COGNITIVE SCIENCE AND HATHAYOGA

by Ellen Goldberg

Abstract. Cognitive science and hathayoga both make emphatic claims about the relationship between the body and the mind. To examine this complementary relationship I draw upon the five main approaches currently being used by cognitive science and then consider their implications within the context of three specific points of contact with hathayoga theory: the rejection of dualism, the nature of consciousness, and the role of the nervous and circulatory systems in religious experience. This type of comparative analysis can provide additional information about the nature of consciousness and the potential practices that heighten our awareness or knowledge of it. Consequently, cognitive science offers a new and provocative way to dialogue with Indian yoga traditions in terms of the methods and theories of modernity.

Keywords: cognitive science; cognitive theory of religion; hathayoga; religious studies; yoga.

In this essay I apply current theories in cognitive science to an analysis of hathayoga. Recent cognitive studies of religion have had little to say on the subject of Indian yoga practice. In fact, this is one area that has yet to be seriously examined. Here I offer only preliminary observations on this complex study, speculating on three significant points of contact between cognitive science and Indian hathayoga and how an application of these theories might proceed.

I also draw upon an outline of three approaches to cognitive science offered by Richard Payne (2002). Payne describes three cognitive models: (1) computational-symbolic, (2) connectionist-dynamic, and (3) embodied-enactive. I extend this general framework to include two additional approaches—(4) biological-evolutionary and (5) mind-brain identity thesis—

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because they also are representative of current research in the field and offer important strategies for my own work on hathayoga. First I briefly delineate the theoretical foundations of these five categories so as to consider any specific implications for our discussion of hathayoga. These approaches, it might be added, do not necessarily proceed sequentially or chronologically. Rather, the categories are fluid and at times even overlap, given the extensive, interdisciplinary nature of cognitive science.

I focus on three points of intersection between cognitive science and hathayoga. The heritage of yoga scriptures in India is vast. Medieval *hatha*[1] or *kriyayoga* scriptures, such as the *Hathayoga pradipika* (HYP), *Gheranda Samhita* (GS), *Siva Samhita* (SS), *Goraksa Samhita* (GoS), *Hatharatnavali* (HR), and *Siddha Siddhanta Paddhati* (SSP), to name just a few, represent a genre of medieval, aphoristic Sanskrit literature that primarily provides a regimen of embodied strategies leading the adept practitioner to the highest states of pure consciousness called *nirbija samadhi* and *samarasya*. This is represented in hathayoga as the union of Siva and Sakti, a primordial unity that includes within itself the conjoined masculine and feminine principles (GS 1:10–11; 3:41–42; 7:12–13; HYP 3:101).

To explore this tradition more fully from a modern, living yogic perspective I also refer briefly to the oral and written commentaries of the monastic lineage of Swami Krpalvananda.[2] Krpalvananda's commentary on the *Hathayoga pradipika* (HYPR), subtitled *Rahasyabodhini* (*The Secrets of Knowledge*), was written as a manual to clarify and illuminate the renunciant path (*nivrtti marga*) of hathayoga for his initiated disciples, and it offers testimony to the lived tradition of yoga in modern India. Quite often the textual teachings of hathayoga are intentionally ambiguous. Consequently, direct transmission and written commentary by a competent master or guru is considered more authoritative than even the printed word or manuscript among recognized adepts (HYP 3:79; 4:8–9; SS 3:11; HR 2:68; HYPR 2:4–6). Alongside primary textual sources, the oral and written commentaries of interpretation and explication by recognized teachers offer a valuable resource for our scholarly endeavors. Consulting these sources is imperative, given that authors of studies in cognitive science are frequently unfamiliar with primary sources and their oral commentarial tradition and often are even unaware of significant and subtle differences between various Eastern practices of meditation.

Five Approaches in Cognitive Science

The emerging revolution in the cognitive studies of religion attempts to explain the nature of religious experience from the perspective of the neural or cognitive function of the human mind or, as Jensine Andresen explains, "from the bottom up" rather than as simply "*sui generis*" (2001, 1). Generally, cognitive scientists of religion rigorously test the formation of

religious conceptualization and ritual enactment without explaining away the systems of belief from which these phenomena derive. This new approach argues in favor of a cognitive basis of religion while respecting the integrity of religious experience, behavior, and phenomena. This innovative field of inquiry is particularly relevant to our study because of the important role that both human consciousness and biology play in the historical development relating to various theories of yoga and its pursuit of pure consciousness. Nevertheless, we must bear in mind that presently there is no consensus in cognitive science and that there are few definitive explanations as to how the body, the mind, and the mental infrastructure that underlies our experience are actually connected. This means that cognitive theories of religion (Boyer 2001; 1993; 1994; Lawson and McCauley 1990; 2002; Sperber 1985; 1990; 1996; Varela, Thompson, and Rosch 1991; d'Aquili and Newberg 1999; Rosch 2002; Andresen 2001; Pyysiäinen 2003; Atran 2002) are still largely conjectural.

