Neuroscience Reveals the Mind/Brain Interface and How It Controls Our Behaviors and Our Lives

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ABSTRACT

One hundred twenty-five cases were examined, data was collected over a 12 month period, in three different locations, with different EEG technicians, using two different types of EEG equipment; showing the p-value is <=0.010. This paper presents research that clearly links the mind/brain interface. It also provides insight into how subconscious belief patterns affect our behaviors and control the outcome of those behaviors in our life. This kind of research might well be very important and useful providing a greater understanding of how to implement processes oriented toward integrating thought and behavior patterns in all areas of our life. The creation of the essential neuropathways, indicated by the author, most certainly will help in processes oriented to integrate three main components: (1) research, (2) education and (3) consulting. The process is key to improving the performance of each of these three activities.

Keywords: QEEG, Quantum, Brain Mapping, PSYCH-K®, Thought, Subconscious, Belief Patterns

1. INTRODUCTION

We have explored the mind/body conundrum since man first became aware of his own existence. We have pondered concepts like the *mind, consciousness, thought, intelligence* and *awareness* in an effort to begin to define the relationship between the mind and body. We believe that by defining such words we will come to an understanding of what is happening in the *process,* and/or the *experience*. Down through the ages the questions of the human mind's consciousness seem to create problems that we try to explain away. Harvard cognitive scientist Steven Pinker commented on consciousness. *Although neither problem has been solved, neuroscientists agree on many features of both of them, and the feature they find least controversial is the one that many people outside the field find the most shocking. Francis Crick called it, "the astonishing hypothesis" – the idea that our thoughts, sensations, joys and aches consist entirely of physiological activity in the tissues of the brain. Consciousness does not reside in an ethereal soul that uses the brain like a PDA (personal digital assistant); consciousness is the activity of the brain* [1].

Prevailing hypothesis posits that the brain is the seat of consciousness. Further more, the brain actively is a self-emergent property of the brain itself. This paper challenges this hypothesis, and argues that which we call the mind is separate from the brain and is the true origin of brain activity. This conclusion is evidenced by the emerging field of epigenetics.

Our journey should begin by understanding the anatomical and functional process of consciousness. We begin our understanding by distinguishing between the *operation of consciousness* and the *content of consciousness* [2]. The *general operation of consciousness* (GOC) is characterized by longer time intervals and relatively time invariant processes such as sleep, wakefulness, arousal, and coma. The GOC is a relatively tonic state, with slow adjustments of the levels of arousal (i.e., on the order of minutes and hours), such as changes in levels of awareness and/or drowsiness and are mediated by reticular-limbic and thalamic excitatory control systems. In contrast, the *content of consciousness* (COQ) is defined as the momentary collection of sensations and thoughts that we would call the "present moment," which is temporally and hierarchically nested within the GOC and is mediated by the coherent activation of large ensembles of neurons.

William James referred to the content of consciousness as the *specious present*, which he defined as that "interval of time (about 1 to 7 seconds) when an event that belonged to the present is distinctly perceived as the past" [3]. A finer temporal grain of the content of consciousness is provided by the psychophysical experiments of Efron [4], [4a] that demonstrated an approximately 20- to 200-ms *perceptual frame* in which nearly simultaneous events were integrated into a perceptual whole event [5], [5a].

This work was reviewed and summarized in a publication entitled, *Functional Landscapes of the Brain: An Electrotopographic Perspective*, in which the results of

both spatial principal components analysis (SPCA) and temporal principal component analyses with Varimax rotation (TPCVA) analyses were presented in a series of experiments [6], [6a]. Grossberg and Somers did mathematical and simulation studies by demonstrating that zero phase locking between connected networks occurs whenever two conditions are met: (a) there is strong coupling and (b) there is some form of delay (or inhibition) involved in the coupling between networks [7]. Other studies have postulated a specific role of feedback and feedforward inhibition in the creation of synchronized zero phase locked neural activity [8] [8a]. Thus, strong coupling and delays appear to be necessary. Studies completed at the National Institutes of Health involved the neuronal mechanisms by which human voluntary movements occur using multimodal registration of EEG, MRI, and PET. EEG coherence and phase measures were obtained, before and after finger movements, and specific patterns of neuronal activation were observed to correlate with the allocation of resources that underlay the finger movements. A neural network switching model was developed in which loops of cells behaved similar to spinning tops or gyroscopes. The justification for this view was standard neural network models that involve nearly instantaneous switching dynamics that could not explain the computation of strong second derivatives involved in the dynamics of neuronal switching, and essential elements in the establishment of zero phase lag coherent neural activity. However, precisely which brain regions (e.g., thalamus, reticular formation, limbic cortex, etc) control the spatial and temporal distribution of inhibitory and excitatory drives at a given moment of time, is very complicated, and likely task specific [9] [9a].

