

THE

INTERNATIONAL JOURNAL OF MANAGEMENT AND BUSINESS



ISSN 1949-2847

Volume 3 - No. 1
August 2012

Published by:

 The International Academy of
Management and Business (IAMB)
Silver Spring, Maryland, USA

NOTE: The paper contained in this PDF has been extracted from the complete Vol. 3 Issue 1, August 2012. The complete published journal contains 156 pages. The authors of this paper extracted their work for easier access to the reader.

Journal Editor's Introduction

The paper written by **Jeffrey L. Fannin and Robert M. Williams**, entitled “Neuroscience Reveals the Whole-Brain State and Its Applications for International Business and Sustainable Success” [from USA]; discusses the fascinating aspects of the recent development in neuroscience and their applicability to management and leadership. The authors discuss number of studies in neuroscience of consciousness that provide some insight into the interrelatedness of subconscious belief patterns with behavior that affect decisions made by business leaders, and indirectly affect their overall performance in business. This paper presents research that associate the mind/brain interface, displaying empirical evidence of what the authors describe as the *Whole-Brain State* (a bi-lateral, symmetrical brain wave pattern) and how it causes sustainable success and some potential implications it has on international business. The authors focus on research that has the potential to change the subconscious beliefs of an individual (PER-K®) and suggest aligning that with the *Principles of Nature*. The paper provides an in depth discussion in one of the most intriguing scientific developments of the 21st century, the study of the brain, and describes one specific application to the area of study of leadership, that might have significant impact on individuals and organizations in the near future.

Neuroscience Reveals the Whole-Brain State and Its Applications for International Business and Sustainable Success

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Abstract

At first glance, neuroscience and business may seem an odd juxtaposition. However, the neuroscience of consciousness provides some understanding of the interrelatedness of subconscious belief patterns that drive behaviour and affect optimal decisions by business leaders, as well as overall performance in business. Our thoughts and beliefs, i.e. our mindsets, drive our actions and create the results we are getting. This paper presents research that clearly links the mind/brain interface, presenting empirical evidence of what the authors identify as the **Whole-Brain State** (a bi-lateral, symmetrical brain wave pattern) and why it is fundamental to achieving sustainable success and the implications it has on international business. This paper will offer insights into one of the most important issues addressed in this writing; that is, the misalignment of the principles of business with the Principles of Nature, resulting in potentially catastrophic consequences for the economy, the ecology, individuals, businesses, and the planet [1]. This research also identifies and explores the process of changing subconscious beliefs.

Key Words: EEG, subconscious, leadership, business, nature, principles, beliefs

The authors of this paper offer a word of warning, that the level of scientific depth presented here may be more information than some readers care to navigate. If the waters of the science get too deep, feel free to float gently to the **Summary** at the end of the paper, which will provide sufficient understanding regarding our conclusions, without having to paddle your way through the scientific details.

Introduction

Our research gathered and documented one hundred twenty-five (125) cases, 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 .

To better understand the scientific significance of this report, knowledge of the relevance of p-value will help to put this research into perspective. In statistical significance testing, the **p-value** is the probability of obtaining a test statistic at least as extreme as the one that was actually observed. When the result falls at 0.05 or 0.01, it is said to be statistically significant. In the case of the Fannin-Williams research, a very high degree of statistical significance occurred: ≤ 0.010 . This indicates that the relationship between the two phenomena explored in the research is highly significant with less than a 1% possibility of being related to chance.

The authors of this paper offer a point of view based on new research in biology and human consciousness. For example, the emerging field of epigenetics is fast replacing the older concept of genetics. It

is apparent from the failure of the genome project that genes do not possess self-emergent properties that cause the genes to express potentialities originating in the brain. Instead, it is the epigenetic signals (signals above the genes) that trigger such events [2]. Analogously, the authors are suggesting that activity in the brain is largely triggered by epigenetic signals (signals outside of the brain, e.g. mind/consciousness field), creating subsequent biochemical and physiological responses. The essence of this new hypothesis is incorporated in this paper, and constitutes what the authors call the *mind/brain interface*.

We suggest that the data from our own studies and the research of others show that it is our thoughts and beliefs that drive our actions and create the outcomes we get. By changing our conscious thoughts and *subconscious beliefs*, we facilitate changes in our behaviours and consequently in the results we experience. Some conventional thinking would suggest that changing brainwave patterns that affect subconscious processing is a lengthy process and occurs slowly over time. This paper offers data that suggest that the brain has the ability to reorganize brainwave energy, creating the **Whole- Brain State**, and thus allow for more optimal performance of subconscious belief patterns. This phenomenon has great importance to the principles of international business, leadership and creating sustainable success. The research further suggests that the process is not lengthy, nor complex.

Once the possibility and practicality of changing our subconscious beliefs is established, it becomes clear that we are no longer trapped by the automatic mindsets of our past experiences, which often drive self-limiting and self-defeating behaviour. Instead, we are free to change our perceptions and beliefs in order to create new mindsets and behaviour that will generate new results in our business and personal lives. Freed from the limitations of past “programming,” we are able to move to a higher order of consideration of *what is worth changing*, in order to create sustainable success, both personally and professionally.

As we become more educated about the difference between the conscious and subconscious minds, with emphasis on the *subconscious*, we realize the importance of recent research that reveals that at least 95% of our thoughts and behaviour originate at the subconscious level of the mind [3]. The authors of this paper crossed paths in January of 2010, bringing together a mutual interest in human performance and a shared scientific curiosity about human consciousness. The opportunity to scientifically test the authors’ hypothesis in a controlled environment, utilizing a subconscious belief change process already available worldwide, presented itself when the neuroscientific technology was available to do so. Both authors were surprised, as well as pleased and encouraged with the results, and what those results may mean for the collaboration of neuroscience and business, now and in the future. As a society we are facing many difficult challenges in the world today, e.g. political, ecological, social, and economic. The authors believe that, used properly, this collaboration between business and neuroscience can help individuals develop *creatively different* solutions to many of these challenges.