Nonetheless, in a special issue of the *Journal of Consciousness* (2000), Andresen and Robert Forman presented a methodological challenge to scholars in the field of religious studies to extend their theoretical frontiers and to consider more seriously the implications of cognitive studies of religion. Leading explanatory theories in the academic study of religion deriving from Karl Marx, Emile Durkheim, E. B. Tylor, Mircea Eliade, Clifford Geertz, and others have identified religion primarily as a cultural phenomenon. However, cognitive studies of religion hypothesize that religion also is related to human physiology. As such, cognitive theories introduce us to the possibility of the "naturalness" (physicality) of religious ideas (Boyer 1994; Slone 2004) and to claims of universality based on panhuman properties of the mind/brain. Such universalist claims are said to be valid in physics, mathematics, and chemistry, so why not in cognitive science or, more specifically, in the cognitive study of religion?

Broadly stated, cognitive theories of religion are informed by current research in cognitive science, a relatively new and diverse interdisciplinary field. Its primary focus is the nature of mind and consciousness, and its research is still in the formative stages. The field emerged out of the cybernetics movement in 1956. Today it brings together six affiliated though heterogeneous disciplines: psychology, linguistics, neuroscience, anthropology, artificial intelligence, and philosophy. More recently, it has been applied to the study of religion as well as to art, physics, mathematics, and biology. It has even been suggested by Bernard Baars (1986, 3) that cognitive science could represent a "living scientific revolution." To do justice to this emerging field and its contributions to the study of religion, it is necessary to look briefly at the five major theoretical approaches that have helped to shape it.

The Computational-Symbolic model. The field of cognitive studies was initially inspired by insights and developments such as the Turing machine (Turing [1950] 1981, 53–67) and the neuronal model (McCulloch and Pitts 1943). It was rule-governed, and its most influential figures were intent on understanding how the brain functions. Cognitive science is still concerned primarily with seeing the "mind/brain" as a digital machine based on a computational-symbolic paradigm with domain-specific modules for processing information and acquiring knowledge (Putnam 1997; Fodor 1981; Pinker 1997; Auyung 2000).[3]

In the 1960s Noam Chomsky singlehandedly spearheaded the cognitive revolution in linguistics. He argued against the empiricist and behavioral models of B. F. Skinner and disputed the prevailing assumption that the mind is a *tabula rasa,* or blank slate,[4] that is environmentally and linguistically determined. Chomsky theorized that the human brain/mind is genetically programmed or predisposed toward unconscious linguistic structures. These linguistic structures, or the language organ (or mental organ), as Chomsky calls it, are characterized by a universal grammar and form an innate, genetic part of the human brain's infrastructure—that is, our biology (Chomsky 1957; 1980; 1997a, b; Fodor 1981; Pinker and Bloom 1992; Pinker 1997; Auyung 2000). Consequently, the language organ functions both as a natural phenomenon and as a universal, domain-specific, causal process. Based on the theory of automata—a complex mathematical explanatory theory rooted in the paradigm of a machine that generates linguistic strings according to the rules that have been programmed into it (Chomsky 1957; 1997a, b; Baars 1986; Gardner 1987)—Chomsky's notion of universal grammar represents the linguistic equivalent of the Turing machine. This idea was revolutionary insofar as it showed that the acquisition of language and, by extension, human behavior was not simply a product of culture but also a process integral to the complex structures of the human mind/brain.

Amid similar discussions, cognitive scientists developed a theory of the mind/brain that resembles the information-processing activity of a computer, claiming that most of our human cognitive activities, including desires and beliefs, correspond to a symbolic-computational software system with information-processing capabilities. Data-centered descriptions of bodily and mental states such as perception, memory, reason, decision making, learning, and judgment implied that behavior could be severed from the constitution of the human nervous system. In the 1960s American philosopher Hilary Putnam also based his theories on the Turing machine and the neuronal model as he attempted to solve the mind-body problem once and for all by eliminating, at least in theory, the need for physical embodiment, leading us eventually to the brain-in-the-vat idea (Putnam 1997; Dennett 1991). One fallout, particularly from the perspective of Indian yoga traditions, is that functionalist theories such as

Putnam's sharply separate mind and body. Early functionalists and supporters of automata theory, informed by the computational-symbolic model based on such a rigid dualism, opened the door to the dominant role that artificial intelligence and robotics played in the early years of the cognitive revolution.

