

# **Decoding the Chalmers Hard Problem of Consciousness: Qualia of the Molecular Biology of Creativity and Thought**

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## **Abstract**

This update and decoding of the Chalmers hard problem of consciousness integrates philosophy, psychology and the humanities with current evolutionary concepts of molecular biology. We summarize research that suggests how the natural variation and selection of molecular processes in primordial RNA world evolved into RNA/DNA transcription/translational dialogues with the qualia of human experience in rhythms of performance, stress and healing today. Pilot research on a new creative psychosocial genomic healing protocol, which activates the bioinformatics of qualia-dependent gene expression associated with stem cell healing and a reduction in chronic inflammation and cellular oxidation stress, is now a priority for translational research on human health and well being.

**KEY WORDS:** Chalmers, consciousness, DNA microarrays, dreams, evolution, experience-dependent gene expression, psychotherapy, qualia, RNA world.

# 1. Introduction

This paper reviews Chalmers (1996) “Hard Problem of Consciousness” that was originally formulated as follows:

“The really hard problem is the problem of *experience*. When we think and perceive, there is a whirl of information processing, but there is also a subjective aspect. . . Why should physical processing give rise to a rich inner life at all? . . . Here, the topic is clearly the hard problem – the problem of experience. . . What makes the hard problem hard and almost unique is that it goes beyond problems about the performance of functions. . . *Why is the performance of these functions accompanied by experience?* . . . There is an *explanatory gap* between functions and experience, and we need an explanatory bridge to cross it. . . A full theory of consciousness must build an explanatory bridge . . . To account for conscious experience, we need an *extra ingredient* in the explanation . . . What is your extra ingredient, and why should *that* account for conscious experience?” (pp. 6-13).

Throughout this paper we will note the “extra ingredients” we are contributing to bridge the *explanatory gap* between biological functions and the qualia of psychological experience for a more satisfactory theory of consciousness to guide further research.

## 2. Darwin’s Daily & Hourly Work of Evolution

We introduce a new perspective on bridging the explanatory gap between the qualia of consciousness and their biological functions by quoting what Darwin wrote about the daily and hourly operation of evolution in chapter four of *The Origin of Species*.

“It may be said that *natural selection is a 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.” (Italics added here)

We take this apparently casual, intuitive and highly speculative comment by Darwin very seriously because it helped us catch a glimpse of the natural time parameters of the molecular-genomic dynamics underpinning the qualia of consciousness, healing, and problem solving that we witness in our *daily and hourly work* with our patients in psychotherapy (Lloyd & Rossi, 1992, 2008; Rossi & Nimmons 1992). Figure 1 illustrates how an evolutionary co-creative

complex adaptive system that includes culture, qualia, eRNA, genes and the brain can move molecules to facilitate new conscious experiences.

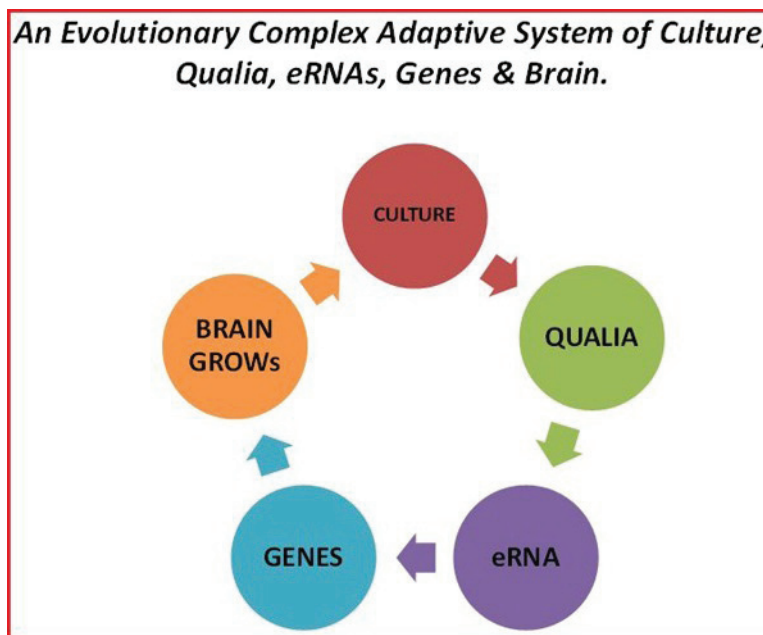


Figure 1. The evolutionary complex adaptive system of culture, qualia, eRNA, genes & brain growth.

In brief, current epigenetic research explores why and how qualia of experience “dialogues” with the DNA of our experience-dependent gene expression via the signaling functions of RNA molecules (Mattick, 2010; Yarus, 2010). We propose that novel qualia of human experience contribute to the adaptive updating of consciousness on the molecular-genomic RNA/DNA level by modulating brain plasticity via natural variation and selection daily and hourly (Rossi, 1972, 1985, 2000, 2002, 2004, 2007, 2011). We support this proposal in the following sections by reviewing research on this adaptive function of qualia in the daily and hourly cycles of human experience from the quantum to the cognitive-behavioral levels.