The current nature of business on a global scale, demonstrates the unprecedented challenges and undesirable consequences that many companies face, bringing into question the very survival of current *business principles and practices*, as well as the belief systems that drive them. Regrettably, fear and avarice are too often primary driving forces in business, and if unaddressed, will virtually ensure the destruction of our *global economy*. Ignorance of the complexity and interdependency of our environment virtually ensures the destruction of our *global ecology*. Both are *potentially lethal* to our entire civilization. The basic solution to this problem was succinctly stated by business leader, Peter Senge [4] when he said, “It’s *not about doing what we are doing more efficiently. It’s about doing something different.*”

“Humans now dominate Earth, changing it in ways that threaten its ability to sustain us and other species,”[5, p. 740]. It seems that for decades, business practices from around the world have brought us to this critical point in history. We stand on the brink of an unsustainable future, desperately hoping that things will get

better. If we are to avoid this unstable and destructive future, we must heed the words of business visionaries such as Peter Senge when he says, ...we *must do something different*. This paper and the research associated with this writing offer the argument that, in the main, business principles and practices are misaligned with those needed to create *sustainable success*, and *only a significantly visionary realignment will create something different*.

The kind of research in this writing might well be important and useful in providing a greater understanding of how to implement processes oriented toward integrating thought and behaviour patterns applied to leadership and management, as well as the fundamental structure of business principles and practices.

Our very existence, as well as the existence of this planet, is made possible and sustained by the underlying intelligent design of nature's principles. Nature has millions of years of experience in creating *sustainable success*. In fact, nature may be the best "business consultant" any business could ever have, if only we are willing to follow her principles. Humanity's presence here is testimony to the wisdom and practical application of those principles. Some of the most salient *Principles of Nature* include adaptability, resiliency, harmony, balance, collaboration, growth management, diversity, and more [1]. These principles are applicable to business *and* our personal lives, although sadly they are frequently lacking in both.

This paper presents research that clearly links the mind/brain interface, presenting empirical evidence of what is identified by the authors as the **Whole-Brain State** (a bi-lateral, symmetrical brain wave pattern). It also provides insight into how subconscious belief patterns affect our behaviour and control the outcome of such behaviour in our life. Subconscious belief patterns circumscribe our perception and drive our behaviours. By knowing how to change perception at the subconscious level of the mind, we can transform subconscious belief patterns. Brainwave energy can now be depicted in a manner that scientifically shows the creation of the **Whole-Brain State**. Practical applications of changing subconscious belief patterns, using the processes presented in this paper, have existed for over two decades; today we can measure them and graphically demonstrate their efficacy, leading to further understanding and utilization of this important aspect of human existence, in virtually all walks of life.

Default Network of the Brain

In recent years, a series of papers presented insights derived from QEEG (quantitative electroencephalogram) investigations, into the operation of a more efficient *default network* in effective vs. less effective leaders.

The understanding and acceptance of the existence of the brain's *default network* has helped us better understand that there are regions of the brain characterized by decreased neural activity during goal-oriented tasks. We have come to know the relationship of these regions as a "default mode" of brain function. Studies suggest that the brain's default mode supports *self-referential* mental activity. To quote Marcus E. Raichle, whose research group in 2001 first identified the default mode network "When *healthy people engage in a very focused activity, they in a sense, lose themselves. If you really are engaged in something, you kind of forget yourself, and that loss of self corresponds to the deactivation we observe in brain scans of the default network*" [6, p. 1944].

In a follow up fMRI study, Raichle and colleagues identified a group of individuals whose brain images indicated that they were unable to "lose themselves" in work, music, exercise or other activities that enable most healthy people to get "outside" of themselves, and interestingly, it turned out that these were highly stressed, depressed individuals, people whose emotions and thinking maladaptively colored their response to their environment, the task at hand, or the people around them as denoted by Sheline [7]. So, perhaps Raichle's results give us a hint regarding the significance of the more efficient default mode network in the QEEG

leadership study. Simply put, the ability to maintain effective relationships with others begins with a healthy relationship with self; with a healthy relationship to thoughts, beliefs and emotions, which subconsciously influence our own behaviour and judgment, see Figure 1.

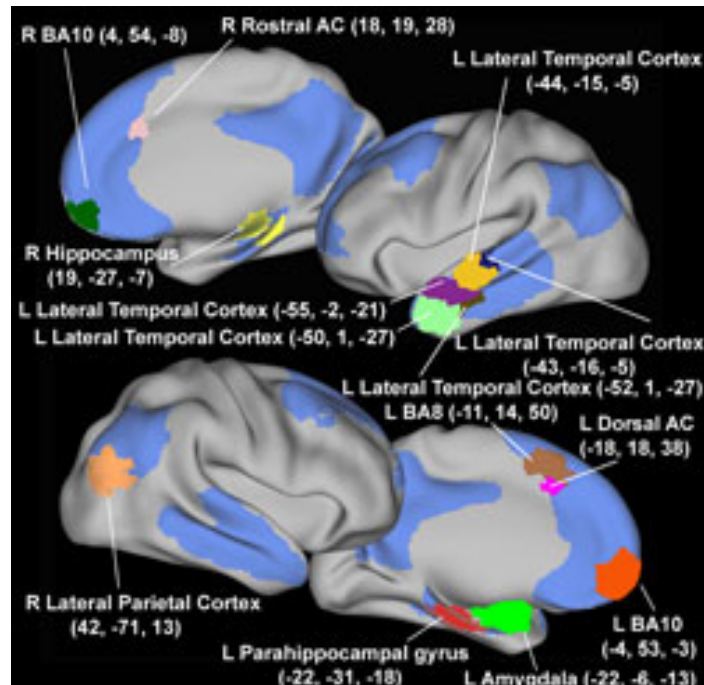


Figure 1: Default mode network illustrated in blue. Note high degree of overlap with additional colored regions reflecting maladaptive sustained activation during task in depressed individuals. Free via Open Access: OA. [8]

The literature related to the default network indicates brain activity that offers an awareness of the *autobiographical self*, *stimulus independent thought*, *mentalizing*, and most recently *self-projection*. Damien Fair explains that these regions integrate into a cohesive, interconnected network [9].

