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Chapter 4

What Makes Us Human? A Neuroscience Prolegomenon for the Philosophy of Evolution and Consciousness

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This prolegomenon to the philosophy of evolution and consciousness includes the perspectives of all peoples from the mythological and ethical doctrines of ancient cultures to our modern sciences around the globe. This chapter presents a neuroscience integration of ancient perspectives and practices with modern research on facilitating the co-evolution of human consciousness and the brain. We review selective aspects of the theory, research, and experience of consciousness as a novelty-seeking modality and experience-dependent process that drives the co-evolutionary spiral of mind and brain. We seek to answer questions such as these.

- What makes us human? What is the major distinction between humans and other primates?
- What are the modern scientific techniques of DNA microarrays and functional magnetic resonance imaging (fMRI) that now can measure what makes us human?
- Do ancient and modern self-directed activities of consciousness contribute to the co-creation of the mind and brain over a lifetime as well as their Darwinian co-evolution over millions of years?
- What is the scientific evidence that consciousness, dreaming, meditation, therapeutic hypnosis, and psychotherapy can contribute to the daily and hourly re-construction of our mind and physical brain for positive adaptation?
- What are the salient psychological and spiritual functions of consciousness that evoke activity and experience-dependent gene expression and brain plasticity for building a better brain in daily life?
- Could an integrative non-dualistic approach to the philosophy of meditation and creative psychotherapy facilitate activity and experience-dependent gene expression and brain plasticity to optimize adaptive consciousness and behavior, health and well being?

Since 2009 celebrates the 200th birthday of Charles Darwin and the 150th year anniversary of his “The Origin of Species,” there is no shortage of excellent reviews of his two major works: *Principles of Evolution: Heritable Variation and Natural Selection*^{1,2}. We therefore focus primarily on the more recent discoveries in the fields of genetics, epigenetics, neuroscience, and psychosocial genomics that are the scientific foundation of any natural philosophy of the co-evolutionary spiral of consciousness and the brain.

Darwin’s Daily and Hourly Co-Evolution of the Human Mind and Brain

In a little noticed statement in chapter four of *The Origin of Species*, Charles Darwin, commented on the daily and hourly operation of his principle of natural selection as follows.

“It may be said that natural selection is daily and hourly scrutinizing, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life. We see nothing of these slow changes in progress, until the hand of time has marked the long lapses of ages, and then so imperfect is our view into long past geological ages, that we only see that the forms of life are now different from what they formerly were.”

We take this statement by Darwin very seriously to help us unify the many interdisciplinary psychobiological perspectives of this chapter. Recent research in psychobiological rhythms, for example, conceptualizes Darwin’s “natural selection” within “the time domains of living systems” in figure 1. The “bottoms-up” perspective from molecules to cells and organisms in illustrated figure 1 illustrates how many biologists currently present a reductionist view of life without even mentioning mind and consciousness^{3,4}.

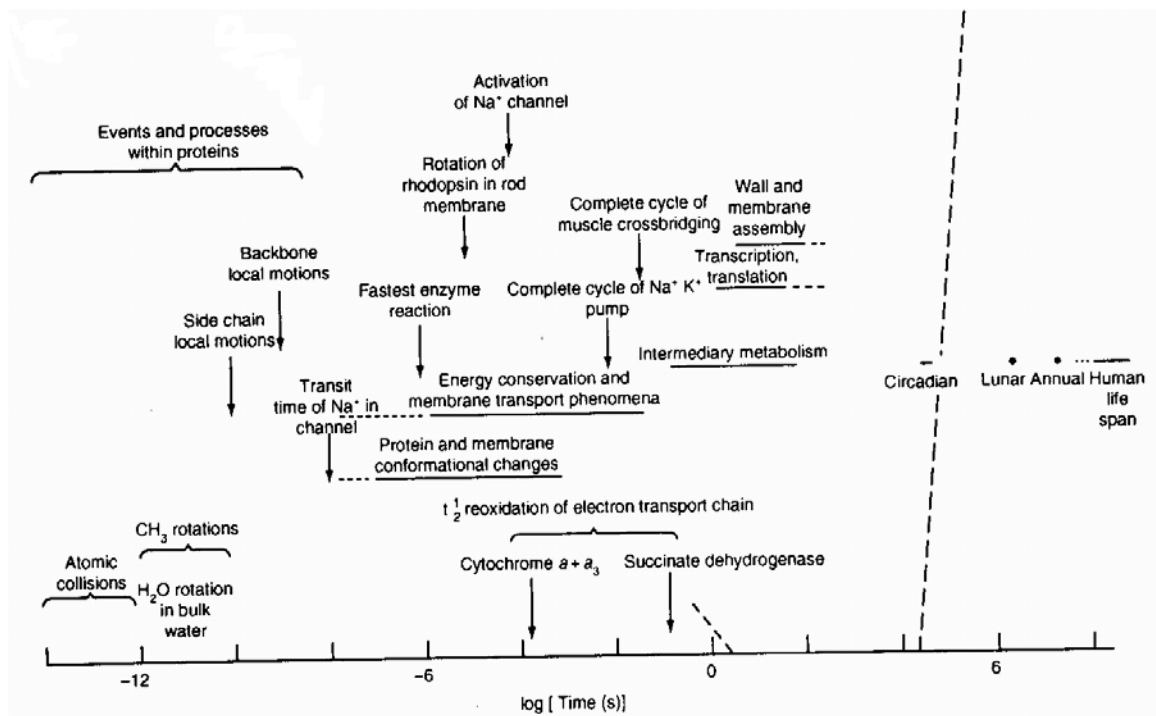
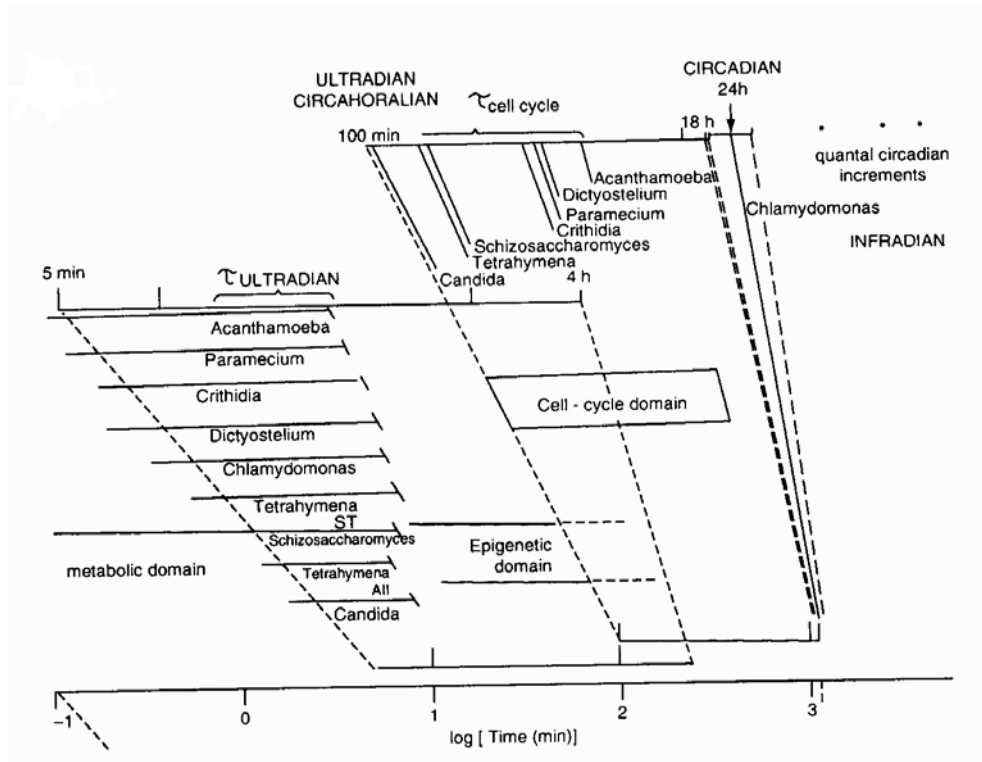


Figure 1 – Time Domains of Living Systems with permission (from Lloyd & Rossi, 2008). While this bottoms-up perspective of the circadian (daily, about 24 hours) and ultradian (less than 24 hours) rhythms of life is scientifically valid, it is not satisfying for the philosophical mind searching for the meaning and significance of human life and conscious experience. For meaning, our consciousness usually prefers a “top-down” perspective to construct a more useful view of how we interact with the world as illustrated in figure two.

