

Chapter 14

Neurologic Constraints on Evolutionary Theories of Religion

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Abstract Patients with Parkinson’s disease (PD) experience a selective depletion of neostriatal and meso-frontal dopamine and thus provide an ideal model for assessing potential dopaminergic influences on religious cognition and experience. We review three specific studies conducted in our laboratory focusing on reports of various facets of religiousness in patients with PD. We find that (1) there is a reduction in self-reported religiousness among these patients as compared to healthy age-matched controls; (2) PD patients with left-onset disease (right hemispheric impairment), report less detailed religious ritual action scripts; and (3) PD patients are less able to recall and access religious experiences. Our findings are consistent with adaptive theories of religion that point to evidence for functional design of religious cognition.

14.1 Introduction

A fundamental question for evolutionary theories of religion is whether any aspect of religion is an adaptation. The best way to identify a trait as an adaptation is to demonstrate correlated evolution of that trait with some other functionally linked trait over evolutionary time. For example, if it could be demonstrated that whenever religiousness appeared or increased in a human lineage, so, too, did some other trait with which it was functionally linked, then it would be reasonable to ask if religiousness functioned to enhance or support the second trait. If, for example, religiousness increased across human lineages in tandem with innovations in healing practices or with new forms of cooperation, then it becomes more reasonable to functionally link religiousness and innovative healing practices or cooperative practices. Or, to take an example less rooted in cultural change, if REM sleep durations increased

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over a number of animal lineages in tandem with increased volumes in the amygdalar complex and associated emotional memory capacities, then the case for REM sleep as an adaptation for amygdalar-linked emotional learning capacities would be correspondingly strengthened. New statistical techniques can now reliably identify instances of correlated evolution while controlling for Galton's problem of non-independence of cultural samples. These techniques can and should be exploited to test adaptive hypotheses of various components of religion. To do that one needs a large range of cultures with reliable data on religious practices as well as some knowledge regarding the phylogenetic history of the cultures under investigation. That history can be obtained with use of the relevant language phylogenies, but again, these techniques have not yet been exploited in studies of the evolution of religion. Although correlated evolution is one of the best ways to identify a trait as a potential adaptation, there are other important diagnostic criteria to consider as well. Another way to show that a trait is an adaptation is to demonstrate that it exhibits "functional design."

14.1.1 What Is Functional Design?

Functional design refers to the thing that that features or working parts of a trait accomplish. If the features of a trait seem to work together to produce a common effect that benefits the organism in some way, then that trait likely exhibits functional design. Sleep exhibits functional design. Its features seem designed for restoration and repair of the body. Sleep is associated with a specific set of brain activation and de-activation patterns and neurophysiologic events. It is even associated with its own peculiar forms of cognition. When activated, sleep allows animals to restore biochemical housekeeping functions and immune system functions, so sleep confers a benefit on animals.

An adaptive trait is likely to be more complex than a non-adapted trait given that its features must mesh with and address some problem or opportunity for an organism in the environment. The greater the specific fit of the trait to the problem, the more likely that the trait was designed by natural selection to address that problem. The lesser the fit, and the lack of evidence of functional design, the more likely that the trait in question was not an adaptation but was instead a mere chance association or by-product from some other functional complex.

It is important to point out that evidence of functional design does not mean that the trait in question is always going to appear "optimal", "functional", or create a "happy" organism. Because of their complexity, adaptations are often costly to operate. They require that the organism give something, expend some effort or energy to keep the trait operating in good condition. The brain, for example, requires a tremendous metabolic investment on the part of the animal who "chooses" to build a brain – the more complex the brain, the greater the metabolic investment, and the greater the chance that other parts of the animal go without. The brain, in turn, will create all kinds of opportunities and all kinds of new costs for the animal.

Even very basic adaptations may not necessarily appear to be good for the animal. Fever, for example, creates a very uncomfortable organism that can barely move around or defend itself. Yet, fever saves lives by making it difficult for pathogens to thrive in the host. The higher the fever, the more effective it is, but at higher temperatures, fever can produce delirium and physiologic collapse. Even at lower temperatures, fevers can kill sperm and so produce temporary sterility in males. Here we have an adaptation that directly produces a short-term impairment in reproductive fitness! Similarly, religiousness may sometimes appear to cause dysfunction, but it may, nevertheless, be an adaptation if it can be shown that it exhibits functional design and that it benefits the individual (or, more precisely, that they benefited our ancestors) in the long term. With respect to religiousness, there are a converging number of studies that show that religiousness acts as a protective influence on mental and physical health – at least for some illnesses (Musick et al. 2000; Powell et al. 2003; Strawbridge et al. 1997; Townsend et al. 2002). Religiousness also appears to promote prosocial and cooperative behaviors. Thus, there is a reasonable argument to be made with respect to the usefulness of religiousness for individual fitness. Nevertheless, we will not pursue that line of inquiry here. Instead, we will bracket for the time being what effects religiousness have on individuals and instead focus on the question of functional design.

