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ART BEAUTY and TRUTH

The Psychosocial Genomics of Consciousness, Dreams, and
Brain Growth in Psychotherapy and Mind-Body Healing

ABSTRACT

Art, beauty, and truth are essential human experiences in a new Psychosocial Genomic theory of how gene expression, brain plasticity, and rehabilitation can be facilitated by novelty, enrichment, and exercise in psychotherapy. Although we can cite many scholarly sources from the history of war and peace, the humanities, and psychoanalytic traditions, spiritual practices that are consistent with this new mind-body perspective on the construction and reconstruction of memory, learning, and social dynamics require more careful experimental confirmation. The DNA gene chip technology able to measure the initiation of gene expression and brain plasticity in response to the creative replay of the novelty-numinosum-neurogenesis effect within the typical time frame of a single session of psychotherapy now exists and needs support from the psychotherapeutic community.



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*"Beauty is truth, truth beauty,—
That is all ye know on earth, and
all ye need to know." —John Keats,
Ode on a Grecian Urn*

Eric Kandel (1998), a 2000 Nobel Laureate in physiology and medicine, sounded the clarion call of what I now conceptualize as the new discipline of psychosocial genomics as the foundation of mind-body psychotherapy with these words:

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 that alters 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.140, italics added).



It is rather surprising for most of us to learn that ordinary aspects of everyday life such as waking, sleeping, dreaming, working, playing, learning, relaxation, memory, stress, conflict, health, and illness are all associated with uniquely individual patterns of gene expression. Many of our genes are active players responding adaptively, cooperatively, and creatively to the cues, challenges, and contingencies of our ever-changing daily experience. Biologist and science writer Matt Ridley (1999) describes how our thoughts, emotions, behavior, and apparent free will are associated with modulations of gene expression in private experiences and social life.

It is time to put the organism back together again. It is time to visit a much more social gene, a

gene whose whole function is to integrate some of the many different functions of the body, and a gene whose existence gives life to the mind-body dualism that plagues our mental image of the human person. The brain, the body, and the genome are locked, all three, in a dance. The genome is as much under the control of the other two as they are controlled by it. That is partly why genetic determinism is a myth. The switching on and off of human genes can be influenced by conscious or unconscious external action (p.148). ... genes need to be switched on, and external events—or free-willed behavior—can switch on genes (p.153). ... Social influences upon behavior work through the switching on and off of genes (p.172). ... The psychological precedes the physical. The mind drives the body, which drives the genome" (p.157).

Psychosocial genomics is a new perspective on the role of genes as active players in psychological experience. Psychosocial genomics focuses on how the highly personal and subjective states of human consciousness can modulate gene expression in the brain and body for illness or health (Rossi, 2002, 2004a). This article illustrates a practical approach to this new psychosocial genomic perspective in psychotherapy by examining two dreams that I had while in the process of rehabilitating after having a stroke (Rossi, 2004b).

Creatively Replaying the Psychosocial Genomic Sources of Healing (Third week of rehabilitation.)

A neurologist filling out a routine medical form asked me if my stroke had resulted in a loss of physical strength so that I could no longer do



my job. I grimly grinned at him, squared my shoulders a bit, and humorously responded with my stroke-slurred speech, “Well, I’m not exhashly (slur for exactly) an iron foundry worker you know.” That night I had this dream:

A huge Paul Bunyan-type man in the hellish glow of an iron foundry is using gigantic iron pliers and tongs to manipulate small metal objects. He is going to teach me how to do it skillfully. I am experiencing great awe that he notices me, and I feel very grateful about the prospect of his help.

I viewed this figure from my dream to be analogous to my occupational therapist who was assessing and facilitating recovery of my damaged hand-eye and muscle coordination by giving me many tasks involving puzzles, picking up small metal objects with tweezers, etc. I told my occupational therapist about this

dream and explained my psychosocial genomic perspective on it: The Paul Bunyan figure is a metaphor of an inner implicit healing process operating via *activity-dependent* gene expression that is turning on *activity-dependent* brain plasticity (the growth of new synapses and neurons) that I hope are now being *behaviorally activated* by all this occupational therapy to repair my brain. The occupational therapist had never heard of this new neuroscience view of rehabilitation, but I assured him that my new book was coming out soon so he could read about it (Rossi, 2002). I was too exhausted mentally and physically to try to explain it all at that moment.

