

## The Genomic Science Foundation of Body Psychotherapy

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### Abstract

This paper introduces the genomic science foundation of body psychotherapy ranging from Darwinian evolution and classical Mendelian genetics to the Watson and Crick molecular dynamics of DNA in human development, adaptation, stress and performance. Most of our genes are active players responding adaptively and cooperatively to the stimuli, challenges, stresses and traumas of our ever-changing daily activities. We outline how DNA microarray of research into gene expression will make it possible to define the specific characteristics and therapeutic values that distinguish each school of body psychotherapy on a molecular-genomic level.

### Introduction: From Classical Genetics to the Functional Genomics of Body Psychotherapy

A recent issue of the popular magazine *Scientific American* told the story of how “gene doping” could be used to create superior Olympic medal-winning athletes by illegally injecting them with genes. Almost simultaneously the *New England Journal of Medicine* (Schuelke et al., 2004) reported the discovery of a human genetic mutation in a 5-year-old boy who is being dubbed “Baby Superman” because of his bulging arm and leg muscles. Meanwhile remarkable pictures of the “Belgian Blue Bull” were published to illustrate the “double-muscled” cattle that also have a natural gene mutation that enhances a rippled physique while reducing fat deposition. The common factor behind all these stories is the myostatin gene that controls the normal checks and balances on muscle growth. Most professionals engaged in body psychotherapy, physical development, and the rehabilitation therapies have not been prepared to understand the implications of these reports about genomic science for their daily work. In this paper I propose to fill the gap by introducing genomic science as a common foundation for the research and practice of all the body psychotherapies ranging from the classical medical model approaches of psychosomatic medicine, psychoneuroimmunology and sports medicine to the alternative and complementary models of mind-body healing such as acupuncture, Alexander, bioenergetics, chiropractic, dance and movement schools, Feldenkris, therapeutic hypnosis, massage, -Pilates, Rolfing, yoga, etc. (Young, 1997).

Most of us understand that classical genetics is the science of how physical and mental traits are passed on from parents to children.

We all learned that the “laws of heredity” were first discovered about 150 years ago by the Austrian monk, Gregor Mendel who studied how physical traits such as the shape and color of peas were transmitted from one generation to another. Classical genetics is concerned with how the genes that make up the *genotype*, or *genomic level* within each cell of the body, are transmitted from one generation to the next as the biological basis of observable traits that make up the *phenotype*. Mendel studied the distribution of such structural traits over the *broad time frame of many generations*.

Likewise, Darwin’s evolutionary view of the biological origin of species explores how the principles of natural variation and selection of genes can account for the emergence of new forms of life. The evolution of new life forms is usually believed to require long time frames of eons. Many modern studies note, however, how important changes in the environment can alter the course of evolution in a generation or two. The recent discovery of the emergence of a new human mutation in the myostatin gene in “Baby Superman”, noted above, is an example of this. Since the boy’s mother was a professional sprinter with a brother and three other male relatives who were unusually strong, it is quite probable that she passed on one copy of the mutated gene to super baby while another came from his father.

Darwin, however, actually wrote that “natural selection is a daily and hourly scrutinizing, throughout the world,” (Weiner, 1994, p. 6, ital. ours). Neuroscience now documents how novel experiences in everyday life can change gene expression within seconds, minutes, and hours to modulate our health and performance in all activities. These relatively brief time frames mean that gene expression can operate within the typical hour of body psychotherapy sessions. It is now believed that Darwinian variation and natural selection also operate on the level of human consciousness during memorable, stimulating, and enriching life experiences that turn on gene expression in neurons of the brain. Recent research demonstrates how novel and stimulating mental and emotional experience, as well as physical exercise, can turn on gene expression in a manner that is fundamental for understanding the healing dynamics of body psychotherapy.

Gene expression is the process whereby the information encoded in the sequence of nucleotides (the ladder-like steps illustrated in all images of the DNA molecule) that make up our genes is “transcribed” into messenger RNA (mRNA), which is then “translated” into amino acids and proteins. This discovery of how the information of the DNA molecule can be replicated and translated into proteins is the foundation of molecular biology for which Watson and Crick received the Nobel Prize. These proteins make up the physical structure of the body as well as the molecular machines and messengers of life such as enzymes, hormones, and neurotransmitters that drive the dynamics of

energy, physiological functions, and all our mental and body experiences. The link between physical activity, gene expression, proteins and physiology is now called “functional genomics.” Figure 1 illustrates how the psychological experiences of mind, cognition and emotions are integrated into the broad circular process of functional genomics in the foundation of body psychotherapy (Rossi, 2002, 2004).