Many scientific perspectives consider consciousness to be the result of sensory input brought into the brain by different sensory afferents; the very function becomes the basis for cognition [10]. Some have looked at cognition as an intrinsic functional state of the brain. It has been proposed that consciousness is an oneiric-like internal functional state modulated, rather than generated by the senses [10a]. As a child we may remember the sound of a curtain fluttering in the dark and how it could evoke worrisome images that were immediately dispelled when the lights were turned on. Understanding that the internal events we perceive as *thinking, imagining* or *remembering* are related to an intrinsic activity. A large percentage of the connectivity in the brain is recurrent and that much of its activity is related to intrinsic connectivity not necessarily related to the immediacy of sensory input.

We are aware that when we are very tired, we fall asleep very quickly, and while asleep an extraordinarly strong stimulus is given us (i.e. an alarm clock), we can then awaken remarkably fast. Understanding that the substrate capable of supporting the speed of these two events must be electrical in nature, in the sense of the electrical activity of neurons and the synaptic input that initiate or terminate such activity. This would prompt the question, what is the basic difference between being awake and being asleep? The answer to this question would provide the fundamental clues as to the nature of consciousness.

Being asleep does not support the feeling of self-existence. We might also equate consciousness with cortical function almost on an exclusive basis. One additional assumption related to consciousness is that it is a global function state of the brain relating to more cortical activity. Perhaps the energy measured in the brain relating to consciousness and the creation of a unified brain function may be both resonant, and have properties of oscillation.

2. THALAMOCORTICAL GAMMA-BAND RESONANT COLUMNS

In recent years, studies have shown that coherent electrical activity in the cortex is relevant to the function of resonance when considering its relationship to cognitive thought [11]. This work proposed that coherent events occur at the cortical level, and such cortical events are the primary binding substrate [12]. Other experimental results illustrate that the *binding event* must not be cortical but rather thalamocortical [13]. The use of magnetoencephalography (MEG) in humans and extracellular and intracellular recordings in cats *in vivo,* indicate that such activity is supported by resonance between thalamic and cortical structures at gamma-band frequencies (i.e. with frequencies between 20 and 50 Hz), and are often centered close to 40 Hz [14]. The results of this study favored the hypothesis that cognitive events depend on activity involving thalamocortical resonant columns. These neuronal mechanisms are responsible for high-frequency thalamic oscillations that support the synchronization of thalamocortical structures and their relationship to coherence.

3. OSCILATORY PROPERTIES OF THALAMIC CELLS

Nearly twenty years ago it was suggested that there is an intrinsic neuronal element with the oscillatory or resonant properties related to a neuronal network that facilitates the occurrence of coherence between interconnected elements [15]. Llinas explains that the intrinsic electrical properties of thalamic neurons support high-frequency (20-50 Hz) subthreshold oscillations when thalamic neurons are depolarized beyond -45mV [16]. Previous studies *in vivo* describe oscillations in both relay and reticular thalamic neurons [17]. Understanding the basis of the dendrite conductance is a key issue for the effect of fast oscillation in thalamocortical cells. They depend on

the activation of voltage-dependent calcium conductance [18]. This demonstrates that neurons exhibit active membrane oscillations and are part of intrinsic oscillation properties of the thalamic cells. These findings are in accordance with previous work reporting that thalamic cells display highly rhythmic activity in the gamma range of frequencies [19].

