Holistic NeuroIntegration: The New Mind Model

A Bio-psycho-social qEEG Guided Neurofeedback Method

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This evolving e-book is intended to train neurofeedback (NFB) clinicians how to use The New Mind System and explain the theoretical reasons for the form it has taken over the years. It also provides a theoretical basis for the bio-social-psychology of NFB. Those people seeking more basic and general information regarding NFB should take our didactic web course at www.newmindacademy.com or read our book, *Doing Neurofeedback,* which can be purchased from the ISNR bookstore.

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Introduction

Over the past three decades, a great number of methods for doing neurofeedback (NFB) have emerged through clinical trial and error. These various methods have attracted audiences of clinicians. Many clinicians prefer one method over another, while other clinicians use multiple methods. Often the developers of these methods move into manufacturing NFB equipment and sometimes sponsor research around their methods. Although clinicians often declare their faith in one primary method based on their clinical experience or their loyalty to a particular piece of equipment and vendor, to date no research demonstrates the superiority of one approach over another. This practice is similar to other fields such as psychology—where there are over 2000 different methods of therapy or medicine and many schools of thought such as homeopathy, naturopathy, osteopathy, etc. In fact, the number of approaches in NFB today remains relatively small by comparison. Most of the methods available appear to be effective. A few methods have published research, however limited, demonstrating their efficacy.

The purpose of this text, in contrast to the New Mind web course, is to present the New Mind Model which is the method that I feel has developed in a unique, congruent, and consistent way over time. This method has been developed through both clinical trial and peer review research into a method that is being used in over 500 clinics around the world in an empirically documented and successful manner. I would characterize this perspective and method as the next step in main stream or traditional NFB as opposed to a radical leap into a highly innovative method and technology with limited prior support.

The New Mind Model builds upon decades of research done around one channel NFB and the customary methods of uptraining and down training amplitude in frequencies that appear abnormally high or low. It moves to the next level of innovation by using two channels and carefully determining how best to implement those channels. It explores the new dimension of dynamics that emerges with two channels, how these dynamics play into the training process, and how to adjust equipment to harness these dynamics. It redefines methods for observing and interpreting these dynamics over the course of a training sessions and what their implications are from a neurophysiological perspective. It grounds these observations in the emerging literature from many different fields and explains how and why a clinician can make predictions regarding behavior and outcomes based on these observations. It defines specific phases of training and provides landmarks of expected progress and how to measure them based on empirically collected data from over 500 clinics worldwide. In addition, it accounts for why efforts at NFB sometimes fail and how to remediate the circumstances to obtain success. Most importantly of all, it provides a perspective for correlating the EEG

observed with both physiological and psychological symptoms and behavior. In this handbook, I will discuss the theory and method of this approach in detail using the existing literature from NFB as well as many other disciplines.

The field of NFB draws from many disciplines and is used in return by many types of professionals. It is fast becoming an important tool in the arsenal of health professionals and slowly becoming recognized for its worth. Larger and more sophisticate studies are emerging regularly in support of its validity and efficacy. The level of skepticism prevalent in contemporary medical clinicians is no longer warranted; and arguments against it are typically based upon casual hearsay and innuendo rather than a careful review of the existing literature. The recently discovered poverty of present medical research in general (Ioannidis, 2005) does not argue well for the ability of these critics of NFB to assess scientific literature in general nor does the degree qualification for an MD include research training as with a Ph.D. In view of this shortage, I will present the emerging literature validating NFB as well as draw on outside literature to support its validity, reliability, and efficacy as well as explain the method we presently employ.

The Emerging Validity of NFB

The recognition of neurofeedback (NFB) as a legitimate intervention has been very gradual, and this trajectory of acceptance has puzzled many professionals as well as the public that has utilized this technology. Both parties are typically impressed by its efficacy when they experience it first hand and find it difficult to reconcile their experience using it with official policies adopted by insurance companies and medical professionals, including psychologists. Typically, psychiatrists and neurologists dismiss it casually as ineffective or claim the benefits are due to the placebo effect. This response is even more surprising when one actually reads the literature on it. It is easy to insinuate that these medical and psychological professionals are developing their opinions based on superficial analysis or thoughtless bias at worst. These theories can frequently discourage those who might benefit from NFB from pursuing treatment. Such outcomes might be considered a result of negligence, unethical behavior, and carelessness because it deprives suffering individuals from an important potential source of remediation of their suffering.

A recent publication in a peer review journal addressed these issues quite succinctly, powerfully pointing out the flaws in prevailing arguments and opinions regarding NFB by the professional community (Pigott, Bondenhammer-Davis, Dacis, & Harbin , 2013). The evidentiary standards for treatment proposed for NFB are, upon inspection, not actually met by the medical and psychological treatments in present use. Additionally, these accepted and reimbursed treatments fail to remediate disorders such as ADHD. In fact, published research demonstrates NFB exceeds the efficacy of these present methods.

Additionally, the use of stimulant drugs to treat disorders such as ADHD frequently lead to the increase use of antipsychotics on this specific population.

To date, in most disciplines, it is certainly not uncommon for new technologies and methods to be ignored or even persecuted by otherwise reasonable established professionals. History is replete with such denials. This problem has been eloquently and empirically documented by Thomas Kuhn (1970) in his book on the nature of scientific revolutions. Even handwashing by physicians to improve outcomes in surgery was ridiculed at one time. Its primary proponent was drummed out of his profession and died in ridicule and poverty.

Adam Crane and I reviewed some of the cultural and social resistances to NFB in our book, *Mindfitness* (Soutar & Crane, 2000). It was clear back then that there were social norms and values that conflicted with the use of NFB. A key problem was that NFB did not typically produce an immediate noticeable change like drugs do. Instead, of realizing that healing is a gradual process, the typical idea in our society is to equate "effective" with "immediate." The equation of the two is very ingrained that most people are not aware that they carry this bias nor how much it drives medicine. Delaying gratification and supporting long terms solutions is also not a dominant perspective in our culture. This perspective has been especially apparent in American business management practices when compared to many oriental cultures.

To recognize and use NFB, individuals must be open to these values. Fortunately, with the published failure of pharmaceuticals to adequately deal with mental disorders (Whitaker, 2010), the public as well as many professionals are opening up to new options. The American Academy of Pediatrics (Shonkoff & Garner, 2012) has called for a reorganization of our entire health model to orient us as a society toward the fact that toxic stress has a lifelong course of effect such that intense experiences of toxic stress in youth leads to chronic health problems and early death. They indicate that public health could be improved by 40% by addressing this issue with consistent long-term prevention methods. NFB is clearly one of the leading technologies that can be employed in this type of agenda because one of its primary mechanisms of action is through the readjustment of the reticular set point in the central nervous system (CNS). This ability allows it to address PTSD and the long-term effects of stress.

The Historical Record in Brief from a Practical Perspective

NFB sprang from three sources primarily. Barry Sterman at the Department of Psychiatry at UCLA, Joe Kamiya at the University of Chicago, and a bit later by Elmer Green at Menninger Clinic in Topeka, Kansas. Each source generated a different tradition or method that provided the basis for many of the present approaches. Sterman's work focused on eyes open training of what he termed the sensory motor rhythm (SMR) which initially proved to be effective with seizure disorder and later

through the work of Joel Lubar with ADHD. Joe Kamiya explored the relationship between alpha wave training and anxiety that led to using it with insomnia, meditation, and peak performance. Elmer Green explored theta wave training which developed into alpha theta (AT) training for addictions, PTSD, personality integration, and even peak performance training. At this point and time, these methods often are termed fast wave (Sterman method) and slow wave (Kamiya and Green methods) training (Soutar & Crane, 2000). These approaches constitute the basis for standard or traditional NFB and much of the written literature up to this point has developed around these general approaches.

Recently, new methods have emerged based on radical advances in technology, such as Z-score training, LENS, MicroTesla, ILF, and IFS. There is no literature to demonstrate their superiority over older methods although theoretically they would appear at first glance to provide advantages. Most of these methods have developed around vendors who promote them, provide workshops, and then engage in some basic but limited research. Most of the professional training in the field is provided by vendors as well, which begs the question regarding conflict of interests. This method is a radically different model than the traditional university-based education, development and research of applied healing technologies in the mainstream, and it often does not sit well with professionals in other fields.

Most research confirming the efficacy of NFB has been and is being conducted using the basic training methods involving one and two channel training that first emerged in the field (Myers & Young, 2012). These methods are used because it is easier to control for confounds with simple methods, and it reduces the cost of the research. The newer training methods, involving very complex equipment and software, allow more room for confounds and make radical leaps in applications of technology based on assumptions and theories not yet confirmed. At the time of this writing there are over 250 research articles demonstrating the efficacy of basic NFB and only six articles at most regarding Z-score training. Many senior clinicians in the NFB community went from a one channel training method to a four channel or more method utilizing Z-score dlls without exploring in depth the possibilities of two and four channel training with both monopolar and bipolar montages. Many of them also abandoned this method when the promised spectacular improvements did not occur.

At our clinic and in our affiliated clinics we take a different direction with the technology and have moved methodically to explore a two-channel paradigm, partially to be sure the field is not losing valuable information, but also to develop a theoretically consistent progression of technical understanding regarding how the brain dynamically responds to more complex training methods that can lead step by step to the next level of technical applications. Training in two channels independently in two hemispheres at

the same time greatly increases the complexity of the brain's responses. It is important to understand how coherence, symmetry, and dominant frequency patterns shift dynamically during this type of training before moving on to even more complex interventions such as training coherence and amplitude or even more dimensions at the same time. It takes considerable time and clinical observation to evaluate each aspect, such as secondary compensatory responses, and determine the efficacy of the various technical adjustments to thresholds and training location with respect to the training session. We have spent over a decade researching these new aspects of training. This research will be covered in detail in the section regarding two channel training.

Using the first standardized clinical NFB assessment and training system available in the field, here at New Mind Technologies, we have had many of our initial expectations altered when looking at the data. This system, which can analyze the pre/post maps, the symptom tracking, and the outcomes of standardized computer derived protocols has allowed us to statistically evaluate methods and outcomes in a far more rapid and accurate rate than is possible working with clinics using a variety of different map systems, protocols, and equipment.

Consequently, we have learned to look at the brain and NFB in a very new way. We finally have some clarity on the process because of the statistical analysis that is now possible. We have been able to discuss and share our findings in weekly Internet meetings with a wide variety of clinicians over the last 10 years and adjust our system, based on ongoing statistical sampling, to be more accurate and effective. We expect this trend to continue as we get better at what we do, and the system gets smarter as we process more data. To some degree the New Mind Model is a new form of clinical group sourcing and self-organizing system.

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Chapter 1: An Overview of The New Mind Method & Related Theoretical Considerations

Our basic approach to managing disorders is to begin training depression or mood instabilities first, either clinical or subclinical, and then to begin training anxiety as the depression lifts, then to train cognition. However, we are training all three at each stage, but with a different emphasis on each one. Anxiety and depression are ubiquitous regarding mental disorder. Our rationale for this training sequence is that even if we normalize cognitive networks, they will still be compromised if anxiety and mood continue to be significantly dysregulated. The research on this sequence is quite abundant and clear, so is our clinical experience and statistical analysis. If we note an increase in nightmares, anxiety attacks, or raging during the later phases of mood regulation and in the first phases of anxiety training, then we assume that severe trauma or PTSD is present; and we begin alpha theta (AT) training. This result, of course, will lengthen the training process. In addition, we introduce heart rate variability training (HRV) for most clients at the outset to provide them with autonomic self-regulation skills to assist them as anxiety emerges more strongly after mood is resolved and stabilized. For those clients interested in continuing beyond the resolution of clinical symptoms as measured by socio-emotional analysis and neurometrics, there is meditation and peak performance training as well. These sessions can go on indefinitely and clients should evaluate them based on a cost/benefit ratio basis as it relates to their financial resources.

The New Mind clinical session looks like this: The client is hooked up with appropriate sensors to both HRV and a two channel NFB montage after they are seated. The client fills out their symptom tracker, part of the New Mind System, on a tablet which we access through the Internet. We review any symptom changes and record them. The client does approximately 15-20 minutes of HRV training. The HRV audio is turned off, and then the client begins 30 minutes of NFB training while HRV is monitored. We then review both trend screens for NFB and HRV, evaluate the session together, and assign any homework to be done prior to the next session.

Typically, on average, it takes about 15 sessions to resolve mood issues and normalize the alpha asymmetry that indicates its presence. It then takes another 20 or so sessions to resolve anxiety. Training locations are based on map report output in the protocol section. We have found anxiety tends to be more persistent than depression and usually more difficult to remediate. During the mood regulation training, clients begin to feel relief in as early as five sessions. They become less reactive, mood stabilizes, sleep improves, and energy increases. They become particularly aware of improved mood around 12-15 sessions. Then they begin to experience increasing anxiety. Usually they report increased irritability and may find themselves more

confrontational in personal relationships. Dreams maybe become frequent as well as darker in theme and content and be more vivid. They usually express concern regarding their stability and the future course of training. Sleep may begin to degrade in quality again.

Most new clinicians interpret this phase of training as a failure of the protocol, their equipment or of NFB in general. They may begin to start rapidly changing protocols in desperation to find the magic one. They may even be inspired to purchase new equipment thinking that their equipment and method are substandard in some way. The reason for this response is a lack of understanding of the principles of psychotherapy and biofeedback. Those clinicians who are trained in both areas have an advantage. They understand the concepts of adverse response and abreaction to treatment. In progressive relaxation methods and in autonomic training, it is not unusual to have individuals experience increased anxiety and even panic when they begin to relax during a guided relaxation session in talk therapy.

Clients with previous trauma will begin to spontaneously experience a variety of images, emotions, and sensations related to prior trauma. This tendency is especially marked in PTSD clients. This same response often occurs during peripheral biofeedback sessions. In biofeedback, clients reflect trauma in instabilities in different autonomic phenomena. Men tend to store trauma more in their muscles, which registers in EMG monitoring, while women tend to store it more in galvanic skin response or temperature changes reflecting peripheral vascularity. (This response is why so many women complain of cold hands and feet.) During biofeedback sessions, it is not uncommon to see finger temperatures in the 75 to 80 degree range in women with moderate to severe anxiety when it should be in the 90 degree range.

If you discuss a client's history with them during biofeedback sessions, you can easily see these incidents measure covary with the intensity of emotion behind the various topics. If a client displays increased anxiety while relaxing or talking about a trauma, it does not make sense to stop the feedback or discussion. If you work them through the emotion while giving them feedback on EMG or TMP, then they often can integrate the trauma. This idea is the concept behind talk therapy. For the same reason, it does not make sense to discontinue an NFB protocol if a client is experiencing discomfort.

It is important to be flexible in protocol use. When clients have an adverse reaction to a protocol, in most cases it is because we are exerting too much pressure on the CNS to change too rapidly. The New Mind Model protocol assessment system statistically determines the most sensitive and dysregulated 10-20 locations based on a comprehensive analysis of all neurometric domains and factors rather than symptoms and related Brodmann area functions. This method allows the clinician to determine the most dysregulated areas and begin training there. These areas, however, may be too

much for the client at first and result in symptoms of anxiety, agitation, and insomnia. These symptoms are indicators that it is time to back off and train a less sensitive area. I usually recommend C3 and C4 as these are two of the architecturally oldest most regulated cortical locations with respect to thalamocortical loop control networks. Training with the recommended protocol at these locations will usually stabilize the brain after 5 sessions, so that the client can begin resuming the training at the most dysregulated locations. Our experience over the last ten years of training and mentoring individuals in hundreds of clinics supports this strategy.

Types of Protocol Decision Making

There are several ways to determine an NFB protocol. Intuition, observation of symptoms, responses to training, peer reviewed protocols based on clinical labeling or DSM categories, anatomical-functional considerations based on BA areas, neurometric statistical analysis, and network theory are some of the more common approaches. All these approaches can be effective and require different levels of clinical skill. Clinicians should adopt the approach that seems intuitively at first to resonate with them and their cognitive emotional biases. Then they should expand into other methods over time as they gain experience and insight into the NFB process. There is no research to demonstrate the superiority of one approach over any other. A “tool box” approach is widely regarded as the best. As clinicians gain experience, they should investigate new methods and technologies to develop a range of technical and theoretical resources. Many clinicians end up with several different systems and even databases.

At New Mind, we feel a bio-psycho-social perspective and report system is best. We designed the map system around that idea. In terms of protocol derivation, it relies purely on statistical analysis of all five major neurometric dimensions to determine the most dysregulated areas of the brain as a system. This approach is based on neurophysics and is a very empirical and unbiased. It means our protocol decision is based on the solid ground of physical science. We have found that basing protocols on DSM categories or Brodmann areas is less accurate and effective. There is strong theoretical support for this observation in the research literature as well, and we have presented it over the years at professional meetings and in publications.

Some older clinicians will review the client’s case and spontaneously decide on a favorite protocol that has worked for them in a similar case. Clinicians using infra low training (ILF) typically closely observe their clients and adjust the low frequency filters up and down looking for the client “sweet spot” that seems to relieve symptoms. Problems can be encountered with this approach in terms of client report skills. We have found that most children and adults with disorders are not very good at self-reporting; the clinician is often left guessing based on subtle physiological cues.

Early in the field, prior to the emergence of qEEG maps, clinicians used protocols that were found effective based on peer review. Beta to theta ratio training at Cz for attention enhancement in ADHD was a common one. This approach also relies often on DSM categories and diagnostic labels, such as ADHD, general anxiety disorder, ASD, OCD, etc. The weakness with this approach is that qEEG studies have shown that many disorders such as schizophrenia have at least 5 subtypes, ADD has at least 5 or 6 and OCD at least 2 as do most other disorders (Soutar, 2014). In each subtype, the EEG neurometric analysis shows completely different EEG patterns, so how can one protocol address all these types? Obviously, it cannot. This reason is why qEEG analysis has progressively dominated the field.

Another method, as we mentioned, involves determining what Brodmann area is functionally responsible for an issue, such as Broca's area for a speech problem like word finding deficits. In this version of electronic phrenology, each Brodmann area has a specific and unique function that can be tied to the deficit and remediated by training that location or region of interest (ROI). Using LORETA full cap training, clinical enthusiasts feel they can pin point and fix the problem through a form of electronic surgery that favors the "magic bullet" paradigm of the drug companies. It is true that you can pinpoint and train these locations to normal specifications based on a database using Z-score training technology, but often the real problem can be upstream or downstream regions, hubs, and networks in the brain. In addition, everyone may require different focal parameters for functioning at these locations based on distributive network demands. Many networks converge on any given Brodmann area; their interface occurs a micro level beyond the resolution of LORETA technology. There is no research that identifies these profoundly complex parameters. We presently do not understand the relationship between physical networks and functional connectivity (Honey et al, 2007: Meehan & Bressler, 2012).

Neurometric statistical analysis involves doing a qEEG and using statistical tools to determine the best protocol locations and frequencies to be trained. This method often involves multivariate analysis at a fairly high level of complexity. New Mind and Neuroguide utilize this approach and have developed software for this purpose. The methods used, however, do vary considerably. Neuroguide, although an excellent research tool, requires a much more sophisticated grasp of mathematics, statistics, and neuroscience to deploy than the average clinician possesses and is usually far beyond the reach of most clinicians. New Mind's approach is to keep most of the complexity "under the hood." It is designed exclusively for NFB clinicians and purposes. It is primarily a clinical tool.

Network analysis looks at both network functions as well as network informational processing streams. More recently network theory has begun to develop in quite

sophisticated ways in the neuro imaging community. Unfortunately, we still do not know how the functional networks map to the fiber pathways we have been able to image (Meehan & Bressler, 2013). These fiber pathways also vary considerably from person to person and are based on statistical probability, much like the location and speed of electrons in their orbits. We also are not able to image micro networks that make up the larger networks, especially with EEG. We can identify large meso level-based networks in the form of macro level networks using qEEG and fMRI. This method has been done quite effectively by Laird et al (2012).

There appear to be approximately 18 of these meta networks, and they have general functions, not specific functions. In addition, they are bilateral in nature and occupy homologous sites. They are primarily inter-hemispheric in nature, although they manage intra-hemispheric longitudinal pathways as well (Gomez, 2009). The longitudinal pathways in the brain comprise the dorsal and ventral streams. These streams flow from the posterior to the anterior cortex and aggregate and assimilate data from different processing centers as they flow forward. They also have feedback loops and pathways for correctional processes. The New Mind protocols are based on these patterns and were anticipated by us based on our brain mapping technology as well as the earlier fMRI and neurological research. This method is described in more detail in the protocol chapter.

Again, New Mind and Neuroguide have taken the lead in this area of analysis. Our approach, however, is based less on Brodmann network, DTI fiber analysis and anatomical concepts of network hubs and based more on non-linear dynamical theories of network function as well as systems and field theory as espoused by Freeman (2005; 2009). We see the 18 meta networks as comprising a complex of highly dynamic interacting functional systems. Each system has its own attractor basin characteristics that cycle through sequential patterns of entropy in response to social and environmental stress. We can identify weak areas in this system and apply feedback to help each system self-correct to an optimal attractor state that resonates most efficiently with the other major networks. This identification is done through statistical analysis of the neurometric dimensions to find the weakest areas in the system and adjust them based on empirical measurement of client response. Using a NFB protocol is applying corrective feedback loops to each network in the correct sequence to achieve optimal overall function. In addition, we have identified the global patterns of neural system degradation in response to oxidative stress and the research and theory on this process is presented in the chapter on metabolics.

Since protocols are based on carefully calculated neurometric analysis, they can be safely utilized quite flexibly. This fact is why a protocol that pushes a client too fast at sensitive locations such as P3-P4 and T3-T4 can be stabilized with the same protocol at

C3-C4. In addition, several different protocols may be effective at several different locations. In NFB, we are looking for optimal, not "correct," protocols. Because of the brain's complexity, there can be no single solution—only many possible ones that occupy a complex solution space of high order.

The Issue of Do No Harm

It has been decades since NFB began being used in clinics across the country. There are now thousands of clinics engaged in NFB. The FDA has not acknowledged one law suit regarding an NFB clinician "doing harm" and is not likely to establish one. This effect is because NFB is biofeedback. It is not coercive or invasive. It is not a medical procedure. It is best characterized as operant conditioning and consequently learning. We invite the brain to respond to a stimulus.

Anyone who does NFB for a living knows how hard it can be to get a brain to respond to training, especially if it is a brain on pharmaceuticals. These drugs can do harm and are often misused. They also hold the brain hostage and rigid. They reduce plasticity. It is not uncommon for an NFB clinician to be confronted by a client with complaints that the NFB has given them headaches, insomnia, balance problems, tachycardia, etc., only to find that the client has had a medication change, and these items are the listed side effects. Another problem with drugs is that they reduce the efficacy of NFB. It is also common for side effects to occur due to NFB because clients are getting better, need their meds reduced, and their medical physician is refusing their request. Often in this case, clients assume the NFB is doing something "bad." They are often afraid to reduce their meds as they have become dependent on them. This situation can become a catch 22 for clinicians. Many times, when I have finally gotten clients to reduce meds, they are shocked to find that their symptoms (side effects) not only go away but most of their long-standing symptoms diminish! When things go well, and clients feel better. However, they tend to think it is because of a new vitamin or gadget they have purchased that has made the difference. On more than one occasion a client has mentioned that their new breakfast cereal has made a recent major improvement in their symptom and "how long will it be before the NFB does something?" We cover this topic and discuss how to deal with it and other issues in Chapter 13 on Managing Clients.

