disintegration per se but rather with its altered functional connectivity with structures like the hippocampus and the salience network. Ego dissolution in fact strongly correlated with disintegration of the salience network. The authors make the interesting suggestion that while the salience network mediates what some have called the “minimal or embodied self,” the DMN might be more closely aligned to the “narrative self.” It only takes decreased functional connectivity (or disconnection between hippocampus and either the salience network or the DMN) within the salience network to get an ego dissolution experience.

Other neuroimaging studies of ego dissolution have largely reported similar findings to Lebedev et al. (2016). Decreases within network integrity of the DMN or the salience network are associated with ego dissolution experiences. Decreased coupling between sites like the precuneus, the posterior cingulate and the mPFC appear to be associated with some mystical-like experiences and decreases in alpha, gamma and possibly theta

oscillatory activity in the mPFC, which may also be related to mystical-like experiences when on psychedelic agents.

Ego dissolution then is not associated with mere down regulation of the DMN or related sites. It may also be associated with up regulation of several brain regions, increased functional connectivity between some networks as well as greater brain activity overall. Atasoy et al. (2017) applied connectome-harmonic decomposition to investigate dynamic changes in brain states under LSD, and found an expansion in the number/variety of active brain states. Preller et al. (2019) applied dynamic causal modeling to resting-state fMRI data acquired under LSD, and found that LSD systematically modulated 5HT_{2A} receptor signaling from the thalamus to posterior cingulate cortex causing increased functional connectivity between these regions, and simultaneously decreased effective connectivity from the ventral striatum to the thalamus independently of serotonin 5HT_{2A} receptor activation.

Explanations of Brain Effects of Psychedelics

According to Yaden et al. (2021) there have been three detailed hypotheses to explain alterations of integration and segregation patterns of brain connectivity under psychedelics – particularly with reference to ego dissolution and mystical experiences. These three hypotheses can be called the relaxed beliefs under psychedelics (REBUS) model, the cortico–striato–thalamo–cortical (CSTC) model and the claustrum model.

The REBUS model (Carhart-Harris & Friston, 2019) largely relies on the Free Energy Principle (Friston, 2010), which claims that brains seek to reduce uncertainty and do this largely via simulation of expected states or processes. As discussed in previous chapters of this book these simulations of expected events occur at all levels of the neural hierarchy with the top-most node in the hierarchy, the PFC, presumably playing a crucial role in enabling these predictive simulations and processing error messages when simulations do not match up with what actually occurs. The REBUS theory proposes psychedelics disrupt these predictive simulations and error processing essentially by down regulating prefrontal and anterior cingulate cortex “top-down” control of the DMN and by disrupting intrinsic DMN circuits themselves. The precision weighting of prior beliefs is disrupted thus allowing prior expectancies and beliefs to undergo reevaluation. The relaxation of top-down priors allows bottom-up information to exert more influence on brain function, and this is what underlies the experiences induced by psychedelics.

But can a simple increase in impulses or information coming from the bottom (e.g., distal sensory receptors), or even a reduction in filtering information coming from the distal sensory receptors result in the kinds of experiences people undergo on psychedelics? Would not the information simply be a barrage and blur of inchoate sensory experiences unless some kind of higher cortical cognitive processing was intact at the top of the hierarchy during a psychedelic experience? Instead, people report highly structured sensory experiences and indeed full-blown cognitive apperceptions of intricately structured worlds.

The CSTC model is similar in some respects to the REBUS model in that it implicitly adopts the idea that psychedelic experiences basically involve a removal of top-down inhibitory effects or a removal of the filtering functions of executive control networks in the cortex. This model (Vollenweider & Kometer, 2010) proposes that psychedelics disrupt the gating functions of the thalamus, so all kinds of information gets into the system, flooding the brain/mind and causing ego dissolution and other psychedelic effects. The loss of gating functions of the thalamus allow increased sensory and interoceptive information to flow from thalamus to cortical regions. While LSD, as noted earlier, does appear to increase thalamus to cortex connectivity, we can ask again whether this information overload is enough to account for the structured experiences we see? Would not this information overload again result in merely bombarding cortical sites with impulses that cannot be processed or structured in any way. All higher cortical centers cannot be downregulated or unchanged from resting state after administration of a psychedelic agent. Some executive processing must remain in order to make any sense at all of the barrage of impressions produced by the experience. Note that not only is some sense made of the experiences, but also that people report noetic insights, entity encounters, visual phantasmagorias of counterfactual worlds and ecstatic states of consciousness. These are highly structured cognitive events.

The claustrum-cortical circuit model argues that the claustrum is key to psychedelic drug effects (Nichols, 2016). The claustrum exhibits a large number of 5HT_{2A} receptors and is intensively interconnected with a large number of cortical regions. Therefore, when you perturb the claustrum you demodulate a very large number of cortical networks. Psilocybin alters connectivity between the claustrum and both the default mode and frontoparietal attention networks in the human brain, but it is not clear exactly how alteration of claustrum activity then alters other brain networks in such a way as to account for the structured experiences we see in psychedelic states.

The Link with Religious Experiences

So what to make of all this? What is really going on during one of these psychedelic experiences? How do mystical experiences, including the encounters with SAs, emerge?

I suggest that religious and mystical experiences (including encounters with SAs) occur because serotonergic psychedelics expand perceptual and information pick-up from internal and external sources, and information processing capacities are expanded such that there is a real bona fide knowledge gain. This emphasis on epistemic aspects of the psychedelic experience is not meant to deny that hallucinations occur or that the visions on psychedelics can be bizarre and filled with nonsense. It only means that the visions can also sometimes carry information of great value to the individual and the groups he or she moves in. That information and knowledge cannot be taken at face value. It has to be reflected upon over time. It has to be subjected to critique. The knowledge that is gained from the experience will not “occur” unless the visionary experience is reflected upon and integrated into the individual’s cognitive systems over the long term. Nor will the knowledge gained have persisting long-term positive effects unless the knowledge influences interactions in social groups and cultural formations. The idea is that some sort of real knowledge is gained, and this knowledge is what causes the mystical experiences, not just the ego dissolution experience. Ego dissolution is an index of knowledge gain and is just one facet of the range of mystical experiences individuals report. You can get mystical experiences without ego dissolution and conversely you can have ego dissolution and no mystical experience. The ego dissolution experience, furthermore, varies dramatically from mild to intense. Why is it that you can have profound mystical experiences and entity encounters with mild or even no ego dissolution? The indigenous shaman who regularly takes ayahuasca in a ritual context does not always have ego dissolution experiences but he does report visions and encounters with SAs. Ego dissolution is predictive of long-term benefits of the psychedelic experience perhaps because it is a proxy for the range and variety of mystical experiences occurring as well as a shorthand measure of the intensity of the mystical experiences occurring in a particular session. The knowledge gained because of those mystical experiences is, in my opinion, the proximate and ongoing cause of long term positive mental health effects of a psychedelic experience. All three theoretical accounts of psychedelic effects on brain functioning, the REBUS model, the CSTC model and the claustrum model, are consistent with this epistemic claim of psychedelic’s effects, but none provides any sort of proof for the claim.

The psychedelic experience is so richly detailed and so complexly structured that its cognitive structure and content implies some amount of real knowledge acquisition secondary to the experience. The cognitive psychologist Benny Shanon wrote a book-length monograph on the kinds of knowledge gained from the ayahuasca experience (Shanon, 2002). He summarizes his analysis of ayahuasca-associated cognitive phenomenology thus:

Ayahuasca induces powerful visions as well as hallucinations in all other perceptual modalities. Pronounced non-perceptual cognitive effects are also manifest. These include personal insights, intellectual ideations, affective reactions, and profound spiritual and mystical experiences. Moreover, Ayahuasca introduces those who partake of it to what are experienced as other realities. Those who consume the brew may feel that they are gaining access to new sources of knowledge and that the mysteries and ultimate truths of the universe are being revealed to them. All this is often coupled with what drinkers describe as an encounter with the Divine. (Shanon, 2002, p. 13)

Basing his analysis of ayahuasca phenomenology on his own experiences with the drug as well as interviews with dozens of informants, Shanon argues that the “brew” yields several different types of knowledge for the “drinker.” First Shanon notes that the knowledge often comes in the form of “visions” – emotionally intense visual scenes that are vivid, geometrically complex, colorful and exceedingly beautiful, and are described as being “more real than real.” Drinkers find themselves immersed within the scenes of the visions and often interact with SAs who, in turn, are experienced as otherworldly but intensely alive and real. The visions and encounters are construed by the drinker as carrying special significance, as articulating definite meaning, as conveying messages, as imparting knowledge that could not be acquired otherwise and/or as serving as vehicles for higher teaching and learning. What makes these visions something more than mere hallucinations is that the contents and themes of the visions as well as the cognitions associated with them are not merely idiosyncratic. They occur across individuals – even individuals who have never spoken together before or are naïve with respect to the brew at all. In that sense the knowledge gained via the visions is public and verifiable. Shanon argued that his data suggested that there were several forms of knowledge obtained from ayahuasca experiences. 1) *Factual knowledge*. This was the most common type of knowledge mentioned by his informants. Drinkers pick up facts about other people and the natural world, and even directly observe other places/worlds and other times. Especially common are instances in which people have visions of scenes that the drinkers at first believe are ancient civilizations. Sometimes these counterfactual worlds are later understood

to be certain specific ancient civilizations, and the drinker believes he or she has learned something factual about these places (e.g., how buildings looked at that time and so forth). 2) *Psychological knowledge*. This kind of knowledge is basically personal insights or greater self-understanding. Interpersonal empathy is elevated as well. In some cases there is full blown identity transformation and metamorphosis. The drinker becomes an animal or a spirit being, for example. The shamans claim that these possession states give them healing powers. 3) *Knowledge related to nature and life*. Frequently ayahuasca drinkers experience a special, close link to nature with ensuing insights and apprehension concerning plants, animals and the global phenomenon of biological life. 4) *Philosophy and metaphysics*. The ayahuasca experience often provokes prolonged philosophical and metaphysical reflections both during and after the experience. This happens regardless of the educational background of intellectual interests of the drinker. The metaphysical reflections tend to converge across individuals upon a kind of monistic pantheism, deep animism, with consciousness at the center and populated by myriad SAs but with one divine being conferring upon all optimism, joy and love. Interestingly this happy concoction was virtually never countered with reports of experiences that undermined this rosy outlook. 5) *Well-being and wisdom*. Drinkers report that the experience led them to a state of wisdom which is of course a form of practical knowledge. 6) *Specialized knowledge*. The indigenous shamans are healers, and they primarily use the visions for medical care. 7) *Artistic performance and creativity*. Across all informants objective measures of artistic creativity are increased. 8) *Consciousness*. The visions reveal new powers of the mind.

But these forms of knowledge delineated by Shanon do not exhaust what can be learned from the visions. Take, for example, Shanon's analysis of the visual elements of the ayahuasca experience. These comprise fourteen types and stages (Shanon, 2002, p. 293):

- 1) bursts, puffs and splashes of color;
- 2) repetitive, multiplying non-figurative elements;
- 3) geometric designs and patterns;
- 4) designs with figures;
- 5) rapid figural transformations;
- 6) kaleidoscopic images;
- 7) well-defined, stable, single figurative images;
- 8) proto-scenes;
- 9) full-fledged scenes;
- 10) interactive scenes;

- 11) scenes of flight;
- 12) celestial and heavenly scenes;
- 13) virtual reality;
- 14) supreme light.

In his analysis of the geometry of the visions encountered on DMT, Andrés Gómez Emilsson (2016) described six levels of the visual experience, depending on dose. 1) *Threshold*. The individual experiences an expectancy and initial opening onto visionary worlds. 2) *Chrysanthemum*. This second stage is named after a flower because the shapes witnessed in vision reflects those seen on a chrysanthemum, including surfaces saturated with textured fabric composed of intricate symmetrical relationships, shifting edges and “shimmering pulsing superposition patterns of harmonic linear waves of many different frequencies.” 3) *Magic Eye*. Here spirit entities begin to show up, but there is little interaction with them. Whole landscapes and worlds are now seen often populated with impossible objects. The objects are made of the same repeating patterns and textures so that the surfaces of the objects, the bodies of the people and so on are all completely contorted to accommodate the curvature of the scene. 4) *Waiting Room*. At this level the individual focuses on a very complex visual element in the scene and it explodes or opens up as a window into another dimension. One can start to see actual 3D hyperbolic spaces and objects. There is a synchronization of all senses into a unified synesthetic experience. Spirit entities start to interact with the individual. 5) *Breakthrough*. Topological conversions of objects and scenes start to happen uncontrollably and complexify into higher dimensional spaces. The spirit entities at this level communicate with the individual telepathically. 6) *Amnesia*. DMT usually does not produce ego death directly. Rather, the amnesic properties of DMT at high doses are largely due to the ineffability of the experience. It is difficult for us to visualize multidimensional or hyperbolic spaces or worlds, and therefore difficult to recall in such a way as to accurately communicate the experience.

In formal geometric terms hyperbolic space or scenes or objects entail a simply connected Riemannian manifold with negative Gaussian curvature. It is the geometric opposite of a sphere. On a sphere, the surface curves in on itself and is closed. A hyperbolic plane is a surface in which the space curves away from itself at every point, but it is not a simple planar surface. This kind of direct experiential knowledge of hyperbolic scenes could be invaluable for mathematicians and so should be considered real knowledge.

Neurology of Entity Encounters on Psychedelics

Central to the visions obtained on ayahuasca or DMT are the appearances of and interactions with spirit entities or SAs. Indeed SAs are central to most experiences on most serotonergic psychedelics. They are the warp and hoof of mystical experiences for most people.

How should we understand these encounters? Entity encounters are explained by naturalists as defective attributions of agency. It is argued that we normally distinguish between perceptual inputs caused by oneself and those caused by others out in the world by intuiting or deducing when the action in question emanates from an impulse within me or not. Those actions that come from within are mine and those that do not come from within, but are nevertheless registered by me somehow, are actions initiated by others. So how do we tell when an impulse comes only from me, from within? So-called corollary discharges are neuronal signals that are sent along with neuronal impulses that initiate a motor action from within. They are copies of the motor command (to raise my arm, for example). From a predictive processing framework perspective the corollary discharges are just like motor commands in that they are shaped by predictions about the sensory consequences of my actions. The corollary discharge compensates for predicted sensory effects of my intended action by registering the particular action underway at any given moment. If the two signals cancel out, then I know that the action is mine because they both matched expected consequences of my action – they had the intended effects. If the cancellation of the corollary discharge does not happen and expected consequences are not met for the motor command/prediction, I conclude that the movement/action is from another agent – not me, even though it was in reality initiated by me. The corollary discharges that would usually cancel out the expected consequences of actions fail to do so, generating an increase in prediction error at lower motor planning levels. These unexpected consequences then need to be explained away and they are done so by attributing the actions in question to external rather than internal causes. In short, the more prediction error generated, the more likely an action (or thought) has external sources rather than endogenous causes.

But can this attributional or corollary discharge account explain entity encounters under psychedelics? If I do not feel any subjective sense of agency and yet something moved or happened, then I need an explanation for the movement. What the attributional account does, however, is merely tell me whether the movement began within or without me. It does

not tell me if the external agent was a person or an animal or some impersonal force. If I make further deductions about the external agent based on the mismatch signal I receive, then I might be able to infer that the agent is intelligent and perhaps human. But can that error signal tell me that the external agent has superhuman powers? If the entities I encounter are hallucinations or confabulations based on the mismatch signal, then they should mirror my motor commands or internal thoughts concerning sensory consequences of my actions. There should be a “solipsistic bias” to the entities I encounter if they are only my projections or inventions.

But as has been pointed out many times by people who have encountered entities on psychedelics, the entities encountered in psychedelic experiences do not merely mirror the individual’s mind, desires or movements. Instead, the entities operate independent of and often against the will of the individual. They often know things about the world that the individual does not know. There are also commonalities of entity characteristics across individuals – even individuals who do not or did not know one another. All of this does not rule out the naturalistic attributional account of entity encounters on psychedelics. It merely argues that we cannot build a complete naturalistic account of entity encounter on the mere decision that an action originated outside me.

What kinds of SAs appear in ayahuasca or DMT visions? They are very similar to the SAs reported in other serotonergic psychedelics and reviewed earlier in this chapter. They are most often described as “beings,” “aliens,” “guides” or “helpers,” who appear as dwarfs, elves, imps, angels, spirits, gods or just as a presence. Shanon (2002) classified the entities he found in his dataset as:

- 1) *Mythological beings*: such as gnomes, elves, fairies and monsters of all kinds;
- 2) *Chimeras or hybrids*: typically half human half animal shapeshifting beings;
- 3) *Extraterrestrials*: aliens; insectoid-aliens, especially in the form of a praying mantis;
- 4) *Angels and celestial beings*: often composed of light;
- 5) *Semi-divine beings*: like Buddha or gods from various religious cosmologies;
- 6) *Demons, monsters and beings of death*: such as the angel of death; a being encircled with serpents, for example.

It is a remarkable fact that people experiencing these encounters almost always say that the encounter was realer than real, that the SA imparted

something beneficial to the individual and that the knowledge imparted was real and actionable. Individuals furthermore report that it was that encounter that was the real transformative experience during the “trip.” Although ego dissolution surely matters a great deal for accounts of introvertive mystical experiences, entity encounters matter as well, but these have not been adequately studied by scientists. There is in fact a good argument to be made that it is precisely these encounters with SAs that most potently predict long term beneficial mental health effects of the psychedelics.

Davis et al. (2020, p. 11) point out that SAs often give individuals insights into ways in which to pull through spiritual struggles and psychic pain. Davis et al. note that “the frequent reporting of psychological insights occasioned by these entity encounters suggests that such experiences may have therapeutic potential.” Lutkajtis (2020) pointed out that most clinical research on psychedelics has focused on abstract or introvertive forms of mystical experience and neglected study of these entity encounters. Yet the phenomenology associated with the SA encounters is striking. The SAs act as if they were autonomous entities which appear to possess intelligence and agency. They are often accompanied by positive emotions such as joy, trust, surprise, love, kindness and friendship (although fear and awe are also common). Note that the psychedelically encountered SAs are not dissimilar from SAs reported in all the world’s religious traditions, so the two sources of information reinforce one another. Communication with entities can involve telepathy, speech or even active touch. In the Davis et al. (2020) survey study more than two-thirds of respondents (69 percent) endorsed receiving a message, task, mission, purpose or insight into personal issues from the entity encounter. All this speaks to the potential therapeutic benefits of such insights. The individual is receiving highly meaningful information from an awe inspiring source, so the information is taken to heart in a way that could impact therapeutic potential.

Encounters with divine entities, such as angels or other celestial beings, may induce strong feelings of wonder and awe, which once again can have positive mental health effects.

One of the most interesting parts of the entity encounter experience concerns reports that the SA performs some kind of surgery on the individual. Reports of these “magical operations” abound in anthropological accounts of shamanic experiences.

All of this suggests that SA encounters are crucial elements of the mystical experiences undergone by psychedelic users. These SA encounters are furthermore very likely strong predictors of long-term beneficial effects of

the experience just as they are in traditional religious experiences. Finally the SA encounters are real sources of knowledge for people who have them. To get encounters with entities that confer on the individual some sort of noetic insight or spiritual knowledge on the individual, the brain/mind needs to find that sweet spot between surprise and uncertainty or between sturdy but flexible priors, while sufficiently precise levels of expectancies or uncertainty yield a sense of picking up maximally important or valuable information despite significant levels of noise in the sensory surround. If priors are more precise than sensory inputs, they will dominate active inference, making information pick-up minimal as incoming prediction errors will be ignored. By contrast, if we have more precise prediction errors than priors, then error signaling will dominate priors and priors will be ignored. Accurate predictions made under highly uncertain conditions represents one phase of that sweet spot. When such predictions occur, dopaminergic striatal prefrontal systems fire to reward these sorts of predictions. Conversely, when uncertainty is low but surprise is high, prediction proves to be a failure (anyone should be able to predict or not be surprised when uncertainty is low). But that sort of failed prediction is also extremely valuable information, and thus leads to mystical experiences that deliver intense meaning and value to the individual.

In mystical experiences the brain computes a level of “precision” to assign to sensory experiences and expectancies at each level of the neural hierarchy in order to regulate the interaction between top-down and bottom-up signals. The precision computation encodes both the reliability and value of the incoming sensory information. The minimization of surprise through active inference involves acting so as to reduce uncertainty, and to do this the system must model itself across time, exploring the value and potential reliability of taking any number of potential paths in the future. Thus, model optimization intrinsically involves the generation of many counterfactuals or scenarios as to how potential or intended actions might turn out and what the expected consequences would be of implementing a given scenario. These counterfactual models also include or project potential time depths associated with each potential scenario. When looking to find that sweet spot that generates the optimal balance between surprise and uncertainty, the brain/mind must also generate models of its at varying degrees of temporal depth. Once a scenario is found that optimizes balance between surprise and uncertainty, the associated self is considered the ideal self and the individual identifies with that ideal self and becomes more susceptible to mystical experience. Operating in terms of an ideal “future self” with a multiply tested and therefore reliable

self-model that contains significant temporal depth or thickness helps to order all other subself-positions in the overall dialogic or plural sense of self we each carry within us. The individual achieves a unified sense of consciousness and this contributes to mystical states. The psychedelic state hyperstimulates myriad counterfactual scenarios and then the sense of a unified consciousness by finding that sweet spot between surprise and uncertainty. It hyperstimulates brain regions such as the salience network and the medial temporal lobe responsible for counterfactual generation. Can this rationale also explain mystical experiences that are not associated with psychedelics? It is to classical religious mystical experiences we turn next.

Mystical Experiences

Introduction

We have had several occasions in this book to talk about mystical religious experiences. They were the focus of the review in Chapter 6 of religious and spiritual experiences associated with use of psychedelics. But now, to place those experiences within the larger context of the world's religious traditions, and to compare findings we obtained when examining brain correlates of mystical experiences when on psychedelics against findings concerning brain correlates of mystical experiences when not on any special substances, it is necessary to look at mystical experiences per se, as they arise "naturally" for most people without the aid of extreme practices or special substances. There are many students of religion who suggest that the primary experiential source of religions is in fact rooted in mystical-type experiences. Whether or not that is the case there is little doubt that mystical experiences are a crucially important part of the religion and brain story. The renaissance in psychedelic research has demonstrated that mystical experiences associated with the ingestion of serotonergic psychedelics predict some of the positive health, mental health and well-being outcomes associated with psychedelics. The powerful experience of self-transformation we have highlighted in this book as one of religion's key effects on the individual brain/mind appears to be strongly related to mystical experiences. Mystical experiences both promote deep transformational experiences and accompany these transformational experiences. Mystical experiences fund some of the claims that philosophers and religious adherents point to when asked for evidence that supernatural agents (SAs) exist independent of our minds, wishes or desires. Finally, there has been some important neuroscience research on mystical experiences. For these reasons some account of what neuroscience can tell us about mystical experiences and vice versa is in order here.

Mystical Experiences: Definition

I take a Wittgensteinianism family resemblance approach to the problem of defining mystical experiences, thus avoiding the claim that there is a common core of mystical experiences that are always and everywhere present when people claim these experiences, or conversely avoiding the claim that there is no consistent unity at all within this family of experiences. Instead, the idea is that there are a number of characteristics that are typically but not invariably associated with mystical experience, but with personal history and local culture influences when there are enough of these characteristics present to deem the experience “mystical.”

That family of subjective characteristics deemed mystical by most westerners with a broadly Abrahamic orientation (i.e., Jewish, Christian and Islamic) background include things like intense *positive emotions* bordering on ecstasy, deep personal insights (*noetic quality*) associated with the experience, *unity* (the dissolution of boundaries between self and world or self and the divine), *transiency* (they do not last more than a few hours), *passivity* (the sense that personal agency is transiently reduced), *paradoxicality* (seeing how apparently contradictory concepts can be true in some sense) and *ineffability* (they are difficult to capture in words). I would add here that spirit entities or SAs tend to show up in most mystical experiences in these traditions as reported down through the ages. These are the characteristics originally proposed by William James and William Stace in their phenomenological analyses of hundreds of reports of mystical experience. Some scholars argue that an introvertive form of mysticism is characterized by an experience of unity or pure consciousness devoid of local ideological content, while an extravertive form of mystical experience is an experience of unity but manifested in local cultural dress or ideological content. Thus, SAs tend to be more prevalent in extravertive forms of mystical experience.

The James/Stace list was taken up and largely confirmed by some but certainly not all philosophers and psychologists in the century of work that followed. Among the scholars who agree that the James/Stace list refers to real experiences, there is disagreement as to the relative contribution of brain versus culture in production or mediation of these experiences. Whether or not these subjective qualities are solely or primarily culture-dependent or are merely results of a socially dependent attribution process, all scholars who have studied these experiences agree they are real subjective experiences that carry substantial consequences for religious traditions and for the individual who experiences them. Given that these are real subjective experiences, they require nonrandom brain network activation

patterns to be expressed or experienced. That is an important fact. The association of mystical experiences with selective activity in selected brain networks does not mean the experiences are nothing but brain impulses; and does not mean that there is a specialized brain circuit encoding religious experiences only and so on. It just means that the brain is a crucial factor in production or manifestation of those experiences.

Although culturally dependent attribution theory is surely part of the explanation for mystical experiences, it cannot be the whole explanation. The disposition to undergo these experiences appears to vary across individuals just like any other dispositional trait, and it appears to be a universal human capacity. While I am focusing on the Abrahamic traditions here, there is an abundant literature on the mystics of the east as well. The two traditions, west and east, are starting to interact and to spark new mystical practices, experiences and insights that cannot be reviewed here – though the importance of the new religious movements emerging from the east–west interactions cannot be overstated.

Returning to our focused study on western mysticism, Hood (2006) has studied the James/Stace list for decades. He has based his research program on the intensely disputed claim that there is a universal common core of qualities expressed in mystical experiences. Using standard psychometric methods, he developed and validated a scale assessing the presence and intensity of the Jamesian qualities. Hood's mysticism scale has been used extensively in both the psychology of religion and the psychedelic literature. These studies have now confirmed that mystical experiences as measured by Hood's mysticism scale can be reliably "produced" or made more likely to occur when people ingest serotonergic psychedelics. In addition, the relation is dose dependent: the larger the dose (up to a point) the more likely mystical experiences will occur. These data point to the fundamental role of the brain in manifesting mystical experiences.

Existing Neurological Data on Mystical Experiences

The neurological investigation into mystical experiences has proceeded in a relatively atheoretical manner. As discussed in Chapter 6, investigators have reported brain associations of people who report mystical experiences or elements of mystical experiences. Often the medial temporal lobe (MTL), the temporoparietal-occipital (TPO) junction and medial pre-frontal cortex (mPFC) are mentioned in association with mystical experiences. In almost all cases SAs are experienced in association with these mystical experiences.

These SAs can manifest as a mere “sensed presence” or a full-blown angel or divine figure. Isolated sleep paralysis (ISP) is a relatively common experience that is often associated with the experience of a sensed presence. ISP is typically characterized by an inability to move or speak after waking up, as well by the eerie sense that someone or something is in the room with you who is somehow evil or malignant and threatening you. The individual/patient is really still in rapid eye movement (REM) sleep although he might believe he has fully awakened or at least his mind is awake. The experience is caused by fragmentation of the brain state associated with REM such that one does not move entirely out of REM when one transitions from REM to wakefulness. The potential causes of the failure to completely transition out of REM into waking consciousness are multiple. They include stress, disease, injury, illness, chemical imbalances and sleeplessness among many other causes (Denis et al., 2018). Some two-thirds of people who experience these episodes report some sort of sensed presence or an encounter with a spirit entity. They sense that someone or something is in the room with them that usually intends them harm. So the individual attempts to scream for help but cannot. They hear the sensed presence breathing or moving towards them and can actually feel them touching or pressing in on them. Often the individual can hear voices or can communicate with the entity. Forty to thirty percent report out-of-body experiences (OBEs) where they could see themselves from a point above their bodies, while only about 20 percent report autoscopia (seeing a double). Almost 100 percent of respondents reported fear. But substantial percentages also reported feeling erotic feelings and even bliss.

Within the predictive processing framework (PPF), the experience of a sensed presence in ISP would presumably be explained away as the brain’s attempt to infer causes for the unusual kind of experiential and sensory feedback occurring when one part of the brain (higher cortical centers) is in an awake state while other parts of the brain (limbic system) and the body have not fully emerged from the REM state. But of course it is not at all clear why a mind/agent presence with (typically malign) intentions would be inferred given the feedback the brain is getting in this hybrid state. Why confabulate a threatening demonic presence in such a state? And why is the confabulation experienced as so utterly real?

The role of OBEs in mystical experiences needs to be more closely examined. Arzy and Idel (2015) linked OBEs and autoscopic phenomena to mystical experiences reported by some of the great mystics of the ecstatic Kabbala tradition. Arzy and Idel examined texts and reports of mystical experiences written by several mystics within this tradition

and identified four main techniques utilized by them to obtain mystical insight. The autoscopic technique essentially involved inducing an image of oneself, a doppelganger outside one's body as a first step toward ecstatic intuition. "Ascencion ecstasy" involved leaving the body via OBE and then journeying through supernatural realms. Unitive ecstasy aimed at union with God via OBE and dissociative ecstasy involved promoting or allowing a spirit entity to possess one's consciousness and body. The authors noted instances of seeing one's double, of heautoscopy (alternation between seeing one's body and world from both personal and out-of-body perspectives) and OBEs with entity encounters. In the case of Abrahan Abulafia (approximately 1240–1291), the mystic developed a version of prophetic mysticism involving meditation upon and chanting the names of God with the aim of uniting one's individual mind with the "agent intellect" of the divine. Some of Abulafia's practices involved taking the twenty-two letters of the Hebrew alphabet and combining pairs to produce varying combinations of mystical names to be chanted while performing specific bodily postures and breathing exercises. During these exercises the mystic would visualize and meditate upon the names, rotating them in the mind until a deep absorption experience ensued and "fear and trembling" seized him. Often an entity would appear and the mystic would interact with that entity, obtaining knowledge of the divine. In the case of "maggid" spirit possession, the entity possessing the mystic would speak using the mouth of the mystic, thereby producing religious revelations and so on.

Patients suffering from right temporal lobe epilepsy frequently report OBEs and mystical experiences during or after seizures. In addition, OBEs are frequently reported in association of near death mystical experiences (discussed later). OBEs can be induced via stimulation of the TPO junction, and appear to be due to a failure of multisensory integration at the TPO (Blanke, 2004).

Remembering mystical experience was associated with right middle temporal lobe regions (BA 21) (Beauregard & Paquette, 2006). Picard (2013) reviewed cases of so-called ecstatic seizures which often involve mystical and blissful states. Picard hypothesizes that during ecstatic seizures the neurocognitive comparison between predicted states and actual states that typically is accomplished in sites deep to temporal lobes such as the anterior insula and anterior cingulate cortex no longer functions due to neurological changes associated with seizure activity. Therefore, mismatches between predicted state and actual state are no longer processed, blocking negative emotions and negative arousal that is associated with

error signaling. Sensing that error signaling will no longer occur, the brain concludes that all is right with the world and mystical bliss ensues.

Cristofori et al. (2016) demonstrated that executive functions (mediated by the dlPFC) appeared to be engaged when down regulation of mystical experiences occurred. Conversely, individuals with damage to the dorso-lateral prefrontal cortex (dlPFC), reported more mystical experiences than individuals with damage elsewhere in the brain. Newberg et al. (2006) observed decreased activity in the dlPFC in a small sample of practitioners of glossolalia. Urgesi et al. (2010) found that selective lesions to left and right inferior posterior parietal regions specifically *increased* reports of self-transcendence in glioma patients after neurosurgery. Self-transcendence measures among other things the sense of oneness with something larger than oneself, ego dissolution and the merging of self with the group – all consonant, it seems, with the mystical experience of unity. Johnstone et al. (2012) have also investigated religiosity in populations who have suffered a stroke or another type of brain injury. Johnstone et al. (2012) found that decreased function of the right parietal lobe (RPL) was associated with increased senses of closeness to a transcendent being. They concluded that the RPL is an important region for mediating experiences of selflessness, which is an important factor in mystical experiences. A follow-up study looked at 109 Christians, Muslims and Hindus with traumatic brain injuries (TBIs) and also found an association between decreased RPL functioning and spiritual transcendence (Johnstone et al., 2017).

PPF Model of Mystical Experiences

We have seen that existing neurologic evidence suggests that when parietal-prefrontal lesions disinhibit limbic and deep temporal networks people are more likely to report mystical experiences. From the decentering point of view this makes sense as it suggests that once the neural networks associated with the executive attentional network and sense of self are damaged or taken off-line liminal experiences ensue. Mystical experiences, however, are not mere aimless liminal experiences. They are most often experienced as positive; there is an SA present; there is a feeling of deep insight as well as dissolution of self–group or self–other boundaries and so on. Therefore, I doubt that Picard’s suggestion that ecstatic mystical experiences are due primarily to a cessation of the mismatch error signaling process can fully account for religious mystical experiences. I suggest that the trigger of these kinds of experiences is the decentering mechanism or the taking off-line of neural networks at topmost levels of the neural hierarchy such that

the sense of self is called into question. The mismatch signal or degree of surprise is extreme enough that it calls for an entire dismantling of existing priors associated with the executive self and the construction of a new set of priors to support the agentic self and its active inferencing activities. However, the dislodging of the executive self is not yet enough to produce a mystical experience. Instead the construction of the updated beliefs and sense of self has to perfectly hit that sweet spot between resilient but flexible priors and then a sense of control over the noise or uncertainty/precision levels experienced during sensory sampling during active inferencing. In short, mystical experiences emerge from optimal balance between surprise and uncertainty via construction of an ideal self.

If priors are more precise than sensory inputs, they will dominate active inference, making the agentic executive self-monadic and inflexible. Incoming prediction errors will be ignored. By contrast, if we have more precise prediction errors than priors, then error signaling will dominate priors. The executive self will be weakened and sensory sampling and error signaling will drive belief updating. We need an optimal balance between priors and prediction errors. What set of circumstances makes prediction most informative? It is that sweet spot between priors and input; between surprise and uncertainty levels that yields potential for mystical experience. Accurate predictions made under highly uncertain conditions represent one phase of that sweet spot. When such predictions occur, dopaminergic striatal prefrontal systems fire to reward these sorts of predictions. Conversely, when uncertainty is low but surprise is high prediction proves to be a failure (anyone should be able to predict or not be surprised when uncertainty is low). That sort of failed prediction is also extremely valuable information and should lead to a decentering process where the current priors are taken off-line to undergo an overhaul and subsequent construction of a new more ideal self that fits into that sweet spot. The overhaul of rigid inadequate priors occurs in my view, as discussed in other chapters in this book, in REM sleep and dreams. Parameters of the old self model are dismantled and then a new ideal self is constructed. That new self has to have optimal capacity for active inferencing. It also needs to interact optimally with other people. We cannot improve active inferencing without interactions with others. We need a standard via which we judge what is really out there. We only know when a prediction is successful with respect to the social world if we check to see if other people experience the same perceptions and if our inferences check out against social practices, agreements and norms. Thus, the new self constructed during and after mystical experience must be able to interact optimally with others. It must be able

to model its self in relation to others, to make predictions about others, to model a mind outside itself optimally and so on. Thus, this is the final element required for a true mystical experience.

We can check this model of mystical experiences against the case of near death experiences (NDEs) in what follows.

Near Death Experiences as Mystical Experiences

After being ignored for decades and then maligned as obscurantist, the work of pioneers on NDEs such as Raymond Moody, Bruce Greyson, Pim van Lommel and others has finally received the attention it deserves. NDEs are now established as real phenomena and typically classified as a type of mystical experience. The pioneers of the study of NDEs are ambitious, however. They see the phenomenon of NDEs as presenting a fundamental challenge to current materialist models of brain/mind function. Whether or not that is the case, it is clear that NDEs have much to teach us about both the brain and about mystical experiences.

NDEs have been documented to occur in about one in five patients undergoing cardiac arrest, but they also occur in all kinds of other close-to-death illnesses and traumatic situations. NDE experiences can include feelings of peace and joy, OBEs where the individual can see their bodies from a point above or nearby, seeing an unusually bright light that is sometimes personified as a “Being of Light,” seeing and interacting with SAs or religious figures depending on background and local culture, seeing other human beings some of whom are known to the individual to be deceased and some who are not known to be deceased, a flood of mental images experienced as memories and often a full life review, seeing or experiencing some beautiful counterfactual world or heavenly realm, sensing a barrier or border beyond which the person cannot go, and finally sensing a pull or call to return to the body and then a reluctant return to normal consciousness (van Lommel, 2011). In addition, less often there are associated paranormal phenomena such as *terminal lucidity*, the unexplained return of mental capacity and memory shortly before death even in patients who had suffered years of chronic schizophrenia or dementia. In the majority of cases patients report that the experience is more real than reality, that they felt mentally clear, that they could make logical inferences and more easily direct their attentional processes. The most frequently encountered NDE experiences are feelings of peacefulness, seeing a bright light, and encountering SAs. The SAs are typically clothed or described in terms that are consistent with the individual’s religious and cultural background. Among

the SAs encountered by western patients are God, guardian angels, spirit helpers, wisdom figures and saints. Finally, as is the case with other forms of mystical experiences, NDEs are associated with long-term positive outcomes such as greater serenity in life, more prosocial behaviors and less stress.