Active dendritic oscillations are functionally significant, in that they return input from the cortex to thalamic neurons providing a unique opportunity for resonance between intrinsic dendritic oscillation and rhythmic synaptic inputs [20]. We can conclude from this that coherence of fast rhythms in thalamocortical loops might depend on the patterns of synaptic inputs and on the responsive state of the neurons.

When considering the neuronal circuit oscillating in the Gamma band (40-60 Hz), the neurons in specific thalamic nuclei establish cortical resonance by direct activation of pyramidal cells and feedforward inhibition through the activation of 40 Hz inhibitory interneurons in layer IV. These oscillations re-enter the thalamus via layer VI pyramidal cell axon collaterals, producing thalamic feedback inhibition via the reticular nucleus [21]. In layer V, pyramidal cells return oscillations to the interthalaminar nuclei in the gamma-band and are capable of recursive activation [22]. It is understood that neither of these two circuits alone can generate cognition. This would offer the notion that there is a specific organization of the thalamocortical system that when it receives special input activity, resonation occurs. After optimal activation occurs in the thalamocortical loop, then oscillation in the gamma-band is easily recognized over the cortex by its oscillation characteristics. Thereby, causing the sites to peak and become a cognitive component that is capable of optimal activity.

The body of work preceding this study suggests that there are several different rhythmic and oscillatory functions that travel between the thalamus and the cortex. They function on the basis of temporal coherence and the simultaneity of neuronal firing. In turn, the neuronal firing is based on the passive and active dendritic conduction, and would provide a mechanism for global binding. Such a system would provide the content that relates to the external world, and the non-specific system would give rise to a context that is more concerned with alertness. Together they would generate a single cognitive experience [23].

4. THE ISSUE OF ZERO PHASE LOCKING

E. Roy John presents information related to zero phase locking of coherent neural activity during perception and memory that is of great significance to understanding the brain's ability to provide for optimal performance, and what I would characterize as the whole-brain state [24]. What is especially unique and important is the finding of five spatial principal components (SPCs) capable of accounting for 90% of the variance of scalp voltage patterns that reflect coherent activation of large ensembles of neurons. The fact that the SPCs were similar during different cognitive tasks and in different subjects suggests fundamental subsets of organized neural resources that are common to all people performing these tasks. This suggests further that these SPCs reflect a binding process that brings together spatially distributed fragments of the past to evaluate and experience the immediate present in a brain state [25].

Oschman says that atoms are measured by their vibration, while in constant motion. They create wave patterns similar to the expanding ripples from pebbles thrown into a pool of water. Each atom is unique because the distribution of its negative and positive charges coupled with its spin rate, generates a specific frequency pattern [26]. Bruce H. Lipton adds an important point to the phase locking issue with consideration of *destructive* and *constructive interference patterns*. He explains that the behavior of energy waves is important in biomedicine because vibrational frequencies can alter the physical and chemical properties of an atom. An example of *destructive interference* would be when a pebble is dropped into water and the waves are moving outward from the center. Shortly after the first pebble is dropped, a second pebble is dropped. Since the pebbles do not hit the water at the same time, the waves will not be aligned; they will be out-of-phase. *Constructive interference* would be similar except that when the second pebble hits the water, the ripples moving outward are in-phase and come together to create higher amplitude of the composite wave. Lipton explains when you want to enhance, rather than stop atoms, you find a vibration that creates harmonic resonance [27].

5. THE COHERENT VIBRATIONS OF THE AXONS' GLYCOCALYXES

Axons have a repeating structure, spaced at fixed intervals, and specifically designed to amplify the signal from the thalamus by activating the gate-channel complex, embedded in the axon's membrane. One particular membrane structure that should give rise to coherent energy waves is the glycocalyx, or sugar coating, which is composed largely of glycoproteins, or proteoglycans. These include a number of derivatives of chondroitin sulfate and heparan sulfate. All of these structures are inside the myelin sheath of each axon. Glycoproteins have an uncharged protein end, which dissolves in the fatty membrane, and a very negatively charged sugar end, which sticks out into the external fluid, somewhat like a ball on a rubber stick [28]. Jonathan D. Cowan explains that together, these sugars form the bulk of the glycocalyx. There is a gate/channel complex that changes conformation to briefly allow ions