Treating Anxiety and Depression as a Continuum: A Fundamental Paradigm Shift

Through observation and statistical analysis of the clinical data at the neurometric level, we have arrived at a conclusion that has fundamentally shifted our perspective on mental disorder and how to deal with it effectively. The New Mind Model has evolved in response to this insight, and it informs every aspect of assessment and training that we have developed as a group of affiliated clinics utilizing the system. We have come to

understand that anxiety and depression are normal universal responses to social stress and disease. They can be both a response and a root cause of physical and mental disorder. Furthermore, depression is an advanced form of anxiety that emerges as the physiological system reaches a critical stage of exhaustion and energy depletion. Later in the book, I present research to demonstrate and support this claim. This understanding has compelled us to generate a new perspective and method for implementing NFB. Anxiety and depression then become proxy measures of the physiological status and severity and chronicity of mental disorder. This reaction can be measured by qEEG and the metabolic correlates of qEEG are presented in a later chapter with supporting statistical analysis. It also allows us to empirically track recovery from disorder as we train with NFB.

Before the advent of the widespread use of psychotropic drugs to manage mental disorder, psychiatry saw anxiety as the basis of all disorder and depression as an outcome of anxiety. Years ago, a major drug company began marketing Prozac as a solution to depression which they claimed was an independent and widespread problem. Their marketing was intense, well-funded, and effective. With the use of drug reps who bought doctors goodies, they were able to persuade them with poor and biased research that this idea was true and managed to sell billions in drugs to the public through medical doctors. This arrangement was an international disaster that took decades to unravel. Most of the public is still oblivious to this story as are many medical doctors as well—despite massive lawsuits and congressional hearings. One of the participants in this drugging of the public wrote a book, *Let Them Eat Prozac,* where he apologetically outlined the marketing plans of the whole scheme (Healy, 2004). Today Ritalin and its isomers are among the best-selling and still most popular drugs of all time. Yet some panels assembled to study the matter have concluded that there is insufficient evidence to support the notion that ADHD is a real disorder and this idea has been echoed by Jerome Kagan, one of the leading psychiatric authorities on the topic at Harvard University (Pettus, 2006). In fact, the DSM has become recognized as mostly a marketing tool for drug companies and the NIH refuses to allow it to be used as the basis for any further research.

The neuro imaging research of the past few decades has started to reveal that the old psychiatric model might be right. Anxiety is the key to mental disorder and results in progressive disconnection between sub-cortical limbic structures and the cortex itself. Our research and data support this perspective. We devote a chapter with research involving statistical analysis of our clinical data from our database system that supports this hypothesis very strongly. Anxiety, as Le Doux (1996) notes, issues from fear circuits in the brain; it comes in the form of worry, rumination, and panic for human beings according to Engels et al (2007). The profound excess of energy these activities demand from the neuronal system eventually exhaust it because of oxidative stress (Moratini et

al, 2005) resulting in neuroinflammatory processes that lead to reductions in cognitive function (Yuen, 2012) and depression (Alkadhi, 2013). We discuss this finding in more detail in the chapter on metabolics. Once in depression, it is difficult to get out, but the body provides natural cycles that lead from withdrawal behaviors to re-engagement with the social context when drugs do not interfere. NFB can accelerate this process. We can train alpha asymmetry and generate a significant reduction in depressive symptoms (Choi eta al, 2011). This process results in a brief period of elevated anxiety which can also be resolved through NFB, biofeedback, and counseling.

Acquisition and Consolidation: Phases of Learning, Phases of Training

NFB is a learning process and is subject to the scientific findings of the last 100 years regarding classical conditioning and operant conditioning. The field of psychology has done exhaustive work in this area, and classical conditioning is well established and a very empirical paradigm. There are two major phases to this learning process. Barry Sterman (Sterman & Egner, 2006) has outlined these nicely with respect to NFB. The initial acquisition phase involves the repetition of the response until a threshold is achieved in which long term potentiation (LTP) occurs and networks consolidate the behavior. If this level of repetition is not achieved, according to Pasqual Leon et al (2005), then the learned behavior may degrade. We refer to this as backsliding. Sterman & Egner (2006) describe in detail the mechanisms of NFB and see it as a form of task learning involving the basal ganglia. This concept was confirmed by an fMRI experiment performed by Birbaumer (2013). Once learned, these new behaviors generalize and continue indefinitely unless some trauma derails the networks involved. NFB requires a significant number of sessions to afford permanent change. There is no quick fix. Many developers in the field are looking for the fast track magic NFB bullet/method which will “fix” people in a couple of quick sessions. This type of thinking led us to the drug solution for disorders that never really worked. Healing takes time as the wounds people acquire took time to develop from successive traumatic events. This lesson is important to learn. The New Mind System has evolved a clinically conservative, efficient, and reliable method for reducing symptoms of disorder very effectively. We enhance the efficacy by adding supportive adjunctive methods including biofeedback, counseling, and nutritional metabolic support. A bio-psycho-social approach is where the future enhancements are likely to come from for a while.

Behavior Modification and NFB

Many authors, who do not actually do NFB but speculate regarding its efficacy and how it should be done according to the rule of behaviorism, make many false assumptions regarding the training process that result in erroneous conclusions. What looks good on the drawing board does not always work during application. You must be

intimately familiar with NFB at the clinical level to really understand it and properly critique it.

One key area is auto-thresholding. Until the advent of auto thresholding, clinicians were required to constantly monitor and change thresholds. The reason for this requirement is that during NFB clients frequently have very long periods of major shifts in EEG amplitude. If thresholds are not adjusted, clients often become trapped in these shifts and are no longer reinforced for very long periods of time—even five minutes and beyond. This lack of reinforcement is recognized as a ratio strain in the behavior modification paradigm and begins to result in a failure to learn and possibly even extinction of the desired EEG behavior. To avoid this result, it is necessary to lower the threshold until a reasonable percent of reinforcement is achieved and shape the EEG response to the original or higher level of amplitude. This step can be true of either enhancements or inhibits. This outcome is an intractable observable fact of clinical NFB. Yet some theorists argue that the clinician should wait until the client responds to the original threshold or after the post reinforcement synchronization period (Sterman & Egner, 2006). We tried this approach for quite some time until we discovered the absurdity of it and achieved much better results abandoning such theoretical rigidity.

Armchair speculation will not always address this reality. Theory does not always work in the field and some have even argued against auto-thresholding as a violation of operant conditioning theory (Strehl, 2014). However, this theory does not hold up in clinical settings and ignores some key features of clinical training and the dynamics of the human EEG in real time. Consequently, when done properly, auto-thresholding maintains an optimal reinforcement rate of about 70% (Travis et al, 1974). This rate guarantees that clients are being conditioned in the most efficient manner. The proof is in the results, which are easily observed to be much better. Our data, based off thousands of clinical sessions from hundreds of clinics across the country for over a decade clearly show from pre/post QEEGs, training trend screens, client symptom reports, and pre/post CPTs that auto-thresholding works very well despite neat arguments to the contrary. You will find this data within these pages.

Post Reinforcement Synchronization (PRS).

Sterman (2006) advocated that PRS was crucial to operant conditioning of clients based on his research with pilots. It was also based on his work with animals and operant conditioning. The theory is that there should be a pause in the stimulus following every reward for the brain to take an alpha break or rest to reset for the next event. I believe this theory is too discrete and simplistic of a model to apply to human beings who constantly deal with very dense and continuous flows of information which they organize and learn from on an ongoing basis. It may apply to animals, but it does not appear to generalize to humans at the level of milliseconds. It does seem to apply

based at the temporal level of task periods involving several minutes of effort such as reported in Sterman's research on pilot tasks. Although the theory is sound in many ways and appears supported, the fact is that we have hundreds of clinics doing NFB without PRS considerations for a decade; we are getting excellent results on their trend screens from operant conditioning of the EEG. Results like these are empirical and have been repeated thousands of time with thousands of people with a very wide variety of disorders and documented excellent outcomes on behavior rating and qEEG pre/post assessments.

How the New Mind System Works: An Overview

The New Mind Assessment System is a qEEG based bio-psycho-social assessment instrument designed exclusively for the purposes of NFB and not for medical intervention, diagnosis and not for psychological diagnosis as well. It does not employ the DSM paradigm. It measures behaviors, symptoms, symptom levels, relates them to brain locations and related functions, and then assesses electrophysiological status to confirm or disconfirm client symptom reports. It then statistically evaluates NFB training locations and determines the most likely optimal locations for intervention as well as the best frequency training strategies.

Each client fills out an Interactive Self-Inventory, a Cognitive Emotional Checklist and a Physiological Symptom List. A qEEG assessment is made using EEG amplifiers and a 19 channel qEEG cap. The results are compared to a normative database using statistical analysis resulting in Z-score ratings of deviance or normalcy. The two sets of findings, client responses and EEG measures, are then merged and compared. The results are presented in the form of a dashboard that is quick and easy to read as well as a CSV file of measurements and qEEG head maps. Physiological data is presented in a normed ranking of metabolic systems and supplement recommendations are made based on the qEEG profile. A narrative summary of findings is also included.

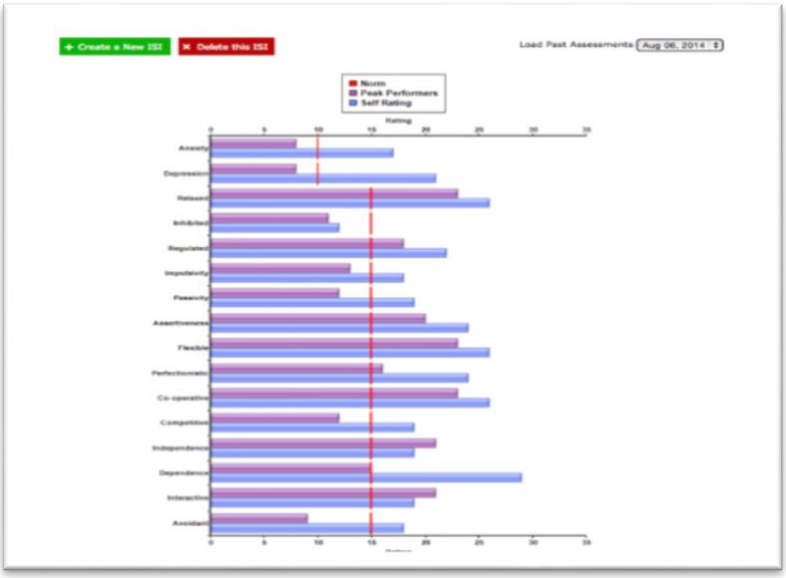


Figure 1 ISI assessment

The Interactive Self Inventory (ISI)

The interactive self-inventory (ISI) is a socio-emotional assessment tool that has been

statistically validated using a large sample size from hundreds of clinics. It compares the clients scores with the scores of well-adjusted top performers from various professions as well as a statistical mean score index. This method allows the clinician access to information regarding key dimensions of social behavior such as perfectionism, competitiveness, independence, assertiveness, etc. The clinician can then determine the role of toxic stress in a client's socialization, and its potential impact on the neural system. It also confirms and disconfirms arousal levels noted in the qEEG by measuring symptoms related to overarousal (anxiety like behaviors and complaints) and inhibited (depressive like social withdrawal behaviors) as well as underarousal behaviors (issuing from neuroinflammatory processes related to TBI and stroke). This method provides a comprehensive assessment of emotional status as well (see Figure 1).

The Cognitive Emotional Checklist (CEC)

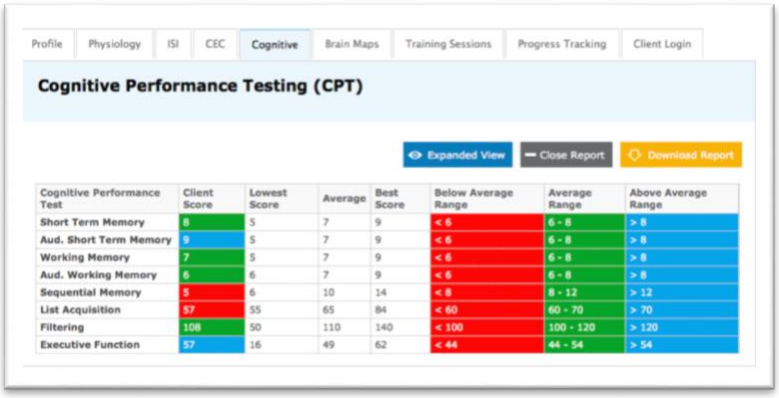
The cognitive emotional checklist (CEC) asks the client directly about problems with attention, filtering, memory, and mood. It probes factors related to cognitive performance. Clients rate themselves on these factors. This process results in a predictive map of what areas should be dysregulated in the brain. This map is compared to the actual client qEEG map and presented on the report dashboard (see Figure 2). Client problems are then either confirmed or disconfirmed by dysregulation of networks in the brain as measured by qEEG. False positives and negatives then provide a basis for deciding which complaints are from neurogenic sources and which complaints are from psychogenic sources. For instance, difficulty transitioning between tasks could be an outcome of general anxiety due to psychological factors and resulting general global EEG patterns of asymmetry, or it could be a consequence of head trauma in a specific location, such as the midline parietal

Figure 2 CEC response assessment

region over Pz and the local dysregulation from lesions and inflammation. In addition, problems occurring in certain combinations of social behavior typically lead to relationship difficulties which generate stress that impedes and interferes with NFB protocols.

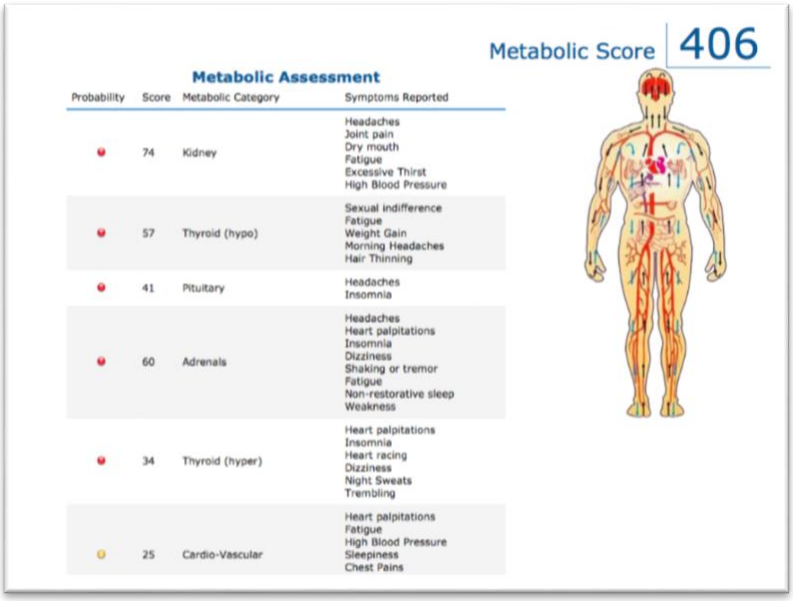
Computerized Performance Tests (CPTs)

The cognitive deficits confirmed by both client report and qEEG (Figure 3) measures can be further confirmed by using computerized performance tests (CPTs) in real time to assess actual real time deficits in performance. These tests also allow for a determination of deficit severity. These tests also provide the basis for pre/post assessment of client performance and function that is robustly empirical and complimentary in this respect to the qEEG pre/post data. The tests offer measures of attention, multiple dimensions of memory processing, measures of filtering, and measures of executive function. The details of these tests and information regarding validity and reliability can be found in the help section of the New Mind Maps website. The longest test is 7 minutes in length.



Cognitive Performance Test	Client Score	Lowest Score	Average	Best Score	Below Average Range	Average Range	Above Average Range
Short Term Memory	8	5	7	9	< 6	6 - 8	> 8
Aud. Short Term Memory	9	5	7	9	< 6	6 - 8	> 8
Working Memory	7	5	7	9	< 6	6 - 8	> 8
Aud. Working Memory	6	6	7	9	< 6	6 - 8	> 8
Sequential Memory	5	6	10	14	< 8	8 - 12	> 12
List Acquisition	57	55	65	84	< 60	60 - 70	> 70
Filtering	108	50	110	140	< 100	100 - 120	> 120
Executive Function	57	16	49	62	< 44	44 - 54	> 54

Figure 3 Cognitive performance test



Probability	Score	Metabolic Category	Symptoms Reported
	74	Kidney	Headaches Joint pain Dry mouth Fatigue Excessive Thirst High Blood Pressure
	57	Thyroid (hypo)	Sexual indifference Fatigue Weight Gain Morning Headaches Hair Thinning
	41	Pituitary	Headaches Insomnia
	60	Adrenals	Headaches Heart palpitations Insomnia Dizziness Shaking or tremor Fatigue Non-restorative sleep Weakness
	34	Thyroid (hyper)	Heart palpitations Insomnia Heart racing Dizziness Night Sweats Trembling
	25	Cardio-Vascular	Heart palpitations Fatigue High Blood Pressure Sleepiness Chest Pains

Figure 4 Metabolic assessment

The Symptom Checklist

The symptom checklist (see Figure 6 Symptom checklist) allows us to determine which metabolic systems such as adrenal or thyroid are related to abnormal qEEG

patterns and confirm or disconfirm their effect on qEEG distribution. It also provides advanced warning of which metabolic deficits might mitigate our efforts to alter qEEG distribution through NFB. Many such patterns such as slowed elevated diffuse alpha will not respond well to NFB until the client receives supplements and other metabolic supports. The system also provides indications of which supplements might assist the most in the effort to support metabolic systems and can be a useful adjunctive resource to other health professionals in their decision making and diagnostic processes.

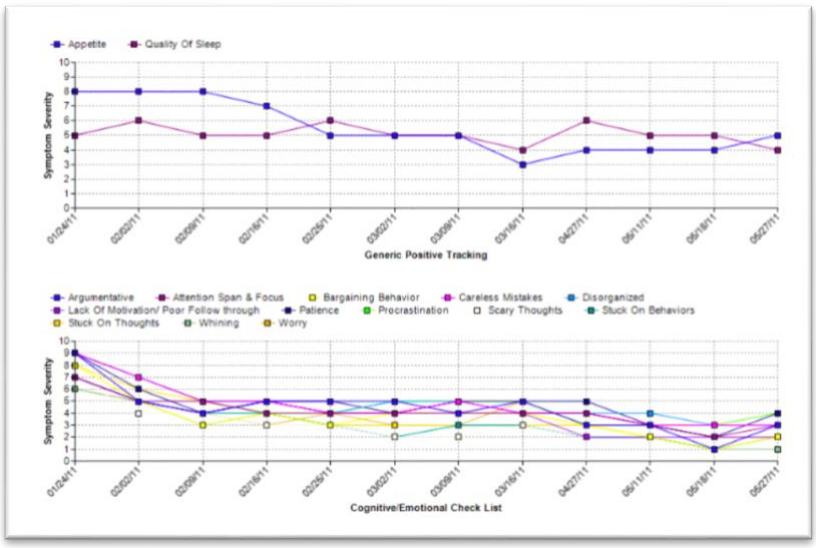


Figure 5 Cognitive/emotional checklist

The symptoms that are correlated as problematic by both the CEC and qEEG trigger a symptom checklist that the clinician and clients can review and then post for a session by session self-evaluation by each client. Clinicians provide clients with a tablet at each training session where they rank order their symptoms on a 10-point Likert scale (see Figure 6 Symptom checklist and Figure 5 Cognitive/emotional checklist). These results are then converted to

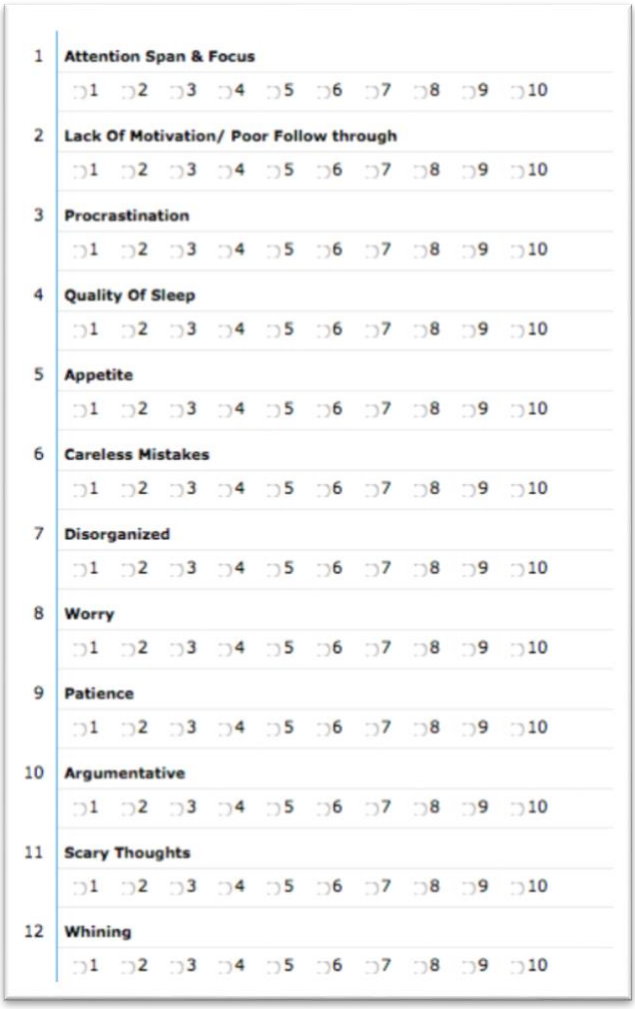
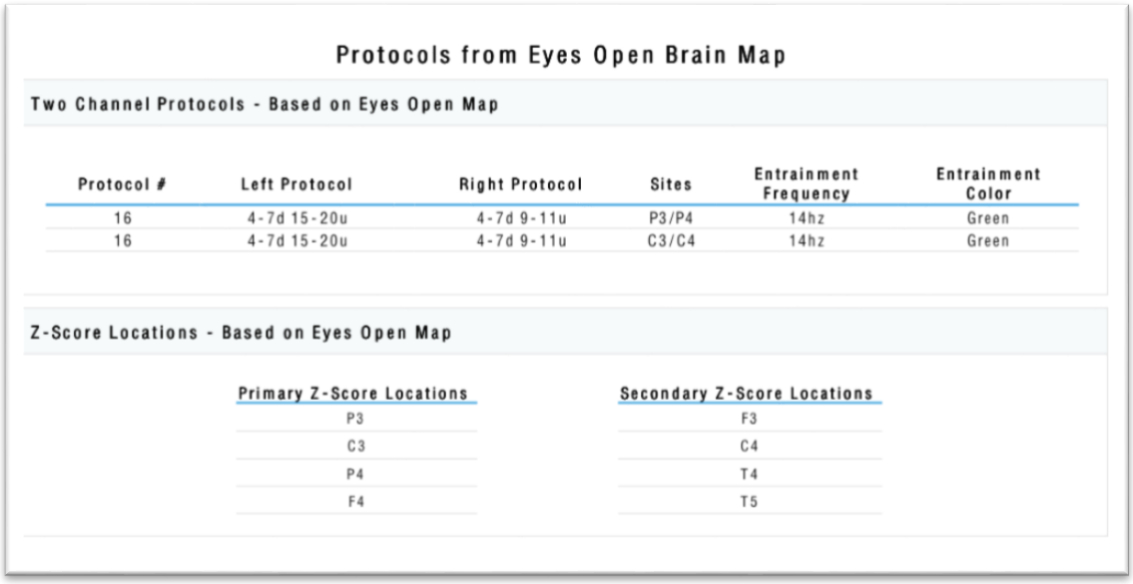


Figure 6 Symptom checklist

various kinds of graphs that track client symptom changes over time as well as first and most recent graphing of symptom changes.