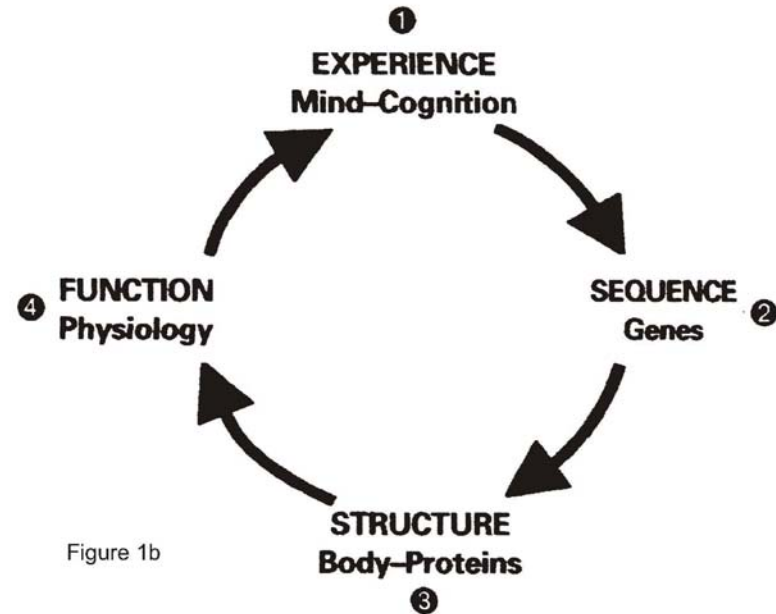


Figure 1b

**Figure 1: The 4-stage functional genomics cycle of body psychotherapy.** Mind-body communication takes place at the molecular level between (1) mental experience (2) the code of gene sequences (3) the structure of body proteins and (4) the physiological functions.

The popular but erroneous idea about genes is that they are independent biological determinants and the source of physical traits, inherited abilities, dysfunctions, etc. - a view that gives rise to the nature-versusnurture controversy: Is human behavior and experience determined primarily by nature (genes) or nurture (life experiences)? Functional genomics resolves this controversy in a new way. Genes interact with the environment to modulate human behavior and vice versa. Stahl (2000) summarizes the implications of this interaction between daily behavior and genes as follows.

But can behavior modify genes? Learning as well as experiences from the environment can give rise to changes in

neural connections. In this way, human experiences, education, and even psychotherapy may change the expression of genes that alter the distribution and strength of specific synaptic connections. *Thus genes modify behavior and behavior modifies genes.* Psychotherapy may even induce neurotropic factors to preserve critical cells and innervate new therapeutic targets to alter emotions and behaviors (p. 37, Italics added).

The accumulating evidence that psychological experiences and physical activity modulate gene expression as well as vice versa is the basic insight indicating why functional genomics is the foundation and common denominator of body psychotherapy. In a much cited paper, Eric Kandel (1998), a Nobel Laureate in Physiology of Medicine in 2000, described the relationship between psychotherapy, gene expression and *brain plasticity*, which is the growth and changes in the organization of synaptic connections between brain neurons as a result of psychological experiences, as follows.

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).

To draw attention to this little understood research that documents how psychological, social, and cultural processes can modulate gene expression, I have conceptualized the work of Kandel and others as the emerging science of psychosocial and cultural genomics illustrated in all the figures of this paper (Rossi, 2002, 2004). Many ordinary aspects of everyday life such as waking, sleeping, dreaming, work, stress, play, sports, exercise and all forms of activity, in general, are associated with unique profiles or patterns of gene expression. In the research literature in this area it has been called by many names such as *“Immediate Early*

*Genes, Behavior State Related Gene Expression, Activity Dependent Gene Expression, and Experience Dependent Gene Expression.*" These apparently different expressions all focus on varying nuances of a surprising but fundamental idea of psychosocial genomics and cultural genomics: *Most of our genes are not independent biological determinants of behavior. Most of our genes are active players responding adaptively, cooperatively and quickly from one moment to the next to the stimuli, challenges and contingencies of our ever-changing daily life.* The biologist, Ridley (1999), describes how thoughts, emotions, behavior and apparent "free will" modulate gene expression in health and optimal performance as well as stress and illness.