into the axon during a nerve impulse, thus causing the nerve cell to depolarize. It then returns to its original shape when the impulse has passed. When this gate/channel complex in the membrane moves rapidly in response to a nerve impulse, the charged sugar ends, that line the axonal membrane, should all vibrate back and forth. These glycoproteins are either directly or indirectly connected to the channel protein. As the channel opens and then closes in response to each impulse, its kinetic energy is transferred to the glycoprotein and to other surrounding structures, which vibrate and emit an electromagnetic wave, until this motion is damped out. Other vibrational modes and frequencies as well as the related electromagnetic waves, result from the movements of charged atoms within the membranes. Lipton says this is roughly analogous to what happens every time we open, then slam a door shut. Some of the kinetic energy is transferred to the surrounding walls, where it vibrates their internal layers, as well as the surface structures [29]. External energy oscillations will undoubtedly affect the structures, combining to create a condition that is both subject to resonation and oscillation, resulting in the creating of a unified whole-brain state.

6. THE ZERO-POINT FIELD AND ENTANGLEMENT

For centuries, the Newtonian perspective that the universe was mechanistic and things work in a comfortable and predictable manner has long been replaced by quantum theories. We understood that subatomic particles were not solid little objects like billiard balls; Einstein taught us that they are vibrating packets of energy that sometimes acted like a particle and sometimes like a wave. Heisenberg presented the notion that quantum particles are *omnipresent.* Quantum physicists discovered a strange property in the subatomic world called *nonlocality* to describe the properties of what we now call quantum entanglement. This refers to a quantum entity such as an individual electron influencing another quantum particle instantaneously, over any distance, despite there being no exchange of force or energy. It also suggested that quantum particles once in contact, retain a connection even when separated, so that the actions of one will always influence the other, no matter how far they are separated [30].

Pribram presented ideas that the mind and consciousness are not just local events. Rather, they exist as part of a constantly changing fundamental field that he termed the *biofield* [31]. Noted physicist David Bohm based his analysis of the nonlocal field on empirical evidence of quantum theory [32]. Pribram agreed with Bohm's idea that there is an *implicate order* to the universe that pertains to all matter. As it pertains to brainwave activity he proposed that there are holonomic overlapping patches of holographic structures in the cortical surface layers of the brain, which would transform inputs from perception and thoughts into slow electrical potentials presented in EEG brain wave patterns. Bohm also suggested that several different types of fields, each operating at many spatial and temporal frequencies, may well be involved. He said that the characteristics of the particular type of *oscillation* would partially determine the range and resolution of the potential information transfer; this has yet to be understood. Quantum fields do not diminish as quickly over distance as electromagnetic fields do in the brain [33].

7. INTRODUCTION TO QUANTUM EFFECTIVENESS

While quantum correlations, or entanglement, are clearly of paramount importance for efficient pure state manipulations, mixed states present a much richer arena and reveal a more subtle interplay between correlations and how to distinguish between them [34].

We do not generally understand why events we observe around us are correlated in the first place. Correlations themselves are very simply quantified within the framework of Shannon's information theory. Suppose we repeatedly perform measurements on a given system, at different instants of time. Let us record the outcomes of our observations as a sequence. Different sequences of outcomes will naturally have different probabilities associated with them.

Correlations now suggest that this probability will most generally not be expressible as a product of probabilities of subsequences. Shannon introduced the notion of mutual information in order to quantify how correlated different observations are [35].

For simplicity, if we divide measurements into two groups, A and B, each of them having a well defined probability distribution, respectively, as well as a joint probability distribution, then the mutual information between A and B is defined. This is the well-known Shannon entropy model. There is a certain degree of subtlety in trying to extend Shannon's mutual information to more than two different sets of outcomes (A and/or B). The concept of mutual information is so general that it can easily be extended to quantum systems [36]. This leads us to understand that having of quantum mutual information, which, for a general state of either A and/or B is now defined and provides the basis by which the relationship can be understood.