### **3. Evolutionary Complex Adaptive Systems of Consciousness via Quantum Entanglement**

Consciousness and non-locality in quantum physics and psychology have generated profound quandary seeking resolution (Rossi, 1988 a, b, c). Rappaportini (2010), for example, outlined the evolution of complex adaptive systems of the qualia of consciousness via quantum entanglement as follows:

“In the course of an evolution process begun with inorganic chemical compounds and proceeding in steps of ever increasing complexity, life, thought and consciousness have emerged as a bonus that cannot be explained on a purely computational basis. Because in quantum physics we no longer have observables representing the ontology of the world, but only observations representing epistemic knowledge, it implies a psychological dimension which so far has been neglected. It is therefore necessary, in order to complete the picture, to introduce the psychological dimension best represented in the western tradition by Jung and by Buddhist practices in the East. Contrary to Buddhist tradition however, the brain not the mind, is considered here a sensory organ on a par with the other five. In fact, because of quantum entanglement between observer and the observed, it is possible to state that the observer (the brain) is part of the physical world (the observed) whose representations (qualia), as generated by the brain includes the representation of the brain itself. This leads to an innovative definition of qualia and their role in the emergence of consciousness: the mind is the qualia of the brain’s neural mechanisms, this is how the perceiver perceives himself, from within. This is how consciousness emerges (Rapparini, 2010, p. 169). This is what qualia are for: the objectivity of cognition as obtained from the subjectivity of feelings of what happens. . . The closing of the explanatory gap makes it possible for the mind to change the brain by self-directed neuroplasticity in agreement with the Buddhist belief on the mental power of meditation through bare attention. Finally, the concept of entanglement has been instrumental in reaching a definition of consciousness based on the innovative role of qualia.” (Rapparini, 2010, p. 173).

This leads to the co-evolution of complex adaptive systems of life and the qualia of consciousness from the primordial RNA world over 4 billion years ago (Atkins, Gesteland, & Cech, 2011).

## **4. Qualia of Complex Adaptive Molecular Systems of Consciousness via RNA World**

How and why do the *complex adaptive systems* (Mitchell, 2009) of culture, qualia, eRNAs, genes and brain plasticity co-evolve? Kim et al. (2010) recently described the identification of a new class of 12,000 enhancer Ribonucleic Acid molecules (eRNAs) that are involved in regulating gene expression during neuronal activity in mouse cortical brain tissue (Ren, 2010). The significance of this research as an “*extra ingredient*” for bridging the *explanatory gap* between the novel qualia of consciousness and their molecular-genomic infrastructure became apparent in related research on the genome of the zebra finch described as follows by Warren, Clayton et al. (2010. p. 758).

“The zebra finch is an important model organism in several fields with unique relevance to human neuroscience. Like other songbirds, the zebra finch communicates through learned vocalizations, an ability otherwise documented only in humans and a few other animals . . . We show that song behavior engages gene regulatory networks in the zebra finch brain, altering the expression of long non-coding RNAs, microRNAs, transcription factors and their targets. We also show evidence for rapid molecular evolution in the songbird lineage of genes that are regulated during song experience. These results indicate an active involvement of the genome in neural processes underlying vocal communication and identify potential genetic substrates for the evolution and regulation of this behavior.”



Figure 2. Micro eRNAs respond to thought by modulating transcription/translation via qualia-dependent gene expression.

Clayton, one of the co-authors made the salient comment, “this is the first time a microRNA has been shown to respond to a particular thought process” (Saey, 2010). We now propose eRNAs are an “*extra ingredient*” mediating between the novel qualia of *activity or experience-dependent gene expression that underpins brain plasticity and consciousness* (Kempermann, 2006; Van Pragg et al., 1999). *Consciousness is a novelty-seeking modality that evolved as a sensitive detector or qualia to facilitate rapid and creative adaptation to environments manifesting constant change with natural variation and selection* (Rossi, 2002, p.135). Molecular biologists believe that “Cells are masters of regulating genes in response to environmental cues.” (Liu & Arkin, 2010, p. 1185). Culler et al. (2010, p. 1251) recently reported a profound proof-of-principle experiment wherein they showed how RNAs function as “sensing-actuation devices” transmitting the qualia of information from the environment to modulate the gene expression of DNA within cells as follows.

“Cellular decisions, such as differentiation, response to stress, disease progression, and apoptosis, depend upon regulatory networks that control

enzymatic activities, protein translocation, and genetic responses. Central to the genetic programming of biological systems is the ability to process information within cellular networks and link this information to new cellular behaviors, in essence rewiring network topologies. . . *RNA is a promising substrate for platforms to interface with cellular networks because of the versatile sensing and actuation functions that RNA can exhibit and the ease with which RNA structures can be designed. RNA-based sensing-actuation devices have been engineered that respond predominantly to externally [environmental] applied small-molecule and nucleic acid inputs and control gene expression through diverse mechanisms.*" (p. 1251, italics added here).

It appears that sensitive and fragile "RNA-based sensing-actuation devices" were the primordial molecular qualia signaling epigenetic information from the environment of early earth to the more stable DNA molecule. One possibility is that DNA may have been a mutation in RNA world that began to function as memory molecule which eventually made natural evolution possible from one generation to the next possible. *We propose that this adaptive coordination between the sensing (qualia), signaling, and catalytic self-replicating properties of RNA (with A-U, G-C base pairings) interacting with the more stable memory properties of DNA (due to A-T, G-C base pairing) was the original bridge over the explanatory gap between the molecular-genomic qualia and functions of life and consciousness.* Wang et al. (2011, pp. 279 & 289) expressed it in this way:

"A major surprise arising from genome-wide analyses has been the observation that the majority of the genome is transcribed, generating noncoding RNAs (ncRNAs). It is still an open question whether some or all of these ncRNAs constitute functional networks regulating gene transcription programs. However, in the light of recent discoveries and given the diversity and flexibility of long ncRNAs . . . it becomes likely that many or most ncRNAs act as sensors and integrators of a wide variety of regulated transcriptional responses and probably epigenetic events. . . Together, the ncRNA sensor code appears to be a robust and critical strategy underlying a wide variety of gene regulatory programs."

If we are willing to take a philosophical, linguistic and quantum leap from "ncRNA sensor code" to "ncRNA qualia code" such research could be another "extra ingredient" in our evolving theory of the origin of life and the qualia consciousness via the dynamics of RNA/DNA coordination during transcription and translation. *Current research implies that the more fragile but versatile molecular RNA signaling software of RNA world became integrated with the more stable DNA memory hardware to initiate the evolution of life as we know it.* It is interesting to note that when Gilbert (1986) first introduced the

concept of “RNA world” in a bottoms-up approach to the evolution of life and mind, Rossi (1986a, 1986b) began exploring such research from a top-down approach. A comprehensive theory, of course, requires an integration of both approaches to fill in the qualia gaps that remain between them. In the following sections we review the incredibly wide range of *qualia-dependent molecular-genomic processes* that underpin the deep psychobiological rhythms of human consciousness and experience.