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 lie 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, Italics added)

Table 1 introduces the broad perspective of genomic science as the scientific foundation of body psychotherapy by listing the various classes of genes that are currently recognized as being modulated by the deep psychobiological dynamics of behavioral, cultural, psychological, and social experiences. The most general and popular understanding of genetics that originated in the work of Darwin and Mendel are placed on the top two rows of Table 1. The relatively brief time frames of psychosocial and cultural genomics that are of essence in body psychotherapy (daily to hours, minutes and seconds) are in stark contrast with the much longer time frames of Darwinian evolution over eons, and Mendelian classical genetics over generations as illustrated by the example of the myostatin gene in super baby described above.

**Table 1: The Genomic Science Foundation of Body Psychotherapy.** A comparison of the wide range of time frames in the activation, functions, and domains of gene expression ranging from Darwinian Evolution and Classical Mendelian Genetics to the Watson and Crick molecular dynamics of DNA in human development, adaptation, stress and performance in daily life and body psychotherapy. (Adapted from Rossi, 2002, 2004).

Gene Expression	Time Frame	Major Function	Research Domain
Evolution	Eons	Origins	Darwin
Inheritance	Generations	Replication	Mendel
Development	A life time	Molecular Biology	Watson & Crick
Housekeeping	Daily, Hourly	Metabolism	Functional Genomics
Clock Genes	Monthly, Daily	Adaptation	Chronobiology
Late activated	4-8 hours	Immune	Immunology
Intermediate & Early Active	1-2 hours	Environmental Interaction	Psycho-neuro-immunology
Behavior State-Dependent	Hours	Wake, Sleep, Dreams, Mood	Psychology
Activity-Dependent	Minutes, Hours	Brain Plasticity	Neuroscience
Immediate Early	Minutes, Seconds	Arousal, Stress, Creativity	Body Psychotherapy

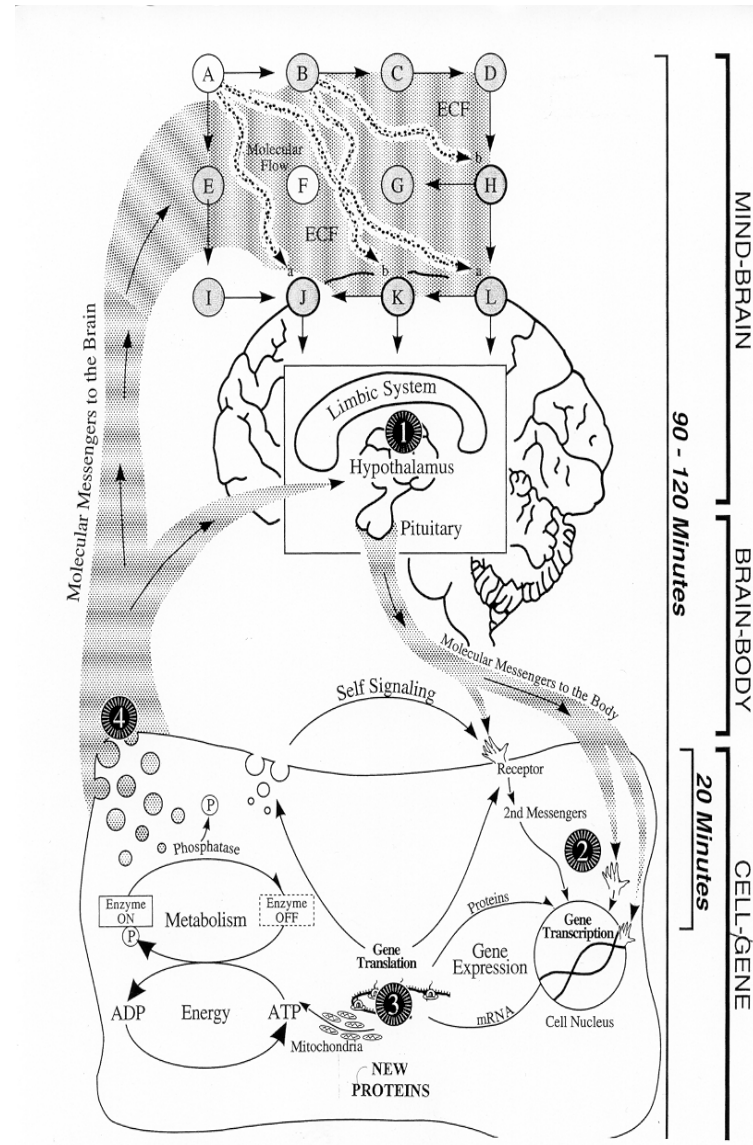
### Human Development, the Life Cycle, and Body Psychotherapy