Now for a student of the neuroscience of religious experiences there are several issues here worth exploring, among which two seem most salient: 1) how to account for complex mental and experiential phenomena associated with NDEs when most areas of the brain are not functioning properly, and 2) how to relate the NDE findings to the rest of the literature on brain and mystical experiences.

With respect to the first issue, all we can do is keep gathering data to clarify whether NDE-related mentation is actually occurring when brain systems are decoupled, damaged or, as some claim, fully shut down – that is, dead. Instances of *enhanced* neurocognitive functions are not uncommon after brain damage. Indeed, in Chapter 5 we reviewed some of these instances with respect to mystical experiences occurring after lesions to selected right-sided hippocampal and parietal and prefrontal networks. The account most neuroscientists would endorse here is that some higher cortical centers operate to inhibit and regulate centers or networks lower in the neural hierarchy, and thus when you remove that regulatory influence the lower centers are released from inhibition and you see the upregulated form of function associated with those networks. While it is surely the case that release from inhibition is operative at some point in NDEs, it seems unlikely to account fully for mystical experiences whether they occur as part of NDEs or not. Why is it, for example, that you only or primarily get peace, joy, insight and prosocial behaviors with mystical and NDEs? If all that was occurring was release from inhibition of functions lower in the cortical hierarchy, you would expect all kinds of behaviors and impulses emerging (as you do with TBIs). In particular, why do you get experiences of “unity” in mystical experiences including NDEs? Unless there is some set of scientific principles not yet discovered that can show that mental functioning can occur without a brain, then we are left with the task of accounting for NDE features with reduced or residual brain functioning. There are rational accounts of dualism in the philosophical literature that cogently argue that the mind or at least the sense of unity we all feel as core to our sense of self or consciousness is “simple” in the sense that it has no parts and cannot be reduced to anything. If that philosophical position is correct, then the NDE data might be partially understood within that context. As far as I know, however, NDE experiences

have not been discussed in relation to the immaterialist theories of unity and the self. What about enactivist accounts of the mind that situate the mind in affordances in the environment and culture rather than in the brain? Here again, it seems reasonable to assume that insights from the enactivist paradigm might help to account for some of the features of NDEs. When a person is emerging from the physiologic crisis that threatened death, the sensorimotor systems would reengage with culture world affordances and mind would reemerge and so on. But it is difficult to see how this approach would explain most of the core features of NDEs. Why do peace, joy, insight, unity and so on emerge when culture reasserts its directive and content-related guidance? Enactivist accounts might help to explain that spirit encounters are clothed in local custom and so on, but I do not see how the approach might explain most of the NDE features. What about the idea that all of the core features of NDEs occur as a kind of recall and confabulatory process upon “awakening” from the crisis? Again I doubt that this approach would work. It would require pretty powerful cognitive resources to be functioning immediately upon awakening from the crisis, but we know that that is not the case. The unconsciousness produced by cardiac arrest, for example, leaves patients amnesic and confused for events immediately preceding and following these episodes. In addition, a substantial number of NDEs contain apparent time “anchors” in the form of verifiable reports of events occurring during the period of insult itself. In short, although we have no adequate account of how you can have complex mental functions in the absence of a functioning brain, the NDE data cannot simply be explained away without further investigation. I disagree with the immaterialist account of NDEs and assume that the brain is integral to NDEs.

With regard to the second point, how to relate NDE findings to the rest of the literature on brain and mystical experiences, some progress has been made. All of this, however, has assumed that some residual brain functions are occurring before, during and after the crisis and that the brain has not fully ceased functioning. So let us assume that some portions of the brain remain functional during an NDE and see how far we can get with that assumption. In fact, NDEs are more likely to occur in people who load high on personality variables such as absorption, which also predict openness to mystical and paranormal states.

NDE candidate mechanisms include electrical spikes in the temporal lobes, intrusion of REM sleep into wakefulness and endogenous release of internal opiates and global demodulation of serotonergic transmission, as seen after ingestion of psychedelics such as DMT.

With respect to the idea of electrical spikes in the temporal lobes, our review in a previous chapter on cases of enhanced religiosity after brain damage revealed that atrophy or damage to right hippocampus was associated with enhanced religiosity. We theorized that right hippocampal atrophy/damage would then have downstream effects releasing from inhibition right-sided medial temporal and prefrontal networks and it was these networks that mediated the enhanced religiosity. In addition, Blanke and Dieguez (2009) have argued that there are two types of NDEs with corresponding temporal lobe alterations. Type 1 NDEs are associated with right temporoparietal junction dysfunction and characterized by OBEs and related phenomenology. Type 2 NDEs are associated with left temporoparietal junction dysfunction and characterized by feeling of a presence and communication with SAs. Blanke may be correct with regard to NDEs, but as far as I can tell right-sided hippocampal atrophy is associated with religious experiences that also involve communication with SAs. There is dense interconnectivity between hippocampus and medial temporal structures as well as the temporoparietal junction.

With respect to the idea of demodulation of serotonergic transmission, it is noted that there is substantial overlap between psychedelic experiences associated with the classical serotonergic psychedelics and NDEs. Overlapping experiential phenomenologies should have similar patterns of brain mediation. Indeed, existing data support the idea that serotonergic demodulation can produce the classic NDE experience.

Timmermann et al. (2018) administered the serotonergic psychedelic DMT in a placebo-controlled study to thirteen volunteers and then also administered validated scales for both NDEs and mystical experiences. Results revealed that all thirteen participants scored above the standard threshold for an NDE. By psychometric standards, then, these people all had NDEs even though none of them were near physiologic death. In fact, fifteen of the sixteen NDE items were rated significantly higher under DMT than placebo. The strongest point of overlap between the mystical experience questionnaire items and the NDE score was the item referencing “experience of oneness or unity with objects and/or persons in your surroundings.” When the authors then compared the DMT experiences with those from a matched sample of actual NDEs, the two were nearly indistinguishable phenomenologically. The conclusion is that the experience of unity with the universe or with an SA may be the core experience of both DMT and NDE mystical experiences.

REM and Mystical States

In any case unity with the universe (whatever that might mean!) or an SA (e.g., God) is only one piece of the puzzle of NDEs – not to mention mystical experiences more broadly construed. How do we explain the constellation of characteristics normally associated with mystical experiences of NDEs? Perhaps the best explanation we have for NDE phenomenology was provided by Nelson (2015). He suggested that mystical experiences associated with NDEs represented an intrusion of REM phenomenology into waking consciousness and neurocognitive functioning. We know how REM intrusions work because they are a common occurrence for people with various neuropsychiatric disorders such as narcolepsy. In narcolepsy, when REM intrudes it often includes cataplexy, vivid auditory and visual hallucinations including encounters with figures and spirit beings and much else besides. Part of the neural circuitry that controls the onset and offset of REM includes the periaqueductal grey and the adjacent deep serotonergic reticular nucleus. Importantly the midbrain periaqueductal grey matter has been implicated in religious mystical experiences (Ferguson et al., 2022). In addition, Nelson (2015) found that the prevalence of REM sleep intrusion was 60 percent in a sample of people with NDE and 24 percent in controls. A crowdsourcing study (Charland-Verville et al., 2020) of 1,000 unprimed laypeople from thirty-five countries confirmed an association between the two conditions: people with evidence of waking REM intrusion were much more likely to report NDEs than those without such evidence (OR 2.85, $P < 0.0001$).

Thus, the idea would be that we all have this innate REM system that is closer to the surface for some people or is more easily triggered in some people. When it is activated or approaches daytime consciousness it produces conditions for reception or production of mystical-type and paranormal forms of experiences. The fact that REM sleep might be so intimately tied to mystical experiences is a fundamentally important fact for an understanding of the neurobiological roots or correlates of religious and mystical experiences. We have seen how enhanced religious and mystical experiences are related to right hippocampal atrophy and the resulting release from inhibition of MTL and mPFC networks. Carhart-Harris and Nutt (2014) called attention to a rare patient case study in which intraoperative electrical stimulations of the posterior cingulate cortex (PCC) in a conscious patient induced transient dreamlike states (Herbet et al., 2014). The PCC is connected with the hippocampus,

the precuneus and with the mPFC. As noted in previous chapters, this network constitutes a core portion of the larger default mode network (DMN); a system when down regulated via psychedelics induces mystical states.

As Herbet et al. discuss, stimulation of the PCC/cingulum bundle (white matter tract connecting the PCC to the mPFC) likely interrupted communication between the mPFC and PCC. According to Carhart-Harris et al. (2012), altered mPFC–PCC functional connectivity was reliably associated with the production of dreamlike states and vivid visual imagery in psilocybin volunteers (Carhart-Harris et al., 2012, 2014; Muthukumaraswamy et al., 2013). Recall, as noted in previous chapters, as PCC cerebral blood flow is decreased in REM, while the MTL is enhanced in REM sleep (Braun et al., 1997; Maquet et al., 1997). In addition, MTL activity is coupled to phasic events in REM sleep, including REMs themselves. Thus, disrupting the DMN with psychedelics may increase religiosity via disinhibition of REM physiology, especially MTL activity (Carhart-Harris et al., 2014). Similarly, atrophy of the right hippocampus would also have disinhibitory effects on both the salience network and on the MTL and mPFC. Again MTL activity is also enhanced in humans during REM sleep (Kussé et al., 2010; Miyauchi et al., 2009) and pathological increases in MTL activity due to temporal lobe epilepsy can result in Geschwind’s interictal behavioral syndrome of hyperreligiosity. Dreamlike experiences can be elicited by direct electrical stimulation of the MTL/hippocampus (Halgren et al., 1978). In summary, heightened activity in the MTL and mPFC either due to release from inhibition secondary to subcortical atrophy of right hippocampus or PCC suppression during REM or during psychedelic administration, all result potentially in increased religiosity and potential mystical states.

As we all know, REM dreams are characterized by vivid imagery, loss of the sense of agency and volitional control, and heightened emotional reactivity. This dream phenomenology obviously overlaps considerably with psychedelic phenomenology that produces mystical states. Sanz et al. (2018) investigated the semantic similarity between a large number of subjective reports of psychedelics and reports of high/low lucidity dreams. An analysis of the most frequent words in the subjective reports of dreams and psychedelics revealed that terms associated with perception (“see,” “visual,” “face,” “reality,” “color”), emotion (“fear”), setting (“outside,” “inside,” “street,” “front,” “behind”) and relatives (“mom,” “dad,” “brother,” “parent,” “family”) were the most prevalent across both experiences.

Thus, converging lines of evidence suggest that heightened medial temporal and medial PFC activity as appears in REM neurobiology is important for the generation of mystical religious states.

But perhaps the most important factor driving or accompanying mystical states is deep transformation of the self; a topic to which we turn in Chapter 8.

Religious Experiences and Transformative Experiences

Introduction

Many religious practices function to facilitate transformation and growth of the self – often by attempting to reduce the discrepancy between the current self and an ideal self. But how does religion reduce that discrepancy, spiritually, psychologically and neurologically? In general we experience two types of religiously informed transformative experiences: (1) experiences that we undergo and (2) experiences that we aim at, aspire to or seek to make happen. The latter are generally treated by philosophers as decisions. Within the “man as a rational actor” paradigm, we choose actions that, all things considered, serve to maximize utility. Similarly, in evolutionary terms we choose actions that serve to maximize our fitness (ultimately actions that increase the chances that we will have grandchildren). But these rational actor paradigms don’t seem to work too well for transformative experiences. The philosopher L. A. Paul (2014) looks at the decision of whether or not to have a child. Most people would agree that having a child is a transformative experience. She argues that in order to determine whether or not having a child would maximize utility, Sally would need to know “what it is like” to have a child. Indeed, to really perform the relevant calculations to maximize a utility function she would need to know all kinds of things about herself and her baby *after* she has undergone the change of having the baby. Since she cannot possibly know all these things she cannot make the decision in a fully informed, rational way. That is why Sally (and most other people) will then seek out as much of the relevant knowledge that is available from doctors, friends, family members and other sources so that she can make a better-informed decision. But all this supplementary information will not allow her to maximize utility, because if she bases her decision on all of this supplementary information she is basing her decision on other people’s ideas, preferences and values concerning having a baby. Her decision will be alienated from her

own values and preferences. The old rational actor paradigm, and indeed normative decision theory itself, would demand that Sally *replace* her initial preference regarding having a child with that of some community consensus, and this consensus may not maximize Sally's utility. Sally's interest may or may not match group interests as captured in normative custom or moral standards. Normative consensus certainly would not tell Sally "what it is like" to have a baby or to undergo the transformative experience of having a baby. We cannot get what we need regarding transformative experience from normative decision theory. Transformative experiences appear to involve outcomes that are epistemically inaccessible to the agent prior to making the decision precisely because they involve the birth of a new self (with new preferences, values, perceptions, aspirations, etc.).

The Divided Self and Transformative Experience

But now suppose I wish to transfigure myself into the image of Christ to become Christlike. Is the outcome of this wish/decision to transform myself into a saint epistemically inaccessible to me prior to making the decision? Yes I think so, given that I cannot know or experience "what it is like" to be Christlike before I actually experience it. But does this mean I cannot assign a value to the transformative experience? Why can't I look at other people who have become saintly and say that I want that too? Paul, I think, would concede that I can assign a value to the saintly experience because I can imaginatively access what it is like. But the worry is that if I base my cogitations on what other so-called saintly people are saying or doing I necessarily end up using other's people's values and information, and thus the decision will not actually be mine – my current self. Can I make a rational decision to aim for saintliness if I cannot ensure that the values of my future self are my own values? But the values of my current self are precisely the values I want to discard – except of course the set of values that have me wanting to become a saint. Thus, one part of me I want to discard and another part of me I want to keep. Will this divided self survive the transformative experience? Hopefully not! Will my self-preferences and values change upon making the transformation into saintliness? I certainly hope so! The upshot of these reflections it seems to me is that "I" am not a single unified self with one consistent set of preferences and values. "I" hold inconsistent beliefs, values, motivations, urges, desires, thoughts and information, and therefore my decisions too will be inconsistent. I am, in short, a divided self. As St Paul famously put it (Romans 7: 15–20):

I do not understand my own actions. For I do not do what I want, but I do the very thing I hate. Now if I do what I do not want, I agree that the law is good. So then it is no longer I that do it, but sin which dwells within me. For I know that nothing good dwells within me, that is, in my flesh. I can will what is right, but I cannot do it. For I do not do the good I want, but the evil I do not want is what I do. Now if I do what I do not want, it is no longer I that do it, but sin which dwells within me.

Here St Paul disidentifies himself with that part of himself which does the things “he” does not want to do. The part of himself he identifies with wills to do some things he wants to do, but he finds that “he” does not in fact do those things “he” actually wills. Rather, some other part of him he calls “sin” is in more control of his actions than “he” himself is. Modern biomedicine is very intimately acquainted with cases of the divided self. Some of these cases we understand as “addiction” or more specifically an individual attempting to quit an addiction. Other cases involve neurologic disorder and yet others neuropsychiatric dissociation. All of these cases make it plainly clear that we are not unified selves. What are the implications of this fact for religion and transformative experiences?

One implication is that there are forms of disunity or the divided self that are unpleasant and indeed excruciating for the individual. For example, addiction very often involves tremendous suffering for the individual and everyone who loves him/her. Therefore, there must be some forms of a unified self that are to be desired. Some forms of religion/religious practices provide tools to achieve this kind of healthy internal unity. Another implication of the divided self is that the rational actor theory needs to be supplemented with other ideas if we are going to understand transformative experiences. If my current “I” has no access to the future self or if normative consensus is not a reliable source of information, does that “I” change at all during transformative experience? What actually happens to the current “I” during transformative experience? Does the current self get discarded or just simply stop working or die off? Or is it used to build a new self? Who or what gets changed when we undergo transformative experiences? Religions tend to speak of a death and a rebirth of a person when they speak to transformative experiences. Can a new self be born out of the ashes of an old self? What actually do we mean by the term “self” when we speak of transformative experiences?

Predictive Processing Framework and Self Transformation

According to the predictive processing framework (PPF), the self is a simulation created by the mind to facilitate the binding or integration of information coming up from multiple levels of the neural hierarchy. It is an

attempt to use all available information to simulate the current state of the individual and her world and to predict what will happen next to the individual and the world. But this simulation, this self-model, not only integrates all available information at its disposal, but it also uses active inference to plan and to intend and to act on the world. It is in short a causally efficacious entity, information structure or simulation. Because it is capable of downwards causation it can claim ownership/authorship of experiences, and other cognitive events and actions. This high-level integration of all available sources of information and the subsequent temporal and functional binding of this information into a simulation or self-model that has causal powers yields the sense of unity or a unified self that we all experience. But then whence comes the experience of disunity and the divided self? The divided self comes from breaks in the effort at integration. Neurologically the sense of unified self is related to activity in the network of midline structures involved in emotion, motivation, salience and executive control (Qin et al., 2020). These structures include the default mode network (DMN) including the medial prefrontal cortex, the anterior cingulate cortex, implicated in error detection and task switching, the anterior insular cortex, implicated in interoceptive processing, and the precuneus associated with self-conscious emotional feelings. Executive control is associated with parietal-prefrontal interactions. All of these networks participate in supporting the overall construction of an ever-shifting but relatively stable sense of self that has ownership of actions and causal powers (agency) and that constantly issues predictive simulations of the world to come. The sense of unity, however, is constantly shifting such that most days evidence some disunity. Integration is difficult and requires constant effort. It is no surprise that breaks in unity are common. It may even be that those breaks are functional or ultimately fitness enhancing – as long as the breaks in unity are not too extreme. Imperfections in the process of integration may not be the only road to disunity in the psyche.

The Dialogic Self and Transformative Experiences

One model of the psyche that accommodates this kind of a healthy sense of a unified self where some level of disunity is adaptive is the dialogic model of the psyche (Hermans et al., 2017). Dialogic self theory builds upon the idea that the mind be construed as a hierarchically organized network of agents that together function as a society. Every mind contains a host of agents called positions, with one agent more or less stably taking on the major role of the “I.” “I” refers to the subject-position, a first-person perspective, from which the world and the self is experienced. “Positions”

are dynamic everchanging entities that interact constantly with other positions both within and without the psyche. Positions can be active when they act to form coalitions with other positions or they can be passive when they are positioned by others (e.g., excluded from a coalition). The process of positioning is an iterative and reciprocal way of the “I” and other positions/agents placing themselves and others as part of social, cultural or societal forms of relationships. The “I” “appropriates” some of the positions and rejects others and in this way positions begin to contribute to parts of a coherent psychic structure. The organizing capacity of the “I” position results from its ability to appropriate or control the places and roles these positions play in the overall psychic structure. Sometimes the internal positions are experienced as internal voices that interact like characters in a drama or even a dialog or a negotiation. These interactions over time inevitably cumulate a record or history of the interactions in order to decide whether a voice is trustworthy or a free-rider when it comes to cooperation. **Thus, the social nature of the psyche takes on a narrative structure that also can be understood within current theory concerning the evolution and dynamics of social cooperation.** At one level the problem of optimally unifying the various positions within the society of mind amounts to an aggregation problem if each position/agent within the mind simply presents to the “I” a recommendation on how to proceed or model the world. The Arrow theorem, however, suggests that no procedure for aggregating rank orders of preferences in a society of rational actors would necessarily satisfy axioms of rationality; that is, would be rational. But then how does the “I” assign weights or integrate preferences and information coming to it from all sources where each source may have differing ultimate interests from the “I”? The answer is that it usually does not decide. When the internal agents of the society agree, the “I” arrives at a consensus and there is the subjective sense of unity. When disagreement reigns disunity is the experience.

In the first edition of this book and earlier chapters I pointed out that we are composed of differing genetic elements that are in conflict with one another. Fitness for one genetic element is not in the interest of another and so forth. For example, nuclear genes are transmitted via both parents (eggs and sperm) while mitochondrial genes are transmitted only via the mother. In the case of genomic imprinting, paternal line genes are in conflict with maternal line genes. Genes of paternal origin promote the interests of the father’s side of the family but not the mother’s, while the mother’s genes do the same for mother’s side. This array of conflicting genetic elements within us make us a society of interacting genetic elements. It may be that these conflictual genetic elements contribute to

the “mind as a society” psyche we come equipped with and thus to the competing selves we experience subjectively. These constantly conflicting agents within us make for a tentative and weakly constrained unity among multiplicity that we all experience as the “I.” But if we have too much multiplicity and conflict such that consensus never arrives, then we are submerged in chaos and nothing ever gets done. On the other hand we need to avoid premature consensus or tyrannically imposed consensus with a self that is too strong as this will inevitably produce explosions. When as the PPF demands, the self becomes hierarchically organized to a degree that one supreme voice dominates all others, the self may become monological, thus preventing innovation that comes from competing voices and sources of information. So how does the dialogic self find the middle ground of some disunity but not too much?

Hermans points to special positions he calls promoter positions as one method the “I” uses to overcome extreme disunity without falling into monological forms of integration. A special feature of a promoter position is that it stimulates the development of a broader range of more specific internal and external positions of the self and moves them to a higher level of integration. These promoter positions are positioned at special places in the neural/psychic hierarchy such that they occupy neural hubs that allow them to integrate information from superordinate positions in the organization of the self. We might think here of neural networks with bottlenecked hubs such as the precuneus and the anterior insula as candidate promoter positions. Psychically these promoter positions are engaged/activated via potent cultural symbols such as high status individuals who can serve as models for the ideal self we want to become.

Lysaker and Lysaker (2008) use dialogic self theory to understand what happens to the sense of self in schizophrenia. Based on their experiences as clinicians who treat patients with schizophrenia, they treat positions as habits of mind. They highlight three positions: character, organismic and metapositions. Character positions capture the roles we play in our lives (parent, worker, friend, etc.). Metapositions assess and reflect on these character and other positions. Organism positions are prereflective intuitions or assessments concerning bodily integrity. As noted earlier, for Lysaker and Lysaker our sense of self appears to emerge from interactions among varying positions/voices within the overall society of mind. There is no ongoing deep core self that supports a sense of unity. Rather, a sense of self coheres transiently due to ordered interactions among positions. One “encounters” oneself in movements among character positions and metapositions. Given that ordered interplay among self-positions discloses

the sense of self, disruption to this ordered interplay will produce either a diminishment in the sense of self associated with negative symptoms of schizophrenia, or conversely an inflated sense of self when a monological tyrannical and paranoid sense of self attempts to coerce all other self-positions. The hierarchy of self-positions can become disinhibited in such a way as no ordered interaction or constellation of selves could emerge against the noise or activity of too many active self-positions (the cacophonous self), or conversely if the hierarchy of self-positions are down regulated in such a way as to make interactions among self-positions too slow or downright impossible (the barren self), then no sense of self would be able to emerge at all. Or yet again, if a single self-position rigidly (the monological self) was assigned all decision-making capacities without interaction from other self-positions, then once again no sense of self could be disclosed given that no ordered interactions among positions would be possible.

While schizophrenics experience pathological forms of the cacophonous, barren and monological selves, these are dangers we all experience with respect to our psychic and social experiences. What can be done to find that sweet spot between a monological and a disorganized and cacophonous sense of self? Religions have always offered a set of transformative practices, most especially rituals (discussed later in this chapter) that assist in attaining these kinds of healthy senses of self. One way to summarize what religion offers in terms of finding that sweet spot is that it helps us to construct a transformative orientation toward ourselves; that is, a transformative self.

What is a transformative self? A transformative self optimizes the balance between the self-positions in an individual psyche. It does so by aiming for an “ideal” self. In dialogic self theory terms the “I” position decenters itself by refusing to own its current position and attempts to own a position of the ideal, imagined or simulated self. Thus, it places all other positions within the psyche in dynamic interplay relative to the *ideal self-position*, as well as the current “I” position and to one another. The “I” position is experienced as in transit or in a “liminal place” where change over time becomes inevitable and narrative logic captures the transformative experience. Bauer (2021) provides detailed analyses of the transformative self. He defines the transformative self as a narrative self-identity that has personal growth toward the good life as its aim and purpose. It draws on cultural master narratives or stories of what a transformative character is and how it obtains to the good life as inspiration. For example, the novelistic *bildungsroman* genre wherein characters undergo transformation in their questions for self-discovery and the good life. These are coming

of age stories, rags to riches stories or stories of suffering and transformation. Of course religion provides an inexhaustible source of master narratives on what the good life is and how to obtain it. Bauer notes that most master narratives on the transformative self aim at a balance between hedonic pleasure-seeking and eudaimonic wisdom-/meaning-seeking motives. There also needs to be a balance between breadth of perspectives on values (perspectivity of value) and depth of commitment to a set of values. Personal growth itself must be among those values. Bauer recommends what he calls a “euvitalistic personhood,” which aims at a balance of hedonic and eudaimonic motives, and communal and agentic impulses. Growth takes time so commitment must occur across time and despite the pull of time. Because time, chronology and personal life stories are crucial for growth, the transformative self necessarily involves a narrative form of identity. Narrative identity in turn is composed of both structure and content. Narrative structure involves complexity and coherence elements where complexity refers to the number and variety of value perspectives the individual incorporates into her worldview, while coherence refers to the integration and differentiation of those value perspectives into a life-affirming stance. Measures indicating coherence include thematic, causal and temporal elements. Content of narrative identity refers to tones and themes that recur in one’s life story. These help, along with structural elements, to confer continuity of identity over time. No continuity, no self. That narrative identity is a self-position in the language of dialogic self theory that engages with other positions both within and outside the psyche. These engagements or interactions also vary in complexity from dyadic, group and collective to political, with each level introducing or subtracting positions within the psyche. This is one place where culture directly shapes intrapsychic functioning; that is, via the insertion and subtraction of self-positions with the individual psyche. Inserted self-positions obviously begin to interact with other self-positions and thus alter the dialogue within the psyche ultimately influencing decisions taken by the individual. Religion, when it is operating normatively and buttressing existing societal norms, constrains the self-positions inserted into the individual to positions that are promoters of an “I” that adjusts itself to those norms, thus making cooperation possible at the societal level. But religion can also operate against existing societal norms, and then it seeks to insert positions that voice objections to those norms in favor of another set of values.

Is adopting a transformative self or position or mindset oriented toward personal growth the only thing we need to do to achieve intrapsychic balance? Unfortunately no. The ultimate aim of all that growth has to be

toward what Bauer calls the good life where the values of the good, the true and the beautiful count. The teleologic aim of the individual confers unity of purpose on the “I” position which in turn allows for some unity of aims among the positions with the psyche. But as we all know very few of us agree on what exactly constitutes those transcendental values. Religions in fact disagree on precisely what to count as the good the true and the beautiful. At the individual level, however, a consensus can be reached on the transcendental values as long as the individual chooses a set of those values and then commits to those values in depth. This is called “conversion.” This commitment to ultimate values confers on the individual some intrapsychic peace for a time. So let us next look at the dynamics of conversion as they are central to the transformative religious experience.

Conversion

What happens to the sense of self after a religious conversion experience? Presumably conversion is a transformative experience, so one would expect some fundamental transformation of character traits, and in terms of dialogic self theory a rearrangement perhaps of existing self-positions, and promotion of new character positions into metapositions and so forth. Recent reviews of the psychological literature on conversion experiences (Paloutzian et al., 2013) however, find little evidence of short term effects on personality. On the other hand, to see evidence of the impact of religious conversion on personality requires large longitudinal samples assessed over long periods of time. When these large-scale longitudinal projects have been done adequately, clear effects begin to emerge. Converts load higher in extroversion, agreeableness and conscientiousness and lower in neuroticism following their conversion. They also score higher on honesty/humility scales relative to controls. These character transformations took at least three to six years to manifest after conversion.

This latter result, the time it takes to undergo transformative experiences or to successfully complete transformative experiences, suggests that lasting change occurs slowly; it takes time. This, I suggest, follows directly from the fact that habits take time to inculcate. Habits in turn take time because of the neurology involved in habit formation. While there is significant plasticity in brain functionality for higher level cognitive functions, more fundamental organismic functions such as basic orientation toward selected values are not allowed to vary as much once fixed. In these sorts of deep conversions involving lasting change, a series of small changes result in an eventual overall reorientation away from an old self's values toward

the ideal self's values. We gradually become that ideal self if we persevere. Because religious conversion is understood to involve this turning away from old to new values, they are also often understood to be tied to one's essential identity, to the real "substance" of what makes one oneself. But if we see the conversion experience in terms of the dialogic self theory, what is occurring is the gradual introduction of new voices or positions as habits into the economy of the plural psyche, with these new voices becoming orchestrators of the overall consensus among voices in the psyche. For that to happen the new voices have to be buttressed by Herman's "promoter positions" in order to take up strategic positions in the neural hierarchy to guide information processing and motivational aims. The new constellation of positions within the psyche constitutes a new self-consciousness that freshly defines the essence of the identity of the person, as long as we understand that essence as something dynamic and constantly moving in an orderly fashion between positions.

The creation of this new consciousness, this new set of habits or constellation of voices within, necessarily involves the death of the old self. It is the death of the old self that can often be sudden, as when an addict hits bottom or a visionary gets a dream vision or when an individual has her first ayahuasca experience. In really intense experiences the death of the old self is experienced as an annihilation of self or a sudden freeing up of the new possibility due to the sudden death of the old self. In these cases the experience is ecstatic, euphoric and visionary. In the sudden death of the old constellation of voices within and the birth of the new constellation the experience of self-transcendence occurs, sometimes with extraordinary experiences occurring like out-of-body sensations or the merging of oneself with another or with God.

Yaden et al. (2017) have used the term "self-transcendent experiences" (STEs) to describe transient mental states in which the subjective sense of one's self as an isolated entity can temporarily fade into an experience of unity. STEs involve at least two interrelated phenomenological ingredients: 1) an annihilation of the sense of self, accomplished by dissolving self-boundaries and self-salience; and 2) a relational sense of unity with something beyond the self (e.g., others or the natural world). As mentioned earlier, the sense of self is mediated in part by a suite of structures along the cortical midline which overlap to some extent with the DMN with the precuneus and the inferior parietal lobe (IPL) as central key functional nodes in the network. STEs should therefore involve demodulation to some extent of these posterior parietal networks including the IPL. We know that the IPL is demodulated in association with the ego dissolution

experience on psychedelics (see Chapter 6). In addition, when the IPL and precuneus are experimentally inhibited we get similar (though of course milder) effects, as occurs in ego dissolution during psychedelic administration. For example, Urgesi et al. (2010) found that selective lesions to left and right inferior posterior parietal regions specifically *increased* reports of self-transcendence in glioma patients after neurosurgery. Johnstone et al. (2012) found that decreased function of the right parietal lobe was associated with increased self-transcendence. Crescentini et al. (2014) combined continuous, intermittent and sham theta burst stimulation (cTBS, iTBS and sham TBS) with tests of implicit religiosity/spirituality. The authors found a decrease of implicit religiosity/spirituality with increasing IPL excitability with iTBS. Boosting IPL excitability reduced implicit religiosity/spirituality presumably due to a decrease in extended self-awareness experience. No self-transcendence is possible with IPL excitability apparently.

Dreams and Transformative Experiences

All kinds of dramatic character transformations occur in dreams. For example, the key attribute of mind or intentionality often becomes decoupled from an ordinary human body and then gets recombined with special bodies (e.g., animal bodies) so that you have a man's mind in a bear's body and so on. When minds are placed in unusual bodies in a dream, these new beings are also invested with unusual powers or abilities. They might have special mindreading and other abilities, and are interacted with in the dream as if they were real. A man's mind in a bear's body, for example, might lead to the idea that the composite being is especially strong, cunning, dangerous and so on.

To complete these transpositions of mind or agency from one character to another in a dream, one needs placeholder empty characters who can receive attributions projected by the dreamer during a dream. Strangers (or unfamiliar characters) and animals fill the bill here. Because strangers are literally nonentities, they can be filled with anything the dreamer wishes to project onto them. Once a stranger is invested with special mental and physical attributes by the dreamer, he or she becomes a *special* character who drives the action of the dream forward. These on-the-fly dynamic character transformations (including loss of agency in the dreamer with subsequent overattribution of agency and other abilities in a stranger character) occur in what appears to be a five-step decentering process:

- 1) Occurrence of an anomaly or unexpected event along with a diminution in agency or power of the dreamer (this is the “surprise” event that triggers decentering);
- 2) Enhanced agency or powers appear in another dream character – usually a stranger or unfamiliar or ill-defined character who can now potentially become a supernatural being;
- 3) A period of liminality when the dreamer is disoriented or fearful;
- 4) Efforts by the dreamer to fix the anomaly or reestablish a sense of agency;
- 5) Outcome – either success at reestablishing agency or failure and misfortune.

In short, dreams give rise to character transformations by reducing agency in the dreamer and transferring it several times over to another dream character (typically a stranger). The chemical environment of high acetylcholine and low serotonin activity in rapid eye movement (REM) sleep promotes all of these steps by facilitation of the detection of unexpected events or anomalies and then preventing agency or power within the dreamer and plunging the dreamer into a liminal state almost akin to an LSD trip – though of course not quite as intense.

These metamorphoses of one character into another very likely contribute to the transformative experience of the dreamer. In myths and fairy tales conscious beings (people, gods) tend to be transformed into entities nearby in the conceptual structure so that animals were transformed into other animals and humans into other humans and so forth. This also occurs in dream reports, but perceptual nearness seemed more important than conceptual nearness. That is, a bear-like man could be transformed into a bear because of perceptual similarities – not conceptual nearness. Character lines in dreams start when a character enters a dream; properties and theory-of-mind attributions tend to be preserved along the line, regardless of whether metamorphoses occur on it. Now because unfamiliar or poorly defined vague characters make up between 50 percent and 80 percent of the character lines in dreams, these metamorphoses will inevitably mostly involve a stranger. In short, there is a transformational character line in the dream for each animate entity, and when there is a metamorphosis along some line, the number of characters on that line increases and they begin to transform into other entities. When a new character is produced he/she tends to exhibit most of the properties specified for that entity line as captured by the original character. Consequently, the two entities (new and old) tend to be of the same or nearby conceptual categories.

We can apparently see the cognitive mechanics of transformative experience involving identity changes within the dream-work. In terms of dialogic self theory, when a new set of self-positions are being introduced into the constellation of existing self-positions, new character lines are introduced. To fill in those character lines the cognitive system selects cognitive elements from nearby conceptual space to produce those new positions. The neurological machinery of REM sleep supports these cognitive dynamics.

The Self and Its Transformation in Islamic Mystical Practices

It is generally agreed that one of the major lineages in Islamic forms of mysticism is the Sufis. Their histories and sacred texts are rich in explicit reference to transformation of the self as the aim of all religious practices. According to the scholar of Islamic mysticism Sara Sviri (2002), the immediate Arabic equivalent for “self” in Sufi literature is *nafs*. “In Sufi psychology *nafs* became, primarily, the designator of a negative, earth-bound fiery entity that needs to be constantly condemned and watched over” (p. 195) or better, the *nafs* needed to be transformed into a better, higher self in order to leave egocentricity and selfishness behind.

Interestingly, Sviri (2002) remarks that for the Sufis “It is that very culpable nature of man that in the end, when transformed, ennobles him. Static goodness, such as that of angels, ranks inferior to that which man acquires through repentance and effort” (p. 196). The “Felix culpa” of the Christian tradition is similar in spirit, it seems to me, to this Sufi sentiment regarding the *nafs*. To actively choose “goodness” over sloth, indolence, egocentricity and evil is a greater vocation than that of the angels presumably because it involves the free and sustained effort of a being who could have done otherwise. In support of the high vocation of man, the Sufis cite the story that God, when asked why he created human beings, replied “I was a hidden treasure and wished to be known.” You can only really know someone when you choose to do so. I cannot say that so and so really appreciates me if so and so had no choice about becoming acquainted with me. A person wishes to be chosen, and certainly a lover wishes to be chosen by the beloved.

The concerted effort, then, to get to know God is an effort to overcome the *nafs* so that a new person or self will emerge. One that is capable of discerning and choosing the good over the “apparently” good.