Protocol Generation

Finally, the system statistically analyzes the deviance of each qEEG location with respect to magnitude, dominant frequency, coherence, phase, symmetry, and rank orders them according to their total deviance across all these dimensions. This analysis results in a rank order system for purposes of determining training location. The ranked locations are listed under the heading Z-score locations. Clinicians typically pick the top-ranking deviant two sets of bilateral network locations and train several sessions at each location set. NFB session trend screens can then be inspected for optimal protocol impact and the best location can be selected for further training (see Figure 7).



Protocols from Eyes Open Brain Map

Two Channel Protocols - Based on Eyes Open Map

Protocol #	Left Protocol	Right Protocol	Sites	Entrainment Frequency	Entrainment Color
16	4-7d 15-20u	4-7d 9-11u	P3/P4	14hz	Green
16	4-7d 15-20u	4-7d 9-11u	C3/C4	14hz	Green

Z-Score Locations - Based on Eyes Open Map

Primary Z-Score Locations	Secondary Z-Score Locations
P3	F3
C3	C4
P4	T4
F4	T5

Figure 7 Protocols from eyes open brain map

The Pre/Post Map Compare Tool

A pre/post map compare tool (see Figure 8) is also provided for ongoing assessment purposes. Clients can choose which maps they have done over time to compare and get a report providing side by side comparisons of each dimension of qEEG. Areas that move toward the norm, representing normalization of the distribution, are circled in green. Those that moved away from the norm, representing deviance and reorganization processes, are circled in blue. The total movement toward the norm and away from the norm is represented in at-a-glance meters labeled normalization and reorganization. A total normed percent change meter is also provided so clinicians can get a sense of total change in the EEG distribution because of protocols, training sessions and other interventions.

This method is the first standardized system of its kind for NFB and for clinical work in general as far as we know. It allows us to utilize information from hundreds of clinics to analyze and enhance the system itself toward the goal of more effective outcomes. The qEEG analysis system also provides auto artifacting that generates a consistent quality of artifact free data for analysis regardless of the practitioner's experience and training in qEEG artifacting. This feature further enhances data quality for comparison purposes.

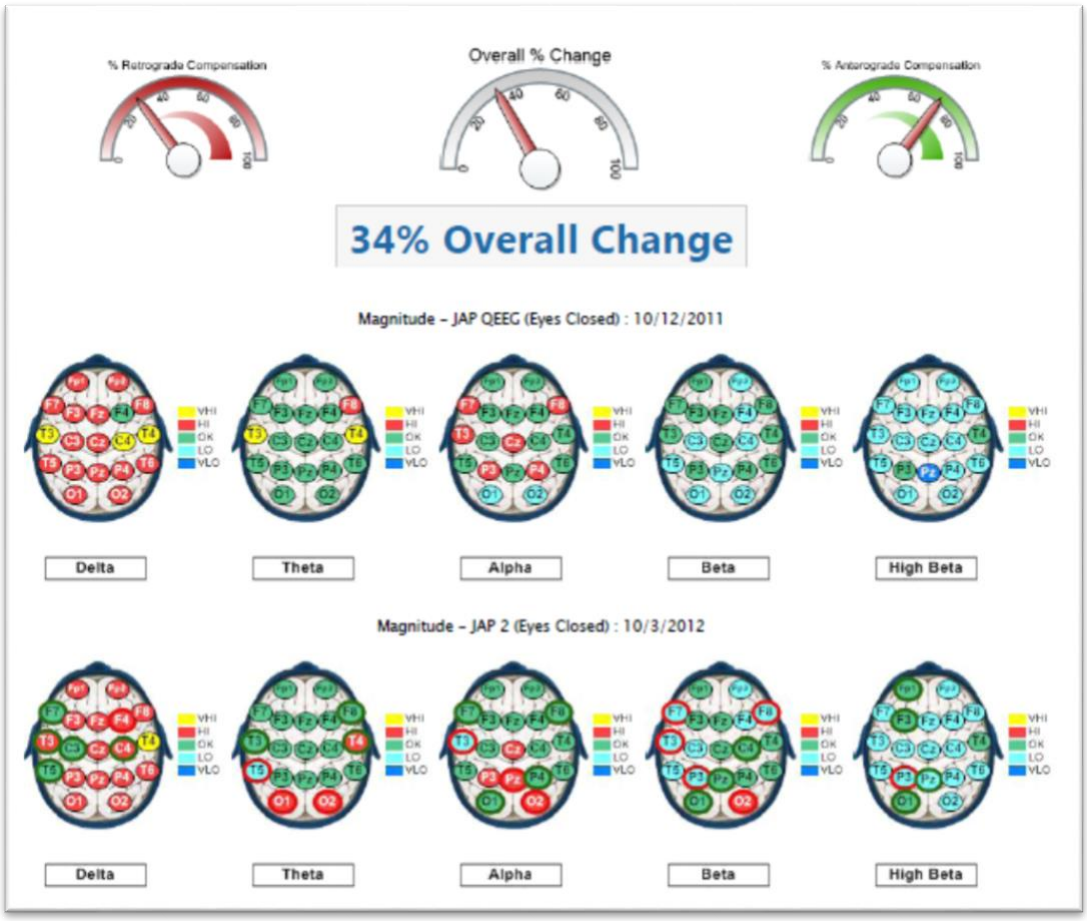


Figure 8 Pre-post map compare tool

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Chapter 2: The Sequence of Training Stages.

Even after decades of NFB great confusion surrounds how to proceed with NFB training. However, a consensus is beginning to emerge. The ISNR published a position paper (Hammond et al, 2004) over a decade ago that recommended some form of qEEG analysis precedes the implementation of NFB protocols. In addition, we feel that most of developers and vendors have promoted using forms of fast wave or infra slow training followed by some form of AT training. David Trudeau (2016), in a chapter reviewing the history of the field, noted that there were originally two identity groups attending the ISNR conferences. One group was biased toward fast wave training and one group was biased toward slow wave training. Adam Crane and I mentioned this fact in our book, *Mindfitness Training*, written in the late 90's as well. It was widely recognized. Many began to use both modalities.

Over the past two decades of running our own clinics around the country, we have found this combination of complimentary methods inevitable and indispensable. We begin with fast wave training to remediate complaints related to depression (inhibited electrophysiology), TBI, inflammatory processes related to heavy metals, toxins and lesions. Inevitably after this initial work, we are left with core anxiety which is either related to emotional trauma from socialization trauma or from severe emotional and physical trauma related to toxic stress. This anxiety may respond to fast wave training or if grounded in severe emotional trauma and PTSD may require AT training. The AT training can continue up to 90 sessions or more depending on the depth of the trauma and the life circumstances of the individual. For those clients who wish to continue, we offer peak performance and meditation training using NFB. This training allows people to confirm the effectiveness of their meditation techniques and further enhance their life experience.

We have seen exaggerated claims of exotic NFB technologies that work ultra-fast. When we have investigated these claims, they have proven false. These investigations include acquiring these proposed technologies at the clinical level and trying them at several different clinics compared to our own standard NFB methods. They have not proven themselves superior. In many cases they are even found less effective. Many of these claims are made by vendors drawing upon anecdotal stories of success made by their customers. Many of whom have minimal clinical experience with NFB or have never tried other methods. They often base their opinions on superficial clinical observation rather than psychometrics, CPTs, or other empirical pre/post measures. In addition, there is typically no comparative research to substantiate these claims. Most of the research has been done on one and two channel NFB protocols using standard equipment. We have had quite a few clinicians buy these innovative or exotic systems

only to be discouraged, put them on the shelf, and come to us for further training using our standard NFB version.

We have found with large N size statistical analysis done with the New Mind database that most individuals coming to NFB clinics have a significant number of health problems and tend to score quite high, over 100, on the normed metabolic dysregulation score system we have for assessment. Many clients are in the 150 range; and the worst clients are in the 250 range. They also usually have a fair amount of sub clinical depression and anxiety. These scores mean that they get by but only with the help of various addictions, drugs, and eating disorders. Only about 40% clients exercise regularly. They are not as happy as the better adjusted top performers who we use as a benchmark. These clients score in the normal range on the Beck Inventories, but the ISI is designed to be more sensitive; we have found a whole unresearched grey area that is confirmed by asymmetries measured in qEEG analysis. This data is published in a later chapter.

We have found it critical to resolve the subclinical depression to get the best effects from training, especially training the anxiety down. Many people diagnosed with depression and are on SSRIs score in this range. They live in a blunted emotional limbo that they have habituated to but feel at some level is robbing them of a satisfactory life experience. The New Mind Model tends to generate frontal asymmetry type protocols based on the statistical assessment of the EEG data. These findings are consistent with the findings of other investigators in the literature (Choi et al 2011, Engels et al 2007, Davidson, 1995). If sufficient TBI and elevated slow wave activity is present, the protocols will add a slow wave suppression component with delta and or theta suppression in both hemispheres.

At the outset we also utilize heart rate variability (HRV) training which we cover more in the adjunctive methods chapter. This method helps clients alter breathing style, tidal Co_2 rates, and reduce sympathetic arousal. This method aids in altering alpha asymmetry associated with inhibited individuals and helps reduce the inevitable discomfort that comes when anxiety increases as depressive withdrawal symptoms and physiology abate. This result is important because as we point out in the data on asymmetry, individuals shift back into the original anxiety-overarousal state after about 15 sessions once the depression and alpha asymmetry diminishes. This reversion increases their experience of anxiety which is often very unpleasant and sometimes overwhelming.

As clients shift back out of their withdrawal state, they feel exposed, vulnerable, and underequipped to deal with old dilemmas. They are often agitated, irritable, and quick to anger. This period usually only lasts a week or two; then the anxiety intensifies, and insomnia increases. Clients begin to frequently say, “no” when they used to say, “yes”,

and begin to draw healthier boundaries. They experience more dream intensity and sometimes nightmares. The greater the emotional instability and the nightmares, the more likely they are dealing with PTSD. If it is not PTSD, we usually train most of the time with fast wave protocols. If it is PTSD, we shift, as we mentioned, to AT training. Clinicians who remap at this point usually find that they have protocol outputs that recommend temporal or posterior training, especially at O1-O2. These locations are almost pure asymmetry protocols, often emphasizing right hemisphere alpha. Within 10 sessions, these clients begin to feel substantial reductions in their anxiety. They sleep well and often feel that they are less reactive, and other people don't "push their buttons" so easily. It is important that clients finish out this portion of the training. Clients who stop too early experience backsliding and must have more return visits later.

Acquisition and Consolidation

When dealing with children and primarily ADHD, we have found for decades that many of them do not shift behavior significantly until around session 18-20. Part of this lack of progress is that most parents and children are poor at self-reporting. Progress with children must be interpreted more through behavior. The child checklist and tracker focus more on behavior. If the checklist is employed, it is easier for clinicians and parents to note changes earlier than casual observation. Children who do not run a full 40 sessions—even though symptoms diminish in 20 sessions—tend to backslide. Many unexperienced clinicians send children out the door when the job is only half done thinking they have "fixed" things in 20 sessions.

Around 25 sessions, most clients experience improvements in their symptoms lasting longer and longer between sessions. Experienced clients see reduction in symptoms that first last one day, then two, then three, etc.—until the reduction lasts an entire week. The first stage we refer to as the "acquisition" stage. The second stage we refer to as the "consolidation" stage. Sterman & Egner (2006) have identified these stages as key phases of NFB. We feel that this is how they manifest in relation to the training process. LTP has had time to consolidate the new networks and, as Pascual Leone et al (2005) has noted, once the new behaviors have become permanently learned, there is little backsliding.

The Review and Trend Screens

Not all, but many vendors provide software with EEG trend or review screens. These training screens, when developed properly, allow us to monitor training in real time. This monitoring is critical for good clinical work. Unfortunately, much of the software has been developed by non-clinicians who have left out critical components. As a result, New Mind has created our own training software and equipment to provide optimal monitoring screens based on actual clinical needs. We have uncovered clear and

universal EEG trends that arise from training. Including trends that indicate to the clinician the level of responsiveness to training, the progress of the client at a given site, and an indicator of when to change training location. Most clinicians complain of a lack of these clear guidelines regardless of the system and vendor they use. Often the criteria they are given are based on superficial analysis and limited population samples that fail to be relevant beyond an individual clinic and clinician. By basing our criteria upon decades of research and widespread confirmation of clinical experience as well as a wide range of empirical pre/post measures, we are in a better position to develop and test clear and consistently effective guidelines.

At the outset, our bilateral protocols allow us to clearly measure asymmetry and coherence as well as amplitude. Most clients start out with large swings in amplitude, and very high coherence as well as large asymmetries. The trend line for each component band is widely separated and often asymmetrical as well. Often alpha will be higher in the left hemisphere than the right, and the beta will be higher in the right hemisphere than in the left. This amount correlates with anxiety and depression measures. As training progresses, magnitude becomes more consistent and stable. It tends to diminish especially in the slow wave frequencies that are often abnormal in their amplitude. At the same time, we note that asymmetry diminishes, and the amplitude lines of the left and right hemisphere component bands begin to merge. Thus, we have two measurable events occurring dynamically at the same time. This combination appears in the form of "compression" of the fast and slow waves and "converging" of the hemispheric amplitudes. Figure 9 Trend screen to the right demonstrates this pattern. Channel 1 represents the left hemisphere, and channel 2 represents the right hemisphere.

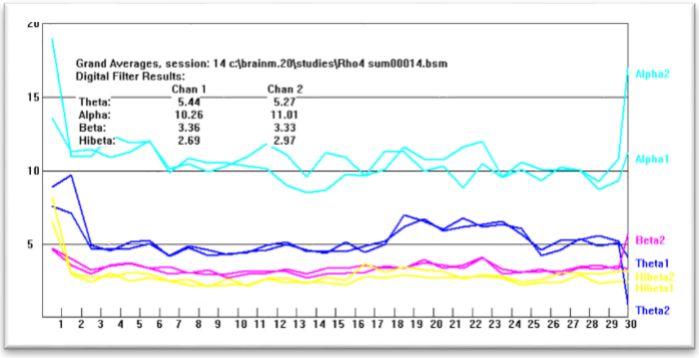

Figure 9 Trend screen

We refer to the vertical compression as "vertical integration", and this integration is discussed in detail with the relevant scientific support from the literature in the section on Dynamics of the Horizontal and Vertical Axis of Arousal in Chapter 8. We refer to the convergence of the magnitudes of the two hemispheres as "horizontal integration", also covered in that chapter. Coherence does not need to be trained or monitored—although it can be—because it normalizes along with these other two measures. This outcome is because the brain is a highly integrated system. It is so integrated that training one key area can bring other areas into normal range. You can monitor vertical and horizontal

independently and you will find that one leads to the other. We train both at the same time to enhance the outcome.

As you train one frequency, others will shift in response because of the natural compensatory response from the brain. The more disordered the brain, the more it will compensate. This compensation is similar to how people move with their body when they are in good health compared to how they move when they have a bad shoulder or back. The whole system compensates in an exaggerated fashion to maintain balance. Figure 10 Brain compensation is an example of this compensation.

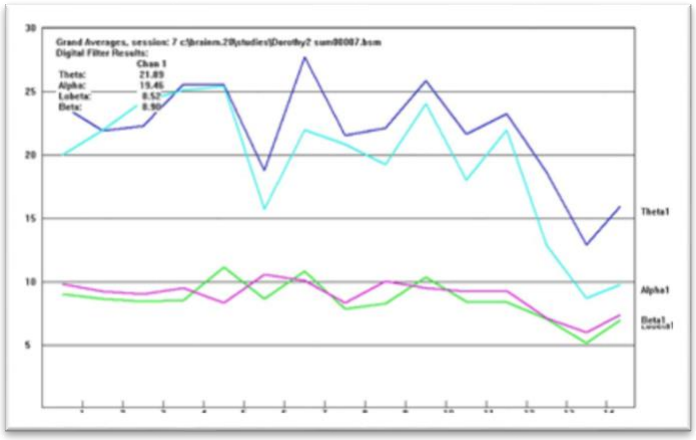

Figure 10 Brain compensation

Even more interesting is that this movement reaches a point at which all the lines begin to move more independently again along the vertical axis. We interpret this movement as plasticity and normalization of allostasis or natural organic balance of the neural system. This point is somewhat different for each individual brain and CNS. As we mention in the Chapter 3: Client Tracking & Pre-Post Trend and Map Analysis, people rarely move their maps from disordered to completely normal. Normal is a statistical concept. If they move approximately 30% in the normal direction as measured by the pre/post qEEG, they will exhibit significant changes and up to 80% improvement in symptomology. Again, the brain is not a linear system, and it changes in a nonlinear fashion. Progress is curvilinear as in learning. Many individuals will not achieve full normal asymmetry or amplitude, but they will come very close. Unfortunately, it appears that once our basic qEEG pattern changes due to challenges and trauma, it never fully returns to that original state but reorganizes into a neo-allostasis.

Effective Magnitude Changes

How much change in a session is expected? The trend lines should move either up or down in the expected direction at least 3-5uv if you have a good protocol and you are getting good results. However, this estimation only holds true for delta, theta, and alpha. Beta requires much more energy for the brain to produce, and its range of movement is much smaller. A change of .5 to 2uv is sufficient. To observe the changes in beta you must shift the scale of your review or trend screen (See Figure 11 on the next page). Many new clinicians make the mistaken assumption that you can see all the

changes well on one scale setting. It is important to shift the scale of the trend screen from 5 or 10 uv to 20 or 30uv to inspect the changes in all the component bands effectively.

Changing the Thresholds and Percent Reinforcement

The New Mind System is very automated. Thresholding is automated as well. It is not necessary in general to change the thresholds manually while training a client, but on some occasions, it helps. For instance, you may find that you cannot train alpha down in the left hemisphere very much. The brain seems resistant to change. However, if you train beta down in the right hemisphere, often alpha will come down in the left. Why? This is part of the compensatory process. The New Mind protocols are built upon a set of expert rules that have evolved from 20 years of clinical experimentation and observation. They are used to determine the protocols once the worst locations are analyzed in terms of frequency.

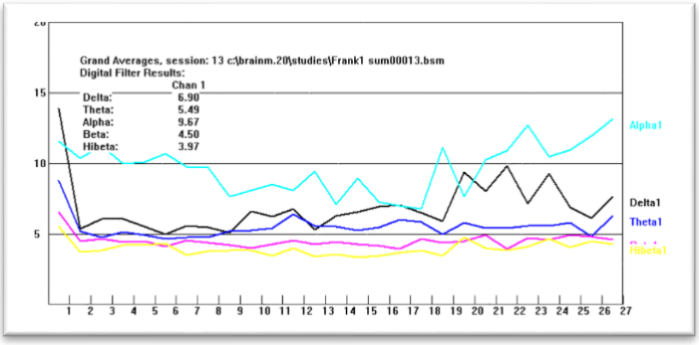

Figure 11 Shift the scale of the trend Screen 202

Training two channels systematically allows us greater freedom and leverage than training one location at a time. However, we have not found that training large numbers of locations gives us an exponential impact on the system. It tends, instead, to overly constrain the system. There is a point of diminishing returns. On occasion training four channels at a time can provide a nominal edge, but we have not found this result to be consistently the case. This result is one of the reasons that we have not fully embraced full cap 19 channel Z-score training. It brings minimal advantage, unnecessary complexity, and discomfort into the clinical setting.

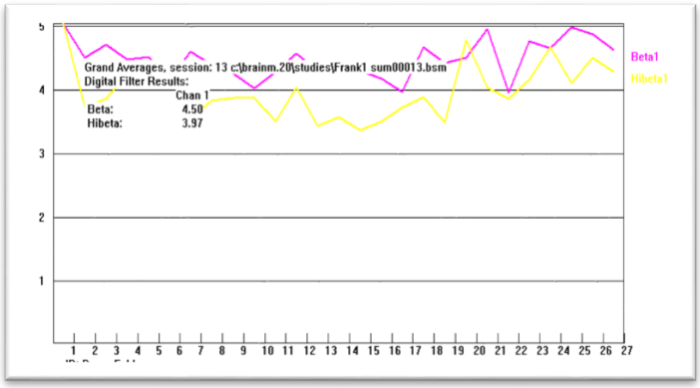

Figure 12 Shift scale from 0-20uv to 0-5uv to see beta changes

When training in one hemisphere is slow, try making changes in the other hemisphere to gain leverage. The correct strategy cannot typically be predicted in advance. It is best to change reinforcement in 10% increments whether you are

uptraining or down training a frequency or component band. The optimal range of reinforcement varies from 60% to 90% depending on the individual. The typical range is around 70% as we have noted previously. For most clients, this range will give a consistent and satisfactory response.

Divide and Conquer

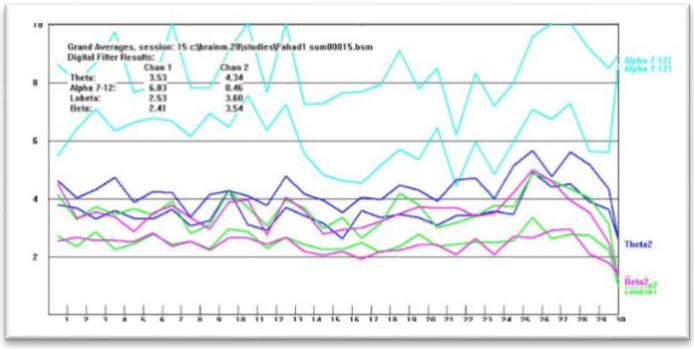

Figure 13 Beta inhibit increased in right hemisphere AT 12 minutes

Another protocol enhancement that can be employed is to reduce the number or narrow the range of frequencies you are training. The New Mind Maps System often produces a protocol that calls for down training a combination of delta, theta and alpha or 2-12hz. This range happens because the eyes open map shows a lot of elevated slow wave. But a tired brain cannot always do so much lifting. Its ability to produce energy may be compromised; it may respond better to a challenge involving only 1-4hz or 4-7hz. We have often found as a group that narrowing the expected range of change will produce better and more measurable results. We have also often found that training 4-7 down will also bring down 1-4hz and 8-12hz because of the law of compensation. Don't be afraid to make these adjustments once you have become familiar with the system. They are, however, enhancements and the generic protocols the system generates will work fine.

How Long to Train

Early on, before the advent of video-based training we used images and games to train people. We encouraged them to make a more conscious effort to do NFB. We found, however, that these gimmicks were not necessary and often counterproductive. Clients would develop unique and useless strategies to achieve their goals. We had to give clients a rest every seven to ten minutes and with children even shorter training time periods were often used. Since we began using videos and video contrast or brightness, we have found that we can easily train for a full 30 minutes without overly tiring the brain. A tired brain shows up as drowsiness and or increasing slow wave activity on the trend screen. You can train longer if you have time, but we are often limited to an hour. We usually do some life coaching and HRV training in each session as well.