First of all there is entanglement. Given a bipartite quantum state (where there are two separate entities with substrates), entanglement by the states of the form are known as separable or disentangled. Entanglement is then

most easily quantified by calculating how different this state is to any separable state. This will simply mean that there is a state for system A and a separate state for system B. Shannon says, the more correlated A and B, the more we can learn about one of them by measuring the other. Suppose we make measurements of A. For each measurement there is an outcome occurring with probability. We can also define this quantity by swapping the roles of A and B. It is true that separate states contain correlations over and above just the classical ones. The discrepancy between the two is known as the quantum discord. We will call discord the correlations over and above classical brain states but excluding entanglement [37]. The general picture is this, quantum mutual information in any quantum state, A or B, can be written as a numeric value of entanglement in the state as measured by the relative entropy of entanglement [38] to put it on an equal footing with other entropic measures of correlations. Physically this means that the quantum mutual information measures total correlation in a quantum state.

We might ask, what feature of quantum mechanics makes quantum information processing more efficient than classical resonation? *It has been said that quantum entanglement is clearly that feature.* The answer seems obvious in the case of pure states. If there is no entanglement during the evolution of pure states, then that evolution can efficiently be simulated by classical systems [39]. But, we should remember that according to our above discussion, pure states contain the same number of classical correlations as entanglement. Therefore, we might well say that it is classical correlations of resonance in pure brain states that are responsible for the speed-up. And that, the oscillations from entanglement create the quantum effectiveness, which leads to the unified whole-brain state, which in turn can now operate with complete balance and efficiency in all areas, adding to a heightened level of consciousness and cognitive ability.

8. DISCUSSION OF THE WHOLE-BRAIN STATE'S EFFECT ON OUR BELIEF SYSTEM

A controlling factor in human interactions seems to be the whole-brain (hemispherically synchronized) state. A study reported in 1988 in the *International Journal of Neuroscience*, by researchers at the Universidad Nacional Autonoma de Mexico, suggest that synchronized brain states significantly influence nonverbal communication. The study was done with thirteen paired subjects. The subjects were tested in a darkened and soundproof Faraday cage (a lead-lined screened chamber that filters out all outside electromagnetic activity). Each pair of subjects was instructed to close their eyes and try to "communicate" by becoming aware of the other's presence and to signal the experimenter when they felt it had occurred. The brainwave states of the subjects were monitored during this process. Experimenters reported that during the sessions an increase in similarity of EEG (brainwave) patterns between the pairs of communicators developed. Furthermore, the experimenters noticed, "The subject with the highest concordance [hemispheric integration] was the one who most influenced the session." In other words, the EEG patterns of the individual with less synchrony between the brain hemispheres would come to resemble the EEG pattern of the person whose two sides more closely resembled each other [40].

These conclusions support the allegation that our thoughts, even nonverbally expressed, can influence others. In fact, the more whole-brained *we* become, the more we influence *others* toward that state of being as well.

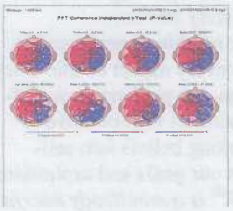
In Dr. Bruce H. Lipton's bestseller, *The Biology of Belief*, he says, "*Our positive and negative beliefs not only impact our health, but also every aspect of our life.*" He goes on to say, "*Your beliefs act like filters on a camera, changing how you see the world. And your biology adapts to those beliefs.*" [41]
Robert M. Williams M.A., originator of PSYCH-K®, explains the significance of subconscious belief patterns. Our beliefs, usually subconscious, are the cumulative effect of life-long "programming." As a result of past conditioning, we sometimes think and behave in self-defeating ways. Conscious thoughts can be changed easily by simply receiving information: reading a book, having a conversation, or seeing the results of actions. However, if conscious information were all that was needed to lead satisfying and successful lives, most of us would already be doing that. Unless changes are made at the subconscious level, however, repeating undesired reactions and behaviors will likely continue. Subconscious beliefs have far reaching consequences, both positive and negative, in every aspect of life. They affect our moods, relationships, job performance, self-esteem, and even physical health. It is imperative to know how to change self- limiting beliefs into self-enhancing beliefs that support our goals and aspirations. Williams explains, "*PSYCH-K® is a mind/body interface process that gives us control over the detrimental effects of past experiences, freeing us from those habitual reactive behaviors that no longer serve us.* " [42].