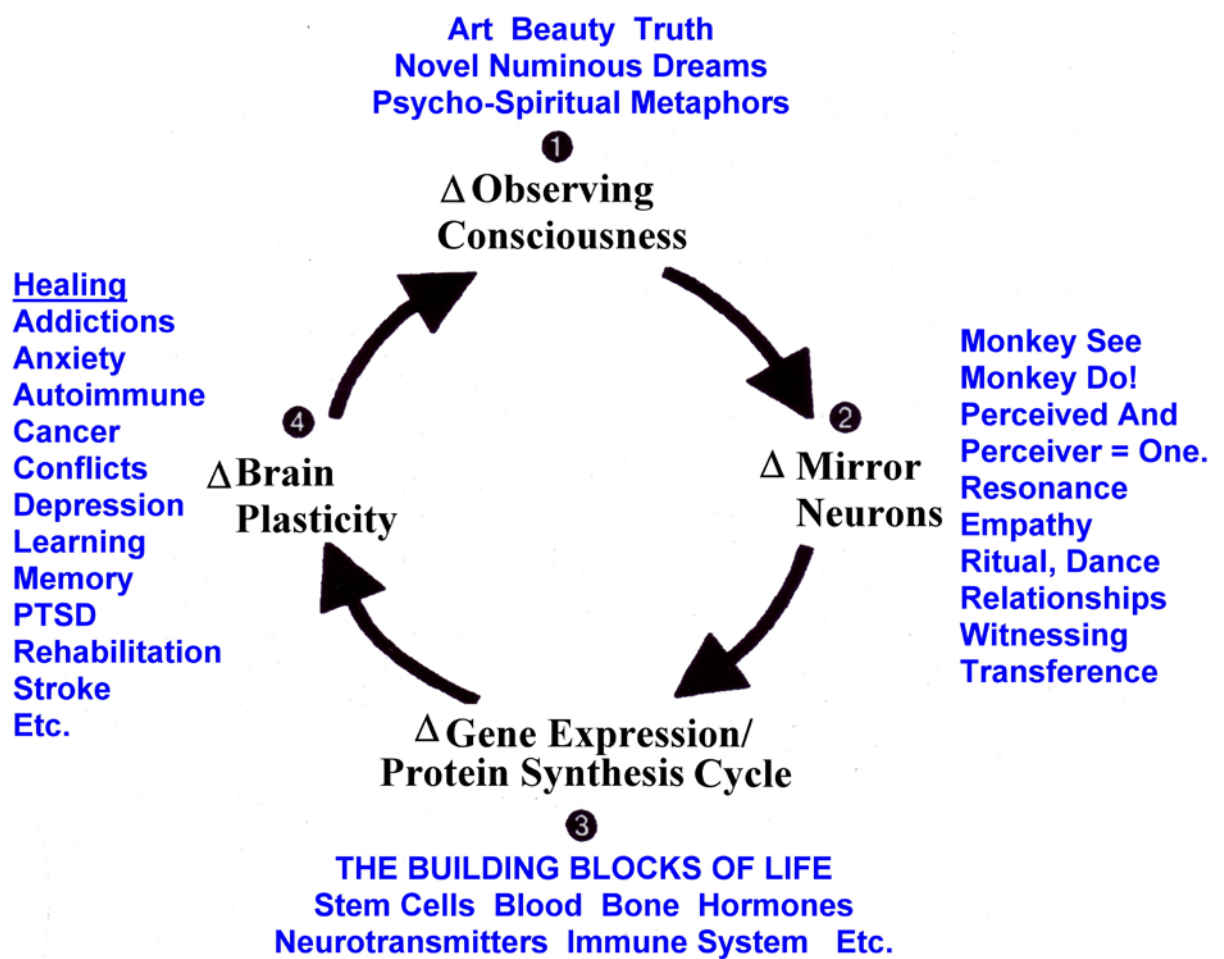


Figure 2: Rossi's Bioinformatics Cycle of Psychosocial and Cultural Genomics. A model of how (1) art, beauty, and truth, novel and numinous dreams, and the psycho-spiritual metaphors of meditation and psychotherapy (2) heighten the activity of mirror neurons to (3) activate the experience-dependent gene expression/protein synthesis cycle, which create the building block of life to (4) facilitate brain plasticity and mind-body healing. We hypothesize that this activity and experience-dependent gene expression and brain plasticity cycle is the basic molecular-genomic mechanism of the 4 stage creative process and Buddha's Four Noble Truths as the essential dharma of meditation and psychotherapy.

Figure two presents an overview of the perennial mystery of how consciousness and nature seemingly reflect each other in the mirror of the human mind⁵. Mirror neuron research demonstrated how specialized neurons not only interface between our inner mind and the outer world, but how they actually match and synchronize the brain state of the observer with the observed. This has profound implications for any general philosophy of mind and ethics (e.g. the golden rule – do unto others as you would have them do unto you). In particular it implies that solipsism, the philosophical view that the self and consciousness can be aware of nothing but its own experiences and states of mind, no longer makes as much sense today as it may have in the past. Brain imaging research indicates that autistic children and adults have malfunctioning mirror neurons – thus accounting for their well know inadequacies in normal social functioning even while, in the extreme, they may be artistic or mathematical idiot savants. It is now a matter for

future research to determine to what degree other social pathologies (conflict, war, social exploitations, etc.) can be accounted for by mirror neuron malfunctioning.

Well functioning adults are not lost in a solipsistic sea of subjectivity! A well functioning mirror neuron system automatically matches and replays the brain states and experiences of others within one's self. How then can a person sort out what their brain is matching from the outside world and what is being created intrinsically within their own individuality? In a word: "Dialogue." We will illustrate such consciousness and identity creating dialogues with examples of how we engage the co-creative and co-evolutionary spiral of mind and brain later in this chapter.

Figure two outlines our neuroscience model of how novel activity and consciousness updates and reconstructs the brain's neural networks at the levels of activity and experience-dependent gene expression and brain plasticity. Each of us has our private space around us. Private, personal, or as the neuroscientists now call it, "Peripersonal Space", is a highly flexible, subjective sense of space depending on the context. When another person enters our peripersonal space, which generally extends an arm's length around one's body, varying patterns of activity-dependent genes are turned on and off. Psychosocial genomics⁴ is an emerging field of epigenetics that deepens our understanding of the reach of consciousness from the cognitive-behavioral level to activity and experience-dependent gene expression and brain plasticity. This has profoundly important implications for turning on gene expression and brain plasticity – the physical growth or inhibition of neural networks of the brain - via personal relationships during the mother-child bond as well as mentoring, modeling, and education in all areas of life from work and play to business, politics and spiritual practices and rituals.

This neuroscience perspective is consistent with the Nobel Prize winning research of Eric Kandel⁶ who first described the relationship between activity-dependent gene expression and brain plasticity, memory, learning, counseling and psychotherapy as follows⁷.

"Insofar as psychotherapy or counseling is effective and produces long-term changes in behavior, it presumably does so through learning, by producing changes in gene expression, which alter the strength of synaptic connections and structural changes that alter the anatomical pattern of interconnections between nerve cells of the brain. As the resolution of brain imaging increases, it should eventually permit quantitative evaluation of the outcome of psychotherapy . . . Stated simply, the regulation of gene expression by social factors makes all bodily functions, including all functions of the brain, susceptible to social influences. These social influences will be biologically incorporated in the altered expressions of specific genes in specific nerve cells of specific regions of the brain. These socially influenced alterations are transmitted culturally. They are not incorporated in the sperm and egg and therefore are not transmitted genetically." (p. 460, italics added here.)

The value of our combining Kandel's concept of activity and experience-dependent gene expression and brain plasticity with the mirror neuron concept in figure two is that it avoids the issue of infinite regress implied in circular definitions of mind, consciousness, and brain. While this neuroscience model of the co-creation and co-evolution of the mind and brain does not entirely solve "the hard problem" of how physical molecular-genomic mechanisms give rise to subjective experiences of consciousness, it could integrate research data in new mathematical models of this philosophical conundrum. In reality, of course, there are no physical mirrors in the mind or brain. Many brain neurons, however, do respond to novel, salient, and surprising psychological experiences by turning on activity and experience-dependent gene expression and

brain plasticity to construct and reconstruct neural networks that presumably encode images, memories, words, concepts, etc. that function as the phenomenological “mirrors” or “windows” of consciousness to the inner and outer world^{5,8,9,10,11}.

We propose that this new neuroscience model bridges the “Cartesian gap” between mind and body, at least in part, by using the concept of biological information. Our current concept of biological information was originally formulated as “the dogma of molecular biology” by Watson and Crick for which they received the Nobel Prize in 1962. We expand their original dogma of molecular biology in Figure 3a to include “psychological experience” in the multi-level non-linear circular loop illustrated of bio-informatics in Figure 3b.



Figure 3a

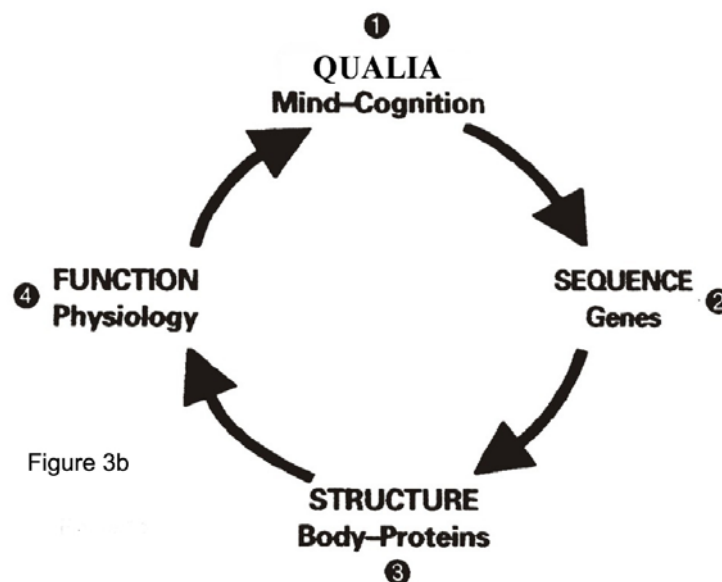


Figure 3b

Figure 3a: The Original Linear Dogma of Molecular Biology by Watson and Crick in 1953. The original Watson & Crick linear dogma of molecular biology of 1953 has no explicit role for human consciousness and psychological experience.