Do not however use a training screen mode that involves starting and stopping the video and audio, as this action will reduce training efficiency because it leads to an

operant conditioning schedule resulting in ratio strain. Client's may become frustrated and perform more poorly. Also, changing both volume and video contrast for many people is overwhelming and frustrating, especially if they have sensory integration problems. Many people with disorders have filtering problems as well as sensory integration issues. It is best to keep things simple. In addition, when some clinicians start out, they make the mistake of using the full range of contrast, so the screen goes from full bright to full black. This practice is also a mistake that reduces training efficiency. A modest contrast is all that is needed. Why don't we encourage the client to focus hard on consciously changing the contrast? Birbaumer et al (2013) has already demonstrated experimentally that NFB is not a conscious process and that conclusion agrees with decades of clinical experience as well. Clients' neuronal systems do most all the necessary adjustment automatically; and again, clinicians don't have to rush in with detailed manipulations of the software to get good results. We try to keep things simple because in fact they are so complex.

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Chapter 3: Client Tracking & Pre/Post Trend and Map Analysis

It turns out that client tracking is one of the most important clinical activities you will engage in. We found this fact out the hard way through decades of NFB across hundreds of clinics. NFB is a slow acting and gradual process. Change can come quickly, but often it does not—especially for clients with severe or chronic conditions. When clients begin saying things like, “I’m not sure this is working” or “I don’t feel any different”, it can be very difficult to maintain clients and keep them on board clinically. To lose clients at this point is often a failure of clinical implementation. It hurts clients, clinicians, and the field of NFB. It really helps to be able to provide a chart that clearly shows each client’s symptom improvement. It is especially valuable when clients have constructed their own charts over time with their own subjective evaluation.

For this reason, we built the symptom tracker. I started this system in 1997 and have been developing the system ever since. We have made it as simple and convenient as possible, but it still takes clinicians some time to become used to it. Clinicians can provide clients with tablets, type in their “my-newmind” password, and pull up their symptom questionnaire. They receive a personalized list of symptoms based on their map and self-report. They can then rate their symptoms on a scale from 1 to 10 and save their information. The system automatically updates the charts that track their changes. The system also automatically generates pre/post graphs and histograms. There is considerable research on this method of tracking in the psychometric literature demonstrating the validity and reliability of this method of symptom tracking. Below are some images of the different charts in the system.

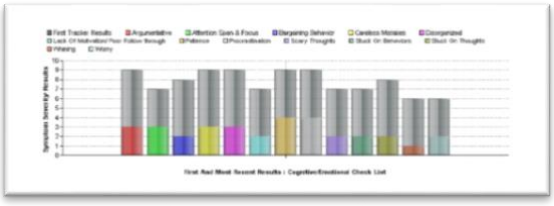

Figure 14 First and most recent results

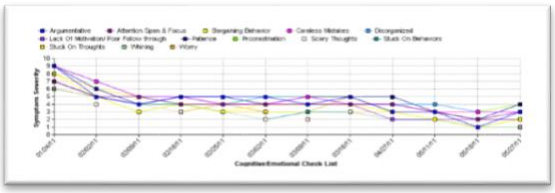

Figure 15 Cognitive emotional check list

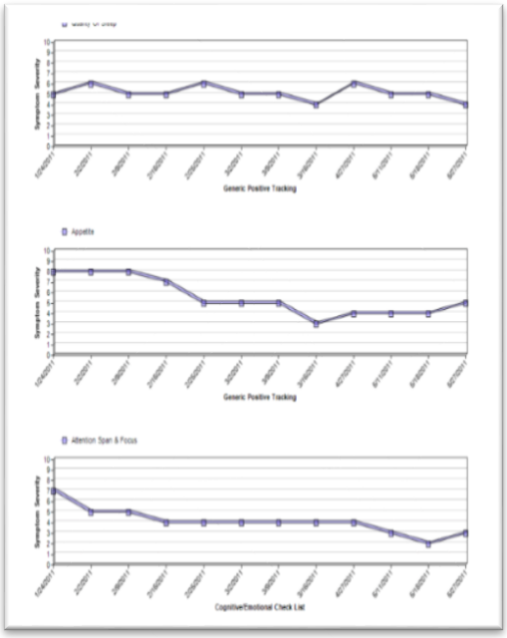

Figure 16 Tracking charts

These graphs are invaluable tools for ongoing assessment. In conjunction with pre/post CPTs and qEEG brain maps, as well as the training session trend screens, you have one of the most comprehensive, reliable and valid empirical assessment systems in existence for clinical work. Most clinicians tell me they are stunned when they discover the full capabilities of the system. The efficacy of NFB is now empirically documented automatically in thousands of case studies across clinics in the U.S because of this system. This system demonstrates the efficacy of NFB better than large scale double blind studies. There is also a section to manually enter notes from the clinician's observations and impressions. These notes can include client medication changes, insights, and challenges to the NFB process. This record is client documentation at the highest level. In most cases when clinicians review the client's progress with these notes and charts, clients are very surprised at their progress; they are also very convinced because it is their own data. They realize they have habituated to a new level of relief and improvement slowly without realizing it. This insight usually results in a renewed commitment to the process and results in higher clinical retention records with better outcomes.

The Computerized Performance Tests

The computerized performance tests or CPTs are another important tool for progress tracking that we have developed within the system. This battery of tests includes an attention test and other tests that assess the major aspects of memory, filtering, and executive function. They are based on standard test formats going back almost 100 years, and they have been normalized or use norms already developed such as those for the digit span short term memory test. These tests are in the public domain and have been adapted to the New Mind System, so that they are computerized performance tests done in real time rather than using paper and pencil. They are a real-time measure of client abilities and deficits and are an excellent empirical tool for tracking and demonstrating changes in performance in these areas resulting from NFB and other interventions. They have been statistically normed specifically to the system under conditions of clinical and at home use. They are also a valuable tool for confirming map findings and determining severity of cognitive deficits identified in the map analysis. If all the New Mind assessment and tracking tools are used, you will have a very comprehensive understanding of your client's issues and limitations as well as their capacity to recover from their challenges and deficits. You will also be able to very accurately judge the effectiveness of your interventions and protocols.

The pre/post map evaluation tool or "compare tool" is one of the easiest tools to use and easiest to understand measures in the qEEG field. It was designed specifically for busy clinicians with only basic statistical training. Until we had this tool, there was a great deal of conjecture about what the qEEG was showing us and what kinds of

changes in brain maps were normal and to be expected. We have now answered many of these questions with data and statistical analysis of a large and high quality clinical sample from hundreds of clinics and thousands of their clients. In terms of statistical sampling theory, it is about the best you can get realistically speaking. We have used this data to enhance the system and even change its format. The clinician can quickly choose between maps they wish to compare and separately generate compare reports for any combination. Both eyes open and eyes closed maps can be compared. Areas that move toward the norm, representing normalization of the distribution, are circled in green; and those that moved away from the norm, representing deviance and reorganization processes, are circled in blue. The total movement toward the norm and away from the norm is represented in at-a-glance meters labeled normalization and reorganization. A total normed percent change meter is also provided, so clinicians can get a sense of total change in the EEG distribution due to protocols, training sessions, and other interventions.

Our research with this tool and large sample sizes is reported in more detail in a later section. We have found the normal rate of change from map to map is approximately 30-40% and that low rates of change are in the 20% range and high rates are above 40%.

Figure 17 Glace meter with reorganization and normalization measurements

Clients will frequently, consistently change 30% or more from map to map even when mapped every 15 sessions. This range appears to be a constant in qEEG guided NFB. If clients average an amount of change in the 30-40% range, then they have an effective protocol and are making good progress. Without NFB, the brain rarely changes more than 5 or 10% on average unless it is being forced to change due to drugs or injury. Clinicians will find significant changes if they map clients in the morning and afternoon due to circadian cycles, so clinicians should remember to remap at the same time of day that the original map was done.

Another surprise is that the standard amount of normalization, or percent of change in values toward the database norms, seen in a map regardless of technology and protocol used is around 40%, and the amount of movement away from the norm is around 60%. (We have clinicians using Z-score and full cap training as well as infra slow training). As clinicians train and perform successive maps, the normalization value tends to increase while the reorganization value tends to decrease. Now we know with certainty how much change to realistically expect in a qEEG in basic and easy to understand terms rather than obscure abstract statistical jargon meant for researchers and not clinicians.

We interpret movement away from the norm, which is ever changing and constant, as an aspect of the brain's self-organizing patterns. The brain is clearly a self-organizing system that operates at the border of chaos, and it is also an error detection system (Buzsaki, 2006). Reorganization involves a lot of trial and error and adjustment through multiple iterations. This reorganization is why clinicians cannot add up the percent change over time to arrive at a total 100% percent change in an arithmetical fashion. There is no linear starting point nor ending point. The brain is dynamically cycling through successive iterations as a system that is forever updating and changing. It does not systematically return to prior forms or patterns of activities, instead it constantly adapts and reinvents itself in new forms and patterns. This behavior is a fundamental feature of the principles of plasticity and compensation. This response is also very confusing to clients who do not understand these principles, so it is best not to discuss reorganization with them.

This pattern of reorganization is a common feature of physiology and illness. The physiology of an individual never returns to its original status after an illness; the illness can often be identified by the state of the biological system after it recovers from the illness (Millis, 2016). This response is well understood in the physiology literature. So, expect the brain to go through constant iterations that result in a constant rate of change due to NFB. The worst outcome is when there is very little or no change at all. We have seen interventions such as pre/post hyperbaric that resulted in almost zero change in a client's map over a year's time. I even have pre/post maps ten years apart that show almost no change (See Figure 18 Pre-post maps 10 years apart above).

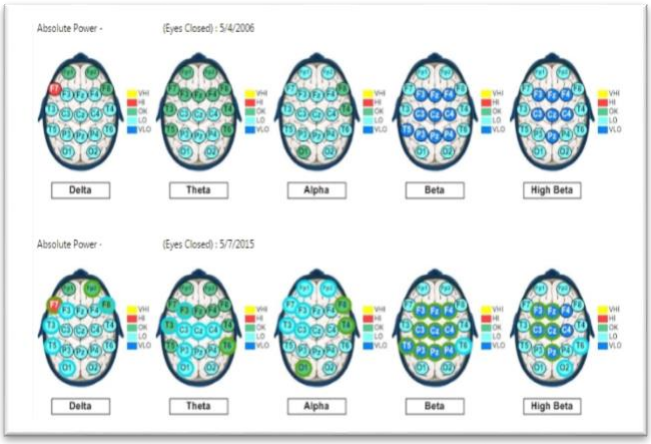

Figure 18 Pre-post maps 10 years apart

This response supports the research done on reliability of qEEG (John et al, 1988). Maps do not change much unless the client is exposed to drugs, surgery, or trauma that force the brain to change because of the impact on brain physiology. When maps change during NFB sessions, it is proof of concept every time. This concept is what clinicians should be emphasizing to their clients: the percent change and the changes in symptoms as recorded in the symptom tracker. Clinicians can also use the pre/post CPT and ISI anxiety and depression measures. The primary interest is in symptom changes is why they seek help and is the most reliable measure of change.

The amount of change in Z-scores in each 10-20 location across all five dimensions of neurometric analysis including magnitude, dominant frequency, asymmetry, phase, and coherence is the percent change shown in the New Mind compare tool. We consistently find magnitude the primary dimension of analysis with the others being adjunctive and supportive of findings. We discuss this magnitude in more detail in Chapter 6: Map interpretation and Analysis. Why is the Map System Built This Way? We use the same dimensions of analysis to arrive at the normalization and compensation measures.

Auto-Artifacting in New Mind

The New Mind Maps System now provides auto-artifacting of the raw EEG record, so that clinicians can save time and increase the accuracy and reliability of their maps. Until recently this process was a very primitive and often produced mixed results. The New Mind auto-artifacting feature uses a proprietary method to analyze the content of the EEG and eliminate most of the artifact in the record. It is done in a fashion similar enough to manual artifacting, so that it does not distort the phase features of the record. Consequently, phase and coherence remain as accurate as in manual artifacting.

Despite this accuracy, the system does have limitations. If clinicians are too careless and don't collect a good quality record, the system will reject the data and recommend manual artifacting. This behavior is usually because the record is so contaminated that a certain amount of artifact must be accepted to accomplish editing. In this case, it is up to the clinician to choose through manual artifacting what kind of artifact and how much artifact to accept. The system requires at least 30 seconds of edited data before it will process a map. Clinicians who are not sure how to edit can find a video on the topic in the New Mind help section. The New Mind editing tool now provides clinicians with professional and consistent auto editing that has never been previously possible.

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Chapter 4: The Interactive Self Inventory (ISI) and Sociometrics

The two major confounds of NFB are metabolic deficits related to toxins, pathogens, and physical trauma; and social relationship problems or social distress. Social distress results in psychological distress that leads inevitably back to physical distress. Shonkoff & Garner (2011) promote the general term of "toxic stress" to this social psychological dimension in their review of the largest longitudinal health study in recent history known as the Adverse Childhood Experiences (ACEs) study. According to this study, toxic stress is responsible for most of adult health problems, both physical and psychological. As Bessel van Der Kolk (2014) notes, the body keeps the score. It stores this distress in many ways. We have known for decades that stress suppresses immune function and degrades memory function. The average individual coming into an NFB clinic today is likely to have a significantly high number of symptoms in various metabolic categories. We have published a sample of thousands of individuals in this book that clearly profiles this problem. Social psychological distress and physical health problems are part of a bio-social feedback loop dating back millions of years. The New Mind Maps System attempts to capture and measure the dynamics of that loop and quantify it, so that it can be used as a vehicle for healing and wellness. Part of this measurement process is the interactive self inventory (ISI).

The ISI is a socio-emotional assessment tool developed exclusively for the New Mind Maps System and provides the theoretical foundation for the entire bio-psycho-social assessment system. In the latter part of this chapter we provide a literature review and explication of the theory behind the instrument as well as the statistical validation process and values derived from that validation process. It is an indispensable tool and should be used with all clients over the age of 18. It should not be used with younger individuals as their capacity to self-report, according to decades of psychometric literature, is very poor. Instead the children's version of the CEC should be used as it is designed to be used in this capacity. The system automatically selects the correct version when you enter in the client's age. Adolescent clients require third party reports and evaluations.

The ISI assumes that anxiety and depression, or what we prefer to call from a psychophysiological model overarousal and inhibited, are the fundamental dimensions of disorder due to stress to the biological system and the CNS. Closely affiliated with them are the behavioral dimensions of social approach and social avoidance. Increases in anxiety and depression result in increases in inhibited expression of emotion and avoidant behavior and vice versa. This behavior results in a reduction in sociality. Emile Durkheim showed long ago in one of the first sociological statistical studies with human populations ever done that the resulting "Anomie" leads to isolation and increased risk

of depression and suicide. There is a reason we use solitary confinement as a form of punishment. Aristotle notes that we are first and foremost social or "political" creatures. Walter Freeman, a leading neuro imaging researcher, notes that we are first and foremost emotional decision makers. Fear increases anxiety and reduces our access to emotions resulting in poor social accuracy, inadequate behavioral responses, and failure to thrive. The ACE study states that toxic stress from inadequate and abusive socialization processes is the leading cause of physical and mental illness. They believe it accounts for as much as 60% of adult health problems (Shonkoff & Garner, 2011).

The scores for anxiety and depression are posted on the New Mind qEEG report dashboard along with the overarousal and inhibited meters that correlate with these states. We have confirmed decades of research in this direction and our statistical findings are published in this book. When using the ISI, clinicians will notice common patterns. Most individuals with significant scores on anxiety will also show high scores on the inhibited scale and the impulsivity scale. When we statistically analyze individuals with impulsivity problems, we find most of them do not have excess slow wave activity but rather excess fast wave activity and beta asymmetry. Another common feature of anxiety is elevated scores on the perfectionism scale. This tendency is usually a consequence of their efforts to control the environment and keep themselves safe. Depression on the other hand usually includes all these features plus an elevation in competitive scores.

Most of these people also report excessive self-critical thinking. They derogate themselves constantly. This tendency is usually indicative of poor socialization and emotional trauma in the family of origin. High scores on the avoidant dimension also confirm higher levels of family systems problems. So, these behavioral patterns covary with EEG asymmetry and can to some degree be predicted from a brain map. High scores in dependent usually indicate co-dependency. These individuals usually carry a high score in passive as they tend to go along to get along and are poor at drawing boundaries. I began investigation of this tendency back in 2000; I formally presented it at several ISNR meetings over the years. I had been working on the ISI for almost a decade and had presented it at an AAPB conference to some very dubious onlookers at the time. New ideas are always confusing.

The ISI is very useful to determine whether depression is a consequence of physiological problems or psycho-social problems. This distinction is important for determining which protocols to use and how to deal with clients. Clients showing high psycho-social features will respond well to NFB and counseling. Whereas those clients with strong map asymmetries have slowed alpha and low scores on these dimensions and will respond better to metabolic based interventions. We have learned from clinical

experience that you cannot train away or talk people out of a metabolic condition like a hypothyroid condition.

The ISI is also very useful for identifying the weak point in a clients' dimensions of social interaction and can be an excellent guide for life coaching or counseling to assist them more specifically in ways to improve their behavior and social interaction outcomes. It is also an excellent tool for peak performance. Consequently, the ISI provides two references for interpretation. The red lines are the average score for all dimensions and the purple bar graphs represent well-adjusted and successful individuals. We used individuals who were top performers in business, training, and sports to assemble these norms. They provide a basis for assessing present behavior in comparison to optimal behavior. The blue bar graph represents client's scores. The ISI also provides a narrative that explains the meaning of each dimensions as well as steps to change that can be practiced assisting in changing behavior. In addition, potential visualizations are provided for AT training and performance enhancement.

Figure 19 Comparison of two pilots compare a pilot who is flight ready on the left with a pilot who is having significant psychological problems below.

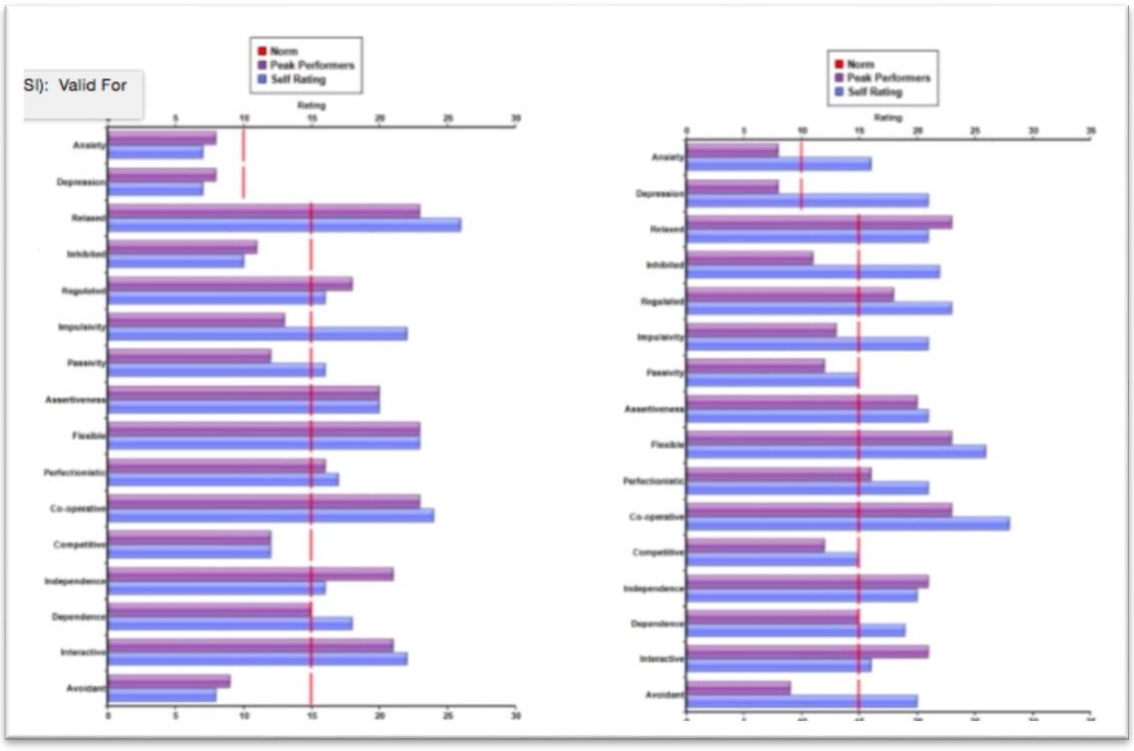

Figure 19 Comparison of two pilots

Theoretical Basis for the Interactive Self Inventory

The ISI proposes domains of measurement of human behavior based on constructs grounded in social psychology and electrophysiology. The primary purpose of the ISI is

to cross-correlate patterns of social behavior with the neurophysiological domain of electrical activity in the brain. The secondary purpose of the ISI is to develop an instrument that is more clinically relevant than existing instruments for the assessment of clinical problems in terms of social interaction and defining avenues of behavioral change. Many of the existing instruments, such as the MMPI, utilize very abstract dimensions of measurement that clinicians find difficult to specifically operationalize clinically to implement change in clients.

Previous efforts to define and measure human dimensions of behavior have been isolated within disciplinary boundaries. These boundaries have also defined their limits of analysis. These efforts have generated valuable but incomplete theories and measurement techniques, such as behaviorism, that often lead to puzzling conclusions. By engaging in a more interdisciplinary approach that includes biological, psychological and social dimensions of analysis, the ISI attempts to bring more of the various pieces of the behavioral puzzle together.

The scientific analysis of human behavior evolved over time into two fundamental domains of analysis, the sociological and the psychological. In the 1930s several theorists began to identify problems with confining analysis to either domain and began a synthesis of these domains in the form of social psychology. This synthesis has resulted in a more satisfying hybrid of theories.

In psychology, Watson and Skinner defined the powerful research tradition of behaviorism. Behaviorism proposed that rewards and punishments in an environment predicted behavior. This paradigm focused on the reinforcing properties of the environment and discounted subjective states as unimportant. Personality theorists on the other hand looked for consistency of behavior over time across situations. One group, including Allport and Cattell, sought to identify traits that could be measured to define and predict personality. The operational source of these traits was never acknowledged, although some discussion acknowledged that they may emerge from some unidentified internal process that was also discounted. Consequently, these personality theorists tended to discount eternal rewards and punishments. Personality theorists, such as Freud, Adler, Horney, and Maslow in contrast attempted to devise theories to explain how personality emerged from internal drives as well. These theories, although useful clinically, were difficult to verify empirically because of the nature of their theoretical constructs.

In sociology, structural theorists such as Durkheim defined behavior as a result of social environmental forces that were external and coercive. The symbolic interactionists in contrast, initially defined by Mead, proposed an alternative social-psychological tradition that identified the personality or “self” as a process that emerged from the interaction of the biological and the environmental forces resulting in

a self-society dialectic. Objects were always, by definition, social, and the self-emerged from social interaction, whether imagined or real. Parsons later attempted to synthesize these perspectives into an integrated systems theory perspective. Festinger, one of the first social psychologist, was dissatisfied by both psychological behaviorism and sociological structuralism and developed theories such as social comparison theory that moved beyond behaviorism and structuralism as well.