As I continued to *emotionally replay* this dream in my active imagination throughout the day, the Paul Bunyan figure from my dream became somewhat evocative of Mr. Spock of *Star Trek* fame. The figure appeared to be Chinese blood-red-orange, with a thunderous body stretching from the center of

the earth to the sky. He had huge, massive muscles and an impassive demeanor. He did not speak and he hardly noticed me, but I became fascinated with the possibility that he actually was a genial gene: ready, available, and fully capable of firing the sources of life should he be called.

After a week or so of watching the figure from my dream do nothing but stand there silently poised with his huge iron tools, the figure finally became activated in my imagination. One morning I woke with grateful tears after dreaming that I saw him pounding a huge glowing gold ingot on a mighty anvil with flashing lightning leaping about with every stroke. I gained reassurance as I witnessed the figure’s continuous methodical pounding whenever I called him forth in my creative imagination. On one level this was an awesome experience—a drama that I felt to be deeply healing. Simultaneously, on another level, I recognized with calm objectivity *that this positive emotion was good for me, so I tried to replay it as long as I could.* This inner drama wherein I was both healer and the healed reminded me of Milton H. Erickson’s emphasis on the value of such multi-level states in psychological development and healing (Rossi, 2004b). Does this healing dream and emotionally heightened imagination mean that my rehabilitation will be facilitated by my being *actively and intensely engaged in the real and imaginative replay of exercises* like manipulating the tongs as illustrated with the Paul Bunyan/Spock figure from my dream?

Ironically, this was the essence of my recent book (Rossi, 2002), which was completed a few months before my stroke occurred. Therein I discuss many examples of the psychobiology of mind-body healing and rehabilitation *via activity-dependent gene expression.* Neuroscience research is now documenting how facilitating gene expression and *brain plasticity* (involving *synaptogenesis* as well as *neurogenesis* by stem cell

differentiation and maturation in the brain) via *activity-dependent cognitive-emotional-behavioral experiences* is a basic mechanism of molecular healing that makes rehabilitation possible. Patients with severe trauma resulting in loss or paralysis of sensory-motor functions due to physical injury, cardio-vascular accidents, extreme psychological trauma, and chronic stress, for example, can recover their abilities via occupational therapy and counseling, which works primarily by *activating their behavior*. Until recently, this molecular-genomic mechanism of rehabilitative healing by behavioral activation was not understood. The new neuroscience hypothesis is that cognition and behavioral action initiates activity-dependent gene expression. This activity-dependent gene expression initiates healing by the generation of proteins that facilitate brain plasticity and stem cell differentiation into new tissues that can be initiated within minutes and continue for the hours, days, and weeks required for full rehabilitation. Cohen-Cory (2002) describes this process as follows.

In the CNS [central nervous system], as with the NMJ [neuromuscular junction], a developmental, activity-dependent remodeling of synaptic circuits takes place by a process that may involve the selective stabilization of coactive inputs and the elimination of inputs with uncorrelated activity. The anatomical refinement of synaptic circuits occurs at the level of individual axons and dendrites by a dynamic process that involves rapid elimination of synapses. As axons branch and remodel, synapses form and dismantle with synapse elimination occurring rapidly, in less than two hours. ... hippocampal neurons in which glutamate receptor function was altered demonstrated that synapse disassembly in the CNS occurs rapidly, within 1.5 hours after synapses are no longer functional (p. 771). ... Studies investigating the

effects of long-term synaptic plasticity have generally used experimental paradigms in which repetitive, high-frequency stimulation gives rise to synaptic potentiation [called long-term potentiation, LTP] that is accompanied by structural and molecular changes at the level of single synapses (p. 773, italics added).

