

RESPONSE TO JOHN COWAN'S PAPER: THOUGHT AND MIND AS THE PROJECTION OF MENTAHOLOMORPHIC FIELDS BY THE BRAIN: A PROPOSED MECHANISM

by Larry Goldberg, Ph.D. and Beverly Rubik, Ph.D.

Responses to the classic mind-body problem typically led to theories reducing mind to matter, matter to mind, epiphenomenal views of brain producing mind without feedback, mystical or creationist views of spirit producing mind and matter alike (again often without feedback), direct dualistic interaction between mind and body, or to the identification of both mental and physical realms as aspects of a neutral or more fundamental phenomenon. The growing sophistication of research in the cognitive neurosciences in recent decades, however, has enabled the formulation of more precise questions, at least, about the mind-body relationship. Since the decade of the brain in the 1990s, neuroscience has come to study the complexity of brain process, from its molecular mechanisms, to its neuronal firing patterns and localization of function, to its signature brainwaves and other "biofield" manifestations. Most importantly, the cognitive neurosciences have identified neural correlates of consciousness (NCC) in the higher frequency bands of brain function, ranging from gamma at 30 to 60 Hz (cycles per second) and higher. Specific areas of the brain, associated with the thalamocortical oscillations (TCO), seem to be involved in producing these frequencies. These oscillations and their electromagnetic signatures have been strongly correlated with general presence of consciousness in waking and dreaming and the specific experiences of consciousness. The intensities and frequencies of these oscillations and their electromagnetic emissions have also been shown to be greater in healers, meditators, mystics, and psychics, who have presumably cultivated higher states of consciousness.

The identification of some important NCC does not, of course, solve the mind-body problem. Not only does it not solve the “hard problem” of what produces consciousness, but it also does not solve the easier problem of modeling the relationship between brain and consciousness. It does permit us, however, to ask more precise questions. Do the TCO and their electromagnetic emissions induce consciousness and provide it with its content; or does consciousness bring coherence to the oscillations or fine-tune the details of the neuronal behavior involved? Some researchers in the field, including the late Francis Crick (at least in his earlier thought on the subject), believed that the coherence of these firing patterns “binds” neuronal activity in different areas of the cortex, enabling (somehow) an integrated conscious experience. Another Nobel Laureate, Gerald Edelman, emphasized that the high degrees of neuronal information processing in the TCO are associated with the balance between correlated and independent neuronal firing, only producing the so-called 40 Hz waves on the average. Edelman demonstrated that the information processed in this region of the brain is greater than anywhere else in the brain, and suggested that a threshold of information processing must be exceeded to produce consciousness.

Studies of the TCO have actually made it legitimate to use the term “consciousness” in the cognitive sciences, a new field embracing the neurosciences, cognitive psychology, and the philosophy of mind. Jon Cowan, although he doesn't use the term consciousness extensively, makes three contributions to the ongoing research and dialog regarding the significance of the TCO for our understanding of the relationship between the brain and thought, mind and particular states of consciousness. First, he provides an excellent review of what the neurosciences have learned about the TCO, one subset of which is more closely associated with our consciousness in general, scanning all areas of the cortex and bringing information back down the thalamocortical column to the intralaminar nuclei of the thalamus. There the various neural components of events are analyzed and synchronized, contributing to the next scanning pulse up the thalamocortical column and across the cortex. This “event binding rhythm” is always present during waking and present more weakly during dreaming. The other subset of the TCO is more closely correlated with specific sensorimotor experiences. The former is sometimes thought to provide the context and the latter the content of experience. Both are associated with relatively coherent neuronal firing patterns and the resulting brainwaves in the “40 Hz” (35-45 Hz) range. Cowan reminds us that it wasn't until digital

recording systems replaced analog devices that we could get serious about the quantitative analysis of higher frequency brainwaves. His review explores the neurophysiology associated with these gamma waves.