Sviri continues:

Sufi authors see the transformation of qualities, *tabdil al-akhlaq*, as the process whereby a holy man, the friend of God, is forged out of faulty human nature. Significantly, one of the highest ranks in the mystical hierarchy is reserved for the *abdal*, the “Substitutes.” These are holy men and women, usually forty in number, without whom the world cannot subsist. The term *abdal* derives from a verbal root, *b d l*, that denotes transposition and substitution. Hence, according to the standard explanation, the *abdal* are so called because whenever one of them dies, God substitutes (*buddala*) another for him. Yet within Sufi circles an additional explanation circulated: they are so called because they have transformed (*baddalu*) their base qualities. (p. 196)

In the Sufi tradition, apparently, and in most if not all of the other religious traditions, religious practices are focused on transformation of these base qualities in order to turn them into gold or a set of higher qualities. When enough such qualities have been transformed you get a new self.

Sviri points out that:

The idea of the transformation of the self has been understood to rest upon three Qur’anic verses which address *nafs* explicitly. The first verse addresses the *nafs* as “that which incites to evil” (*al-nafs al-awammara bil-su*; 12:53); in the second, it is designated “the *nafs* that blames” (*al-nafs al-lawwama*; 75:2); and in the third it is described as “the serene self” (*al-nafs al-mutma’inna*; 89:27). These three designations, culled from disjoint locations, were seen, when juxtaposed in the foregoing order, as a paradigm for the progressive transformation of the lower self through effort, discipline, introspection, and, ultimately, divine grace, into the desired state of fulfillment. (p. 197)

This progressive transformation of the qualities of the self are remarkably similar to the decentering process discussed in this volume. There is an initial enhancement of imagery, negative affect and internal dialogue (self-blaming and incitement to evil). After reductions in volitional control and the turn inward, there is alteration in perception and awareness, an increase in positive affect and a heightened sense of meaning (the serene self). Presumably, each of these mini-experiences involves a decentering effect and they build over time to issue in a consistent sense that a new self has emerged and that this self is serene and joyful. But it is crucial to keep the mini-religious experiences coming, and for this you need to keep prolonged effort and frequent performance of religious practices. Sviri (2002, p. 199) describes a short treatise entitled *Rules of Conduct for Acts of Worship* (*Adab al-‘ibadat*) by Shaqiq al-Balkhi, a second/eighth-century mystic from Transoxania. Shaqiq describes four progressive stages in the process of transformation of the *nafs*: abstention (*zuhd*), fear (*khawf*),

longing for paradise (*al-shawq ila-l-janna*) and love of God (*al-mahabba li-llah*). Different religious practices are recommended for each particular stage: “The period assigned for each stage is limited to forty days, at the end of which the practices pertaining to it may be abandoned” (p. 199). Most of the recommended religious practices in the first stage are ascetic practices, thus the name abstention. Abstention involves a reduction in food intake so that hunger is experienced. Alternatively, one can opt, as Jesus did, for total fasting for forty days. The effects of abstention are such that God plucks the desire for superfluous things out of the Sufi’s heart. The Sufi is then on the road to freedom. The next stage, however, is Fear: “The practice here begins with contemplating death and educating the nafs to fear God intensely” (Sviri, 2002, p. 201). Forty days of soberly and piously cultivating fear of God results in what Shaqiq calls *mahaba*, or awe. “After forty days, the effect of the inner light of awe becomes apparent on the practitioner’s face, and he, too, becomes an object of awe...” and reverence (Sviri, 2002, p. 201). Interestingly, Shaqiq points out that the emergence of religious awe produces an emotional upheaval in the psychology of the “seeker.” Although he prays constantly he finds no pleasure in religious practices or in social contact or in the world. In the Christian tradition this stage is often referred to the period of dryness or the desert experience. If the seeker persists, however, the emptiness, fear and restlessness are replaced with a longing for God and the seeker enters the next stage, longing for Paradise “The practice here is to contemplate the everlasting bliss of paradise and its delights, such as the black-eyed beauties (*al-hur al-in*), that await the blessed ones. As earlier, here too: when the practitioner, in earnest commitment, disciplines his self to endure the practice of longing, God rewards him by implanting the light of longing in his heart” (Sviri, 2002, pp. 201–202). Shaqiq’s forty-day effort at self-transformation is remarkably similar to Ignatius of Loyola’s “spiritual exercise.” The Ignatian exercises are based on four “weeks.” The first two weeks involve contemplation of one’s own sin and cultivation of fear of God and hatred of Satan. The second two weeks are focused on cultivation of love of Jesus and conversion to Jesus’ “standard.” My point in summarizing Sviri’s treatment of some early Sufi texts is to point to how clearly the recommended religious practices are aimed at transforming the self.

Why Does Religion Seek to Transform the Self?

Many influential theories of religion’s functions point to social cooperation and cohesion as its major positive function. Fewer and perhaps less

influential theories of religion's positive function have pointed to individual socialization, integration and autonomy. Now of course these two positions need not be mutually exclusive. It could be that religion functions to promote self-transformation so that social interactions and social cooperation may have a chance of succeeding. Conversely, religion may promote social cooperation in order to protect individual self-transformation. Whatever the case may be, it is clear that social cooperation would be more likely if individuals had some help in learning to see one another's or the other's perspective about matters in dispute. In addition, social cooperation would be more easily achieved if individuals could be brought to actually care about one another as well as the welfare of more than just immediate kin. While human beings are born with some capacity for social cooperation and empathy, that capacity needs a lot of care, nurture and development if it is to operate to promote social cooperation among individuals outside one's immediate genetic relatives. Religion may encode one set of procedures for creating individuals capable of real, long-term social cooperation that transcends altruism directed toward one's own genetic kin.

I do not believe that religion's interests in the individual are merely about creating civilized, trustworthy, cooperative individuals who can be relied upon to cooperate with others if that cooperation protects long-term (genetic) interests of the individual. Religion certainly *is* about creating such individuals, as such individuals are good for creating humane and working societies. Such trustworthy and cooperative individuals also display the best of the martial virtues, of courage, fearlessness, loyalty to comrades, self-sacrifice, ferocity in battle and steadfastness under fire. But religion does much more than this. Among its capacities for promotion of personal transformation is the use of rituals. We will discuss the brain basis of these rituals in Chapter 10. Here it is necessary to examine the power of rituals to facilitate transformation.

Religious Ritual Facilitates Transformative Experience

Religious rituals function in part to facilitate personal transformation of individuals involved in the ritual. Participants in a ritual undergo a formal, rule-governed, relatively invariant pattern or sequence of actions that systematically downplays agency of their current selves and focuses participants on some sacred ideal or cultural master narrative. Most often religious rituals take place in the company of others and involve reference to normative moral or community ideals. Thus, they represent an opportunity

to insert new self-positions into the psyche's repertoire of participants. Or the rituals could be said to boost "promoters" within the psyche so preexisting self-positions are reinscribed into the overall economy of the psyche. Rituals impose order upon the array of behaviors and competing voices within and without the psyche. Via the sequential episodes in a given traditional ritual they literally quiet the mind enough so that renewal and transformation become possible. The reduction of surrounding noise actions and events into an invariant traditional sequence of actions reduces the complexity of information being processed and thus gives the mind a chance to focus or refocus on hoped-for aims. Participation in the ritual also signals to others in the ritual space willingness to pay the price for admission into the community and to eschew free-rider strategies. Thus, the ritual reconciles the individual to the wider cultural context and community, making personal transformation culturally permissible. But of course, rituals do more than this, as we will discuss in Chapter 10.

Liminal Reality as the Transformative State

A key characteristic of transformative experiences is that they place the individual within a liminal space for varying periods of time. This follows from the necessity that the old self dies or is discarded. That old self had a place within the tribe or local normative group. But when the old self is discarded the old tribe or community is discarded as well. When you reject an old self you are also rejecting the community of individuals who interacted with that self over time. Think of the addict who will no longer associate with addicts currently using. Sobriety is not stable until a new community of associates is established. Until that new stability is attained the individual will be partly dead and partly alive. She will be in a liminal, threshold space. Religious rituals can help an individual through that space. Intrapsychic and external real life guides can facilitate the transformation or passage through liminal space, but fundamentally the individual has to navigate it themselves as they will not only be establishing a new sense of self. They will also be establishing a new community, a new world.

Death and Transformative Experience

The literature on near death experiences and reports from people who know that they are dying all convincingly demonstrate that imminent death for most people is a transformative experience. Concerns switch from petty matters to improving relations with those you love. Ultimate

values become salient and motivating. Often the dying become quite religious. Terror management theory has noticed this fact and devised a theory of religion (and other forms of culture) as a buffer against the anxiety of death. Freud and many others have suggested similar defensive functions for religion. In obsessive–compulsive disorder, anxiety compulsions can certainly take on a religious nature. The greater the anxiety the greater the intensity of religious delusions adopted as coping mechanisms. There appears to be an effort by the individual to use religion to transform the current dying self into something else that somehow lives.

People also use dreams to cope with and facilitate the transformative process of dying. Two dream types are of special importance with regard to death: 1) “visitation” dreams and 2) end of life dreams or dreams of the dying.

Visitation dreams occur when the bereaved is “visited” by someone deceased whom they knew or loved. Many of the bereaved are utterly convinced that their deceased loved ones were really there with them in the room and that they touched, embraced and communicated in the night. Equally importantly, these visitation dreams are therapeutically beneficial for the bereaved as they are comforted by the visitation. Wright et al. (2014) surveyed 278 bereaved persons regarding their dreams and found that 58 percent of respondents reported dreams of their deceased loved ones, with varying levels of frequency. Prevalent dream themes included pleasant past memories or experiences, the deceased free of illness, memories of the deceased’s illness or time of death, the deceased in the afterlife appearing comfortable and at peace, and the deceased communicating a message (usually that they are OK). The respondents also noted that these visitation dreams increased acceptance of the loved one’s death.

With regard to end of life dreams, the same group of researchers conducted a fascinating study on dreams of hospice patients. What do people dream about when they are dying? These authors collected (and content analyzed) dreams from fifty-nine hospice patients in roughly the twenty or so days before they died. Most (61 percent) of the patients were dying from cancer. The most common dreams featured friends or relatives of the dying patient who had died before them. These deceased persons conveyed a message to the dreamer that they were all going somewhere and that things would be OK. The appearance of these relatives in dreams were experienced as real or highly realistic, rather than dreams per se, and the visitations were rated by the patients as a highly comforting experience. For example, Tim (age fifty-one) had dreams that included his deceased parents, grandparents and old friends who were “telling me I will be okay.”

“I haven’t seen some of these people for years,” he stated, and “I know we are going somewhere but don’t know where.” The authors stress the fact that their patients were not experiencing delirium or confusional states when they reported these dreams. Most interestingly, these realistic visitations and comforting dreams/visions of the deceased became more prevalent as death approached, significantly predicting the onset of death.

Thus, the deceased “visit” us after they die and later when we are facing death ourselves. In both instances, these “visits” are experienced as real, not dreamlike or hallucinatory. Communication with the deceased occurs and the message is typically (though not invariably) comforting. In the process of dying these visits increase in frequency and intensity, heralding death itself.

A commonsense explanation of these visitation dreams suggests that Mother Nature uses the dream state to carry us through intensely painful and wrenching transformative experiences: the loss of a loved one and our own impending deaths. From a Freudian perspective, these are classic wish-fulfillment dreams: we lose a loved one but then we have a visitation dream; our wish of being with that loved one once again is fulfilled and there is an emotional resolution. Similarly, in the face of our own deaths, our lost loved ones step in once again and fulfill a wish that we will not go through the terror of death alone. While this commonsense explanation makes sense, it’s not completely satisfying. If it were solely about wish fulfillment why the extreme realism? Mother Nature could accomplish the same goal without using scarce metabolic resources to create hallucinatory states. If these are hallucinations, they are unlike all other hallucinations known to medical science, given that the patients involved are not cognitively impaired and virtually all senses are involved. The level of realistic detail in the visitations is extraordinary. Sometimes dreamers can even smell the perfume the deceased always wore! Either medical science needs to increase its inventory of hallucinatory states or we need a better way to understand these visitation dreams.

Another factor, in addition to mortality salience, dreams and rituals that promote fundamental self-transformation, is interactions with others. In the religious realm this includes interactions with supernatural agents, and it is to that issue we turn in Chapter 9.

*Supernatural Agents and God Concepts***Introduction**

One of the things that makes religious cognition unique is its reference to supernatural agents (SAs). When people think religiously they tend to think of counterfactual realms and minds where the minds in question exhibit very special properties like omniscience, omnitemporality and superhuman powers. The fact that people would postulate SAs flows logically from the process of decentering and from the principles of the predictive processing framework (PPF). After the agency is undermined and the sense of self is taken off-line in the first step of the decentering process (which is triggered by unusually surprising events, as discussed in a previous chapter), the old self is placed into a holding position so that it can undergo editing and updating. The individual experiences the process as a liminal, transitional and fearsome process depending on its intensity. During the liminal process (steps 2 and 3) the mind searches for explanations as to why its sense of agency is reduced. In order to accurately model the causes of agency displacement it confabulates or projects or concludes or infers that another, more powerful mind was responsible. Similar processes likely occur under the PPF. When predictive simulations set up the brain/mind to expect randomness or noise in a particularly challenging situation but instead it finds “pattern,” maximum surprise ensues as the mismatch implies that something with great information content has been identified. The brain/mind explores new state spaces among the “unknown unknowns.” It seeks to model what kind of process could have produced that kind of surprise event. The brain/mind concludes, infers, guesses that only an intelligent agent, and only an agent with superhuman powers, could have produced that particular kind of surprise, and thus SAs are born.

But these explanations, however promising they may be, are simplistic. How do we make predictions about the mental states of others? How do we build accurate simulations of the mental states of others, including SAs? In

the human social world, several factors make thinking about other minds more difficult than thinking about objects. Under PPF, mental states are represented higher in the cortical hierarchy than lower-level causal effects like sensory features of the environment. When we model/simulate a mind causing an event we presumably start with the physical sensory features of the event and ask what forces could have produced it, and then infer the kinds of motor outputs and motor commands that could have had those effects, and then infer the kinds of intentions that could have created those motor commands, and so on. To reason about other minds, we have to depend on this hierarchy of inferred causes. But that is not all. When reasoning about other intelligent agents we have to factor in the fact that they know we are thinking about them and that they will adjust their actions accordingly, and so we must do the same, and so on. In short, arms races in mentalizing about what they are mentalizing about me take off and have to be modeled as well. Clearly, simulating intelligent agents with superhuman powers must be a complex process.

Yet as far as we know human populations everywhere and across all time epochs appear to have effortlessly multiplied pantheons of SAs. For most people across most epochs, the supernatural is not “super-natural” at all. It is entirely normal and in fact the norm. Some data are available to us from ethnographies gathered by anthropologists over a century ago, before traditional peoples were infected with modern ideas, suggests that these traditional peoples actually lived constantly within the supernatural realm. If the evidence from traditional peoples gives us clues as to what our ancestors were like, then our ancestors too lived within the supernatural realm as much as they did the natural realm. For example, although they marked the difference between dreams and waking life, they nevertheless treated dream characters as spirit beings, ancestors or gods and the dream realm as absolutely real, but more powerful than the waking realm. They afforded some dream characters an amount of ontological weight equal to or better than ordinary people in their waking lives. They lived their daily lives with ancestor spirits dwelling among them. Places, animals, artifacts and climatic events were all infused with agency and consciousness. The supernatural was so natural to them that it seems absurd to call it anything but natural. It is reasonable to assume that the supernatural was natural for us human beings for 99 percent of our history right up until the modern age.

But has the supernatural realm really receded from human consciousness? Most people in most cultures still believe in the existence of supernatural beings and other SAs. Belief in the supernatural is still prevalent even in the USA – one of the most “advanced” economies on the planet according to the

“progressive” vision of history. In the USA today nine out of ten individuals report that they believe in God, heaven and angels. How is it then that the supernatural is said to be a vestigial relic of bygone irrational ages that we have progressed beyond in the enlightened present? It must be that some people see it that way. We are told that “science” believes that the supernatural is not real, but there are many scientists who believe in the supernatural. In addition, the basic materialist premises underlying the old sciences is rapidly crumbling under the weight of advances in every branch of the new sciences today. To say that the real is entirely “material,” whatever that means, just does not tally with the data anymore. Some kind of mysterious “immateriality” is also a difficult to impossible stance to defend. We are left then with the old categories of the natural and the supernatural. So if science does not dictate the banishment of the supernatural, where does the inversion of the terms “supernatural” and “natural” come from? If we can take self-professed “atheism” as a marker for loss of supernaturalism, then that loss and the concomitant rise of atheism appears to occur most often in rich countries of the global North where there are extensive social safety nets and better health care. But of course, most working-class and poor people in the global North have less access to riches and excellent health care, and not surprisingly they still largely believe in the supernatural, so it is only a thin slice of people within rich countries who deny the supernatural. There is some data which suggest that IQ, as well as reflective and analytic ability, is correlated with atheism or at least nontheism, but careful efforts to replicate these results have foundered (e.g., Farias et al., 2017) and there have been and still are quite a few very smart theists out there. Indeed, the founders of the scientific enterprise (e.g., Bacon, Galileo, Newton, Pascal) were very likely all fervent theists.

In any case, the norm is to see the so-called supernatural as natural. Given the ubiquity of belief in the supernatural realm, we have to assume that the human brain operates on the assumption that the supernatural is natural, is real. It is designed to either pick up evidence for the supernatural realm or to produce this belief in the supernatural whether or not the supernatural really exists. Either way, we need a theory as to how the brain mediates apprehension of the supernatural and SAs.

SAs as Anxiety Buffers

There are of course many scientific theories concerning SA cognitions. I mentioned a couple earlier (the decentering account and PPF). One theoretical framework suggested by many authors from Freud and Marx on the one hand to modern cognitive neuroscientists on the other is that SAs serve to

ameliorate anxiety. There is a good evidential base for this assertion. The idea is that SAs are produced via desire within the imagination and so should be regarded as “fictive kin” or security blankets to comfort us and to help us manage the awareness that we will someday die. A lot of the best ideas within this theoretical tradition have coalesced into something called terror management theory (TMT). TMT argues that human beings have cognitively evolved to the extent that they can recognize their own mortality, and that specific anxiety-buffering cognitive defenses function to help cope with this overwhelming anxiety. When thoughts of death and its associated anxiety are in conscious awareness, the proximal defense of *death thought suppression* emerges, helping remove thoughts of death from awareness. When death thoughts are out of conscious awareness, the distal defenses act on the lingering effects of death anxiety. These distal defenses proceed unconsciously (perhaps in dreams) and include the development of cultural worldview adherence (e.g., development of a religious worldview), self-esteem enhancement and increased commitment to romantic relationships. Working together, these defenses help the individual overcome the overwhelming and acute death anxiety that would otherwise compromise their ability to function in society.

Despite the growing body of evidence supporting some of the TMT central propositions, the mechanisms of anxiety-buffer defenses and of disruption remain unclear. Nor is it clear how SAs fit into the picture. Beside the general claim that the supernatural realm functions as a defense against death salience and terror, it is not clear that TMT can clarify the actual ways in which SAs are created or perceived via neurocognitive systems. Even if we grant that the supernatural realm protects against terror, why should *fictive* kin be so effective a buffer? How can something fictive work so well? Isn't the impact of the supernatural realm on human consciousness too effective if we assume TMT premises? TMT is right to point to the anxiety-buffering functions of the supernatural, but the supernatural does far more than mere anxiety buffering. It also builds up executive control functions, foresight, mind-reading abilities, social bonds, reproductive strategies, parenting commitments, strategic coalition building, cultural cooperation and war-fighting abilities to name a few. Are all of those cultural constructions dependent upon a reaction to mortality salience?

SAs and Attachment

Another theory with strong empirical support regarding the emergence of SAs is attachment theory. The basic idea behind attachment theory is that between birth and eighteen months infants develop a particular bond

of emotional trust with the caregiver. The attachment system is a biobehavioral regulatory process that adjusts physical and emotional closeness between caregiver and child. “Secure attachment” occurs when the infant is consistently cared for by the caregiver and therefore, develops comfort with closeness and comfort when leaving the caretaker’s immediate physical presence to explore a little.

A child with inconsistent parenting develops an insecure and anxious orientation which is evidenced by the inability to tolerate separation from caregivers without emotional crisis. These kids are difficult to console after separation and prefer to continually seek proximity to the caregiver. A child with insecure-avoidant orientation on the other hand prefers to avoid interactions with the caregiver and appears emotionally inhibited. Similar attachment orientations occur in adults, and such attachment orientations are conceived as cognitive working models capturing perspectival relations between the self and the attachment object such as a romantic partner or in our case an SA. That is, each of us cognitively represents attachment relations as a representation of relations between self and other. This is another reason why religion fundamentally concerns the self. We handle relations with others via self–other representations or internal working models (IWMs) of self and other. We, therefore, inevitably handle our relations with SAs via these sorts of IWMs or schemas of self and other. Adults with secure orientations tend to have positive views of themselves and their attachment targets and are comfortable with intimacy and independence. Individuals with insecure-ambivalent or preoccupied orientations overly value their attachment targets while devaluing themselves, and are uncomfortable with independence. Individuals with insecure-avoidant orientations have negative views of themselves and their attachment targets, but are comfortable with independence. And finally, individuals with dismissive orientations have inflated views of themselves and negative views of their attachment objects. There is increasing evidence that these IWMs of self and others are formed updated and during rapid eye movement (REM) dreaming. I will return to this issue later.

The attachment framework was first productively applied to the psychology of religion by Kirkpatrick (2005) who proposed that an individual’s IWMs of their relationship to authority figures provide the framework through which they develop relational perceptions of God. Successive work in attachment theory (Granqvist, 2020) has clustered around a couple of major hypotheses: The “correspondence” hypothesis, which suggests that individuals will model their relationship to God based on their relationship

(good or bad) with their caregiver; and the “compensation” hypothesis, which predicts that individuals with insecure relationships may compensate for poor relationships with significant others by casting God as all loving, and so on. There is some data to support these hypotheses. Individuals with insecure orientation do tend to turn to God in times of suffering and are statistically more likely to undergo an extreme conversion experience later in life. But unlike attachments to frail human beings, attachments to divine figures tend to be constantly saturated in fear, dependency and longing. SAs are venerated, placated, adored, feared and desired, and command absolute commitment in some cases. These relationships can, furthermore, elicit intense emotional commitment from the believer that is sustained over decades and even unto the point of death.

Regardless of attachment orientations, people tend to derive some of their conceptions of SAs from their cultural environments. Official or culturally sanctioned doctrinal God concepts likely differ substantially from personal concepts of God, as these are based on personal religious experiences, such as dreams, visions or other altered states of consciousness.

Mental Representations of SAs

A good portion of our religious beliefs, practices, rituals and experience is derived from and dependent upon our conceptions of SAs. Shtulman and Rattner (2018) pointed out that people with highly anthropomorphized conceptions of God tend to (1) view God as a palpable influence on human affairs, (2) anthropomorphize angels and Satan; (3) spatialize heaven and hell, (4) assume that God played a role in the origin of the universe and the origin of humans, (5) assume that God allows human suffering and punishes human misdeeds and (6) engage in traditional religious activities, like prayer and worship. It seems clear that representations of SAs are distinct from representations of other social agents, and therefore, religious cognition cannot be easily reduced to or explained by social cognition alone. In addition, unlike ordinary agents, religious believers typically have vastly asymmetric relationships with SAs. SAs are powerful while ordinary believers are not.

3D Mind Model and SAs

Another potential theoretical framework for understanding SA emergence and properties is the so-called 3D mind model. According to Thornton et al. (2020):

This model posits that when people think about others' mental states, they consider three key features: the rationality, social impact, and valence of each state. Attending to rationality means that one can distinguish cognitive states like calculation and planning from emotional states like ecstasy and grief; attending to social impact means that one can distinguish intense, social states like love and envy from low energy, asocial states like exhaustion and stupor; attending to valence means that one can distinguish positive states like awe and gratitude from negative states like sadness and anger. By encoding mental states along these dimensions, the mind uses a parsimonious, yet accurate, scheme to represent others' complex internal states. (Thornton et al., 2020, p. 1)

If we are attempting to relate to an SA it is easy to see that all three dimensions would be elevated relative to ordinary interlocutors. For SAs, we would be less interested in attending to the SAs' emotional responses rather than their rational ones; less interested in attending to their asocial states and less interested in attending to their negative valence states. If the SAs were demonic these dispositions may be reversed. For demonic SAs, we would need to attend to their wrathful emotional states, their asocial indifference to us and their anger-tipped valence.

Counterintuitive Concepts and SAs

Boyer (2001) suggested that SAs emerge when we mix category concepts in ways that violate their prototypical properties. Boyer dubbed these concepts that violate their natural categorial properties "counterintuitive concepts." He further stipulated that most of these violations are minimal so that they initially seem possible. It seems plausible that a being can have a mind but not embodied in the standard way we are. Minimally counterintuitive concepts violate certain intuitive assumptions about properties of categories such as agents, objects and artifacts, rendering such concepts more salient, memorable and inferentially rich, and consequently more likely to successfully achieve cultural transmission.

REM Sleep, Dreams and SAs

Another theory concerning the emergence of SAs is that the cognitive materials for SAs come out of REM dreams (McNamara, 2016). Nordin and Bjälkebring (2019) noted that the content of dreams contain many instances of Boyer's minimally counterintuitive conceptual violation, and thus dreams appear to be a natural place for the emergence of SAs. It is to REM dreams we now turn to as a final theoretical framework for the emergence of SAs.

Many students of religion and myth suggest that one primary source of SAs lies in dreams. Generations of ethnographers and anthropologists have produced data-based ethnographies, dream compilations and documentary accounts of dream-based sources of religious ideas and myths in both small- and large-scale societies around the world. Bulkeley (2016) has made a strong data-based argument for the idea that much of religious experience is rooted in what he called “Big Dreams” – dreams associated with intense arousal and huge emotional impact on the dreamer. Bulkeley argued that big dreams can be analyzed in terms of four prototypes: aggressive, sexual, gravitational and mystical. Each type of big dream is associated with specific patterns of brain activity, physiologic and emotional arousal, dream form and dream content. Each of the big dream prototypes, in turn, plays a role in various domains of religious experiences such as demonic attack, prophetic visions, ritual healing and contemplative practice. For example, the second-century Christian martyr Perpetua was imprisoned and executed by Roman authorities for professing Christianity. While in prison her family begged her to abjure her Christianity. That night she had a dream involving a beguiling serpent who meant her harm, a ladder to heaven, a white-haired shepherd and people dressed in shining white robes. The shepherd gave her something sweet to eat and all around said Amen; then she awoke chewing, but resolved to be martyred for the faith. The big dream in this case drew upon the full imaginative capacities of the brain to project and envision a possible future for the dreamer, in this case death. But she went to her death with dignity and apparent fearlessness. The dream form and content was filled with vivid color and visual details and other sensory impressions, including taste. The emotional impact was such that she could even face pain and execution with a sense of peace. Her example converted many thousands of second-century Romans to the Christian faith. Bulkeley’s work here on big dreams seems correct to me, but I want to argue that it is not only big dreams that shape religious experiences or SAs – it is garden variety everyday/night dreams that provide the cognitive materials for SAs.

On the face of it, dreams are reasonable places to look for neurocognitive systems capable of producing SA cognitions that influence daily waking behaviors. REM dreams very reliably and consistently produce remarkably detailed simulations of everyday social interactions that are known to influence waking cognitions. Those simulations are invested with intense emotion, set in a narrative context and often involve dreamer interactions with very unusual dream characters, including SAs. In essence, REM dreams are emotional stories concerning dreamer interactions with both

ordinary and extraordinary characters. Of the roughly 50 percent of dream characters that are strangers (characters unknown to the dreamer), the vast majority of these morph into “fantastic beings” that can be monstrous, threatening or friendly entities, particularly in bad dreams and nightmares (McNamara, 2016). The unfamiliar dream entities that characterize both nightmares and ordinary dreams are embedded in a narrative context that involves sequential interactions with the dreamer. Many dreams instantiate the common storylines that literary theorists have identified to be ubiquitous in texts of all kinds. These dreams at the very least reinforce and may actually create similar tropes in the surrounding culture, thus contributing to cultural myths. Of course, cultural tropes likely also influence dream content. It is not just that cultural tropes influence us on a conscious level when we encounter them at movies or at church services or in texts of all kinds; it is that they resonate deeply for us because we experience them on an almost nightly basis in our dreams.

Now those dream stories, once generated, do not just dissipate without effect. Even those dreams that are not consciously recalled are nonetheless encoded into long-term memory systems. People experience a minimum of three or four REM cycles per night. If we assume one dream per cycle then people experience between twenty-one and twenty-eight dreams per week. But we know that people can experience more than one dream per cycle and that people can experience dreams outside REM sleep as well; so twenty-eight dreams per week is a reasonable low estimate. Of these twenty-eight dreams per week between three and five are recalled on average, but with 37 percent of young adults reporting that they recall a dream “every night” or “very frequently.” In traditional societies, it was/is not uncommon for people to remember several dreams per night and recount these for others in exquisite detail. In modern societies, most people share at least one dream every couple of weeks with others, usually intimate others. Once a dream is shared it becomes a social act and a potential cultural artifact.

Dream story elements are memorable not merely because they contain ideas with counterintuitive characteristics but because REM biology promotes emotional memory consolidation. We and others (Keller, 2011; McNamara et al., 2001; 2004a, b; 2014; Mikulincer et al., 2009; Selterman et al., 2014) have also shown that REM dreaming facilitates attachment orientations and emotional commitment to others. For example, Selterman et al. (2014) showed that if a dreamer in a romantic relationship dreamed of positive social interactions with the partner, then partners within the relationship rated the relationship as close the next day. Conversely, if the dreamer had no dream of the partner or dreamed a negative interaction,

distancing between the partners occurred the next day in the relationship. Thus, dreaming possesses the psychobiologic architecture to promote emotional commitment to selected others, including SAs. In summary, REM dreams seem to be naturally conducive to the production of SAs because they (1) regularly generate emotionally vivid stories of dreamer interactions with both significant others and with unusual supernatural characters, (2) modulate social attachment processes during the daytime with characters dreamed the night before and (3) act to consolidate emotional memories into long-term memory systems.

It is not surprising that dreams generate simulations of social interactions with familiar characters from the dreamer's waking life, but why do dreams generate unknown characters and supernatural characters so regularly as well? Once again REM biology is likely responsible. It promotes the production of bizarre events and characters in dreams. Our investigations (reviewed in McNamara, 2016) of this question suggests that dreams spontaneously produce SAs because dreaming is naturally associated with a transfer of cognitive agency from the dreamer to a different unfamiliar but salient character who then (frequently though not invariably) assumes supernormal forms of agency in the dream. Because REM is associated with both periodic bodily atonia and fluctuating activation levels in midline and ventromedial and supplementary motor cortex (sites associated with the sense of agency), the sense of agency itself fluctuates during REM dreaming. McNamara et al. (2015, 2018) noted that loss or reduction in the sense of agency within the dreamer (e.g., "I was stuck in quicksand and could not move!") was invariably associated with *increased* agency in another dream character – typically a dream character that was hitherto an unknown character or stranger to the dreamer in the dream. If this reduced agency in the dreamer is extreme or prolonged in the dream, some other dream character will assume supernormal forms of agency and become monstrous (e.g., "Then I noticed that the stranger was actually a monster coming toward me but I could not move due to the quicksand"). This is most clearly the case in bad dreams or nightmares, but it occurs in all dreams. We found that when SAs appear in a dream or nightmare they are reliably associated with diminished agency in the dreamer. Diminished agency within the dreamer occurs in over 90 percent of dreams (whether nightmares or unpleasant dreams) that have overt SAs and virtually never occurs without SAs. In about half of the nightmare reports, the SA appears suddenly with no clear emergence pattern. In some two-thirds of unpleasant dreams, however, the SA emerged from a human character. The SA's gender was indeterminate in most dreams with SAs,

but the SA communicated with the dreamer in 24 percent of nightmares and only 13 percent of unpleasant dreams. In most nightmares, the SA intended to harm the dreamer and in one-third of nightmares the dreamer was the victim of physical aggression by the SA. SA intentions in unpleasant dreams were more varied and actually benign in 13 percent of cases. These patterns in the ways in which SAs appear and act in dreams are consistent with character transformation in dreams in general and suggest that there may be a principled way to study their cognitive dynamics and origins in dreams.

SAs and Psychedelics

SA encounters are often a part of religious experiences had when on psychedelics. They are of course ubiquitous when they are part of ordinary religious experiences. But some empirical data have been collected on SA types and phenomenology as part of the psychedelic experience. Existing reviews (Davis et al., 2020; Griffiths et al., 2019) report that on average greater than 80 percent of people who have taken a psychedelic at moderate to high dosage report encounters with SAs. The most commonly endorsed labels for the SAs they encountered were “being” (60 percent), “guide” (43 percent), “spirit” (39 percent), “alien” (39 percent) and “helper” (34 percent). Shanon (2002) classified the entities he found in his dataset as:

- 1) *Mythological beings*: such as gnomes, elves, fairies and monsters of all kinds;
- 2) *Chimeras or hybrids*: typically half-human half-animal shapeshifting beings;
- 3) *Extraterrestrials*: aliens; insectoid-aliens, especially in the form of a praying mantis;
- 4) *Angels and celestial beings*: often composed of light;
- 5) *Semi-divine beings*: like Buddha or gods from various religious cosmologies;
- 6) *Demons, monsters and beings of death*: such as the angel of death, a being encircled with serpents, for example.

Virtually all respondents reported having had an emotional response to the experience including joy (65 percent), trust (63 percent), surprise (61 percent), love (59 percent), kindness (56 percent), friendship (48 percent) and fear (41 percent). The SA was considered to be a conscious being (96 percent), intelligent (96 percent), benevolent (78 percent), sacred (70 percent) and had agency in the world (54 percent). Most respondents

believed that the SA was absolutely real, not hallucinated, with 72 percent believing that the entity continued to exist after their encounter. The SA encounter also produced dramatic psychic and spiritual effects in respondents. For example, approximately one-quarter of the sample reported that they were atheist (28 percent) and one-quarter reported they were agnostic (27 percent) before taking the drug and the entity encounter, but there were only 10 percent of respondents who were atheist and 16 percent agnostic after the encounter. Respondents also reported that the entities operated independently of and often against the will of the individual. They often know things about the world that the individual does not know. There are also commonalities of entity characteristics across individuals—even individuals who do not or did not know one another.

It is a remarkable fact that people experiencing these encounters almost always say that the encounter was realer than real, that the SA imparted something beneficial to the individual and that the knowledge imparted was real and actionable. It is no wonder that SAs are central to virtually all known religious traditions.

If SAs are mere simulations generated by our brain/mind predictive regimes, why are they (the SAs) so impactful on these very same brain/mind predictive machines? Why have they been so desired, feared and propitiated down through the ages? Why do some people even die for their gods?

To answer these questions we need to turn to consider ritual (Chapter 10) and group effects on religiousness in individuals (Chapter 12).

CHAPTER 10

Ritual

Introduction

Ritual is one of those things that the student of religion looks at and then despairs in attempting to define, given its varied manifestations. What does the dream-guided dark tent rite of the Ojibwa have in common with the elaborate bear ceremonialism of a vast number of circumpolar tribes and peoples? Both very likely date back to the Paleolithic but one is simple, requiring only dreams, a tent at night and a group of people listening to the animal spirits and other spirits, while the other takes weeks to perform and involves elaborate purification rites, dream-guided hunts for a bear, some sort of worship of the bear spirit, then the sacrifice of the bear and its consumption by the tribe, and finally the placing of the bear's unbroken bones into a kind of sacred grave. What do male initiation rites of numerous small-scale hunter-gatherer societies have in common with a modern Catholic mass? Can there even be neurology of "ritual"? Probably not. Nevertheless, there can be and must be neurology of particular parts of the vast number of social practices we describe as ritual. In fact, there may even be a neurology for the practice of "ritualization" itself. Ritualization may be the common behavioral denominator among the family of social practices we call ritual. Ritualization becomes religious ritual when it involves supernatural agents.

Ritualization

Ritualization is the process by which selected behavioral processes are pulled out (by natural selection, repeated reinforcement learning or cultural selection) from the background of other physiologic and behavioral processes and then stylized into repetitive and sequentially ordered stereotypes, and then made to perform certain functions or to signal certain messages to conspecifics or adversaries. Dissanayake (2006) has argued

for the significance of ritualization for all kinds of human cognitive and behavioral processes, including music and the arts and of course religious rituals. She argued that ritualization involved formalization (stereotypy), repetition, exaggeration, and elaborations of behavioral displays of various kinds. So, for example, components of behavior that occur as part of normal, everyday, instrumental activity are reinforced via the attention of another animal, while opposing behavioral capacities are suppressed or inhibited. Then the original animal repeats the reinforced behavior and suppressed opposing behavioral tendencies in exaggerated form over and over until it becomes an ordered stereotypy. It then functions as a signal to the other animal concerning something that both animals benefit from. It may be a signal that no aggression is intended or that sexual congress is desired or that cooperation is possible and so on. Then the behavior becomes ritualized as it is automatically elicited whenever these two animals encounter one another. Once elicited it must unfold in an ordered sequential manner. In the course of ritualization particular changes occur in the original behavior pattern so that the resulting behavioral stereotypy acts as a signal that becomes prominent, distinctive and unambiguous, and consequently functions as an honest signal. Ritualized behaviors become simplified or formalized (stereotyped), repeated rhythmically, repeated in order and exaggerated in time and space. When these stereotypies increase the overall reproductive fitness of the animals involved, they are preserved in the process of natural selection and gradually become part of the behavioral repertoire of the species. Thus, ritualization has to be seen as one process via which behavioral innovation and evolution occur within a species.