The Dynamic-Connectionist Model. The connectionist or neural-network model has been strongly influenced by the structure of the brain yet considers functional applications as well. It often is viewed as in contrast to the symbolic-computational model, though much less research has been done on this particular paradigm. Steven Pinker (1997, 114) claims that the connectionist model is not an alternative to the computational model but is simply a variation of it. A result of the work of David Rumelhart and James McClelland in the 1970s, this theory emphasizes the interdependence of units and connections and their basic neurological correlation with neurons and synapses. As a result, this model's strengths lie in its ability to adapt and organize symbols, recognize patterns, generalize information, and accomplish holistic processing (Dinsmore 1992). This model does not figure prominently in the present discussion of cognitive science and religion, so a brief description here will suffice.

The Embodied-Enactive Model. Maurice Merleau-Ponty's phenomenological philosophy (1962) challenged the Cartesian dualisms and hierarchies fostered in classical Western thought and offered in their place an embodied-enactive approach based on his notion of the "lived body." For Merleau-Ponty, pragmatic structures such as cognition, sensation, perception, and will originate with embodied subjects and lived experience. Merleau-Ponty was committed to an interdisciplinary and complementary cognitive approach that embraced psychology, neurophysiology, and direct or "embodied" experience.

This existential epistemology has significantly influenced the work of Francisco Varela (Varela, Thompson, and Rosch 1991; Varela and Shear 1999; Varela 1996; 2001), Eleanor Rosch (2002), and others who see the possibility of self-transformation through ritual activities such as Buddhist mindfulness meditation. Drawing on his training in biology as well as on the work of Merleau-Ponty, Edmund Husserl's fundamental structures of mind and intentionality, and Buddhist philosophy, Varela argues that cognition is dynamic, embodied action (Andresen 2001; see Lakoff and Johnson 1999). Positing the natural or biological roots of mind, Varela develops an "enactive" approach and applies it to significant points of contact between cognitive studies and nontheistic religious traditions such as Buddhist Madhyamika philosophy and Taoism. According to Varela (2001), neurophenomenology and cognitive science identify an implicit link between the "psychological level" and the "domain of the empirical" that has pragmatic imperatives for the cognitive study of religion.

In his later work Varela often focuses on the specific contributions that Buddhist doctrines such as *anatman*, or no-self, bring to the cognitive-science dialogue. However, Sunny Auyung (2000, 86) contends that although Varela and colleagues are "right" to extend their investigation of the enactive approach beyond Western intellectual history, the use of mindfulness-meditation practice as their primary practical resource is "too restrictive." That is, it yields a model of embodiment that is ultimately limiting and limited. An analysis of additional schools of meditation, such as hathayoga, will extend our understanding of these important linkages.

The Biological-Evolutionary Model. Current cognitive studies of religion are introducing us to ambitious theories that move well beyond the foundational role of experience pursued in the pioneer research of psychologist William James ([1902] 1982). Yet, to some extent, they also reaffirm and build upon his original hypothesis of the biological nature of mind and its cognitive role in religious experience.[5] Theories of mind as a symbolic-computational model have been stimulated by cognitive psychology, linguistics, and cultural studies in anthropology and have substantively influenced the biological-evolutionary theories of Pinker (1997), Dan Sperber (1985; 1990; 1996), Pascal Boyer (1993; 1994; 2001), and E. Thomas Lawson and Robert McCauley (1990; 2002).

For instance, Sperber proposes a theory of culture based on an "epidemiology of belief" using cognitive causal chains (CCC) and the effective, though "imperfect," propagation or transformation of memes[6] (Sperber 1985; 1990; 1996; Dawkins [1976] 1981). Boyer's cognitive theories of religion are marked by his emphasis on counterintuitivity in the cultural transmission of religious ideas. For Boyer, counterintuitivity enhances the likelihood of transference and memory of religious representations without making them implausible (1993; 1994; 2001; see also Pyysiäinen 2003). Using the principle of superhuman agency, the principle of superhuman immediacy, and the theory of high performance frequency or extraordinary emotional stimulation, Lawson and McCauley stress the structural and psychological integrity of ritual patterns and agency (1990; 2002).