14.1.2 How Do We Look at the Design of a Trait Such as Religiousness?

There are a multitude of psychometric instruments and constructs that identify a reliable trait that can reasonably be called “religiousness” (Hill and Hood 1999). We want to know whether that trait exhibits features of functional design. How do we do that? The answer lies within the brain. We have to look at the specific cognitive architecture and brain mechanisms of religiousness. If we are able to look at the cognitive architecture that supports religiousness to understand how religiousness is organized, then we can begin to entertain claims that the trait “religiousness” is non-trivially dependent upon specific neural networks of the brain. Therefore, we want to look at the brain correlates of religiousness and see how the design changes as a result of brain dysfunction. Before we go any further, we describe what we mean by “religiousness.”

14.1.3 Definition of Religiousness

If we summarize across hundreds of psychometric studies on religiousness (Hill and Hood 1999), we find that religiousness can be profitably construed as comprised of three basic components. The first component is the positing of belief in supernatural agents. Belief is the cognitive mechanism that allows us to posit and think about supernatural agents, to suppose that they have “minds” like our own and can be

communicated with. The second component is the tendency to perform rituals in order to relate to those supernatural agents. And the final component is the experience, or state of consciousness, that results from the actual belief in supernatural agents and the performance of rituals. The experience of religiousness is distinct and results from a combination of different brain areas and functions.

Is it possible that each of the components of our definition have a separate brain realization? They probably do as there are likely different networks that support these behaviors. We will focus on the third component of religiousness – the capacity to engage religion experientially. We present evidence that suggests that this component process may be diminished in PD while the capacities to posit supernatural agents and to perform/understand rituals are relatively intact.

14.2 Our Program of Research

14.2.1 Why Study Patients with Parkinson's Disease (PD)?

Parkinson's disease is a progressive neurodegenerative disorder with a life-time course of about 30 years after its onset (Aarsland and Karlsen 1999). Dopamine projections from the substantia nigra to the basal ganglia and the prefrontal cortex are diminished. Meso-cortical dopaminergic activity is crucial for obtaining rewards from experiences. Without this capacity, rewarding aspects of religious experience should be diminished, and therefore, PD patients should be less inclined towards religiosity. The hallmark of PD is a loss of cells in the substantia nigra (SN) which manufactures dopamine neurons (DA) and in the ventral tegmental area (VTA) which also manufactures DA neurons. Both neurons from the SN and the VTA have projections to the pre-frontal cortex (PFC). Without these dopaminergic projections, the PFC does not function normally, and the patients experience prefrontal dysfunction such as inappropriate social behaviors, impaired judgment and planning abilities, an impaired theory of mind, etc. (McNamara et al. 2006a, 2006b, 2006c, 2006d, 2008, 2007). We are interested in whether dysfunction in these prefrontal striatal dopaminergic networks can selectively impact religiousness.

Most importantly, PD is associated with a localized area of function in the brain: the nigro-striatal and meso-cortical DA circuits are impaired within the basal ganglia and the ascending dopaminergic tracts that project to the prefrontal lobes.

What is more, PD is an asymmetric disease, at least initially – either the patient suffers a depletion of DA in the left brain or the right brain with motor symptoms emerging most dramatically on the contralateral side. If a patient has right-onset PD, there is a deficit of DA in the left brain; if a patient has left-onset PD, there is a deficit of DA in the right brain. As a result, we can evaluate right hemispheric and left hemispheric contribution to religiousness by examining these patients.

Although these PD patients have brain dysfunction, they are not psychotic or demented; they can still reflect on their capacities and beliefs. Anecdotally,

clinicians who deal with PD patients on a daily basis have remarked to us that is not uncommon for some patients to “lose” their religion while other patients have an opposite experience: they may undergo deep conversion experiences. This latter set of events, however, is very rare, apparently.

In any case, the profound deficit in forebrain dopaminergic activity within this patient population allows us to evaluate the role of dopamine in production of religious experience. There are several lines of evidence that suggest that dopamine is crucial for production of religious experience:

- Dopaminergic drugs reliably induce changes in religious experience (Nichols and Chemel 2006);
- Religious delusions of epileptics, OCD patients, schizophrenics, and bipolar patients are linked to abnormally high dopaminergic states (Geschwind 1983; Dewhurst and Beard 1970; Siddle et al. 2002; Tek and Ulug 2001); and
- High self-transcendence scores on the Cloninger (Cloninger et al. 1993) personality inventory known as the Temperament and Character Inventory (TCI) are correlated with genetic markers of dopaminergic transporter molecule (Comings et al. 2000; Hamer 2004).