Characteristics of Human Ritualization

Rappaport (1999) suggested that human rituals involve “the performance of more or less invariant sequences of formal acts and utterances not entirely encoded by the performers” (Rappaport, 1999, p. 24) – a definition that arguably describes a ritualization process. Liénard and Boyer (2006, p. 20; Boyer and Liénard, 2020) proposed that ritualized behaviors are characterized by

- 1) *Compulsion*: The agents feel a strong motivation to perform that set of actions, although they may not represent any specific reasons for performing it;
- 2) *Scriptedness*: The agent also feels that the actions must be performed in a specific way, and in a specific order;

- 3) *Goal-demotion*: The overall series of actions may be described as directed to a goal, but there is no representation of how the different parts contribute to that goal; and
- 4) *Redundancy*: In many cases, actions are repeated.

Although these components once again echo what I have described as the ritualization process whereby selected behaviors become stereotypes, Lienard and Boyer instead see these behaviors as rooted in the activation of human threat detection psychology. The threat-detection system is specifically focused on potential hazards that were recurrent in ancestral conditions, such as predation, threats by strangers, contamination from infested foods, contagion via invisible germs and so on. This take on ritualistic behaviors as organized around threats is consistent with Freud's suggestion that defensive protection against guilt and anxiety is at the root of ritualistic behaviors. However, it is difficult to see how repetition or redundancy in behavioral displays might decrease anxiety or protect against seen or unseen threats. If anything, redundant behavioral displays make the individual more vulnerable and visible. They serve to reduce uncertainty in signaling behaviors and to amplify the signal in otherwise noisy conditions, thus making the animal or individual much more conspicuous and vulnerable to the other animal. Indeed, the whole purpose of these ritualization processes is precisely to make opposing animals more conspicuous in order to reduce losses due to aggression or to increase chances of successful copulations and so on. The compulsion and scriptedness conditions follow from the need to reduce ambiguity as much as possible in the signal. The behavioral display must not deviate from the stereotype that signaled sexual receptivity or nonaggression in the first place. Honesty in signaling requires a reduction in ambiguity and noise. The behaviors must (compulsion) unfold in the precise manner (scriptedness, redundancy) that was by chance reinforced by conspecifics or predators long ago and taken by them as a signal of nonaggression (or whatever) originally, back when the display was ritualized in the first place. There is "goal demotion" simply because the aim of the behavioral display is unclear or opaque to the animal displaying it. It is a stereotype automatically elicited (outside voluntary control or awareness) under certain conditions that were specified long ago by processes of natural selection. For example, the process of ontogenetic ritualization in primates is described by Call and Tomasello (2007) as proceeding in three steps:

- (1) Individual A performs behavior X (not a communicative signal), and individual B consistently reacts by doing Y
- (2) Subsequently B anticipates A's overall performance of X by starting to perform Y before A completes

X (3) Eventually, A anticipates B's anticipation and produces an initial portion of X in a ritualized form XR in order to elicit Y. (Call and Tomasello (2007, p. 33)

These kinds of spiraling, anticipatory strategic interactions between individuals create arms races that can only be partially and temporarily modulated by ritualization processes.

Cultural selection accomplishes similar things in the realm of ritualization as natural selection does for human beings. It too uses ritualization processes and stereotypes to build behavioral displays that signal various things for social animals. But it crucially uses social learning processes to do so and adds language and meanings to otherwise apparently meaningless or causally opaque behavioral displays.

Humphrey and Laidlaw (1993) emphasized a cultural process in ritual that speaks to the fact that rituals seem to be causally opaque to us. Humphrey and Laidlaw pointed out that the normal relation that obtains between an actor's intentional states and their motor acts is altered in ritual. Instead of performing one's own intended actions during a ritual, one performs actions stipulated by others who devised the actions long ago – sometimes centuries ago. Ritualized acts in liturgical traditions appear as already formed by others, almost like an object or tool. The individual must then use the tools appropriately. But their original purpose is lost to us.

Whitehouse (2000; 2004) suggested that religion's key rituals might be usefully classified into two broad cultural subgroups: There would be the high-arousal, intensely imagistic but low-frequency rituals versus the high-frequency, more verbalcentric doctrinal rituals. The former are characterized by dysphoric experiences (e.g., via painful or terrifying initiation experiences), while the latter doctrinal rituals, by contrast, are very frequent, are less emotionally intense and may even be quite tedious. Kapitány et al. (2020) conducted a factor analysis on 651 rituals from 74 cultural groups, in which 102 binary variables were coded. The factor analysis supported orthogonally placed groups of features, indicating that ritual experiences are, indeed, clustered in relatively orthogonal euphoric, dysphoric, frequency and cognitive (imagistic) dimensions.

Religions in the doctrinal mode rely on verbal expression, are highly repetitive, are spread by proselytization and can occur over wide areas. Religions in the imagistic mode prefer the use of visual symbols and iconic imagery. Reliance on imagery reduces the need for verbal exegesis. The high memorability of visual displays means that rituals in these religions need not be performed frequently. On the other hand, these rituals and religions are hard to spread because they tend to occur only locally.

Whitehouse tentatively suggested that the contrast between imagistic and doctrinal modes of religiosity is mediated by differing forms of memory: flashbulb memories for the former and semantic memory for the latter. But performative aspects of ritual form may not derive only from underlying memory systems but also from the degree to which the supernatural agent or god is the central actor or agent in the ceremony. McCauley and Lawson (2002) note that in religious rituals God or a supernatural being may act as the doer (and thus appear in the agent slot of a ritual representational sentence) or the receiver, and thus would appear in the patient slot, of the main clause in the sentence. The centrality of a ritual will correspond to how deeply the supernatural being is embedded in a sentential clause. They also argue that “special agent rituals” (those in which the relevant supernatural being is the agent of the action) are reversible but nonrepeatable: There are rituals that can reverse the results of these rituals (for a marriage ceremony there is, in principle, a divorce ceremony), but in general, there is no need to repeat these rituals, since once they have effected a result, that result is fairly permanent. Special patient rituals, in contrast, are repeatable but nonreversible. Similarly, special agent rituals tend to be performed less often than special patient rituals because they need not be repeated, and they tend to be associated with greater sensory stimulation.

The Whitehouse work and McCauley and Lawson work remind us that rituals for human beings are embedded in systems of meaning and symbolism, but that nevertheless they are a category of social behavior and thus involve processes of ritualization involving behavioral displays that ritually include predefined sequences of action characterized by rigidity, formality and repetition. The displays seem causally opaque, mysterious and/or meaningless and outside our individual agency precisely because they were formulated by generations past – not us. There are broadly speaking two families of ritual practiced by human beings: one an affectively intense, infrequently occurring, visionary process and the other a frequently occurring, verbally based, didactic process; but both are rooted in the signaling capacities made possible by ritualization processes.

Ritualization, Sexual Conflict and Group Signaling

Men and women typically build different kinds of group alliances, and this fact may help to explain the two different modes of ritualization Whitehead and others have documented. As is often pointed out in the evolutionary sciences, males and females have conflicting reproductive

interests and therefore conflicting behavioral strategies for things like who to mate with, how often to mate and degree of parental effort. Sexual conflict in primates involves males seeking to impregnate as many females as possible and female managing their mating opportunities via various group-supported strategies, like concealed ovulation/reduction of estrus in order to confuse males concerning paternity status. Females can garner greater male investment in herself, and her offspring (and avoid male efforts to kill infants that are not his), by letting the male think that he is the father; that the juvenile carries his genes.

In addition, females tend to form coalitions with other females to prevent male attacks on offspring and to channel male aggressiveness into protection for the tribe. Among social mammals, there are marked differences in the kinship structure of female relative to male groups: In most species, female group members are philopatric (they live and move about in the region where they were born) and they are composed of matrilineal relatives. But in our ancestors among the great apes, chimpanzees and bonobos the mammalian trend is reversed: males stay put and females disperse out of the local group.

In the case of female dispersal, where females are genetically unrelated with one another in the groups they join after dispersal, in-group trust is hard to construct and cooperative behavior is seldom highly developed. These fission–fusion communities are less cohesive, constantly on the move and covering a lot of ground in which temporary foraging parties constantly form/fuse and then dissolve (fission). A majority of human populations exhibit female bias in dispersal. Murdock's compendium (1967) lists patrilocal residence (where males stay put and females disperse) as the rule in 68.6 percent of 857 human societies, whereas uxorilocal, or male-biased, dispersal occurs regularly in only 13.0 percent of human societies.

What kinds of coalitions can a female form when she joins a group of nonrelatives? Coalitional strategies depend on trust as all cooperative strategies do. But dispersed females are in a low trust situation given that none of her relatives are present. Her most trusted allies would be her future offspring and her kin via marriage. She would probably establish some allies with other females for help with childcare and obtaining resources and so forth, but again these “friends” are not genetic kin, so the dispersed female finds herself in a low trust environment when trying to build group coalitions. Given the low trust environment, her interests would dictate group and coalitional structures that emphasized direct and indirect reciprocity, lots of verbal negotiating and mindreading, surveillance of and harsh strictures against free-riders, supernatural punishment of free-riders

by moralizing gods and similar norm-enforcing mechanisms. Thus, female ritualization strategies would promote these kinds of doctrinally based religious rituals.

Males, on the other hand, would be biased to form enterprise associations or coalitions – that is, task-oriented groups. They evolved in a high trust environment given that they did not disperse out of their natal groups and lived among relatives and genetic kin. Although their within-group situation was stable and high trust, the situation with respect to out-groups was different. There was a lot of intergroup conflict and outright warfare among early human groups. Therefore, the types of groups males had to form had to do with the tasks imposed on them by ancestral conditions of intergroup conflict and the hunt. Men were more likely to be hunters and warriors. They needed groups focused on effectiveness in the hunt and in war. They needed men who could work cooperatively as a team, who could think strategically and who had specialized skillsets. For the hunt, you would need people who specialized as trackers, spear throwers, ambushers and so forth. For war you would need similar skillsets, but in addition you needed men who had the ability to operate psychologically at the boundary between controlled frenzy and chaos versus calmness during the chaos and the ability to plan strategically to outfight and outwit adversaries and competitors. Therefore, the ritualization process favored by male groups would likely be shamanistic and visionary forms of ritual. These forms can enhance the out-of-the-box thinking that is so crucial for the instrumental goals of task-oriented groups like war parties and hunting teams. Following the literature on teams and the philosopher Michael Oakeshott (Oakeshott, 1990), I call these sort of task-oriented groups enterprise groups or associations. Male groups arose within the context of high amounts of intergroup conflict and low amounts of intragroup conflict. Men's coalitional psychology was, therefore, formed by these kinds of challenges posed by intergroup conflict and the hunt.

These differing male versus female coalitional and ritualization strategies are supported by experimental findings. Males provide more intragroup support than females if the social context is one of the intergroup competitions. Males more readily dehumanize out-group members than do females. Relative to females males show greater in-group loyalty and more strongly resist financial incentives to betray their in-group. Relative to females, males also show an inclination to use danger-relevant stereotypes about out-groups when faced with threatening situations. Finally, male intergroup bias is primarily directed at men in opposing groups, while women's intergroup bias is less selective.

Given the high trust context in ancestral conditions for men, there was less need to enforce doctrine or to punish free-riders within the group in order to achieve cooperation. You are looking to defeat the outgroup. All members within the in-group have their assigned tasks based on their innate abilities and talents with respect to the overall group goal. The overall aim of the enterprise group is to accomplish a goal: in the case of ancestral males, this aim was to defeat the outgroup or to score in the hunt. Enforcement of norms, worry about free-riders and so on occur, but these are much less of a problem for male groups than female groups.

These dichotomies between male and female coalitional psychologies, however, should be seen as tendencies, not absolutes. There was undoubtedly much overlap and many exceptional cases. The point here, however, is to understand the range of ritualization strategies utilized and bequeathed to us by our ancestors. Now of course within any ancestral human group you had both males and females, and thus you had both of these ritualization and coalitional strategies operating at all times. They undoubtedly interacted, and attempts were made to fuse them or to utilize them in such a way as to optimize group life. They continue to operate to this day. Typically, they are in uneasy equilibrium with each other, but more often they are in tension.

These differing ritualization and sex-related group strategies are reflected some extent in the brains of males and females. Females are better at verbal tasks than men. They have proportionally larger Wernicke and Broca regions than males. They have larger corpus callosum than males and they exhibit less cerebral lateralization (more bilateral representation of language and other functions). They are better at learning second languages. This makes sense if they had to disperse out of their natal groups, find and be accepted into a foreign group, and learn their languages and customs.

Neurology of Ritualization

To some extent, these sex differences in coalitional psychology and ritualization strategies can be discerned neurologically when we look at ritualization processes in neurological disorders. Males score higher on tests of autistic tendencies while females tend to score higher on standard indexes of schizotypal cognition, which quantify such traits as magical ideation and paranormal or spiritual experiences. Crespi and Badcock (2008) pointed out that autism spectrum disorders can be partially understood by contrasting their symptoms with schizophrenia spectrum disorders (ASDs). They theorized that there are two major axes of cognition, one

determined by sex and one by the paternal or maternal bias in gene expression (genomic imprinting). Mental dysfunction is more common but less severe where these two axes are compatible, in males with autism and females with schizotypal traits.

For some of the interesting contrasts, Badcock and Crespi noticed, consider that ASD individuals typically want to avoid the gaze of others, while people who load high on schizotypal traits too often develop paranoid delusions of being watched or spied upon. The autistic inability to appreciate what goes on in social interactions can also be seen as the antithesis of schizotypal paranoid delusions of group conspiracies multiplying everywhere. Furthermore, schizotypals tend to more readily engage in magical and paranormal thinking and see evidence of agency and mind everywhere: they hypermentalize; whereas ASD individuals struggle to interpret the minds and intentions of others: they hypomentalize. The sense of self in ASD individuals is starkly minimal, while it is too often inflated in schizotypals, and in cases of psychoses, there is outright megalomania and delusions of grandeur.

With respect to ritualization and spirituality, ASD individuals tend to buck culturally imposed doctrinal religions and norms and adopt more analytical, mechanistic and tangible religious practices than schizotypal spectrum individuals. Schizotypals on the other hand tend to prefer ritualization processes and religions that are more mentalistic, verbally based and less mechanistic. Their doctrinally based ritualization strategies involve ideas of reference that are elaborate belief systems that tend to assert or support the idea that innocuous events refer significantly to oneself. In schizotypal religious thought, there is an overdeveloped sense of agency and a heightened sense of saliency and significance.

Interestingly both ASD and schizotypal individuals generally do subscribe to a belief in supernatural agents, but they relate to these SAs differently and they conceive of them differently, with AD individuals endorsing more unconventional and impersonal conceptions and schizotypal individuals endorsing more conventional moralizing notions of God.

Given this background in the differing spiritual profiles of ASD versus schizotypal spectrum individuals, let us now look at the neurology of ritualization processes in each. As discussed earlier, the brain supports ritualization via the production of stereotypies. The prevalence of motor stereotypies in ASD ranges from 21.9 percent to 97.5 percent, with a median of 51.8 percent. Stereotypies of ASD include hand flapping, body rocking, spinning, repetitive jumping, finger flicking, echolalia, repetitive handling of objects, symmetrical aligning of objects and complex repetitive

behavioral displays or ritualisms. Stereotypies in several disorders including ASD have been broadly associated with the dysfunction of the prefrontal-corticobasal ganglia circuits or cortico–striatalthalamo–cortical pathways (Péter et al., 2017). In animal models, stereotypies unfold in an ordered manner after the administration of dopaminergic and catecholaminergic agents such as levodopa, amphetamine and cocaine. These agents disinhibit selected circuits within the prefrontal-corticobasal ganglia network. Anything (dopamine transporter knockout mice, pharmacological stimulation, etc.) that enhances dopaminergic transmission within these networks appears to create prominent motor stereotypies.

An old but still viable model (Cooper & Shallice, 2000) of the emergence of stereotypies and perseverating cognitive elements contends that a contention scheduling system (CSS) mediated by basal ganglia pathways selects and sequences behaviors on the basis of external reinforcing stimuli, and a supervisory attentional system mediating by striatal–anterior caudate–prefrontal dopaminergic circuits modulates the action of the CSS on the basis of internal context.

The selection and then highlighting/emphasizing of a behavioral display (stereotypy) is accomplished via interaction between these systems as played out in two agonistic basal ganglia pathways within each cortico-striatal circuit-loop. The first, direct, pathway activates existing and developing motor programs, while the second, indirect, pathway is inhibitory, acting to control the orderly expression of available and developing displays. Dopaminergic induced stereotypy involves a selective down regulation of the CSS or disinhibition of the indirect pathway. This results in the repetition or perseveration of whatever behavioral display was scheduled.

In rats, ritualization is accomplished via enhancing forebrain dopamine to very high levels. As the level of dopamine in the system increases a smaller number and variety of behaviors are emitted until only one or two stereotyped displays are emitted over and over again. Depletion of central dopamine stores prevents this sort of ritualization of behaviors.

With respect to functional behaviors, it seems clear from the animal literature that the ritualization of behaviors tends to act as a signal that the animal will not attack another animal; or that the animal is interested in cooperating (e.g., in a sexual act). Interestingly, ritualization seems to facilitate the evolution of signaling production and comprehension/receiving behaviors (Bradbury & Vehrenkamp, 1998, pp. 499–500). In any ritualization process, a set or sequence of behaviors that are reliably associated with a biologically significant event or process is selected and then reduced to more simple forms. If, for example, the set of behaviors in question

involves sixteen identifiable subcomponent processes, then ritualization will reduce the sixteen to eight such subcomponents. Next, these eight fundamental components will then be exaggerated and repeated during a signaling display. Over time and with repetition the animal learns to reduce the variability in expression of the display, such that the display becomes a stereotypy. Finally, the set of stereotypic behaviors that have been used to signal one thing become emancipated from this original signaling context and are then used to signal something related but more abstract. In this manner, ritualization serves to facilitate the communication of very abstract information between two animals.

We have seen in previous chapters that central dopamine, particularly dopamine in the prefrontal cortex, may play a key role in support of religiosity. It may be that the links between dopamine and religiosity begin with dopamine's role in the selection of behaviors for output given a social context and in the restriction of the range of behaviors to a single type given a social context. The role of dopamine in the production of a single, high-profile behavior that is emitted over and over again highlights dopamine's role in the production of information. The emission of a redundant and repetitive signal reduces uncertainty obtaining between a sender and a receiver and thus increases the information content of the signal.

Ritualization Narrative and Myth

Many students of religion have observed that religious rituals are invariably associated with complex stories concerning the relation of the group to the supernatural realm. These stories have come to be known as myths. Some myths are intimately tied to rituals, where the rituals help to explain the stories or the stories help to explain the otherwise opaque rituals. The myth-ritualist theory was exemplified in the several volume compendium of worldwide mythology called *The golden bough* (1890/1959) by James George Frazer. Rituals were rooted according to Frazer in magical thinking that believed the imitation of action could cause that action to occur. Ritual puts magic into practice. The enactment of a god's death and rebirth could magically cause the rebirth of crops or success in the hunt and so on. In this monumental work on ritual Frazer had uncovered the extreme importance of the phenomenon of the "divine king." His paradigm case involved the king who protected a sacred oak grove, a shrine of the goddess Diana at Lake Nemi in Italy. The king slept in this grove (supposedly protecting a golden bough on one of the trees) and fought off men who wanted to replace him as king. Diana's priestesses supplied the king with

all his needs, but he would forfeit the kingship whenever someone could kill him. That person then became the next king until someone killed him and so on. In short, when the king's vitality began to wane, he was ritually killed so that a healthy and more vigorous man might be installed, thus sustaining life within the kingdom. Although one king would die, the king's vitality was sustained mystically via what we today would call the office, the institution of kingship. It was always staffed by a man infused with strength, health and vitality because his body was identified with the health and prosperity of the people. Frazer identified the mytheme of the dying and resurrecting kingship throughout the mythology of the world's peoples. It appeared to be one of the founding myths of human society. In the West, the divine king myth has been traced back to the bear hunt and associated bear ceremonialism. The bear too would die (hibernate) each winter and be reborn in spring. The divine king ritual–myth complex is worldwide in its distribution and appears to be one of the sources of ritual sacrifice of human beings and of animals. As every student of religion knows, ritual sacrifice is one of the most ancient forms of ritual. We need to understand ritual sacrifice if we are ever to understand ritualization and religion. What then is at the root of this ritual–myth complex concerning the dying and resurrecting king? One root source of the complex is the neurology of male ritualization processes. But to see this fact we need some background on the divine kings.

The divine kings emerge on the stage of history out of the tribal chieftains and visionary shamans of the late Upper Paleolithic. They come into their own with the onset of the Neolithic period. The divine kings inherit the shamans' myriad roles of diviner, healer, master of ceremonies, visionary, leader and so forth. As societies became more complex the kings, in turn, delegated some of these healing, religious and leadership functions over the course of centuries to priests and prophets. Divine kingship lasted arguably right up to the modern age. It ended when the fanatical protestant warlord Cromwell and his henchmen murdered King Charles.

The first "cities" that appeared in the transition from the Upper Paleolithic to the Neolithic were actually ritual centers – where interrelated clans and trading groups would gather, perform religious obligations and then conduct business. These religious centers likely included sites like the temple on Malta, Catal Huyuk, the complex at Gobelet Teke in Turkey and Newgrange in Ireland. These sites were probably built by men's secret societies and these societies likely attempted to monopolize the religious festivals that took place there each year. The man most venerated in the secret society at some point was invested with authority to oversee the

religious festivals and thus became a chieftain. As ritual centers grew, people began to build villages and other permanent settlement sites nearby. When agriculture took off these permanent settlement sites became wealthy and started trade with other settlement sites. When disputes arose the chieftain settled them with ritual ceremony and at least occasionally with some sort of justice. All this is the speculation of course, but it is likely that some such scenario gave birth to the phenomenon of the divine king.

The Divine Kings as SAs

Both ritual and our relationships with supernatural agents have been decisively influenced by the rule of the divine kings for the last 10–15,000 years. They were tangible supernatural agents. At some point in the early Neolithic, villages and cities and complex hunter-gatherer societies began to be overseen by something more than chieftains or Big men. These new rulers are what we today would call divine kings – individuals invested with supernatural powers and significance and who had power to compel other people to do his will. In his classic work *Kingship*, Hocart (1927), reviewed the cross-cultural literature on rituals associated with the kingship. Installation or coronation rituals typically involved mind-altering substances as when the Fiji islanders used kava to install a king. In the Fijian language “to be installed as King” is identical to “to drink the Kava.” The specially prepared “chiefly kava” was thought to induce possession by the spirit entities called the water sprites which made the man the god-king. Hocart argued that coronation rituals the world over included up to twenty-six characteristic features that ranged from purification rites to spirit possession to the reception of the regalia of rulership. To maintain his kingship the king had to repeatedly demonstrate at least some competence with respect to the needs of these developing ritual centers and cities. He had to display some shamanistic or supernatural powers; he had to show strength and vitality and that he could, like other supernatural agents, heal others and enhance the prosperity of his people by calling the animals to sacrifice or by creating rainfall or by creating trade links and so forth. He had to arbitrate disputes and promote large cooperative enterprises. As populations grew and conflict with nearby tribes grew in intensity the king also had to become an effective warrior.

The king unifies the people and makes intragroup cooperation possible because each person in the group is related to the king (as subjects) *in the same way as subjects to his objective law*. The king is set apart from the rest of the group precisely because he alone is related to all of the subjects in

the group or realm. He has a legal relation to each person in the group, and thus every person in that group is united by or shares that common relation to the king. He is the hub in a small-world network. This universal relation to the king simultaneously makes him sacred (a unifier) and a potential scapegoat because he alone is in a position to receive contaminating contact with all persons if and when the group is infected with some sort of evil. Most of the rituals surrounding the king are aimed at keeping the king sacred or set apart or pure, spotless and healthy. Sanctification and purification rituals were a constant of the life of the divine kings. His person was surrounded by all sorts of taboos regarding contact and behavior. The waning of his vitality and his death was fraught with foreboding and dread by the people because his death would inevitably imply that all the poisons and evils that the king would normally “channel” and eliminate ritually would now have no effective elimination mechanism. An early solution to these sorts of problems would be to ritually turn the king himself into a receptacle of all the impurities and evils accumulated in the society and then kill the king. The sacrifice of the king would “kill” the impurities along with the king since the king had been made to contain or embody these evils in the first place.

Thus, divine kingship represents a paradox at the heart of the social compact: He is simultaneously sacred and polluted; good and evil. The job of the priests was to perform the rites of purification to expel evil spirits from the king’s body/person and thereby from the realm. These rites of purification eventually became bloody sacrificial rites and then rites of exorcism.

We have some recent spectacular archaeological evidence for this sort of sacrifice of royalty in the case of what appears to be a Celtic prince whose body was recovered in 1984 from Lindow Moss, a peat bog in England. The remains dated back 1,800 years and were of a young man aged about twenty-five when he died. He was naked, except for a fox fur band around one arm. The condition of his body led the forensic scientists dissecting it to suggest that he must have been royalty given that they could find no wear and tear and no signs of hard labor or warfare on the body. It was considered easier to ritually purify a healthy man than an unhealthy man. But there were other signs of trauma – clearly, the things that killed the man before he was thrown into the bog. He had blunt injuries to the head probably made with an ax. He had also been hit in the back, which broke a rib, and then he was strangled or garroted such that his neck was broken. The consensus of the scientists studying this man was that he was a royal sacrifice. He had probably been ritually prepared for the sacrifice

by a process that ensured he had taken on the sins of the people. Then the druids would make that certification and then perform the sacrifice, killing him four times (blow to the head, then the back, then the garroting and then the drowning). By this sacrifice a new king (probably a relative of the young victim) could be installed without sin as the sin of the community had been poured into the victim and then eliminated along with the victim. The royal victim thus gave the community a new lease of life and the new king a fresh start.

Other examples of the rituals surrounding both the sacrifice and exaltation of the divine kings abound. I will provide one other example. At Copan, in what is now Honduras, there is a massive complex of structures including pyramids, a hieroglyphic stairway, a ritual ball court, the Popol Na, the so-called Rosalia building and elaborately carved altars and stelae portraying Copan's sixteen divine kings, all oriented around the rituals of divine kingship. Copan's divine kings reigned from about 426 to 822. In the great plaza at Copan, there is a stele with carvings depicting the sixteen divine kings (four to a side) with the founder of the dynasty K'inich Yax k'uk Mo depicted as handing off the emblems of dominion and a flaming torch to the most recent king (when the stele was constructed). On this stele ("Altar Q"), the kings are seated on their name glyphs, but all owe their origin to the founder K'inich Yax k'uk Mo, who was buried at Copan and apparently was a master at spirit possession rituals. Wisely, however, he also established strong ties to the powerful cities of Tikal and Teotihuacan and that, along with his spiritual powers, helped to cement his power and establish his dynasty. Rosalia was the principal ceremonial temple at Copan and his burial place. The height of its use was approximately the sixth century CE. The temple appears to have been dedicated to the sun god K'inich Ajaw, the divine patron of Copan kings. Interestingly, Hocart believed that one of the constants of the divine kingship was that kings almost invariably operated under the aegis of the solar cult – that is, they were patronized by or they considered their patron to be the sun god. The sun was nonarbitrary and all powerful. K'inich Ajaw was the titular spirit entity of the dynastic founder K'inich Yax k'uk Mo. It was as if this king was in a state of constant possession by this sun god. The king not only embodied the Sun God and his impartial justice – he WAS the Sun God materialized – in person right before the eyes of the Copan peoples. Within the Rosalia temple complex lay the tombs of K'inich Yax k'uk Mo and his wife. The tomb itself was apparently intentionally buried – despite the fact that it was covered with a magnificent white stucco façade and elaborately covered panels depicting the founder as sun god.

The excavators of this building found extensive evidence of spirit possession rituals conducted within the temple/pyramid after the founder was buried there. There were beautifully carved incense burners and mirrored divination instruments typically placed on jaguar pedestals, sacrificial stone knives that were more than just decorative pieces, ceremonial scepters known as eccentric flints, stingray spines that the kings used to pierce their tongues in order to get a copious flow of blood to use during spirit possession rituals, jaguar claws, jade jewelry and much else besides. Clearly, these pyramidal mortuary complexes were sites created by and for the divine kingship. They commemorated founder kings/gods and they facilitated maintenance of kingship via spirit possession rituals of the most elaborate variety. In other temples excavators have found traces of mind-altering substances of various kinds (e.g., ayahuasca derivatives), still in divination bowls involving mirrors and incense. Other hallucinogens were derived from nerve toxins found in the glands of a specific toad. There are carved altars with images of the god-king wearing a spoon that was used to ingest hallucinogens that facilitated spirit possession. We also have extant carved figurines, for example, the figure holding a jaguar cub from Alta Verapuz, Tamahu (400–200 BCE) now at the Museo nacional de Arqueología y etnología in Guatemala City, where one can see forms of the jaguar emerging from beneath the human form. The eyes of the king/jaguar god were originally made of a glowing pyrite to emphasize the spiritual entity within the human form. We also have hundreds of artifacts or tools the Mayan kings used to induce mystical states. There are jade “perforators” used to puncture the tongue or ears to induce blood flow trance and then spirit possession. Once possession occurred in these bloodletting rites the king would hallucinate the “vision serpent” and receive divine knowledge. There are “censers,” which were carved figurines often depicting an ancestor king seated in the cross-legged royal pose, wearing the royal headdress and carrying a small tray for offerings and a small mirror for divination purposes. The king would inhale the smoke of the incense and look into the “smoking mirror” to see visions induced by the hallucinogenic incense.

Rituals and Sacrifice

How to explain these bizarre spirit possession and sacrificial rituals that surrounded the divine kings for thousands of years? Can neurology shed any light on these rituals? Girard (1977) has argued that competitive rivalries within a society (driven by envy and imitation processes) led to scapegoat killings. The German classicist Walter Burkert (Burkert et al., 1987)

argued that ritual killings are built upon customs and formalities involved in hunting. The so-called social control hypothesis (Watts et al., 2016) argues that human sacrifice legitimizes political authority and social class systems, functioning to stabilize such social stratification. Watts et al. (2016) supplied empirical support for this hypothesis by phylogenetically analyzing a geographically and socially diverse sample of ninety-three traditional Austronesian cultures. They found that ritual human sacrifice appears to reinforce social inequalities and inherited class systems.

But these extant theories of sacrifice, while helpfully explaining some aspects of ritual sacrifice, do not appear to be able to explain most aspects of ritual killing, including its roots in male secret societies and the divine kingship. There is often some sacrifice associated with male initiation rituals such as the circumcision or amputation of a finger or knocking out a tooth. Prehistoric rock art throughout the world testifies to some of these ritual sacrifices. Reversed handprints with clear amputated digits are not uncommon even in the cave art of the Upper Paleolithic. The sacrifice and training for war begin quite early. The Gallas peoples of Northeast Africa amputate the nipples and breasts of boys soon after birth, “believing that no warrior who possesses them can possibly be brave” (Davie, 1929, p. 239). Boys in traditional societies around the world are trained to sacrifice and suffer. They spend hours in frozen rivers to inure themselves to cold; they are expected to endure long treks into the wilderness and are often left alone to fend for themselves. On the island of Tud, Torres Straits, the boys and young men would drink the sweat of renowned warriors, and eat the blood-soaked refuse from the clothes and skins of great warriors in order to imbibe their strength and courage.

Given the deadly ubiquity of war across all human cultures and periods as well as the great prestige accorded to the warrior by men and women of the tribe, it is no wonder that religious rituals were recruited to turn boys into warriors. Davie reports that:

Among the Dieri and other kindred tribes of Central Australia, the next ceremony after circumcision is one called Wilyaru. The boy is directed to close his eyes. One of the old men then binds the arm of another old man pretty tightly with string, and with a sharp piece of flint lances the vein about an inch from the elbow, causing an instant stream of blood, which is allowed to play over the young man until he is covered with it, and the old man is exhausted. Another then takes his place, and so on until the young man becomes quite still from the quantity of blood adhering to him. The reason given for this practice is that it infuses courage into the young man, and also shows him that the sight of blood is nothing, so that should he receive a wound in warfare he may account it as a matter of no moment.

The next stage in the ceremony is that the young man is told to lie down on his face, when one or two young men cut from three to twelve gashes on the nape of his neck with a sharp piece of flint. These, when healed into raised scars, denote that the person bearing them has passed through the Wilyaru. (Davie, 1929, pp. 238–239)

The shaman or priest, along with leaders among the warriors typically carry out the initiation rituals and the gods of war are invariably invoked to witness the rituals. The boys are urged to identify themselves with the war god and to learn fearlessness. “Another excellent example of the relation of religion to war is the Omaha ceremony of cutting the hair, by which the boy was consecrated to the thunder god, who thenceforth became the arbiter of life and death to the man. The hair which was cut off was laid away in a sacred case, in care of the thunder priest” (Davie, 1929, p. 240). In so-called primitive societies, after the ceremonies and prayers of the initiation ritual are over the boy is given a new name and a weapon. Then he is instructed in the myths, religious rituals and mores of the tribe. He is told what his duties will be: these are typically to uphold the traditions of the tribe and to wage war on behalf of the tribe.

The neurology of ritualization is based upon the biology of animal combat. Animals develop stereotypies in order to develop behavioral displays to signal aggressive or nonaggressive intent to an adversary and thus to minimize damage. Ancestral males were under tremendous pressure to use the ritualization process to win at war or to avoid a war. According to Frazer the sacrifice of the divine kings was aimed at unifying the tribe and renewing resources associated with the spring resurrection. But if we base our approach to human and other forms of sacrifice on male ritualization processes, then the function of sacrifice very likely had something to do with signaling something concerning aggressive intentions to out-groups; that is, to groups with whom one was at war with in the past.

Peter Leeson (2014) points out that human sacrifice can be construed as a form of wealth destruction. His mathematical modeling of the issue demonstrated that:

[H]uman sacrifice can be construed as both rational and efficient if it satisfied four conditions: 1. *Wealth destruction must be preemptive*: it must occur before the community is attacked by an outsider; 2. *Wealth destruction must be public and verifiable*: wealth destruction only depresses a community's expected wealth in its neighbor's eyes if its neighbor knows and is convinced that the community has in fact destroyed that wealth. 3. *Contributions to wealth destined for destruction must be incentivized*: the individual members of a destroying community aren't indifferent to whose wealth is surrendered for destruction. Such destruction benefits the community. But

the persons whose wealth is destroyed for this purpose alone bear the cost of providing that benefit. To overcome this collective-action problem, contributions of wealth for destruction must be incentivized. This is usually accomplished via supernatural benefits and sanctions. 4. *Human sacrifice must destroy valuable property*: to depress a community's expected wealth sufficiently, immolating persons must destroy the requisite part of the community's property value. 5. *Sacrificed humans must be construed in some sense as outsiders or purchased from outsiders*. (Leeson, 2014, p. 51)

When conflict is sufficiently costly, the wealth lost in violent clashes without human sacrifice exceeds that which is destroyed via human sacrifice. Human sacrifice ritually signals to predators that we as a community have nothing worth stealing. This would particularly apply if we kill our kings or our very best specimens of strength and vitality. Unlike burning a mound of crops, human sacrifice is spectacular, communicating a sacrificing community's wealth destruction far and wide. This permits would-be predators who do not observe destruction directly to learn of it nonetheless. Killing human beings sends a signal that is honest and impossible to fake. This ensures would-be predators/attackers who seemingly destroyed wealth are in fact destroyed. Thus, sacrifice served as a ritualized form of a signal to avert outright destruction during the war. Given that war was a male specialization, it likely arose from male ritualization processes.

While we have seen that religious rituals help to generate, support and sacrifice SAs, another extraordinarily important effect of rituals was to generate sex-differentiated groups and collational strategies among ancestral humans. We will discuss group effects in Chapter 12, but first, we need to add one final element to the religion and brain mix before we can fully explicate the human evolution of religious groups: it is religious language.