Fair and his group of researchers consider the default network as a functionally interconnected *default system* that is required for internally directed mental activity. They explain that it stands to reason that the default system should demonstrate a mature, or near mature, pattern of functional connectivity at a time in development when internally directed mental activity is demonstrable [9]. We would contend that the research they present regarding the *autobiographical self*, *stimulus independent thought*, *mentalizing*, and *self-projection* is another way of describing subconscious beliefs, and their potential impact on a leader's way of relating to others.

Emotional Engagement and Subconscious Thought

Dr. Fannin's involvement in the investigation of neuroscience and business began in 2001 as a member of a research team at Arizona State University. Their work included research related to neuroscience and leadership done at the United States Military Academy at West Point. This research established an undeniable connection between neuroscience and business. This work yielded evidence that successful leaders, whether military or civilian, used their brains differently than less effective leaders, and was featured in a September 20, 2007 article (This Is Your Brain on the Job) that appeared in the Wall Street Journal. Many other articles followed, appearing in national and international publications. Previous work by the Arizona State University

group also included insights into the crucial role which engagement of right hemisphere empathetic networks plays in effective leadership. In a subsequent study involving 46 senior leaders, those who scored highest for their charismatic, visionary and socialized communication style demonstrated increased engagement of right frontal networks, suggesting a capacity to engage empathically in motivating their workgroup [10]. The authors of this paper offer new research and insights, along with an effective applied leadership process called PER-K®, to change subconscious beliefs.

This most recent work assists us in understanding the internal mechanisms that enable some people to be effective leaders and lends further support to the idea that neuroscience will help us to know how some people can form effective leadership relationships, and why some people can sustain their effectiveness, while others cannot.



Figure 2: Anterior Cingulate Cortex

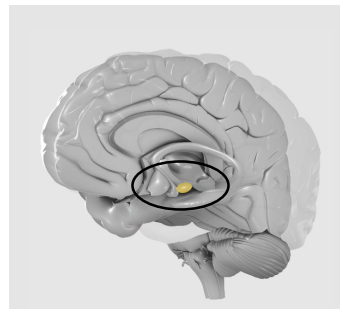


Figure 3: Amygdala

Figures 2&3 adapted from Emotional Intelligence: Toward Clarification of a Concept. [13]

The basis for understanding why we feel a particular way is centered in the relationship between the *anterior cingulate cortex* (ACC), see Figure 2, and the *amygdala*, see Figure 3 [11]. The amygdala, usually thought of as a fear detector, also detects all other emotions. It lights up to fear because it processes emotions in order of their significance. So when fear is the most significant emotion in the brain, the amygdala will light up [12]. When fear is the most dominant emotion in your thinking, it taxes the subconscious mind, which does most of the fast processing of information.

For example, if an entrepreneur who left a secure job to pursue her dreams started to read statistics about how unlikely it was to be a successful entrepreneur, the amygdala would have been activated, making her more anxious. As a result, her *subconscious fears* would be spinning even when she was thinking about other things. Scientific experiments found that when fearful facial expressions were shown so that people did not consciously know they had seen them, the amygdala was still activated [14, 15, 16].

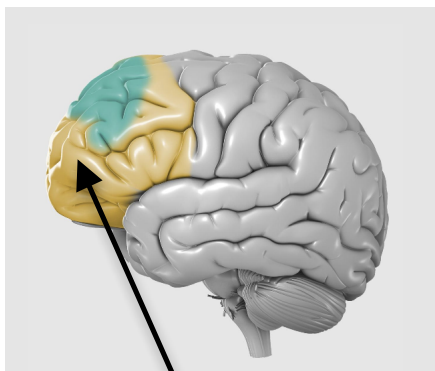


Figure 4: Prefrontal Cortex (PFC)

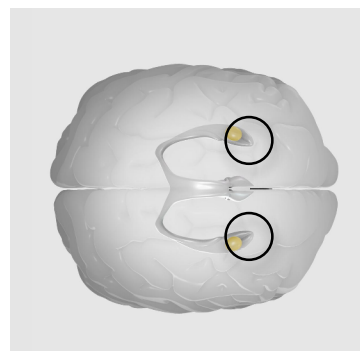


Figure 5: Amygdala

Figures 4&5 adapted from Emotional Intelligence: Toward Clarification of a Concept. [17]

The amygdala is connected to multiple brain regions. One of those regions is the frontal lobe, where many important (business) decisions are processed. If the amygdala, see Figure 5, is activated, the activation affects various regions in the frontal lobe, particularly the *prefrontal cortex* (PFC), see Figure 4, and thereafter affects decision-making, as well as emotional centers. We can recognize that we are vulnerable to fear and anxiety in such a way that it compromises our own abilities to attend to relevant content. The impact of this is that it consumes our *thinking resources*. We should also understand that the amygdala is the *emotional relevance detector* rather than just a fear detector. The amygdala-PFC connection is important because a part of it acts as short-term memory and another part as the “accountant” in the brain calculating the risks and benefits of our thinking. Subconscious threats over activate the amygdala and lead to a decline in thinking and productivity when we focus on negative statements such as:

- “How am I ever going to sustain my profit margins? What if I lose everything?”
- “My business is going to fail under the current economic down turn.”
- “The government is not supportive of small business so the odds for success are stacked against me.”
- “What if I get laid off?”
- “I’m not smart enough to be successful.”