In summary, PD patients are an ideal patient population to study to identify neural correlates of religious experiences. We will now present data from three preliminary studies that we have conducted with our PD patients to illustrate the role of DA in religiousness and what makes PD patients different from normal controls. Each of our studies touch on a separate component of the definition of religiousness that we presented earlier in this chapter: belief, ritual, and experience.

14.3 Data from Our Studies

14.3.1 *Study 1: Religiosity in PD Patients*

Our first study examined religious beliefs in PD patients and healthy age-matched controls (McNamara et al. 2006a). PDs and controls were asked about their religious beliefs and were administered a spirituality questionnaire known as the Brief Multidimensional Measure of Religiousness/Spirituality (Fetzer 1999). The BMMRS was developed by a panel of experts on religion and health from the Fetzer Institute and the National Institutes of Health and Aging. The BMMRS contains 38 statements in Likert scale formats that cover 11 religious domains. Examples of questions/statements on the BMMRS include "To what extent do you consider yourself a religious person?" or "I feel God's presence." Results revealed a trend toward reduction in religious beliefs and religiosity levels among PD patients as compared to age-matched controls (see McNamara et al. 2006a).

14.3.2 Study 2: Social Action Scripts

In this study, we examined PD patients’ access to routine religious ritual knowledge by examining their production of social action scripts. We asked patients to tell us the steps they would take to go to the doctor’s office, to order a meal at a restaurant, to attend a religious service, and to make a good sandwich. For the purposes of this chapter, we are going to look at the social action scripts for attending a religious service and only one of the other social action scripts as a comparison – going to the doctor’s office. In Appendices 1 and 2 are examples of the social action scripts for visiting the doctor’s office and attending a religious service. Below in Fig. 14.1, we present the percentage of basic actions that PD patients and healthy controls produced for going to the doctor’s office.

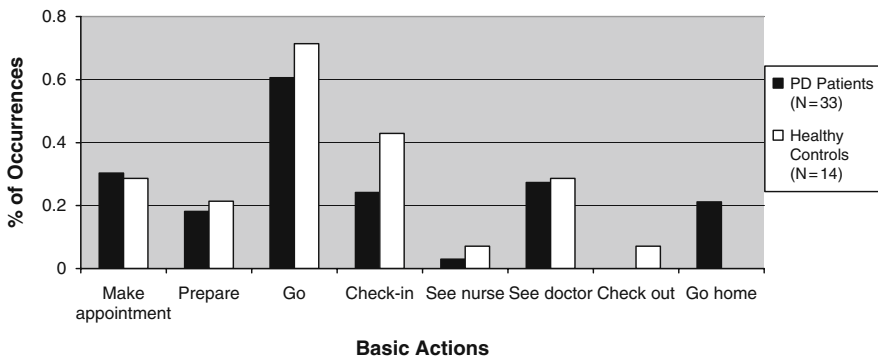


Fig. 14.1 Percentage of basic actions for visiting the doctor’s office among PD patients and healthy controls (*PD* = Parkinson’s disease)

Figure 14.1 shows that the controls are much more organized and provided more of the basic actions than the PD patients to accomplish the superordinate goal of going to the doctor’s office. However, we did not find any differences in routine access to knowledge about going to the doctor’s office. This is no surprise since PD patients go to the doctor’s office quite often. As a result, this offers evidence that PD patients can access routine scripts. However, when we look at the script for going to a religious service (Fig. 14.2), we find that the controls are producing more of the basic actions for the "religious rituals": sit (meet and greet others), listening/participating in the service, and singing hymns. The PD patients are having more difficulty with these actions.

When we look at the percentage of basic steps that were produced by right- vs. left-onset PD patients for going to a religious service, we find that those who have right-onset PD (left-hemisphere dysfunction) produced more basic steps than patients who have left-onset PD (right-hemisphere dysfunction). For the basic action of singing, the left-onset PD patients completely drop this step (see Fig. 14.3).