Religious Language

Introduction

Religious language can be defined as the language that occurs in religious contexts and is found in religious texts, sermons and discourse. Religion both shapes language and is shaped by language. Although selected elements of the brain-related precursors of language (e.g., hemispheric asymmetry and right-handedness, vocal tract musculature, Broca's and Wernicke's related network architectures) appeared sporadically in our ancestors *Homo habilis* (2.5 million years ago), *Homo erectus* (1.8 million years ago) and *Homo neanderthalensis* (0.6 million years ago up to 30,000 years ago), most experts agree that language as we know it arrived fully with the advent of behavioral modernity among anatomically modern humans between 150,000 and 50,000 years ago.

While theories concerning the origins of language are legion, it is reasonable to suppose that it emerged along with the sense of agency, self-consciousness and behavioral modernity more generally, during the period of the Upper Paleolithic. Consciousness itself is the appearance of a world and a self in that world. The phenomenal world is subjectively experienced or constituted as an egocentrically organized three-dimensional universe of self and other selves and objects. Language helps to constitute this self-world system in ways that are still mysterious for us. Nevertheless, because the self or agent is central to phenomenal consciousness and the world, it is also central to language. I, therefore, wish to focus on ways in which language is intertwined with religion and to do that we need to focus for the moment on the ways in which language handles "agency." As discussed in previous chapters, agency is the unifying principle of the dialogic or plural self and it is modulated by decentering and related processes.

Agency and Religious Language

Both language and the decentering mechanism (which I argue is key to religious cognition) described in this book highlights agency as a structuring

linchpin for its major elements and operating principles. Agency is roughly the personal sense that I, a subject, can initiate actions and can cause things to happen in the world. Within language the basic structural unit – the sentence or phrase – pivots on the role of the agent. Actions are cognized in terms of what happens to the agent and what the agent causes to happen. The agent is theorized linguistically in terms of what has been called a thematic role: an agent, who does something to a patient, via an instrument and object. These roles capture most of the meanings typically expressed in sentences. Decentering as well depends upon what happens to the agent. Agentic reduction (i.e., where the sense of agency is reduced, impeded or dissolved) triggers the liminal process characteristic of decentering and experienced as varying degrees of out-of-body experience and self-transcendence and then the search for a new sense of self that reestablishes agentic control. I will return to the issue of the ways in which religious language reflects the decentering process in due course. For now, the aim is to consider ways in which religious language and language more fundamentally are intertwined with agency.

With respect to language and agency, all known languages display a variety of grammatical devices for representing agency and the ways in which agency operates in the real world. Indexicality, for example, would be impossible without a conception of agency. It requires fitting speech to context, through the appropriate use of deictics like pronouns and demonstratives. In conversation, we use deictics like “you” or “I” with a sense of things being centered on an origin we call “I.” From that deictic origin, we derive commonly used notions such as “close,” “intimate,” “myself,” “far,” “foreign” and “other.” In normal everyday speech the agent is constantly referred to, assumed or operated upon. It is the object of the bulk of linguistic interchange. In some disorders like obsessive-compulsive disorder and some forms of schizophrenia, patients feel as if the thoughts they are having are demonic or not their own. In schizophrenia, for example, patients cannot make the indexical distinctions between their own speech production and others’ speech. They, therefore, ascribe some speech content to alien/other agents. Our ability to distinguish self from others and sometimes the “real” from the “false” requires the ability to attribute agency correctly: is it coming from me or from some other source outside me?

Chilton and Kopytowska (2018) describe Deictic Space Theory to model how agents/speakers position various entities (other people, objects, events supernatural agents, etc.) in relation to themselves – a deitic origin. Using background information, including cultural information and indexical

cues, the agent cognizes various entities in terms of positions they occupy in deitic space – namely a space composed of three intersecting axes of time, space and modality. The modality axis captures our sense of what we construe as real or true; that which is closest to us, present, now and within our grasp. Indexicality, therefore, measures our subjective sense of the real and the true, our certainties, including those related to supernatural worlds and agents. As entities increase their distance from us spatially (attention), temporally (past or far future) and modally, our epistemic judgments are adjusted accordingly. You can add vectors to that tridimensional deitic space to represent an entity dynamically moving or changing with respect to the agent. In addition, whole other reference frames with their own tridimensional deitic axes can be positioned within the original deitic coordinates representing a second agent or speaker. These other frames embedded within the original base deitic frame can interact with the base frame. The axes of the embedded frame can follow a vector toward the base frame or the axes can be translated topologically so that the origin of the embedded frame coincides with the origin of the base frame until the base frame dissolves or is translated to another position with the embedded frame. This kind of deitically organized translation process sounds something like the decentering process.

Languages have been classified in terms of how they encode agency. For example, according to Duranti (2005), grammarians distinguish among the following three types of languages: nominative-accusative (e.g., English), ergative-absolutive (e.g., Basque) and stative-active (e.g., Lakhota). The grammatical and expressive properties of each of these language families flow from the way they handle agency such as the way they encode the Agent noun phrase (NP) versus other types of NP arguments of the verb. In nominative-accusative languages like English, the NP with the agent role is typically chosen to be the subject, unless the verb is in the passive voice. In ergative-absolutive and stative-active languages, level or degree of agency is encoded directly in the grammar. The agent is highlighted and is defined as that entity that affects objects. In stative-active languages, intransitive verbs are divided into two categories, those that mark their subject as traditional agents that cause actions and those that treat agents as entities that undergo a process or event (i.e., a kind of patient). In short, agency is central to language, with all known languages possessing complex grammatical machinery to represent agency and its levels of intensity. But we have to think of it as a socioculturally mediated capacity to intend and to act. *It is a resultant of the individual's personal initiative and the surrounding cultural-political affordances for scope of goal-directed action.*

Now in religious cognition, the level of agency as just defined regularly undergoes modulation via the decentering process. Most of the time this modulation in the sense of agency is minimal but occasionally it is profound as in mystical experience, which may be associated with a reduction in agentic intensity to zero. But when this occurs it signals a dramatic change in subjective values as well as the social and political status of the individual – or at the very least that an individual’s beliefs and aims regarding their scope for agency with regard to their personal networks as well as the wider social-political field. We can observe these modulations of agency in language samples used within religious contexts.

Features of Religious Language

Du Bois (1986) listed the following linguistic features as characteristic of religious language: “marked voice quality, greater fluency relative to colloquial speech, stylized and restricted intonational contours, gestalt knowledge (speakers often learn texts as a whole and cannot recite them in parts), personal volition disclaimer (crediting a traditional source for one’s words), avoidance of first and second person pronouns, and mediation through several speakers” (Keane, 1997, pp. 52–53).

Du Bois (1986) argued that these features tend to shift the source and control of speech from the individual to some other more superior agent or the god. Other markers that shift the focus from the individual on to the god is the use of archaistic elements (including words and grammatical forms that speakers believe to be archaic), elements borrowed from other languages and solemn use of repetitive chants, declamations and petition. In short, the speaker’s or the ritual participant’s volitional agency in the discourse is reduced while the speech acts and therefore the presence of the god is increased.

All of this indicates that during a religious act involving religious language such as prayer or ritual celebration the individual sets aside his or her own identity to interact with or participate in the identity of the spirit or the god. As mentioned in previous chapters, I call this process of the reduction in the agentic self and the enhancement of an alternative identity, in this case the god, “decentering.”

Religious language appears to both mark the onset of decentering process and to facilitate it. Religious ritual and language facilitate the search and integration process whereby the old self integrates into a higher self or god. When, for example, the traditional Xavante peoples narrate their dreams, they alter their pronoun use, voice quality and language style in

order to facilitate identification with the spirit being encountered in the dream. The use of glossolalic style utterances also seems to facilitate the onset of decentering. The individual who engages in glossolalia describes a lack of voluntary control over the vocalizations. Self-consciousness is reduced so that the spirit can speak, and the fusion of the old identity with the god can be facilitated.

Speech Acts and Decentering

Several authors (Bell, 1997; Rappaport, 1999; Tambiah, 1979) have pointed out that many forms of religious ritual are characterized by the use of a very formal style of language. Crucial to the creation of the formal religious style is the use of special types of speech acts.

A speech act is often defined as a linguistic utterance that accomplishes some action; the utterance or language itself instantiates an action. If I am a religiously certified specialist like a minister or priest or rabbi and I say “I now pronounce you man and wife,” **that utterance is an action that creates a social reality.** Speech acts exhibit special formal cognitive properties and rules, and they are ubiquitous in religious contexts. Searle (2007) said that the speech act is more than just the expression of an intention or the expression of a belief; it is a public performance, referring to something about the world represented by those beliefs and intentions. “When I make a statement I not only express a belief but I commit myself to its truth” and “intentional acts of meaning ... necessarily involve a deontology” (Searle, 2007, p. 40). Once deontology is collectively created, it can be extended to social reality, and a reality can be created that consists in part of representations. “We create private property: money, property, government, marriage and a thousand other such phenomena by representing these phenomena as existing (Searle, 2007) (p. 41).” A person who can get other people to accept this declaration will succeed in creating an institutional reality that did not exist prior to that declaration (Searle, 2007, p. 40). It follows that the normativity module, as described by Downes (2011), with its language of norms and commandments, helps to create a reality for the group of believers, and thus guides behavior.

Speech acts used in religious rituals include confessions of faith, praying, petitioning, promising, asserting beliefs, praising and blessing. Speech acts also include language devices by which people commit themselves to certain things. For Downes (2011) collective prayer promotes collective commitment to shared values via liturgy. **By witnessing other people professing the same thing, believers coordinate desires and wills.**

There are four main types of performative speech acts (where speaking the phrase accomplishes the action): declarations, directives, commissives and expressives. While all four forms are found in religious language and all four can facilitate binding or commitment to truth content and value, we are most interested in commissives here as they most obviously facilitate binding/commitment. Commissives include promises, guarantees, offers and other language elements that accomplish the binding of the speaker to a certain standard of behavior or future course of action and so forth. The linguistic structure of commissives facilitates the binding of the agent to the object as specified in the commissive verb phrase (e.g., I promise to ...). In present-day English, for example, the coreference of the indexical subject (I) and the object of the verb are more tightly controlled in the case of commissives than in other subject–verb–object sentences.

Searle and Vanderveken (1985) note that speech acts are associated with varying levels of intentional force called illocutionary force. Illocutionary force (the force associated with the use of speech acts like performatives when uttered in a specific context) can be understood in terms of seven features: (1) *Illocutionary point*. The characteristic point of a commissive like a promise, for example, is to commit oneself to something by committing oneself to a future course of action. (2) *Degree of strength of the illocutionary point*. Commissives can vary in strength. Promising to do something is one thing but guaranteeing to do it is stronger. Giving your life for a truth or value is still another. (3) *Mode of achievement*. Commitments can be realized in multiple ways and it makes a difference when and how commitment is realized. (4) *Propositional content conditions*. Commissives typically require certain content conditions to be true before they can be taken seriously. I can only promise what is within my capacity to deliver. (5) *Preparatory conditions*. These are context conditions that make a commissive realistically possible. (6) *Sincerity conditions*. Promises are worthless unless the individual really intends to keep the promise. Religious contexts often require a display of sacrifice or costly behaviors or signals from the individual to underline the seriousness of commitment to the beliefs of the group or the religion. (7) *Degree of strength of the sincerity conditions*. If I promise something at a high cost to myself (i.e., display of costly behaviors), then the strength of the promise is higher than when I promise something that exacts no costs from me (Searle & Vanderveken, 1985).

Religious language elements, especially insofar as they involve commissives and related speech acts to facilitate commitments to ultimate values, will be characterized by *Illocutionary points* that enact commitment with a very high *degree of strength of the illocutionary point* in a variety of *modes*

of achievement that are nevertheless constrained by realistic *propositional content conditions* and *preparatory conditions*, and that involve strict *sincerity conditions* with a very high *degree of strength of the sincerity conditions*.

To the extent then that religious language is specialized to grapple with questions of ultimate reality and ultimate value, it will use these sorts of linguistic devices that enable higher degrees of commitment from participants.

Cho and Forster (2017) proposed that in the Bible the words of Jesus are the locution, that they have an illocutionary force and should result in a perlocutionary force; that is, a change in the behavior of the believer. They concluded that divine speech acts, based on an understanding of illocutionary force, have an impact on the believing community, making room for the performance of the ethics of the kingdom and God's intended perlocutionary effect in the present world. Tunde et al. (2016) evaluated the discourse functions of modal verbs in Christian prayers. The modal verbs that were studied included "will" and "shall." These verbs in English are a class of auxiliary verbs that have no participle or infinitive forms. This study examined the discourse functions that certain illocutionary acts perform with modal verbs in Christian prayers. The data included recordings of preaching and prayer sessions of four popular Nigerian pastors. The author found that by using "will" and "shall" a prayer statement can perform both assertive and commissive speech acts based on the relationship of the participants to the propositions. Assertive acts show that the pastor is positively committed to the truth of the expressed prayer statement; the function of commissives is to prophesy and promise – in this case, the pastor is considered to perform the act on God's behalf. Alternatively, directives indicate that the pastor tries to get the recipient of the prayer to see him- or herself as the performer of the action stated in the prayer, and the function of these speech acts is to assure. The study concludes that the choice and use of modal verbs in Christian intercessory prayers functions to enhance and elevate the recipient's level of belief in God and the expressed proposition; likewise, in God's ability to grant the prayer requests.

The Neurology of Speech Acts

Brain systems' support of speech act comprehension and production can only be partially sketched at this point. Empirical studies with patients suffering from Parkinson's disease (PD) and Huntington's disease point to the role of basal ganglia, left-sided peri-sylvian and right-sided prefrontal

regions in speech act processing – in particular in the comprehension of implicit speech acts, and grammatical rules (e.g., Holtgraves & McNamara, 2010; Holtgraves et al., 2010). Holtgraves and McNamara (2010) showed that PD patients evidence significant deficits in the recognition of speech act verbs. Briefly, in this study, the participants read different scenarios presenting a conversation, followed by a lexical decision task requiring them to determine if a string of letters was a word. Importantly the speech act types used in these studies consisted mostly of assertives and commissives – those speech acts we identified earlier as particularly important for religious language. Participants suffering from PD were slower at recognizing the word that reflected the speech act implicit in the scenario. In a second task, the participants were asked to identify the speech act performed with the utterance, and PD patients recognized a lower number of them. The authors concluded that in PD there is a language disorder that involves a selective deficit in implicit speech act comprehension. The speech acts included in this study included assertives (e.g., agree), expressives (e.g., thank), directives (e.g., warn) and commissives (e.g., promise). Similar deficits in PD patients have been found in the interpretation of indirect speech (e.g., McNamara et al., 2010). Taken together, these studies indicate a deficit in pragmatic communication skills in PD – a disorder that affects basal ganglia and mesocortical prefrontal networks. Interestingly, Butler and colleagues (Butler et al., 2010; Butler et al., 2011a, b) have independently demonstrated that a subset of PD patients evidence significant difficulties in accessing religious concepts.

Long-term value commitments transform the individual so that these commitments become habits and part of the person's character. Given the role of the basal ganglia in habit acquisition, procedural learning and in understanding speech acts, it would be expected that damage to these brain structures would alter religious language. Indeed, studies have found that PD patients show delayed access to religious concepts in semantic memory (Butler et al., 2010). Briefly, in these studies a word (prime) was presented before a target phrase, the word and the phrase were matched or not in terms of the category of word, civic, religious or nonsensical. The participant had to decide if the phrase represented an activity that could be performed. In contrast to control participants, participants with PD showed slower response to religious actions than to civic actions; in fact, there was no difference in response speed between the phrases representing a nonsensical activity (e.g., push waterfall) and the phrases representing a religious activity (e.g., pray quietly). The lack of effect of the religious prime correlated with the self-report of religiousness: participants with PD reported

fewer private spiritual practices and fewer positive spiritual experiences in a standard measure of religiousness and spirituality (Butler et al., 2011a, b). Thus, basal ganglia function appears to be necessary for understanding religious concepts and possibly for meaningful religious experience.

Speech acts and overlearned language sequences that can be described as habits occur in all kinds of religious language, especially prayer. Neuroimaging studies have addressed the issue of prayer and the neural structures associated with it (Schjødt et al., 2008). In the study, the authors described the activation of brain areas during formal prayer, defined as abstracted recitations with little personal content, versus personal prayer that involves a conversation with a personal god and a nursery rhyme versus expressing their personal wishes, using fMRI. During personal prayer, they found the activation of areas related to ToM: the temporopolar region, the medial prefrontal cortex, the temporoparietal junction and precuneus.

Interestingly, recent neuroimaging studies found the activation of brain regions and pathways implicated in the semantic processing network with the appraisal of a statement as doctrinal/semantic versus experiential knowledge (Kapogiannis et al., 2009; Kapogiannis et al., 2014). Specifically, the results of these studies suggest that statements reflecting doctrine implicate temporal lobe regions involved in decoding metaphorical (right inferior temporal gyrus) and abstract linguistic content (left superior temporal gyrus) (Kapogiannis et al., 2009). Statements reflecting experiential religion activated a network that mediates visual and motor imagery of the self in action, based on episodic memory retrieval that included the bilateral occipital lobes (including the left precuneus), the left precentral gyrus and the left inferior frontal gyrus (Kapogiannis et al., 2009). In their more recent study (Kapogiannis et al., 2014), the authors analyzed the connectivity of their functional magnetic resonance imaging (fMRI) data and found that “doctrinal/semantic knowledge versus episodic memory/imagery recruited a pathway running from left precuneus to left inferior frontal gyrus (Broca’s area) and from there to left superior temporal gyrus (Wernicke’s area), nodes of the semantic processing network” (Kapogiannis et al., 2014), in both religious and nonreligious subjects.

The Self and Religious Language

In the first edition of this work, I (McNamara, 2009, p. 45) argued for a model of religious language that involved linguistically mediated cognitive processes that accomplished the elevation of a deity or value and

a corresponding diminution of the self in the presence of sacred values or the deity. The diminution of the self was a way to mark the presence of sacred values that elicited commitment from the agent. Once again I call this process “decentering.” In terms of the role of commissive speech acts in this process, decentering operates to bind the individual to a new higher or better sense of self than the previous sense of self. The old self is decoupled from its position of control over executive cognitive and motor functions and then placed in abeyance or in a “possible world” space where a search for a new more complex and value-enriched self can ensue in lieu of the old self (McNamara, 2009, p. 45). Once a higher self is identified (with help of religious symbols), the old self is linked up with the higher self, thus accomplishing the commitment of the old self to a new set of values embodied in the new higher self. In religious language, the decreased use of first person pronouns, along with increased use of formal, elevated tone and third person reference, mark the onset of the first stage. Speech acts such as commissives facilitate the final stage in the decentering model, wherein the old self is bound to the newer higher self, thus accomplishing commitment to that higher self that embodies ultimate values for the individual. The second and third stages are facilitated by other elements of religious language such as sacred symbols, metaphors, conceptual blending and narratives. I have discussed this decentering process in other chapters in predictive processing framework terms as a process where surprise interrupts an action and then an orienting reaction occurs with a switch of processing resources away from executive control frontal-parietal central executive networks and not integrative processing systems such as that which occurs between the hippocampus and medial temporal lobe and mPFC during rapid eye movement sleep. Once integration completes there is a return to executive control and active information seeking for a new surprise and so on. The return to executive control at a higher level of integration is facilitated linguistically via the use of cultural narratives, symbols and metaphors.

Religious language contains an array of further elements that enable the articulation of ultimate realities as well as the commitment to ultimate values. These other elements include religious symbols that are references in religious myths and narratives as well as metaphors that elucidate those symbols and that operate within the myths. These language elements facilitate commitment because in various ways they engage emotions of participants and then translate those emotions into reverence and loyalty to values as cognitively apprehended or as embodied in higher selves.

Religious Language and Metaphor

There was a landmark volume of essays on religion, language and mind published in 2018 (Chilton & Kopytowska, 2018). The bulk of the authors of those essays argued that metaphor was key to religious language and most of these authors relied on conceptual metaphor theory (CMT) to understand the nature and operations of metaphor. For CMT, metaphor refers to a group of cognitive operations that depend on cognitive fluidity or the intermixing of conceptual domains. Conceptual elements or representations in one semantic domain are related to or mapped into another conceptual domain. The source domain may concern physical objects, for example, while the target domain may involve something more abstract such as time. Each cross-domain mapping has an internal structure such as slots, relations and properties. The conceptual blend resulting from a cross-domain mapping can be a nonsensical concept and thus discarded, or it could result in a new and innovative way to think about physical objects (e.g., an object must be marked by time). The base domains can be inherited schemas or they can be learned or derived from the surrounding culture. Many are rooted in our concrete three-dimensional spatial sensing systems. Thus, there are domains related to orientation and navigation in space such as near–far and path–goal. The general direction of the cross-domain mappings in CMT appears to be from concrete physical or graspable domains to more abstract domains. For CMT, cognition is embodied or rooted in our physical experience. This physical rootedness produces the concrete domains we all work with when mapping to more abstract domains.

But what have CMT-related analyses uncovered about religious cognition? Buildings, bodies, journeys, fishing and hunting characterized source domains in the Hebrew Bible but it is difficult to imagine these source domains *not* being mentioned in virtually any extended narrative text penned by people living in ancient Palestine. In terms of source domains for God, CMT investigators have produced a veritable wealth of domains including everything from container to force domains. It is difficult to find a source domain *not* yet ascribed to God. As far as I can tell after reading essays and papers applying CMT to various religious texts from the Zohar to the Hebrew Bible, ancient Tantric texts, the Buddhist diamond and heart sutras, texts within the Islamic prophetic tradition and various Christian doctrinal works, religious discourse is like any other complex topic area or discourse tradition. Except for a slight preference for spatial orientational domains as base domains, I could discern no particular religious preferences for certain source domain mappings.

Perhaps we need to look more closely at the cognitive structure within the mappings. Conceptual mappings between a source and a target domain are not necessarily value neutral. Many mappings assign a positive or negative value to the target domain and resultant metaphor. For example, “God is a loving healer.” We evaluate one domain of experience by comparing it with another in these value ascribing mappings. Religious experiences, practices, traditions and cultures provide value-laden source domains that then generate whole universes of evaluative metaphors to cognize the world around us. Conceptual blending theory (CBT) is often brought in to supplement CMT. In CBT, concepts are built from interlocking networks of source domains rather than one source domain. A basic diagram capturing the operation of blending or mapping is composed of at least two inputs (from traditional source domains), an abstract space and then a space dedicated to blending concepts. Blendings can be triggered or promoted via many processes involving cognitive fluidity, but typically appear to occur when there is some identity or commonality between elements in spaces/domains. Many animals can accomplish simple types of conceptual blending but only humans exhibit double-scope blending where the frame and matching/identity properties of to-be-blended elements come from each of the two input spaces. Metaphor appears to be so embedded within human cognition that it is synonymous with thinking or cogitating itself. Therefore, at a minimum, CMT and CBT represent relatively new and useful tools to study religious forms of cognition. Even if no specific or preferential metaphoric domains have yet been discovered to characterize religious cognition, the field is still young and there are new developments occurring all the time. Recent applications of mathematical topological theory to the study of conceptual mappings and blendings promise to yield new insights into this area of the religion–language relationship.

If we use metaphors to conceptualize and cognize religious experiences, we use narratives to live through and interpret them. A narrative is typically a temporal ordering of a series of events involving a challenge, climax and resolution. The plot includes goals and an agent who strives to achieve these goals and experiences. The Christian cross is a symbol that can denote a complex meaning such as “victory even in apparent defeat” given the narrative context in which it is embedded. That narrative context is the cosmological Christian claim/story of Jesus’ crucifixion as leading to the atonement and redemption of mankind. Once valorized by the religious metanarrative, the symbol can then serve as potent aid in the metaphorical individual Christian journey through life. In the decentering model of religious cognition, for example, the trials that an individual

agent undergoes, leads to the decentering process of the self as executive agent. In extreme cases, the sense of loss of agency that suffering entails is analogous to a crucifixion of the self and its goals and desires. Once agency is diminished the religious individual can use the symbols afforded to her by her cultural and religious tradition (in this case the cross) to assist in the process of building an enriched sense of agency and a more complex sense of self-oriented toward “redemption” – another potent Christian symbol. Thus, religious narratives give the individual access to the rich store of culturally grounded, power-infused symbols that a religious tradition offers its adherents. If the religious adherents use these symbols to live their lives in life-enhancing ways, then those symbols can be considered living symbols that shape people’s lives and communities.

While it is clear that religious language, in the form of religious narratives and symbols, can be used as powerful tools by individuals in their quests for commitment to ultimate values and richer lives, elements of religious language can also be used to understand the great unknowns – both the known unknowns and even the unknown unknowns (Downes, 2011). Religious metaphors and myths are a prime mode of religious language used to comprehend what is finally incomprehensible.

Ineffability and Language

Mystical experience is often said to be ineffable or inexpressible (“Words fail!”) or unsayable. Yet mystics themselves often say quite a lot about their experiences. Similarly many of the mystical experiences reported in association with psychedelics have been described, painted, enacted and quite often put to music.

Vörös (2015) argued that the Wittgensteinian distinction between “pointing” and “saying” helps us to understand what is going on when religious mystics attempt to use language to say the unsayable. As noted earlier, language is just as much a tool as a conceptual apparatus. In terms of the 4E paradigm in cognitive science language is *embedded* cognition (as it facilitates thinking via dialog with others in the room); its *extended* cognition (the books I read are part of my language as they enrich my language and thinking) also *enacts* a world, by literally describing it as it happens in real time; and finally, language is *embodied* as its root grammatical structures emerge from the sense of bodily agency described above. Mystical utterances, more than most other parts of language obey the 4E principles. Mystical utterances do not merely *refer* to the mystical, but *embody* and *enact* it. The mystic literally kneels or lies face down or opens

his arms wide and chants incessantly or speaks in tongues and so forth. Other enactments of the mystical include silence or the use of paradox, or using only negations to “refer” to the divine. Because the mystic is pointing beyond existing language elements, this pointing is also the identification of the limits of the linguistic world the mystic inhabits. Mystical language, therefore, acts to cancel or supersede or overcome existing linguistic constraints on what it is permitted to say or think. It moves beyond and therefore ends or overthrows existing cultural norms and breakthroughs to some new world. The *via negativa*, as exemplified by the Upanishadic *neti* and St. John of the Cross’ *nada* points toward the unthinkable and the “unknown unknowns” that are so crucial to an individual’s and a group or culture’s life and growth.

We turn next in Chapter 12 to the issue of group and cultural effects on religion and brain, and vice versa.

*Group Effects and Religion***Introduction**

Most students of religion notice its groupishness. People who worship the same gods tend to form cooperative groups. Members direct their pro-social and altruistic behaviors toward other members of their religious group and their hostility toward competing out-groups. Some theorists of religion have argued that moralizing high gods have made cooperation among large groups of people possible. It is very likely also the case that “religion” as defined in this book also played a central role in the formation and evolution of particular types of small group formations that are uniquely culturally innovative and distinctive to humans. Before discussing these distinctive group formations and the role religion played in their evolutionary history, it is necessary to discuss some of the evolutionary background to group formation more generally.

Formation of groups among our ancestors is part of the story of the evolution of sexual conflict and of cooperation. The evolution of altruism can be partially understood via inclusive fitness theory, indirect reciprocity/evolutionary game theory and multilevel selection theory (Wilson & Wilson, 2007). Inclusive fitness refers to investment in genetically related others. We propagate our own genes by helping and cooperating with those who are genetically related to us. Indirect reciprocity basically involves self-interested give and take with nonrelated others. I scratch your back, you scratch mine (literally in the case of our primate ancestors). Multilevel selection refers to the fact that selection pressures occur at the level of genes, epigenetic mechanisms, individual/organismic level and the group level. Group effects are most clearly seen when groups are involved in direct conflict and competition with other groups. Culture is another evolutionary force affecting all levels of the multilevel selection process as well as the formation of distinctive human groups. The dual inheritance model of human evolution refers to two interacting processes in the evolution

of human groups: biological evolution and cultural evolution. Models of cultural evolution (Richerson & Boyd, 2005) are crucially important for understanding religion. Human evolution is *coevolution* with cultural evolution mediated largely by processes of social learning, language, symbols, norms and so on.

Individual versus Group Relations

Cultural evolution played a role in shaping a social form of identity that is added to one's individual identity (self-concept). *Social identity theory* (Tajfel, 1981) describes the relation between the self-concept and the social groups to which one belongs. From a social identity perspective, threats to one's self-concept or self-esteem or even one's general well-being can be partially compensated via increasing one's identification with the group. The emotional and objective value of membership in a group is integral to the individual's sense of self. The greater the emotional identification with a group the greater the individual wants that group to distinguish itself from others. Thus, individual group members can, under certain circumstances (when members' well-being is threatened or when outgroups are threatening, etc.), push the group into becoming highly exclusive and distinctive (highly entitative). Overidentification with the group (fusion) can lead to dysfunctional states within both individual members and the group. Therefore, the aim is to find the sweet spot or the optimal balance between the motivations for individual uniqueness and for group belonging. To achieve the optimal balance, the individual brain must constantly monitor individual-group interactions and then make appropriate adjustments. If you stray too far away from group consensus then the adjustment involves more closely aligning oneself with an entitative (i.e., pure or clearly defined) group (Hogg et al., 2007). Conversely, to avoid fusionist dysfunctions distancing mechanisms are used.

To return to the discussion of the evolutionary background of innovating forms of human groups, we need to note the obvious cognitive scaffolding these groups received via the emergence of language and symbol-making capacities of early humans. I briefly discussed salient aspects of language evolution in other chapters of this book. A "symbol" is typically a visual or linguistic token that forms a link between things/processes previously unrelated where one element in the pair refers to or carries a reference to the other. This arbitrary form of reference is in turn related to the cognitive function we call "intentionality" and subjectively experienced as

“agency.” Once you have a repertoire of socially shared symbol systems they rapidly become complex, with higher-order relations between symbols and with each level forming nested systems that interlace with group and individual identity systems. Symbolic identity-markers can make it easier to identify who is within my group and therefore who I can trust and interact with. Symbols thus become infused with a tremendous value given that they can determine whether or not you receive group benefits.

Ancestral Group Formations

Distinctive forms of human groups were largely forged within the hunter-gatherer ecological niche that lasted apparently for hundreds of thousands of years. Our hunter-gatherer ancestors were not mere kin groups like extended clans. Instead, they often included individuals who were not genetic relatives. While local, face-to-face hunter-gatherer bands may have consisted of approximately thirty to forty members, the mating pool from which these bands drew was much larger and may have included thousands when many bands gathered at predetermined seasonal intervals and in sacred locations (Hill et al., 2014). At these gatherings trade occurred, marriages were contracted, information was shared, ceremonies were performed and so forth.

As discussed in other chapters of this book, it is generally agreed that the religious expressions most characteristic of ancestral hunter-gatherer societies were animism and then shamanism. While shamanism was certainly central to hunter-gatherer religious consciousness, I suggest that it was only a part of it. Instead, the religious form I think most important for the formation of strategic and innovation-oriented groups so distinctive of human cooperative forms was much more likely to be male secret societies. Later in the evolutionary story, with more complex hunter-gatherer societies and chiefdoms, these all-male secret societies would be called “religious sodalities” by some ethnographers. The modern ethnographic record testifies to the near-universal occurrence among hunter-gatherer and small-scale horticultural societies of all-male secret societies within which lore about the hunt, weapons, initiation rituals and supernatural agents (SAs) was the order of the day. In small-scale hunter-gatherer societies, these all-male groups within the tribes were organized around the purpose of optimizing the hunt by creating specific interdependent relations among group members based on the skillsets of each member in the group. Some members were good at tracking animals, others are spearing them, others at chasing them, others at planning large-scale stampedes

and so forth. These all-male groups virtually created the class of groups known as “enterprise associations” characterized by internal division of labor, interdependent relationships among members, long-range strategic planning, regular methods for generating creative associations among disparate ideas and subordination of all within the group to the overriding purpose of the group. As hunter-gatherer societies became more complex, with larger populations and surpluses from the hunt and from small-scale horticulture, the all-male societies became tools for the greed, advancement and aggrandizement of the initiates who ran the societies – especially for those higher in the organizational hierarchy of the group. But before that could happen the original innovation in group organization around enterprise associations created a very effective and unique form of human cooperation that promoted the cultural revolution that also gave birth to religion.

Male Groups

There have been some recent reviews of the role male secret societies played in the evolution of human social formations (e.g., Hayden, 2018). These all-male groups within the local hunter-gatherer band were called men’s secret societies by the ethnographers and anthropologists who first studied them because their ceremonies and practices were kept secret from other coalitions within the local band and from larger populations at the seasonal gatherings of all regional bands. In particular, the lore, knowledge and traditions of these all-male groups were kept secret from women and children. To keep the lore secret, very harsh penalties were imposed on anyone who broke the taboo against revealing the secret lore of the group. In some bands, an individual could be put to death for the violation of the taboos around the secrecy of these societies. The secret societies very often used separated dwellings to house their weapons, tools and ritual artifacts (such as masks for ritual ceremonies). The structures were large enough sometimes to hold meetings among group members. Sometimes the men’s societies would build much larger structures away from the band’s encampment. It may be, for example, that Göbekli Tepe, the circular site of massive carved blocks of stone depicting mythical beasts and predatory animals in Turkey, dating from around 12,000 years ago, may represent a sanctuary for a men’s secret society. The painted caves of the Upper Paleolithic may also have been used to initiate candidates into secret societies. The dwellings of the local men’s society within and without the band encampment were considered by ethnologists who studied

them to be the center of social and religious life of the local band or tribe. This is where the men made decisions about upcoming hunts and organization of the tribe's ceremonies, and where teenage initiates were trained before their initiation ceremonies. The initiation ceremonies for boys could be quite intense. They involved years of apprenticeships in weapons, ritual practices, learning the mythological lore of the tribe and of course intensive training in hunting techniques. If warfare was frequent or other forms of intergroup conflict were present in the region, the initiates would also learn warfare. Then when the boys came of age the actual initiation into the secret society was often physically brutal. All Aboriginal societies in the western desert of Australia practiced subincision, for example. But beatings were common, as were so-called "vision quests," weeks of fasting, physical ordeals and ritual isolation and seclusion.

Ceremonial masking seems to have been a crucial identity marker for the secret male societies. The masks typically represented SAs, including animal spirits, ancestor spirits and symbolic representations of other spirit beings. Masking differentiated the secret society members from all other members of the tribe. They were also used to terrify people outside the secret society, as when an initiate claimed to be possessed by the animal spirit depicted by the mask. In West Africa, the leading men's society is called the Poro. This was very powerful and influential, in part because of its control over spirit entities.

Importantly, you could only become a member of a male secret society via an initiation ritual. These rites of passage virtually always involved masks, ritual beating or traumatizing of the boys, banishment of women from the rites and, crucially, change of social status after the rites. Boys became men after the initiation. They could hunt, marry, go to war and have a say in tribal councils and so forth. In the Poro society initiation rituals, boys were secluded in the forest and then ritually "eaten" by demons, they received scarifications on their bodies that represented the demon's teeth marks and so forth. After this death experience and after the period of seclusion in the forest, they were then reborn into adult status after extensive (masked) ceremonials. The boys-become-men were then given the tribes' stories and were told the secrets of the men's society, which it was death to reveal. The Chewa (pl. Achewa) live in the area where Zambia, Malawi and Mozambique meet. Nearly every Chewa boy between the ages of twelve and fifteen is initiated into a secret society, and males are not considered to be adults until they join. The association and its maskers are called nyau. In one rite, called bona (part of a funerary ritual that marks the end of mourning), a ritual beer drink (possibly with

psychedelic properties) is prepared. The beer is not only for the people attending the rite but also for the spirits of the dead embodied by nyau. Nyau masqueraders come to the village every day to participate in the brewing of the beer. Presumably, the intoxicating effects of the beer facilitate the transformation of boys into men. The North American Iroquois confederacy, consisting of the Mohawk, Seneca, Onondaga, Cayuga and Oneida nations, is interesting in many ways from the point of view of a theory of early human religious groups because the Iroquois society was a matriarchally organized society. Women held the political power in these societies, yet all-male secret societies were ubiquitous in this matriarchal culture. The secret societies were not mere instruments of patriarchy. They performed some vital functions for early human groups.

Aside from rites of passage, men's secret societies preserved the mythological lore of the tribe, its medicinal lore, its magical practices to ward off evil spirits and many other ritual and religious duties. Many secret men's societies were responsible for funeral rites and still others for various religious festivals and so forth. Many of them gained enormous political power and functioned as agents of social control and apportionment of wealth and resources. They used lore around supernatural powers, SAs and outright force to buttress their political power. It was these societies that developed the ideologies of sacred chiefdoms that would later evolve into the religious concepts of divine kingships in more complex societies. But originally the all-male enterprise groups organized around the hunt or around intertribal conflict developed those cognitive capacities that involved strategic thinking, group belongingness along with an emphasis on individual excellence, long-range planning, group-level theory of mind capacities (GoTM) and charismatic leadership. Early human religious forms very likely emerged out of these secret male societies. Shamanism clearly was another form of early human religion, but it was practiced mostly by lone individuals with schizotypal traits, whereas the members of the all-male societies were highly skilled individuals who regularly practiced complex and long-range strategy planning because they had to in order to cope with the hunt and with intergroup competition and conflict.