Figure 3b: Rossi’s multi-level circular bioinformatic model of psychosocial genomics. Note how there is an explicit role for consciousness in the activity and experience-dependent mind-gene-brain-body communication loop of psychophysiological function and development.

The original Watson and Crick dogma of molecular biology illustrated in figure 3a proposed how (1) the linear sequence of nucleotides in our genes is a code of biological information that (2) generates the 3-dimensional structure of the proteins, which (3) function as the physiological molecular machines of the brain and body. Watson and Crick were not willing to go any further in 1953 – there was no place for consciousness and psychological experience in their original dogma of molecular biology. There was no answer to the question of what makes us human. Current

neuroscience and psychosocial genomics, however, imply a new concept of Darwinian consciousness as an adaptive activity associated with experience-dependent gene expression and brain plasticity illustrated in our circular loop of mind-gene communication in figure 3b.

What Makes us Human? Consciousness is a novelty-seeking modality of heightened neural activity that drives activity and experience-dependent gene expression and brain plasticity

Recent experimental research with DNA microarrays, which now can assess the momentary activity status of an entire genome (e.g. ~ 23,000 human genes) in a single study, has identified heightened neural activity and experience-dependent gene expression as the salient features that distinguish the functioning of the human brain from that of other primates¹².

*“To investigate the genetic basis of human specializations in brain organization and cognition, we compared gene expression profiles for the cerebral cortex of humans, chimpanzees, and rhesus macaques by using several independent techniques. We identified 169 genes that exhibited expression differences between human and chimpanzee cortex, and 91 were ascribed to the human lineage by using macaques as an out group. Surprisingly, most differences between the brains of humans and non-human primates involved up-regulation, with ~90% of the genes being more highly expressed in humans. By contrast, in the comparison of human and chimpanzee heart and liver, the numbers of up- and down-regulated genes were nearly identical. *Our results indicate that the human brain displays a distinctive pattern of gene expression relative to non-human primates, with higher expression levels for many genes belonging to a wide variety of functional classes. The increased expression of these genes could provide the basis for extensive modifications of cerebral physiology and function in humans and suggests that the human brain is characterized by elevated levels of neuronal activity.*”*
(p. 13030, italics added here)

Is this, then, what makes us human on the molecular-genomic-neural level? From a neuroscience perspective human consciousness appears to be context-sensitive, highly flexible, and responsive to nuances of change. These features are consistent with research that documents how novelty¹³, along with environmental enrichment^{14a,b}, and exercise^{15a,b,c}, are the necessary and sufficient conditions for facilitating activity and experience-dependent gene expression and brain plasticity. Consciousness, behavior, novelty, gene expression, and brain plasticity are a mutually supportive complex adaptive mind-body system that now can be assessed objectively with DNA microarrays. There is now experimental evidence that it is the new neurons generated by brain plasticity throughout a lifetime that underpin new developments in the finest nuances of perception discrimination in the evolution of complex levels of consciousness^{14b}. *This leads us to view consciousness as a novelty and experience-dependent modality that evolved to facilitate rapid and creative adaptation to environments manifesting constant change. Consciousness manifests Darwinian variation and natural selection on a daily and hourly basis*⁷.

As any mother knows, a child’s attention is instantly drawn to whatever is changing, novel and interesting. Researchers showed 16 to 30-week old babies a visual slide with two bright dots that immediately caught their conscious attention⁹. With repeated showing of the same slide, however, the novelty effect wore off and the babies spent less time gazing at it. When the slide was replaced with a new one containing a slight variation in the arrangement of the dots or their color, the baby’s attention was immediately recaptured. With each repetition of the same

stimulus, however, attention again diminished. Other researchers used this same experimental methodology with infants just a few days old to show how they could distinguish between the numbers two and three. Recently the association between consciousness, change, and novelty in the auditory modality was explored in four day-old infants. Initially the babies showed great interest in random noise by sucking vigorously on a nipple. When the novelty of such noise wore-off, however, their sucking rate decreased. When researchers increased the number of syllables from two to three, the infants immediately responded with a renewed high rate of attention and sucking.

These developmental studies of consciousness and cognition in infants took place before current neuroscience research on the relationships between novelty, activity, experience-dependent gene expression, and brain plasticity. In sum these independent lines of research now have profound implications for a general philosophy of consciousness, novelty, activity-dependent gene expression and brain plasticity as a complex adaptive system that bridges the Cartesian gap between the phenomenological experiences of mind and the molecular-genomic structures of the brain and body. Extensive research with DNA microarrays is now required to understand the details of how experiences of novelty, cultural enrichment, and exercise evoke psychobiological arousal, activity-dependent gene expression, protein synthesis, and brain plasticity^{5,9,10}.

Consciousness and the Novelty-Numinosum-Neurogenesis Effect in the Humanities and the Healing Arts can be Assessed with DNA Microarrays

Consciousness and its associations with novelty, experience-dependent gene expression and brain plasticity have important implications for a new philosophy of aesthetics and the role of the creative arts and culture in facilitating the growth of the brain. Novel epigenetic interactions between the organism and the environment, which evoke experience-dependent gene expression and brain plasticity, operate via the Darwinian principles of natural variation and selection on all levels from the molecular-genetic to the subjective states of consciousness. Zeki¹⁶ has described how all forms of artistic creativity are related to the dynamics of Darwinian variation and the selection of subjective states of consciousness. This evolutionary perspective on the role of consciousness in focusing and facilitating the growth of the brain has deep implications for understanding the relatedness of many approaches to creative experience in all times and cultures. In the West, the ancient Greek concept of ekstasis, the breakthrough moment of creative consciousness, was described as the activating emotive force of a daemon (demon) driving human experience, whether we liked it or not. In the Eastern Buddhist tradition, the Zen koan was developed as a way to activate and intensely focus meditative consciousness to facilitate heightened states of arousal called “satori” or a milder “kensho.” Ritual, music, dance, drama, and story-telling in all cultures are means of focusing the alternating states of attention, arousal, and relaxation to facilitate the dynamics of curiosity and wonder that nurtures imagination and psychological transformation that now can be assessed objectively with DNA microarrays.

The German theologian, Rudolph Otto¹⁷, summarized the three human experiences of fascination, mystery, and the tremendous by coining the concept of the "numinosum" derived from Greek roots. Otto documented how the experience of the numinosum was highly characteristic of the peak moments of spiritual insight and transformation^{5,9,10}. Otto's numinous experiences are characteristic of the alternating psychobiological states of arousal and relaxation in the dynamics of creativity and the transformations of consciousness while awake, sleeping, and dreaming^{3,4}. For

the psychiatrist, Carl Jung^{18,19,20}, the experience of the numinosum became the essential driving force of human motivation in personal development and evolution.

The novelty-numinosum-neurogenesis effect has been described as the integration of novelty with the arousal/motivational aspects of the numinosum, activity and experience-dependent gene expression and neurogenesis^{5,9,10}. Experience-dependent creative experiences in the arts, cultural rituals, humanities, and sciences as well as the peak experiences of everyday life are manifestations of the novelty-numinosum-neurogenesis effect that now can be investigated objectively with DNA microarrays. When viewing awesome art or architecture, when moved by cinema, music and dance, when enchanted by drama, fantasy, fairytale, myth or poetry, we are experiencing mythopoetic transmissions of the numinosum from the life of artist to our own. In fact, we might say that the co-evolutionary function of the creative arts and sciences is to evoke experiences of novelty and the numinosum, which drive activity-dependent gene expression, brain plasticity, healing, and well being. From this perspective we may regard heightened experiences of consciousness via the novelty-numinosum-neurogenesis effect as composing or facilitating the co-creative and co-evolution of mind and brain on many levels as illustrated in figure four.