9. QEEG AND QUANTUM EFFECTIVENESS

Our research gathering documented one hundred twenty-five (125) cases, with data gathered over 12 months in three different locations, utilizing different EEG technicians, using two different types of EEG equipment; the result of this investigation produced a p-value of <=0.010.

A baseline of EEG data was established for each case. Using EEG caps calibrated by Electro-Cap International, standard procedure was to inject each of the 10-20 international systems for electrode placement with standard electro-gel making contact with the scalp and the electrode. Ensuring that the dc-offset voltages were within acceptable range, three (3) baseline readings of five (5) minutes each was recorded; five minutes eyes open, five minutes eyes closed and five minutes with the brain on task (reading silently in a magazine).

A Certified PSYCH-K Facilitator, used standard PSYCH-K® practices to achieve the whole-brain state with the subject. Following the intervention of the PSYCH-K® change process (aka a *balance*), a post-intervention EEG was recorded in the same manner as the EEG baseline stated above. The *balance* took approximately 10 minutes to complete. Raw EEG data was artifacted to eliminate eye movement, tongue movement, swallowing or other unwanted disturbances in the EEG. Standard EEG artifacting criteria was used and accomplished by an experienced qualified EEG technician. A minimum of 1 minute of artifacted *clean* data (although data presenting at .90 or above is considered acceptable; standards for artifacted data for this study must meet or exceed .95 in both *Split-Half* examination and on *Test-Retest* examination). Statistical analysis was performed by NeuroStat, a function of the NeuroGuide program from Applied Neuroscience. NeuroStat allows for individual independent t-tests to be performed. The following are several examples from the base of 125 cases examined for the whole-brain state.

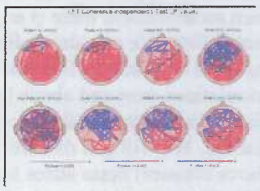


The independent t-test compares condition A to condition B and shows if there are differences in the dominant brain function (consider the discussion of Shannon's method above).

In all of the depictions shown here the legend is the same. The RED represents the dominant brainwave pattern prior to the facilitation of the PSYCH-K® *balance*. The BLUE represents the dominant brainwave pattern after the energy balance had been facilitated. The thickness of the line, indicates level of P-factor, see legend below figures.

The whole-brain state is considered to be the combination of RED; condition A, dominance prior to energy balance. And condition B, dominance after the energy balance was facilitated.

Due to the space restriction of this paper, it is not possible to provide a comprehensive treatment of this subject. However, the amount of data collected, and the unique properties it represents, afford us the opportunity to evaluate and continue to understand what it means, as well as providing intriguing hints the nature of its potential.



10. CONCLUSION

Clearly there is more to learn and understand in this robust field of study. More scientific papers are forthcoming to better identify the nature and results of this work, as well as its relationship to neuroscience. A greater understanding of the relationship between the oscillation of the zero-point field and brainwave resonation is an area for continued research. In addition, more research needs to be done to discover the significance of thought and it's effect on subconscious belief patterns. Clearly, subconscious belief patterns guide our perception and behavior. Knowing how changing perception at the subconscious level of the mind, can change a subconscious belief pattern, can now be depicted in brainwave energy and the creation of the whole-brain state. Continued research in this area will assist in recognizing and adopting applications that will be beneficial in academics, personal health, professional performance, and virtually every area of human life. Practical applications of changing subconscious belief patterns have existed for over two decades; today we can measure them and graphically demonstrate their efficacy, lending to further understanding and utilization of this important aspect of human existence in virtually all walks of life.

"A human being is a part of the whole, called by us 'Universe,' a part limited in time and space. He experiences himself, his thoughts, and feelings as something separated from the rest, a kind of optical delusion of his consciousness. This delusion is a kind of prison for us, restricting us to our personal desires and to affection for a few persons nearest to us. Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living creatures and the whole of nature in its beauty. Nobody is able to achieve this completely, but the striving for such achievement is in itself a part of the liberation and a foundation for inner security."

–Albert Einstein-

Only now we are beginning to understand! -JLF-

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