These kinds of self-defeating thought patterns can create what could be identified as an *amygdala hijacking*. The amygdala kicks into action in preparation for “fight or flight,” creating unacceptable levels of anxiety and fear at a subconscious level that negatively impact our behaviour and productivity. This subconscious patterning becomes part of the default network and will focus on looking out for danger. The authors of this paper contend that entering into what we call the **Whole-Brain State** will move the brain out of the negative default mode and allow access to more resourceful thinking processes.

Worry is another component related to normal brain function. It is the brain’s response to fear. It is thought of as a response of the brain to block out negative emotions that reside in the subconscious [18]. Some neuroscientists have suggested that worry is a strategy of cognitive avoidance in which internal verbalization acts to suppress threatening emotional imagery. It is believed that worry leads to missing important negative information such as risk that may be relevant to making optimal decisions. This information is mostly subconscious. Worry disrupts the “brain-bridge” (corpus callosum), see Figure 6, and slows the transfer time from the left to the right hemisphere, taking additional time for processing without creating a solution to the problem [18]. Leaders or managers who are constantly worried often see this worry as an attempt to find a solution, but may in fact be stuck in worry, which usually keeps productivity to a minimum. The **Whole-Brain State** increases communication between the left and right hemispheres of the brain, and speeds up the transfer of information across the corpus callosum, thereby diminishing the capacity to worry.

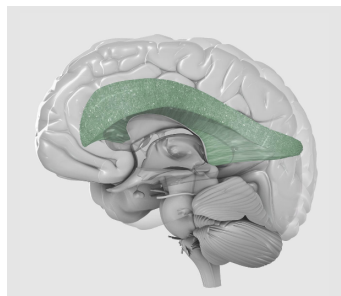


Figure 6: adapted from Emotional Intelligence: Toward Clarification of a Concept. [19]

The authors of this paper present research that suggests that the **Whole-Brain State** allows access to the inter-hemispheric activity connecting to more efficient brain function. Interhemispheric activity is regulated by the corpus callosum which controls the speed of emotional information from the left to right hemisphere. Worry is a process that can be disruptive to the efficiency of that processing.

Further, we would have you understand the **Whole-Brain State** (a bi-lateral, symmetrical brain wave pattern) allows access to positive mood and cognitive openness and allows for more efficient processing of the “brain-bridge,” i.e., the corpus callosum [20].

Boyatzis’ research claims that negative emotions are stronger than positive emotions. He says that the contagion of negative emotion would ignite a stronger neural sequence than positive emotions. This may serve evolutionary functions but, paradoxically, it may limit learning. As a consequence, arousal of strong negative emotions stimulates the *Sympathetic Nervous System* (SNS), which inhibits access to existing neural circuits and invokes cognitive, emotional, and perceptual impairment [21, 22, 23].

The benefits of a leadership style arousing positive emotions over negative (P/N) ones, have been demonstrated by Fredrickson and Losada and others [24]. They found that a powerful indicator of what is possible for a system is the positivity/negativity ratio of feedback; that is, how many instances of positive vs. negative feedback we can observe in a human interaction process, such as a team meeting or in a couple's conversation. P/N is measured by counting the instances of positive feedback (e.g. “that is a good idea”; vs. negative feedback (e.g. “this is not what I expected; I am disappointed”). Marcial Losada found that high performance teams have a P/N ratio of 5.6; medium performance teams have a P/N of 1.9 and low performance teams have a P/N of 0.36 (there is more negativity than positivity). These ratios determine the level of connectivity that a team or workgroup can reach according to Losada [25]. They developed an empirical model demonstrating that the ability of a leader to project a positive emotional tone directly corresponds to the flexibility and creativity of these teams.

Some researchers are beginning to hypothesize that this positive or negative impact of leadership style on workgroup creativity actually has a neural component. They argue that the sustainability of leadership effectiveness is a direct function of a person’s ability to adapt and activate neural plasticity. Neural plasticity is the ability to adapt to new situations and environments. The *Sympathetic Nervous System* (SNS) and *Parasympathetic Nervous System* (PNS) are both needed for human functioning. They each have an impact on neural plasticity. Arousal affects the growth of the size and shape of our brain. Neurogenesis allows the human to build new neurons. The endocrines aroused in the PNS allow the immune system to function at its best to help preserve existing tissue [26].

Boyatzis explains that a contagion of positive emotions seems to arouse the PNS, which stimulates adult neurogenesis (i.e., growth of new neurons), a sense of well-being, better immune system functioning, and cognitive, emotional, and perceptual openness [27, 28, 29]. By contrast, there are suggestions in neuroscience literature that anxiety-inducing, or negativity based leaders may not only undermine morale but may actually impede the workgroup’s capacity for new learning and creative growth at a neural level. Elizabeth Gould a Princeton University psychology professor has demonstrated, in rats and primates, the detrimental effects of chronic stress on “neurogenesis” or the brain’s capacity to create new neuronal connections [30].

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*” [31, p. 143].

The optimal state of consciousness is to have the qualities and attributes of both hemispheres of the brain operating simultaneously, in order to have the full response potential of the mind/brain system available to us, as well as creating a “user-friendly” state of consciousness for changing subconscious beliefs. We refer to this as the **Whole-Brain State**. This state of being can beneficially influence an individual’s own state of consciousness, and consequently his or her own performance. This positive influence extends to other individuals, as well.

Our research differs significantly from earlier work by Herrmann in his book, *The Whole Brain Business Book* [32]. In that book, he proposed the Herrmann Brain Dominance Instrument, presenting more than 30 discreet applications of what he referred to as Whole Brain Technology. His work proposed that by simply working with these discreet phrases in business it would “solve problems and improve business results.” The most significant difference from our research to Herrmann is that he suggests that conscious processing is all that is necessary to achieve a different result. Our research points out that thinking, emotions, and behaviour are directed by our subconscious belief patterns. If all that was required to create sustainable change and success was to attend a seminar, read a book, listen to a lecture...in short doing something conscious, many of us would have achieved sustainable success long ago.