## 5. Qualia of Consciousness during the Basic Rest-Activity Cycle (BRAC)

The top of figure 3 illustrates the 90-120 minute Basic Rest-Activity Cycle (BRAC) of human performance that is the chronobiological foundation of many of the ultradian rhythms (less than the 24 hour circadian cycle) on many levels (Lloyd & Rossi, 1992, 2008). The lower part of Figure 3 illustrates the selection-amplification SELEX (SElection of Ligands by EXponential amplification) cycle in modern experiments of the possible evolution of RNA world (Yarus, 2010). We propose the SELEX experiments as molecular-genomic analogues of the evolution of the BRAC. The qualia of the BRAC are the phenotypes of the RNA/DNA genotypes of transcription and translation.

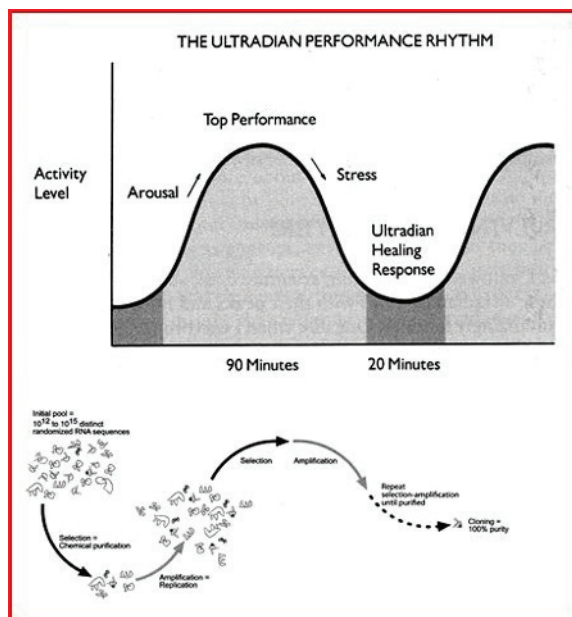


Figure 3. The Basic Rest-Activity Cycle (BRAC) and ultradian rhythms of human performance & stress (top part) analogous to the SELEX RNA dynamics of selection and amplification (bottom part).

The contrast between the qualia of the BRAC as typically experienced during the *Ultradian Healing Response*, when people take appropriate rest-breaks every 90-120 minutes or so throughout the day and the qualia of the *Ultradian Stress Response*; when people chronically attempt to forego taking appropriate rest periods is presented in table 1 (Rossi, 1996; Rossi & Nimmons, 1991).

Table 1. The contrast between the qualia experienced during the *ultradian healing response*, when people take appropriate breaks throughout the day, versus the *ultradian stress response* leading to behavioral, cognitive and emotional problems or psychosomatic symptoms when they do not take appropriate healing breaks throughout the day.

THE ULTRADIAN HEALING RESPONSE	THE ULTRADIAN STRESS SYNDROME
<p>1. <i>Recognition Signals:</i> An acceptance of nature's call for your need to rest and recover your strength and well-being leads you into an experience of comfort and thankfulness.</p>	<p>1. <i>Take-a-Break Signals:</i> A rejection of nature's call for your need to rest and recover your strength and well-being leads you into an experience of stress and fatigue.</p>
<p>2. <i>Accessing the Deeper Breath:</i> A Spontaneous deeper breath comes all by itself after a few moments of rest as a signal that you are slipping into a deeper state of relaxation and healing. Explore the deepening feeling of comfort that comes spontaneously. Wonder about the possibilities of mind-gene communication and healing with an attitude of "dispassionate compassion."</p>	<p>2. <i>High on your Hormones:</i> Continuing effort in the face of fatigue leads to the release of stress hormones that short-circuits the need for ultradian rest. Performance goes up briefly at the expense of hidden wear and tear so that you fall into further stress and a need for artificial stimulants (caffeine, nicotine, alcohol, cocaine, etc.).</p>
<p>3. <i>Mind-Body Healing:</i> Spontaneous fantasy memory, feeling-toned complexes, active imagination, and numinous states of being are orchestrated for healing and life reframing.</p>	<p>3. <i>Malfunction Junction:</i> Many mistakes creep into your performance, memory, and learning; emotional problems become manifest. You may become depressed or irritable and abusive to yourself and others.</p>
<p>4. <i>Rejuvenation and Awakening:</i> A natural awakening with feelings of serenity, clarity, and healing together with a sense of how you will enhance your performance and well-being in the world</p>	<p>4. <i>The Rebellious Body:</i> Classical psychodynamic symptoms now intrude so that you finally have to stop and rest. You are left with a nagging sense of failure, depression and illness.</p>

It appears as if the art and quality of life is determined by how well we negotiate the *qualia-dependent molecular-genomic processes* of these alternations between performance, stress and healing in the arts, humanities and sciences as well as the work and play of everyday life.

## 6. Qualia of Consciousness during the 4-Stage Creative Cycle

A cartoon of the qualia of consciousness as experienced during the 4-stage creative cycle in the arts, sciences and everyday life is illustrated in figure 4.



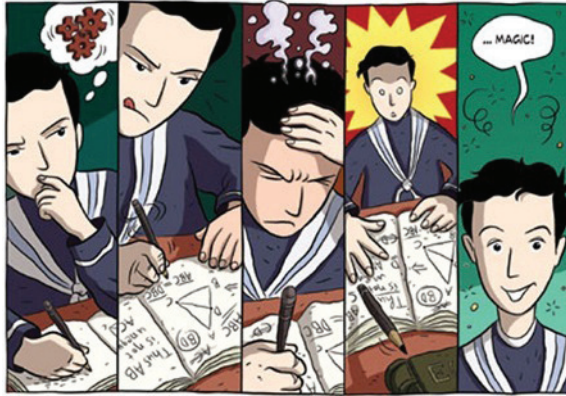


Figure 4. A cartoon of the Qualia of the 4-Stage Creative Process (Tomlin, 2005, with permission).