The basic structuring and pattern of human development - how a single fertilized egg grows into a human being - is now understood as carefully scheduled profiles or patterns of gene expression and protein synthesis over a lifetime. Every living cell of the body contains all our genes (red blood cells are the exception). Why, then, are so many of our cells, tissues, and organs so obviously different in appearance, structure and function? The answer is that relatively few subsets of our total genome need to be expressed to generate the proteins that make up each type of cell in the body. The *structure*, *function* and *identity* of any particular cell is due to the particular subset of genes that are turned on and expressed during the cell's formation and daily interaction with its environment.

Figure 2 illustrates how the structure, function and identity of all cells are associated with circular loops of communication between the brain and body at all stages and levels of human development. Embryonic development, infancy, childhood, adolescence, adulthood, and death itself are now understood as outcomes of interactive patterns of communication between environment, gene expression, and protein synthesis over the course of a lifetime. While most research on the

changing patterns of gene expression during the life cycle has been carried out primarily on lower animals, current studies are throwing light on the human life cycle from the earliest stages of the mother-infant bond to the aging process that have important implications for body psychotherapy.

**Figure 2: The 4 stage mind-body cycle of communication at the molecular-genomic level.** Four levels of the complex psychobiological domain of body psychotherapy. (1) Information from the outside world encoded in the neurons of the cerebral cortex of the brain is transformed within the limbic-hypothalamus-pituitary system into the messenger molecules that travel through the blood stream to signal receptors on all cells of the brain and body. (2) The receptors on the surface of cells transmit the signal via 2nd messengers to the nucleus of the cell where immediate-early genes signal other target genes to transcribe their code into messenger RNAs. (3) The messenger RNAs serve as blueprints for the synthesis of proteins that will function as (a) the ultimate healing structures - the *soma* of the body, (b) enzymes to facilitate *energy* dynamics and (c) receptors and messenger molecules for the *informational* dynamics of the cell. (4) Messenger molecules function as a type of "molecular memory" that can evoke state-dependent memory, learning and behavior in the neural networks of the brain that are encoded and transformed by body psychotherapy (illustrated as the rectangular array of letters A to L on the top).



**Touch and the Body Psychotherapies: Mother- Infant Bond in Physical and Mental Development**



In one form or another touch, sensation, movement, mental and physical activity are evoked in all the body psychotherapies. They all initiate neural stimulation, which turns on the gene expression/protein synthesis cycle throughout the brain and body as illustrated in Figure 2. The association between touch, gene expression and body psychotherapy is well illustrated by the pioneering research of Schanberg (1995) and the case of “A Sister’s Helping Hand” (Rossi, 2002).

The helping hand story begins with the premature birth of twins. Each of the twins was immediately placed in a separate incubator in accordance with the normal hospital rules. One of the twins, the weaker of the two, was not expected to live, however. A sympathetic nurse, following her heartfelt intuition and sense of sheer desperation, defied hospital rules by placing the two babies together in one incubator. Unexpectedly the healthier twin then threw an arm over her sister in an endearing embrace. The smaller baby’s heart soon stabilized, her temperature returned to normal, and she survived. The twins thrived together and now, at home, they still sleep snuggling together.

How can we account for what appears to be a heart warming miracle wrought by a newborn sister’s helping hand? No one was around at the time to measure gene expression in the twins during their early life crisis. Current research in gene expression and human experience, however, is now finding an answer to how healing by touch is possible. Saul Schanberg and his colleagues at Duke University, for example, discovered how maternal touch could activate *immediate early genes* such as *c-myc* and *max*, which in turn activate a target gene called ODC (ornithine decarboxylase). Turning on the ODC gene leads to the synthesis of proteins that contribute to physical growth and maturation at the cellular level. Schanberg’s (1995) research illustrates how deprivation of maternal touch for 10 or 15 minutes results in a dramatic drop in ODC gene expression and the physical growth of 10-day-old rat pups. Within two hours ODC activity is down 40% - where it remains until maternal touch returns. A full recovery of heart rate and even an over compensation to 300% of normal ODC gene expression in the brain is noted when the touch-deprived pups are returned to their mother. A graduate student stroking the pups lightly with a soft, tufted artist’s paintbrush for 15 minutes was enough to turn on the ODC gene and other genes and hormones associated with biological growth as well. Surely if a graduate student can turn on gene expression in a baby mouse

with a paint brush, one wonders, why can't we research to document how psychotherapists do it even better with all their approaches to the body ranging from acupuncture and bioenergetics to yoga?