To some extent, all of these explanatory theories of religion advance a biological-evolutionary hypothesis that claims that religious activity, along with all other activities, results from precisely one and the same cognitive system, or mind/brain. They also argue persuasively for a developmental and social scientific framework to guide our current understanding of all human cognitive activity including religion. Perhaps the central feature of these theories is their emphasis on the reflective human capacity to "believe" rather than on the specific contents of belief itself. Hence, Pinker, Sperber, Boyer, Lawson, and McCauley are concerned not so much with what people believe as with the human mind and its mental infrastructure based on a computational model that enables them to do so.

The Mind-Brain Identity Model. Further applications of the symbolic-computational theory of mind supported by extensive research on the relationship between the mind/brain in neuroscience and neuropsychology also have contributed the mind-brain identity thesis. In the 1970s, under the auspices of the Alfred F. Sloan Foundation, research was funded in the neurosciences, a consortium of various disciplines ranging from "neurophysiology and neuroanatomy to neurochemistry and neuropsychology," to discover the computational capacities of the mind and their structural relations with the brain (Gardner 1987, 35). The underlying assumption is that there is a basic, coextensive relationship between behavior (or experience) and specific brain structures. Karl Lashley, who devoted his entire career to studying the nervous system, proposed a doctrine of neurological equipotentiality that maintains that psychological functions are related to brain structures (Gardner 1987, 265; Fodor 1981, 80).

In the 1970s, Eugene d'Aquili and Charles Laughlin (1975), as well as Nobel Laureate Roger Sperry and James Ashbrook, who coined the term *neurotheology*, pioneered the field sometimes referred to as theological phenomenology. Sperry hypothesized that consciousness is a "dynamic emergent property of cerebral excitations" (1969, 80). Similarly, d'Aquili and Andrew Newberg defended the thesis that there is an intrinsic relationship between religious rituals/practices and core neurophysiological mechanisms in our mind/brain that stimulate or discharge feelings of ecstasy, awe, peace, tranquility, and so on (d'Aquili and Newberg 1999; 2000). They used state-of-the-art imaging technologies such as positron emission tomography (PET), functional magnetic resonance imaging (fMRI), and electroencephalography (EEG) to investigate the relationship between neural excitation and biological nature of the "mystical" mind. They observed that hyperstimulation of either the ergotropic or trophotropic systems results in deafferentiation (d'Aquili and Newberg 1999) and that, by activating parts of the limbic system such as the amygdala, the hippocampus, and the neocortex of the human temporal lobe[7] (see McNamara 2001), feelings of bliss, ecstasy, and awe are aroused. Other responses include visions, out-of-body experiences, heightened awareness, and profound unitary states that d'Aquili and Newberg call "absolute unitary being" (d'Aquili and Newberg 1993; 1999; 2000; Auyung 2000; Gellhorn and Kiely 1972).

Although these theories produce some useful findings, Auyung (2000) cautions against what he calls "nothing but-ism"—positions in neuroscience such as the mind-brain identity thesis that rely strongly on the untenable theory of ontological reductionism. Andresen reports that biological accounts of religion "still remain largely suspect in some circles" (2001, 10), and Jason Slone refers to a condition called biophobia in the humanities and social sciences (2004, 43). In contrast, cognitive scientists argue that by probing such claims we can broaden our understanding of the biological dimensions of religious experience.

Three Points of Contact

Rejection of Dualism. Overall, one of the most challenging contributions of the cognitive revolution has been providing empirical evidence of the mind's infrastructure leading to a radical breakdown and complete rejection of deeply entrenched hierarchical oppositions between mind/brain and body. The fixed Cartesian oppositions between mind and body, matter and life, and the duality between inner and outer reality that are integral to traditional science and philosophy no longer seem empirically tenable and are being supplanted by persuasive theories in cognitive science claiming that a person has both consciousness and corporeality (James [1902] 1982; Merleau-Ponty 1962; Varela, Thompson, and Rosch 1991; Comfort 1984; Damasio 1994; d'Aquili and Newberg 1999; 2000; Auyung 2000). The dichotomy of mind/brain and body that once held authority is being recast in increasingly holistic terms.