A profile of qualia of the 4-stage creative process: *initiation*, *incubation*, *aha!*, and *verification* during the 90-120 minute BRAC experienced 12 times a day while awake, sleeping and dreaming is illustrated in figure 5.

Table 2 outlines creative experiences that turn on qualia-dependent gene expression and brain plasticity, which we call, “the Novelty-Numinosum-Neurogenesis Effect,” from two complementary perspectives: the bottoms-up approach of neuroscience (Rossi, 2002, 2007, 2011) and the top-down approach of heightened states of purported spiritual experience that are called, “the numinosum” (Otto, 1923; Jung, 1958).

Table 2. Three qualia associated with experience-dependent gene expression and brain plasticity by neuroscience research and the corresponding three qualia experienced during the heightened states of consciousness associated with purported spiritual experience.

Qualia of Human Experience that Activate The Novelty-Numinosum-Neurogenesis Effect	
Neuroscience	Numinosum
<ul style="list-style-type: none"> <li>▪ Activity</li> <li>▪ Novelty</li> <li>▪ Enrichment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Fascination</li> <li>▪ Mysterious</li> <li>▪ Tremendous</li> </ul>
Kempermann, 2006; Ribeiro et al., 2008	Otto, 1923; Jung, 1958

Recent research reveals many possibilities for exploring the molecular-genomic evolution of the qualia of the 4-stage creative cycle. Ramakrishana (2011), for example, presents an overview of the translation pathway of the eu-

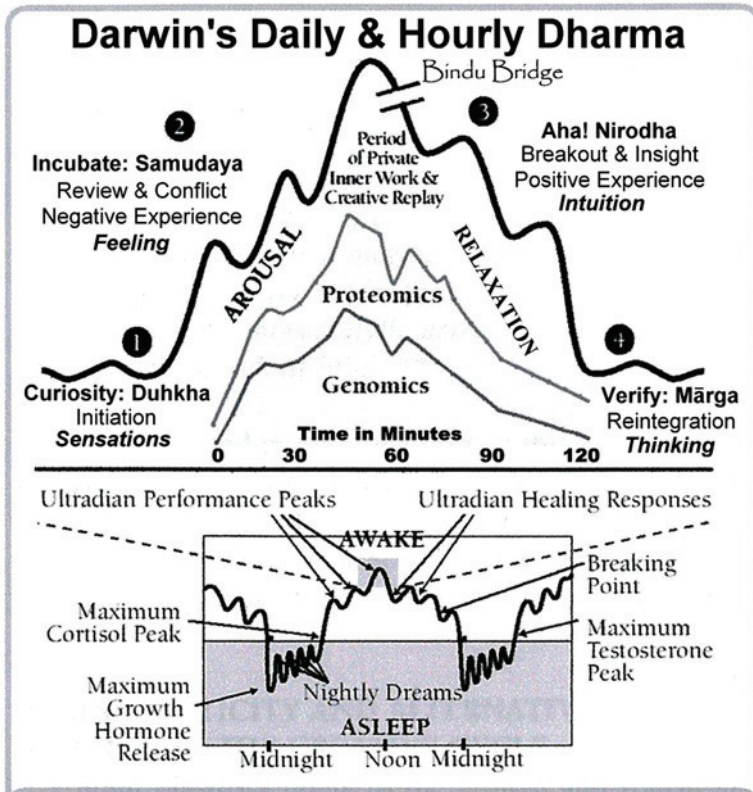


Figure 5. Qualia of Darwin’s daily and hourly work of the 4-Stage Creative Cycle in one 90-120 minute basic rest-activity cycle (top) of the ~24 hour circadian cycle (bottom). The Sanskrit terms represent the qualia of Buddha’s Four Noble Truths. The proteomics (protein) profile in middle curve depicts the energy landscape for protein folding within neurons of the brain (Cheung et al., 2004). The functional concordance of co-expressed genes are illustrated by the genomics profile below it (Levsky et al., 2002). The lower diagram illustrates how the qualia of human experienced are typically experienced as the BRAC within the circadian cycle of waking and sleeping.

karyote cell in 4 stages: *initiation*, *elongation*, *release*, and *recycling* that looks remarkably similar to the dynamics of 4-stage creative cycle. Further, within the process of transcription/translation, Breaker (2011) describes how *riboswitches* regulate experience-dependent gene expression to form Boolean logical gates, which could function as the molecular infrastructure for the qualia of creativity and thought.

“The term riboswitch was established to define RNAs that control gene expression by binding metabolites without the need for protein factors. More recently, the name has begun to be used for riboswitch-like RNAs that respond to temperature. . . Riboswitches need to form molecular architectures with

sufficient complexity to carry out two main functions: molecular recognition and conformational switching. Simple riboswitches each carry one aptamer that senses a single ligand and one expression platform that usually controls gene expression via a single mechanism. . . . Although simple riboswitches only respond to one ligand type, this restriction in signaling complexity can be overcome by stacking tandem riboswitches from different ligand-binding classes such that gene expression is responsive to more than one chemical signal. Indeed, a natural example of such two-input Boolean logic gate has been observed . . . the tandem arrangement functions as Boolean NOR gate . . . integration of multiple aptamers . . . functions as a Boolean AND gate” (p. 64 -75).