We have long known that baby human orphans fail to thrive and to grow physically when isolated in an institution without the normal amount of touch -- even when all other needs for warmth, food, and care are provided. This has been called *psychosocial dwarfism* or *non-organic failure-to-thrive*. When nurses supplied these infants with tender loving touch, however, their growth returned to normal within hours. This failure-to-thrive diagnosis was also documented by social workers investigating homes where the environment was described as psychosocially inadequate. It was found that failure-to-thrive babies in these homes had abnormally low growth hormone levels that are associated with low ODC gene expression activity. It was found that when the babies received adequate maternal touch, ODC gene expression, growth hormone, and physical growth returned to normal. Simple administration of growth hormone alone, without continued maternal touch, failed to improve the growth of these failure-to-thrive babies. (Rossi, 2002, p.16).

These associations between gene expression and hormones in early human development are typical of all other significant transition stages such as birth, puberty, menopause and the aging process. They are examples of the complex adaptive systems typical of all life processes that are facilitated by body psychotherapy. Many of the structural, functional, integrative, and energetic processes of body psychotherapy access this complexity across so many levels, ranging from molecule to mind, that they are difficult to sort out. A new way of exploring this complexity utilizes computers to sort through the DNA microarray data of functional genomics that identifies which genes are turned on and off during the transitions of daily psychobiological experiences of work, play, stress, sleep and performance in sickness and health (Rossi, 2002, 2004).

One still reads, for example, many dubious press reports touting how expensive hormone injections are the key to life rejuvenation, life extension, and perpetual youth. Such reports have not yet caught up with the genomics revolution. They apparently ignore the fact that hormones come from proteins that come from appropriate profiles of gene expression over time. Normal aging is the result of accumulated errors in the transcribing and translation of genes into their "cognate" proteins over a lifetime. Any truly fundamental and integrative approach to life extension and body psychotherapy must include the entire mind-

gene cascade illustrated in Figures 1 and 2. The true molecular-genomic science of aging, rejuvenation, life extension and performance optimization is only now emerging from pioneering research into bioinformatics with DNA microarray data, which will provide a new research paradigm for body psychotherapy in the future.

### **DNA Microarray Research and the Dynamics of Body Psychotherapy**

The invention of a new instrument, technique or technology can revolutionize our understanding of life. The telescope, microscope, EEG and now, in our own time, “The Human Genome Project” and the development of DNA microarrays -are expanding human perception of our own nature far beyond what could have been imagined previously. DNA microarrays or “gene chips” consist of wafers of glass or other bonding surfaces about halfinch square that appear to be analogous with the silicon chips of computer technology. Each chip is lined with thousands of microscopic spots of short bits of DNA that can bond with any matching genes in a biological sample being studied. DNA microarrays could be used to assess the expression and coordinated profiles of activity of all the genes in the human body (~30,000) during any body activity or any form of body psychotherapy.

Gene chips provide the prospect of being able to identify the activity patterns of gene expression at any given moment in any condition or state of health or illness. For example, we can compare the differences in gene expression during cell growth versus a resting cell. We can explore the differences in gene expression between a normal cell, a cancerous cell or any other state of dysfunction. Physical activity, emotional arousal, and relaxation during the body psychotherapies all represent different states, which have different profiles of gene expression. This means that eventually we may be able to define exactly what we mean by arousal, activity, and energetics during the various states of healing in body psychotherapy with such DNA microarrays.

### **The 4-Stage Creative Process in Body Psychotherapy**

Although there are great differences in the theory and practice of the various schools of body psychotherapy, I have proposed that they all manifest the basic 4 stage creative process originally described by Poincaré about a century ago. The relationship between these 4 stages of the creative process and the genomic science foundation of body psychotherapy is outlined here and presented in greater detail elsewhere (Rossi, 1972/2000, 2002, 2004).