To illustrate my point, d'Aquili and Newberg (1999) offer a comparison with quantum physics wave-particle theory insofar as wave and particle, like mind/brain and body, are not separate things but rather two ways of looking at the same thing. Antonio Damasio (1994) claims that our mind is not simply "embrained" but also "embodied." Embodied-enactivists, such as Varela, Evan Thompson, and Eleanor Rosch (1991), reject a dualism that is based on a coevolving relationship between mind (cognition) and body (matter) arising from the activity of embodied agents and their environment. In this sense, Varela and colleagues see no apparent separation between the producer and the product. Emerging arguments for the neural basis of experience are replacing the certainties of binary discourses with theories that maintain the interdependence, reciprocity, and complementarity of mind/brain and body. In this new scientific paradigm we are also introduced to ideas of engagement, embodiment, and the ontological rejection of dualism based on a fundamental presupposition of interdependence—concepts central to the *yogin/is* (adept practitioner-observer) of nondualist Saiva hathayoga traditions as well as all schools of Buddha dharma.

Over the course of its history, hathayoga treatises have prescribed a daily ritualized program of powerful techniques for cultivating and exploring the embodied universe in order to attain knowledge of and union with Siva. Embodied strategies involving psychophysical and spiritual practices (collectively called *sadhana, upaya,* or *upasana*) that could include *asana* (preliminary yoga postures), *mudra* (advanced postures), *mantra* (repetition of sacred sound), *satkarma* (physical purification techniques), *bandha* (internal locks), *pranayama* (breathing meditations), *pratyahara* (withdrawal of the senses), and *dhyana* (meditation) lead to various levels of *samadhi* (*sunyata*, or emptiness, SS 5:160). Such practices, ordinarily learned under the close instruction and guidance of a realized guru (master, HYP

1:14, 2:1, 4:8; SS 5:192, 196; HYPR 1:14, 2:1), progressively navigate the adept practitioner through the body to a gradual and direct experience of one's own essential nondual nature. That is, self-cultivation in hathayoga tradition always presupposes that Siva (pure consciousness) and Sakti (creation, mind and body, matter, and so on) are essentially one (GS 7:12–13; SS 1:34, 46, 52; HYP 4:58–59, 102; HYPR 4:58–59). Hence, the goal of hathayoga *sadhana* is a direct and sustained realization of the nonduality of human consciousness, by means of its absolute interdependence and interpenetration with the body and mind, constituted through a complex network of energy centers (*cakras*) and channels (*nadis*) that are stimulated and subsequently absorbed (*laya*) by the *yogin/i's* lifeforce or the evolutionary power of *kundalini-Sakti* (SS 5:127, 157; GS 6:16).

By means of disciplined and one-pointed (*ekagra*) practice, the *yogin/i* develops the ability to guide the energy (*prana*) through various embodied pathways or inner channels from the base of the spine to the top of the head and, in rare cases, bring about the cessation of the *cittavrttis* (fluctuations of mind, that is, thought). The beginning of the *Yogasutras* (1:2) states that yoga, or the state of nonduality known as *samadhi*, is the cessation of the *cittavrttis*. In hathayoga terminology, this defining *sutra* is represented in terms of the absolute nonduality of Sakti-Siva insofar as Sakti (*vrtti*) becomes dormant or arrested (*nirodha*) when Siva, or nondual consciousness, is fully realized. Hence, the active (Sakti, matter, empirical life) and the inactive (Siva, consciousness, seer) are experienced as duality (producer and product, as in moon and moonlight) as long as the ultimate goal of self-realization remains unattained.

The Nature of Consciousness. Cognitive studies in neurophysiology also have made significant advances in our understanding of the interdependence of the mind/brain in mystical experience. However, the question of whether these experiences are caused by the mind/brain or are considered external to it raises an epistemological problem of understanding subjectivity, objectivity, and consciousness that has proven far more difficult for cognitive scientists to answer. Most cognitive scientists are somewhat tentative in their approach to the problem of consciousness and openly acknowledge the profound challenge it presents. As d'Aquili and Newberg observe (1999, 180), the question of consciousness remains a philosophical inquiry that "has generally not even been entertained as a problem in science."[8]

One possible explanation for this lies in the pervasive theory of the computational-symbolic model of mind and, by extension, all mentation. As Auyung argues, the most influential cognitive theories still see the mind as "nothing but behavior, nothing but the brain, nothing but computation" (2000, 5). Regrettably, this leads us back to a disembodied interpretation of consciousness that emphasizes the neural processes or infrastructural

levels of the brain that can be measured rather than thinking or mental processes that cannot (Auyung 2000). Consequently, in their empirical and interpretive attempts to explain religious experience using cognitive science, meaning, understanding, and knowledge still remain mostly unaccounted for. Such fundamental questions as Who am I? What is self? Where do we come from? and What is the nature of consciousness? are still left to philosophy.