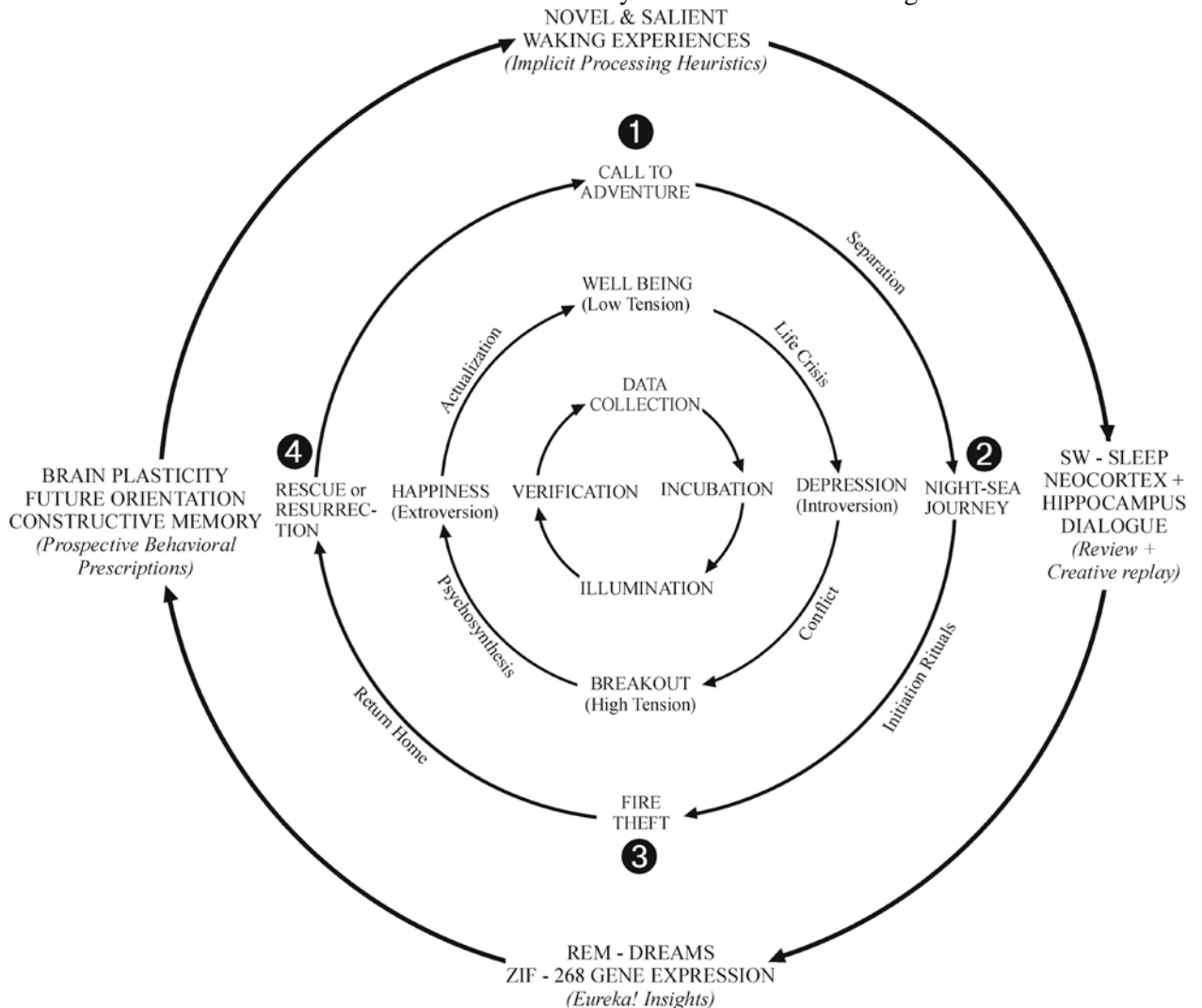


Figure 4: A mandala of Rossi's Breakout Heuristic. This mandala of Rossi's breakout heuristic integrates four levels of the co-creative cycle of mind and brain in human experience. The inner circle is the 4-stage creative cycle. The next wider circle illustrates these four stages as they are experienced in creative meditation and psychotherapy. The next wider circle illustrates

these corresponding four stages as they are described in Joseph Campbell's mono-myth of humankind. The outer circle illustrates how the activity and experience-dependent gene expression and brain plasticity cycle is the corresponding molecular-genomic mechanism underpinning all these cycles of psychosocial experience.

We hypothesize that the three psychological experiences of novelty, cultural enrichment, and exercise described by neuroscientists as turning on activity-dependent gene expression and brain plasticity, are essentially similar to the three spiritual experiences of fascination, mysteriousness, and tremendousness that Otto and others²¹ have described as the type of heightened consciousness characteristic of the founders of the world's great religions such as Buddha, Moses, Christ, and Mohammad. Such empirical and scholarly research is the empirical basis for our adding the dimension of psychological experience to Watson and Crick's linear dogma of molecular biology of figure 3a to construct the circular mind-gene-brain-body loop of psychosocial genomics in figure 3b, which illustrates how psychosocial experiences of mind, consciousness, and cognition interact with activity and experience-dependent gene expression and brain plasticity.

The most profound implication of this mind-gene-brain-body loop in figure 3b is that the heightened activities of focused consciousness and positive expectancy can evoke activity-dependent gene expression, brain plasticity, and mind-body healing in the complex computations (iterations and recursions) of personalized medicine. This implication is now well documented for the modern practices of meditation (Dusek et al.²²), therapeutic hypnosis (Lichtenberg et al.²³; Rossi et al.²⁴) and creative psychotherapy that have been objectively assessed with DNA microarrays. A recent pilot study documents how we light and brighten the lamps of human consciousness as assessed with DNA microarrays.

The Creative Psychosocial Genomic Healing Experience: A Pilot Study

In a recent pilot study we used DNA microarrays to explore the molecular-genomic basis of human resilience and resourcefulness (Rossi et al.²⁴). DNA microarrays are a tool for assessing the expression of the entire human genome (~21,329 gene probes) in a single experiment. This pilot study assessed the hypothesis that a top-down creatively oriented positive human experience could modulate experience-dependent gene expression. A DNA microarray analysis of the white blood cells of three human participants (with a total of more than 191,961 data points for statistical analysis) was performed immediately before, one hour after, and 24 hours after the administration of *The Creative Psychosocial Genomic Healing Experience*, an easy-to-learn approach to therapeutic hypnosis. We documented changes in the expression of 15 early response genes within one hour that initiated a further cascade of 77 genes 24 hours later. This proof-of-principle pilot study now requires cross validation with more participants with a variety of diagnostic classifications to document the validity, reliability, and limitations of using DNA microarrays to assess the value of our new creative psychosocial genomic therapeutic protocol for facilitating human resilience and resourcefulness.

We used Gene Set Enrichment Analysis (GSEA), the free bioinformatics software program from MIT (<http://www.broadinstitute.org/gsea/>) to assess the meaning and therapeutic implications of our findings. We documented how *The Creative Psychosocial Genomic Healing Experience* reduces (1) dysfunctional chronic inflammation and (2) oxidative stress while (3) increasing the activation of stem cells to facilitate the deep psychobiological sources of human resilience and resourcefulness. We hypothesize that such mind-gene healing factors plus others such as microRNAs to be determined by further research, defines what we call, "*The Psychosocial Genomic Healing Response*." Future research could examine these therapeutic effects directly

using novel markers of inflammation and oxidative stress such as 5'-ectonucleotidase (NT) in humans as described by Blake-Mortimer et al.^{44,45,46}. Such research documents the core of our neuroscience could eventually determine if *The Psychosocial Genomic Healing Response* could facilitate the molecular-genomic signature of human resilience and resourcefulness as well as the healing placebo. Our results are consistent with other research that documents how interventions via therapeutic hypnosis (the Ultradian Healing Response) and meditation (the Relaxation Response) reduces stress and promotes healing on the molecular-genomic level. Much of this research documents how opportunity as well as stress during important life turning points can modulate activity and experience-dependent gene expression and brain plasticity. Such research documents the core our neuroscience prolegomenon to a philosophy of the co-evolution of mind and brain: creative activities of consciousness modulate activity-dependent gene expression and brain plasticity to build a better Darwinian brain in daily life. A cartoon of the creative process will help us understand this core concept.

A Cartoon of the Co-Evolutionary Creative Process from Mind to Gene

The cartoon of figure five illustrates the 4-stage creative process of a young student proving the Pythagorean Theorem (Tomlin²⁵). Stage one is shown in the first two panels illustrating the initial experience of curiosity that starts the gears of the mind/brain turning. Stage two is illustrated in the middle panel by the metaphorical smoke coming out of his head from the inner heat of incubating intense mental activity. *We hypothesize that this heightened neural activity of consciousness stimulates activity and experience-dependent gene expression and brain plasticity, which drives the co-creative evolutionary spiral of mind and brain. We propose that the activity and experience-dependent gene expression and brain plasticity cycle is the basic molecular-genomic mechanism of the 4 stage creative process.*



Figure 5: A cartoon of the creative process. The first two panels illustrate the first stage of curiosity and engagement with problem solving. The middle panel illustrates the second stage where intense effort is required. The next panel illustrates stage three - the moment of creative enlightenment! The final panel illustrates stage four when there is a happy acknowledgement of one's creative accomplishment.

Stage three is illustrated in the panel with a flash bulb of light and *insight* as a new neural network suddenly becomes functional in human consciousness. Stage four in the last panel is something of a joke – all the previous intense activity and work of the mind-gene-brain loop finally flashes into awareness so quickly in a creative moment that the student calls it, “magic.” This magic, however, betrays a consciousness or non-verbal gap about what is actually experienced at the top of figure 6a – just before the “aha!” insight of stage three of the creative process. We propose that a “Bindu Bridge,” celebrated in Indian philosophies of enlightenment, connects this non-verbal gap integrating left and right cerebral hemispheric activity.

