

Neuroscience and Spirit

THE GENESIS OF MIND AND SPIRIT

by John A. Teske

Abstract. Spiritual life is made possible by the evolution of a human neuropsychology that requires social interdependence for its development. Extensive neuroplasticity requires experiential shaping throughout life. The evolution of frontal cortex hypertrophy suggests that much of this shaping is produced by a socially constructed virtual reality, extending beyond immediate experience. Prefrontal colonization makes possible the social scaffolding of neuroregulation, including the emotional attachments necessary for moral life. Cognitive independence from immediate environments enables symbioses with external memory systems, producing novel forms of socially constituted experience and making possible the transformative effect of religious systems upon individual biologies and psychologies.

Keywords: brain development; cognitive evolution; emotion; internalization; neuropsychology; social construction; spirituality; virtual reality.

It is the present contention that human spirituality is a product of the very processes of human evolution that make the social construction of human culture, human meaning, and individual psychology possible, and even necessary. Evolutionarily adaptive characteristics of human neuropsychology require that we live in a social world, making the construction of personhood nearly inevitable and making a spiritual life possible. Our species is likely to have evolutionarily benefited by the extended childhood and

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complex social interdependency that the coevolution of brain and language required (Deacon 1992). This included the capacity to function in an “as if” manner that intentional representations of the world make possible and that allow us to operate within socially constituted understandings of the world, our fellows, and ourselves. Such understandings are also grounded in prelinguistic and subdoxastic capacities to coordinate our behavior and our emotional lives with each other. The human nervous system is likely to have evolved in ways that require social interdependency, not only for the survival of groups but for the canalization of individual nervous systems and the genesis of individual psychologies. We human persons, inclusive of and embodied in our neuropsychological development, are constituted by our placement within larger social wholes, no less real for being symbolically generated and evolutionarily emergent. Religious systems may themselves function as higher-order evolutionary units, in which social interaction and individual mental lives are embedded and in which they find their meaning.

When we understand that the self, our subjectivity, our internal life, is a socially constructed logical space, we have a handle on the constitution of individual spiritual lives. Julian Jaynes (1976) and others (see, for example, Hermans, Kempen, and van Loon 1992) argue that our very consciousness of self is constituted and organized metaphorically *as* a space. Metaphor is a central concept, given our ability to direct our lives toward conceptual objects—to live, as it were, metaphorically, “as if,” in the virtual reality of symbolic systems, fully capable of sustaining spiritual presence. This is also what allows us to build a meaningful communal life, to step beyond our own egos into a world transcending them. Nevertheless, evolutionarily and historically contingent though they may be, the forms that constitute our selves are interiorized in a particular way, nested within the evolutionary biology of socially interdependent nervous systems, deeply interwoven with the neuroanthropological fabric. Spiritual life does not escape the sociohistorical and evolutionarily embodied contingencies by which it is constituted. The central focus of this article is to draw out some of the fibers of the neuroanthropological fabric from which our psychology, and our spiritual experience, is woven. The passions of faith, and “spiritual” questions about boundaries between self and other, alienation, will, surrender, communion, and even the experience of grace, may ultimately be understood more fully as embodied phenomena if we give attention to these fabrics.

The present work is part of a larger attempt to map out the constitution and the embodiment of our spirituality in terms of what we know about human minds and brains from contemporary cognitive and neurosciences. This project is necessary for any kind of theological or religious system that is coherent with science, the only chance for its viability in a world dominated by a scientific episteme. Both our self-transcendence and the self-limitations that require it are made possible by our neuropsychology

(Teske 1996a). Nevertheless, the very neuropsychological characteristics that make spirituality possible also provide limits that *individuals* cannot alone transcend (Teske 1996b). Neuroscience alone cannot provide a complete account of human nature or human spirituality (Jones 1992) because many of the important characteristics of both mind and spirit not only are emergent properties of an individual's central nervous system (Sperry 1991) but may be *social* emergents, that is, properties of a number of individuals in interaction. The evolutionary and developmental evidence will show us why and how our social interdependencies—our membership in larger human groups—are both necessary for and constitutive of the mental and spiritual life of human beings. We will begin by addressing the dependency of mental, and hence also spiritual, life on neuroplasticity and cognitive evolution. Then we will examine the specific developmental changes, both evolutionary and ontogenetic, that support the social constitution of mind and spirit.