In an interesting exploration of state-of-the-art portable EEG monitoring, Cowan also reviews his own EEG monitoring technology for the brain's gamma wave emissions and his associated computational system, which enable cognitive neurofeedback training as well as identification of the cognitive parameters associated with different kinds of conscious experience. His system measures the 40 Hz rhythm associated with the frontal cortex while filtering away the EMG contamination, in a product that is known as the Peak Achievement Trainer. This includes the Neureka! Protocol that records the 40 Hz wavetrain conveniently from a single point at the center of the forehead. His technology also offers neurofeedback at 40 Hz, whereby the subject can train to produce greater intensity, as well as more sustained release, of 40 Hz waves. Clinical experience and some research seems to indicate that enhanced 40 Hz activity may be associated with higher levels of awareness in the experience of meditation, healing, mystical states, creativity, enhanced attention and memory, etc. Cowan's system may make it possible to explore more directly the relationship between 40 Hz brainwave emission from the frontal cortex and the inner experience of higher states of consciousness as well as deeper forms of concentration. It is also possible that learning to enhance 40 Hz waveforms by using Neureka! neurofeedback might help researchers studying the effects of intention and/or healing on various target systems in the laboratory. One may speculate that accessibility to higher consciousness may be improved with training, so that the psi effect size in these experiments, which is typically small, may increase with the intensity of the "broadcast of intention." If so, that would indeed be a boon for subtle energy research.

In addition to his reviews of the neuroscience literature and the potential contributions of his own monitoring system for studying the TCO in a cognitive science and training context, Cowan develops a speculative, yet provocative and potentially testable theory of how "thought, mind, and particular states of consciousness" might be related to the TCO (and associated activity in the surface layers of the cortex). His hypothesis explores the possibility that a "biofield" composed of multiple simultaneous modes of coherent microwave radiation, which he calls a "brain laser," arises from the TCO, becomes informed through interaction with the upper layers of the cortex, integrates its

coherent microwave components through interference effects in the form of a hologram (or holonomically overlapping patches of holograms), and produces what he calls a “mentaholomorphic field” that mediates the relationship between our specific conscious experience and neuronal behavior in the cortex.

Cowan's argument acknowledges the importance of both coherence and differential firing in the TCO. He considers the glycoproteins that form arrays in the membranes around axons that line up in parallel in vertical columns and connect the thalamus and cortex in the TCO. He postulates that the resonance of groups of these vibrating glycoproteins produce emissions of photons in multiple microwave ranges that are coherent enough to be considered masers. In aggregate, the masers produce “coherent electromagnetic and multidimensional multifaceted (EMMM) radiation,” or what Cowan calls a “brain laser.” The brain laser is transmitted through, reflected, absorbed, and reemitted by the skull, cortical layers, and other structures such as the dura, pia, and arachnoid. (He emphasizes reflection, but all of these radiative processes would be expected.) Upon exchanging information with the upper layers of the cortex, the superposition and interference of the resulting waves produces something of a holographic (or holonomic) image of the neuronal activity in the cortex. He suggests that this holonomic image, or “mentaholomorphic field,” hovers, as it evolves in and around the brain, providing continual feedback to its cortical activity.

Cowan's mentaholomorphic field also seems intended to contribute to our specific conscious experience and to reflect our conscious experience in the feedback it provides to cortical activity. It is unclear from his discussion whether consciousness should be viewed as a property of the mentaholomorphic field or as exchanging information with it. His technical term for this field, the “multifaceted multidimensional 'mentaholomorphic' field,” may suggest the subtlety of his view. There is more to his hologram than a dynamic spatiotemporal radiative process in that its “mental” component may be associated with non-spatial dimensions.

It is unclear how literally to take Cowan's claim that resonating glycoproteins act as masers (the analog of lasers emitting in the microwave range). A physical laser involves stimulated emission of a cascade of coherent light. It requires an energy pump, a laser medium that is pumped up in energy, and a metastable state at a higher energy level at which the system remains until a stimulus or spontaneous process leads to a release of energy, all at once, in a cascade of coherent light. A

physical laser goes through this cycle repeatedly over time, producing pulses of monochromatic (single frequency and in-phase) coherent light. Cowan indicates that the firing of neurons in the thalamocortical column would serve as the energy pump. The other components of his glycoprotein masers (such as the maser medium, the quasi-stable energy state, etc.) would need to be specified.