Enterprise Associations

We cannot recount the entire story of the early evolution of religious consciousness here. Enough has been said, however, to establish a reasonable case for the role of men's secret societies in creating a primal human group form that we now call "enterprise associations" after the philosopher's

Michael Oakeshott's distinction between enterprise and civil associations. Enterprise association/groups are formed around a task or purpose for the group, while civil associations are not organized around a single purpose. Instead, they are held together by a common recognition of all members of the association of locally prevailing norms, customs, agreements and laws that govern interactions between members of the civil association. Enterprise or task-associated associations, on the other hand, are animated by purpose and teleologic aims. That teleologic structure then has downward effects on the internal structure of the within-group relationships among members of the group. Enterprise associations are capable of great good and great harm because of their extreme effectiveness at what they do when organized correctly. It was the ecologic imperatives faced by the all-male hunting-related secret societies of ancestral human populations that created the original form of the enterprise association. They needed to strategically hunt all kinds of animals that sought to avoid or foil the carefully laid plans of even the best and most accomplished groups of hunters. The generations of predator-prey relationships and the arms race between predators and prey generated an impetus for innovation in early human group formations and structure. It was the need to form task-related or enterprise association group structures that also gave birth to a form of religion (in the form of the secret male societies) and then facilitated or enforced alterations in brain functions that helped to optimize enterprise associations. Thus, to fully understand the religion, group and brain story, we need to turn to these task-oriented group forms and their complex relations to brain and religion.

Structure of Enterprise Associations

Religion facilitates in-group cohesiveness and effectiveness in task-oriented groups. It does so in a variety of ways including via the promotion of specific decision-making procedures within the group, to be discussed later. Now all of these group effects also impose costs on human brains. Members must monitor their standing within the group, the overall standing of their group relative to competitive out groups, decision-making procedures within the group and much else besides. Brain processes have been associated with each of these performance tasks. Most importantly, emerging evidence suggests that specific aspects of religious cognition (called "decentering" in this book) are required to support the kinds of interdependent decision procedures that promote enterprise associations and the striking phenomenon of group agency or group mind. In addition, religious versus nonreligious

members may drive innovation in the group. When you have individuals undergoing a more pronounced or more frequent decentering process, the decision-making within the group will evidence more variability than when individual group members undergo no such decentering process or minimal forms of decentering. Thus, their decisions will be found at both extremes (extremely effective and ineffective for example). Finally, religious members will also drive innovation via the development of new ideas and group norms that are then shared with others.

Task groups or enterprise associations are uniquely specialized to enable humans to address novel, unpredictable or difficult recurring challenges. Task groups also contain the key interdependent elements of teams such as clearly defined roles and responsibilities where members contribute relevant knowledge and skills, which differentiate this particular organizational form from larger groupings characterized by group member homogeneity and interchangeability. Members of enterprise associations are specifically not interchangeable as the success of the group depends critically on the unique and complementary skillsets of each member.

The specific need to solve problems drives the form and structure of enterprise groups or teams. As mentioned earlier, these small groups are structured via interdependencies between members in terms of the excellences or competencies of its members. The fact that all members are in the group in order to solve some problem gives members a sense of a shared destiny, and thus the cohesiveness of the group is quite high. An ancestral hunting team, for example, had to precisely coordinate strategic activities; otherwise the tribe would starve. The structure of the team (stemming from its overall problem-solving purpose) required that members become experts overtime at identifying the talents of individuals as well as the best combination of individuals and skillsets to solve the problem. This kind of thinking encourages the evaluation of persons as individuals endowed with gifts. It also encouraged specialization, division of labor and future-oriented strategic planning. The team does not need everyone to be good at every skill, but insofar as they can leverage each member's expertise while working interdependently toward the end objective (e.g., a successful hunt), the group succeeded and drove innovations.

Yong et al. (2021) noted that the evolution of team group forms facilitated the rise of *distributed forms of cognition*, where individual members draw upon the pool of expertise and shared information across group members to expand their cognitive capacity into an extended mind. Members are forced to acquire some metaknowledge about the team (i.e., knowing who knows what) and when that separate knowledge is to be deployed to

solve the task at hand. Team members also form a kind of identity around their shared destiny or endpoint when the problem gets solved. Each member must acquire *shared task representations* in order to fulfill their roles on the team. By creating shared mental models within the team, the coordination of unique expertise afforded by team members is further enhanced. In addition, it is within the early enterprise associations and secret male societies where *leadership* based on merit emerged. When the aim is to solve an urgent problem as optimally as possible, leaders can quickly solve the coordination problems associated with group decision-making. When facing urgent and daunting challenges you go with the individual who has the greatest metaknowledge about the pool of talent available, the deepest mental model or shared representations about that talent and the associated problem, and finally the best strategic planning capacity to put it all together and deploy it at the right time. These are the kinds of leaders enterprise associations can produce when they are working well. Finally, Yong et al. argued that teams are also characterized by *leveraging belongingness and distinctiveness*; that is, enterprise groups can give individual members the satisfaction of both belonging to a prestigious and supportive group with a shared destiny (belongingness) as well as a group that highlights and fully values the distinctive talents the individual brings to the group (distinctiveness). In short, the enterprise association finds that “sweet spot” between emphasis on the group versus the individual’s needs.

Teams or enterprise associations also have distinct forms of decision-making procedures. These are structured once again by the overriding purpose of the group. The decision-making process is organized around plans that determine the best courses of action to achieve the aim of the group. Given that decision-making procedures are organized around plans of action that would best solve the problem at hand, democratic aggregation or voting procedures were generally not as important as the evaluation of alternative plans of action, with the best plan winning. These systematic forms of evaluation of competing plans of action entailed standards of reasoning and conduct within the enterprise group that were different from and more stringent than those of society generally. Because members of the group are in the group precisely because of their specialized skillsets, their role in solving the problem the group faces confers on them certain powers and greater or lesser weighting of their opinions during the decision-making process. Given that decision-making procedures are organized around action plans that undergo systematic evaluation via presentation and evaluation of counterfactual scenarios, they are strategic *and rational*. Reasons can be cited for any given action plan adopted.

Now if reasons can be cited for decisions taken by the group, we are then licensed to say that the group is behaving rationally and may even possess a kind of responsibility for actions taken because of that decision-making process. However, when the decision-making processes occur within the enterprise group, individual intentions are subordinated to the finalized corporate decision. Even if an individual's intention is in line with (or satisfied by) the corporate decision, the group-structured intention and individual's intention are not identical. The group decision and intention arise out of the interaction of the individuals around the counterfactual evaluation of proposed plans of action utilizing group structure, decision recognition rules, group norms and formal or informal guiding principles. Once a plan is adopted we are also licensed to say that the group is now functioning as an agent and has a group mind, insofar as mind and agency depend upon intentional and rationally arrived at cognitive states.

We have seen that the group has intentionality in that it is oriented and structured by a purpose and that this structure then imposes certain rule-governed decision-making processes on group members and that the results of this decision-making process are rational because reasons can be cited for the decision taken by the group. The group displays a crucial characteristic of mind or agent, and that is intentional states via joint commitment of members of the group to solving the problem at hand. For List and Pettit (2011), a properly defined group agent will generally act in a manner that is rationalized by independently discernible representations and goals; and within relevant domains, it will generally form and uniform those representations in a manner that is rationalized by the evidence we take to be at its disposal. In particular, it will manifest this sort of functional organization, not just at a time but over time; it will display the degree of constancy as well as the degree of coherence that we expect in any intentional subject.

Group Agency

List and Pettit argue that "group agents" display the following decision procedures: (1) *Universal domain*: The group has the ability to have as inputs any set of (individually) complete and consistent attitudes; (2) *Collective rationality*: Group positions on a given agenda are consistent and complete and (3) *Anonymity*: All individual attitudes are given equal weight in determining group positions.

Enterprise associations satisfy these three conditions for group agency. The universal domain is the set of shared representations or shared mental

models of the pool of relevant knowledge and talents the group possesses across all individual members. Collective rationality flows from the fact that decision procedures are strategic and intentional, oriented toward the overriding purpose of the group itself, arrived at by reasoning about alternative/counterfactual plans of action, and these strategic plans of action have reasons to support them. Anonymity is satisfied in that each and every member's talents are required in order to solve the problem. In short, it is legitimate to ascribe the very special property of "group agency or group minds" to enterprise associations given their specialized internal structures and decision-making processes. These are the kinds of groups that gave rise to religion.

I suggest that the rise of enterprise associations among ancestral populations also promoted a new form of the so-called theory of mind (ToM) capacity. What emerged after the rise of enterprise associations was the theory of the group mind (ToGM) capacities – that is, the ability to read the mind of these enterprise groups or ToGM. Both individual ToM and ToGM are important for religious cognition. ToGM is characterized by the ability to predict what a group of people organized into an enterprise group will do next given their past and current membership make-up and their overall purpose. Obviously, ToGM was most important for ancestral forms of warfare and intergroup conflict. When we engage in ToGM we move beyond a mere summation of what each member of the opposing group might be thinking. Instead, I attempt to cognize what the emergent group mind has settled upon (I think that they think that ...). To do so I need to run through mental simulations of what key members of the opposing group might be thinking as well as their resources and aims. I need to surmise what subcoalitions exist within the opposing group and how intragroup rivalries will contribute to the emerging group mind consensus. Once I tabulate all of these serial simulations of what each mind in the opposing group is thinking, I then need to take that final calculation or simulation or guess as to how all of these individual aims sum to a group action; and that is group mindreading. Strategic military manuals and histories are filled with examples of successful and unsuccessful ToGM attempts.

Religious Evolution and Enterprise Associations

Now what do the enterprise association and the group mind have to do with brain and religion? If we conceive the religious group as inherently an enterprise association (it exists for the salvation of souls, etc.), then several

things follow for how the neurocognitive architecture of individual versus group relations will draw upon brain networks for support. In line with social identity theory, the individual brain will need to devote resources toward monitoring individual closeness or identity fusion levels with the religious group. In addition, individuals will need to find a way to blend their contributions to the group with all other member contributions. They will need to become interdependent and oriented toward the overriding purpose of the religious group. That overriding purpose is typically to exalt a selective group of SAs and to produce the ideal Muslim, Buddhist, Catholic or Jew, for example. Since religions are highly entitative groups, becoming an ideal member will mean to some extent signaling honest adherence to the doctrines, rituals, practices and prescribed behaviors of the religious group – all of which will be costly for the individual and the brain's processing capacity. Therefore, at a minimum, in order for an individual to be a member of a religious group the individual must utilize brain systems to monitor standing within the group and how to adjust that standing; that is, to (1) monitor for mismatches between individual versus group demands/doctrines/identity markers; (2) when mismatches occur, disengage or take offline executive control systems and internal working models (IWMs) of self in relation to the group's symbolic identity markers such as its SAs, in order to format these IWMs for later repair; (3) repair and adjust IWMs of the self in its relationship to SAs and group doctrines, and update beliefs and cognitive models of that relation of self to group and SAs and (4) register updated models as successful and consonant with group doctrines. Remarkably, existing neuroscience studies of various forms of religious cognitions are consistent with this basic picture.

Brain networks anchored on the anterior cingulate cortex and Ventromedial prefrontal cortex (vmPFC) tend to monitor for closeness to or conflict with overall group doctrine and SAs, while the networks typically associated with ToM processing and social cognition more generally – the default mode network (DMN) and vmPFC, temporoparietal junction, inferior frontal gyrus, inferior parietal cortex and precuneus – are engaged when assessing the religious group and group mind. The fact that regions greater than standard ToM networks are engaged when cognizing religious groups suggests GoTM networks are real and operative here. In order to adjust conflict or closeness to the religious group, the DMN and related midline structures mediating sense of self are engaged to repair IWMs in relation to SAs. Once that “sweet spot” is found after adjustment and repair work on IWMs of self in relation to the group are accomplished and optimal balance is restored, “consonance” occurs. Consonance

is experienced as ecstatic and mystical states as well as self-transcendence. Such altered states are mediated by structures deep to the temporal lobe that are under modulatory control by the PFC and parietal executive control networks. When these executive control networks are lesioned or downregulated, anterior temporal networks are released from inhibition, resulting in feelings of self-transcendence.

The tension or tug of war between individual and religious group also generates a good deal of religious experience. But personal religious cognitions and experiences can both shape and be shaped by cultural group doctrines. The latter stipulates and constrain the range of acceptable experiences for a member of a culturally delimited group. Group doctrines will define that member's experiences as acceptable, ordinary, extraordinary or anomalous and heretical depending on their alignment with official doctrine. The individual's power to shape or revise group doctrines is limited relative to the group's power to delimit and shape personal experiences. Thus, the bulk of the individual's response to group-level doctrinal precepts must be to recruit cognitive/brain resources to adjust individual experiences, beliefs and behaviors to group-level demands and standards rather than the other way around – attempting to change group-level doctrines. The latter can occur but typically fails, and when it fails, when the individual cannot reconcile his/her beliefs to those of the group's, some unusual individuals attempt to either split the group or leave the group entirely.

Just as enterprise groups help to create that “sweet spot” between belongingness versus distinctiveness, so too religious groups can generally accomplish the same healthy balance between individual versus group interests precisely because religious groups are enterprise associations. Nevertheless, an individual's relationship to group doctrine can become out of balance in several different ways. The individual will virtually always be out of alignment with at least some group demands and doctrines. The optimal alignment between personal experiences and group-level doctrinal representations may be one of the *relative congruence* between the two. With congruence there is some contradiction between the two, but it is manageable and does not cause personal distress in group members. As mentioned earlier, we call this optimal situation *consonance*. In consonance, there is a healthy congruency and meshing of personal experiences with group doctrinal precepts, but there is no strict identity between self and group. In cases where the self is overidentified with the group, there are no nondoctrinally shaped anomalous experiences, and thus fewer chances for further growth for the individual. For individual growth to be possible,

some amount of misalignment between group and individual experiences is required. Distress due to too much misalignment or cultural mismatch will trigger 5HT_{2A} signaling systems (which in turn triggers brain systems that support repairing the deficiency) until the individual estimations of his personal experiences or practices match that of the cultural ideal.

Another potentially important neural mediating system for consonance experiences involves the hormone oxytocin. Oxytocin is known to modulate social affiliation and feelings of belonging, and is beginning to be recognized as a major factor in human sociality, serving as the neuro-endocrinological hub for social cognition. The effects of oxytocin on the brain are primarily characterized by increased effective connectivity both between and within emotion, reward, salience, attention and social cognition processing networks and their interactions with the default mode network. Top-down control over emotional processing regions such as the amygdala is enhanced. Interestingly, the effects of oxytocin on effective connectivity are sex-dependent, being more extensive in males.

While brain recruitment in service to the religious group versus individual relationship is most often triggered by a lack of perceived lack of alignment between individual and group, there is also the question of brain mediation of interdependent relationships of people within the religious group. Here decentering comes into play. In an enterprise group, you need to modulate the urge to be the center of attention and you need to learn to defer to others who have more expertise than you with respect to the problem at hand. But you also need to shine when it is time for you to shine – when your skills are needed by the group. Decentering, downregulation of executive control and self-related networks and then the activation of an ideal self accomplish these seemingly opposite aims in a single brain process. It therefore, also enables the alignment of the individual with the overall group through the updating of their religious beliefs and their IWMs of the self in relation to important SAs, which often occurs through dreams and other subconscious processes. If this process is successful, it will lead to a deeper sense of consonance between the individual and their social group, which corresponds with higher levels of self-satisfaction and resilience.

We, therefore, see how the decentering model of religious cognition allows for interaction between individual and group in a potentially mutually enriching manner. But the religious mind is also designed to overcome and transcend the group and its norms. It moves into a realm beyond good and evil. The religious brain/mind is structured or functions in such a way as to seek out the “unknown unknowns” or those so-called ineffable

experiences that extend beyond everyday human consciousness by creatively accessing previously unused or unexplored combinations of brain networks and brain states (Atasoy et al., 2016; Barrett et al., 2020; Carhart-Harris & Friston, 2019; Tagliazucchi et al., 2014) in order to discover the most information-rich events available to it. It is particularly interested in information-rich events related to the self in relation to the group. It uses the self-structure or process to both seek out these information-rich events and to enrich self and others, including its local group. Its neurocognitive tool in these efforts is the decentering mechanism (which overlaps with the neurocognitive systems underlying “surprise”). The decentering mechanism is unique to religious cognition and is used to update self-models while looping in the rapid eye movement sleep/dreaming system to integrate its findings concerning the self and the ineffable into long-term memory systems so that the self and his or her group can mutually enrich one another and the surrounding human cultural matrix might flourish without end.

References

- Abramowitz, J. S., & Jacoby, R. J. (2014). Scrupulosity: A cognitive-behavioral analysis and implications for treatment. *Journal of Obsessive-Compulsive and Related Disorders*, 3, 140–149.
- Ackermann, S., & Rasch, B. (2014). Differential effects of non-REM and REM sleep on memory consolidation? *Current Neurology and Neuroscience Reports*, 14, 430–438. <https://doi.org/10.1007/s11910-013-0430-8>
- Andersen, M. (2019). Predictive coding in agency detection. *Religion, Brain & Behavior*, 9(1), 65–84. <https://doi.org/10.1080/2153599X.2017.1387170>
- Arzy, S., & Idel, M. (2015). *Kabbala: A neurocognitive approach to mystical experiences*. New Haven, CT: Yale University Press.
- Asma, S. (2017). *The evolution of imagination*. Chicago: The University of Chicago Press.
- Atasoy, S., Donnelly, I., & Pearson, J. (2016). Human brain networks function in connectome-specific harmonic waves. *Nature Communications*, 7, 1–10. <https://doi.org/10.1038/ncomms10340>
- Atasoy, S., Roseman, L., Kaelen, M., et al. (2017). Connectome-harmonic decomposition of human brain activity reveals dynamical repertoire re-organization under LSD. *Scientific Reports*, 7(1), 1–18. <https://doi.org/10.1038/s41598-017-17546-0>
- Azari, N. P., Nickel, J. P., Wunderlich, G., et al. (2001). Neural correlates of religious experience. *European Journal of Neuroscience*, 13, 1649–1652.
- Aznar, S., & Hervig, M. E.-S. (2016). The 5-HT_{2A} serotonin receptor in executive function: Implications for neuropsychiatric and neurodegenerative diseases. *Neuroscience and Biobehavioral Reviews*, 64, 63–82.
- Barrett, F. S., Doss, M. K., Sepeda, N. D., et al. (2020). Emotions and brain function are altered up to one month after a single high dose of psilocybin. *Scientific Reports*, 10(1), 1–14. <https://doi.org/10.1038/s41598-020-59282-y>
- Barrett, F. S., & Griffiths, R. R. (2018). Classic hallucinogens and mystical experiences: Phenomenology and neural correlates. *Current Topics in Behavioral Neurosciences*, 36, 393–430. https://doi.org/10.1007/7854_2017_474
- Barrett, F. S., Johnson, M. W., & Griffiths, R. R. (2015). Validation of the revised Mystical Experience Questionnaire in experimental sessions with psilocybin. *Journal of Psychopharmacology*, 29(11), 1182–1190.
- Bauer, J. J. (2021). *The transformative self: Personal growth, narrative identity and the good life*. Oxford: Oxford University Press.

- Bear, D. M., & Fedio, P. (1977). Quantitative analysis of interictal behavior in temporal lobe epilepsy. *Archives of Neurology*, 34(8), 454–467.
- Beauregard, M., & O’Leary, D. (2007). *The spiritual brain: A neuroscientist’s case for the existence of the soul*. San Francisco: HarperCollins.
- Beauregard, M., & Paquette, V. (2006). Neural correlates of a mystical experience in Carmelite nuns. *Neuroscience Letters*, 405(3), 186–190. <https://doi.org/10.1016/j.neulet.2006.06.060>
- Bell, C. (1997). *Ritual: Perspectives and dimensions*. New York: Oxford University Press.
- Bernstein, A., Hadash, Y., Lichtash, Y., et al. (2015). Decentering and related constructs: A critical review and metacognitive processes model. *Perspectives in Psychological Science*, 10(5), 599–617.
- Blanke, O. (2004). Out of body experiences and their neural basis. *BMJ*, 329(7480), 1414–1415. <https://doi.org/10.1136/bmj.329.7480.1414>
- Blanke, O., & Dieguez, S. (2009). Leaving body and life behind: Out-of-body and near-death experience. In S. Laureys & G. Tononi (Eds.), *The neurology of consciousness* (pp. 303–325). London: Academic Press.
- Block, N., & Miller, B. (2020). Religion and frontotemporal dementia. In A. Coles & J. Collicult (Eds.), *Neurology and religion* (pp. 161–170). Cambridge: Cambridge University Press.
- Boyer, P. (2001). *Religion explained: The evolutionary origins of religious thought*. New York: Basic Books.
- Boyer, P., & Liénard, P. (2020). Ingredients of ‘rituals’ and their cognitive underpinnings. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1805), 20190439. <https://doi.org/10.1098/rstb.2019.0439>
- Bradbury, J. W., & Vehrenkamp, S. L. (1998). *Principles of animal communication*. Sunderland, MA: Sinauer Associates.
- Braun, A. R., Balkin, T. J., Wesenten, N. J., Carson, R. E., Varga, M., Baldwin, P., Selbie, S., Belenky, G., & Herscovitch, P. (1997). Regional cerebral blood flow throughout the sleep-wake cycle. An H₂(15)O PET study. *Brain*, 120(7), 1173–1197. <https://doi.org/10.1093/brain/120.7.1173>
- Brouwer, A., & Carhart-Harris, R. L. (2021). Pivotal mental states. *Journal of Psychopharmacology*, 35(4), 319–352. <https://doi.org/10.1177/0269881120959637>
- Brüne, M. (2004). Schizophrenia – an evolutionary enigma? *Neuroscience and Biobehavioral Reviews*, 28(1), 41–53.
- Bruner, E., Fedato, A., Silva-Gago, M., et al. (2018). Cognitive archeology, body cognition, and hand-tool interaction. *Progress in Brain Research*, 238, 325–345. <https://doi.org/10.1016/bs.pbr.2018.06.013>. Epub 2018 Jul 14. PMID: 30097198 Review.
- Bulbulia, J., Geertz, A. W., Atkinson, Q. D., et al. (2013). The cultural evolution of religion. In P. J. Richerson & M. H. Christiansen (Eds.), *Cultural evolution* (pp. 381–404). Cambridge, MA: MIT Press.
- Bulkeley, K. (2016). *Big dreams: The science of dreaming and the origins of religion*. Oxford: Oxford University Press.
- Bullmore, E., & Sporns, O. (2009). Complex brain networks: Graph theoretical analysis of structural and functional systems. *Nature Reviews Neuroscience*, 10(3), 186–198. <https://doi.org/10.1038/nrn2575>

- Burkert, W., Girard, R., Smith, J. Z., & Hamerton-Kelly, R. (1987). *Violent origins: Walter Burkert, René Girard and Jonathan Z. Smith on ritual killing and cultural formation*. Stanford, CA: Stanford University Press.
- Butler, P. M., McNamara, P., & Durso, R. (2010). Deficits in the automatic activation of religious concepts in patients with Parkinson's disease. *Journal of the International Neuropsychological Society*, 16(2), 252–261. PMID: 19958570.
- Butler, P. M., McNamara, P., & Durso, R. (2011a). Side of onset in Parkinson's disease and alterations in religiosity: Novel behavioral phenotypes. *Behavioural Neurology*, 24(2), 133–141. <https://doi.org/10.3233/BEN-2011-0282>
- Butler, P. M., McNamara, P., Ghofrani, J., & Durso, R. (2011b). Disease-associated differences in religious cognition in patients with Parkinson's disease. *Journal of Clinical and Experimental Neuropsychology*, 33(8), 917–928. <https://doi.org/10.1080/13803395.2011.575768>
- Buzsáki, G. (1996). The hippocampo-neocortical dialogue. *Cerebral Cortex*, 6, 81–92. <https://doi.org/10.1093/cercor/6.2.81>
- Call, J., & Tomasello, M. (2007). Intentional communication in nonhuman primates. In J. Call & M. Tomasello (Eds.), *The gestural communication of apes and monkeys* (pp. 1–15). Mahwah, NJ: Lawrence Erlbaum Associates.
- Carhart-Harris, R. L., Erritzoe, D., Williams, T., et al. (2012). Neural correlates of the psychedelic state as determined by fMRI studies with psilocybin. *Proceedings of the National Academy of Sciences*, 109(6), 2138–2143.
- Carhart-Harris, R. L., & Friston, K. J. (2019). REBUS and the anarchic brain: Toward a unified model of the brain action of psychedelics. *Pharmacological Review*, 71(3), 316–344. <https://doi.org/10.1124/pr.118.017160>. PMID: 31221820.
- Carhart-Harris, R. L., Leech, R., Hellyer, P. J., et al. (2014). The entropic brain: A theory of conscious states informed by neuroimaging research with psychedelic drugs. *Frontiers in Human Neuroscience*, 8, 1–22. <https://doi.org/10.3389/fnhum.2014.00020>
- Carhart-Harris, R., & Nutt, D. (2014). Was it a vision or a waking dream? *Frontiers in Psychology*, 5, 255. <https://doi.org/10.3389/fpsyg.2014.00255>. PMID: 24772095.
- Carhart-Harris, R. L., Muthukumaraswamy, S., Roseman, L., et al. (2016). Neural correlates of the LSD experience revealed by multimodal neuroimaging. *Proceedings of the National Academy of Sciences*, 113(17), 4853–4858.
- Cauda, F., Geminiani, G. C., & Vercelli, A. (2014). Evolutionary appearance of von Economo's neurons in the mammalian cerebral cortex. *Frontiers in Human Neuroscience*, 8, 104. <https://doi.org/10.3389/fnhum.2014.00104>. PMID: 24672457.
- Chan, D., Anderson, V., Pijnenburg, Y., et al. (2009). The clinical profile of right temporal lobe atrophy. *Brain*, 132, 1287–1298. <https://doi.org/10.1093/brain/awp037>
- Charland-Verville, V., Ribeiro de Paula, D., Martial, C., et al. (2020). Characterization of near death experiences using text mining analyses: A preliminary study. *PLoS One*, 15(1), e0227402. <https://doi.org/10.1371/journal.pone.0227402>. eCollection 2020. PMID: 31999716.
- Chilton, P., & Kopytowska, M. (Eds.) (2018). *Religion, language, and the human mind*. New York: Oxford University Press.

- Cho, A., & Forster, D., (2017). The religious linguistic characteristics of the presence of the Kingdom in the light of Speech Act Theory: Christian ethical implications. *Scriptura*, 116(1), 1–12. <https://doi.org/10.7833/116-1-1223>
- Clark, A. (2015). *Surfing uncertainty: Prediction, action, and the embodied mind*. Oxford: Oxford University Press.
- Cooper, R., & Shallice, T. (2000). Contention scheduling and the control of routine activities. *Cognitive Neuropsychology*, 17(4), 297–338. <https://doi.org/10.1080/026432900380427>. PMID: 20945185.
- Craig, A. D. (2009). How do you feel – now? The anterior insula and human awareness. *Nature Reviews Neuroscience*, 10(1), 59–70. <https://doi.org/10.1038/nrn2555>. PMID: 19096369 Review.
- Crescentini, C., Aglioti, S. M., Fabbro, F., & Urgesi, C. (2014). Virtual lesions of the inferior parietal cortex induce fast changes of implicit religiousness/spirituality. *Cortex*, 54, 1–15. <https://doi.org/10.1016/j.cortex.2014.01.023>
- Crespi, B., & Badcock, C. (2008). Psychosis and autism as diametrical disorders of the social brain. *Behavioral Brain Sciences*, 31(3), 241–261; discussion 261–320. <https://doi.org/10.1017/S0140525X08004214>. PMID: 18578904.
- Crespi, B., Summers, K., & Dorus, S. (2007). Adaptive evolution of genes underlying schizophrenia. *Proceedings of the Royal Society: Biological Science*, 274(1627), 2801–2810. <https://doi.org/10.1098/rspb.2007.0876>
- Cristofori, I., Bulbulia, J., Shaver, J. H., et al. (2016). Neural correlates of mystical experience. *Neuropsychologia*, 80, 212–220. <https://doi.org/10.1016/j.neuropsychologia.2015.11.021>
- Crow, T. J. (1993). Sexual selection, Machiavellian intelligence, and the origins of psychosis. *Lancet*, 342, 594–598.
- Crow, T. J. (1997). Is schizophrenia the price that Homo sapiens pays for language? *Schizophrenia Research*, 28, 127–141.
- Crow, T. J. (2000a). Schizophrenia as the price that Homo sapiens pays for language: A resolution of the central paradox in the origin of the species. *Brain Research Reviews*, 31, 118–129.
- Crow, T. J. (2000b). Sexual selection, timing and an X-Y homologous gene: Did Homo sapiens speciate on the Y chromosome? *Psychology*, 11, 1–18.
- Crow, T. J. (Ed.) (2002). *The speciation of modern homo sapiens*. Oxford: Oxford University Press.
- Crow, T. (2008). The ‘big bang’ theory of the origin of psychosis and the faculty of language. *Schizophrenia Research*, 102, 31–52.
- d’Aquili, E., & Newberg, A. (1993). Religious and mystical states: A neuropsychological model. *Zygon*, 28(2), 177–200.
- Damasio, A. (1991). *Somatic markers and the guidance of behavior*. New York: Oxford University Press.
- Dannemann, M., & Kelso, J. (2017). The contribution of Neanderthals to phenotypic variation in modern humans. *American Journal of Human Genetics*, 101(4), 578–589. <https://doi.org/10.1016/j.ajhg.2017.09.010>. PMID: 28985494.
- David, N., Newen, A., & Vogeley, K. (2008). The “sense of agency” and its underlying cognitive and neural mechanisms. *Consciousness and Cognition*, 17(2), 523–534.

- Davie, M. R. (1929). *The evolution of war: A study of its role in early society*. New Haven, CT: Yale University Press.
- Davis, A. K., Clifton, J. M., Weaver, E. G., et al. (2020). Survey of entity encounter experiences occasioned by inhaled N,N-dimethyltryptamine: Phenomenology, interpretation, and enduring effects. *Psychopharmacology*, 34(9), 1008–1020. <https://doi.org/10.1177/0269881120916143>. Epub 2020 Apr 28. PMID: 32345112.
- Davis, E. B., Moriarty, G. L., & Mauch, J. C. (2013). God images and god concepts: Definitions, development, and dynamics. *Psychology of Religion and Spirituality*, 5(1), 51–60.
- Davis, E. B., Granqvist, P., & Sharp, C. (2021). Theistic relational spirituality: Development, dynamics, health, and transformation. *Psychology of Religion and Spirituality*, 13(4), 401–415. <https://doi.org/10.1037/rel0000219>
- Denis, D., French, C. C., & Gregory, A. M. (2018). A systematic review of variables associated with sleep paralysis. *Sleep Medical Review*, 38, 141–157. <https://doi.org/10.1016/j.smr.2017.05.005>
- Devinsky, O., & Lai, G. (2008). Spirituality and religion in epilepsy. *Epilepsy & Behavior*, 12(4), 636–643. <https://doi.org/10.1016/j.yebeh.2007.11.011>
- Dewhurst, K., & Beard, A. W. (1970). Sudden religious conversions in temporal lobe epilepsy. *The British Journal of Psychiatry: The Journal of Mental Science*, 117, 497–507.
- Dissanayake, E. (2006). Ritual and ritualization: Musical means of conveying and shaping emotion in humans and other animals. In S. Brown & U. Volgsten (Eds.), *Music and manipulation: On the social uses and social control of music* (pp. 31–56). Oxford and New York: Berghahn.
- Doblin, R. (1991). Pahnke's Good Friday experiment: A long term follow up and methodological critique. *Journal of Transpersonal Psychology*, 23(1), 1–28.
- Dolgoff-Kaspar, R., Ettinger, A. B., Golub, S. A., Perrine, K., Harden, C., & Croll, S. D. (2011). Numinous-like auras and spirituality in persons with partial seizures. *Epilepsia*, 52(3), 640–644.
- Downes, W. (2011). *Language and religion*. Cambridge: Cambridge University Press.
- Dressler, W. W., Balieiro, M. C., Ribeiro, R. P., & Santos, J. E. D. (2009). Cultural consonance, a 5HT_{2A} receptor polymorphism, and depressive symptoms: A longitudinal study of 42 gene × culture interaction in urban Brazil. *American Journal of Human Biology: The Official Journal of the Human Biology Association*, 21(1), 91–97.
- Du Bois, J. W. (1986). Self-evidence and ritual speech. In W. Chafe & J. Nichols (Eds.), *Evidentiality: The linguistic coding of epistemology* (pp. 313–336). Norwood, NJ: Ablex.
- Dunbar, R. I. (2009). The social brain hypothesis and its implications for social evolution. *Annals of Human Biology*, 36(5), 562–572. <https://doi.org/10.1080/03014460902960289>
- Duranti, A. (2005). Agency in language. In A. Duranti (Ed.), *A companion to linguistic anthropology* (pp. 451–473). London: Blackwell.
- Eisen, J. L., Goodman, W. K., Keller, M. B., et al. (1999). Patterns of remission and relapse in obsessive-compulsive disorder: A 2-year prospective study. *Journal of Clinical Psychiatry*, 60, 346–351.