One of the central principles necessary for understanding human development is that of our extensive neurobehavioral plasticity. The last few decades have uncovered a great deal about how biological processes interact with the external world during growth and development, showing measurable effects on the anatomy, physiology, and chemistry of the nervous system (Blonder 1991). Although genetics do set some constraints, there is plasticity at every level of development (Nowakowski 1987). Cells and their interconnections proliferate, migrate, differentiate, and are pruned directly by experience with the external world, affecting synaptic connections, dendritic growth, neurotransmitter synthesis, and even vascularization.

The result is a brain that is constantly being shaped, in structure and function, by its history of developmental interactions with the outside environment. David Hubel and Thorstein Wiesel, recipients of the Nobel Prize in 1981, found that depriving cats or monkeys of certain visual stimuli (such as vertical lines) resulted in the loss of cells in the cortex for detecting them. Rats reared in enriched environments have larger neurons, greater dendritic spread, and greater enzyme production. William T. Greenough also provides evidence for both “experience-expectant” *overproductions* of synaptic connections for species-ubiquitous environmental information (experience itself selecting which connections remain) and for “experience-dependent” *novel* synaptic connections formed in response to idiosyncratic experience (Greenough 1986; Greenough, Black, and Wallace 1987). There is also a growing body of evidence for lifelong neurobehavioral plasticity in human beings: the dependence of left-hemisphere, language-area maturation on appropriate prepuberty stimulation; the quantitative increases in left-hemisphere language dominance produced by literacy; the *elimination*, during adolescence and young adulthood, of excess synapses in the principal sulcus, which appears to be necessary for fully mature delayed-response functioning; and the extensive dendritic growth in the learning

and memory-crucial parahippocampal gyrus among normal elderly people (Blonder 1991; Goldman-Rakic 1987).

The evidence of neurobehavioral plasticity makes clear that the cognitive abilities required for spirituality (see Teske 1996b) are not just genetically constrained but epigenetically constructed and dependent on extensive environmental experience for their emergence. It is also clear that the developmental environment of human beings and their hominid ancestors is a socially mediated environment, an environment increasingly influenced by human activity, to the point of becoming a virtual reality of human artifacts. That there may be less than a one percent difference between the DNA of chimps and that of human beings suggests that any determinant of cognitive abilities not shared between us is likely to be epigenetic or even developmental rather than strictly constrained by genetics (King and Wilson 1975). Evolutionary changes in cognitive abilities, despite their cultural amplification, may not involve radical changes at the genetic level. Small differences in DNA must play a role in a number of differences between human beings and other primates, including speech, bipedalism, and brain size. Human language capacities are also likely to be polygenetic, shared with other developmental domains, tied to epigenetic and probabilistic maturational events and, given the multifunctional and individual variability of human brains, not strictly universal in functional organization (Mueller 1996). The plasticity of epigenesis and development suggests that the processes needed to replicate human cognitive functions may depend upon the storage devices of culture. The replication of human spirituality, in turn, is likely to depend upon the storage devices of institutional religion.

The other general principle needed for understanding the ontogenesis of human cognition is the hypertrophy of prefrontal cortex (Deacon 1992). This is the major neurological change behind our being, relative even to other primates, linguistic or combinatorial savants, creatures that can live in symbolic virtual worlds, can construct meaningful narratives, can imagine their own origins and ends, and can conceive of God. Prefrontal hypertrophy, in combination with an overall neurobehavioral plasticity, also guarantees the colonization of human neuropsychology by the prefrontal functions of attentional control, planning, and complex motor sequencing, and so constitutes the particular character of higher cognitive functioning. Such functioning is also prerequisite to a spirituality that includes shifting attention from self to other (or, alternatively, from the mote in a neighbor's eye to the log in one's own), planning one's life around goals that survive individual mortality, and coordinating one's actions with others in community.