Other researchers have vividly illustrated how the number of synapses can double during the growth process of *synaptogenesis* over a period of one hour. *This implies that the dynamics of gene expression and brain plasticity can be initiated within the time frame of a typical psychotherapy session.* In addition, it has been documented that the timeframe of *neurogenesis*, the growth and development of new neurons from stem cells in the adult human brain, requires about a month or two, precisely the timeframe many psychotherapists recommend for short-term psychotherapy (Rossi, 2002, 2004a). We do not yet know the full range and limitations of this new neuroscience approach to psychotherapy, mind-body healing, and rehabilitation. Bentivoglio and Grassi-Zucconi (1999), for example, ask questions about immediate-early genes (IEGs) that are fundamental for the psychosocial genomics of consciousness.

IEG induction [within minutes] may reveal the activation of neural networks in different behavioral states. Although stimulating, these findings leave unanswered a number of questions. *Do the areas in which IEGs oscillate during sleep and wake sub-serve specific roles in the regulation of these physiological states and in a general 'resetting' of behavioral states?* Is gene induction a clue to understanding the alternation of sleep and wake, and REM and non-REM sleep? ... Could behavioral state-related IEG induction underlie, at least in part, learning mechanisms? The oscillation of IEGs effects the expression of target genes, and thus brings about other questions: May the transcriptional cascade explain the biological need

and the significance of sleep? *Does this explain the molecular and cellular correlates of arousal, alertness, and, more in general, of consciousness?* (p. 249, italics added).

Whitney et al. (2003) recently documented how individuality and variation in gene expression patterns in human blood throughout the day and night can be assessed with DNA microarray (gene chip) technology to investigate these questions about varying states of consciousness.

The extent, nature, and sources of variation in gene expression among healthy individuals are a fundamental, yet largely unexplored, aspect of human biology. *Future investigations of human gene expression programs associated with disease, and their potential application to the detection and diagnosis, will depend upon an understanding of normal variation within and between individuals, over time, and with age, gender, and other aspects of the human condition (p.1896, italics added).*

These DNA microarrays (often called "gene chips") could be used as a more sensitive, comprehensive, and reliable measure of consciousness and varying psychological states as well as brain plasticity and mind-body healing as an emerging psychosocial genomic data base for psychotherapy.

A Dream of Numinous Beauty and Clarity

(Fourth week of rehabilitation.)

Dream: I enjoy the numinous beauty and wonderment of looking through a new clear crystal cover on our swim spa, seeing the delightful light blue, clean water in the sparkling sunlight.

We actually did not have such a new crystal cover over our swim spa, but evidently this dream was a metaphor for some sunlight clarity coming into the waters of my brain. A battery of psychological tests administered to me at this time told the story of my mental status in a stark manner. The good news was

that my abstract reasoning was still at the 99th percentile level and my capacity for mental organization was at the 97th percentile. The bad news was that I was way below normal in perception and discrimination, at the 45th percentile level, and even worse was my short-term memory, which was down to the 37th percentile.

I spent many afternoons sitting entranced in the sunlight gazing into the clear crystal water of our swim spa with a deep spiritual hunger to drink it all in somehow to assuage my still-stunned brain. For the longest time I found myself struggling to recall the words of the poem *Vacillation*, by Yeats, which I once knew so well.

My fiftieth year has come and gone,
I sat, a solitary man,
In a crowded London shop,
An open book and empty cup
On the marble table-top.

While on the shop and street I gazed
My body of a sudden blazed;
And twenty minutes more or less
It seemed, so great my happiness,
That I was blessed and could bless.