Orchestrating RNA/DNA transcription and translation via riboswitches forming “Boolean logic gates” is another *extra ingredient*” spanning the *explanatory gap* for decoding the Chalmers hard problem of consciousness. Riboswitch Boolean logic gates could be the molecular-genomic basis of mind-body computation, creativity and thought that takes place in every cell of the brain and body. Further research could now assess how the binding kinetics of simple and complex riboswitches (Breaker, 2011, p. 72) could account for the scalloped fractal dynamics of the basic rest-activity cycle illustrated in figure 5.

## **7. Qualia of the Molecular Biology of Memory & Learning during Sleep and Dreaming**

Our psychosocial genomic model of creative psychotherapy that emulates the natural process whereby novel qualia experienced in our waking hours induce mind-brain-gene dialogues during slow wave sleep and REM state dreaming in Ribeiro’s evolutionary theory of sleep and dreaming illustrated in figure 6.

The unexpected role of the qualia in the molecular biology of sleep and dreaming was outlined as follows (Rossi, Erickson-Klein, Rossi, 2008, pp. 344-345):

“The central hypothesis of Ribeiro’s (2004) evolutionary theory of sleep and dreaming is that dreams are probabilistic simulations of past events and future expectations. The adaptive function of such simulations is to construct and explore novel behaviors for future survival. A salient function of dreams is to utilize memories processed during the circadian cycle of waking, sleeping, and dreaming for the creation, selection and generalization of adaptive scenarios about the world. Ribeiro et al. (1999, 2002, 2004, 2008) provide extensive details about what they call the “cognitive role” of focusing activity-dependent gene expression and brain plasticity for adaptive behavior during the two major phases of sleep. This theory proposes that the first phase of slow-wave (SW) sleep evolved from rest in early reptiles as a quiescent, “offline state” suitable for the consolidation of new memory and learning. Consistent with much cur-

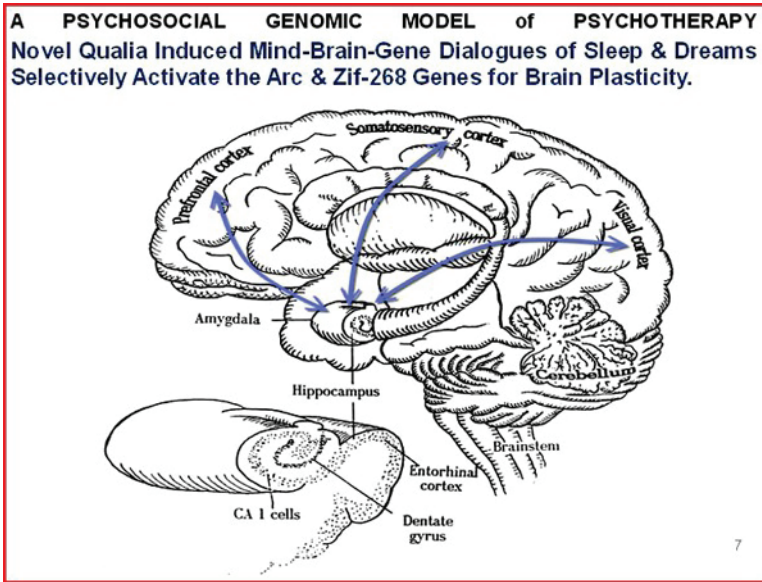


Figure 6. A functional psychosocial genomic approach to creative psychotherapy modeled on the natural dynamics of qualia-dependent gene expression during REM dreaming.

rent neuroscience research, these researchers believe that this cognitive role takes place through the reverberation of novel waking patterns of neuronal activity during SW-sleep. The second major phase of sleep, rapid-eye-movement (REM) dreaming, which is characterized by heightened cerebral activity, first evolved in early birds and mammals as a post SW-sleep state that was capable of facilitating memory consolidation by activating gene expression to make the proteins needed for generating the activity-dependent synaptic plasticity of neurons, that became the neural correlates of adaptive behavior. Mammals then evolved extended REM states of dreaming to prolong neuronal reverberation in novel ways that could promote memory reconstruction in a behaviorally adaptive manner rather than mere rote record of past events. *In brief, sleep and dreaming became an inner stage for integrating past events with current novel experiences to simulate and creatively replay the present as a rehearsal for future adaptive behavior.”*

The intensity of important life turning points (adolescence, marriage, divorce, trauma, war etc.) are associated with vivid dreaming that activates qualia-dependent gene expression and brain plasticity illustrated in figure 7.

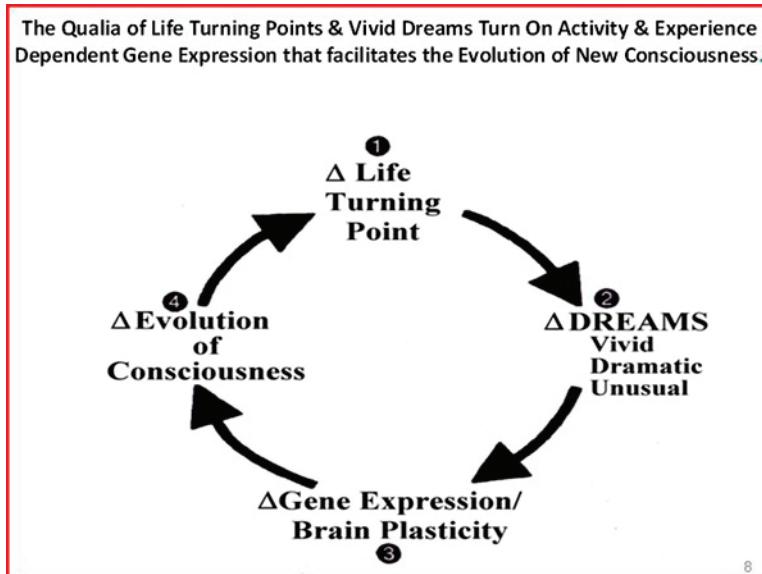


Figure 7. Significant life turning points that activate vivid, dramatic and unusual dreams associated with qualia-dependent gene expression and brain plasticity.