Terrence Deacon (1992) makes the case for prefrontal colonization clearly. He accounts for the absence of even simple languagelike symbolic systems in other primates by drawing our attention to the most robust and divergent neuroanatomical features of human brains relative to other pri-

mate species, namely, the enlarged prefrontal cortex and expanded projection fields, which contribute to the attentional-mnemonic supports critical to symbolic and associative learning and make possible the broader belief and meaning systems of ideology and religion. This prefrontal hypertrophy guarantees a predisposition to employ symbolic learning and facilitates the computational learning behind the evolution of human cognition, consciousness, and culture, including religious systems. The primary evidence has to do with the fact that, whereas most brain structures in human beings have grown in an unchanged ratio to body size and other brain structures, the ratio of neocortex to other structures is larger. The neocortical hypertrophy produces a kind of bias in the competition for space in which the structures of the brain most directly controlled by input from the outside world remain the same relative size but smaller than the rest of the neocortex. The prefrontal areas therefore inherit the largest share in competition for space and increasingly come to dominate connections to other parts of the brain, especially those contiguous areas controlling vocalization. The disproportionate frontal impact thereby produces novel functions not found in other animals such as complex symbolic representation and the capacity to construct systems of meaning that transcend individual death. The evidence from electrical stimulation, cerebral blood flow, and brain damage suggests that frontal-cortex function is what is behind our abilities to shift categorization criteria and generate the novel patterns that enable us to learn through insight. Frontal-cortex function is also responsible for our ability to transform our lives, or undergo conversion.

Deacon (1992) argues further that emergent frontal-cortex functions are what give us *entrée* to a symbolic “virtual reality.” The result is that representations are not simple indexes but parts of systemic symbolic reference. Once this systematicity is present, we can always learn new symbolic associations by restructuring, by retrospectively reorganizing previous connections in respect to one another, as we do for our lives as a whole in psychotherapy or in confession. This also is what gives us the capacity for generating an abstract virtual world only indirectly connected to the concrete present, for representing possible and impossible futures, and for having access to an illimitable symbolic world, even a transcendent one. We become overdependent on the symbolic transfer of learning and enter a way of life driven by a compulsion to symbolize, a world in which the meaning of our lives is contingent upon realities beyond our immediate sensory experience. We also have the capacity for symbolic empathy, via corticolimbic ties that allow us to match arousal states to representations, to make believe, and to imagine the experience of fellow beings—from the sublime to the horrific. With the symbolic capacities made possible by prefrontal hypertrophy, human sociability is no longer based solely on genetic contributions or animal communication but also on the symbolic transfer of sociohistorical learning and the colonization of human psychology by higher cognitive function.

We can now examine more specific neurological structures and functions in terms of the evolution and ontogenesis of the human need to live in socially constructed, symbolic virtual realities. Without such realities, the largest and furthest-reaching of which are ideological and religious systems, we could not construct a meaningful human existence.

We start with the fairly primitive brain structures that mediate arousal, influencing attentional selection in ways mediated by both circumstances and past experience. Arousal is a prerequisite for attention, involving stimulation from the reticular formation, itself a distributed network that also includes cortical connections. However, not only is it clear that we need brain stem (and limbic) interactions to understand the cognition that is built upon them, but, given the extensive epigenetic and ontogenetic shaping of this relationship, we also must understand its embedding within a complex system of developmentally supportive social interchanges. The role of symbiotic caregiver-child interactions in the scaffolding of the child's ability to self-moderate arousal begins a process of social internalization. This process extends throughout our lives and, reciprocally, beyond our individual demise into the lives of others.

The social scaffolding that structures the regulation of arousal and attentional mechanisms emerges from the basic mammalian attachments that form the foundation of our emotional lives. The mother's role as regulator of physiological and behavioral systems in the infant is most evident in the synchrony and reciprocity of nursing and in the responses of infants to separation (Hofer 1987). James Ashbrook (1994) characterized the early experience of separation from a loved object, and the emotional need to fill this separation with transitional objects and symbols, as central to a spiritual "cry for the other" and as motivating the meaning-making that roots consciousness, creativity, and faith. Given a lengthy period of dependency in human child rearing, attachment patterns and developmental experience within both familial and communal contexts are likely to be deeply determinative of the social and emotional patterning of adult lives, including our trust and faith in a larger world of spirit. Recognizably human affect complexes and fuller emotional scenarios are built out of biologically primary motivators only over decades of biographical development (Tomkins 1979), producing different emotional tones and different kinds of self/not-self and self/other emotional boundaries.