Another piece of literature from 1997 by Leonard and Straus [33], *Putting Your Company’s Whole Brain to Work*, presents ideas such as, conflict should take place constructively among people who do not initially understand one another. Leonard and Straus contend that all ideas pass through similar cognitive screens, and only familiar ones survive. Our research has its basis in the subconscious patterns, that our perceptions and filters are based in the subconscious beliefs that guide our behaviour. We would also offer the understanding that having the right kind of subconscious beliefs is the fundamental difference for people to understand one another. We contend that the *Principles of Nature* discussed earlier, are the basic elements that constitute the connection between individuals, their behaviour, their perceptions of themselves, their work and the world. Just being consciously aware is only that, being consciously aware and that alone makes it more complex to not only affect change but also to create sustainable success. Leonard and Straus contend that cognitive preferences reveal themselves in “work styles” and “decision-making” activities. Our research would have us understand that both work styles and decision-making activities are not a function of cognitive preferences but rather of the core principles that one subscribes to as part of their subconscious belief systems.

Another premise, presented by Leonard and Straus, is a concept that is widely accepted in neuroscience and psychology. They affirm a “cognitive distinction” between left-brained and right-brained ways of thinking. Further, they offer that an analytical and sequential approach to problem framing differs from an intuitive, value-based, and nonlinear one (right-brained thinking). We support that idea, but our research presents updated information that offers new understanding that a **Whole-Brain State** is not only desirable, but also essential to achieve synergy and harmony within the individual, work group and company to achieve sustainable success. Further, quantum physics would have us understand that the **Whole-Brain State** is necessary when interacting with others.

A study reported in 1988 in the *International Journal of Neuroscience*, by researchers at the Universidad Nacional Autónoma de México, 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” [34, p. 1]. 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 [34].

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 [35]. In 1993, Singer proposed that coherent events occur at the cortical level, and such cortical events are the primary binding substrate [36]. Other experimental results illustrate that the *binding event* must not be cortical but rather thalamocortical [37]. 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 [38]. The results of this study favoured 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 its relationship to coherence.

In physics, **coherence** is a property of waves that enables stationary (i.e. temporally and spatially constant) interference. When interfering, two waves can add together to create a wave of greater amplitude than either one (constructive **interference**), see Figure 7, or subtract from each other to create a wave of lesser amplitude than either one (destructive **interference**), see Figure 8, depending on their relative phase. Two waves are said to be coherent if they have a constant relative phase. The degree of coherence is measured by the interference visibility, a measure of how perfectly the waves can cancel due to destructive interference. Cancellation is virtual or local since a wave cannot have negative energy.

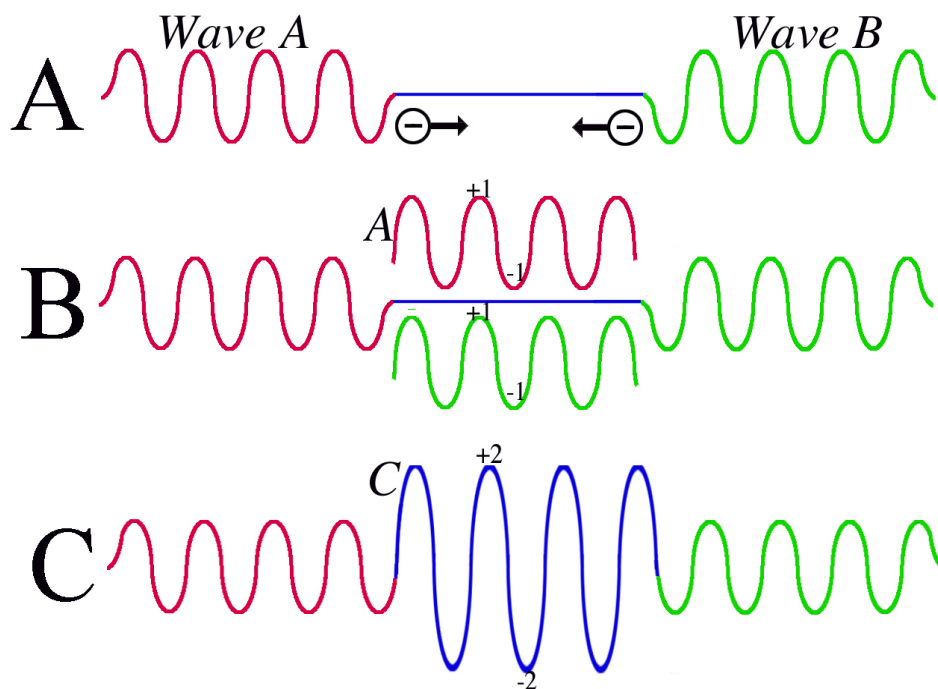


Figure 7. Constructive Interference [39]

Constructive Interference as seen in Figure 7, for example, would be like two sets of ripples moving across the surface of water toward each other. Both wave A and B are moving toward each other with their ripples in phase, in this case both waves are leading with their negative amplitude. Their cycle patterns are aligned. The waves merge together at the interface where two ripples meet. As a consequence of this merger, the waves are drawn with one above the other as seen in middle depiction “B.” The amplitude of A is +1, the amplitude of B is also +1. Add the two together, and the resulting amplitude of the composite wave, seen in depiction “C” is +2. Likewise, where A is -1 so is B, together the total amplitude will be -2. The resulting higher amplitude composite is seen in depiction “C.”