### Stage 1: Preparation, Data Gathering, Activities, Sensations.

Our genes are not always in an active state; different patterns of gene expression are turned on in everyday life by novel internal and external environmental signals to generate the proteins that are the molecular machines of life that do creative work. In stage one of the creative process the body psychotherapist usually begins by presenting novel and stimulating situations, activities, or *appropriate challenges* (breath, pound pillows, do this yoga exercise, feel the energy, tell me your dreams, early memories, traumas etc.) to the client that evoke novel experiences and sensations. These novel and arousing sensations stimulate neural activity, gene expression, and the desire to learn more that -sets the client forth on deeply motivating outer and inner journeys of self-discovery, transformation, and self-creation.

It is now known that any intense psychological state of arousal - such as trauma, pain, stress, novelty, dreaming (REM sleep), and creative moments in everyday life, as well as all the arts and sciences, can initiate the expression of *Immediate Early Genes, Activity (or Experience) Dependent Genes*, and *Behavioral State-Related Genes* in our brain and body. The molecular biologists Bentivoglio & Grassi-Zucconi (1999), for example, ask questions about immediate-early genes (IEGs) that are of fundamental importance for the body psychotherapist whose *appropriate challenges may evoke such activity on the genomic level in their clients.*

*The study of IEGs indicates that sleep and wake, as well as synchronized and desynchronized sleep [REM or dream sleep], are characterized by different genomic expressions, the level of IEGs being high during wake and low during sleep. Such fluctuation of gene expression is not ubiquitous but occurs in certain cell populations in the brain. . . 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.

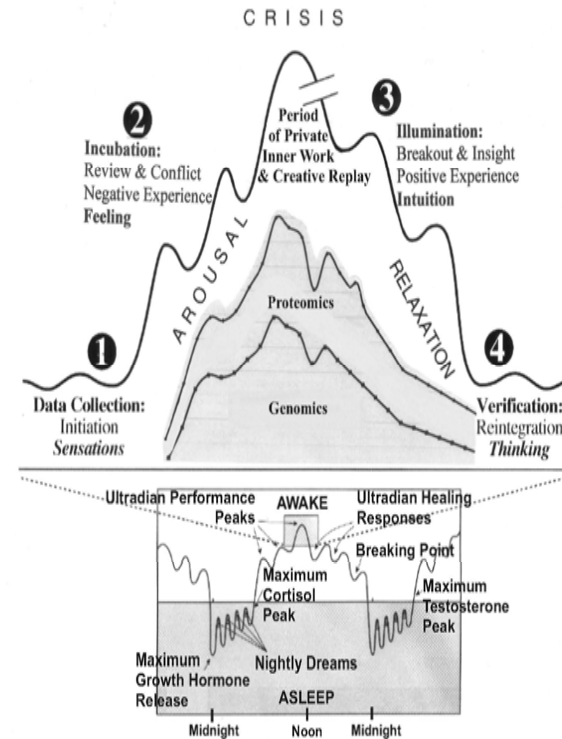
The extent, nature, and sources of variation in gene expression among healthy individuals are a fundamental, yet largely unexplored, aspect of human biology. *Future investigations of human gene expression programs associated with disease, and their potential application to the detection and diagnosis, 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)

This means that DNA microarrays could be used as a sensitive and scientific measure of behavioral arousal, consciousness and varying psychological states, as well as brain plasticity in body psychotherapy.

### **Stage Two: Incubation, Arousal, Conflict, Negative Experiences and/or Symptoms.**

Often this second stage is characterized by a mild state of anxiety, fear, confusion, stress and even psychosomatic symptoms as the client responds to the body psychotherapist's initial suggestions for behavioral and mental activity. Emotional conflicts, tears, anger, depression, aggression and symptoms experienced in this stage are mind-body language about unresolved issues at an unconscious, genomic level that require review, replay, re-synthesis and therapeutic reframing on the conscious level. The client needs to experience his or her self from different activity perspectives to learn about their maladaptive response patterns on deep genomic levels. Clients manifest their outer, observable or *phenotypic* mind-body response patterns of emotional arousal when their inner, unconscious *genotype* or *genomic* profiles are evoked during this stage of arousal. It is during this second stage of the creative process of body psychotherapy that we expect DNA microarray technology will reveal each client's unique gene expression profile in response to the appropriate therapeutic challenges presented in stage one.

Many experienced body psychotherapists have noted how many clients experience a spontaneous, quiet period of private inner work and reflection after a crisis of abreacting negative emotions and conflicts that is illustrated at the peak of the creative process in Figure 3.