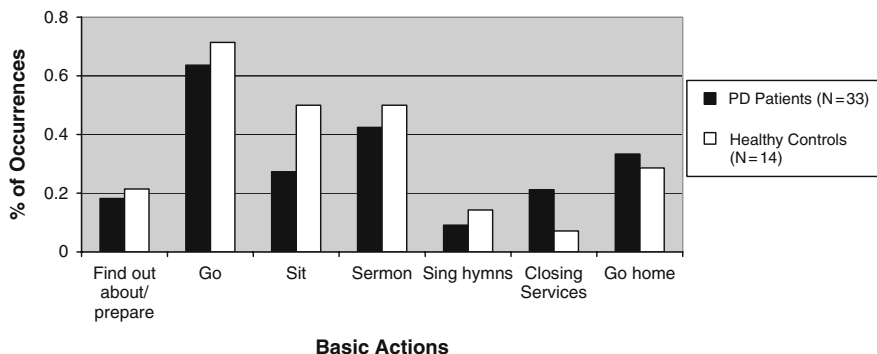


Fig. 14.2 Percentage of basic actions for going to a religious service among PD patients and healthy controls (*PD* = Parkinson’s disease)

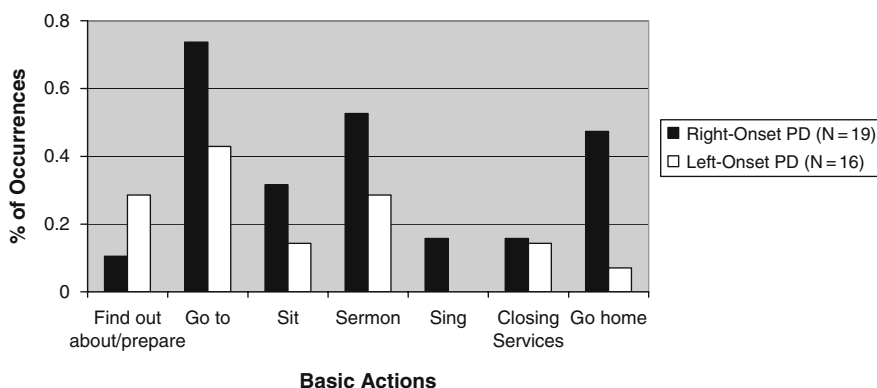


Fig. 14.3 Percentage of basic actions for going to a religious service among *Right-Onset* vs. *Left-Onset PD* patients (*PD* = Parkinson’s disease)

14.3.3 Study 3: Memory of Religious Experiences

We now discuss our final study (done in collaboration with Wesley Wildman, Ph.D.) which involved asking participants to report different types of experiences and administering a phenomenology questionnaire known as the Phenomenology of Consciousness Inventory (PCI) (Pekala 1991). The result from administration of this inventory is a quantitative, survey-based "signature" or profile of an extended state of consciousness. The signature is produced by triggering a memory using carefully designed prompts. The experimental subjects are then asked to fill out a 53-item inventory based on their subjective experience of the event. A quantitative profile of the contents and quality of personal consciousness along 26 measures, grouped into 12 major dimensions (positive affect, negative affect, altered

experience, imagery, attention, self-awareness, altered state of awareness, internal dialogue, rationality, volitional control, memory, and arousal) is produced. The PCI has been validated by Pekala and colleagues (Pekala 1991) and has been repeatedly tested; its domain of validity has been extended in numerous studies since it was first introduced.

In our study, we asked PD patients and healthy controls to report about three experiences: religious, ordinary, and happy. They were asked to reflect for a minute or two on each experience and then fill out the PCI for each experience. Below (see Fig. 14.4) we present some pilot data reflecting the major and minor dimensions of the PCI for our participants.

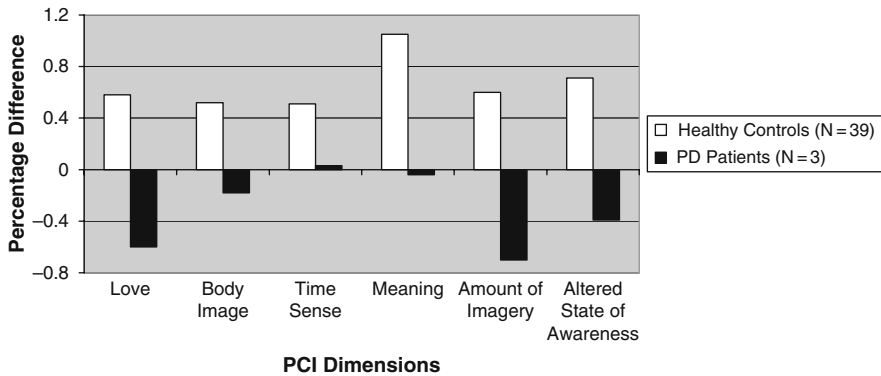


Fig. 14.4 Pilot data reflecting the major and minor dimensions of the PCI for our participants (*PD* = Parkinson's disease; *Love* = positive affect major dimension; *Body Image*, *Time Sense*, and *Meaning* = altered experience major dimension; *Amount of Imagery* = imagery major dimension; *Altered State of Awareness* = major dimension)

Note that the baseline for the experiences is 0. The baseline represents the scores that healthy controls and PD patients produced for ordinary experiences.