These insights into the role of qualia during memory, learning, sleep and dreaming motivated us to construct a new model of evidence-based psychotherapy, which we call “The Creative Psychosocial Genomic Healing Experience.”

## 8. Qualia of the Creative Psychosocial Genomics Healing Experience (CPGHE)

An overview of our new protocol for facilitating the “Creative Psychosocial Genomics Healing Experience” in psychotherapy is illustrated in figure 8.

We used DNA microarrays in a pilot study to explore the molecular-genomic underpinning of the qualia of experience associated with mind-body healing and problem solving (Rossi et al., 2008; Atkinson et al., 2010). We hypothesized that a top-down creatively oriented experience could modulate qualia-dependent gene expression associated with memory and learning as well as wide range of brain plasticity and psychoneuroimmune effects such as the healing placebo.

A DNA microarray analysis of the white blood cells of human subjects was performed immediately before, within one hour after, and 24 hours after being administered the *Creative Psychosocial Genomic Healing Experience (CPGHE)*. The rationale, administration, and scoring of this new protocol now is freely available at “[13](http://www.ernestrossi.com/ernestrossi/Neurosciencere-</a></p>
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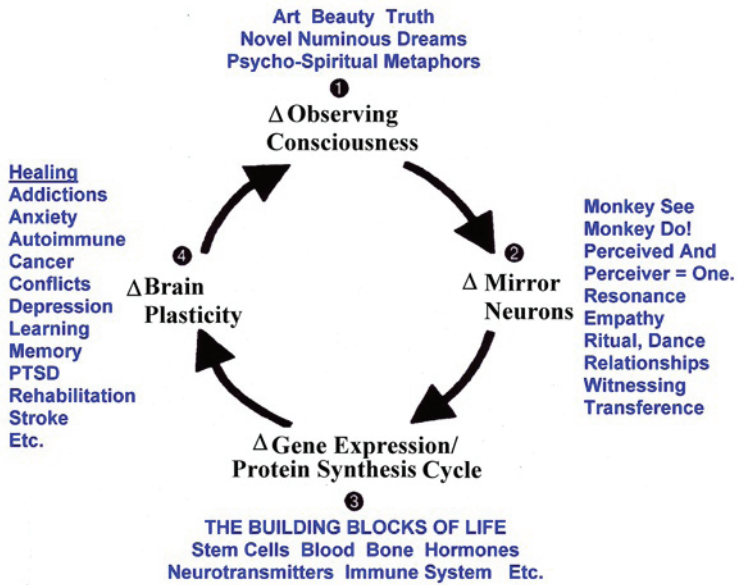


Figure 8. An overview of the Creative Psychosocial Genomic Healing Experience (CPGHE).

searchgroup.html. We found that the qualia of the CPGHE are associated with (1) a molecular-genomic signature for the up-regulation (heightened activity) of genes characteristic of stem cell growth, (2) a reduction in cellular oxidative stress, and (3) a reduction in chronic inflammation as illustrated in figures 9 and 10.

These three empirical associations are an initial beta version of the molecular-genomic signature of the qualia of the CPGHE that requires further replication. These results have been partially confirmed in related research using DNA microarrays to compare qualia-dependent gene expression in beginning and advanced students of meditation. It was found that the “relaxation response” associated with meditation also reduces chronic inflammation and oxidative cellular stress (Dusek et al., 2010).

## 9. Summary

This update and decoding of the *Chalmers Hard Problem of Consciousness* has skirted the precipices of metaphysics in seeking what is currently known about qualia of the molecular biology of life and mind that are ready for further experimental evaluation.

We reviewed research on the evolutionary continuum of RNA world from quantum entanglement to the qualia of consciousness during the 90-120 minute basic rest-activity cycle of the 4-stage creative process in the chronobiology of performance and stress.

**The Qualia of the Creative Psychosocial Genomic Healing Experience are associated with a gene expression pattern that is similar to that observed in stem cell activation.**

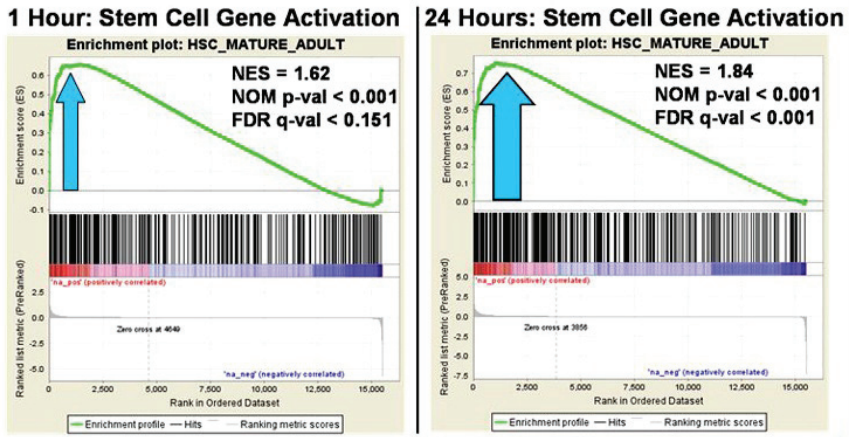


Figure 9. The Creative Psychosocial Genomic Healing Experience associated with qualia-dependent gene expression similar to stem cell healing. What appears to be a bar code are genes that are expressed during DNA microarray experiments. The up-regulation of gene expression generated by the CPGHE is emphasized by the large upward pointing arrow.