Despite this, a new wave in cognitive science, especially among advocates in cognitive psychology, raises the question of consciousness in relation to subjective and objective experience, and, as a result, the nature of mind has (re)emerged in the last decade as a hot research topic. Careful studies of the architecture of the brain have also opened the way for a deeper understanding of human consciousness. For many cognitive scientists, consciousness is precisely what distinguishes us from inanimate things; yet, for all their theories and scientific research, Western science is still unable to unravel its mystery. For that matter, Baars observes that religion and philosophy in the West have not fared much better. Although the presumed goal of science is to reveal the workings or mysteries of all natural phenomena, the fact that it has not been able to explain or provide an adequate theory of consciousness is not the fault of the scientific process. Rather, it points to the baffling nature of the inquiry itself.

The great *yogin/is* of Indian tradition also have sought an understanding of the mind and consciousness. They have developed systematic and sophisticated spiritual strategies (*sadhanas*) for cultivating introspection and self-knowledge through the awakening of the mind (*bodhicitta*). Lately behavioral medicine has become interested in the efficacy of some of these practices (meditation, for example) and their positive health benefits, which adept practitioners of hathayoga have known and experienced for centuries. The authors of the hathayoga treatises, such as Svatmarama and Gheranda, present themselves essentially as interpreters and adept practitioners of tradition. In their short manuals, they set forth a precise training method for penetrating the holistic and integral nature of reality. This involves heightened awareness not only of the subjective world but also of the objective one, since understanding pure consciousness in hathayoga, as was mentioned earlier, involves the recognition of a nondual relationship between subject and object.

Hathayoga essentially recasts the dualistic concepts *purusa* (self) and *prakrti* (matter) found in the *Yogasutras* (c. second century C.E.) of Patañjali as the masculine and feminine theistic principles Siva and Sakti. In hathayoga, Siva, the male-identified aspect or self, is the center of consciousness and is one with yet distinct from Sakti, the body-mind complex (matter). Such higher realizations are dependent upon the state of awareness cultivated by the *yogin/i* and are certainly not a given just by virtue of being human. A rigorous training involving formal introspective practices

and experimentation is required to overcome the transient condition of duality, or, as Alex Comfort suggests, "to remove the filter which determines normal, or middle-order, experience" and thereby eradicate the ignorance imbued in human biology (Comfort 1984, 33; HYP 4:7; HYPR 4:7). Siva (self, *atman*, *purusa*, *sunyata*) is reflected in, or illuminated by, Sakti, the inherent, mirrorlike principle of the mind (*buddhi*) through which consciousness reveals itself (see Goldberg 2002b). Consequently, in this tradition the duality between subject and object is neither fundamental nor eternal; it is contingent upon the purification of the so-called veils of ignorance (for example, *maya*) in the human mentation of the practitioner. This conviction is based on direct, empirical (subjective, experiential, first-person) knowledge rather than on indirect (abstract, third-person) knowledge attained simply by theory. Here we see Comfort's claim echoed, insofar as introspection when properly performed can be as valid a source of scientific knowledge as extrospection (Comfort 1984, 29). Not only does *sadhana* present a critical method of introspection, but, according to Comfort, when the goal of yoga is actually attained it also verifies the "reification" of the entire phenomenal world—a compelling point also made in quantum physics. Consequently, pure consciousness is attained in yoga when the relative distinctions between knower (cognizer, perceiver, *jñata*, subject), known (cognized, perceived, *jñeya*, object), and knowledge (cognition, perception, *jñana*) ultimately dissolve (YS 1:41).[9]

The Role of the Nervous and Circulatory Systems. As mentioned earlier, several models in recent cognitive theories are concerned with the body, specifically the nervous and the circulatory systems. Cognitive studies in neurophysiology consider the biological dimension, or brain/mind correlates, of religious experience (d'Aquili and Newberg 1993; 1999; 2000; Auyung 2000; McNamara 2001; Gellhorn and Kiely 1972). According to recent studies in neuroscience and neuropsychology, specific areas of the nervous and circulatory systems are related to unitive states of mind. Auyung explains:

> Two great circuits, the nervous and circulatory systems, connect the brain to other parts of the body. From every muscle, joint, and sensory and internal organ, peripheral nerves originate and move to the central nervous system, some entering the brain at the spinal cord, others at the brain stem. From there, signals from the periphery project to various parts of the brain dedicated to perception, emotion, reasoning, and sensorimotor and body regulation, which integrate on a larger scale to produce unitary conscious experiences. (Auyung 2000, 327–28)

Research in cognitive neuroscience shows that although "the neural system dominates most discussions of brain and mind," it is not the only system that maintains an organism (p. 327). The circulatory system supplies chemicals such as hormones, neural transmitters, and modulators through the blood stream that are essential for life support. Hormones directly alter

neural and bodily activities. For instance, the hormone epinephrine secreted by the adrenal glands indirectly affects memory and therefore contributes to cognitive functioning. Hence, we see a cooperative and interdependent relationship between the nervous and the circulatory systems that, according to Auyung, "underscores the inseparability of brain and body in supporting mental processes" (Auyung 2000, 328–29; Fodor 1981, 80).