Drawing on Gestalt theory in psychology, another of the first social psychologists Kurt Lewin, looked at the impact of processing on behavior in his formulation of social-psychological analysis. This study of the perception of social objects, rather than just physical objects, reflected the work of Mead and others in sociology. Gestalt contained the concept of self as process, like Mead's theories, and this self-process was derived from interaction. From this perspective, how social environments were "construed" defines the identity of rewards and punishments studied in behaviorism. Therefore, how social environments were construed (perceived, interpreted, and distorted) was critical to the formulation of human response.

From research we see that people form construals (Ross & Neisbett, 1991) of their social environment as a basis for behavior. Construals are based in two fundamental motives: "the desire to maintain self-esteem and the desire to form an accurate picture of oneself and the social world" (Aronson, 1998). Social cognition theory proposes that social behavior is driven by "expectations" involving "self-fulfilling prophecy" (Rosenthal & Jacobson,1968) based on construals. Social cognition is defined as how people select, interpret, remember and use social information to make judgments and decisions and then act. There are many basic components to the process of social cognition. For instance, individuals use schemas as theories on how things work as a basis for evaluation and action. Schemas can distort what we see perceptually and what we remember. Schemas persist when discredited in the form of "perseverance effect." "Self-fulfilling prophecy" occurs when our schemas result in (influence) behavior that reinforces them by eliciting behavior in others that reinforces our expectations. "Judgmental heuristics" are processing patterns, mental short cuts, that we use to process vast amounts of information. All of these can be greatly distorted by network dysfunctions. Neurologists have noted for over a century that damage to temporal lobe networks can lead to confabulations that distort the employment of schemas and judgmental heuristics (Demasio, 1994). Yet, this source of behavior is a missing dimension of influence not included in the analysis of social-psychologists.

Cognitive dissonance is a social psychological theory that Leon Festinger proposes that is also associated deeply with self-esteem. This theory reflects a trend in thinking about the sources of human behavior. In psychology Albert Bandura's social cognitive theory connects learning to behavioristic theory and personality theory through the

medium of self-efficacy and provides a parallel theoretical picture. Self-efficacy is like self-esteem theory. Julian Rotter's theories of expectancies mirror expectation theory in social psychology.

These theories emphasize the importance of emotion and self-evaluation in the determination of human behavior. This theoretical approach also more specifically reflects the anatomical development and physiological dynamics of the human brain. Human behavior is profoundly influenced by emotional processes (Goleman, 1995). There is a human need to maintain a positive view of ourselves according to the self-esteem approach (Aronson, 1992). From the social-psychological perspective the psychological dimension of denial stems from the desire to maintain one's self-esteem (although it may emerge from confabulation). The perspective behind the ISI proposes that self-esteem is dependent on social accuracy, which can derive from either socialization or from the processing efficiency of neural networks. Negative emotional valancing (as well as positive) (Demasio, 1999) provides individuals with important feedback regarding the success of their behavior.

Another key mediating variable, proposed by this author, in the process of achieving social accuracy is "effective cognitive processing." When we are not accurate, we engage in denial and rationalizations to sustain self-esteem. Accuracy tends to be a more cognitive process, while self-esteem tends to be a more emotional process that is valancing our accuracy. Individuals engaging in approach behaviors are more likely over time to refine their interaction techniques and gain access to social resources such as attention, status, power, and money. Their ability to maintain a dominant "approach" style of behavior is a measure of their success at interaction and indirectly a measure of the social resources they have accessed. Individuals engaging in avoidance behaviors are more likely over time to fail at practicing and refining behaviors and to poorly access social resources.

Approach and avoidance have a typical EEG signature. The amygdala and the nucleus accumbens subcortical affective related structures play key roles in providing emotional valancing to networks guiding attention and cognitive processing as well as primary bottom up sensory processing (LeDoux, 1996; Chow and Cummings, 1998). Negative interactions, both internal and external, tend to increase right hemisphere activation and anxiety (Davidson, 2000). Continued negative interaction results in withdrawal behaviors and depression (Davidson, 2000). This interaction provides a starting point for correlating behavior with neurophysiological activity. Individuals with a dominant approach behavior pattern will consistently demonstrate a stereotypical EEG pattern in which the left hemisphere is more activated than the right hemisphere (Davidson, 2000). Other patterns that correlate behavior with neurophysiology are likely to emerge as well.

The researchers in neurophysiology (Sacks, 1985; Ramachandran, 1998; LeDoux, 2002; Demasio, 1999; Davidson, 2000; Cozolino, 2002) have provided a new window into human behavior exposing a dimension previously ignored or discounted in the behavioral sciences: the physiological. Based on their findings, there are distinct correlates between human behavior and electrophysiological events. These findings suggest that processing and the resulting construals can be profoundly altered and that the resulting behavior will be novel and socially inaccurate. A consequence of this finding is the implication that an additional causational link, among several mentioned above, exists between behavior and physiology that can provide cause and effect consequences in either direction between the correlating factors. The further implication of this hypothesis is that any event which disrupts, disturbs or profoundly alters physiology can also alter human behavior. This includes drugs, trauma, intense emotional states, viral infection, and toxins. The enduring consequence of trauma can result in unanticipated social consequences with respect to human behavior that are both subtle and socially destructive, particularly if they occur in individuals who reside in key hubs of power; in which case, they are likely to have extensive negative consequences for the social order.

The ISI is based on a theory of personality that is social and psychological as well as grounded in the biological or physiological. This bio-social-psychological theory draws from the concept of social accuracy derived from social cognition theory (Fiske & Taylor, 1991) and links it to approach-avoidance theory emerging from the investigations of Richard Davidson regarding affect regulation and EEG asymmetry. The approach avoidance theories emerging from labs are grounded in neurophysiological measures of affect regulation, specifically EEG. The ISI seeks to correlate approach and avoidance behavior with EEG distribution and cortical activation patterns. The approach avoidance sub-dimensions are expected to be influenced at the very least by EEG asymmetry as well, but more extensive correlations are also expected. Table 1 General clinical correlations between EEG and behavior is a chart showing these observations.

Research questions begin to naturally emerge from the foregoing. Where does the problem with social accuracy emerge from in terms of social interaction? What is interfering with the processing and interaction of individuals who are depressed and causing them to retreat? What are the key dimensions of interaction that lead to retreat? Inhibition, passivity, perfectionism, excess competitiveness, and over-dependence are proposed negative dimensions associated with social retreat trajectories. In terms of established social-psychological concepts, it could be said that these dimensions are related to low self-esteem. They can emerge from processing errors due to network dysfunctions. They feedback into network processing and enhance negative self-evaluations that further destabilizes networks. The positive dimensions of assertion, co-operation, independence, relaxed, and self-regulated tend

to lead to approach trajectories with positive outcomes with respect to social accuracy and acquisition of social resources.

Table 1 General clinical correlations between EEG and behavior

Delta Theta	Alpha 8-9hz	Alpha 9-11hz	Beta 1	Beta 2
Hypercouple 1 AD/HD	Hypercoupled 2 Depression	Optimal Coupling	Hypocoupled 1 Insomnia	Hypcoupled 2 Hypervigilance
Impulsive	Dependence	Flexible	Anxious	Independence
Independence	Inhibited	Co-Operative	Inhibited	Controlling
Interactive	Perfectionistic	Interactive	Perfectionistic	Competitive
	Passive	Regulated	Competitive	Passive
	Avoidant	Relaxed	Assertive	Avoidant
		Approach		
Lo Dopamine	Lo Serotonin		Hi Norep	Lo Gaba

To ensure convergent validity as well as item face validity, the ISI dimensions and items were selected based upon a meta-analysis of existing scales in peer reviewed psychological instruments (Corcoran & Fischer, 2000), and based upon their usefulness in defining clear alternative lines of interaction that would result in enhanced social accuracy. Individuals scoring high in the negative dimensions tend to engage in withdrawal behaviors and attribute errors to others. They lack self-efficacy. Their schemas tend to be negative; they select, interpret, and remember in negative terms. “Perseverance effect” emerges when their schemas fail to be effective. They blame others and see themselves as victims. They have a negative self-fulfilling prophecy because negative expectations result in behaviors in others that reinforces those expectations. Judgmental heuristics dominate processing in a negative form.

Some predictions regarding behavior can initially be made based on these dimensions:

- If individuals are impulsive, they will violate norms and erode trust in others and consequently themselves. If they are regulated, they will build trust.
- If they are inhibited, they will not self-disclose and engage others to build relationships. If they are relaxed, they invite interaction.
- If they are passive and go along with others all the time, they will violate themselves by not getting the resources they need. If they are assertive, they will act to secure resources.
- If they are perfectionistic, they will frustrate themselves and others in attempting to get things done to secure resources. If they are flexible, they can

adjust to change and adapt to circumstance to overcome adversity and challenge.

- If they are overly competitive, they will discourage others from participating and diminish their self-esteem. If they are co-operative, they will encourage others to participate and improve outcomes through sharing resources.
- If they are overly dependent, they will not take initiative and generate conflict by attempting to have others secure their resources for them. If they are independent, they demonstrate confidence, feel self-empowered and actively define clear boundaries.

The New Mind System is designed to investigate the relationship between electrophysiological patterns in the brain and human behavior. It provides social-psychological measures in the form of the ISI, cognitive, and emotional measures in the form of the cognitive emotional report, and physiological measures in the form of the physiological report. These measures are cross-correlated with each other and with a qEEG report showing the distribution of electrical activity in the brain. This activity is a proxy measure of activation of brain networks showing effective and functional connectivity (Freeman et al, 2009) between hubs and nodes in the brain network system (Hagmann et al, 2008). The “at rest” measures of the EEG record the “default mode” (Buckner et al, 2008) of brain processing and the functional connectivity of brain networks. Through the correlation of these bio-psycho-social dimensions emerges the ability to measure and identify specific features of disorders, which may transcend diagnostic categories, and generate interventions as well as track the results of their implementation.

Subjects

Questionnaires were taken from N = 3000 subjects. Subjects were drawn from over 300 clinics around the country and constituted a volunteer sample of high quality. Since the clinics were in a variety of geographical locations across the country and represented a variety of socio-economic groups, they were close to being as random a sample as possible without engaging in formal targeting procedures using stratified sampling methods. Subjects included both males and females and ranged in age from 16 to 92 years of age. All subjects presented themselves to clinics as having a disorder of some form and eventually received NFB training after testing.

Methods

Data was collected anonymously from the New Mind database containing responses to the ISI questionnaires. There was a total of 136 items that defined two meta-dimensions of approach and avoidance and 14 sub-dimensions measured using a five-point Likert scale. Dimensions were each composed of 5-16 questions on average with anxiety and depression measures containing 15 and 16 items respectively. Anxiety and

depression scales showed an average correlation of 86% with the Beck Inventories when comparisons were run for cross-validation. These scales were included in the measures to validate approach and avoidance validity and to enhance cross validation with other psychometrics. By correlating factor loadings of approach and avoidance with depression and anxiety, discriminant validity of metascales and subscales would be confirmed. They could then later be cross-correlated with EEG asymmetry measures. Scale items are listed by scale in the Appendix.

Items were initially evaluated for substantive validity through initial inspection of the descriptives run on a group of 30 peak performers in business and athletics. Results indicated all items represented valuable measures of the constructs of interest. None of the items appeared skewed or unbalanced, no response sets emerged, and all items were retained for further analysis.

Each scale was statistically analyzed using factor analysis. Initially oblique rotations were employed for each dimension to determine orthogonality of constructs. Results indicated that there was significant overlap between constructs with values typically exceeding .32 in the correlation matrix (Tabachnick and Fiddell, 2007). This outcome was considered desirable since we sought overlap for these dimensional subscales that would later be analyzed as sub-dimensions of approach and avoidance where orthogonality would be considered a critical issue from a theoretical standpoint. Data was subjected to Bartlett's test of sphericity to confirm the matrix was an identity matrix and Kaiser-Meyer-Olkin principal to confirm sampling adequacy. Next a set of reliability analyses was conducted on all scales utilizing Chronbach's alpha to applied to confirm scale structure characteristics.

This approach provided an opportunity to inspect how subscales intercorrelated, how broad each construct remained, and to determine which scale items should be removed to improve the internal consistency and reliability of measures. Following this step, a new set of reliability and factor analyses was applied using orthogonal varimax rotation to each scale. Eigenvalues were extracted for each dimension, and scree plots were evaluated for key factors ranking above 1.0 in eigenvalue. These results found that additional modification was necessary regarding six scales with additional items being removed; and the reliability analysis then being rerun for this scale along with a new factor analysis. Finally, the correlations of the sub-dimensions with the meta dimensions, which were the focus of these analyses, were conducted along with a final set of reliability analyses for all finalized scales.

Results

First, the following table (see Table 2) summarizes the final set of scales included in these analyses. The total number of items associated with these finalized scales are

presented, along with measures of Cronbach's alpha and a listing of the specific items not included in each of these scales, where applicable.

Table 2 Summary of final scales

Scale	# of Items	Alpha	Items not Included
Avoidant	6	.915	NA
Interactive	6	.894	NA
Dependence	5	.716	NA
Independence	5	.660	6
Competitive	8	.880	NA
Cooperative	6	.809	NA
Perfectionistic	7	.828	4, 5, 6, 7
Flexible	7	.879	7
Assertiveness	5	.677	4
Passivity	6	.712	NA
Impulsivity	9	.829	8
Regulated	6	.741	1, 2
Inhibited	10	.912	NA
Relaxed	8	.765	NA
Depression	16	.921	NA
Anxiety	15	.891	NA

A Cronbach's alpha of 0.70 or higher indicated an acceptable level of internal consistency reliability. As shown in the table, all scales were found to have a Cronbach's alpha equal to this threshold or above except for independence and assertiveness, with both scales only being marginally below this threshold of 0.70. Therefore, based on these results, this set of scales were deemed to have an acceptable level of internal consistency reliability.

Additionally, as illustrated in this table (see Table 2), most of these scales did not need to be modified based on the results of the factor analyses as well as the reliability analyses conducted. These unmodified scales consisted of the following: avoidant, interactive, dependence, competitive, cooperative, passivity, inhibited, relaxed, depression, and anxiety. Specifically, the only scales that were modified consisted of the independence, perfectionistic, flexible, assertiveness, and impulsivity scales.

Regarding the independence scale, only the sixth item was removed, which stated, “What other people say doesn’t bother me”. When reviewing this item alongside the remaining items, it appeared conceptually different than the remaining five, which focused on the factors of the respondent enjoying being by themselves. They did not rely/depend on other people and did not care what others thought about them. What other people said about the respondents appeared to be substantially different from these other measures, which made the removal of this item statistically, theoretically, and conceptually justified.

Next, the perfectionistic scale was also modified by removing items 4 through 7. The retained items associated with this scale focused generally on mistakes and failures made by the respondent or in other people’s projects. However, items four through seven focused on making mistakes and paying attention to details in a much more abstract way as well as whether others took advantage of the respondents’ mistakes. These specific items appeared to be conceptually different from the retained items, so it was felt that the removal was justified statistically based on the results of the factor analyses and reliability analyses as well as theoretically or conceptually.

The next scale which had been modified consisted of the flexible scale, in which only a single item, question 7, was removed. Respondents evaluated this statement, “At times a sudden change of plans is necessary”. This concept of a sudden change of plans appeared conceptually different from the remaining items, which focused upon learning new things, new points of view, trying new things, etc. Therefore, it was felt that the removal of this item was both theoretically and conceptually justified.

Next, the assertiveness scale was modified by removing item 4. Respondents evaluated this item, “When I’m asked to do something, I always want to know why”. This item also appeared distinct from the remaining items, which focused on issues such as being honest about their feelings, meeting new people, complaining, and confronting others. Due to this reason and the results of the factor and reliability analyses, this variable was removed from this scale.

Following this adjustment, the impulsivity scale was also modified by removing item 8. Respondents evaluated this statement, “I say things without thinking”. This item also appeared distinct from the remaining items, which asked about factors such as planning, solving problems, sitting still/being restless, and so forth. Based on this fact along with the results of the analyses conducted, this measure was removed from the scale.

The final modified scale consisted of the regulated scale, in which items 1 and 2 were removed. Item 1 stated, “I plan things carefully”, while item two stated, “When I get angry, I wait for a while before I respond”. While there was an item like question one included in this scale (“I plan each day with a written list”), item 2 appeared conceptually distinct from the remaining items, which discussed factors such as keeping

things organized, setting aside time for themselves, avoiding excess, and so forth. It was not felt necessary to keep both items and the similar item 4. As components of this scale and based on the statistical results, items 1 and 2 were removed.

The following table (see Table 3) summarized the results of the correlations conducted between the scale items and the avoidant as well as the approach factors. As shown, both Pearson's and Spearman's correlations were conducted. While Pearson's correlation was excellent at estimating a linear association, Spearman's correlation was superior at modeling non-linear correlations. As indicated in the following table, these two sets of correlations produced nearly identical results in all cases. Additionally, for the purposes of interpreting these coefficients, correlations of +/- 0.10 were considered weak correlations, with correlations of +/- 0.30 considered moderate correlations.

Table 3 Correlations with avoidant and approach interactive

Measure	Avoidant		Approach	
	Pearson	Spearman	Pearson	Spearman
Dependence	.248***	.244***	.033	.024
Independence	-.059**	-.072***	.113***	.118***
Competitive	.179***	.190***	.009	.016
Cooperative	-.229***	-.256***	.375***	.367***
Perfectionistic	.381***	.377***	-.159***	-.154***
Flexible	-.205***	-.233***	.286***	.288***
Assertiveness	-.325***	-.318***	.400***	.387***
Passivity	.226***	.222***	-.101***	-.105***
Impulsivity	.234***	.239***	-.050*	-.053**
Regulated	-.063**	-.065**	.103***	.094***
Inhibited	.578***	.570***	-.339***	-.336***
Relaxed	-.264***	-.277***	.342***	.334***
Depression	.453***	.440***	-.303***	-.301***
Anxiety	.420***	.409***	-.259***	-.265***

Notes: *p<.05, **p<.01, ***p<.001; N = 2721, df = 2719.

Correlations that were found to be +/- 0.50 or larger in magnitude were considered strong correlations. While similar, the Pearson's correlations were used to interpret these correlation coefficients.

First, regarding the avoidant scale, the following scales were found to have positive and significant correlations: dependence, competitive, perfectionistic, passivity, impulsivity, inhibited, depression, and anxiety. The correlations with dependence, competitive, passivity, and impulsivity were found to be weak while the correlations with perfectionistic, depression, and anxiety were found to be moderate in strength. Additionally, the correlations conducted with inhibited was found to be strong. Next, significant, negative correlations were found between the avoidant scale and the independence, cooperative, flexible, assertiveness, regulated, and relaxed scales. All these correlations were found to be weak except for the correlation conducted with assertiveness, which was found to be moderate in strength.

The following set of correlations were conducted with the approach scale. Here, significant, positive correlations were found with the following scales: independence, cooperative, flexible, assertiveness, regulated, and relaxed. The correlations conducted with independence, flexible, and regulated were found to be weak, while those conducted with cooperative, assertiveness, and relaxed were found to be moderate in strength. None of these correlations were found to be strong. Next, significant, negative correlations were found between the approach scale and perfectionistic, passivity, impulsivity, inhibited, depression, and anxiety. The correlation conducted with impulsivity was found to be negligible, while the correlations conducted with perfectionistic, passivity, and anxiety were found to be weak. Finally, the correlations conducted with inhibited and depression were found to be moderate in strength.

Discussion

The results of this analysis provide a new instrument that has begun to bridge the EEG defined dimensions of approach and avoidance with other socio-behavioral patterns. It also has begun to establish the primacy of these dimensions with respect to social and psychological behavior based on empirical measures grounded in physiological patterns of individuals. Previous work done by Davidson, Heller, and others has paved the way for this effort and already established the importance of this direction of investigation. Other such patterns of EEG are beginning to emerge that indicate dysregulation in areas of the brain that clearly influence behavior, such as EEG patterns related to filtering abilities, facial decoding, and impulse control. These other dimensions of activities may result in future modifications of the present ISI model or spawn affiliated instruments that can work in conjunction with the ISI.

At a minimal EEG asymmetry predicts likelihood of behaviors defined within the dimensions of approach and avoidance. This effort further defines what those dimensions of behavior might be and begins to build a theoretical perspective based upon those dimensions that integrate diverse theoretical perspectives presently prominent within the fields of psychology, social psychology, and sociology.

The instrument further provides built in measures of anxiety and depression that can help further define the social-psychological contributors to these measures and further clarify the impact of social distress in the development of psychological disorders. In addition, further correlations between EEG distributions and these patterns of behavior can be further explored in detail.

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Chapter 5: Confounds of Neurofeedback - Metabolic, Social, & Pharmaceutical

When individuals come to a clinic for NFB, they typically carry a great number of assumptions and erroneous ideas with them that are an impediment to NFB. One of the most difficult assumptions to deal with is the "magic bullet" theory of medicine (Whitaker, 2010). This idea is a major concept in medicine and has led us down a very dark road. The idea is that the doctor or healthcare professional carries an arsenal of magic bullets that provide an immediate solution to suffering. If the solution does not work right away, then it probably doesn't work at all. I call this the "John Wayne school of medicine". "Just patch me up doc, and I'll get back on my horse and get my job done!" Medicine has never worked this way—except for antibiotics. Healing has never worked this way either. It takes time to recover from mental or physical trauma. In a society obsessed with production and consumption, we do not provide time for healing. The work of Elizabeth Kubler-Ross revealed in the last century that as a culture, we do not really acknowledge grief nor the stages it requires to heal. People suffering from grief are diagnosed as depressed and are medicated. Consequently, they often never resolve their grief because the medication blunts their emotions and prevents them from experiencing the grief and working through it.

NFB is neither invasive or coercive. It is a form of involuntary learning (Bierbaumer, 2013) called operant conditioning. This distinction is why we tend to use videos for training rather than have clients willfully straining to change an image on a screen, as in the early days of NFB. When we work with the biological system and not try to force it, things go better. One of the important things that our data has shown is that healing takes time. On average, it takes 15 training sessions to generate significant documentable changes in the trend screens that result in significant documentable changes in symptoms. We have thousands of symptom trackers and pre/post maps to prove this point. We have documented it with all current forms of NFB. This tendency does not mean that improvement can't happen faster. We have many trackers that show very large changes in symptoms within five sessions, but those changes will not be sustained unless they are followed up by further sessions.

We urge clinicians to be wary of claims of the magic bullet and quick fixes. This approach has already failed in both medicine and NFB. NFB always works when continued because learning always occurs when basic needs are met. What slows progress down in NFB is externalities such as abusive jobs, family environments, or poor lifestyle habits. Many clients secretly hope they can continue to maintain an unhealthy lifestyle and get "fixed" by the NFB. This desire is simply not possible. Changes in lifestyle are always part of the solution. Even though it may be frustrating, it is hard to get clients to make these required lifestyle changes. It turns out that our biggest

impediment to healing is ourselves and our automatic habits of thinking, feeling, and doing over our lifetimes that lead us to ill health.