Human emotional life, particularly as it is mediated by reciprocal connections between the limbic system and the neocortex, has been viewed as the locus of religious sentiment by a number of thinkers. Ashbrook (1994) focuses on early family dynamics, including maternal nursing, separation cries, and sibling play. Robin Fox (1986) also offers a more detailed analysis of limbic-cortical connections, suggesting that a "wired-in" mechanism for the disruption of social categories is behind both the alerting responses to minor cognitive mismatches and the passionate upsets of horror, dis-

gust, and fear in response to more serious violations of social expectations. Areas of the brain that are involved in emotion are also involved in memory; it is the emotional charge of an event that most directly determines how well it is remembered. Selecting emotionally significant memories for long-term retention is necessary in order to avoid a kind of combinatorial explosion of memory in higher mammals, and it may be a valuational prioritizing of events by ideological, mythological, and religious narrative that provides a socially structured marking of emotional significance. By a limbic-frontal linking of visual images and complex associations to emotionally significant information—especially that tied to initiation, trauma, drama, ritual, and fear (precisely those experiences most strongly tied to learning and relearning of central social categories and to personal transformation and conversion)—these memories are the ones most likely to be consolidated over a period of years, as the plethora of more shallow memories are washed away in the accumulation of experience.

Este Armstrong (1991) provides allometric evidence of some limbic differences between human and primate brains and emphasizes the importance of attentional and memorial endowment of symbols with emotional significance and meaning. Proportionally larger limbic structures include a relatively larger anterior thalamus. This is part of the Papez circuit, which brings emotional information into the cortex for further elaboration and conscious access, is critical for the brain's ability to remember cultural rules and events, and plays a role in the emotional prioritizing and approach/avoidance valencing of symbolic representations of events. Emotional significance can also, then, be shaped by the cortical structuring of our most central religious and spiritual beliefs and can constitute our deeper spiritual sentiments. Alternatively, inhibitory cortical feedback, in embodying ethical, moral, and religious beliefs, is likely to be important for social cooperation, as human beings can approach and engage in joint social activities without direct expression of hostility or sexuality. Moreover, extensive cortical neuroplasticity makes possible, and may even require, cultural and institutional supports in order to produce moral or spiritual, as well as cognitive, development.

Some of the important prerequisites to human-level cognitive and cultural capacities, particularly to having subjective interior lives and to attributing the same to our fellows, are already present in our nearest primate relatives. Dorothy Cheney and Robert Seyfarth have provided evidence in chimpanzees for short-term planning, transitive and analogical reasoning, deliberate deception (Cheney, Seyfarth, and Smuts 1986), and even the attribution of mental states (Cheney and Seyfarth 1990). Gordon G. Gallup Jr. (1982; 1991) has argued that the ability of apes, but not monkeys, to recognize themselves in a mirror is an empirical marker for having a "theory of mind," a capacity to contemplate mental experiences and the means to infer such experiences in other organisms. Daniel Povinelli (1993) provides

evidence that children lacking self-recognition fail to attribute mental states and are incapable of introspection-based social strategies (precisely those that, in taking people's interior life into account, we would consider moral). It is clear that socially relevant cognitive abilities, such as the attribution of intent, require a number of years to develop in human children and may be evident in many rudimentarily moral adult apes. Nevertheless, we now turn to the emergence of the linguistically and culturally supported *human* cognitive capacities upon which our self-conscious moral, religious, and spiritual experience depends.