In hathayoga, the inseparability that Auyung refers to is crucial. Whereas only some recent cognitive scientists seem to find this line of inquiry productive, *yogin/is* have been examining the inseparability between body and mind with great rigor since ancient times. By applying a bottom-up rather than simply a *sui generis* approach, Swami Om Shivatva Muni, a recognized master and one of the principal disciples in the Krpalvananda lineage, explains that there are two phases or subsystems of the autonomic nervous system: sympathetic (also called ergotropic) and parasympathetic (also called trophotropic). According to hathayoga theory, the brain is not the beginning of all nerves but rather the end, where the sum of all impressions is stored. Consequently, we find repeated references to the brain as the "thousand-petalled lotus" in hathayoga manuals (SS 5:145–51; GS 6:9–14; Goldberg 2002). These so-called petals surround what is referred to in yoga as the subtle cavity, or *brahmarandhra* (see Goldberg 2002a).

As human beings we typically cannot control the crucial, involuntary actions of the autonomic nervous system such as heartbeat and breathing; these function regularly and unconsciously. However, prolonged and intense practice of advanced hathayoga techniques, such as *satkarmas* (six actions of purification), *pranayama* (breathing techniques), *mudra* (advanced *asana* or postures), *bandha* (internal locks), *dhyana* (meditation), and *nada* (the spontaneous inner sound of *aum,* for example), enable the accomplished *yogin/i* to control aspects of the autonomic system. All of these practices directly or indirectly affect the nervous and circulatory systems (Sakti) and, in more advanced stages, propel the mind of the *yogin/i* into deep states of absorption (*laya*). As a result, the involuntary actions of the body such as breathing are controlled or restrained. Therefore, advanced stages of hathayoga result in the stilling not only of the mind but also of the circulatory and nervous systems. In hathayoga this is considered only the beginning or "gateway" to yoga,[10] or what Auyung, d'Aquili, and Newberg refer to as "unitary consciousness experiences" (Auyung 2000; d'Aquili and Newberg 1999).

Cognitive scientists in the West are attempting to explain religious experiences through scientific and technical terms relating to the body and the brain (d'Aquili and Laughlin 1975; d'Aquili and Newberg 1993; 1999; 2000; McNamara 2001; Varela 1996; 2001; Gellhorn and Kiely 1972). For example, d'Aquili and Newberg discovered that hypertrophotropic states stimulate a sense of "oceanic bliss," whereas ergotropic states release energy

(d'Aquili and Newberg 2000; Damasio 1994). These research findings help us to understand meditation in the language of neurophysiolgy and neurophenomenology and provide theoretical models of the complex mind/brain activity as it relates to meditative practice (d'Aquili and Newberg 1999; McNamara 2001).

Recently, investigations distinguishing between various types of Asian or Eastern meditative practices show a correlation with specific activity in the sympathetic nervous system or the parasympathetic peripheral nervous system. For instance, using EEG patterns, Gellhorn and Kiely (1972) demonstrate that trophotropic stimulation accords with heightened or full awareness, whereas ergotropic stimulation produces only heightened perception. To extract these and other findings, researchers have resorted to a variety of devices such as EEG to measure the amplitude and rhythms of brain waves during meditation. State-of-the-art imaging technologies such as HMPAO-SPECT (single photon emission computed tomography) and PET imaging are proving particularly useful in determining metabolic functioning and the brain's electrical signals during these highly subjective meditative states, particularly in the thalamus, amygdala, and left and right frontal lobes (McNamara 2001). Also, fMRI has been introduced as a fast way to scan brain activity. Andresen (2001) and James Austin (1999) have compiled an exhaustive amount of data specific to this field to show the usefulness of this information in the pursuit of understanding consciousness.

The idea is that the more phenomenological material is collected, the more researchers will able to understand not only the mechanics of meditation but also the physical or biological correlates of such experiences. Both hathayoga and cognitive science make emphatic claims about the relationship between the body and the mind and the necessity for empirical evidence to support the philosophy of religion. Understanding this basic and complementary relationship can perhaps provide us with additional tools about the nature of consciousness and the practices that heighten our awareness of it. For, as cognitive scientists and *yogin/is* agree, the mind/body is equipped with the natural apparatus necessary for introspection.