Clinicians should emphasize to their clients before beginning treatment that clients alone are responsible for their own healing and not the clinician. Clinicians provide the technical resources and tools for recovery, but the client must do the work and learning. This obligation is the bio-psycho-social approach to healing. It's the clinicians job to help clients identify the lifestyle patterns that are contributing to their suffering and assist them learn to overcome them. NFB works best when it is a partnership and as an adjunct to healing changes in lifestyle patterns and behaviors associated with suffering and ill health. This partnership can be a challenge because it requires empirical measures and tracking of these multidimensional factors across time. As clinicians, we must measure and quantify metabolic symptoms, psychological symptoms, cognitive problems, and physical health problems, and look for patterns of lifestyle and behavior that are contributing to them. We must recommend changes and support them through training, practice, and monitoring techniques. When done properly in conjunction with NFB, profoundly positive changes in symptoms usually follow. When NFB is not working well, it is usually because of a problem that is metabolic or one that is emerging from social relationships in the family or at work.

Drugs

Drugs can aid clients initially in dealing with acute phases of suffering, but drugs often become an impediment when applied to chronic conditions. When doing NFB, it is usually necessary to taper off drugs slowly and reduce them to minimal levels or remove them from use completely. Clients often begin to experience many of the listed side effects of a drug as they continue to train because their symptoms abate. As their biological systems improve, their usual dosage becomes too high. If clients do not taper off, they may not get better and may even begin to feel worse. At this point, clients often blame NFB. This tendency should be avoided at all costs. Clinicians should inform clients of this potential problem at the outset and be sure clients have a list of side effects posted somewhere in their house. Clinicians should also get written agreement to work with clients in this area. Clients need to be sure they have access to a medical doctor who can help them manage and reduce their dosage. Our experience is that the Physicians PDR is often unreliable for this endeavor. Often, we see physicians reducing dosages too rapidly, and we can clearly document the effects in our system. This phenomenon has been widely published and acknowledged in the psychiatric literature as well (Whitaker, 2010). Clients also need to know this information. Clients who start out without drugs frequently do much better and recover more quickly from their suffering.

As I have mentioned, it has been noted in literature that drugs tend to blunt affect. Medication reduces clients' access to emotions and in turn reduces their ability to think clearly and make good decisions. At the same time, too much distress can result in the same problem. A balance must be struck between these two issues. Emotional awareness is crucial for integration from psychological trauma and recovery (Van Der Kolk, 2014). This balance is also why we start out immediately teaching individuals heart rate variability (HRV) and other biofeedback techniques to calm their CNS. These skills allow them to manage the anxiety underlying their distress, provides them with a sense of control, and leads to faster integration.

The drugs that are the greatest impediment to NFB are opioids and benzodiazepines; these drug types are also two of the most commonly abused kinds of drugs. They are addictive, so many clients will underreport their usage. SSRIs on the other hand have a milder affect except when combined with many other drugs. Using large combinations of drugs with high doses is a warning sign that the client is poorly managed and already overmedicated. These clients are also poor candidates for NFB unless they are highly motivated. Table 4 Drug chart on the following page is a chart of drug categories and their effects on the EEG.

Eating Habits and Nutrition

It is well documented that most Americans eat prepared foods that are highly contaminated with untested chemicals and toxins. These toxins include pesticides. As a result, most people's adipose tissue is highly contaminated with these toxins from birth into adulthood. Many manufacturers engage in deceptive practices to hide these contaminants in their products. When children are highly physical and active, they burn fat. This process releases toxins into the bloodstream. In addition, a sub-concussive event can result in a brief breach in the blood brain barrier that can allow these toxins access to the brain. This access can initiate a cascade of inflammatory processes that becomes chronic with a deleterious effect on neural function and neuro endocrine disorder (NED). We review the literature on this process in Chapter 5: Confounds of NFB - Metabolic, Social, & Pharmaceutical.

Even without concussions or sub-concussive events, these contaminants inflame the intestinal tract and result in excessive membrane permeability. This behavior is usually mirrored in the brain membranes as well (Perlmutter, 2015). The result of this permeability leads to an inflammatory response that often ends in an autoimmune cascade (Wang, 2010). This cascade in turn impacts endocrine support of neuronal function and results in a degradation of the neuronal system. Research documents that this inflammation leads to anxiety and depression (O'Mahoney, 2015). The resulting inflammation can be tracked with the qEEG as we demonstrate in this book. Often

clients are suffering with this condition when they come to clinicians as documented in the metabolic checklist and the brain map.

Table 4 Drug chart

Family	Drug	Purpose	EEG Impact
Neuroleptics	Examples	Sedative	Sedative increase delta, theta and beta above 20Hz and decrease alpha and beta below 20Hz.
Neuroleptics	Examples	Non-sedatives types	Decrease alpha and increase beta in general.
Anxiolytics			Decrease alpha and increase beta especially 13-20Hz beta
Benzodiazepines	Valium and Ativan		Decrease alpha and increase 20-30Hz beta
SSRIs	Prozac, Paxil and Zoloft	A class of antidepressants used in the treatment of depression anxiety disorders, and some personality disorders	Decrease alpha in frontal alpha and a mild increase in 18-25Hz beta.
MAO Inhibitors		Antidepressants	Tend to increase 20-30Hz beta while decreasing all other frequencies
Tricyclic antidepressants	Imipramine and Amitriptyline	Useful in depressed patients with insomnia, restlessness and nervousness	Increase delta and theta while decreasing alpha and increases beta
	Lithium	Used for the treatment of manic/depressive (bipolar) and depressive disorders	Increases theta, mildly decreases alpha and increases beta
Amphetamines	Adderall, Vyvanse, and Dexedrine	A group of drugs that act by increasing levels of norepinephrine, serotonin, and dopamine in the brain	Decrease slow wave activity and increases beta in the 12-26Hz range
Marijuana		Recreational	Increases frontal low frequency alpha—affects EEG for three days
Opiates	Opium, Hydromorphone, Oxymorphone, heroin, Morphine, Oxycodone, Talwin, Codeine, Methadone, Meperidine, Hydrocodone, Vicodin		Generate high Amplitude slow alpha in the 8Hz range
Barbiturates	Brevital thiamyl surital thiopental Pentothal, amobarbital, Amtya, pentobarbital, Nembutal, secobarbital, Seconal, Tuinal Phenobarbital, Luminal, mephobarbital, Mebaral	Produce a wide spectrum of CNS depression, from mild sedation to coma, and have been used as sedatives, hypnotics, anesthetics, and anticonvulsants.	Increase beta at 25-35 Hz amplitude
Caffeine			Increases beta and decreases slower waves.
Anticonvulsants			Increases Gamma
Antipsychotics			Increases delta and theta, decreases alpha peak frequency.

To counteract this process, clients must learn to change their diets and make better food choices. It is essential that they eat only organic foods and meals prepared from organic sources as much as possible. This change requires an open mind and experimentation. For many clients, this lifestyle change is as difficult and emotionally challenging as changing their religion. They must learn to eat less meat but more vegetables and fruit. Clinicians can help guide their clients with this change. They can provide their clients with good books on this way of eating. Sometimes even cooking lessons are required to help clients make the transition.

Supplements are also usually important to recovery and the NFB process. Most clients come in with serious nutritional deficits. Prolonged or toxic stress leads to chronically elevated cortisol levels, adrenal fatigue, elevated homocysteine levels, and immune system suppression. These problems in turn lead to deficits in magnesium and zinc. It is well known that most individuals have a chronic deficit of vitamin D, B12, and omega 3 fatty acids as well as severe magnesium and zinc deficits. These mineral deficits affect neurotransmitter production and suppress critical enzyme activity. Without these resources, it is more difficult for the brain to alter structure and function in response to NFB training. The New Mind System provides recommendations of nutritional supplements based on the qEEG profile. Most nutritionists who have reviewed the output have told us that it is usually similar to their own recommendations after assessment. It is meant to be an aid to them as well as other healthcare clinicians in determining nutritional recommendations. It should not be blindly followed. In addition, the metabolic checklist is designed to be used with the Apex Nutritional System and is designed to interface with their products. Clinicians can find a one to one correspondence between the metabolic checklist and their assessment system and its categories.

Relationships & The Family System

Unless they are educated and trained in family systems, most health clinicians are only dimly aware of its importance. There is vast literature on this topic in several disciplines going back to the 1940s (Soutar, 1989). The ability to develop relationships is forged through early socialization in the family system. This relationship building is a biological process as much as a socio-emotional and psychological process. The family is not only a fundamental economic unit, but it is also a fundamental socialization context. It transcends all others in its impact on the formation of personality and behavior. Judith Lubar documented its effect on NFB (Lubar & Lubar, 1999). It can have a profound impact on training and even completely mitigate it.

We have written about this topic in the book, *Doing Neurofeedback* (Soutar & Longo, 2011); it is part of the BCIA Blueprint of Knowledge and the New Mind Academy web course. I develop this theme in detail in Chapter 10: A Psychology of NFB.

Individuals with medical problems such as severe migraine, Alzheimer's, addictions, or psychological disorders all profoundly impact the family system. Financial problems, death, divorce, relocation, and a host of other social circumstances can also adversely impact the family system. The effects of these events impact the formation of personality, the social self, and the ability of individuals to interact in a manner that is socially accurate and allows them access to resources they require to thrive. I cover this idea in detail in Chapter 4: The Interactive Self Inventory (ISI) and Sociometrics.

Individuals living in these relationships and family systems grow and form neural networks and systems that reflect their environments. We not only become anxious, but we also grow an anxious brain; and it operates differently than a healthy brain. This anxious brain cannot be changed overnight. The ISI measures the dimensions of behavior that emerge from social interaction and can indicate if client symptoms issue from an adverse socialization process involving toxic stress or not. Once identified, a clinician can work to help clients reframe their beliefs and change their habits of thinking, feeling, and doing. NFB provides the plasticity and enhanced self-awareness that is required to emit these novel behaviors due to natural insight and creativity of response or action.

Unfortunately, usually the family system pushes back and challenges any change. New behavior in the family system causes tensions as it challenges the natural attractor basin or tendencies the system has evolved. This resistance in turn shows up on the trend screens as a poor training session. On the next page is an example of a boy who was suffering great difficulties at school because of an emotionally abusive teacher and the change that resulted from his removal from that environment (see Figure 20 Emotional Abuse Pre Map).

Note the highly elevated theta that is minimally responsive to training and the post trend screen a few weeks after changing schools (see Figure 21 Emotional Abuse Post Map). Judith Lubar (1999) documents effects such as these with family events such as divorce, alcoholism, or a death in the family. If such events from the family system can entirely short circuit NFB training, then it should clearly be of paramount importance and in the forefront of every clinician's mind with each client at each session. When trend screens change, clinicians should ask questions with direct probes. "Do you like your teachers? Did something bad happen today at work? Did you have a fight with your spouse?"

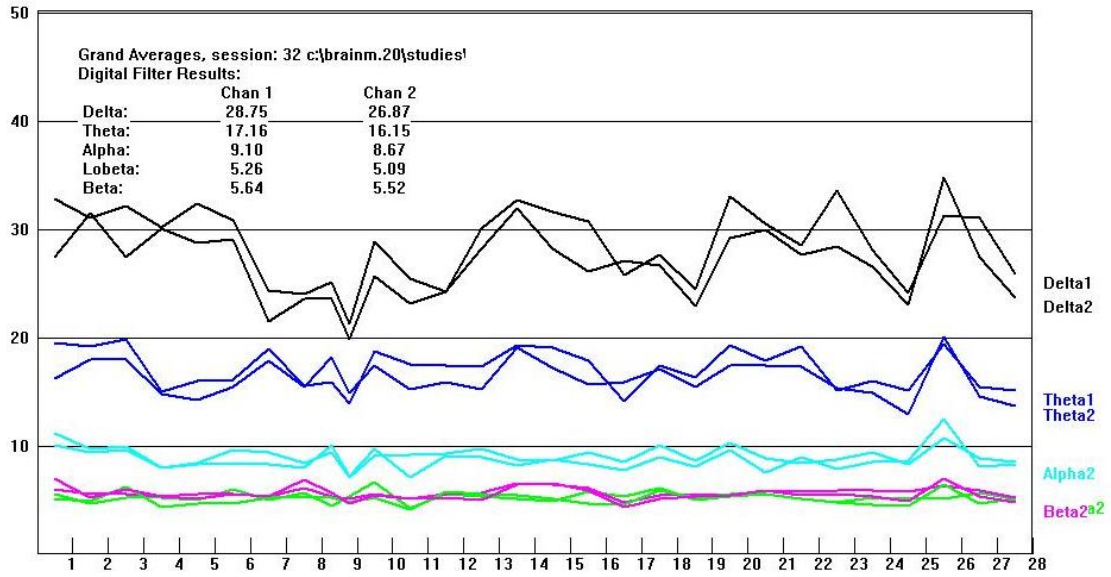

Figure 20 Emotional Abuse Pre Map

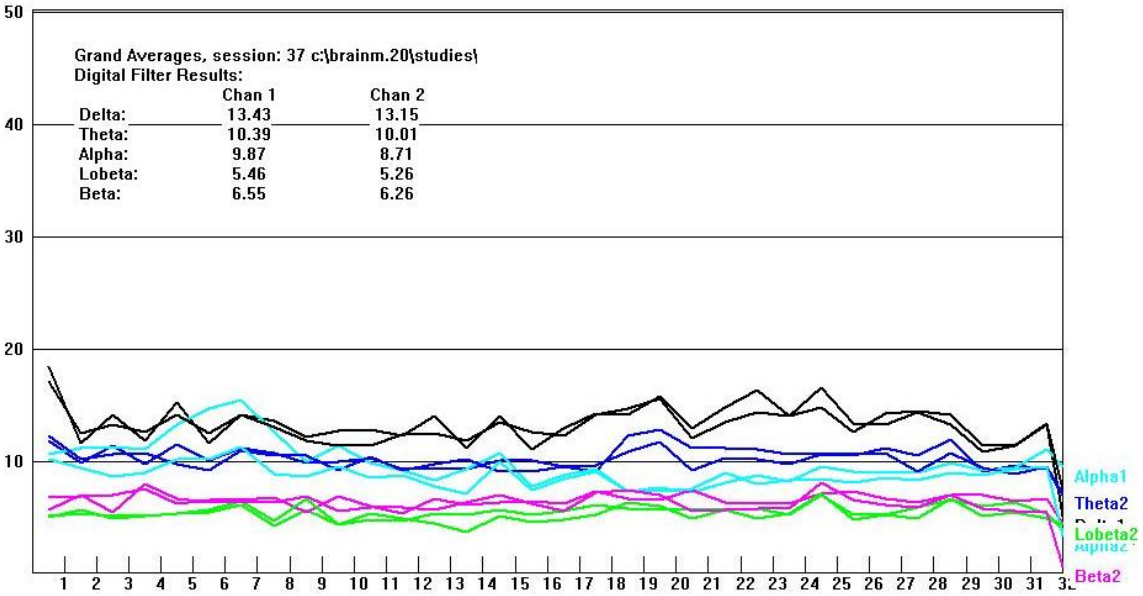

Figure 21 Emotional Abuse Post Map

Occupational Hazard and Dysfunctional Job Environments

The workplace is very similar to family systems and individuals tend to adapt roles in these environments that they had or saw modeled for them in their family of origin. The worst work environments are usually a consequence of unresolved socialization trauma. Fellow workers and bosses can be devastatingly abusive and subtle about it. Clients from similar families can fall into roles of the victim without even realizing what is

happening to them. Clients may be overwhelmed with the abuse they suffer at work, but they are unable to deal with it because the boss or the owner is part of the problem. The option of leaving the workplace may not seem available due to financial circumstances. It is important to uncover this situation as early as possible in the NFB cycle. Often AT training can open clients up to insights that can lead to unexpected possibilities for change.

More on Metabolic Analysis and Confounds

At New Mind we have evolved an oxidative stress model of mental disorder that integrates neurophysiology with qEEG patterns and corresponding symptom categories. We review this perspective in detail in this chapter and discuss the basic metabolic strategy that we have adopted to assess and interpret the effect and role of metabolic problems on the clients qEEG.

The New Mind metabolic checklist was developed in recognition at the clinical level that certain metabolic deficits were interfering with NFB training and outcomes. We became particularly aware of this problem training women with hypo-thyroid problems. They consistently demonstrated significantly elevated global alpha with frequency slowing in the range of 8hz in the one hertz bins analysis maps. This alpha was stubbornly unresponsive to NFB using single channel protocols, two channel protocols, Z-score protocols, IFS protocols, and other interventions that we tried, such as photic. Once we saw the pattern, we sent clients to functional medicine specialists for treatment as acute care physicians failed to recognize or adequately address this problem.

Once thyroid support was sufficiently addressed, these clients responded very well to training. We wondered how many other metabolic issues were interfering in the difficult cases. I brought this up on a major qEEG list serve and was authoritatively informed, to my surprise, by one of the key people in the field that no such problem existed. Upon reviewing the literature, I found large numbers of publications specifically identifying thyroid issues as something reflected in the EEG. So much for the concept of "authority" and "factoids" in science. For this reason, I recommend that everyone challenge and check all authoritatively given "facts" in this field.

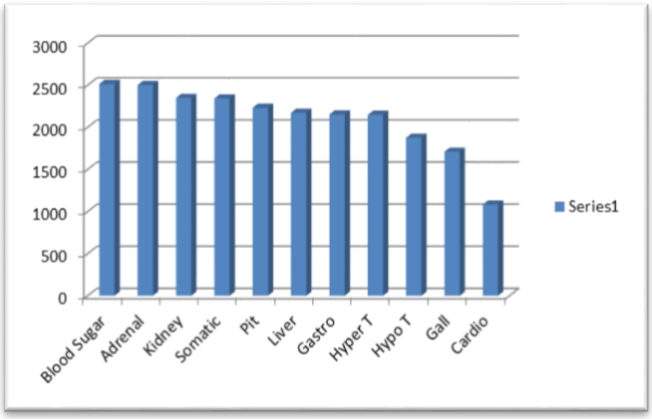

Figure 22 Typical metabolic problems

Because of this outcome, we developed a metabolic checklist

for assessment purposes to identify any metabolic issues that may be affecting the qEEG analysis and interfering with NFB protocols. We created this checklist by identifying the major metabolic categories that typically impacted the qEEG and pulling from the medical literature the symptoms typically associated with these metabolic categories. We then listed the symptoms and using a Likert type scale asked for responses regarding frequency and severity of symptomology experienced from each client. Once we had 3000 checklists and corresponding qEEGs from over 500 clinics across the country, we statistically analyzed the data. We reviewed the distribution of the disorders and normed the data, so that we had a clinically normed symptom checklist. Significant scores in any one metabolic area encouraged clinicians to look for their impact upon the qEEG. Patterns began to emerge, and they were supported in the literature. Figure 22 Typical metabolic problems (previous page) and Table 5 Typical metabolic issues on below show the distribution of metabolic problems in a typical NFB practice.

Table 5 Typical metabolic issues

	N=	MEAN	SD	%
Blood Sugar	2515	16	15.8	88%
Adrenal	2502	18	14.6	87
Kidney	2348	13	10	82
Somatic	2342	18	16	82
Pit	2232	14	6.7	78
Liver	2173	16	14	76
Gastro	2152	17	14.7	76
Hyper T	2147	12	9.5	75
Hypo T	1876	12	9	65
Gall	1710	12	10.6	60
Cardio	1082	13	10	37
Total N=2848				

As you can see, many of the population have significant scores. A healthy person should have no score or a minimal score, so those people with significant scores are very compromised physiologically. We have found that the higher the score, the less

responsive they are to NFB, and the longer it takes to train down their symptoms. This behavior clearly argues against the idea that it's always the protocol or NFB that is not working. If the body and the brain do not have the resources to respond, then the response will be minimal. We will cover a similar issue in Chapter 4: The Interactive Self Inventory (ISI) and Sociometrics.

We feel that we have identified a pattern of physiological response to stress in this data. Initially stress affects adrenals and pancreas showing up in testing as elevated cortisol levels and glucose instability. Over time, the microbiome is affected by an elevated acidic profile and intestinal T joints begin increasing membrane permeability. This pattern occurs, according to the literature, in the brain barrier as well. As the immune system responds to foreign proteins in the interstitial fluid and blood stream, an autoimmune response evolves and assaults the thyroid. We then see hyper and hypo thyroid responses. These assaults reduce available thyroid T3 which in turn has a profound impact on brain function. Cardio vascular problems emerge due to global inflammation. By this time, excessive global muscle bracing in response to stress has shortened and degraded muscle tone and health as well. These patterns can be matched to shifts in the qEEG as it gradually transitions through progressively degrading oxidative stress stages that reflect Selye's alarm response and exhaustion stages of stress model. This model is explicated in more technical terms in the section on Correlating Oxidative Stress and qEEG.

Due to these findings, we refer clients to functional medicine specialists when their global metabolic score, as indicated in the map report, reaches a high level, about 150. We continue to train these clients, but on a reduced schedule to maintain treatment continuity and oversee the client's progress with the progress tracking system, pre/post maps, and the New Mind CPT of cognitive functions.

Paper on: Correlating Oxidative Stress and qEEG

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Jan 25, 2016

Abstract

Fifty-Eight subjects were assessed using measures of qEEG and oxidative stress. Subjects were identified as either fast oxidizers or slow oxidizers using hair analysis. Then they were assigned to categories of either fast wave dominant maps or slow wave dominant maps based on a reviewer shared rating system. Fast wave maps were identified as qEEGs dominated by statistically significant levels of beta frequencies and slow wave maps were identified as qEEGs dominated by delta and or theta frequencies. Chi square analysis indicated that fast wave maps tended to be associated with fast oxidizers and slow wave maps tended to be identified with slow oxidizers.

Keywords: **qEEG**, **oxidative stress**, **neurofeedback**

The American Academy of Pediatrics has recognized toxic stress resulting in chronic inflammation as a leading cause of adult health problems (Shonkoff & Garner, 2012). Neuroinflammatory processes and excitotoxicity leading to neuronal dysregulation and necrosis are often either directly or indirectly a consequence of toxic stress (Sapolsky, 1999). These processes typically have an enduring impact on electrophysiology that can be identified in the EEG and qEEG (Niedermeyer & Lopes da Silva, 2005; Knyazev, 2012) in the form of significantly elevated delta frequencies in addition to other standard measures of neural functioning (Dietzel et al, 2012). Inflammation from other sources such as TBI (Scicutella, 2007) as well as pathogens and environmental toxins (Filley, 2001) have increasingly become recognized as a major health problem also responsible for neuroinflammatory cycles.

Inflammatory processes can arise from sub concussive events resulting in temporary breeches in the brain blood barrier that allow for the entrance of opportunistic spirochetes, bacteria and industrial toxins (Wang & Michaelis, 2010). They can also result from excitotoxicity arising from extreme or chronic emotional trauma associated with dysfunctional family systems and maladaptive behavior patterns arising from inadequate socialization in those family systems (Shonkoff & Garner, 2011). The consequences of emotional trauma appear in the form of elevated fast wave activity and beta asymmetries (Heller, 1997; Engels 2007). Since these patterns of oxidative stress and resulting inflammatory activity appear to have correlating EEG signatures, it is reasonable to speculate that these signatures can be identified more clearly and related to qEEG patterns.