**Figure 3: The genomic science foundation of body psychotherapy.** The lower diagram summarizes the normal circadian (~ 24 hours) profile of alternating 90-120 minute ultradian (less than 20 hours) rhythms of waking and sleeping characteristic of Kleitman's Basic Rest-Activity Cycle (BRAC) for an entire day in a simplified manner. The ascending peaks of rapid eye movement (REM) sleep typical of 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 typical circadian peaks at different times of the 24-hour cycle.

The upper diagram outlines body psychotherapy as the creative utilization of one natural 90-120 minute ultradian rhythm of arousal and relaxation, which is illustrated here as the classical four stages of the creative process: 1) Data collection; 2) Incubation; 3) Illumination; 4) Verification. Body psychotherapy interacts with the proteomics (protein) level illustrated by the middle curve depicting the energy landscape for protein folding into the correct structures needed for physiological functioning (adapted and redrawn from Cheung et al. 2004). This proteomic level is, in turn, emergent from the genomics level illustrated by the curve below it (Adapted from Levsky, et al., 2002). This genomics curve represents the actual gene expression profiles of the immediate-early gene *c-fos* and 10 other genes (alleles) over the typical ultradian time period of 90-120 minutes. All genes showed measurable activation within 5 or 10 minutes. By 40 minutes a peak of activation was reached and by 90-120 minutes gene expression had returned to the baseline. Note how these are all typical time frames for activity oriented body psychotherapy.

The lower diagram in Figure 3 illustrates the normal activity profile for one day that was originally described by Kleitman (1969; Kleitman & Rossi, 1992) as the Basic Rest-Activity Cycle (BRAC). Since this basic rest-activity cycle is evident on all levels from mind to gene, I have proposed that it is natural foundation of body psychotherapy. The daily or circadian (~ 24 hours) profile is made up of alternating 90-120 minute ultradian (less than 20 hours) rhythms of waking and rest, sleeping and dreaming. The ascending peaks of rapid eye movement (REM) sleep typical of 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 part of Figure 3 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*, -have typical circadian peaks at different times of the 24-hour cycle.

The upper part of Figure 3 outlines the basic psychobiological unit of body psychotherapy as the creative utilization of one natural 90-120 minute ultradian rhythm of arousal and relaxation illustrated in the lower diagram. The classical four stages of the creative process: 1) Data collection; 2) Incubation; 3) Illumination; 4) Verification have been well documented by Wallas (1926) and others. The four basic psychological functions of sensations, feeling, intuition, and thinking as originally described by Carl Jung appear to be related to the 4 stages of the creative process (Rossi, 1972/2000, 2002, 2004). The BRAC of 90-120 minutes at the genomic and proteomic levels is included in the top portion of Figure 3 to illustrate our basic genomic science foundation of body psychotherapy. The interaction between environmental stimuli and profiles of gene expression is the ultimate foundation of the classical 4-stage creative process in body psychotherapy.

I originally used this "break" after the peak crisis in Figure 3 to indicate the unknown process by which the *arousal* of stages 1 and 2 was shifted to the relaxation of stages 3 and 4 of the creative process. I now hypothesize that this break is mediated by alternative gene splicing at this critical transition stage of the creative process leading to a dominance of the acetyl cholinesterase gene AChE-R (Relaxation) over AChE-S (Stimulation) that is summarized by Sternfeld et al. (2000).

*"Our current findings therefore demonstrate that AChE-R, most likely with another modulator or modulators, may be beneficial in the response to acute stress at two levels: (i) by dampening the acute cholinergic hyperactivation that accompanies stress and (ii) by protecting the brain from entering a downward spiral into progressive neurodegeneration through an as-yet unidentified mechanism, which could involve non-catalytic activities and/or direct competition with AChE-S"*(p. 8652).

We now need more direct tests of this hypothesis about a basic genomic dynamic of body psychotherapy by assessing the DNA microarray profiles of gene expression between *AChE-S* (Stimulation and arousal more present in stages 1 and 2 of the creative cycle) and *AChE-R* (Relaxation more evident in stages 3 and 4 of the creative cycle).