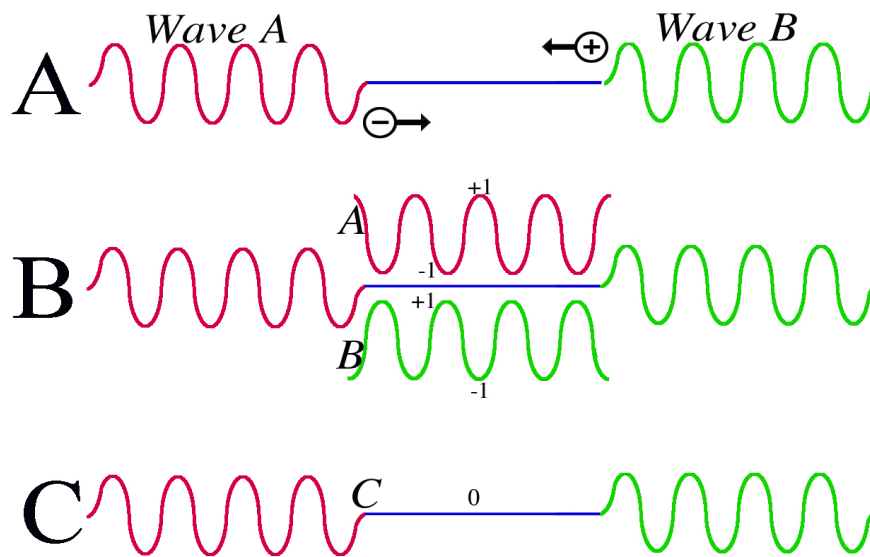


Figure 8. Destructive Interference [40]

In *Destructive Interference*, as seen in Figure 8, for example, the ripples derived from the first pebble, labeled as wave A in depiction B, are moving from left to right. Wave B in depiction B, moving right to left, represents the ripples from a second pebble dropped shortly after the first. Since the pebbles did not enter the water at the same time, the waves will not be aligned when they merge at the interface, they will be “out of phase.” Wave A is leading with a negative amplitude and Wave B is leading with a positive amplitude. Where they meet, the waves are a mirror image of each other, the high amplitude (+1) of one wave is aligned with the low amplitude (-1) of the other, and vice versa. As shown in depiction C, the amplitude values of each wave cancel each other out, so that the composite wave having zero (0) amplitude is no wave at all [40]. The significance of understanding the relationship between constructive and destructive interference patterns is that the ability establishes a sense of harmony and connectedness between individuals, verbally and non-verbally.

Oscillatory 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 coherence between interconnected elements. Llinas explains that the intrinsic electrical properties of thalamic neurons support high-frequency (20-50 Hz) sub-threshold oscillations when thalamic neurons are depolarized beyond -45mV [41]. Previous studies *in vivo* describe oscillations in both relay and reticular thalamic neurons [42]. In their work, the relationship between

electrophysiological properties was not fully understood. Understanding the basis of the dendrite conductance is a key issue for fast oscillation in thalamocortical cells. They depend on the activation of voltage-dependent calcium conductance [43]. This demonstrates that neurons exhibit active membrane oscillations and are part of the intrinsic oscillation properties of the thalamic cells [44]. These findings are in accordance with previous work reporting that thalamic cells display highly rhythmic activity in the gamma range of frequencies [45]. Active dendritic oscillations are functionally significant, in that they return input from the cortex (cognitive thinking) to thalamic neurons providing a unique opportunity for resonance between intrinsic dendritic oscillation and rhythmic synaptic inputs [46]. 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 feed forward 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 [47]. In layer V, pyramidal cells return oscillations to the interthalamine nuclei in the gamma-band and are capable of recursive activation [48]. 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, resonance 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. Therefore, for optimal brain performance to occur it requires both *oscillation* (vibrational information received from the field) and *resonance* (activation of neuronal structures within the brain). Together, awareness is heightened, we are more in harmony with those around us and we are more intuitive with a better sense of the things to which we should pay attention.

The body of work preceding the study presented here 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. The impact of this is directly related to productivity and optimal brain processing. If there are areas of the brain that lack efficient *resonance*, the result can be loss of focus, concentration and inability to make good judgments. 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 that is recorded for future reference and contributes to the catalog of subconscious beliefs that guide our behaviour in the future [49].

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 we would characterize as the **Whole-Brain State** [50]. 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 [51]. This would suggest that for most people, given they have a healthy brain that resonates as described the common processing of information will be similar from individual to individual.

Oschman says, 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 [52]. Bruce Lipton adds an important point to the phase locking issue with consideration of *destructive* and *constructive interference patterns*. He explains that the behaviour of energy waves is important in biomedicine because vibrational frequencies can alter the physical and chemical properties of an atom [53]. An example of destructive interference would be when a pebble is dropped into water and the waves are moving outward to the right. 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 that when you want to enhance, rather than stop atoms, you find a vibration that creates harmonic resonance.

Those vibrations can be of electromagnetic or acoustic origin. Lipton explains that when a skilled vocalist like Ella Fitzgerald maintains a note that is harmonically resonant with the atoms of a crystal goblet, the goblet's atoms absorb her sound waves. Constructive interference explains that, when added energy of resonant sound waves causes the goblet's atoms to vibrate fast enough to break free from the bonds that hold them together, the goblet actually explodes.

Medically, doctors use constructive interference to treat kidney stones. Kidney stones are crystals whose atoms vibrate at a specific frequency. Doctors non-invasively focus a harmonic frequency on the kidney stone. Constructive interference results when the focused energy waves interact in the kidney stone. Like the atoms in the crystal goblet example, the atoms of the kidney stones vibrate so quickly that the stones explode and dissolve. Harmonic resonance influences the function of the body as well as the brain and our ability to connect with each other as human beings [54].

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 act like a particle and sometimes act 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 [55]. 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 [56].

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* [57]. Noted physicist David Bohm based his analysis of the nonlocal field on empirical evidence of quantum theory [58]. 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, might 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 [59]. The implication of this principle of quantum physics suggests that vibrational oscillation from the “field” affects the transfer of information, even in the brain.