Oxidative stress is a process in which the allostatic balance or pro-oxidant and antioxidants becomes disturbed by an overabundance of free radicals (Mancinelli et al, 2011). Under pathological conditions the overproduction of peroxides and free radicals can begin to surpass the body's detoxification capacity. Damage to lipids, proteins, and DNA as well as cellular signaling follows. In the extreme, this damage can result in neuronal necrosis and apoptosis.

A wide variety of phenomena can trigger this response including radiation, ozone, nitrous oxide, heavy metals, pesticides, alcohol, a wide variety of food additives, and many chemical compounds contaminating food and water (Mancinelli et al, 2011). Although these are primary external environmental contaminants, there are psycho-social factors that can precipitate an oxidative stress process through the medium of excitotoxicity (Harvey, 2006). Toxic stress also precipitates excitotoxicity (Savic, 2013). Excitotoxicity is a common feature of extreme states of stress as found in severe emotional abuse and PTSD (Sherin & Nemeroff, 2013).

Neurons have unusually high energy requirements, especially when producing high frequency brainwaves (Alkhadi, 2013). These high frequencies are especially overabundant in individuals with anxiety for prolonged periods of time (Heller et al, 1997). When cortical neuronal columns are over active, they produce excessive amounts of cellular glutamate as a byproduct of cell metabolism. Microglia that typically convert this to glutamine for recycling within the presynaptic neuron become overburdened resulting in a buildup of toxic extracellular glutamate in the interstitial tissue (Wang & Michaelis, 2010). This glutamate binds to NMDA receptors and allows the entry of Ca2 (carbonic anhydrase II) into the postsynaptic neuron that in turn results in necrotic cell death or apoptosis. It also binds to non-NMDA receptors allowing entry of excessive Na (sodium) into postsynaptic neurons resulting in cytotoxic edema.

The excessive Ca2 overwhelms mitochondria that attempt to absorb the excess which in turn degrades mitochondrial DNA. The loss or ATP output from compromised mitochondria leads to reduced efficiency in sodium pumps required for production of high frequency electrical activity associated with EEG (Belanger; Alkhadi, 2013). It leads to leakage or disruption of axonal membranes and the nodes of Ranvier and thereby reducing conduction velocities (Moritini eta al, 2005). The excitotoxic model describes a process of high intrinsic oxidative stress leading to mitochondrial dysfunction low ATP production resulting in a chronic inflammatory response and deficient DNA repair. The outcome is neuronal degradation at all levels and often neuronal death (Wang & Michaelis, 2010).

In addition, astrocytes play a critical role in gating capillary process and determining what molecules can penetrate the blood-brain barrier (Enciu eat al 2013). When these astrocytes are compromised by inflammation secondary to oxidative stress and

excitotoxic activity, this barrier becomes degraded allowing the infiltration of toxins and pathogens normally excluded. This infiltration further compounds the inflammatory process and further degrades neuronal functions. Consequently, environmental factors, TBI, pathogens, and toxic stress can all result either directly or indirectly in oxidative stress leading to chronic inflammatory processes that degrade neuronal function.

The body also has stereotypical responses to these same challenges. These responses have been documented through decades of research in a variety of fields (Shonkoff and Garner, 2011). It is well known that stress increases adrenal activity, the output of epinephrine, and elevates cortisol levels. This behavior in turn also upregulates the hypothalamic-pituitary axis (HPA) altering endocrine functions. Elevated cortisol acts upon the hippocampus to reduce short term memory function and suppress immune function activity. Body pH shifts in a more acidic direction as the enteric microbiome alters its bacterial species distribution. Chronic stress can then result in intestinal inflammation and weaken T joints leading to the migration of foreign proteins into the interstitial matrix and blood stream. This behavior in turn precipitates an overresponse of cytokines resulting inflammatory activity frequently ending in an autoimmune response. Liver function can become burdened as toxin levels rise and hypothyroid conditions develop. This behavior in turn reduces thyroid T4-T3 conversion and deficits of thyroid T3 transport to neurons further degrades processing speed and sodium pump activity resulting in diffuse elevated slowed alpha (Dietzel, 2012). This shift in alpha is then another EEG marker of the stages of stress.

Hans Selye (1982) published a model of stress, *The General Adaptation Syndrome*, that has been continually well supported in research and still endures to the present. This model consists of an alarm stage, a resistance stage, and an exhaustion stage. Based on the foregoing research and observations, it is reasonable to expect the following physiological pattern to attend escalating stress on the organism. The alarm stage results in excitotoxic activity in the brain. Prolonged excitotoxic activity is accompanied by growing inflammation. Chronic inflammation increases over time and slowly degrades physiological function. As physiological function declines, energy production capacity decreases, and high frequency loss occurs with increasing slowing in the EEG.

Since oxidative stress is the underlying physiological process of this model, it stands to reason that progressive stages of one would be reflected in the other. Since electrical activity (Freeman, 2009) and blood perfusion (Rosa et al, 2009) are reflected in EEG activity, qEEG should be a proxy measure of physiological changes in the brain and CNS activity. Based on the above research, it should also reflect bodily dysregulation in many metabolic function areas the related degradation of the associated physiological processes.

Correlations were conducted between psychological anxiety and reports of adrenal symptoms to assess the related variance between these factors. A very high correlation of .719 was noted, confirming the strong association between psychological and physiological factors (See Figure 23). This result is consistent with past biofeedback research (Shwartz, 1995). Consequently, the physiological component of anxiety should be reflected in the brain and the EEG as well. Past research supports this observation (Hammond, 2011).

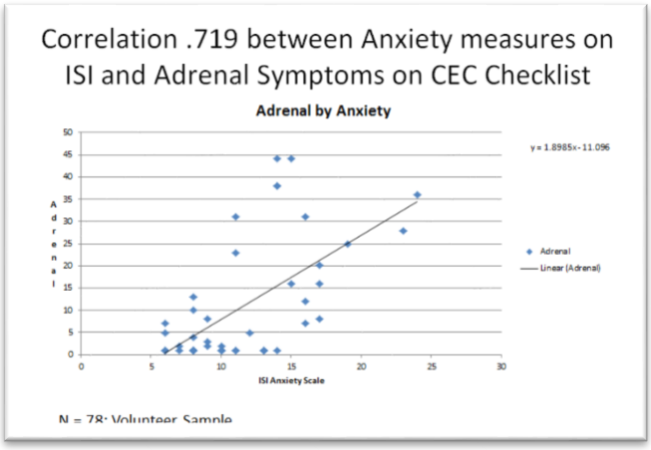

Figure 23 Correlation .719 between anxiety measures on ISI and adrenal symptoms on CEC checklist

Correlations were also conducted between depression and reports of thyroid symptoms. A lesser but nevertheless significant correlation was detected suggesting strong connections between depression and thyroid conditions. This correlation was noted as mentioned previously in other research (Neidermeyer & da Silva, 2005). The lower level of correlation indicated the variance of the dependent variable was shared by other unrepresented but known factors such a mood and serotonin production.

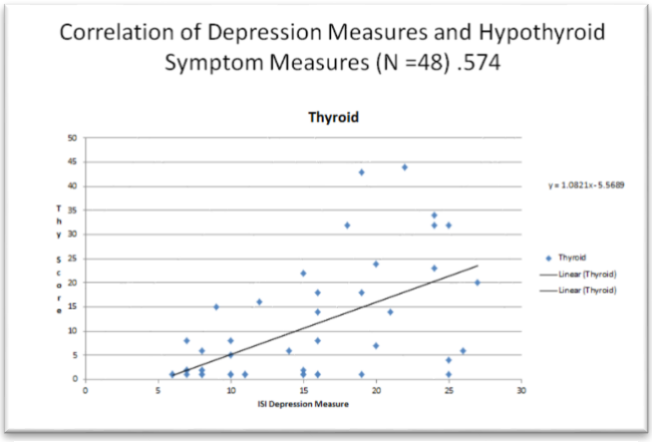

Figure 24 Correlation of depression measures and hypothyroid symptom measures (N=48) .574

The Model

The first signs of stress in the EEG is excessive desynchronization resulting in chronic reductions in alpha and excessive production of beta frequencies (Hardt, J. V., & Kamiya, J., 1978; Avram et al, 2010). This behavior shows a period of increased adrenal activity, elevated cortisol levels, immune suppression, and disrupted melatonin cycles.

Figure 25 Absolute power (1) shows Stage 1 alpha deficit commonly appearing in initial stress.

Over time this behavior results in a chronic beta asymmetry that can be present even when the rest of the EEG appears normal. (Heller;1997; Engles et al 2007).

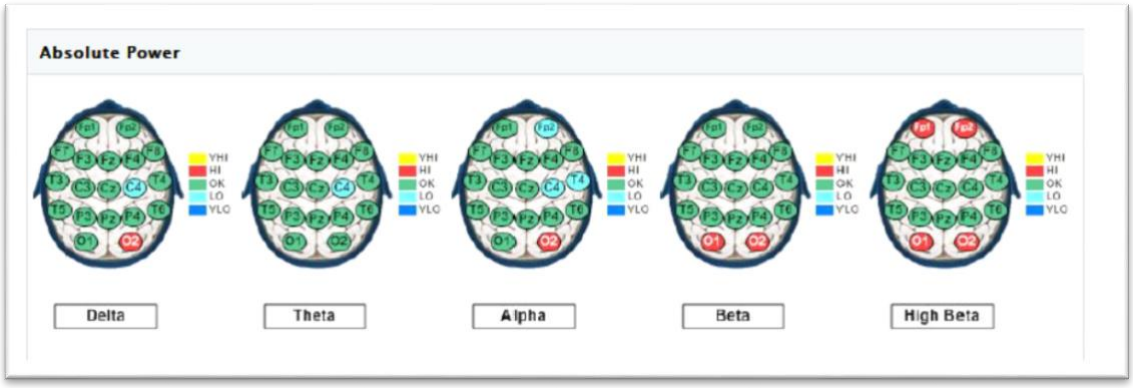

Figure 26 Absolute power (2) in Stage 1 often shows minimal beta elevations related to initial anxiety..

Figure 27 Asymmetry in stage 1 shows beta asymmetry most commonly related to initial anxiety

As anxiety becomes more chronic and sleep losses increase, beta progressively increases with chronically low alpha (Avram, 2010). Common physical symptoms include gastrointestinal problems and headaches. Typically, aldosterone levels decrease with

symptoms of tachycardia and heart palpitations in addition to visual vestibular disturbances.

Figure 28 Absolute power (3) in Stage 2 typically involves increasing frontal beta.

High levels of anxiety, rumination, and panic begin to manifest with more severe physiological problems as the body becomes progressively taxed. Diffuse elevated beta becomes common with high beta reflecting excessive global bracing of the muscle system.

Figure 29 Absolute power (4) in Stage 4 involves frontal and posterior beta from chronic cortical activation.

Compromised mitochondria reduce ATP output and sodium pumps fatigue resulting in diffuse elevations of alpha due to large dipole layers idling due to energy deficiencies.

Figure 30 Absolute power (5) in Stage 4 involves increasing diffuse alpha from mitochondrial fatigue.

Due to prolonged excitotoxic activity, over time the neuronal pump efficiency degrades, and high frequency activity begins to diminish as diffuse alpha activity increases. At this point, the beta again begins to appear normal, although it is due to exhaustion.

Figure 31 Absolute power (6) in Stage 5 involves progressive slowing of alpha and diminishing beta activity

As body physiology becomes chronically mobilized and enteric integrity degrades, inflammation begins to impact thyroid function. This behavior reduces T3 and slows down the alpha frequency. High frequency activity continues to decrease from loss of mitochondrial energy and beta become significantly low.

Figure 32 Absolute power (7) in Stage 6 shows progressive alpha slowing and beta deficits

As inflammation grows from chronic oxidative stress, glucose transport diminishes with growing diffuse theta and temporal delta emerging.

Figure 33 Absolute power (8) in Stage 7 includes theta elevations from decreasing capillary perfusion

Finally, the levels of oxidative stress, inflammation and perfusion overwhelm the brains capacity to produce fast wave activity; it becomes dominated by slow wave activity in the form of diffuse elevated theta and delta.

Figure 34 Relative power shows general trend of global slowing from chronic inflammation.

The entire cycle is represented on the next page as a sequence.

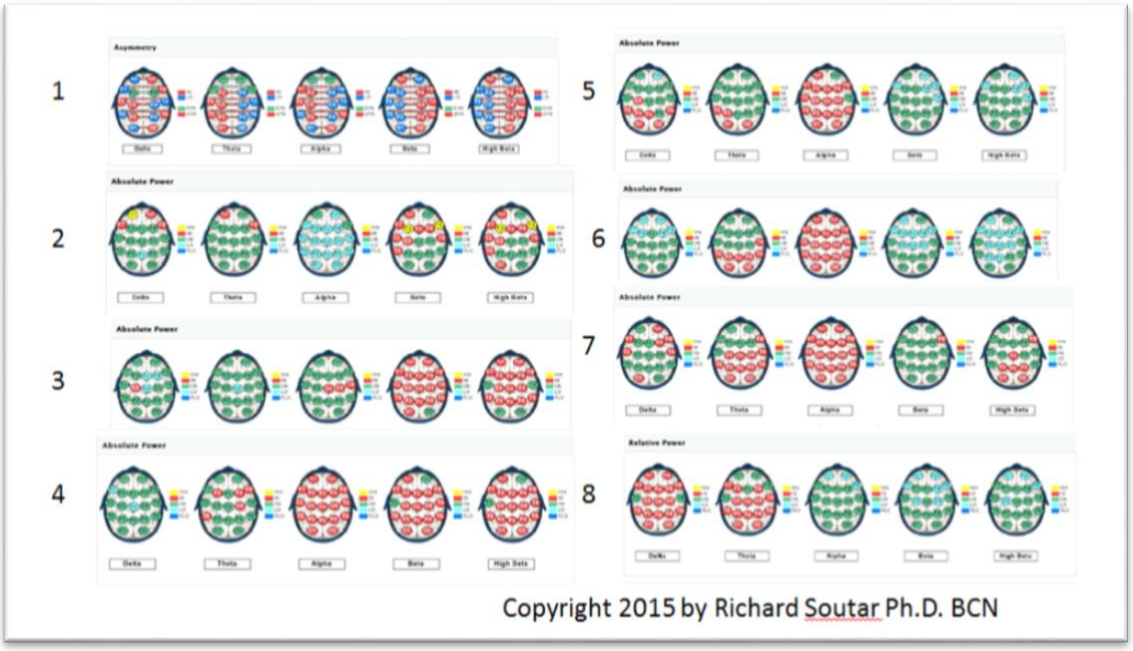

Figure 35 Complete cycle: Stages of Oxidative Stress

This model provides a comprehensive sequence of changes beginning with anxiety and emotional trauma, but an individual can be accelerated into any phase of this process by highly traumatizing events such as assault, TBI, stroke, or exposure to highly toxic substances or pathogens.

At the outset, clients are engaged in rapid oxidative processes, but eventually they become more deficient in resources resulting in a slow oxidative process in many areas. One model provided by Dr. George Watson proposes a fast and slow oxidizer profile that can be measured through hair analysis.

George Watson (1972) distinguishes between individuals with acid blood pH versus slow oxidizers with more alkaline pH as well as Co2 differences between the groups. Paul Eck, M.D. brought techniques of hair mineral analysis to a new sophisticated level to assess these oxidative profiles and relate them to Selye's work on stress. Fast oxidizers are defined as those with a calcium/potassium ratio of less than 4 and a sodium/magnesium ratio of 4.17 or higher. They theoretically have higher sympathetic tone and intake more oxygen with faster breath and heart rates. Slow oxidizers are defined as having a calcium/potassium ratio greater than 4 and a sodium magnesium ratio less than 4.17. They have slower metabolic rates and suffer from chronic parasympathetic activity due to exhaustion and globally deficient mitochondria suffering from electron transport problems. Wilson observes that they are in a chronic stage of resistance to stress or in the exhaustion stage completely. Wilson characterizes them as suffering from sympathetic dominance with adrenal and thyroid insufficiency. Some

factors which sometimes skew analysis results are excessive toxic metals, nutritional deficiencies, infections, and illnesses (Wilson, 2013).

Hair analysis is considered a method of sampling tissue mineral levels as opposed to blood or serum mineral levels. In the past its accuracy was controversial, however the current technology is more advanced. It is presently being used by the courts and medical facilities to accurately assess drug use. A new method has emerged for tracking cortisol changes in the body over time that has proven more accurate than any other method presently being used (Manenschijn et al, 2013).

To test his hypothesis, we compared individuals assessed as either fast or slow oxidizers based on this model of hair analysis and associated metabolic profile with qEEG brain maps. We hypothesized that fast oxidizers should have qEEGs dominated by fast wave activity and slow oxidizers should have qEEGs dominated by slow wave activity.

Subjects

Fifty-eight clients (ages 18-72) from three clinics who had received a qEEG, were resistant to NFB training, and had high metabolic checklist scores were selected for hair analysis. The New Mind metabolic checklist was a normed checklist (N=3000) with a sample derived from over 500 clinics nationwide. Clients were asked to rate their symptoms based on frequency and severity of symptoms related to major metabolic categories. The normed checklist construction and validation can be found in the help section of the New Mind.

Method

Clinical NFB therapists were provided a grading system to rate qEEG maps. Fast wave maps were identified as qEEGs dominated by statistically significant levels of beta frequencies and slow wave maps were identified as qEEGs dominated by delta and or theta frequencies. Client received one hair analysis which was used by the lab to determine if they were fast oxidizers or slow oxidizers. Clients were then assigned to categories of fast oxidizer with fast wave map, fast oxidizer with slow wave map, slow oxidizer with fast wave map, or slow oxidizer with slow wave map. A chi square test of independence was then performed on these ordinal levels of variable categories (see Figure 36 Chi square test results).

	Fast Oxidizer	Slow Oxidizer	Total Col
Fast Wave Map	10	9	19
Slow Wave Map	5	34	39
Total Col	15	43	58

Chi Sq Test Stat = 10.56
Critical Value = 3.8
P = .001

Figure 36 Chi square test results

Results

The results listed on the previous page show a significant chi square test statistic of 10.56, with a critical value of 3.8 and P=.001. Fast oxidizers had an average metabolic checklist score of 55 and slow oxidizers had an average metabolic score of 94. In addition, 86 percent of the entire group had significant elevated aluminum levels.

Discussion

The findings show a clear trend in the data in support of the above theory. The maps tend to reflect patterns of fast and slow oxidizers. Fast oxidizers show more initial high frequency activity as the organism constantly mobilizes itself to deal with chronic environmental challenges and social distress. Slow oxidizers tend to show greater slow wave activity as the organism progressively becomes depleted in resources through the resistance phase and begins the exhaustion phase. Of interest is the fact that slow oxidizers generally scored much higher on the metabolic score indicating that they consistently had more physical symptoms associated with health problems. This finding also supports the notion that their system is compromised and depleted.

There are exceptions to this pattern and that should be expected considering the complexity of the phenomenon being studied. The descent into slow oxidizer status may be erratic and inconsistent in its expression. Some subjects may cling partially to their high oxidizer status as they decline resulting in dual occupation of the perhaps rigid ordinal categories being defined and measured. Others may make more rapid decent with health problems accumulating at a more rapid pattern. The brain and the body have barriers and boundaries that define them partially independent but closely related systems. This result is consistent with the modern model of neuroimaging (Freeman, 2005).

The next phase of investigation will involve collecting larger numbers to confirm the statistical findings here. Since the metabolic score reflects health status of the client and the clearly associated oxidizer status, it is likely we can use the metabolic scores as proxy measure of hair analysis tests. In fact, a normed metabolic measure that reflects oxidizer status is well within reach of the resources of our present database and will likely be employed.

The results clearly support our hypothesis. In addition, the metabolic checklist scores indicate the individuals with fast wave dominant maps had fewer problems than the slow wave maps suggesting that there was a chronological sequence to the acquisition of their problems that began with anxiety. This behavior is consistent with theories that anxiety precedes depression and is a form of end stage depression. This result is further supported by research showing the relationship between depression and neuroinflammation as well as depression and enteric microbiome problems.

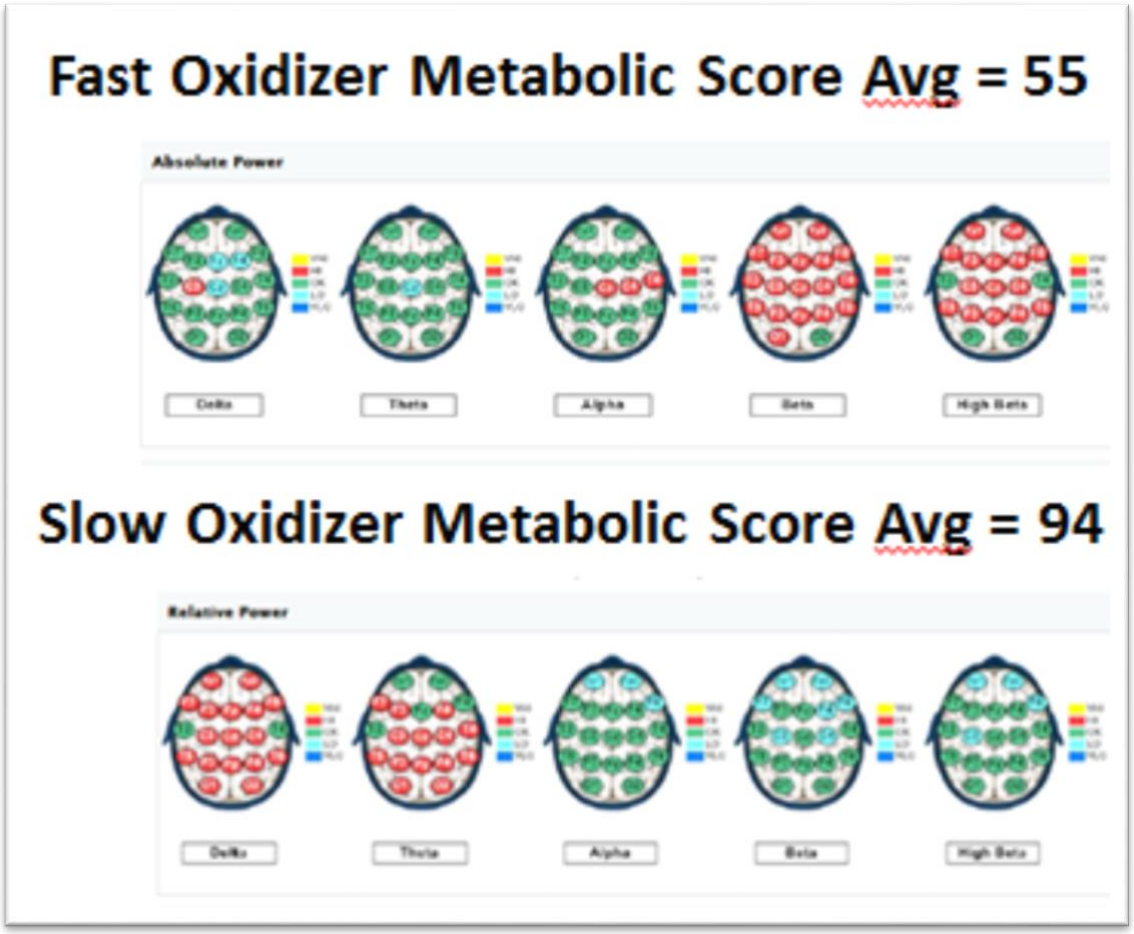

Figure 37 Fast oxidizer metabolic scores

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Chapter 6: Map interpretation and Analysis. Why is the Map System Built This Way?