Conclusion

I have introduced the primary approaches currently being used by cognitive science. Current cognitive theories of religion derive from and base their insights upon these principal presuppositions. In the course of this study, it became increasingly apparent that cognitive research, as a new field of scientific inquiry, is far from being conclusive or self-evident. Its numerous ramifications and applications are providing us with extensive research into the nature of consciousness and the mind. These new theories typically break away from Newtonian-Cartesian models and demonstrate beyond any doubt that there is an interdependence between mind/

brain and body. However, this still does not prove how consciousness is related to matter, or that consciousness is simply a product of the mind/brain, as many cognitive scientists claim.

I have shown that Eastern meditative traditions such as Indian hathayoga are not irrelevant to this inquiry. The hypothesis that consciousness is a product of a highly organized central nervous system has close connection with the embodied strategies and logic of hathayoga theory. As well, cognitive science's replacement of dualism with a more holistic approach emphasizing the interdependence between mind/brain, body, and experience are fundamental presuppositions in hathayoga. Further research by the scientific community into living religious traditions such as hathayoga would enhance empirical content that can assist in providing evidence of specialized methodologies and techniques for accessing and understanding the nature of consciousness. To my mind, it seems that the reason that various meditative traditions such as hathayoga persist has to do with the extraordinary subjective experiences it generates in practitioners. Cognitive science presents a new way of studying and explaining this phenomenon, and it can open exciting new vistas for dialogue and conversation between yoga and the varied methods and theories of modernity.

NOTES

1. Although the technical term *hatha* was first used by Goraksa of the Nathayogi *sampradaya* (lineage) in the *Hathadipika*, I would argue that we see a rudimentary outline of hathayoga practices much earlier in Indian tradition, such as in *Prasna Upanishad* 1:10, 3:6; *Svetasvatara Upanishad* 2:8–5; *Katha Upanishad* 6:16; and *Yoga sutras* (YS) 2:2, 2:28–55.
2. For more on the lineage of Krpalvananda, see Goldberg 2001; 2002a; Krpalvananda 1974.
3. Several scientists, including John Searle and Roger Penrose, have argued against the computational theory of mind. Searle uses the Chinese Room argument, and Penrose draws on Gödel's famous theorem, to show that the human mind is not simply a computer program. However, both of these arguments have been dismissed (see Pinker 1997).
4. The blank-slate metaphor was used by John Locke in reference to the "neonate mind."
5. We should be well advised, however, that cognitive theories of religion clearly demonstrate that religious experience and representations emerge out of our ordinary, or natural, cognitive resources rather than out of extraordinary states, as James suggests.
6. The term *meme* derives from the Greek *mimeme* and refers to Richard Dawkins's theory of "cultural replicators" (see Sperber 1996, 100–106). However, Sperber's use of the word does not indicate endorsement as such.
7. This area is also crucial to working memory. The frontal lobe is responsible for emotion and higher cognitive functioning. The amygdala is at the center of our emotional infrastructure and has many different functions such as emotional expression and modulating the endocrine and autonomic systems, which, in turn, affect the secretion of hormones and neural transmitters such as serotonin and dopamine. However, the amygdala also affects behavior through the motor systems. For a more in-depth look at these aspects of the brain, see Auyung 2000.
8. Francis Crick quotes John Searle at the beginning of his book: "As recently as a few years ago, if one raised the subject of consciousness in cognitive science discussions, it was generally regarded as a form of bad taste, and graduate students, who are always attuned to the social mores of their disciplines, would roll their eyes at the ceiling and assume expressions of mild disgust" (Crick 1994, 1). However, Baars reports that in the year 2000, 1,400 biomedical articles used the word *consciousness*, indicating that the taboo in science created by behaviorism had been lifted (2002, 102).

9. We see a similar argument in the embodied-enactivist approach of Varela, which is inspired by the insights of Buddhist mindfulness-meditation. Also, as Brian Cantwell Smith observes, one of the critical developments in modern science is the unsustainability of traditional lines of demarcation between knower and known (2002, 211).

10. In the context of the *Yogasutras* (also known as *rajayoga*), *yoga* is defined as the cessation of the fluctuations of the mind (*yoga citta vrtti nirodha*, YS 1:2). *Hathayoga* makes this cessation possible (HYP 1:1, 2:76–77, 4:101, 108; GS 1:1; HR 1:2, 16; SS 3:61, 5:157–59).

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