### **Stage Three: Illumination, Breakout, Insight, Positive Experience.**

This is the very rewarding creative moment experienced in all the arts and sciences as well as body psychotherapy. *I propose that such creative moments at this positive stage of body psychotherapy are the outer manifestation of gene expression, new protein synthesis and brain plasticity.* It is of essence that people learn how to recognize and support these new developments in their body experience and consciousness. The main job of the body psychotherapist at this stage is to help clients recognize and appreciate the value of their new experiences and insights. Often a person's conflicts and dysfunctions seem to disappear dramatically as personal problems are resolved with the new joyful and spiritual perspectives and feeling that are expressed at this stage of body psychotherapy.

It is now known, for example, that when experimental animals experience *novelty, environmental enrichment and physical exercise* the *zif-268 gene* is expressed during their REM dream sleep. *Zif-268* is an *immediate-early gene* (IEG) and *behavioral-state related gene* that is associated with the generation of proteins and growth factors that facilitate synaptogenesis and neurogenesis - brain plasticity (growth). Ribeiro et al. (2004) summarize their research on novelty-induced expression of the *zif-268 gene* (also known as neural growth factor) as follows.

The discovery of *experience-dependent brain reactivation* during both slow-wave (SW) and rapid eye-movement (REM) sleep led to the notion that *the consolidation of recently acquired memory traces requires neural replay during sleep. . . 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- 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)

I have proposed how the novel, creative replay of “*recently acquired memory traces*” of stress and trauma are the basic genomic science mechanism of healing in all forms of psychotherapy as well as sleep. From a historical perspective, Rudolph Otto (1923/1950) introduced the concept of the *numinosum*, as a state of heightened psychobiological arousal of *fascination, mystery, and tremendousness*, to describe the emotional arousal that is characteristic of spiritual experiences of naturalistic healing. The creative replay of the *novelty-numinosum-neurogenesis effect* in the arousing activities of body psychotherapy could be understood as an update of James Braid’s historical concept of “The Physiology of Fascination” in the genomic science foundation of therapeutic hypnosis as well as mind-body healing via cultural and spiritual rituals (Rossi, 1972/2000, 2002, 2004).

#### **Stage Four: Validation, Verification and Healing.**

In this final stage of the creative cycle, the client must verify the value of the new experiences of stage three by practicing them in the real world. These new experiences and realizations are often fragile and can be easily lost. It is ironic that the client’s family and friends, who wish them well, often do not recognize the value of the new, and support it as it develops within the client. Thus adolescents naturally have difficulties with their family and friends. Falling in love can be fragile and fickle. Innovators and creative workers have been perpetually misunderstood and persecuted throughout history for daring to assert their new consciousness. The body psychotherapist and the client now work and plan together to discover new and practical changes in lifestyle that need to be explored and tested in the real world.

We expect that the states of relaxation and well being that emerge naturally during this final stage of body psychotherapy, as assessed by DNA microarrays, will be different than those in the first 3 stages. Psychosocial stress, for example, can turn off the early activated interleukin-2 gene so that the immune system cannot communicate well at the molecular level and we are more vulnerable to all sorts of opportunistic infections (Kiecolt-Glaser et al., 2001). Positive psychosocial experiences with children, on the other hand, can turn on the interleukin-2 gene within an hour or two to facilitate molecular communication, healing, and health (Castes et al., 1999). *Late activated*

*genes*, by contrast, require as much as 4 to 8 hours to achieve their peak levels of expression (Table 1). The turning on and off of cascades of gene expression begins within a few minutes of receiving important psychological and social signals and may continue for hours, days, weeks - or even a lifetime.

The new life patterns now evident at all levels from mind and behavior to gene expression, as assessed by DNA microarrays, could document the value of body psychotherapy. All practicing body psychotherapists should consider how they could facilitate such explorations into the genomic science foundations of their daily work by networking with research teams that can assess gene expression before, during, and after their therapeutic sessions.

## Summary

The basic theme of this paper is that all schools of body psychotherapy achieve their structural, integrative, energetic, and functional therapeutic effects by accessing and facilitating the natural molecular dynamics of gene expression, protein synthesis, brain, and body plasticity. DNA microarrays are an emerging scientific methodology that could be used for defining the common denominator and the distinguishing dynamics claimed by the various schools of body psychotherapy. DNA microarrays are a potentially fundamental scientific approach, at the most basic molecular level of the body, for analyzing and resolving the controversies between different schools of body psychotherapy. The genomic science foundation of body psychotherapy needs to be documented with DNA microarrays to explore its possibilities and limitations in facilitating human development, health and transformations via the 4-stage creative process.

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#### Biography

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