**The Creative Psychosocial Genomic Healing Experience is Associated with Experience-Dependent Gene Expression that is the Opposite of Chronic Inflammatory Disease.**

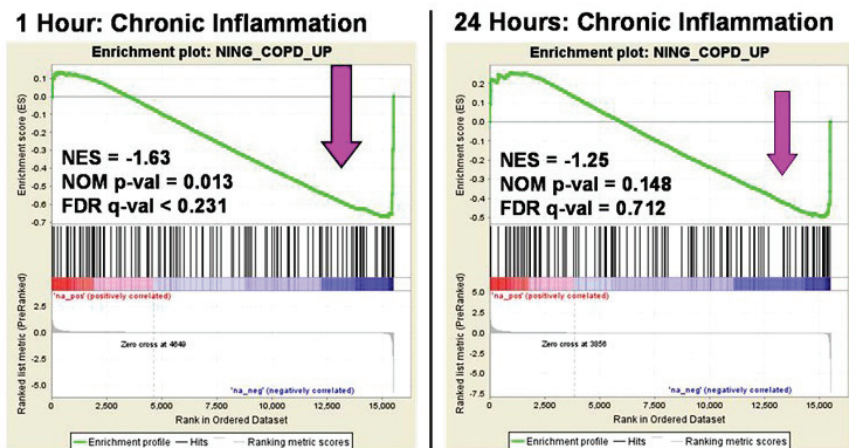


Figure 10. The CPGHE associated with the qualia-dependent gene expression that is the *opposite* of chronic inflammation and cellular oxidative stress is emphasized by the large downward pointing arrow.

The epigenetic and informational dynamics of riboswitches that form “Boolean logic gates” for mediating adaptive changes in behavior and consciousness via RNA/DNA transcription/translation suggests how decoding the *Chalmers Hard Problem of Consciousness* could generate the foundations for a new science of the qualia of the molecular biology of creativity and thought.

There is experimental evidence for the role of novel qualia-dependent gene expression and brain plasticity encoding adaptive memory and learning while awake and during REM dreaming. This motivated our pilot study of the Creative Psychosocial Genomic Healing Experience as a new model for evidence-based molecular-genomic research on psychotherapy.

Replicating research on how the Creative Psychosocial Genomic Healing Experience facilitates qualia-dependent gene expression associated with the up-regulation of (1) stem cell activation, (2) the down-regulation of chronic inflammation and (3) oxidative stress is now a priority for translational research on human health and well being.

## References

- Atkins, J., Gesteland, R., & Cech. (2011). *RNA Worlds: From Life's Origins to Diversity in Gene Regulation*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y.
- Atkinson, D., Rossi, E. et al. (2010). A New Bioinformatics Paradigm for the Theory, Research, and Practice of Therapeutic Hypnosis. *American Journal of Clinical Hypnosis*, 53 (1).
- Breaker, R. (2011). Riboswitches and the RNA World. In Atkins, J., Gesteland, R., & Cech (Eds.). *RNA Worlds*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., 63-77.
- Chalmers, D. (1996). Facing Up to the Problem of Consciousness. In Hameroff, S., Kaszniak, A., Scott, A. (Eds.) *Toward a Science of Consciousness: The First Tucson Discussions and Debates*. The MIT Press, Cambridge, 7-28.
- Cheung, M., Chavez, L., and Onuchic, J. (2004). The energy landscape for protein folding and possible connections to function. *Polymer*, 45, 547–555.
- Culler, S., Hoff, K., & Smolke, C. (2010). Reprogramming Cellular Behavior with RNA Controllers Responsive to Endogenous Proteins. *Science*, 330, 1251-1255.
- Dusek, J., Otu, H., Wohlhueter, A., Bhasin, M., Zerbini, L., Joseph, M., Benson, H. & Libermann, T. (2010). Genomic counter-stress changes induced by the relaxation response. *PLoS ONE*, 3(7), e2576. doi:10.1371/journal.pone.0002576.
- Erickson, M. (1964/2008). The Burden of Responsibility in Effective Psychotherapy. In Rossi, E., Erickson-Klein, R. & Rossi, K. (eds.) *Volume 3: Opening the Mind: Innovative Psychotherapy, The Collected Works of MHE*, pp. 67-71. MHE Foundation Press, Phoenix, Arizona.
- Gilbert, W. (1986). The RNA World. *Nature*, 319, 618.



- Jung, G. (1958). *Psychology and Religion: West and East*. Pantheon Books: N. Y.
- Kempermann, G. (2006). *Adult Neurogenesis: Stem Cells and Neuronal Development in the Adult Brain*. Oxford University Press, N.Y.
- Kim, T., Hemberg, M., et al. (2010). Widespread transcription at neuronal activity-regulated enhancers. *Nature*, 465, 182-187.
- Levsky, J., Shenoy, S., Pezo, C., and Singer, R. (2002). Single-cell gene expression profiling. *Science*, 297, 836-840.
- Liu, C. and Arkin, A. (2010). The Case for RNA. *Science*, 330, 1185-1186.
- Lloyd, D. & Rossi, E. (Eds.) (1992). *Ultradian Rhythms in Life Processes: An Inquiry into Fundamental Principles of Chronobiology and Psychobiology*. Springer-Verlag: N.Y.
- Lloyd, D. & Rossi, E. (Eds.) (2008). *Ultradian Rhythms from Molecules to Mind: A New Vision of Life*. Springer, NY.
- Mattick, J. (2010). RNA as the Substrate for Epigenome-Environment Interactions. *Bioessays*, 32: 548-552.
- Mitchell, M. (2009). *Complexity: A Guided Tour*. Oxford University Press, N.Y., US.
- Otto, R. (1923). *The Idea of the Holy*. Oxford University Press, London.
- Ramakrishnan, V. (2011). The Ribosome: Some Hard Facts about its Structure and Hot Air about its Evolution. In Atkins, J., Gesteland, R., & Cech (Eds.). *RNA Worlds*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., 155-164.
- Rapparini, R. (2010). Complex Systems of Consciousness. In: Rana, U., Srinivas, K., Aery, N., Purohit, A. (Eds.), *The Philosophy of Evolution*. Yash Publishing House, 1 E-14, Pawan Puri, Bikaner-334003, Camp: Jodhpur (Rajasthan), India, 169-174.
- Ren, B. (2010). Transcription: Enhancers make non-coding RNA. *Nature*, 465, 173-174.
- Ribeiro, S. (2004). Towards an evolutionary theory of sleep and dreams. *A MultiCiência: Mente Humana*, 3, 1-20.
- Ribeiro, S., Goyal, V., Mello, C. & Pavlides, C. (1999). Brain gene expression during REM sleep depends on prior waking experience. *Learning & Memory*, 6: 500-508.
- Ribeiro, S., Mello, C., Velho, T., Gardner, T., Jarvis, E., & Pavlides, C. (2002). Induction of hippocampal long-term potentiation during waking leads to increased extra hippocampal zif-268 expression during ensuing rapid-eye-movement sleep. *Journal of Neuroscience*, 22(24), 10914-10923.
- Ribeiro, S., Gervasoni, D., Soares, E., Zhou, Y., Lin, S., Pantoja, J., Lavine, M., & Nicolelis, M. (2004). Long-lasting novelty-induced neuronal reverberation during slow-wave sleep in multiple forebrain areas. *Public Library of Science, Biology*. (PLoS), 2 (1), 126-137.
- Ribeiro, S., Simões, C. & Nicolelis, M. (2008). Genes, Sleep and Dreams. In Lloyd & Rossi (Eds.) *Ultradian rhythms from molecule to mind*. Springer. N.Y., 413-430.
- Rossi, E. (1986a). Altered States of Consciousness in Everyday Life: The Ultradian Rhythms. In B. Wolman (Ed.), *Handbook of Altered States of Consciousness*. Van Nostrand Reinhold. N. Y., 97 - 132.
- Rossi, E. (1986b). The Indirect Trance Assessment Scale (ITAS): A Preliminary Outline and Learning Tool. In Yapko, M. (Ed.), *Hypnotic and Strategic Interventions: Principles and Practice*. Irvington, N.Y.
- Rossi, E. (1988a). Nonlocality in Physics and Psychology: An Interview with John Stewart Bell. *Psychological Perspectives*, 19(2), 294-319.