As I repeatedly replayed this dream in my active imagination while struggling to recall wisps of poetry throughout the day and for many days, it finally dawned on me that my hunger and preoccupation with the numinous experience of crystal clarity may be an example of what I call the “novelty-numinosum-neurogenesis effect.” *The heightened creative psychological experience of numinous beauty, wonderment, and crystal clarity may correspond to the activation of gene expression and brain plasticity to facilitate the healing of my perception and discrimination*, which at the time was way below par at the 45th percentile level. I mused over the similarity of the three psychological qualities characteristic of the numinosum (*fascination, mysterious-*

ness, and tremendousness) in spiritual development described by Rudolph Otto (1923/1950) and the three facets of *novelty, environmental enrichment, and physical exercise* that neuroscience now finds characteristic of the development of consciousness (memory, learning, etc.) via activity-dependent gene expression and brain plasticity to build a better brain in daily life.

After replaying the numinous beauty of this dream for several weeks, I had a particularly vivid experience of it, an epiphany of sorts, while listening to a live performance of The Russian National Orchestra’s rendition of Mussorgsky’s “Pictures at an Exhibition.” The program notes quoted Mussorgsky’s description of his creative fervor while composing this piece: “Ideas, melodies, come to me of their own accord. ... I gorge and overeat myself. I can hardly manage to put it all down on paper fast enough.” Likewise, while listening to this performance, I had a similar experience by recognizing how music, art, poetry, philosophy, and science all come together as one in a new theory of aesthetics: *the numinous experience of beauty could generate gene expression, neurogenesis, and the actual reconstruction of the brain during creative moments described by John Keats as the equivalence of beauty and truth*. At this moment all these connections seem to be an astonishing reification of Carl Jung’s (1916/1960) concept of “The psychological ‘transcendent function’ [that] arises from a union of conscious and unconscious contents as well as the real and imaginary” (p. 69).

Was my repeated replaying of the numinous beauty and clarity of this dream a *novel, enriching exercise* that could facilitate the healing of my brain so that my perception and discrimination would really improve? Can the numinous and creative experiences of the mind really facilitate gene expression and brain plasticity in this way? It is now known, for example, that when experi-

mental animals experience novelty, environmental enrichment, and physical exercise, the *zif-268* gene is expressed during their rapid eye movement (REM) dream sleep. *Zif-268* is an *immediate-early gene* (IEG), and a *behavioral state-related gene* that is associated with the generation of proteins and growth factors that facilitate synaptogenesis and neurogenesis—literally brain growth. Ribeiro et al. (2004) summarize their research on novelty-induced gene expression (transcription) as follows.

The discovery of experience-dependent brain reactivation during both slow-wave (SW) and REM sleep led to the notion that *the consolidation of recently acquired memory traces requires neural replay during sleep*. ... Our results indicate that persistent experience-dependent neuronal reverberation is a general property of multiple forebrain structures. It does not consist of an exact replay of previous activity, but instead it defines a mild and consistent bias towards salient neural ensemble firing patterns. These results are compatible with a slow and progressive process of memory consolidation, reflecting novelty-related neuronal ensemble relationships that seem to be context-specific rather than stimulus-specific. Based on our current and previous results, we propose that the two major phases of sleep play distinct and complementary roles in memory consolidation: *pretranscriptional recall during SW sleep and transcriptional storage during REM sleep* (pp. 126, italics added).

From a theological perspective, Rudolph Otto (1923/1950) formulated the concept of the *numinosum* as a state of heightened psychobiological arousal of *fascination, mystery, and tremendousness*, to describe the intense emotional arousal in spiritual experiences of naturalistic healing. I proposed that the creative replay of the *novelty-numinosum-*

neurogenesis effect as a neuroscience update of James Braid's early concept of "The Physiology of Fascination" as the basic psychobiological mechanism of therapeutic hypnosis, as well as mind-body healing via the cultural and spiritual arts (Rossi, 2002) as follows.

The Creative Replay of the Novelty-Numinosum-Neurogenesis Effect in the Arts, Humanities, and Cultural Rituals: Enriching positive life experiences that evoke the novelty-numinosum-neurogenesis effect during creative moments of art, music, dance, drama, humor, literature, spirituality, awe, joy, and cultural rituals can optimize the psychogenomics of consciousness, personal relationships, and healing.