Merlin Donald (1991; 1993) argues that any comprehensive theory of human cognitive evolution must bridge the huge gap between the animal kingdom and the uniquely human invention of symbols. He bridges this gap with the emergence of self-initiated remembering of items independent of the immediate environment. This ability would provide our hominid ancestors with their first representational ability to "think about" things unrelated to the immediately present environment. It would also root any ability we have to conceive of meanings and purposes of our lives in a world beyond that of our immediate sensory experience. Donald's suggestion is not only consistent with a prefrontal hypertrophy's allowing different access routes to limbically mediated memory; it also is a separate and preliminary step to the evolution of language. There are both anatomic and cultural signs of a major evolutionary landmark with the emergence of *Homo erectus* (1.5–0.3 million years ago), the cultural achievements of which implicate voluntary memory (sophisticated stone tools, long-distance hunting, seasonal adaptations). Nevertheless, these changes are not likely to have been accompanied by language, the anatomic and cultural signs for which do not appear for another million years.

Donald (1993) suggests that prelinguistic memory access allows non-verbal representational skills, the existence of which are also consistent with the autonomy of nonverbal forms of human intelligence. Accompanied by cortically mediated improvements in motor control, this would allow the development of mimetic skills advanced enough to support toolmaking, skill refinement, and a flexible social organization superior to that of apes. Mimetic skills, based on a memory system that, in an extended kinematic imagination, enables the voluntary and systematic rehearsal and refinement of movements (seen frequently even in human children, but rarely in apes), allow for an implementable self-image, have supramodal characteristics such as rhythm (also absent in apes), and make purposive, alterable sequencing possible. Like the sophisticated mimetic and expressive abilities of illiterate deaf-mutes, the culture of *H. erectus* may have been the complex mimetic one in which we can still see our symbolic and linguistic culture to be embedded. This includes crafts, games, social rituals, expressive scenarios, and even many athletic skills—nonverbal skills unaffected by even profound aphasias. Such a mimetic culture, in embodying mean-

ings and purposes beyond the lives of individuals, in providing rituals of propitiation, of celebration, and of various seasonal and life-course changes, in organizing the bodily activity of socially interdependent human beings, is also one in which our religious and spiritual lives are embedded.

According to Donald (1991; 1993), it is in the modern vocal tract and its motor control that we see, with the emergence of archaic *Homo sapiens* between 500 and 100 thousand years ago, evidence for real language. Donald suggests that this second evolutionary landmark corresponds to the evolution of “lexical invention,” the capacity to invent and retrieve thousands of words and the rules for their combination, allowing the construction of narrative commentaries. The shift from reenacting to storytelling also takes the teller outside the story and allows freer examination, reassembling, and sharing of components. The shift also makes possible the incredible speed of language differentiation and the production of collective, standardized narratives in mythology and religion, and it provides a narrative frame for the governance of preexisting mimetic institutions. Indeed, while we may form and maintain our social constitution largely by establishing routines and daily habits and through group rituals, its meaning may depend upon nonautomatized, second-order, symbolic monitoring and commentary. It is this capacity to construct overarching communal systems of meaning that can generate a virtual religious life, the internalization of which constitutes our individual spiritual interior.

Donald’s third stage of cognitive development, the externalization of memory, makes all the more clear the necessity of social interdependency for human cognitive evolution (Donald 1991; 1993). Mimesis and language, although themselves coevolved with culture, still depend on the internal memory capacity of individuals. Biological memory is impermanent, its medium fixed, and its format constrained. Indeed, the evolution of internal memory capacities may itself have depended on ways of editing and pruning them. However, the emergence of literacy, and other skills involving symbioses with symbolic external storage, allows memory to be externalized in ways that are enduring, refinable, and even capable of reformatting. Longstanding religious traditions, as well as more rapidly developing social institutions, provide some of the important and unifying ways that these externalizations take and keep any lasting form. External storage also, via the use of a spatialized external information space, allows us to harness vision for reflective thought, to change the part of the brain used for thinking, to interrelate information and images in novel ways. It enables the development of new cognitive strategies that are socially organized and can be institutionalized to survive the replacement of member individuals. It is here that shared symbolic and iconographic systems, textual and scriptural traditions, and the lasting material cultures of architecture, technology, and bodily presentation make possible the reconstruction of meaning across each generation.