- Rossi, E. (1988b). Beyond relativity and quantum theory: An interview with David Bohm. *Psychological Perspectives*, 19, 25-43.
- Rossi, E. (1988c). Perspectives: Consciousness and the New Quantum Psychologies. *Psychological Perspectives*, 19(1), 4-13.
- Rossi, E. (1990). The new yoga of the west: Natural rhythms of mind-body healing. *Psychological Perspectives*, 22, 146-161.
- Rossi, E. (1996). The Symptom Path to Enlightenment: The New Dynamics of Hypnotherapeutic Work. Zeig, Tucker, Theisen: N.Y.
- Rossi, E. (2002). The Psychobiology of Gene Expression: Neuroscience and Neurogenesis in Hypnosis and the Healing arts. W. W. Norton, N.Y.
- Rossi, E. (2004). A Discourse with Our Genes: The Psychosocial and Cultural Genomics of Therapeutic Hypnosis and Psychotherapy. Available in English and Italian. Editris s.a.s., San Lorenzo Maggiore, Italy. Zeig, Tucker & Theisen Phoenix, Arizona, US.
- Rossi, E. (2007). The Breakout Heuristic: The New Neuroscience of Mirror Neurons, Consciousness and Creativity in Human Relationships: Selected Papers of Ernest Lawrence Rossi Vol. 1. The M.H.E. Foundation Press, Phoenix.
- Rossi, E. (2011). Creating Consciousness: How Psychotherapists Can Facilitate Wonder, Wisdom, Beauty & Truth. Vol. 2, Selected Papers of Ernest Lawrence Rossi Vol. 2. The M.H.E. Foundation Press, Phoenix.
- Rossi, E, Erickson-Klein, R, and Rossi, K (2008). The future orientation of constructive memory: An evolutionary perspective on therapeutic hypnosis and brief psychotherapy. *American Journal of Clinical Hypnosis*, 50:4, 343-350.
- Rossi, E. & Lippincott, B. (1992). The wave nature of being: Ultradian rhythms and mind-body communication. In Lloyd, D. & Rossi, E. (Eds.) *Ultradian Rhythms in Life Processes*. Springer-Verlag: N.Y. 371-402.
- Rossi, E. & Nimmons, D. (1991). *The Twenty-Minute Break: The Ultradian Healing Response*. Jeremy Tarcher, Los Angeles.
- Rossi, E. & Rossi, K. (2008). Open Questions on Mind, Genes, Consciousness, and Behavior: The Circadian and Ultradian Rhythms of Art, Beauty, and Truth in Creativity. In Lloyd & Rossi (Eds.) *Ultradian rhythms from molecule to mind*. Springer. N.Y. 391-412.
- Rossi, E. et al. (2010). What Makes Us Human: A Neuroscience Prolegomenon for the Philosophy of Evolution and Consciousness. In: Rana, U., Srinivas, K., Aery, N., Purohit, A. (Eds.), *The Philosophy of Evolution*. Yash Publishing House, 1 E-14, Pawan Puri, Bikaner-334003, Camp: Jodhpur (Rajasthan), India, pp. 15-38.
- Tomlin, S. (2005). Dramatizing maths: What's the plot? *Nature*, 436, 622-623.
- Van Praag, H., Kempermann, G., and Gage, F. (1999). Running increases cell proliferation and neurogenesis in the adult mouse dentate gyrus. *Nature Neuroscience*, 2, 266-270.
- Wang, X., Song, X., Glass, C., & Rosenfeld, M. (2011). The long arm of long noncoding RNAs: Roles as sensors regulating gene transcription programs. In Atkins, J., Gesteland, R., & Cech (Eds.). *RNA Worlds*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., pp. 279-292).
- Warren, W., Clayton, D. et al. (2010). The genome of a songbird. *Nature*, 464, 757-762.
- Yarus, M., (2010). *Life from an RNA World: The Ancestor Within*. Harvard University Press, Cambridge, MA, US.