The entire history of human approaches to healing that evoke the novelty-numinosum-neurogenesis effect — from ancient spiritual rituals of exorcism, shamanism, and fire-walking, to the still "mysterious" methods of acupuncture, energy medicine, and neurofeedback, is the data base for this hypothesis. *Psychobiological healing during ecstatic religious experiences of the numinosum involving a combined sense of fascination, the mysterious, and the tremendous has much in common with modern rituals of healing associated with the self-help groups, twelve-step programs, and the so-called "miracle cures" of therapeutic hypnosis. I hypothesize that just as negative states of emotional arousal can evoke the psychosocial genomic network to initiate gene expression cascades leading to the overproduction of stress proteins and illness, so can positive psychological experiences initiate the novelty-numinosum-neurogenesis effect to facilitate the adaptive and creative replay of gene expression to optimize brain plasticity, problem solving, and healing* (p. 243).

The New Neuroscience of Psychotherapy: Trace Reactivation Theory

Is there any evidence of the genuine healing of my brain facilitated by my constant replaying of the numinous and creative experiences of my imagination in addition to doing physical exercises? Unfortunately, at the time, the DNA microarray technology was not in place for a direct test of my psychosocial genomic hypothesis. My wife, however, told me that she had noticed around that time that I really was acting with a clear mind with full recovery from my stroke. My slurred speech, partial right-side paralysis, excessive physical weakness, etc., were no longer apparent. A battery of psychological retesting documented that after 15 months of rehabilitation both of my major stroke-induced cognitive deficits were greatly improved: my perception and discrimination improved to the 90th percentile, up from the 45th; and my short-term memory improved to the 66th percentile, up from the 37th. This was enough to lead me to propose that we may have been witnessing the emergence of a new rationale for the efficacy of creative replay in psychotherapy from neuroscience research on the *trace reactivation theory* of memory consolidation.

How are new memories made? Hoffman and McNaughton (2002) describe how memories are made by being replayed "offline" during sleep and dreaming.

Neural ensembles in the rat hippocampus and neocortex show *memory trace reactivation during "offline periods" of quiet wakefulness, slow-wave sleep, and in some cases REM sleep. Reactivation of recent memory traces* is also observed during sleep in motor areas of the zebra finch brain ... *neuro-imaging in humans reveals that brain areas with increased signal during a task have continued or reappearing activity after the*

task is completed (p. 2070, italics added).

Lisman and Morris (2001) summarize the essential dynamics of "repeated replaying" between the cortex and hippocampus of the brain in the construction and reconstruction of memory and learning.

Newly acquired sensory information is funneled through the cortex to the hippocampus. Surprisingly, only the hippocampus actually learns at this time—it is said to be online. *Later, when the hippocampus is offline (probably during sleep), it replays stored information, transmitting it to the cortex.* The cortex is considered to be a slow learner, capable of lasting memory storage only as a result of this *repeated replaying* of information by the hippocampus. In some views, the hippocampus is only a temporary memory store—once memory traces become stabilized in the cortex, memories can be accessed even if the hippocampus is removed. There is now direct evidence that some form of hippocampal replay occurs. ... These results support the idea that the hippocampus is the fast online learner that 'teaches' the slower cortex offline (p. 248-249, italics added).

The implications of research reviewed by Nader, Schafe, and Le Doux (2000) regarding the inherent lability of fear memories and the natural ease with which they can be reconstructed are most significant for a neuroscience of psychotherapy dealing with stress and posttraumatic stress syndromes.

Consistent with a time-limited role for protein synthesis production ... Our data show that consolidated *fear memories, when reactivated, return to a liable state that requires de novo protein synthesis [and gene expression] for reconsolidation.* These findings are not predicted by traditional theories of mem-



ory consolidation” (p. 723, *italics added*).