- Epley, N., Converse, B. A., Delbosch, A., Monteleone, G. A., & Cacioppo, J. T. (2009). Believers' estimates of God's beliefs are more egocentric than estimates of other people's beliefs. *Proceedings of the National Academy of Sciences*, *106*(51), 21533–21538. <https://doi.org/10.1073/pnas.0908374106>
- Farias, M., van Mulukom, V., Kahane, G., et al. (2017). Supernatural belief is not modulated by intuitive thinking style or cognitive inhibition. *Scientific Reports*, *7*(1), 15100. <https://doi.org/10.1038/s41598-017-14090-9>
- Feinberg, T. E., & Keenan, J. P. (2005). Where in the brain is the self? *Consciousness and Cognition*, *14*(4), 661–678.
- Ferguson, M. A., Nielsen, J. A., King, J. B., et al. (2018). Reward, salience, and attentional networks are activated by religious experience in devout Mormons. *Social Neuroscience*, *13*(1), 104–116. <https://doi.org/10.1080/17470919.2016.1257437>
- Ferguson, M. A., Schaper, F. L. W. V. J., Cohen, A., et al. (2022). A neural circuit for spirituality and religiosity derived from patients with brain lesions. *Biological Psychiatry*, *91*(4), 380–388. <https://doi.org/10.1016/j.biopsych.2021.06.016>
- Fox, K. C. R., Nijeboer, S., Solomonova, E., Domhoff, G. W., & Christoff, K. (2013). Dreaming as mind wandering: Evidence from functional neuroimaging and first-person content reports. *Frontiers in Human Neuroscience*, *7*, 412.
- Friston, K. (2009). The free-energy principle: A rough guide to the brain? *Trends in Cognitive Sciences*, *13*(7), 293–301. <https://doi.org/10.1016/j.tics.2009.04.005>
- Friston, K. (2010). The free-energy principle: A unified brain theory? *Nature Reviews Neuroscience*, *11*(2), 127–138. <https://doi.org/10.1038/nrn2787>
- Friston, K., FitzGerald, T., Rigoli, F., Schwartenbeck, P., & Pezzulo, G. (2017). Active inference: A process theory. *Neural Computation*, *29*(1), 1–49.
- Friston, K., Mattout, J., & Kilner, J. (2011). Action understanding and active inference. *Biological Cybernetics*, *104*(1–2), 137–160.
- Gastaut, H. (1954). *Epilepsies*. Springfield, IL: Charles C. Thomas Publisher.
- Gavrilets, S., & Rice, W. (2014). *The genetics and biology of sexual conflict (Cold Spring Harbor perspectives in biology)* Cold Spring Harbor, MA: Cold Spring Harbour Press.
- Gearing, R. E., Alonzo, D., Smolak, A., et al. (2011). Association of religion with delusions and hallucinations in the context of schizophrenia: Implications for engagement and adherence. *Schizophrenia Research*, *126*(1–3), 150–163.
- Geschwind, N. (1979). Behavioural changes in temporal lobe epilepsy. *Psychological Medicine*, *9*, 217–219.
- Geschwind, M., & Picard, F. (2016). Ecstatic epileptic seizures: A glimpse into the multiple roles of the insula. *Frontiers in Behavioral Neuroscience*, *10*. <https://doi.org/10.3389/fnbeh.2016.00021>
- Giaquinto, S., Bruti, L., Dall'Armi, V., Palma, E., & Spiridigliozzi, C. (2011). Religious and spiritual beliefs in outpatients suffering from Parkinson disease. *International Journal of Geriatric Psychiatry*, *26*(9), 916–922. <https://doi.org/10.1002/gps.2624>
- Girard, R. (1977). *Violence and the sacred*. Baltimore, MD: John Hopkins University Press.
- Gómez Emilsson, A. (2016). "Consciousness research," *Qualia Computing*. <https://qualiacomputing.com/category/consciousness-research/page/2/>

- Granqvist, P. (2020). *Attachment in religion and spirituality: A wider view*. New York: Guilford Press.
- Greenberg, D., Witzum, E., & Pisante, J. (1987). Scrupulosity: Religious attitudes and clinical presentations. *British Journal of Medical Psychology*, *60*, 29–37.
- Griffiths, R. R., Hurwitz, E. S., Davis, A. K., Johnson, M. W., & Jesse, R. (2019). Survey of subjective “God encounter experiences”: Comparisons among naturally occurring experiences and those occasioned by the classic psychedelics psilocybin, LSD, ayahuasca, or DMT. *PLoS One*, *14*(4), e0214377.
- Griffiths, R. R., Johnson, M. W., Richards, W. A., et al. (2011). Psilocybin occasioned mystical-type experiences: Immediate and persisting dose-related effects. *Psychopharmacology*, *218*(4), 649–665.
- Griffiths, R. R., Richards, W. A., McCann, U., & Jesse, R. (2006). Psilocybin can occasion mystical-type experiences having substantial and sustained personal meaning and spiritual significance. *Psychopharmacology*, *187*(3), 268–283.
- Hagmann, P., Cammoun, L., Gigandet, X., et al. (2008). Mapping the structural core of human cerebral cortex. *PLoS Biology*, *6*(7), e159. <https://doi.org/10.1371/journal.pbio.0060159>
- Haig, D. (2000). The kinship theory of genomic imprinting. *Annual Review of Ecology and Systematics*, *31*, 9–32.
- Haig, D. (2004). Evolutionary conflicts in pregnancy and calcium metabolism. *Placenta*, *25*(Suppl. A), S10–S15.
- Haig, D. (2006). Intrapersonal conflict. In M. Jones & A. C. Fabian (Eds.), *Conflict* (pp. 8–22). Cambridge: Cambridge University Press.
- Halgren, E., Walter, R. D., Chelrow, D. G., & Crandall, P. H. (1978). Mental phenomena evoked by electrical stimulation of the human hippocampal formation and amygdala. *Brain*, *101*(1), 83–117. <https://doi.org/10.1093/brain/101.1.83>
- Han, S., Mao, L., Gu, X., et al. (2008). Neural consequences of religious belief on self-referential processing. *Social Neuroscience*, *3*(1), 1–15. <https://doi.org/10.1080/17470910701469681>
- Harris, S., Kaplan, J. T., Curiel, A., et al. (2009). The neural correlates of religious and nonreligious belief. *PLoS One*, *4*(10), e7272. <https://doi.org/10.1371/journal.pone.0007272>
- Hayden, B., (2018). *The power of ritual in prehistory: Secret societies and the origins of social complexity*. Cambridge: Cambridge University Press.
- Herbet, G., Lafargue, G., de Champfleury, N. M., et al. (2014). Disrupting posterior cingulate connectivity disconnects consciousness from the external environment. *Neuropsychologia*, *56*, 239–244. <https://doi.org/10.1016/j.neuropsychologia.2014.01.020>
- Hermans, H. J. M., & Kempen, H. J. G. (1993). *The dialogical self: Meaning as movement*. San Diego, CA: Academic Press.
- Hermans, H. J. M., Kempen, H. J. G., & Van Loon, R. J. (1992). The dialogical self: Beyond individualism and rationalism. *American Psychologist*, *47*(1), 23–33.
- Hermans, H. J. M., Konopka, A., Oosterwegel, A., & Zomer, P. (2017). Fields of tension in a boundary-crossing world: Towards a democratic organization of the self. *Integral Psychology of Behavioral Science*, *51*(4), 505–535. <https://doi.org/10.1007/s12124-016-9370-6>

- Hill, K., Wood, B., Baggio, J., Magdalena Hurtado, A., & Boyd, R. (2014). Hunter-gatherer inter-band interaction rates: Implications for cumulative culture. *PLoS One*, *9*(7), e102806. <https://doi.org/10.1371/journal.pone.0102806>
- Hocart, A. M. (1927). *Kingship*. Oxford: Oxford University Press.
- Hogg, M. A., Sherman, D. K., Dierselhuis, J., Maitner, A. T., & Moffitt, G. (2007). Uncertainty, entitativity, and group identification. *Journal of Experimental Social Psychology*, *43*, 135–142.
- Hohwy, J. (2013). *The predictive mind*. Oxford: Oxford University Press.
- Holbrook, C., Izuma, K., Deblieck, C., Fessler, D. M., & Iacoboni, M. (2016). Neuromodulation of group prejudice and religious belief. *Social Cognitive and Affective Neuroscience*, *11*(3), 387–394.
- Holtgraves, T., & McNamara, P. (2010). Pragmatic comprehension deficit in Parkinson's disease. *Journal of Clinical and Experimental Neuropsychology*, *32*(4), 388–397. <https://doi.org/10.1080/13803390903130729>
- Holtgraves, T., McNamara, P., Cappaert, K., & Durso, R. (2010). Linguistic correlates of asymmetric motor symptom severity in Parkinson's disease. *Brain and Cognition*, *72*(2), 189–196. <https://doi.org/10.1016/j.bandc.2009.08.004>
- Hood, R. W., Jr. (2006). The common core thesis in the study of mysticism. In P. Patrick McNamara (Ed.), *Where God and science meet: How brain and evolutionary studies alter our understanding of religion* (Vol. 3, pp. 119–138). Westport, CT: Praeger.
- Huguelet, P., Mohr, S., Borrás, L., Gilliéron, C., & Brandt, P. Y. (2006). Spirituality and religious practices among outpatients with schizophrenia and their clinicians. *Psychiatric Services*, *57*(3), 366–372.
- Humphrey, C., & Laidlaw, J. (1993). *Archetypal actions: A theory of ritual as a mode of action and the case of the Jain Puja*. Oxford: Clarendon Press.
- Iemmola, I., & Camperio Ciani, C., (2009). New evidence of genetic factors influencing sexual orientation in men: Female fecundity increase in the maternal line. *Archives of Sexual Behavior*, *38*, 393–399.
- James, E., Robertshaw, T. L., Hoskins, M., & Sessa, B. (2020). Psilocybin occasioned mystical-type experiences. *Human Psychopharmacology*, *35*(5). <https://doi.org/10.1002/hup.2742>
- Jaynes, J. (1978). *The origins of consciousness in the breakdown of the bicameral mind*. NY: Plenum Press.
- Johnson, K. A., Okun, M. A., Cohen, A. B., Sharp, C. A., & Hook, J. N. (2018). Development and validation of the five-factor LAMBI measure of God representations. *Psychology of Religion and Spirituality*.
- Johnson, M. W., Hendricks, P. S., Barrett, F. S., & Griffiths, R. R. (2019). Classic psychedelics: An integrative review of epidemiology, therapeutics, mystical experience, and brain network function. *Pharmacology & Therapeutics*, *197*, 83–102.
- Johnstone, B., Bodling, A., Cohen, D., Christ, S. E., & Wegrzyn, A. (2012). Right parietal lobe-related “selflessness” as the neuropsychological basis of spiritual transcendence. *International Journal for the Psychology of Religion*, *22*(4), 267–284.
- Johnstone, B., Hanks, R., Bhushan, B., et al. (2017). Selflessness as a universal neuropsychological foundation of spiritual transcendence: Validation with Christian, Hindu, and Muslim traditions. *Mental Health, Religion & Culture*, *20*(2), 175–187. <https://doi.org/10.1080/13674676.2017.1333090>

- Kapitány, R., Kavanagh, C., & Whitehouse, H. (2020). Ritual morphospace revisited: The form, function and factor structure of ritual practice. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 375(1805), 20190436. <https://doi.org/10.1098/rstb.2019.0436>
- Kaplan, J. T., Gimbel, S. I., Dehghani, M., et al. (2017). Processing narratives concerning protected values: A cross-cultural investigation of neural correlates. *Cerebral Cortex*, 27(2), 1428–1438. <https://doi.org/10.1093/cercor/bhv325>
- Kapogiannis, D., Barbey, A. K., Su, M., Krueger, F., & Grafman, J. (2009). Neuroanatomical variability of religiosity. *PLoS One*, 4(9), e7180. <https://doi.org/10.1371/journal.pone.0007180>
- Kapogiannis, D., Deshpande, G., Krueger, F., Thornburg, M. P., & Grafman, J. H. (2014). Brain networks shaping religious belief. *Brain Connectivity*, 4(1), 70–79.
- Keane, W. (1997). Religious language. *Annual Review of Anthropology*, 26, 47–71.
- Keenan, J. P., Nelson, A., O'Connor, M., & Pascual-Leone, A. (2001). Self-recognition and the right hemisphere. *Nature*, 409, 305.
- Kelemen, D. (2004). Are children “intuitive theists”? Reasoning about purpose and design in nature. *Psychological Science*, 15(5), 295–301.
- Keller, P. S. (2011). Sleep and attachment. *Sleep and Development: Familial and Socio-Cultural Considerations*, 49–77.
- Keshavan, M. S., Collin, G., Guimond, S., et al. (2020). Neuroimaging in schizophrenia. *Neuroimaging Clinics of North America*, 30(1), 73–83. <https://doi.org/10.1016/j.nic.2019.09.007>
- Kierkegaard, S. (1846/1989). *The sickness unto death*. London: Penguin Classics.
- Kirkpatrick, L. A. (2005). *Attachment, evolution, and the psychology of religion*. New York: Guilford Press.
- Kogo, N., & C. Trengove. (2015). Is predictive coding theory articulated enough to be testable? *Frontiers in Computational Neuroscience*, 9, 111.
- Kussé, C., Muto, V., Mascetti, L., et al. (2010). Neuroimaging of dreaming: State of the art and limitations. *International Review of Neurobiology*, 92, 87–99. [https://doi.org/10.1016/S0074-7742\(10\)92005-9](https://doi.org/10.1016/S0074-7742(10)92005-9)
- Lacaux, C., Isabelle, C., Santantonio, G., et al. (2019). Increased creative thinking in narcolepsy. *Brain*, 142(7), 1988–1999. <https://doi.org/10.1093/brain/awz137>
- Lebedev, A. V., Kaelen, M., Lövdén, M., et al. (2016). LSD-induced entropic brain activity predicts subsequent personality change. *Human Brain Mapping*, 37(9), 3203–3213. <https://doi.org/10.1002/hbm.23234>
- Lebedev, A. V., Lövdén, M., Rosenthal, G., et al. (2015). Finding the self by losing the self: Neural correlates of ego-dissolution under psilocybin. *Human Brain Mapping*. <https://doi.org/10.1002/hbm.22833>
- Leeson, P. (2014). Human sacrifice. *Review of Behavioral Economics*, 1(1–2), 137–165.
- Li, W., Ma, L., Yang, G., & Gan, W.-B. (2017). REM sleep selectively prunes and maintains new synapses in development and learning. *Nature Neuroscience*, 20(3), 427–437.
- Liénard, P., & Boyer, P. (2006). Why ritualized behavior? Precaution systems and action parsing in developmental, pathological and cultural rituals. *Behavioral and Brain Sciences*, 29, 1–56.

- Lin, K., Marx, C., Caboclo, L. O., Centeno, R. S., Sakamoto, A. C., & Yacubian, E. M. (2009). Sign of the Cross (Signum Crucis): Observation of an uncommon ictal manifestation of mesial temporal lobe epilepsy. *Epilepsy Behaviour*, *14*(2), 400–403.
- List, C., & Pettit, P. (2011). *Group agency: The possibility, design and status of group agents*. Oxford: Oxford University Press.
- Lord, L. D., Expert, P., Atasoy, S., et al. (2019). Dynamical exploration of the repertoire of brain networks at rest is modulated by psilocybin. *NeuroImage*, *199*, 127–142. <https://doi.org/10.1016/j.neuroimage.2019.05.060>
- Lutkajtis, A. (2020). Entity encounters and the therapeutic effect of the psychedelic mystical experience. *Journal of Psychedelic Studies*, *4*(3), 171–178. <https://doi.org/10.1556/2054.2020.00143>
- Luyten, P., Campbell, C., Allison, E., & Fonagy, P. (2020). The mentalizing approach to psychopathology: State of the art and future directions. *Annual Review of Clinical Psychology*, *16*, 297–325. <https://doi.org/10.1146/annurev-clinpsy-071919-015355>
- Lysaker, P. H., & Lysaker, J. T. (2008). *Schizophrenia and the fate of the self*. Oxford: Oxford University Press.
- Maquet, P., & Franck, G. (1997). REM sleep and amygdala. *Molecular Psychiatry*, *2*(3), 195–196. <https://doi.org/10.1038/sj.mp.4000239>. PMID: 9152982.
- Marean, C. W. (2015). An evolutionary anthropological perspective on modern human origins. *Annual Review of Anthropology*, *44*, 533–556.
- Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist*, *41*, 954–969.
- Mataix-Cols, D., Rauch, S. L., Manzo, P. A., Jenike, M. A., & Baer, L. (1999). Use of factor-analyzed symptom dimensions to predict outcome with serotonin reuptake inhibitors and placebo in the treatment of obsessive-compulsive disorder. *American Journal of Psychiatry*, *156*, 1409–1416.
- McCauley, R. N., & Lawson, E. T. (2002). *Bringing ritual to mind: Psychological foundations of religious forms*. Cambridge: Cambridge University Press.
- McCauley, R. N., & Graham, G. (2019). Theory of mind, religiosity, and autistic spectrum disorder: A review of empirical evidence bearing on three hypotheses; *Journal of Cognition and Culture*, *19*(5), 411–431.
- McClenon, J. (2006). The ritual healing theory: Therapeutic suggestion and the origin of religion. In P. McNamara (Ed.), *Where God and science meet: How brain and evolutionary studies alter our understanding of religion: Vol. 1: Evolution, genes, and the religious brain* (pp. 135–158). Westport, CT and London: Praeger Press.
- McNamara, K. J. (1997). *Shapes of time: The evolution of growth and development*. Baltimore, MD: Johns Hopkins University Press.
- McNamara, P. (2000). Counterfactual thought in dreams. *Dreaming*, *10*(4), 232–245.
- McNamara, P. (2004a). *An evolutionary psychology of sleep and dreams*. Westport, CT: Praeger Publishers/Greenwood Publishing Group.
- McNamara, P. (2004b). Genomic imprinting and neurodevelopmental disorders of sleep. *Sleep and Hypnosis*, *6*(2), 100–108.
- McNamara, P. (2009). *The neuroscience of religious experience*. Cambridge: Cambridge University Press.
- McNamara, P. (2015). Do you need cognitive neuroscience to understand religious cognition, experiences and texts? *Journal of Cognitive Historiography*, *66*–74. <https://doi.org/10.1558/jch.v2i1.30988>

- McNamara, P. (2016). *Dreams and visions: How religious ideas emerge in sleep and dreams*. San Diego, CA: ABC-CLIO.
- McNamara, P. (2019). *Neuroscience of sleep and dreams*. Cambridge: Cambridge University Press.
- McNamara, P., Andresen, J., Clark, J., Zborowski, M., & Duffy, C. A. (2001). Impact of attachment styles on dream recall and dream content: A test of the attachment hypothesis of REM sleep. *Journal of Sleep Research*, *10*(2), 117–127.
- McNamara, P., Ayala, R., & Minsky, A. (2014). REM sleep, dreams, and attachment themes across a single night of sleep: A pilot study. *Dreaming*, *24*(4), 290.
- McNamara, P., Minsky, A., Pae, V., & Gusev, A. (2015). Cognitive phenomenology of religious experience in religious narratives, dreams, and nightmares. *Archive for the Psychology of Religion*, *37*(3), 343–357. <https://doi.org/10.1163/15736121-12341311>
- McNamara, P., Holtgraves, T., Durso, R., & Harris, E. (2010). Social cognition of indirect speech: Evidence from Parkinson's disease. *Journal of Neurolinguistics*, *23*(2), 162–171. <https://doi.org/10.1016/j.jneuroling.2009.12.003>
- McNamara, P., Teed, B., Pae, V., Sebastian, A., & Chukwumerije, C. (2018). Supernatural Agent Cognitions in Dreams. *Journal of Cognition and Culture*, *18*(3–4), 428–450. <https://doi.org/10.1163/15685373-12340038>
- Mikulincer, M., Shaver, P. R., Sapir-Lavid, Y., & Avihou-Kanza, N. (2009). What's inside the minds of securely and insecurely attached people? The secure-base script and its associations with attachment-style dimensions. *Journal of Personality and Social Psychology*, *97*(4), 615.
- Miller, B., Seeley, W. W., Mychack, P., et al. (2001). Neuroanatomy of the self: Evidence from patients with frontotemporal dementia. *Neurology*, *57*(1), 817–821.
- Modestino, E. J., O'Toole, P., & Reinhofer, A. (2016). Experiential and Doctrinal Religious Knowledge Categorization in Parkinson's Disease: Behavioral and Brain Correlates. *Frontiers in Human Neuroscience*, *10*. <https://doi.org/10.3389/fnhum.2016.00113>
- Mohr, S., Brandt, P. Y., Borrás, L., Gilliéron, C., & Huguelet, P. (2006). Toward an integration of spirituality and religiousness into the psychosocial dimension of schizophrenia. *American Journal of Psychiatry*, *163*(11), 1952–1959.
- Moon, J. W. (2021). Why are world religions so concerned with sexual behavior? *Current Opinion in Psychology*, *40*, 15–19. <https://doi.org/10.1016/j.copsyc.2020.07.030>
- Morgan, J., Clark, D., Tripodis, Y., et al. (2016). Impacts of religious semantic priming on an intertemporal discounting task: Response time effects and neural correlates. *Neuropsychologia*, *89*, 403–413.
- Miyauchi, S., Misaki, M., Kan, S., et al. (2009). Human brain activity time-locked to rapid eye movements during REM sleep; *Experimental Brain Research*, *192*(4), 657–667. <https://doi.org/10.1007/s00221-008-1579-2>
- Mueller, A. D., Meerlo, P., McGinty, D., & Mistlberger, R. E. (2015). Sleep and adult neurogenesis: Implications for cognition and mood. *Current Topics in Behavioral Neurosciences*, *25*, 151–181. https://doi.org/10.1007/7854_2013_251
- Murai, T., Hanakawa, T., Sengoku, A., et al. (1998). Temporal lobe epilepsy in a genius of natural history: MRI volumetric study of postmortem brain. *Neurology*, *50*(5), 1373–1376. <https://doi.org/10.1212/wnl.50.5.1373>. PMID: 9595989.

- Murdock, G. P. (1967). *Ethnographic atlas: A summary*. Pittsburgh, PA: University of Pittsburgh Press.
- Murdock, G. P., & White, D. R. (1969). Standard cross-cultural sample. *Ethnology*, 8, 329–369.
- Muthukumaraswamy, S. D., Carhart-Harris, R. L., Moran, R. J., et al. (2013). Broadband cortical desynchronization underlies the human psychedelic state. *Journal of Neuroscience*, 33(38), 15171–15183. <https://doi.org/10.1523/JNEUROSCI.2063-13.2013>
- National Academies of Sciences, Engineering, and Medicine (NASEM). 2021. *Sex differences in brain disorders: Emerging transcriptomic evidence: Proceedings of a workshop*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/26058>
- Nelson, K. (2015). Near-death experiences--Neuroscience perspectives on near-death experiences. *Missouri Medicine*, 112(2), 92–98.
- Neubauer, R. L. (2014). Prayer as an interpersonal relationship: A neuroimaging study. *Religion, Brain & Behavior*, 4(2), 92–103. <https://doi.org/10.1080/2153599X.2013.768288>
- Newberg, A., Alavi, A., Baime, M., et al. (2001). The measurement of regional cerebral blood flow during the complex cognitive task of meditation: A preliminary SPECT study. *Psychiatry Research: Neuroimaging*, 106(2), 113–122.
- Newberg, A. B., Wintering, N. A., Morgan, D., & Waldman, M. R. (2006). The measurement of regional cerebral blood flow during glossolalia: A preliminary SPECT study. *Psychiatry Research: Neuroimaging*, 148, 67–71.
- Nichols, D. E. (2016). Psychedelics. *Pharmacological Reviews*, 68(2), 264–355.
- Nordin, A., & Bjälkebring, P. (2019). Measuring Counterintuitiveness in Supernatural Agent Dream Imagery. *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.01728>
- Northoff, G., Heinzl, A., de Greck, M., et al. (2006). Self-referential processing in our brain – A meta-analysis of imaging studies on the self. *NeuroImage*, 31(1), 440–457. <https://doi.org/10.1016/j.neuroimage.2005.12.002>
- Nunn, C. L., & Samson, D. R. (2018). Sleep in a comparative context: Investigating how human sleep differs from sleep in other primates. *American Journal of Physical Anthropology*, 166(3), 601–612. <https://doi.org/10.1002/ajpa.23427>
- Oakeshott, M. (1990). *On human conduct*. Oxford: Clarendon Press.
- Ogata, A., & Miyakawa, T. (1998). Religious experiences in epileptic patients with a focus on ictus-related episodes. *Psychiatry and Clinical Neurosciences*, 52, 321–325.
- Owen, A., Hayward, R. D., Koenig, H. G., Steffens, D. C., & Payne, M. E. (2011). Religious factors and hippocampal atrophy in late life. *PLoS One*, 6(3), e17006. <https://doi.org/10.1371/journal.pone.0017006>
- Oyserman, D., Bybee, D., Terry, K., & Hart-Johnson, T. (2004). Possible selves as roadmaps. *Journal of Research in Personality*, 38, 130–149.
- Pahnke, W. N. (1967). LSD and religious experience. In R. C. DeBold & R. C. Leaf (Eds.), *LSD, man and society* (p. 74). Middletown, PA: Wesleyan University Press.

- Paloutzian, R. F., Murken, S., Streib, H., & Rößler-Namini, S. (2013). Conversion, deconversion, and spiritual transformation: A multilevel interdisciplinary view. In R. F. Paloutzian & C. L. Park (Eds.), *Handbook of the psychology of religion and spirituality* (pp. 399–421). New York: Guilford Press.
- Pardiñas, A. F., Holmans, P., Pocklington, A. J., et al. (2018). Common schizophrenia alleles are enriched in mutation-intolerant genes and in regions under strong background selection. *Nature Genetics*, *50*(3), 381–389. <https://doi.org/10.1038/s41588-018-0059-2>
- Paul, L. A. (2014). *Transformative experience*. Oxford: Oxford University Press.
- Peoples, R., Duda, P., & Marlowe, F. W. (2016). Phylogeny of religion. *Human Nature*, *27*, 261–282. <https://doi.org/10.1007/s12110-016-9260-0>
- Persinger, M. A. (1983). Religious and mystical experiences as artifacts of temporal lobe function: A general hypothesis. *Perceptual and Motor Skills*, *57*, 1255–1262.
- Persinger, M. A. (1987). *Neuropsychological bases of God beliefs*. New York: Praeger.
- Péter, Z., Oliphant, M. E., & Fernandez, T. V. (2017). Motor stereotypies: A pathophysiological review. *Frontiers of Neuroscience*, *11*, 171. <https://doi.org/10.3389/fnins.2017.00171>
- Picard, F. (2013). State of belief, subjective certainty and bliss as a product of cortical dysfunction. *Cortex*, *49*(9), 2494–2500. <https://doi.org/10.1016/j.cortex.2013.01.006>
- Polimeni, J., & Reiss, J. P. (2003). Evolutionary perspectives on schizophrenia. *Canadian Journal of Psychiatry*, *48*, 34–39.
- Preller, K. H., & Vollenweider, F. X. (2018). Phenomenology, structure, and dynamic of psychedelic states. In A. L. Halberstadt, F. X. Vollenweider, & D. E. Nichols (Eds.), *Current Topics in Behavioral Neurosciences* (pp. 221–256). Berlin: Springer. https://doi.org/10.1007/7854_2016_459
- Preller, K. H., Razi, A., Zeidman, P., et al. (2019). Effective connectivity changes in LSD-induced altered states of consciousness in humans. *Proceedings of the National Academy of Sciences*, *116*(7), 2743–2748.
- Puri, B. K., Lekh, S. K., Nijran, K. S., Bagary, M. S., & Richardson, A. J. (2001). Spect neuroimaging in schizophrenia with religious delusions. *International Journal of Psychophysiology*, *40*, 143–148.
- Qin, P., Wang, M., & Northoff, G. (2020). Linking bodily, environmental and mental states in the self-A three-level model based on a meta-analysis. *Neuroscience and Biobehavioral Reviews*, *115*, 77–95. <https://doi.org/10.1016/j.neubiorev.2020.05.004>
- Ramachandran, V. S., & Blakeslee, S. (1998). *Phantoms in the brain: Probing the mysteries of the human mind*. New York: William Morrow.
- Rappaport, R. A. (1999). *Ritual and religion in the making of humanity*. New York: Cambridge University Press.
- Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed human evolution*. Chicago: University of Chicago Press.
- Reisenzein, R., Horstmann, G., & Schutzwohl, A. (2019). The cognitive-evolutionary model of surprise: A review of the evidence. *Topics in Cognitive Science*, *11*(1), 50–74.
- Ritchie, S. J., Cox, S. R., Shen, X., et al. (2018). Sex differences in the adult human brain: Evidence from 5216 UK biobank participants. *Cerebral Cortex*, *28*(8), 2959–2975. <https://doi.org/10.1093/cercor/bhy109>

- Roberts, J. K. A., & Guberman, A. (1989). Religion and epilepsy. *Psychiatric Journal of the University of Ottawa: Revue de psychiatrie de l'Université d'Ottawa*, 14(1), 282–286.
- Romain, W. F. (2009). *Shamans of the lost world. (2009). A cognitive approach to the prehistoric religion of the Ohio Hopewell*. Plymouth, UK: Altamira Press; Rowman and Littlefield Publishers, Inc.
- Sanz, C., Zamberlan, F., Erowid, E., Erowid, F., & Tagliazucchi, E. (2018). The experience elicited by hallucinogens presents the highest similarity to dreaming within a large database of psychoactive substance reports. *Frontiers of Neuroscience*, 12(7). <https://doi.org/10.3389/fnins.2018.00007>
- Sass, L. A. (2014). Self-disturbance and schizophrenia: Structure, specificity, pathogenesis (Current issues, New directions). *Schizophrenia Research*, 152(1), 5–11. <https://doi.org/10.1016/j.schres.2013.05.017>
- Schjødt, U., Stødkilde-Jørgensen, H., Geertz, A. W., & Roepstorff, A. (2008). Rewarding prayers. *Neuroscience Letters*, 443(3), 165–168. <https://doi.org/10.1016/j.neulet.2008.07.068>
- Schjoedt, U. (2009). The religious brain: A general introduction to the experimental neuroscience of religion. *Method & Theory in the Study of Religion*, 21(3), 310–339.
- Schjoedt, U., & Andersen, M. (2017). How does religious experience work in predictive minds? *Religion, Brain & Behavior*, 7(4), 320–323.
- Schjoedt, U., Stødkilde-Jørgensen, H., Geertz, A. W., & Roepstorff, A. (2009). Highly religious participants recruit areas of social cognition in personal prayer. *Social Cognitive and Affective Neuroscience*, 4(2), 199–207.
- Searle, J. R. (2007). What is language: Some preliminary remarks. In S. L. Tsahatzidis (Ed.), *John Searle's Philosophy of Language: Force, meaning and mind* (pp. 15–48). Cambridge: Cambridge University Press.
- Searle, J. R., & Vanderveken, D. (1985). *Foundations of illocutionary logic*. Cambridge: Cambridge University Press.
- Seltermann, D., Apetroaia, A. I., Riela, S., & Aron, A. (2014). Dreaming of you: Behavior and emotion in dreams of significant others predict subsequent relational behavior. *Social Psychological and Personality Science*, 5(1), 111–118.
- Seth, A. K. (2013). Interoceptive inference, emotion, and the embodied self. *Trends in Cognitive Sciences*, 17(11), 565–573.
- Shanon, B. (2002). *The antipodes of the mind: Charting the phenomenology of the Ayahuasca experience*. Oxford: Oxford University Press.
- Shtulman, A., & Rattner, M. (2018). Theories of god: Explanatory coherence in religious cognition. *PLoS One*, 13(12), e0209758.
- Siddle, R., Haddock, G., Tarrier, N., & Garagher, E. B. (2002). Religious delusions in patients admitted to hospital with schizophrenia. *Social Psychiatry and Psychiatric Epidemiology*, 37(3), 130–138.
- Slater, E., & Beard, A. W. (1963). The schizophrenia like psychoses of epilepsy. *The British Journal of Psychiatry*, 109(458), 95–112. <https://doi.org/10.1192/bjp.109.458.95>
- Stace, W. T. (1960). *Mysticism and philosophy*. Philadelphia, PA: Lippincott.
- Stevens, A., & Price, J. (2015). *Evolutionary psychiatry: A new beginning*. London: Routledge. <https://doi.org/10.4324/9781315740577>
- Stickgold, R., Scott, L., Rittenhouse, C., & Hobson, J. A. (1999). Sleep-induced changes in associative memory. *Journal of Cognitive Neuroscience*, 11(2), 182–193. <https://doi.org/10.1162/089892999563319>

- Stromberg, P. G. (2012). Collective excitement and lapse in agency: Fostering an appetite for cigarettes. In D. H. Lende & G. Downey (Eds.), *The encultured brain: An introduction to neuroanthropology* (pp. 315–338). Cambridge, MA: MIT Press.
- Sullivan, P. F., Kendler, K. S., & Neale, M. C. (2003). Schizophrenia as a complex trait: Evidence from a meta-analysis of twin studies. *Archives of General Psychiatry*, *60*, 1187–1192.
- Svirri, S. (2002). The self and its transformation in Sūfism. In D. Shulman & G. G. Stroumsa (Eds.), *Self and self-transformation in the history of religions* (pp. 195–215). New York: Oxford University Press.
- Synofzik, M., Vosgerau, G., & Voss, M. (2013). The experience of agency: An interplay between prediction and postdiction. *Frontiers of Psychology*, *4*, 127. <https://doi.org/10.3389/fpsyg.2013.00127>
- Tagliazucchi, E., Carhart-Harris, R., Leech, R., et al. (2014). Enhanced repertoire of brain dynamical states during the psychedelic experience. *Human Brain Mapping*, *35*(11), 5442–5456. <https://doi.org/10.1002/hbm.22562>
- Tagliazucchi, E., Roseman, L., Kaelen, M., et al. (2016). Increased global functional connectivity correlates with lsd-induced ego dissolution. *Current Biology*, *26*(8), 1043–1050. <https://doi.org/10.1016/j.cub.2016.02.010>
- Tajfel, H. (1981). *Human groups and social categories*. Cambridge: Cambridge University Press.
- Tambiah, S. (1979). A performative approach to ritual. *Proceedings of the British Academy*, *65*, 113–169.
- Tedrus, G. M. A. S., Fonseca, L. C., Fagundes, T. M., & da Silva, G. L. (2015). Religiosity aspects in patients with epilepsy. *Epilepsy & Behavior*, *50*, 67–70.
- Tek, C., & Ulug, B. (2001). Religiosity and religious obsessions in obsessive-compulsive disorder. *Psychiatry Research*, *104*(2), 99–108.
- Thompson, S. T., Lereya, G., & Lewis, S., et al. (2015). Childhood sleep disturbance and risk of psychotic experiences at 18: UK birth cohort. *British Journal of Psychiatry*, *207*(1), 23–29. <https://doi.org/10.1192/bjp.bp.113.144089>
- Thornton, M. A., & Tamir, D. I. (2020). People represent mental states in terms of rationality, social impact, and valence: Validating the 3d Mind Model. *Cortex*, *125*, 44–59. <https://doi.org/10.1016/j.cortex.2019.12.012>
- Timmermann, C., Roseman, L., Williams, L., et al. (2018). DMT models the near-death experience. *Frontiers of Psychology*, *15*(9), 1424. <https://doi.org/10.3389/fpsyg.2018.01424>
- Tononi, G. (2008). Consciousness as integrated information: A provisional manifesto. *The Biological Bulletin*, *215*, 216–242.
- Trimble, M., & Freeman, A. (2006). An investigation of religiosity and the Gastaut-Geschwind syndrome in patients with temporal lobe epilepsy. *Epilepsy and Behavior*, *9*(3), 407–414.
- Triveni, D., Grover, S., & Chakrabarti, S. (2017). Religiosity among patients with schizophrenia: An exploratory study. *Indian Journal of Psychiatry*, *59*(4), 420–428.

- Tucker, D. M., Novelly, R. A., & Walker, P. J. (1987). Hyperreligiosity in temporal lobe epilepsy: Redefining the relationship. *The Journal of Nervous and Mental Disease*, 175(3), 181–184.
- Tunde, A. O. (2016). Discourse functions of Will and Shall in Christian prayers. *International Journal of Humanities and Cultural Studies*, 2(4), 1096–1107.
- Urgesi, C., Aglioti, S. M., Skrap, M., & Fabbro, F. (2010). The spiritual brain: Selective cortical lesions modulate human self-transcendence. *Neuron*, 65(3), 309–319. <https://doi.org/10.1016/j.neuron.2010.01.026>
- Vaitl, D., Birbaumer, N., Gruzelier, J. H., et al. (2005). Psychobiology of altered states of consciousness. *Psychological Bulletin*, 131, 98–127.
- Van Elk, M., & Aleman, A. (2017). Brain mechanisms in religion and spirituality: An integrative predictive processing framework. *Neuroscience and Biobehavioral Reviews*, 73, 359–378.
- Van Leeuwen, N., & Van Elk, M. (2019). Seeking the supernatural: The interactive religious experience model. *Religion, Brain & Behavior*, 9(3), 221–251.
- van Lommel, P. (2011). Near-death experiences: The experience of the self as real and not as an illusion. *Annals of the New York Academy of Sciences*, 1234, 19–28. <https://doi.org/10.1111/j.1749-6632.2011.06080.x>. PMID: 21988246.
- Veronelli, L., Makarets, S. J., Quimby, M., Dickerson, B. C., & Collins, J. A. (2017). Geschwind Syndrome in frontotemporal lobar degeneration: Neuroanatomical and neuropsychological features over 9 years. *Cortex*, 94, 27–38. <https://doi.org/10.1016/j.cortex.2017.06.003>
- Vogeley, K., & Fink, G. R. (2003). Neural correlates of first-person-perspective. *Trends in Cognitive Sciences*, 7, 38–42.
- Vollenweider, F. X., & Kometer, M. (2010). The neurobiology of psychedelic drugs: Implications for the treatment of mood disorders. *Nature Reviews Neuroscience*, 11(9), 642–651. <https://doi.org/10.1038/nrn2884>
- Vollenweider, F. X., & Preller, K. H. (2020). Psychedelic drugs: Neurobiology and potential for treatment of psychiatric disorders. *Nature Reviews Neuroscience*, 1–14. <https://doi.org/10.1038/s41583-020-0367-2>
- Vörös, S. (2015). Saying the unsayable: Mystical experience and language. *Disputatio philosophica: International Journal on Philosophy and Religion*, 16(1), 79–90.
- Walker, M. P., et al. (2002). Cognitive flexibility across the sleep–wake cycle: REM-sleep enhancement of anagram problem solving. *Cognitive Brain Research*, 14, 317–324.
- Watts, J., Sheehan, O., Atkinson, Q. D., Bulbulia, J., & Gray, R. D. (2016). Ritual human sacrifice promoted and sustained the evolution of stratified societies. *Nature*, 532(7598), 228–231. <https://doi.org/10.1038/nature17159>
- Waxman, S. G., & Geschwind, N. (1975). The interictal behavior syndrome of temporal lobe epilepsy. *Archives of General Psychiatry*, 32(12), 1580–1586.
- Weil, S. (1942). The love of god and affliction. In G. A. Panichas (Ed.), *The Simone Weil reader* (pp. 313–339). New York: David McKay Co.
- Whitehouse, H. (2000). *Arguments and icons: Divergent modes of religiosity*. Oxford University Press.