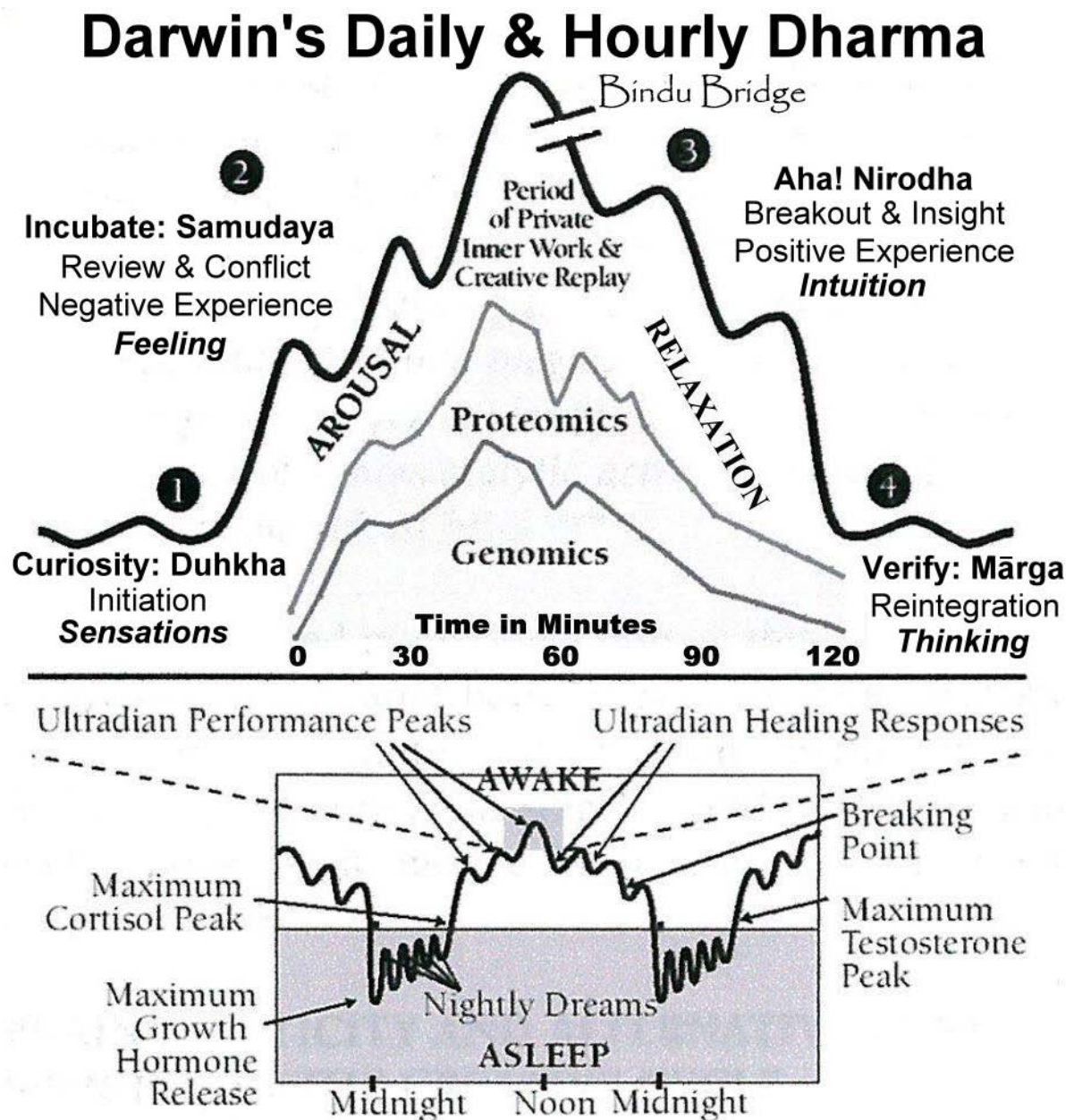


Figure 6a: A two dimensional profile of the creative process from mind to gene. This profile of the 4-stage creative process illustrates Darwin’s daily and hourly co-evolution of the human mind and brain. This creative process is a natural 90-120 minute psychobiological rhythm utilized in ancient and modern approaches to creative meditation and psychotherapy^{3,4}. Note the Bindu Bridge that facilitates the intuitive, non-verbalized, transition between stage two and stage three of

the creative process. We propose that a neuroscience perspective of these 4 stages of the creative process provides the Darwinian evolutionary molecular-genomic underpinning of Buddha's Four Noble Truths and the essential Dharma of meditation and psychotherapy.

Figure 6a is a two dimensional profile of the 4-stage creative process that relates our consciousness psychological experience to the genomic and proteomic levels^{5,9,10}. It is tempting to identify the famous philosophical Cartesian mind-body gap with the non-verbal consciousness gap frequently experienced just before stage three at the top of figure 6a. From a neuroscience perspective we speculate that the Sanskrit concept of the "*Bindu*" indicates the point at which the creation of new consciousness becomes manifest when a new neural network becomes functional in the brain. The consciousness gap has been explored with functional Magnetic Resonance Imaging (fMRI), as well as the literature on the experience of the creative process in the arts and sciences but remains poorly understood. We provide verbatim transcripts of how we utilize the *Bindu* Bridge to cross over the intuitive, non-verbal gap frequently experienced in the creation of new consciousness during meditation and psychotherapy later in this chapter.

We hypothesize that the consciousness gap that we attempt to cross over with the *Bindu* Bridge may be associated with what researchers now call, "the dark matter of the cell." This dark matter involves the non-verbalized molecular-genomic activity of non-coding RNAs in the nucleus of the cell consisting of the (1) promoters and (2) transcription factors that facilitate activity-dependent gene and brain plasticity as well as (3) the recently discovered "Human Accelerated Regions" (HAR1-49), which separated human evolution from that of our nearest primate relatives about six million years ago. The profound implications of psychosocial genomic research on HAR1 for an understanding of what makes us human is emphasized in recent research associating it with the appearance of the language and speech-enabling version of the FOXP2 gene in human evolution²⁶.

The upper part of figure 6a relates Carl Jung's four psychological functions (sensation, feeling, intuition, and thinking) as they emerge from the psychosocial genomics of the creative process in the arts, sciences, and psychotherapy as well as numinous spiritual practices. This upper portion of figure 6a outlines how many schools of mind-body healing, meditation, psychotherapy, and rehabilitation can be conceptualized as the creative utilization of one natural 90–120 minute psychobiological rhythm of arousal, inner creative work, and relaxation^{3,4}.

The lower part of figure 6a summarizes the normal circadian (about 24 hours) profile of alternating 90–120 minute rhythms of waking and sleeping characteristic of Kleitman's Basic Rest-Activity Cycle (BRAC). The ascending peaks of rapid eye movement (REM) sleep typical of our nightly dreams every 90–120 minutes or so are illustrated along with the more variable ultradian rhythms of activity, adaptation, and rest in the daytime. This lower figure also illustrates how many hormonal messenger molecules of the endocrine system such, as *growth hormone*, the activating and stress hormone *cortisol*, and the sexual hormone testosterone, has circadian peaks at different times of the 24-hour cycle. Accumulating empirical evidence^{3,4} suggests that this Basic Rest-Activity Cycle is a multi-level molecular-genomic-hormonal-neural-mental mechanism mediating Darwin's "natural selection [as] a daily and hourly scrutinizing. . .working. . .at the improvement of each organic being in relation to its organic and inorganic conditions of life."

Our basic psychosocial genomic hypothesis is that these BRAC psychobiological rhythms have been entrained and utilized to varying degrees by many ancient practices of meditation, *Patanjali yoga, pranayama, etc. Swara yoga*²⁷, for example, utilizes the 90-120 minute BRAC to facilitate three states of consciousness associated with the alternating flow (*nadi*) of the breath through the left (*ida*), right (*pingala*) nostrils, and both together (*sushumna*). We hypothesize that

these states of consciousness and many others could be explored and their psychobiological functions identified with greater precision with DNA microarrays than has ever been possible previously with the relatively crude psychophysiological measurements available to early researchers.

Likewise, after millennia of specious speculation about the “psychic organs” of the chakras in kundalini yoga²⁸, why should we not seek to measure the most ineffable states of human development with our most advanced and sensitive measurements of the human condition: DNA microarrays research of our ~ 23,000 genes and functional magnetic resonance imaging (fMRI) of our brain plasticity. The range and limitations of all ancient spiritual practices for modulating activity-dependent gene expression and brain plasticity then could be quantified with mathematical models to optimize the co-evolutionary spiral of mind and brain to facilitate the highest ideals of human enlightenment as illustrated in the evolution of information from the big bang to the present in figure 6b.