External storage thus makes possible an even more thorough invasion and use of the brain by cultural programming, especially institutionalized education, the development and elaboration of new devices (from wax tablets to manipulable computer imaging systems), and new visual symbolic codes. This culminates in the deliberate construction of artifacts that produce particular internal mind-states in recipients, states that, like the world of a novel, may be artifact-dependent for their maintenance. Religious experience might readily be construed as the construction of an especially compelling variety of such mind-states. Such experience may change the role of biological memory to be more symbiotic with cultural artifacts and increase demands on certain areas of the brain, which, given its neuroplasticity, can expand their territory at the expense of other functions; for example, loss of rote verbal skills and visual imagination may come with literacy. Finally, we also face a danger to individual integrity. "Free access to external memory tends to pull apart the unity of mind, fragmenting experience, undermining the simpler mythic thought structures humans have grown rather attached to" (Donald 1993, 164). Although this is not the place to rehearse an analysis of the effects of postmodernism on self-identity (but see Cushman 1990; Gergen 1991; Giddens 1991), it is certainly true that such dangers may well extend to the loss of the integrity of meaning in our communal lives, dangers that may be mitigated by the unifying potential of religious systems and spiritual values.

The central point here is that human brains are not evolved to develop in isolation. They are complexly, flexibly, and only loosely constrained by genetics to internalize a whole range of sociocultural practices. Our brains internalize social practice in ways that, by virtue of our neuroplasticity and prefrontal hypertrophy, profoundly influence our psychological functioning, even so far as to our neurophysiology. These influences run the gamut from the extremely commonplace effects of socialization on bodily function to the more profound transformations of social practices such as psychotherapy, religious ritual, and meditative discipline. Walter Freeman (1995) makes the point that our brains have evolved primarily as organs of social cooperation and understanding, involving the construction of symbolic representation and the development of mechanisms to reach social agreement. He suggests that social bonding, the emergence of shared meaning, and the coordination of activity facilitate the unlearning of individual value systems via socially cooperative action, and he encourages us to focus not on individual but societal aspects of neurodynamics and neurochemistry. Indeed, it can be argued that the more important transformative role of religious systems, despite their powerful effects on individual biological and psychological lives, is on the healing of relationships within larger communities. It may be that the salvation or redemption of individual spiritual lives requires nothing less, because such lives are constituted and maintained only within interdependent social systems.

It may be a mistake to look for the origin and locus of religious and spiritual functions within the individual, especially if the cognitive functions on which they depend are themselves socially generated. The origination of putatively individual cognitive activity in social context is amply documented in the psychological literature (Rogoff and Chavajay 1995), and such activities (including memory and problem solving) not only may have social origins but may be socially distributed. Early social embedding is a *sine qua non* of the development of higher functions like language and discernment of meaning. Learning is situated in communities of practice. Cognition is socialized by learning "cognitive values" relating to what and what not to think about. Habitual relations can be institutionalized in ways that result in their being viewed as externally imposed, and later generations can lose awareness of intentional structures buried in history. Religious reformation and spiritual transformation may require a reappropriation of such intentionalities, whose archaism may conceal anachronisms of understanding. Nevertheless, it is the reappropriation of buried intentionalities, particularly those needing updating, that is necessary for the reconstruction of contemporary meaning.

Space limitations preclude a more detailed explication of how our subjective internality, our emotional experience, and our existence as responsible selves are socially constructed. Such an account could also be readily extended to the sociohistorical constitution of individual soul and spirit. We have here built the foundation for such an account in the neuroanthropological fabrics of our evolutionary and ontogenetic development. We have seen that our extensive neuroplasticity and our prefrontal hypertrophy make it necessary that our nervous systems undergo extensive experiential shaping, mediated by social interdependency, well into maturity. We have seen that, during the course of mind/culture coevolution, this shaping has also come to include, by virtue of the cortical colonization of many neurological functions, the entrainment of attention and arousal to social contingencies. This shaping is also rooted in the whole sequence of mimetic, linguistic, and ultimately institutional and artifact-dependent cultural symbioses. Finally, it is the culture, the community, the family, and other human relationships that differentiate and constitute our individual psychology and provide the emergent capacities for transcending its limitations. The social and historical construction of such capacities, made possible by the evolution of a neuropsychology dependent on socially mediated development, constitutes our spiritual life.

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