- Whitehouse, H. (2004). *Modes of religiosity: A cognitive theory of religious transmission*. Walnut Creek, CA: AltaMira Press.
- Wildman, W. J., & McNamara, P. (2010). Evaluating reliance on narratives in the psychological study of religious experiences. *The International Journal for the Psychology of Religion*, 20(4), 223–254.
- Wilkins, A. S., Wrangham, R. W., & Fitch, W. T. (2014). The “domestication syndrome” in mammals: A unified explanation based on neural crest cell behavior and genetics. *Genetics*, 197(3), 795–808. <https://doi.org/10.1534/genetics.114.165423>
- Wilson, D. S., & Wilson, E. O. (2007). Rethinking the theoretical foundation of sociobiology. *Quarterly Review of Biology*, 82, 327–348.
- Wright, S. T., Kerr, C. W., Doroszczuk, N. M., et al. (2014). The impact of dreams of the deceased on bereavement: A survey of hospice caregivers. *Am J Hosp Palliat Care*, 31(2), 132–138. <https://doi.org/10.1177/1049909113479201>
- Wuerfel, J., Krishnamoorthy, E. S., Brown, R. C., et al. (2004). Religiosity is associated with hippocampal but not amygdala volumes in patients with refractory epilepsy. *Journal of Neurology, Neurosurgery, and Psychiatry*, 75, 640–642.
- Yaden, D. B., Haidt, J., Hood, R. W., Jr., Vago, D. R., & Newberg, A. B. (2017). The varieties of self-transcendent experience. *Review of General Psychology*, 21, 143–160.
- Yaden, D. B., Johnson, M. W., Griffiths, R. R., et al. (2021). Psychedelics and consciousness: Distinctions, demarcations, and opportunities. *International Journal of Neuropsychopharmacology*, 24(8), 615–623. <https://doi.org/10.1093/ijnp/pyabo26>
- Yilmaz, O., & Isler, O. (2019). Reflection increases belief in God through self-questioning among non-believers. *Judgment and Decision Making*, 14, 649–657.
- Yong, J. C., Park, G., and Spitzmuller, M. (2021). From the savannah to the corporate office: The evolution of teams. *Small Group Research*, 52, 33–67. <https://doi.org/10.1177/1046496420960516>
- Zhong, W., Cristofori, I., Bulbulia, J., Krueger, F., & Grafman, J. (2017). Biological and cognitive underpinnings of religious fundamentalism. *Neuropsychologia*, 100, 18–25. <https://doi.org/10.1016/j.neuropsychologia.2017.04.009>

Index

- 5HT_{2A} receptors, *see* neurotransmitters, serotonin, 5HT_{2A} receptors
- Abulafia, Abraham, 149
- addiction, divided self and, 161
- afterlife, belief in, 87
- agency. *see also* self
- belief in supernatural agents and, 46–47, 140
 - classification of language by encoding of, 211
 - concept of, 64–67
 - decentering and, 23–24, 30–32, 34–39, 44, 48, 221
 - dialogic self and, 63–64
 - diminution in sense of, 34–39
 - dreaming and loss of, 169, 187
 - effects of religious rituals on, 174
 - group agency in enterprise associations, 229, 232–233
 - as key to religiosity, 63, 72
 - PPF and, 19
 - religious language and, 209–212
 - role of subcortical structures, 55
 - schizophrenia and, 61, 71, 93, 198
 - supernatural agents as cause of displacement, 178
 - surprise events and reduction in, 25–28
 - tendency to {see} everywhere, 61, 62, 93, 198
- akrasia, 69
- Amanita muscaria mushrooms, 89
- amygdala
- degeneration in FTD, 105
 - hyperreligiosity and, 102–103, 105, 107
 - memory and, 83
 - religiosity in TLE and, 102–103, 105
 - REM sleep and, 50
 - salience network and, 112
 - sex differences, 12
- anatomically modern humans (AMH)
- advent of behavioral modernity, 90, 209
 - evolution of REM and decentering, 48–53, 81
 - features of brain evolution, 37–38, 49
 - interaction with existing hominin populations, 37, 49, 74, 76, 78, 79, 90
- ancestor worship, 87
- ancestral group formations, 225–226
- ancient Greeks, 125
- animism, 87, 225
- anterior cingulate cortex (ACC)
- FTD and, 108
 - group doctrine and, 234
 - neuron clusters, 35, 108
 - psilocybin effects, 132
 - reasoning about God's beliefs and, 123
 - role in attentional and executive control, 77
 - role in error monitoring and reflective processing, 96, 124
 - salience network and, 112
 - sense of self and, 162
 - surprise as expectation violation and, 30
- anterior insula, 18
- anterior insular cortex (AIC), 35, 104, 108, 162
- anxiety buffering theory, of supernatural agents, 180–181
- anxiety disorders, 11
- archaeological evidence, of men's secret societies, 226
- arts, ritualization and, 191
- atheistic religions, and belief in supernatural agents, 7
- atonia, REM sleep and, 42, 80, 187
- attachment theory, of supernatural agents, 181–183
- attention-deficit hyperactivity disorder (ADHD), 11
- autism spectrum disorders, 11, 35
- gaze avoidance, 198
 - religiosity and, 61–62
 - vs schizophrenia spectrum disorders, 197–199
 - stereotypies, 198
- autobiographical memory, 54
- autoscopy, 148
- ayahuasca, 125, 136–138, 140, 141, 168, 205

- basal ganglia, 113, 199, 215, 217
 bear ceremonialism, 190, 201
 behavioral modernity
 language and the advent of, 209
 REM sleep and the birth of, 90
 behaviors, ritualization of, 191
 belief updating process
 role of REM sleep, 29–30, 169
 role of surprise, 24, 25
 biocultural approach to religion, 13–15
 bipolar disorder, 70, 116
 brain
 drivers of evolutionary development, 74–78
 effects of serotonergic psychedelics, *see*
 psychedelics
 evolution of, 37–38
 assumptions concerning, 9
 evolutionary impact of human domestication,
 75–76
 initial studies on brain and religion, 97–98
 language precursors, 209
 regions associated with religious experiences,
 119–123
 sex differences, 12
 small world architecture, 23, 36–37, 41, 44–45,
 64
 structures supporting the sense of self, 72
 brain disorders, sex differences, 11
 brain injury. *see also* right hippocampal atrophy/
 damage
 religious experiences and, 116–119, 124, 150
 and religious language, 216
 brain networks, and small group doctrine, 234
 Broca's area, 5, 92, 217
 Brodmann's Area 10, 82
 Buddhism, 7

 Campanian Ignimbrite Eruption, 49
 Catal Huyuk, Malta, 201
 cataplexy, 42, 81, 156
 central executive resources, decentering/surprise
 events and reallocation of, 26
 cerebral torque, 92
 childhood, 13, 68, 75, 93, 120
 choice, 66, 70
 coalitional behavior, 16, 44
 sex differences, 195–197
 cognitive science, 4E framework, 15–16
 conceptual blending theory (CBT), 220
 conceptual metaphor theory (CMT), 219–220
 conflict. *see also* genetic conflict
 intragenomic, 12
 contention scheduling system, 199
 conversion, religious, 167–169
 Copan, Honduras, temple complex, 204, 205

 counterfactuals, function, 28
 creativity
 dreams and, 42, 84
 role of in the decentering process, 41–43
 schizophrenia and, 91, 110
 credibility-enhancing displays (CREDs), 77
 cultural evolution
 brain evolution, drivers of, 74–78
 dependence on social learning behaviors, 77
 executive control network development
 and, 76
 role of REM sleep, 78–90
 schizophrenia and, 90–93
 self-domestication hypothesis, 72, 75–76
 culture, evolution of, assumptions
 concerning, 9

 death, and transformative experiences, 175–177
 decentering
 agency and, 23–24, 30–32, 34–39, 44, 48,
 209, 221
 concept of, 21, 23, 212
 creativity and, 41–43
 dreams and, 29–30, 169, 212, 236
 enterprise associations and group agency, 229
 evolution of, 48–53
 four stages of, 23–24, 30–32
 cultural scripts and reconstruction of the
 ego, 40–43
 diminution in sense of agency/self, 34–39
 reconstruction of self-concept and
 reassertion of executive control, 43–48
 self-concept transferred into suppositional
 liminal space, 39–40
 and generation of supernatural agents, 33–34
 glossolalia and, 213
 hippocampus and, 41
 and interaction between individual and
 group, 236
 key cognitive elements, 47–48
 mechanics of, 23
 metaphor and, 220
 mounting evidence for, 24
 pivotal mental states and, 33
 relationship to religion, 33, 39
 religious language and, 212–215, 218
 role of pattern detection, 27–28
 speech acts and, 213–215, 218
 supernatural agents and, 178
 surprise and, 24, 25
 transformation of the self and, 21
 default mode network (DMN)
 anatomy, 18
 counterfactual support, 56
 decentering and, 45–46

- down-regulation of, 34, 35
 dysfunction in, 71
 effects of psychedelic agents, 132–134, 157
 ego dissolution and, 133
 evolution of the modern human brain and, 37–38
 and evolutionary pressures for self-control, 76
 inhibition of and transfer of self-concept into liminal space, 39–40
 likely mediation of self-transcendent experiences, 96, 124
 LSD and, 133
 narrative self and, 54
 participating structures, 18, 80, 82
 psilocybin and, 132
 religious group assessment and, 234
 REM sleep and, 72, 80
 role in changes in religiousness, 123
 salience tagging and, 77
 schizophrenia and, 112
 sense of self and, 162, 168
 social brain and, 72
 social brain overlap, 18
 social/executive self and, 55
 subsystems, 82
 supporting structures, 72
 Deictic Space Theory, 210
 Denisovans, 74
 dialogic self, 63–64
 and genetic conflict, 163
 and transformative experiences, 162–167
 Dieri peoples, 206
 diffusion spectrum imaging (DSI), 36
 dimethyltryptamine, 125
 discrepancy reduction process, 69, 159
 disinhibition, 44, 105–106, 108, 157
 dissociation, 31, 42, 78, 149
 dissociative identity disorder, 70
 divided self, *see* self
 divine kingship, 7, 200–207
 ancestral roots, 228
 the bear hunt and, 201
 sacrifice and, 203, 205–208
 dlPFC (dorsolateral prefrontal cortex), 117–119, 150
 DMT (dimethyltryptamine), 125, 127, 131, 139–140, 154–155
 dopamine
 ritualization and, 199–200
 role in support of religiosity, 200
 dopaminergic signaling, 95
 doppelgänger, 149
 dorsal medial prefrontal cortex, 18
 Dostoevsky, Fyodor, 103
 double, 148–149, 220
 dreams, 25, *see also* REM sleep
 aggression in, 51
 Bulkeley's "Big Dreams" argument, 185
 creativity and, 42, 84
 cultural evolution and, 78–79
 death and, 176–177
 decentering and, 29–30, 169, 212, 236
 dreaming and loss of agency, 169, 187
 lucid dreaming, 42, 81
 overhaul of rigid inadequate priors in, 151
 phenomenology overlap with psychedelics, 157
 self transformation and, 42
 shamanism and, 90
 simulations of social interactions, 85, 187
 supernatural agents and, 179, 184–188
 transformative experiences and, 169–171
 types of "big dreams", 185
 typical experience, 186
Drosophila melanogaster, 59
 dyslexia, 11, 111
 ecstatic experiences
 encounters with supernatural entities and, 130, 149
 OBEs, 149
 seizures, 103–105, 149–150
 temporal cortex associated with, 124
 trigger, 149
 ecstatic Kabbala tradition, 148
 ego, cultural scripts and reconstruction of, 40–43
 ego dissolution
 associated brain regions, 134
 psychedelics and, 35, 132–136, 169
 egocentric behavior, 106
 enterprise associations, 228–229
 brain networks and, 234
 creation and characteristics, 226
 group agency, 229, 232, 233
 religious evolution and, 233–237
 structure, 229–232
 entheogens, 46, *see also* hallucinations
 entity encounters
 during OBEs, 149
 neurology of psychedelic-induced encounters, 140–144
 epilepsy
 religiousness in, initial studies, 98
 temporal lobe epilepsy (TLE)
 ecstatic seizures, 103–105
 and hyperreligiosity, 98–105
 and Klüver–Bucy syndrome, 101
 Minakata Kumagusu, 98–99
 mystical experiences and, 157

- excessive daytime sleepiness, 42, 81
 executive control network, development
 of, 76
- facial recognition, 18
 flashbulb memories, 194
 fMRI (functional magnetic resonance
 imaging), 2, 30, 121–123, 131, 132, 217
 Frazer, James George, 200
 Free Energy Principle, 19, 134
 free riders, 72
 Freud, Sigmund, 176, 177, 192
 frontal-parietal network (FPN), 108
 activated by religious subjects, 120
 effects of psychedelic agents, 132–133
 genetic background, 59
 potential impact of disabling, 118
 role in changes in religiousness, 123
 schizophrenia and, 71, 112
 social self and, 54
 frontoinsular cortex, 132
 frontotemporal dementia (FTD), 35
 and hyperreligiosity, 105–107
 functional imaging techniques
 fMRI, 2, 30, 121–123, 131, 132, 217
 PET, 106, 119–120, 131
 SPECT, 109, 119–120
 fusiform gyrus, 18
- Gallas peoples, 206
 genetic conflict. *see also* sexual conflict
 Crespi and Badcock's theory, 61
 dialogic self and, 163
 Haig on, 58–60, 67
 glioma, self-transcendence after neurosurgery,
 150, 169
 glossolalia, 120, 213
 dlPFC damage and, 150
 Göbekli Tepe, Turkey, 201, 226
- God
 anthropomorphized conceptions, 183
 attachment theory and, 182
 belief in modulated by down-regulation of
 pMFC activity, 119
 belief in USA, 180
 concept preferences in ASD, 62
 conceptual metaphor theory and, 219
 cross-domain mapping, 219–220
 parts of the brain involved in reasoning
 about, 8, 121–123
 praying to comparable to normal
 interpersonal interaction, 121
 God spot, repudiation of the search for, 2, 4
 'Golden Bough, The' (Frazer), 200
 group effects
 ancestral group formations, 225–226
 characteristic groupishness of religion,
 223–224
 enterprise associations, 228–229
 brain networks and, 234
 creation and characteristics, 226
 group agency, 232–233
 religious evolution and, 233–237
 structure, 229–232
 individual vs group relations, 224–225
 language evolution and, 224–225
 male groups, 226–228
 preservation of lore, 228
 rites of passage, 227–228
 oxytocin and social affiliation, 17, 236
 self-esteem, identification with a group
 and, 224
- Haig, David, 58–60, 67
 hallucinations
 auditory, 92
 hypnogogic, 42, 81
 hallucinogens, 90, 126, 205
 heautoscopy, 149
 Hebrew Bible, 219
 hippocampal formation, 18, 80, 82
 hippocampus. *see also* right hippocampal
 atrophy/damage
 communications between the cortex and
 during sleep, 83
 decentering and, 41
 degeneration in FTD, 105
 dreamlike experiences elicited by direct
 electrical stimulation, 157
 effects of psychedelic agents, 133
 involvement in memory functions, 18, 80, 83
 nonREM sleep and, 83
 place in the DMN, 18, 82, 156
 potential impact of REM sleep deprivation,
 84
 reconstruction of the ego and, 41
 religiosity in age-rated atrophy, 107
 religiosity in FTD and, 106, 122
 religiosity in TLE and, 108, 122
 REM sleep and, 80, 83, 218
 'salience hypothesis' for hyperreligiosity and,
 107–108
 TLE and, 102
- Homo erectus, 209
 Homo habilis, 209
 Homo neanderthalensis, 209, *see also*
 Neanderthals
Homo religiosus, 48, 53
Homo sapiens, 38, 48, 50, 52–53, 111
 homosexuality, 12
 Hood's mysticism scale, 147
 Hopewell shamanism, 87–90

- hormones, masculinization and, 11
- human sacrifice, ritual and, 203, 208
- hunter-gatherer societies
 all male groups, 226, *see also* male groups
 group formation, 225–226
 religious beliefs and behaviors study, 86
 religious consciousness of ancestral hunter-gatherer groups, 225–226
 self-domestication hypothesis, 76
 typical size of a hunter-gatherer group, 16
- Huntington's disease, 215
- hypergraphia, 98, 101, 106
- hypermorphosis, 75
- hyperreligiosity
 frontotemporal dementia and, 105–107
 neurological explanations of, 107–109
 OCD and, 113–114
 related neuropsychiatric disorders, 116–119
 salience hypothesis, 107–108
 temporal lobe epilepsy and, 98–105
- hypnagogic hallucinations, 42, 81
- hyposexuality, 101–102
- hypothalamus, 132
- ideal self, *see* self
- Ignatius of Loyola, 173
- imagination, 34, 48, 110, 181
- ineffability, and religious language, 221–222
- inferior parietal lobe (IPL)
 connection with the salience network, 118
 place in the DMN, 18, 80
 role of in enhanced religiousness, 118, 120
 self-transcendence and, 118, 168–169
- initiation ceremonies, 227–228
- insula, 18, 95, 121
- internal agents, 65, 67, 163
- ipseity, 70–71
- irritability, 101, 106
- Islamic mystical practices
 nafs as Islamic equivalent of self, 171–172
 Shaqiq al-Balkhi on transformation of the nafs, 172–173
 Sūfism, 171–173
- isolated sleep paralysis (ISP), 148
- James, William, 146
 on the varieties of religious experience, 97–98
- Jamesian-Stace list of mystical experiences, 146–147
- kava, 205
- Kluver–Bucy syndrome, 101
- k-selected reproductive strategies, 9, 12
- Kullback–Leibler divergence (DKL), 30
- kykeon, 125
- language
 brain-related precursors, 209
 schizophrenia and the evolution of, 92, 111
 types of languages, 211
- lateral temporal cortex (LTC), 18
- learning, role of REM sleep, 83–85
- left-sided peri-sylvian region, role in speech act processing, 215
- life history theory, 10, 13
- Lindow Moss, England, 203
- liturgy, *see* religious language
- lore, preservation of by men's secret societies, 228
- LSD (lysergic acid diethylamide), 125, 133,
see also psychedelics
- lucid dreaming, 42, 81
- “magic mushrooms”, 125, *see also* psilocybin;
 psychedelics
- magical thinking, and ritual, 200
- male groups, 226–228
 and masks/masking, 226–227
 preservation of lore, 228
 rites of passage, 227–228
- Mayan kings, 208
- medial prefrontal cortex (mPFC)
 activity patterns in Christian vs non-religious participants, 122
 decentering role, 34, 37, 40, 43
 mystical experiences and, 134, 147, 157–158
 place in the DMN, 36, 80, 82, 157, 162
 potential impact of right hippocampal atrophy, 157
 prayer and, 121, 217
 psychedelics and, 35
 reflecting on God's level of involvement with the world and, 122
 REM sleep and, 218
 role in error monitoring and reflective processing, 96, 124, 162
 sense of self and, 72, 82, 121
 sex differences, 12
- meiotic drive, 59
- memory, role of REM sleep, 42–43
- mentalizing
 role of in supernatural agent cognition, 62–63
 schizophrenia and problems with, 91
- metaphor, and religious language, 219–221
- Minakata Kumagusu, 98–99
- Minakata mandala, 99
- mind, 4E framework, 15–16
- mirror neurons, 18
- modal verbs, in Christian prayers, 215
- mushrooms, 89, 99, 125, *see also* psychedelics
- music, 32, 103–104, 221
 ritualization and, 191

- mystical experiences, 145
 defining, 146–147
 dlPFC damage and, 150
 east-west interactions and, 147
 ecstatic seizures, 149–150
 existing neurological data, 147–150
 Hood's mysticism scale, 147
 ineffability, 221–222
 Jamesian-Stace list, 146–147
 near death experiences (NDE) model, 152–155
 out of body experiences, 148–149
 parietal-prefrontal damage and, 150
 PPF model, 150–152
 prevalence of supernatural agents in, 146, 147
 psychedelics and, 156
 REM sleep and, 148, 156–158
 RPL damage and, 117, 150
- narcolepsy, 42, 78, 156
 and REM sleep, 80–81
 symptoms, 42, 80
- narrative self, 54, 71, 133
- Neanderthals, 37, 49, 52–53, 74, 76, 78, 79, 90
- near death experiences (NDEs)
 core features, 154
 model of mystical experiences, 152–155
 neurological basis, 153
 prevalence, 152
 and REM sleep, 154, 156
 transformative experience, 175–177
- negative fitness covariance, 58
- neocortical volume, relationship with social network size, 16
- neural crest, 75
- neurohormones, social brain and, 17
- neuroimaging
 brain effects of psychedelics, 131–133
 of religious affiliation, 107
 of religious practices in healthy people, 119–123
- neurology of religious experiences
 advances in neuroscience, 94–97
 initial studies on brain and religion, 97–98
 neurology of speech acts, 215–217
 neuropsychiatric disorders, sex differences, 11
 neuroscience, as tool to study religion, 1–5
 neurotransmitters, serotonin. *see also* serotonin
- 5HT_{2A} receptors
 pivotal mental states and, 12
 psychedelic experiences and, 20, 35, 110, 131–132, 134, 135
 role in decentering process, 45
 sex differences, 11
 triggered by cultural mismatch, 236
- serotonergic psychedelics, *see* psychedelics
- Newgrange, Ireland, 201
- Nicotiana rustica*, 89
- obsessive-compulsive disorder (OCD)
 anxiety compulsions, religious nature, 176
 and hyperreligiosity, 113–114
 positive symptoms, 39
 religious language and, 210
 ritualistic behaviors, Boyer and Liénard's model, 113
 scrupulosity and OCD case studies, 114–116
- Ohio Hopewell culture, 87
- Ojibwa, 190
- Omaha tribe, 207
- orbitofrontal cortex, 105, 108, 113, 116, 132
- out-of-body experiences (OBEs)
 entity encounters, 149
 NDEs and, 152, 155
 potential triggers, 149, 210
 prevalence, 148
- oxytocin, and social affiliation, 17, 236
- paranoid schizophrenia, religious delusions and, 17
- parietal-prefrontal damage, and mystical experiences, 150
- Parkinson's disease (PD)
 neurology of speech acts and, 123, 215, 216
 reduced access to religious concepts in, 123–124
- paternity uncertainty, 10–11, 58, 60
- pattern detection, role of in decentering process, 27–28
- Paul, St, 160–161
- Perpetua, 185
- pivotal mental states, and decentering, 33
- positron emission tomography (PET), 106, 119–120, 131
- possession by spirits, 138, 149, 202, 204–205
- possible worlds space, 20, 26, 30, 39, 218
- posterior cingulate cortex (PCC), 18, 36, 72, 80, 82, 132–134, 156
- posterior insula, 95
- posterior medial cortex, 122
- posterior medial frontal cortex (pmFC), belief in God modulated by down-regulation of pmFC activity, 119
- posterior parietal cortex, 101, 168
- posttraumatic stress disorder (PTSD), 11
- PPF, *see* predictive processing framework
- prayer, 19, 183, 212
 modal verbs in Christian prayers, 215
 neuroimaging, 119, 121, 217
 religious language and, 215, 217
 repurposing of error monitoring systems, 96
 scrupulosity and, 115–116

- precuneus
- characteristics, 36
 - decentering role, 32, 34, 37, 39, 43, 104
 - function, 18, 38
 - 'hub of hubs' status, 108
 - hyperreligiosity and, 107
 - mystical experiences and, 133
 - place in the DMN, 18, 34, 80, 82, 156, 168
 - potential role in cultural evolution, 77
 - prayer and, 121, 217
 - psychedelics and, 35, 132
 - reflecting on God's level of involvement with
 - the world and, 122
 - religious cognition and, 19
 - REM sleep and, 50
 - salience network and, 112
 - self-transcendence and, 169
 - sense of self and, 55, 72, 162
 - size in humans vs chimpanzees, 38
 - structural core status, 36
- predictive processing framework (PPF), 19, 20, 24
- and development of a neurology of religious experience, 94–97
 - divided self and, 57
 - imperative to minimize "surprise", 24
 - PPF model of mystical experiences, 150–152
 - the self and, 55–57
 - and REM sleep, 72–73
 - self transformation and, 161–162
 - supernatural agents and, 178, 179
- prefrontal cortex (PFC), 38
- dopamine and religiosity, 200
 - executive control and, 76
 - hyperreligiosity and, 107–108
 - predictive simulations role, 134
 - processes implicated in, 19
 - psychedelics and, 132
 - religious experiences and, 95
 - REM sleep and, 50, 82
 - salience network and, 112
 - sex differences, 12
- prestige-biased cultural learning, 77
- primary motor cortex, 67
- primates
- human sleep compared to other primates, 79–82
 - ontogenetic ritualization in, 192
 - sexual conflict in, 195
- Proteanism, 43
- psilocybin, 125, 127, 128, 131–133, 135, 157
- psychedelics
- and 5HT_{2A} receptors, 20
 - anthropological and archaeological evidence of human use, 125–126
 - comparison of psychedelic experiences with classic religious mystical experiences, 128–129
 - effects on DMN, 132–134, 157
 - effects on FPN, 132–133
 - effects on PFC, 132
 - effects on precuneus, 35, 132
 - effects on salience network, 132–133
 - ego dissolution and, 35, 134–136, 169
 - encounters with supernatural agents induced by, 126–127, 188–189
 - atheists' experiences, 126–127, 189
 - examples of, 125
 - facilitation of religious and spiritual experiences, 126–130
 - increase in religiosity via disinhibition of REM physiology, 157
 - link with religious experiences, 136–139
 - mPFC and, 35
 - mystical experiences and, 145
 - NDEs and, 154, 155
 - neuroimaging brain effects of, 131–133
 - neurology of entity encounters on, 140–144
 - phenomenology overlap with dreams, 157
 - religious cognition and, 20
 - serotonergic psychedelics, 1, 20
 - brain effects, 130–134
 - serotonergic psychedelics, brain effects
 - claustrum/CCC model, 135
 - CSTC model, 135
 - explanatory hypotheses, 134–136
 - REBUS model, 134
 - small world neural architecture and, 36–37
- psychological functioning, sex differences, 11
- putamen, 132
- randomness, in animal behavior, 43
- religion
- 4E cognition and, 15–16
 - biocultural approach, 13–15
 - birth of, 52–53
 - characteristic groupishness of, 223–224
 - definition, 6–8
 - evolution of
 - assumptions concerning, 9
 - and enterprise associations, 233–237
 - initial studies on brain and, 97–98
 - Moon on the reproductive-religiosity model, 9
 - neuroscience as study tool, 1–5
 - relationship of decentering to, 33, 39
 - self-transformation functions, 174
 - sexual conflict and, 9–13
 - social cooperation as function of, 9, 173–174
 - as transformational technology, 20–22
 - use of to find ways out of impossible/hopeless situations, 41

- religious ecstasy, 10, 103
- religious experiences. *see also* neurology of religious experiences
- neuroimaging of, 119–123
 - social influences, 16–19
- religious language
- agency and, 209–212
 - brain injury and, 216
 - characteristic features, 212–213
 - decentering and, 212–215, 218
 - defined, 209
 - Deictic Space Theory, 210
 - discourse functions of modal verbs in
 - Christian prayers, 215
 - formal character of language in rituals, 213
 - ineffability and, 221–222
 - metaphor and, 219–221
 - the self and, 217–218
 - speech acts, 213–215
 - illocutionary force, 214–215
 - neurology of, 215–217
- REM Behavior Disorder (RBD), 51
- REM sleep
- active regions of the brain, 82–84
 - chemical environment, 170
 - creativity and, 84
 - critical for cumulative cultural evolution, 78–79
 - dissociated, 42
 - DMN and, 82
 - dreams, 85
 - evolution of, 48–53
 - human sleep compared to other primates, 79–82
 - and mystical experiences, 148, 156–158
 - narcolepsy and, 80–81
 - NDEs and, 154, 156
 - Neanderthal genes and, 78, 79, 82
 - overlap with social learning networks, 82–86
 - promotion of memory consolidation and
 - creativity, 42–43
 - role in the belief updating process, 29–30, 169
 - role of in learning, 83–85
 - schizophrenia's relationship with disruption of, 93
 - self, PPF and, 72–73
 - supernatural agents and, 184–188
 - tonic and phasic characteristics, 80
 - triggering of by surprise events, 25–27
 - typical dream experience, 186
 - visionary mystical religion and shamanism, 86–90
- reproductive effort, 13, 58, 75
- reproductive strategies
- k-selected, 9, 12
 - sex differences, 11
- reproductive-religiosity model, 9
- retrosplenial cortex, 18, 80, 82
- right hippocampal atrophy/damage
- communication with SAs and, 155
 - effects on salience network, 157
 - and enhanced religious and mystical experiences, 99, 101, 105, 106, 117, 118, 128–129
 - hyperreligiosity and, 145
- right parietal lobe (RPL)
- damage to and mystical experiences, 117, 150
 - decreased function associated with increased senses of closeness to a transcendent being, 116
 - self-transcendent experiences, 117
- right-sided prefrontal regions, role in speech act processing, 215
- rites of passage, 227–228
- ritual
- archaeological evidence, 203–205
 - ASD vs schizophrenia, 197–199
 - Call and Tomasello on, 192
 - characteristics, 191–194
 - concept of, 190
 - cultural subgroups of religion's key rituals, 193
 - depiction in prehistoric rock art, 206
 - divine king phenomenon and, 200–202
 - divine kings as SAs, 202–205
 - facilitation of transformative experience, 174–175
 - formal character of language, 213
 - Frazer on, 200
 - Humphrey and Laidlaw on, 193
 - involving mind altering substances, 202
 - Liénard and Boyer on, 113, 191–192
 - magical thinking and, 200
 - McCaughey and Lawson on, 194
 - Murdock on coalitional behavior, 195
 - narrative and myth of ritualization, 200–202
 - neurology of ritualization, 197–200
 - ontogenetic ritualization in primates, 192
 - Rappaport on, 191
 - religious centers, 201
 - ritualistic behaviors in OCD, 113, 191–192
 - ritualization process, 190–191
 - sacrifice and, 203, 205–208
 - sexual conflict and, 194–197, 207–208
 - shamanistic and visionary forms of, 196
 - signaling behavior, 191–197, 207–208
 - speech acts, 213
 - types
 - doctrinal mode, 193
 - imagistic mode, 193
 - special patient rituals, 194
 - Whitehouse on, 193
 - Wilyaru ceremony, 206–207
- r-selected reproductive strategies, 10

- salience network
 connections with FPN, 118
 effects of psychedelic agents, 132–133
 effects of right hippocampal atrophy, 157
 ego dissolution and, 133
 interconnectivity patterns, 112
 response to expectation violation, 30, 122
 role in changes in religiousness, 123
 salience hypothesis for hyperreligiosity, 107–108
 schizophrenia and, 71, 112–113
 the self and, 54
- Santa Claus, 7
- schizophrenia
 aberrant saliency hypothesis of, 112
 vs ASD, 197–199
 auditory hallucinations, 92
 creativity and, 91
 cultural evolution and, 90–93
 divided self and, 70–71
 heritability of, 110
 hyperreligiosity and, 109–113
 cultural variations, 110
 evolutionary explanation, 110–112
 negative symptoms of, 91
 positive symptoms of, 90
 relationship with REM disruption, 93
 religiosity and, 61–62
 religious delusions and, 17
 religious language and, 210
 salience network and, 71, 112–113
 and the evolution of language, 92, 111
 transformative self and, 164–165
- scrupulosity, 113–114, *see also* obsessive–compulsive disorder (OCD)
- segregation distortion, 59
- seizures, ecstatic, 103–105, 149–150
- self, 54–57
 4E paradigm and, 55
 agency and, 64–67
 aspects of, 54–55
 breakdowns in, 69–70
 dialogic self, 63–64
 and transformative experiences, 162–167
 diminution in sense of, 34–39
 divided self, 57
 genetics of, 57–63
 medical perspective, 161
 schizophrenia and, 70–71
 social cooperation and, 71–72
 transformative experiences and, 160–161
 executive, 54
 ideal self
 decentering and, 25, 47, 73, 151, 236
 ideal future self theory, 67–69
 religion's role in promoting, 9, 159, 165
 religious conversion and, 168
 and susceptibility to mystical experience, 143
 narrative self, 54, 71, 133
 neurological basis of the sense of unified self, 162
 PPF and REM sleep, 72–73
 religious language and, 217–218
 supporting brain structures, 72
 theories on religion's transformative functions, 173–174
 transformation of the, 20–22
- self-concept
 reconstruction of, 43–48
 transfer into liminal space, 39–40
- self-domestication of human species,
 evolutionary impact on brain physiology, 72, 75–76
- self-esteem, identification with a group and, 224
- self-transcendence, before and after
 neurosurgery, 118, 150, 168–169
- self-transcendent experiences (STEs), 168–169
- semantic memory, 30, 41, 77, 83, 194, 216
- serotonin, 35, 50, 132, 134, 170, *see also under* neurotransmitters
- sexual conflict, 10
 coalitional behavior and, 195–197
 Moon on the reproductive-religiosity model, 9
 in primates, 195
 and religion, 9–13
 ritualization and, 194–197, 207–208
- shamanism, 78, 86–90, 225
 definition of, 87
 evolutionary emergence, 86–90
 relationship with schizophrenia, 92
 schizotypal traits and, 228
- signaling behavior, 191–197, 207–208
- simulation
 divided self and, 57
 the self as, 55–56
- sleep apnea, 11
- sleep deprivation, 34
- sleep paralysis, 81
- small world brain architecture, 23, 36–37, 41, 44–45, 64
- social brain
 Dunbar's hypothesis, 16
 evolution of, 72
- social cooperation
 divided self and, 71–72
 as driver of brain evolution, 74–76, 78
 as function of religion, 9, 173–174
 ritualization and sexual conflict, 195–197, 207–208
 role of agency, 67
- social groups, sex differences, 17
- social identity theory, 224, 234

- social learning networks, REM sleep's overlap with, 82–86
- soma, 125
- somatic effort, 13
- special agent rituals, 194
- SPECT neuroimaging, 109, 119–120
- speech acts
and decentering, 213–215
defining, 213
illocutionary force, 214–215
neurology of, 215–217
in rituals, 213
- spirit possession, 138, 149, 202, 204–205
- Stace, William, 146
- stone tool technologies, 76
- striatal-prefrontal dopaminergic anatomy, sex differences, 12
- stroke, religiosity and, 117, 150
- Sūfism, and transformative experiences, 171–173
- superior, 80
- superior frontal gyrus, 82
- superior temporal cortex, 80
- supernatural agents (SAs)
anxiety buffering theory, 180–181
atheistic religions and belief in, 7
attachment theory, 181–183
characteristics and features, 8
counterintuitive concepts and, 184
decentering and generation of, 33–34
divine kings as, 202–205
epistemic properties of religious beliefs involving, 7–8
examples of, 141, 179
mental representations of, 183
modern age belief in, 179
NDEs and, 152–153
neurology of psychedelic-induced encounters, 140–144
prevalence in mystical experiences, 146, 148
psychedelics and, 126–127, 188–189
atheists' experiences, 189
religious cognition's reference to, 178
REM dreams theory, 184–188
3D mind model and, 183–184
ubiquity of belief in, 6, 179–180
supervisory attentional system, 199
- surprise
cognitive evolutionary model, 24–25
mystical experiences and, 151
role in the belief updating process, 24, 25
triggering of PGO waves and REM intrusion by, 25–26
- temporal lobe epilepsy, *see* epilepsy
- temporo-parietal junction, 55, 104, 121, 217
- temporopolar region, 121, 217
- terminal lucidity, 152
- terror management theory (TMT), 176, 181
- testosterone, 11, 17
- thalamus, 132
- theory of group mind (ToGM), 233
- theory of mind (ToM)
enterprise associations and, 233
prayer and activation of areas related to, 121, 217
religious cognition and, 19
social cognition and, 93
supernatural agents and, 8
- Theravada Buddhism, 7
- 3D mind model, and supernatural agents, 183–184
- tobacco, 89
- torque effect, 111
- Tourette's syndrome, 11
- transformative experiences
conversion, 167–169
death and, 175–177
dialogic self and, 162–167
divided self and, 160–161
dreams and, 169–171
as function of religious rituals, 174–175
having a child, 159–160
Islamic mystical practices, transformation of the self, 171–173
liminal space and, 175
PPF and self transformation, 161–162
RPL damage and, 169
self-transcendent experiences, 168–169
theories on religion's self-transformation functions, 173–174
transformative self, 165–166
types of religiously informed transformative experiences, 159
- Tud island, Torres Straits, 206
- United States, prevalence of belief in the supernatural, 179
- unknown unknowns, 20–21, 178, 221–222, 237
- vasopressin, 17
- ventromedial prefrontal cortex (vmPFC), 18, 32, 38, 82, 123
- von Economo neurons (VENs), 35, 107–108
- Wernicke's area, 92, 217
- Wilyaru ceremony, 206–207
- Wolbachia, 59
- working memory, 5, 18, 68
- Xavante peoples, 212
- Zohar, 219