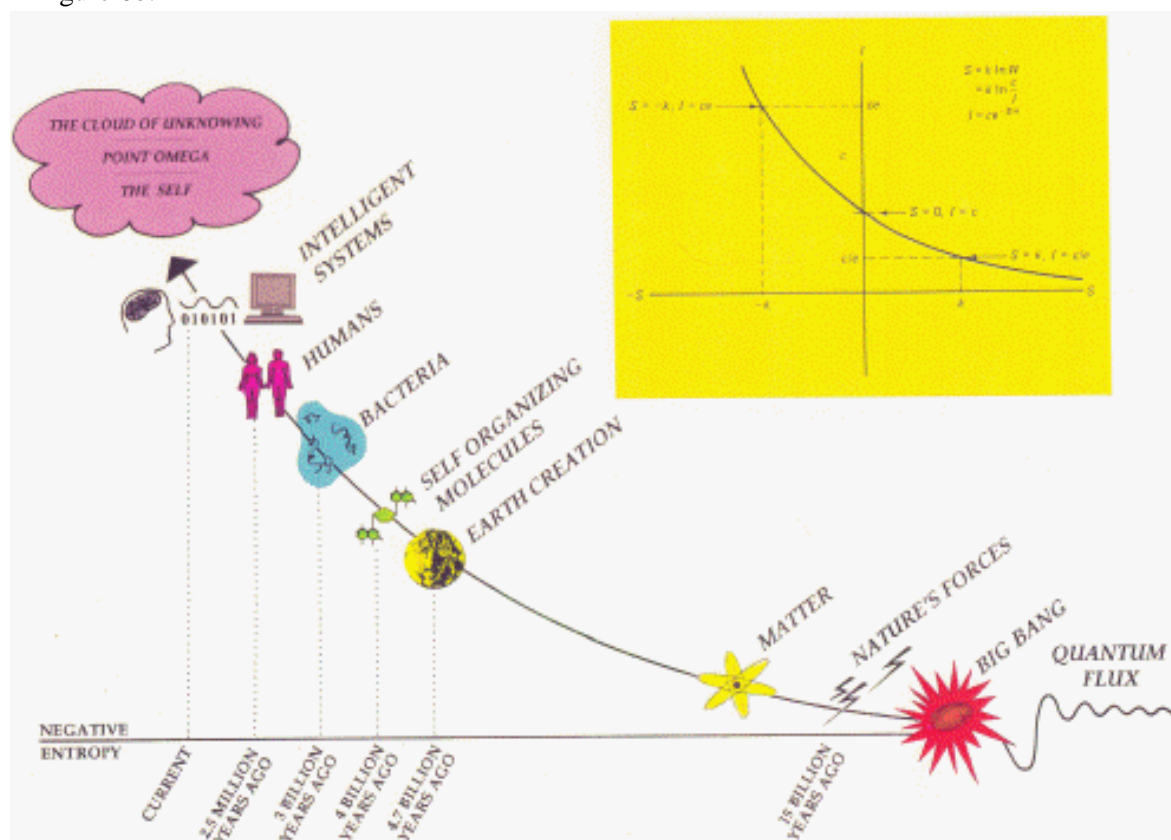


Figure 6b: Rossi’s 2D illustration of Tom Stonier’s evolution of information. The evolution of information and consciousness from the big bang 13.7 billion years ago to the present⁵. The shape of this curve illustrates the physical thermodynamics of the evolution of information and consciousness based on the concepts of Tom Stonier³⁹.

A Mathematical Model of the Co-Evolutionary Spiral of Mind and Brain

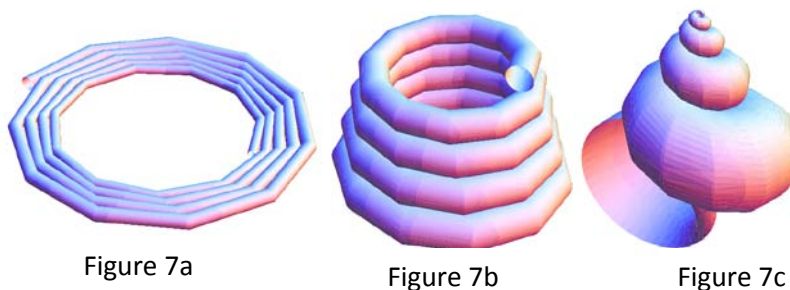
The evolutionary biologist Richard Dawkins²⁹ drew attention to the co-evolution of the mind and brain by asking what the “software of the mind” could be that co-creates the relatively rapid evolution of the “hardware of human physical brain.”

“From Lucy to Homo sapiens, brain size has approximately doubled every 1.5 million years. . . I have been looking for software innovations that might have launched a self-feeding spiral of hardware/software co-evolution to account for the inflation of the

human brain. I have so far mentioned *language, map reading, throwing and memes*. Another possibility is sex selection, which I introduced as an analogy to explain the principle of explosive co-evolution, but could it actually have driven the inflation of the human brain? Did our ancestors impress their mates by a sort of mental peacock's tail? Was larger brain hardware favored because of its ostentatious software manifestations, perhaps the ability to remember the steps of a formidably complicated ritual dance? Perhaps, many people will find language itself the most persuasive, as well as the clearest candidate for a software trigger of brain expansion. (p. 309, italics added here). "I wonder whether the ability to see analogies, the ability to express meanings in terms of symbolic resemblances to other things, may have been the crucial software advance that propelled human brain evolution over the threshold into a co-evolutionary spiral. However it began, and whatever its role in the evolution of language, we humans, uniquely among animal kind, have the poet's gift of metaphor: of noticing when things are like other things and using the relation as a fulcrum for our thoughts and feelings. This is an aspect of the gift of imagining. Perhaps this was the key software innovation that triggered our co-evolutionary spiral. Perhaps it was the step from constrained virtual reality, where the brain simulates a model of what the sense organs are telling it, to unconstrained virtual reality, in which the brain simulates things that are not actually there at the time — imagination, daydreaming, 'what if?' calculations about hypothetical futures." (p. 311-312)

Dawkins' speculation about the *software of the mind* (the qualia of sensations cognitions, emotions, and cognitions such as language, analogies, dramas, emotions, insights, memes, metaphors, rituals, etc.) that drives the co-evolutionary selection and growth of the *hardware of human brain* (genes, RNA molecules, enzymes, proteins, neuro-hormones, neuro-transmitters, neurons and neural networks, etc.) has garnered serious consideration even though he provides no empirical proof or ideas of what such proof might consist of on the molecular-genomic level. We have proposed the "*Novelty-Numinosum-Neurogenesis Effect*" (NNNE) as an evolutionary epigenetic bridge over the Cartesian mind-body gap that turns on activity-dependent gene expression and brain plasticity to drive the mind-brain co-evolutionary spiral^{5,9,10}. Our approach embraces the apparently opposite models of Dawkins' *The Selfish Gene*³⁰ as well as Roughgarden's *The Genial Gene*³¹.

Figures 7a, 7b, & 7c illustrates a three dimensional mathematical model of the co-evolutionary spiral between the software of the mind and the hardware of the brain.



Figures 7a, 7b, & 7c: 3D Mathematical Model of the Co-Evolution of the Mind and Brain. Three dimensional mathematical models of the co-creation and co-evolution of mind and brain. 7a illustrates the organic growth of the physical brain as a concentric cycle on one level only with no elevating assistance from mind and consciousness. 7b illustrates a middle stage of the co-

evolutionary spiral of mind and brain. 7c illustrates a more mature stage in the co-evolution of mind and brain with the increasing the height of the spire provided by activity and experience-dependent gene expression and brain plasticity. (Adapted with permission from the software *Mathematica7*: <http://demonstrations.wolfram.com/ShellSpaceTheSnuggnessCondition>.)

We propose that the dynamics (cognition and energy) of the opposites that drives this co-evolutionary spiral between mind and brain over millions of years is also operative in the Darwinian daily and hourly co-creative selection between the psychological experiences of the opposites in daily life. Jung³² helps us build this bridge for the creative resolution of the opposites as follows.

“Since an energetic current necessarily presupposes the existence of opposition, i.e. of two states of differing potential, without which no current can take place, the concept of opposition is also associated with the energy concept. Every energetic phenomenon (and there are no phenomena that are not energetic) manifests both beginning and end, upper and lower, hot and cold, earlier and later, cause and effect, etc., pairs of opposites. This inseparably of the energy concept from the concept of opposition also involves the libido-concept. Hence libido symbols of a mythological or philosophical-speculative character are either represented by a direct antithesis or become immediately broken up into opposites. . . We also find this association in the Brahman concept of symbol. The character of Brahman as prayer, and at the same time as primordial creative force, the latter being resolved into the opposition of sexes, is very remarkably presented in a hymn of Rigveda (p. 251) . . . In the foregoing passages from Indian sources we have *followed the development of the redeeming principle from the pair of opposites*, and have traced the origin of the pairs of opposites to the same creative principle, thereby gaining an insight into a law-determined psychological occurrence which is found to be easily reconcilable with the concepts of our modern psychology.” (Jung³², p. 257, italics added)

Our mirroring hand protocol is a new activity-dependent approach to the Jung’s “redeeming principle from the pair of opposites” for mediating between destructive conflicts between the opposites, which we demonstrate with two cases in the next section. Further research with the DNA microarray evaluation of psychological experiences such as dreaming³³, meditation²², therapeutic hypnosis^{23,24} and creative psychotherapy²⁴ is the kind of empirical assessment that could differentiate the relative contributions of Jung’s energetic dynamics between the opposites and Dawkins’ other phenotypic psychosocial candidates for the co-evolutionary spiral of mind and the human brain as modeled in figures 7a, 7b, & 7c. Meanwhile, this co-creative spiral between mind and brain can be investigated with careful phenomenological reports of how it is actually experienced during our integrative non-dualistic mirroring hand protocol for facilitating creative psychotherapy.