Cowan proposes that repeating glycoprotein units in the axonal membrane become synchronously excited, along with those of 1,000 to 10,000 other axons in columns of axons leading from the thalamus to the cortex and back again. Even if these glycoprotein units were collectively vibrating coherently in phase, it is not a sufficient condition to produce a laser in the brain. Moreover, lasers do not emit a number of different frequencies as depicted in his model; even a tunable laser emits only a single frequency at a given time. It appears that Cowan envisions a complex dynamic wave that has multiple simultaneous coherent modes which in aggregate constitute what he calls a “brain laser.” A holonomic interference pattern would result from the superposition of the brain laser components with one another and in interaction with neuronal and associated brainwave activities in the cortex, integrating reflections from the skull, neural tissue, and other structures. He suggests that “mind is not just inherent in the brain, but rather exists in a field that is co-located with it and simultaneously external to it”, a “multifaceted multidimensional ‘mentaholomorphic’ field” with dimensions beyond the spatial dimensions of his hologram. This terminology suggests the association of mind with the non-spatial dimensions of the “hologram,” as indicated above, but there is nothing inherent in his account of how the hologram forms and interacts with the cortex to implicate mental dimensions.

One interesting possibility is mentioned by Cowan in passing, namely that there might be a coupling between glycoproteins and such cytoskeletal structures as microtubules, microfilaments, and microtubule related proteins. He has in mind the production of resonances in the microwave range. Microtubules and other cytoskeleton features have also been of interest for their possible role in regulating the release of neurotransmitters by vesicles and their synaptic transmission. For neurons firing at approximately 40 Hz, however, the quantum entanglement and decoherence cycles involved would have to have comparable average frequencies. It has been estimated that the entanglement of tubulin proteins across assemblies of some 20,000 neurons would be involved.¹

Cowan mentions the biofield as another line of thought in field theories that pertain to the mind-matter interface. His mentaholomorphic field proposal may, in fact, be regarded as a special case of the biofield hypothesis proposed by one of us.² According to Rubik, the biofield is the biologic field associated with the living organism, including the human, hypothesized to centrally organize, regulate, and integrate the living state by conveying information throughout the organism extremely rapidly (at the speed of light). The biofield is composed of conventional electromagnetic fields, and possibly other subtler fields that may be involved in living systems. The electromagnetic component of the biofield, which can be scientifically measured, emerges from the superposition of electric and magnetic fields associated with the organism's moving charged particles (ions, peptides, proteins, DNA, etc.), and reveals itself as a complex dynamic interference pattern that functions in the holistic organization of living systems.

Interpreted as a biofield concept, Cowan's brain laser is intended to mediate between mind and body by virtue of its conventional electromagnetic properties and possibly other subtle properties. Cowan explicitly proposes several subtle properties. His multifaceted multidimensional mentaholomorphic field is characterized by more than three spatial (or other undefined) dimensions, and thereby has its access to consciousness. He doesn't develop this point, however. He hypothesizes intriguingly that his mentaholomorphic field mediates (or embodies) the relationship between the surface layers of the cortex and specific consciousness experience. For this holonomic interference pattern to form, the glycoprotein maser emissions that constitute his brain laser must make their way through the various layers of the cortex. Yet it is unclear that the glycoprotein emissions he postulates would be able to radiate much further than centimeter distances in the brain before getting absorbed. So we need to ask how it might be possible to measure the coherence of glycoprotein emissions and their successful transmission through the cortex. For a starter, Cowan suggests that we try to measure the frequencies and degrees of coherence of microwave radiation transmitted through the skull. This is a good idea. Yet even the discovery of coherent modes of microwave radiation leaving the brain wouldn't necessarily confirm the role of glycoproteins he proposes in producing the maser components. Further research would also be needed to investigate Cowan's proposed interactions between neurons in the upper layers of the cortex and the hologram produced by maser interference effects. The theory should specify how to identify the hologram and how to measure its exchange of information with neurons.

Cowan's brain laser emerges from glycoprotein emissions, exchanges information with the cortex, and creates a "holonom" (overlapping patches of holograms) through continual interference effects among its maser components and neuronal "reflections." It is presumed that this "hologram" (to use the more familiar term) has a close relationship with specific conscious experience, although it is not clear whether the relationship is one of interaction or "identity." This notion of an integrated image of cortical activity is indeed interesting, but why would it be any closer to consciousness than the oscillating electrical and magnetic fields (brainwaves) we already know are there? Perhaps light is closer to consciousness than electrical and magnetic fields. Indeed, beginning with the ancient worship of the sun, many spiritual traditions have held light to be intimately related to divinity and higher consciousness. However, some way of demonstrating a special relationship between light and consciousness would have to be suggested. Perhaps a mathematical demonstration that light can store and transmit more information than fields could take us in the right direction. This certainly seems to be suggested by the success of the fiberoptic Internet.