These findings certainly were not predicted by the rather stilted theories of memory and learning based on simple tokens of reward and punishment that most of us were taught in graduate school! *Current neuroscience research supports the view that every time we recall a fear-based memory, nature opens up the possibility of creatively reframing it in a psychotherapeutic manner by creative replay on the levels of gene expression, new protein synthesis, and brain plasticity.* In a sense, psychotherapists have long known this when they say “*every recall is a reframe.*” Consider now how the initial history-taking in psychotherapy is actually a form of creative replay setting up the conditions for reframing and reconstructing the person’s world view on the profoundly deep levels of gene expression and brain plasticity. It is now a short step to realize that most traditional schools of psychotherapy have actually been accessing and utilizing creative replay all along. Consider the emphasis on memory revivification in therapeutic hypnosis, free association and dream work in psychoanalysis, imaginative dialogue in gestalt therapy, reflecting by Carl Rogers, biofeedback, and all the lists and hierarchies of the cognitive-behavioral therapies; are they not all efforts at the creative replay and reconstruction of salient memory traces on the levels of gene expression, new protein synthesis, and brain plasticity that neuroscience is now uncovering?

Implications for the Art and Science of Psychotherapy

Trace reactivation and the *creative replaying* of the *novelty-numinosum-neurogenesis effect* are the essential dynamics of our neuroscience of psychotherapy on all levels, from mind to gene.

Accessing and re-experiencing the novelty-numinosum-neurogenesis effect in creative replays is the essence of the psychological, cultural, and spiritual

approaches to healing. Notice how often I reported being preoccupied with numinous experiences in dreams, which I replayed with many creative variations that continued over days, weeks, and months. Psychotherapeutic approaches that generate mind-body healing require repeated exercises of novel, enriching, and positive inner experiences. Replaying numinous dramas of healing with deep emotions and many creative variations allows a natural Darwinian variation and self-selection of optimal healing strategies to take place on all levels, from mind to gene in the brain and body, to facilitate healing and rehabilitation.

The dark side of the novelty-numinosum-neurogenesis effect is that it is very labile and vulnerable to conflict, trauma, stress, and outright manipulation by authoritarian social forces that seek to manipulate human belief systems and behavior. I speculate, for example, that the natural source of inner human conflict is in the potentially adaptive and creative, but often competitive, psychosocial genomic dynamics that take place in “offline” (the neuroscience term for the unconscious) mind-brain states such as sleep and dreaming. Meditation, prayer, and the constructive cultural processes of the arts and humanities are efforts to literally cultivate the neural landscape of our own mind-brain. As we witness so vividly today, however, authoritarian, constricting, and terrorist forces can hijack and manipulate the novelty-numinosum-neurogenesis effect to exploit the malleability of gene expression and brain plasticity to conquer the territoriality of the mind-brain. Ethics remains the greatest vulnerability and highest priority of the human condition.

Although we can cite many scholarly sources from the history of war and peace, culture, the humanities, psychoanalytic traditions, and current neuroscience to support this emerging view of the psychosocial genomics of creativity, mind-body healing, and social dynam-

ics, these conceptions remain speculative until they receive more careful experimental confirmation. The DNA gene chip technology now exists to measure the initiation of gene expression, brain plasticity, and stem cell differentiation in response to the creative replay of the novelty-numinosum-neurogenesis effect within the typical time frame of a single session of psychotherapy.

Experimental confirmation of the value of creative replay of the novelty-numinosum-neurogenesis effect in the arts, humanities, and cultural rituals would have profound implications for an understanding of the role of consciousness and psychotherapy. It would mean that enriching life experiences that evoke the novelty-numinosum-effect during creative moments of art, music, dance, drama, humor, literature, poetry, spirituality, awe, joy, and cultural rituals could optimize the psychosocial genomics of consciousness, personal relationships, and healing. It would mean that there is something more involved than "art for the sake of art." Rather it would mean "art for the sake of building a better brain" in the daily construction and re-construction of our lives.

This contains the seed of a new theory of aesthetics, creativity, and science that reifies Keats' poetic and philosophical conundrum, "Beauty is truth, truth beauty,—that is all ye know on earth, and all ye need to know." If beauty and truth are both numinous experiences that activate gene expression and brain plasticity, then beauty could actually reconstruct our brain to generate new experiences of truth and visa versa.

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