An Integrative Non-Dualistic Mirroring Hand Protocol for Creative Meditation and Psychotherapy

Current neuroscience research recognizes the non-verbal consciousness gap between stages two and three of the creative process and calls it, “Intuition.” Dual-process theories of cognition distinguish between intuition (fast, emotional, non-verbal) and classical reasoning (slow, controlled, verbal) as the basis of human decision making intuition and deliberation³⁴. An integrative non-dualistic facilitation of the creative process in creative psychotherapy, which

integrates both intuition and classical reasoning, is documented here and presented in greater detail elsewhere^{5,9,10,35,40,41}.

A modern mathematical mandala based on Galois Group Theory³⁶ that complements the traditional visualization of ancient mandalas in the non-dualistic philosophy of Taoism and Buddhism and is illustrated in figure eight.

Axioms of Galois Group Theory Re-Visioned as a Math Mandala

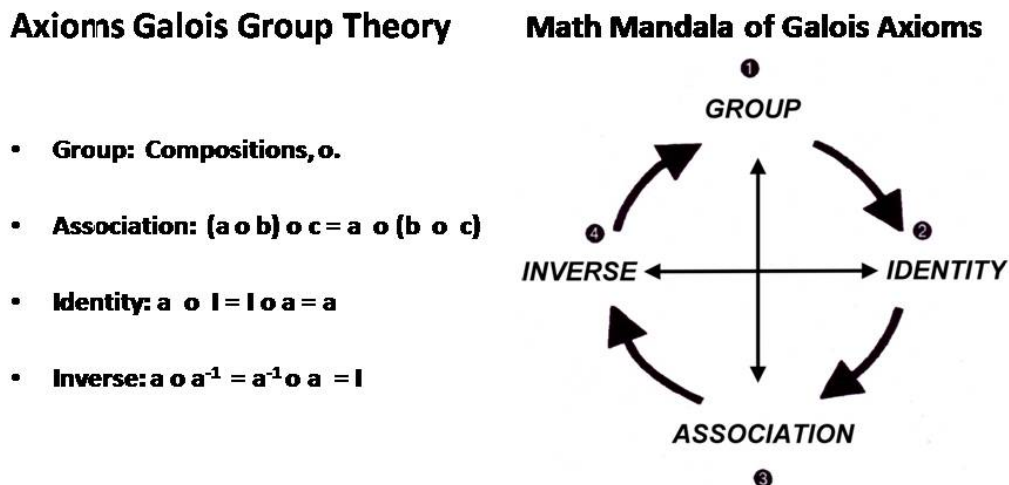


Figure 8: Rossi’s math model of Galois Group Theory. Our mathematical mandala illustrates the axioms and dynamics of Galois Group Theory as “the supreme art of mathematical abstraction”³⁷. We propose that the daily and hourly co-creative dialogues between the opposites of identity and its inverse turn on activity and experience-dependent gene expression and brain plasticity to facilitate consciousness via the co-creation of mind and brain in creative meditation and psychotherapy.

The four basic axioms of Galois Group Theory presented in figure eight are used in understanding the solutions of equations in higher mathematics in a manner somewhat analogous to Euclid’s original five axioms in proving the theorems of geometry³⁷. We propose that the linear list of Galois axioms in the left-hand column of figure eight can be re-visioned as a circular dynamic mathematical mandala in the right-hand column corresponding to Tibetan non-dualistic visualization meditation practices. We generalize our mathematical mandala to compose or integrate many of the inverse *psycho-analytic* (Freudian) and *psycho-synthetic* (Jungian) functions of meditation and psychotherapy to facilitate the “transcendent function” (composing or bridging the conscious and unconscious) for resolving the “*problem of the opposites*” during stressful mental experience.

The profound economy and philosophical generality of Galois Group Theory is evident in the four axioms, which can symbolize any association, relationship, or “*composition*” (symbolized by the small circle \circ) ranging from (1) the elementary inverse operations such as “*plus \circ minus, multiply \circ divide etc.*” in arithmetic to (2) inverse spatial and topological operations such as “*before \circ after, above \circ below, inside \circ outside*” to (3) our proposed biological inverses such as “*Selfish gene \circ Genial gene, genotype \circ phenotype, masculine \circ feminine, oxidation \circ reduction*”

to (4) the psychological inverses between opposites such as “*extraversion o introversion, conscious o unconscious, depressed o elated, problem o solution, war o peace, numinous o boring*” and (5) the ancient dualisms of Taoism such as “*heaven o earth, good o evil,*” as well as modern philosophy such as “*thesis o antithesis, etc.*” Composing, reconciling or resolving the dueling opposites with Socratic or Hegelian dialogues (*thesis o antithesis = synthesis*) experienced as *thinking o intuitive* psychodramas with our mirroring hands protocol is a non-dualistic way of facilitating the 4-stage creative process in the arts and sciences as well as creative meditation and psychotherapy. We illustrate this integrative non-dualistic approach with the following two examples.

Example One: An American woman from a traditional culture

An American woman raised as a child in a traditional culture presents a dream about being back in her home country. She does not recall any previous dreams about returning to her native country and she has no understanding of this dream. She wonders, however, if it could be related in some way to the emotional divorce she now feels in her marriage with her very conservative and traditional husband.

Dream: I am back in my home country that I left soon after I was married as a young woman. But I am my present age in this dream. I wear the traditional dress of my native country and I try to blend in with the general population there. But it does not work. Everyone around me recognizes that I am really a foreigner and they do not accept me anymore.

Stage I: Induction, Focusing Attention, Curiosity, and Positive Expectancy

1:20 pm. *The therapist models the mirroring hands protocol with the palms of his hands about 6 to 8 inches apart facing each other at chest level. The hands in this initial position function as a metaphor for a safe inner space or container within which she can experience a creative dialogue between her symptoms or problem projected into one hand and the “opposite” in the other hand (presumably her inner resources accumulated from positive previous life experiences, memory, learning, etc.). We propose that the intense motivational numinosity of this creative dialogue evokes the psychosocial genomics of activity and experience-dependent gene expression and brain plasticity evolving within her dream. The therapist asks about what aspects of her dream she can experience in one hand or the other.*

This mirroring hands protocol is an application of our neuroscience model for facilitating the developmental co-creative dialogue of her dream, which will generate gene expression and brain plasticity. She initially makes a few exploratory but constrained, tentative hand movements and then closes her eyes spontaneously. *Note that the therapist does not tell her to close her eyes!* The spontaneous eye closure at this point is a minimal behavioral signal that she is entering an “altered state” of focused attention and expectancy characteristic of “the general waking trance”³⁸. To tell her to close her eyes merely would evoke superficial compliance rather than evoking the creative state of focused attention and expectancy characteristic of creative meditation and the transformation of consciousness initiated by the mirroring hands protocol.

Stage 2: Incubation, Facilitating Creative Inner Dialogues of the Opposites

After a few more moments she murmurs that her left hand seems to be moving upward like the Statue of Liberty holding the torch of her dream aloft somehow. *The therapist now asks what she feels in the other hand that is the opposite of the dream. This initiates stage two of the creative process where a focus on the Galois Group Inverse (illustrated in figure eight). This tends to constellate the problem of the opposites between one hand, which contains her experience*

(projection) of the dream, and her other hand into which she will experience (project) the opposite of the dream.

Focusing her consciousness on this tension between the opposites tends to initiate and facilitate a search for her inner resources that may activate the molecular-genomic sources of activity-dependent gene expression and brain plasticity for creative problem solving. Our clinical experience suggests the mirroring hands protocol can initiate therapeutic transformations of consciousness via Plato's eidos ("in-form-ation"), Galois's mathematical group dynamics, Socratic dialogue, Hegel's dialectical method of the thesis-antithesis-synthesis triad, Freud's antithetical meaning of primal words and impulses that is a source of psychological conflict and the mental mechanisms of defense, and Jung's transcendent function for resolving the psychological problem of the opposites.

After a thoughtful pause with much wrinkling of her forehead in an apparently puzzled manner, she whispers that she does not know what's in the other hand – she experiences only distracting comments or static about her dream similar to the confusing noise of many voices as when changing a radio station.

The therapist comments, *"Wonderful, I wonder what kind of a psychological drama you will now experience between those two hands as you allow the dream to creatively replay itself in your mind in new ways - even with all that distracting noise?"*

1:31 pm. After a few moments of silence during which her hands engage in symbolic movements suggesting some sort of private inner psychodrama, tears slowly begin to brim out of her closed eyes and trickle down her cheeks. Her entire face now seems to crumble softly into a painful grimace of profound sadness. [Such tears are typical of *stage two of the creative process when the emotional conflict and stress of a loss of psychosocial coherence* are frequently experienced.]