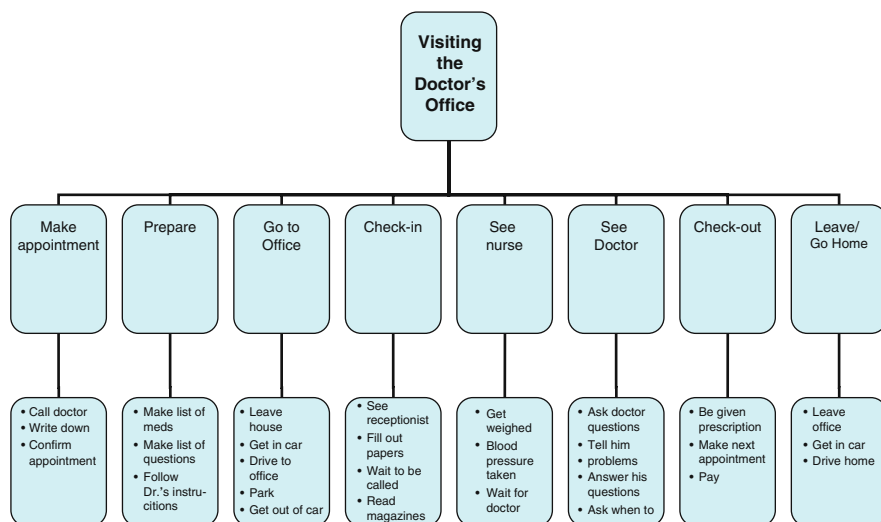
14.3.4 A Summary of Our Studies

- Study 1 showed that there was a trend among PD patients for a reduction among religious beliefs;
- Study 2 showed reduced access to ritual knowledge for PD patients – particularly left-onset (right hemisphere dysfunction); and
- Study 3 showed a reduction in the recall of content of religiousness and access to religiousness per se.

On all three dimensions of religiousness, PD patients are impaired. This evidence is consistent with functional design theories of religiousness.

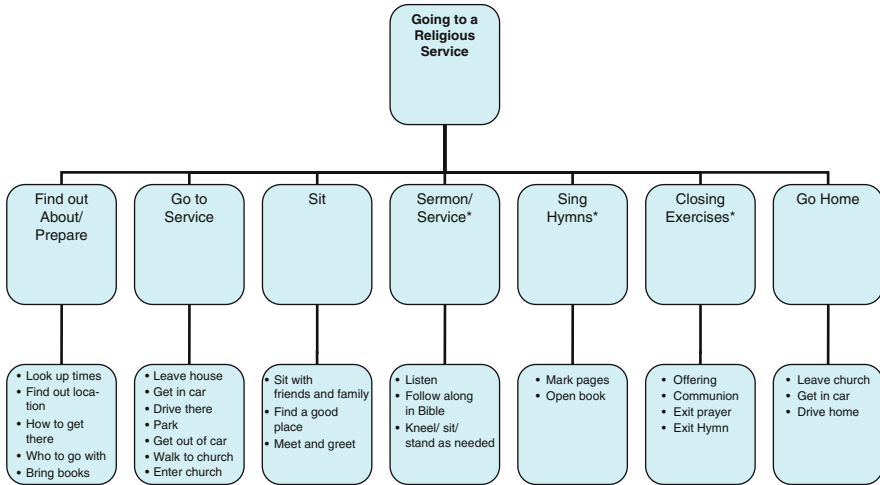
14.4 Appendix 1: Social Action Script for Going to the Doctor's Office

The superordinate goal is visiting the doctor's office. The basic actions, which are the middle row, are the steps that are necessary to complete the superordinate goal. If it were not for these steps, the action would not be able to be performed at all. Finally, we have the subordinate steps. These can be limitless and do not contribute to actually achieving the superordinate goal. Many subordinate steps consist of activities of daily living such as sleeping, eating, bathing, driving, and taking care of finances.



14.5 Appendix 2: Social Action Script for Going to a Religious Service

The superordinate goal for this social action script is going to a religious service. The basic actions and subordinate steps overlap to some extent as steps described in Appendix 1. Note that under the subordinate goals for the basic actions of Sit, Sermon/Service, and Sing Hymns, all of the religious rituals are embedded here which includes following along in the Bible and singing, whereas the other items are not about religion per se. Note: * indicates basic and subordinate actions are religious rituals.



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