There is also the question of competing emissions. Since each conformational change in proteins, DNA, and other biological macromolecules is associated with the absorption or emission of photons in the microwave (or infrared) range or phonons (associated with vibrations in the acoustic range), their interactions with the biofield render it rich in many microwave, infrared, and even acoustic components. What would prevent the glycoprotein signal from getting lost in the sea of other emissions? Why wouldn't these other emissions provide useful information? Cowan also mentions scalar waves and quantum fields (or wavefunctions) as possible components of his mentaholomorphic field. So as he suggested privately, perhaps his theory is really a family of theories—a metatheory of what has been called the "biofield"²

The power of theory lies in the new research questions that it generates, and the new observations that may result. It is unclear that Cowan's multifaceted multidimensional mentaholomorphic field is carefully enough conceived to be tested, but perhaps the theory of the mentaholomorphic field will be refined to motivate experimental tests of its presence and mutual relationship with the surface layers of the cortex. The theory does have the virtue of proposing a non-molecular interface (namely the projection of his mentaholomorphic field in ordinary space and time) between the brain and consciousness. Perhaps such

theories, by nature, require the contributions of multiple cooperating disciplines for their development and testing. Other “interface” theories are certainly needed as well. With enough seriously conceived theories out there, there might be opportunities to test them more systematically in funded research programs. One of us (Goldberg) would vote for quantum theories of possible interfaces between consciousness on the one hand and the brain and all its superimposed and interrelated field effects and radiative processes on the other hand.

Perhaps the biofield, with all its electromagnetic dynamics, has an organizing effect on the quantum vacuum (or “plenum,” as it is sometimes called to emphasize that it is filled with virtual particles, not empty). If the brain and its associated biofield explore alternative patterns, then the organization of virtual particles in the vacuum would reflect these alternatives. Such vacuum effects may support the formation of wavefunctions that represent the alternatives and present them to “consciousness” as options for consideration. Conscious preference may, in turn “collapse” the wavefunctions, favoring the brain/biofield states of choice.³

Many theories are possible, but to contribute to scientific progress, they will have to be developed and tested systematically in interdisciplinary research programs. Knowing full-well the difficulty of doing so, we wish Jon Cowan the greatest luck in contributing, with his theories and neurofeedback training technology, to the development of such programs.

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RESPONSE TO COMMENTS BY RUBIK AND GOLDBERG

by Jonathan D. Cowan, Ph.D.

There are times when an author is left scratching his head in astonishment when he reads a response to his work. Unfortunately, this is one of those times. Although Goldberg and Rubik do make some interesting points in their commentary, and I do appreciate their efforts to understand the paper, it is not clear that we are even discussing the same subject. The title of my paper began with "Mind and Thought...". I deliberately did not use the word "consciousness" because I thought it did not convey the meaning I wanted, and it had too many other meanings. I actually changed the previous version of the paper to eliminate that word, which was in the title.

However, Goldberg and Rubik don't use the words "mind" or "thought" once in their response, but instead use the word "consciousness" many times. The words are not equivalent. For example, John Locke defined consciousness as "the perception of what passes in a man's own mind." That's right at the beginning of the Encyclopedia Britannica entry on "consciousness."

From my perspective, Locke's definition of "consciousness" places it squarely in the intralaminar nuclei of the thalamus, which originate the 40 Hz. event binding rhythm and receive back the modified information from the cortical surface layers that has been influenced by the "mind"-the mentaholomorphic field. The more interesting questions relate to the workings of the "mind" in its processing of "thought" and perhaps other types of content. In recent years, we have overemphasized the importance of the mystery of "consciousness," rather than the mystery of the "mind," or confused the two. The Goldberg and Rubik paper reflects this distorted quest.

Unfortunately, I don't have adequate time to fully detail these complex questions for this issue of the journal. I would like to see a continuing dialog in the future that will bring the discussion into focus on the innovative theory I am proposing.

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