The therapist murmurs soft comments of support: "Only you can have the courage to experience the simple truth that only you can possibly know." After a few more minutes her left hand lifts very slowly as if holding the dream firmly and exhibiting it to the entire world while her right hand of static and confusing voices drops limply to her lap.

The therapist comments, *"You can enjoy an opportunity to explore the whole drama of your life and marriage privately within yourself. You can share an appropriate sentence or two of what you are experiencing if you wish, but only what I need to hear to help you further."* [Preserving the client's privacy at this point is extremely important for permitting a more total immersion into the experience of active imagination and problem solving without the distracting concern about having to convert her non-verbal ineffable emotions and intuitive inner states into words and cognitions for the therapist.

Stage 3: Illumination, A flash of Intuitive Insight and Self Realization!

1:46 pm. After a period with nervous twitches of her closed eyelids and facial movements indicative of her painfully difficult experience of an inner drama her tears gradually dry up. Tears drying up suggest she is safely passing through the crisis and the delicate transition from stage two to stage three of creative process profiled in figures five and six. People are usually silent for a moment at this point when they experience an initial sense of awe – the flash of an intuitive non-verbal essence of insight that is labeled as the *"Bindu Bridge"* in figure 6a. ("Whereof one cannot speak, thereof one must be silent." - Ludwig Wittgenstein) This is the creative moment during which we hypothesize new synapses are coming on line as they spontaneously reorganize themselves into new neural networks that are becoming the molecular-genomic basis of new

awareness and states of consciousness. Almost imperceptibly her face begins to exhibit subtle shifts back to normal awareness and regains its normal features as she pulls herself together.

1:48 pm. The therapist wonders, “Is her face actually beginning to manifest happiness and serenity with a slowly emerging smile?” She is now holding up the dream in her left hand like the statue of liberty firmly holding a torch of freedom aloft for the entire world to see. This is the culmination of stage three of the 4-stage creative process wherein she experiences an aha!, surprise, joy, and satisfaction about her new and unexpected insight – the synthesis stage of Hegel’s thesis-antithesis-synthesis triad.

1:50 pm. She stretches a bit, blinks, smiles slightly, opens her eyes, and laughs softly to herself. She now interlaces the fingers of both hands firmly together (as in a prayer position) and rests them in her lap. She comments shyly that her hands look like yin and yang together.

The therapist gives her a look of inquiry. She smiles more broadly and then in quick succession says, “Look at me! I feel full of life! This is the real me!” This appears to be a full expression of *stage three, the illumination or “aha!” of her intuitive, creative experience.* The sudden alacrity of her voice reveals a dramatic breakout of her *introverted attitude to an opposite extraverted attitude - the inverse in the mathematical mandala illustrated in figure eight.*

Stage 4: Verification, Identifying and Reifying a Therapeutic Breakthrough

The therapist asks how old she feels she is – when was the time in her life when she felt as good as this? This very important request for a creative replay of her positive real life experiences is an implicit processing heuristic⁴¹, a type of permissive suggestion that may facilitate activity-dependent gene expression and brain plasticity. This heuristic is the Bindu Bridge she needs to support, extend, and reify her inner resources from the past (e.g. her best and most successful life experiences, identity and self concepts, skills, personality assets, etc.), which she could now utilize for current and future problem solving. Clinical experience and research indicates that this utilization of real positive life experiences is more effective than artificial suggestions for ego strength and superficial positive thinking^{5,8,9,10,24,40,41,42,43}. Without hesitation she begins to recall a period in adolescence when she began “talking too much” in her traditional home society and “was headed for trouble” with her bursts of self-assertive, extraverted behavior. She also recalls moments in her twenties and some of the good times in the early days of her marriage before her husband became “professional and traditional.”

1:52 pm. *The therapist wonders aloud how she can now use these positive real life experiences to develop a better relationship with her husband for improving their marriage.* With some fresh enthusiasm she begins to hatch a plan to liberate the teen, twenty, and thirty year old woman within her to give her relationship with her husband “another chance to shape up.” This playful creative replay of her real inner resources and resilience during *stage four of the creative process* helps her reintegrate the best of her courageous younger self to help her work through the difficult life transitions of her current marriage.

Example Two: A male rebel with too many causes

A second example of the non-dualistic facilitation of creative psychotherapy occurred with a male in his late fifties. He presented himself as “a pretty smart guy” who, however, had again lost his job because of his constant contending with “the bureaucracies and the powers that be until they finally threw me out.” On his own initiative he wrote this account of the consciousness gap in his very successful experience of the creative process in psychotherapy.

“I felt more alive after the session today. The session was with Rossi’s mirroring two hand technique where I stared at both hands held in front of me. Today I was working on anxiety, worry and ruminations about my lack of income, money and sexual concerns in my long term

relationship with my girlfriend - which was represented by my left hand. Peace, self-acceptance, 'circle-of-life', order within chaos, 'all's right with the world' - was represented by the right hand. After 5 -10 minutes of staring at my hands, they gradually fell into my lap, with the left hand below the right hand. They settled down nicely in my lap as the feeling of comfort and relaxation came over me during 10-15 minutes of a closed eyes trance state.

When I slowly opened my eyes, there was a feeling of safety and relaxation that I rarely ever felt during hour long meditations that I've participated in at various Buddhist centers for over 20 years, usually once per week for an hour. Clearly, my unconscious mind had resolved some fears and obsessions which the conscious mind was unable to accomplish. The amazing part of this therapeutic process was that Dr. Rossi simply observed me and said nothing while I processed this experience on an unconscious level."

This patient's final sentence is very significant. It clearly indicates how this man was so deeply involved in his own inner experience that he needed no guided imagery, commentary, or supportive remarks from the therapist once the creative process was successfully engaged. The entire burden of responsibility for effective psychotherapy was carried by the patient's own creative integration of intuition and thinking. Therapists are ever alert to support patients emotionally when they need it. This is particularly important during the difficult transition between stage two and three of the creative process when some people experience a mild "crisis" illustrated in figure 6a. The client's temporary confusion, uncertainty, and mild crisis at the peak of the 'Period of Private Inner Work & Creative Replay' in figure 6a is an indication that the patient and therapist dialogue is something more than 'talk therapy:' the typical cognitive-behavioral dialogue entirely on the phenomenological level as described by most contemporary accounts of psychotherapy. We propose that people may experience genuine transformations of consciousness and behavior via intuitive, non-verbal processes that engage activity and experience-dependent gene expression and brain plasticity. These intuitive, non-verbal dynamics, which gave rise to this man's "alive feeling" during his experience of healing and self transformation, appear to transcend the limitations of the typical cognitive-behavioral approaches of many western schools of counseling and psychotherapy.

Summary: What Makes Us Human?

This chapter reviews a selection of scholarly studies and neuroscience research that have important implications for a philosophy of evolution.

- Charles Darwin suggested that evolution is a daily and hourly process, which we now propose is manifest in the multi-level molecular-genomic-neural-consciousness dynamics of the 90-120 minute basic activity-rest cycle of mind and brain.
- Mirror neurons match and synchronize the brain states and experiences of the observer with the observed, which are the neurobiological basis of empathy, social relationships, and ethics.
- Consciousness is a novelty-seeking modality that drives activity and experience-dependent gene expression and brain plasticity, which now can be objectively explored and measured with DNA microarrays for assessing creative meditation, therapeutic hypnosis, psychotherapy, and the quality of life and for building a better brain in daily life.
- Art, beauty, and truth are experiences of heightened neural activation that turn on activity and experience-dependent gene expression and brain plasticity that have important implications for the philosophy of aesthetics, consciousness, ethics, and epistemology.

- The range and limitations of ancient yoga practices for modulating activity and experience-dependent gene expression and brain plasticity can now be quantified with mathematical models to optimize the co-creative spiral of mind and brain to facilitate the highest ideals of consciousness and human enlightenment over a single lifetime.
- A two dimensional mathematical mandala of Galois Group theory, which encodes the *co-creative evolutionary spiral of mind-brain-gene developmental over a single lifetime*, complements the traditional visualization of meditation mandalas of many ancient cultures. We review research indicating how this co-creative process of memory, learning, REM dreaming, meditation and psychotherapy can be facilitated with our non-dualistic mirroring hands protocols.
- The “software of the mind” and the “hardware of the brain” have been engaged in a *co-evolutionary spiral that made us human daily and hourly over millions of years of Darwinian evolution*. Three dimensional mathematical models that could quantify this co-evolutionary spiral of mind and brain are now open for further empirical investigation.
- Since time immemorial the quest of Indian philosophy has been to facilitate the co-creation and co-evolution of human consciousness as the highest manifestation of the bodhisattva ideal. Current neuroscience and psychosocial genomic research suggests we can significantly advance this quest of what makes us human with creative meditation, therapeutic hypnosis, and psychotherapy that evoke activity and experience-dependent gene expression and brain plasticity.
- The activity and experience-dependent gene expression and brain plasticity cycle is the basic evolutionary molecular-genomic mechanism of the 4 stage creative process and Buddha’s Four Noble Truths as the essential dharma of meditation and psychotherapy.

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