Introduction to Quantum Effectiveness

Various correlations exist between their subsystems and the distinguishing quality of different quantum states. This is then applied to analyzing quantum information processing. 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. The current work explores a number of issues related to identifying the important ingredients needed for quantum information processing.

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 [60]. 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 mean 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. For simplicity, if we divide measurements into two groups, A and B, each of them having a well-defined probability distribution, 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. The concept of mutual information is so general that it can easily be extended to quantum systems. However, in quantum mechanics, we must discriminate between different forms of correlations, a distinction that has no counterpart in classical information theory.

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 [61]. 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 on 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 [62]. 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 [63] to make 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 resonance? *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 [64]. 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.

These conclusions in the study cited, support the proposition 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. This is an important consideration for effective leadership.

Subconscious Belief Patterns

US News & World Report presented a special issue February 28, 2005, entitled, *The Secret Mind*, featuring a paper, *How Your Unconscious Really Shapes Your Decisions*. The posit of the paper revealed, “According to cognitive neuroscientists, we are only conscious of 5 percent of our cognitive activity, so most of our decisions, actions, emotions and behaviour depends on 95 percent of our brain activity that goes beyond our conscious awareness” [65, pp. 53-61]. The subconscious mind consists of all involuntary processes and functions including *thoughts, beliefs, emotions, memories, skills, instincts, and behaviours* of which we are not consciously aware. They are generated by the subconscious mind, while the effects occur in the brain and body. Many of the processes and functions of the subconscious mind involve implicit memories. Implicit memories drive much of our subconscious abilities such as habits, skills, behaviours, reflexes, conditioned responses and emotional reactions, which we automatically demonstrate or engage in without much or any conscious awareness or thinking. If we want to change any of these subconscious implicit memories, like a recurrent automatic emotional reaction to a situation, a self-limiting or potentially self-destructive belief, or perhaps a negative attitude towards someone or something that limits our capacity to interact constructively, we must interface with the subconscious mind. Often we try to use conscious processes such as visualization, will power, and positive thinking to create the desired changes. Experience, all too often, demonstrates that these processes, when used alone, have a limited effect on creating lasting change. Using our “mind over matter” conscious adaptability is a process that generally works only in the conscious realm. We have to enter the realm of the subconscious mind to create lasting changes.

Further explanation of the significance of subconscious belief patterns suggests that 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 readily changed, by simply receiving information: reading an insightful book, having a compelling conversation, seeing the unarguable results of scientific research, etc. 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*, repeating undesired reactions and behaviours 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. Our contention is that it is imperative to know how to change self-limiting beliefs into self-enhancing beliefs that support our goals and aspirations.

QEEG and the Whole-Brain State

The research design for this study followed rigorous protocol procedures. Baseline of EEG data was established for each case. Using EEG caps calibrated by Electro-Cap International, the 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 were recorded; five minutes eyes open, five minutes eyes closed and five minutes with the brain on task (silently reading a magazine).

A Certified PER-K® Facilitator used standard PER-K® processes. PER-K® is the trade name used for the application of these processes in the business arena. The PER-K® processes are identical to the personal growth version known in the market place as PSYCH-K®. This is a *process for subconscious belief change* to

achieve the **Whole-Brain State**. Following the intervention of the PER-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. 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 is an example 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). The legend is the same in all of the depictions shown in the illustration. The RED represents the dominant brainwave pattern prior to the facilitation of the PER-K® *balance*. The BLUE represents the dominant brainwave pattern after the *balance* had been facilitated. The thickness of the line, indicates level of p-value, see legend below in Figure 9.

The **Whole-Brain State**, as seen in Figure 9, is considered to be the combination of RED: condition A, dominance prior to balance process, and BLUE: condition B, dominance after the balance process was facilitated.

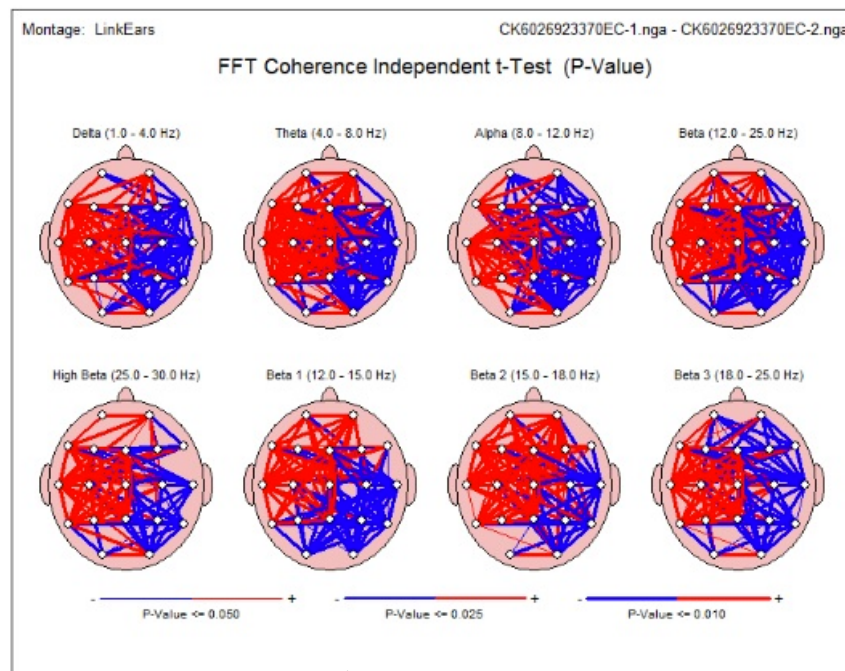


Figure 9: The Whole-Brain State
Created Through NeuroGuide Software
from Applied Neuroscience [66]

The person depicted by the independent t-test above, experienced profound changes. This woman had been an office manager for over ten years. Her dominant pattern before the PER-K® balance was facilitated, (seen in RED), is left hemispheric. Very logic oriented, her management style was “my way or the highway.” Her approach was demanding and she expected others to do exactly as she commanded. Most of the people that worked for her did as she asked out of fear of reprisal from her or at times, experienced her uncontrollable anger. After the PER-K® balance, the dominant pattern, seen in BLUE, represents access to the emotional/right side of her brain, augmenting the qualities and attributes of her left hemisphere. The result was that her consideration of others was noticeably better, and her interpersonal relationships at home and at the office improved substantially. Her leadership abilities began to flourish and she became well liked. In addition, the office ran smoother, with greater efficiency and productivity. Her shift toward a **Whole-Brain State** created a

new attitude toward others, fostering a more congenial work environment. The overall shift in the attitude of her employees toward her was supportive, resulting in a more positive feeling about the work place.

It is not possible to provide a comprehensive treatment of this subject or the numerous changes that each individual experienced in this research data. However, the volume of data collected, and the unique properties it represents afford us the opportunity to evaluate and continue to understand what the data means, as well as provide intriguing hints as to the nature of its potential. The most significant information that surfaced from this research is that 98% of the cases measured presented statistically significant correlations, which demonstrated the difference between baseline measures and the presence of the **Whole-Brain State** after the intervention occurred.

Summary

Subconscious belief patterns circumscribe our perception and drive our behaviours. We now know how changing perception at the subconscious level of the mind can transform a subconscious belief pattern. Further, this transformation in brainwave energy can now be depicted in the form of the **Whole-Brain State**. Continued research in this area will assist in recognizing and adopting applications that will be beneficial with significant implications for international business, academics, personal health, professional performance, and virtually every area of human life. Practical applications of changing subconscious belief patterns, utilizing PER-K® belief change processes, 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.

Aligning the principles of business with the *Principles of Nature*, in order to achieve *sustainable success*, and effect significant thought patterns and behavioural changes in individuals who make decisions that determine the fate our world, are critical to creating a sustainable future for ourselves, and for generations to come. These principles, when anthropomorphized from nature, are applicable in business, and can be internalized at the subconscious level of the mind, using PER-K® belief change processes.

By better understanding the mechanisms of changing subconscious beliefs, we may well be able to ameliorate or even avoid the otherwise probable economic, ecological, and cultural maelstrom we are facing now, and in the future. Our subconscious beliefs may be the single most important factor contributing to the ethical crisis we are facing on a global scale. A commonly heard statement in the business world is, “Don’t take it personally, it’s just business.” The authors of this paper suggest a very *different* perspective. *We must take it personally because it is business!* Often this statement is used as a warning to others that ethics, morality, and human decency are about to be suspended in making a decision or participating in an interaction. Business decisions impact and change our world every day. By aligning the principles of business with the Principles of Nature, we can foster a world where ethics, morality, and human decency create *sustainable success* as an everyday reality, rather than an obscure, idealistic goal. It’s time that business, like any species in Nature, if it wishes to survive, must evolve and adapt, or suffer the very real possibility of extinction. Businesses are continuing to fail at alarming rates. The solutions to our problems are carefully *hidden in plain sight*. They are the Principles of Nature. It's up to us to take the necessary steps to learn Nature's secrets and solve our problems. We have all that we need. The choice is up to us.

Welcome to the Evolution of Business

The following eleven Principles of Nature are derived from studies in the life sciences, common sense, and direct observations of Nature. It is mostly self-evident that while each of these Principles can easily be recognized as necessary to the successful operation of Nature, they are equally relevant to the successful operation of international business. Both have the capacity to create sustainable success, whether we are talking about an ecosystem, including millions of species of plants, animals, and weather systems, or an ecosystem of

businesses, containing, millions of products, services, and people. In the PER-K® and The Nature Consultancy training programs, (designed for leaders in the private and public sectors) these Principles are explored in detail, and the meaning of each Principle is formatted so that it can be easily and quickly internalized by the subconscious mind, vis-à-vis the **Whole-Brain State**, by utilizing the PER-K® high-speed mindset change processes. The net result is that when businesses operate from this new level of awareness, the capacity for creating sustainable success can become a realistic, attainable goal, rather than just wishful thinking. The authors believe that the alignment of the prevailing principles of business with the principles of nature, shown below, represents a kind of evolutionary leap for business. The business climate today is facing the formidable challenges of a fragile economy and ecology.

The Principles of Nature

- | | |
|----------------------------|---------------------------------------|
| 1. Harmony | 7. Balance |
| 2. Adaptation | 8. Ecology |
| 3. Diversity | 9. Timing |
| 4. Collaboration | 10. Effective Use of Resources |
| 5. Cause and Effect | 11. Growth Management |
| 6. Resiliency | |

These core principles of nature provide us with important lessons about sustainable success. While short-term success may sometimes be achieved by ignoring some, or all, of these principles, the long-term downside is indeed costly, both financially and ecologically [67].

Our concern that business practices, as well as human civilization in general, are continuing down a path of *misalignment* with the Principles of Nature, speaks to a sense of urgency in making rapid changes in our business practices and mindsets. If we are to make a significant difference in the way we conduct business, as well as our personal lives, we must start refining and applying our knowledge about how the human mind/brain interface operates regarding subconscious belief systems, as well as how those belief systems affect the *global field of consciousness*, via *quantum entanglement*. As Nobel Physicist Erwin Shrodinger puts it, “The *total number of minds in the Universe is One*” [68]. It’s time to evolve business beyond the outdated Darwinian model of survival of the fittest to a new model of collaboration and interconnectedness.

It’s time for neuroscience and Nature to take the lead in the evolution of business by doing something different!

For more information about aligning your business with the Principles of Nature, visit The PER-K Centre for Sustainable Success at www.per-k.com or contact the authors if you have questions regarding this paper. You can download other articles related to this topic at www.enhanceyourbrain.com

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