The New Mind System is very different from other systems. It was designed specifically for clinical work and not research. Consequently, it selectively presents the neurometric dimensions displays. Only clinically pertinent data and head maps are presented rather than all possible neurometric analysis. Excessive non-relevant data confuses clinicians and slows down the analysis process. Clinicians are not researchers and not usually heavily trained in statistics. Therefore, statistical analysis in the New Mind System is presented in simple and intuitive fashion. Instead of talking in terms of standard deviations, the map legends use terms such as high, low, and very high. The central focus of analysis is on magnitude rather than power because magnitude (average amplitude) is the measure clinicians use in training. They do not use power except in newer and more experimental Z-score training. The System also has head maps for dominant frequency because it is an important measure of physiological dysregulation (Neidermeyer & Lopes de Silva, 2005). We use the term connectivity instead of coherence because it is the common term in neuroimaging. There are several possible measures of coherence. The method we use is known as Welch's averaged periodogram method. With this method, we compute the cross spectral density between two signals *x* and *y* as well as the spectral density of each are computed for a sliding, overlapping window within this observation period and the data from each windowed subsection are averaged.

We also do not supply all possible combinations of coherence on the head maps because they are not clinically relevant, although they may be useful for research. We report mostly longer runs of coherence because shorter runs are distorted in their values by as much as 40% and are therefore clinically inaccurate and useless (Nunez and Srinivasan, 2006, Pascual-Marqui, 2007). We also do not report all coherence combinations because many of the coherence values only reflect a mathematical term and not a measure of underlying anatomical connections. This technique is because there is no fascicular connection for example between P4 and F4 (Kaiser, 2005). The most robust connections for cognitive assessment are arguably across the corpus callosum (Gomez et al, 2009), so interhemispheric connections are emphasized. They reduce data confusion and correlate better with clinical findings.

Figure 38 Inter-connectivity

Coherence is an adaptive response to activation deficits to key hubs and nodes of the brain (Pasqual Leone et al, 2005, Alstott et al, 2009, Meehan & Bressler, 2012). It is a form of compensatory activity to make up for processing deficits in the hubs and nodes. The networks we measure at the meso level are clearly identified in their macro level form in the MRI research at this point (Nunez & Srinivasan, 2006). They align closely with the bilateral coherence measures in our system (Laird et al, 2012). Clinicians can more easily identify the compensatory patterns of the brain in response to deviations in the magnitude dimension.

We do provide phase head maps, but they are not in the default report. We feel that phases are not measured in the correct temporal domain presently in qEEG and do not provide very useful clinical data for purposes of NFB. They unnecessarily complicate the picture for clinicians trying to make sense of neurometric data and what is useful. Asymmetry measures are not Z-score based in our system either. We found Z-score based asymmetry to be less than useless at the clinical level. Instead, following decades of good research on asymmetry and clinical symptomology, we use actual magnitude values. The red locations on Figure 39 Asymmetry (on the next page) indicate that the 10-20 location is high while the blue location on the contralateral side indicates it is low with respect to the other. The line in between is color coded to indicate that the two locations are asymmetrical or equal.

It is then an easy matter to quickly identify alpha and beta asymmetries and correlate them with client symptom reports. Our statistical analysis supports past research in this area. This technique can be reviewed in Chapter 10: A Psychology of NFB in the sections anxiety and depression. Clients begin to report symptoms of anxiety when approximately 50% of locations show beta asymmetry, and they report some symptoms of depression when beta asymmetry reaches 80-90%. Significant clinical scores of depression typically begin to appear when 50% of alpha is asymmetrical.

Figure 39 Asymmetry

The areas of most interest in dominant frequency are in alpha and beta (see Figure 40 Dominant frequency). Low alpha dominant frequency is usually an indicator of metabolic problems resulting in thyroid T3 deficits that reduce sodium pump efficiency. The metabolic indicator light will show when this occurs, or beta is fast (common in hyperthyroid). Clinicians should check the metabolic checklist to see if clients show significant scores in thyroid, adrenal or gastrointestinal categories. There is more on this method in Chapter 5 (see More on Metabolic Analysis and Confounds).

Figure 40 Dominant frequency

The coloration of the maps is specifically adjusted to correlate more with the psychometrics rather than arbitrarily being based on 2 standard deviations. The actual values are proprietary, but the rationale is sound. Deviation does not covary well with symptoms. Be careful not to judge the severity of a symptom based on statistical deviance of a frequency in the qEEG. We have done large scale statistical analyses to determine this outcome and others have found similar results. Symptoms may begin to occur because of a network dysregulation that does not meet the criteria of 2 standard deviations. Keep in mind that 50% of the population is either going into or recovering from a mental disorder (Kessler et al, 2005). This tendency means that anxiety should

begin to appear in 50% of any given population—around 1 standard deviation. If we are using 2 standard deviations as a cut off, we are only looking at 5% or less of the population in the tails of the bell curve as likely to have problems. Clearly, this result makes little sense.

Statistical deviance of the EEG does not mean statistical deviance in behavior and symptoms. Some people with 2 standard deviations deviance also show no symptoms. qEEG appears to only provide a probability that a symptom may be present, and that the individual tends to show a symptom. Consequently, the EEG lights on the New Mind dashboard are based on probability rather than symptom severity. This method is also necessary because backup networks can confound predictions of function as well (Turner et al, 2011).

The Shift Function vs. Relative Power

The "shift function" (see Figure 41 The concept of up shift) in this database system is used instead of a measure used in some other database systems termed "relative power." Relative power is difficult for many clinicians to interpret and is often abused (Thatcher, 2006). It can significantly distort the presentation of the distribution and

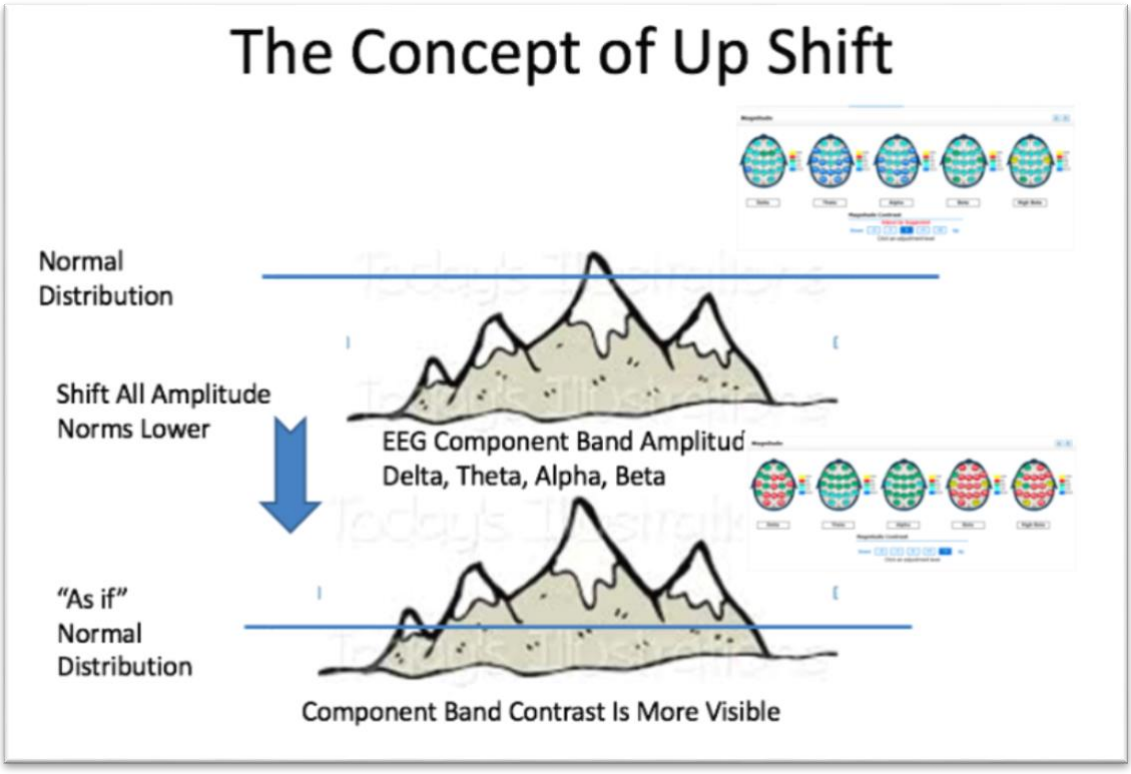


Figure 41 The concept of up shift

should only be interpreted by those clinicians who thoroughly understand it and use it in relation to absolute power. To help resolve this problem, the New Mind System employs a shift function. This shift function increases all EEG magnitude values by one or two

standard deviations, so that values that are globally all low or all high across the frequency spectrum can be compared "as if" they were in range of the database norms to be interpreted.

EEG literature recognizes that there are subtypes of individuals that have all low power, and they can represent as much as 13% of the population and perhaps higher in the clinical population (Neidermeyer & Lopes de Silva, 2005). This low power group can have low voltage slow, low voltage fast, or low voltage normal distributions just as individuals with higher general power present. (You can interchange the concepts of power, magnitude, and voltage in this context). It is not known why this subtype is present or the mechanisms behind the low power.

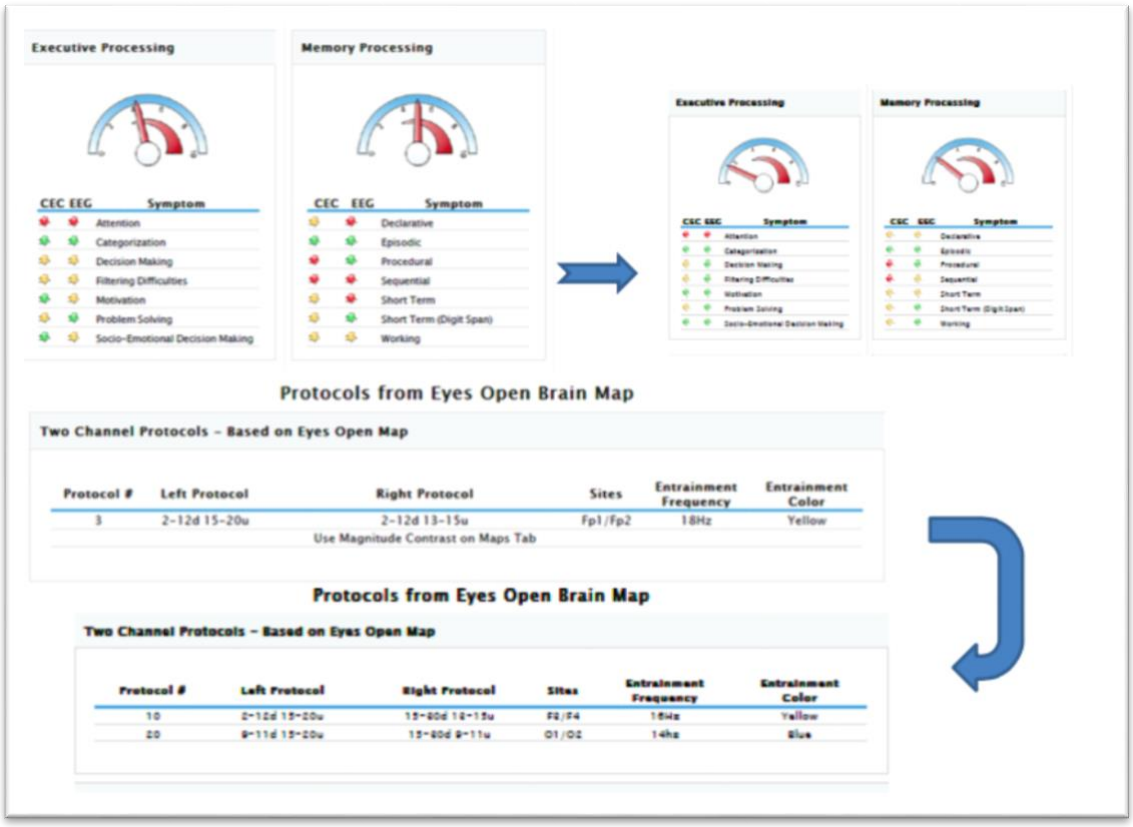


Figure 42 EEG dashboard

After decades of clinical work in NFB, we know that this population responds to the same protocols as others (Soutar, 2014). Consequently, when over 75% of the EEG power is either too low or too high, the system will recommend using the shift function to make it possible to visually inspect the distribution pattern. Protocols are also altered with this shift function, but no other dimensions are altered. If a clinician is in doubt whether he or she is dealing with a low or high-power map, it is best to use the shift that generates the most matches between client endorsed problems and EEG predicted

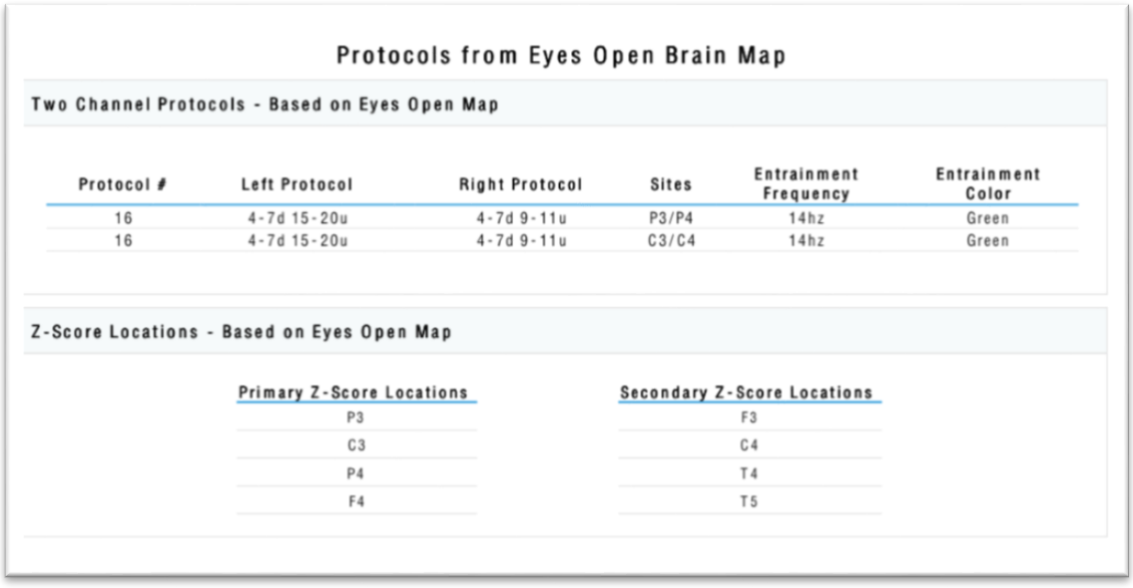
findings in the EEG dashboard. This method is explained in more detail in the New Mind System help section in video format. (See Figure 42 on the previous page.)

Protocol Output

The protocol output system is the only one of its kind. It is based on a library of possible protocols that can be used based on the quadrant rules of standard NFB (Soutar & Longo, 2011). These protocols combine both single and two channel peer reviewed published protocols. The primary validating studies for EEG in the literature use these protocols, unlike Z-score and other methods. There are over 250 studies using one and two channel protocols, but less than half a dozen studies on Z-score training. The New Mind System protocols comprise a conservative and reliable library that has proven itself high effective. Assessing a brain system anatomically makes sense especially based on the existing fMRI research. Attempting to change it through the reverse order process does not make sense because we do not understand the complexity or the system well enough to be that specific. Instead we statistically analyze the data at the neurophysics level to determine the best protocol.

The New Mind System reviews each 10-20 location for deviance in all five neurometric dimensions (magnitude, dominant frequency, coherence, phase, and symmetry) and then computes the total deviance for each location. It then rank-orders locations by severity of deviance. Next it publishes the top eight most deviant locations under the headings of Z-score locations in the protocol output. The System then selects the top two deviant network pairs and lists them under the two-channel protocol heading. After that, the system analyzes the locations for frequency deviance and determines which component bands should be trained up or down. It also uses an expert rule system to account for compensatory measures that may arise during training. In the final step, the system selects the protocol from the protocol library that best meets the training requirements (Figure 43 Protocols from eyes open brain map).

The clinician should select each one of the protocols at different sessions and train the client for two sessions. Then the clinician determines which protocol is most effectively changing the brain by inspecting the component band trends in the review or trend screens. This empirical approach is simple to use and reduces guesswork. Slower frequencies should be shifting 3-5uv and beta frequencies should be shifting .5-2uv on the trend screen in the expected direction as indicated by the map. If theta is too high, then it should be trending down over the course of a session. Clients should also fill out the symptom tracker, so the clinician can check to see if one protocol is more effective than the other in that domain of assessment as well. This approach allows for a thoroughly empirical procedure at each step and has been reliable and effective at all our client clinics.



Protocols from Eyes Open Brain Map

Two Channel Protocols - Based on Eyes Open Map

Protocol #	Left Protocol	Right Protocol	Sites	Entrainment Frequency	Entrainment Color
16	4-7d 15-20u	4-7d 9-11u	P3/P4	14hz	Green
16	4-7d 15-20u	4-7d 9-11u	C3/C4	14hz	Green

Z-Score Locations - Based on Eyes Open Map

Primary Z-Score Locations	Secondary Z-Score Locations
P3	F3
C3	C4
P4	T4
F4	T5

Figure 43 Protocols from eyes open brain map

Adverse Responses

If clients report adverse symptoms, it is likely that they are experiencing a reduction in arousal that is triggering the symptoms. This phenomenon is documented, well known, and common with relaxation protocols and biofeedback (Soutar & Longo, 2011; Perez-De-Albeniz, A. & Holmes, J.,2000). The list of symptoms is very long and includes anxiety, panic, loss of motivation, boredom, pain, dissociation, fear, anger, disorientation, apprehension, despair, confusion, and unusual bodily sensations. These symptoms are not a consequence of any intrinsic and mysterious effect of the NFB.

Often individuals with disorders are highly sensitive, and the training location moves them too quickly. If an adverse response occurs, the clinician should try the alternative location listed in the protocol output section. If the response is still an issue, the clinician should attempt the protocol at C3-C4. If there is still an adverse response, the clinician should try training with the protocol in the session for only 5 or 10 minutes. If the response continues, attempt to train SMR (13-15hz) up at CZ with a single channel protocol for 3-5 minutes. If the adverse response is still present, then the client is too unstable for NFB and requires more physiological treatment from a functional medicine specialist.

Adverse effects tend to wear off in 24 hours except in the case of highly fragile individuals in which case it typically takes 2-3 days. Clinicians should inform clients of these time frames and reassure them that the effects are temporary to reduce any fear or panic they may be experiencing. Over the last two decades, I have never encountered a case that went beyond these parameters.

You can also select protocols based on the Brodmann area and reputed function of that Brodmann area. If a client has short term memory issues, then P3-P4 would likely be the most appropriate location based on this approach. Be advised however, that this simplistic approach does not always work as it might seem at first because Brodmann areas are multimodal and highly interconnected. The problem may lay upstream or downstream from the Brodmann area. This reaction is because the hubs and nodes supporting the area may be the source of dysregulation. This effect is why the New Mind System focuses more on the areas of electrical dysregulation rather than focusing on symptom driven protocols alone. Brodmann areas and related functions are shown in Figure 44.

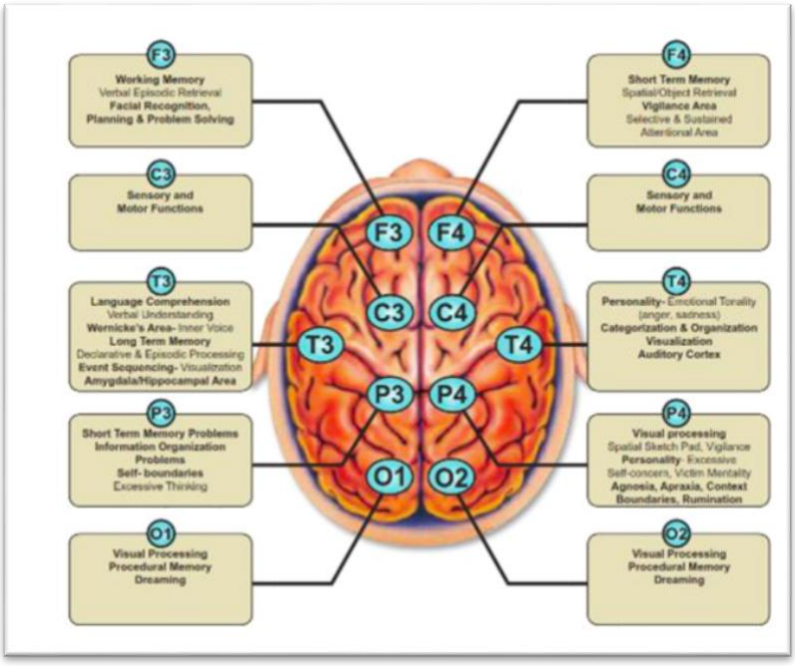


Figure 44 Brodmann areas and related functions

Since the brain is a highly integrated system, the movement of information in processing streams is an important aspect to consider when evaluating where in the system to intervene (McIntosh, 2008; Honey, 2007; Rabinovich et al, 2011). This flow is often characterized in terms of upstream and downstream movement involving feedforward and feedback subsystems (Meehan & Bressler, 2012). Information appears to flow in macro patterns from the posterior to the anterior along two major processing pathways known as the ventral and dorsal streams. The ventral stream processes information regarding what is being experienced, and the dorsal stream is processing concerning from where the experience is coming. This result can often be seen in New Mind System maps in the connectivity maps. When a network like F3-F4 is identified as being most dysregulated, it may be due to problems occurring earlier in the processing sequence that are upstream and posterior to the dysregulation. Training at T3-T4 or T5-T6 could possibly resolve the problem at F3-F4 more effectively than training F3-F4. This is one reason why it is important to have at least two major macro network fields to be reviewed as possible protocols and to try each one.

Interpreting the Dashboard

The New Mind System dashboard has gone through several iterations of development over the years. We have refined it many times based on emerging data. This instance is another example of where form follows function in the emerging format of New Mind System maps. The first section assesses emotional processing related to arousal. We began with only two dimensions of underarousal and overarousal. The research and our own data indicated that three dimensions fit the model best. Overarousal was clearly related to chronically high sympathetic tone resulting from stress. Underarousal was related to the long-term effects of oxidative stress due to excitotoxicity and the resulting inflammatory processes. It was a marker for neurodegeneration and could be a result of disease, lesions, or head trauma. As we inspected the asymmetry data, we realized that what psychologists were calling depression was another step in the continuum from overarousal to underarousal. It appeared to be a stopgap effort by the brain to conserve energy and slow the degenerative process down or in other words a form of inhibitory response. In fact, Davidson's (1995) research identified depression's relation to alpha asymmetry and withdrawal behaviors. Consequently, we called this dimension inhibition.

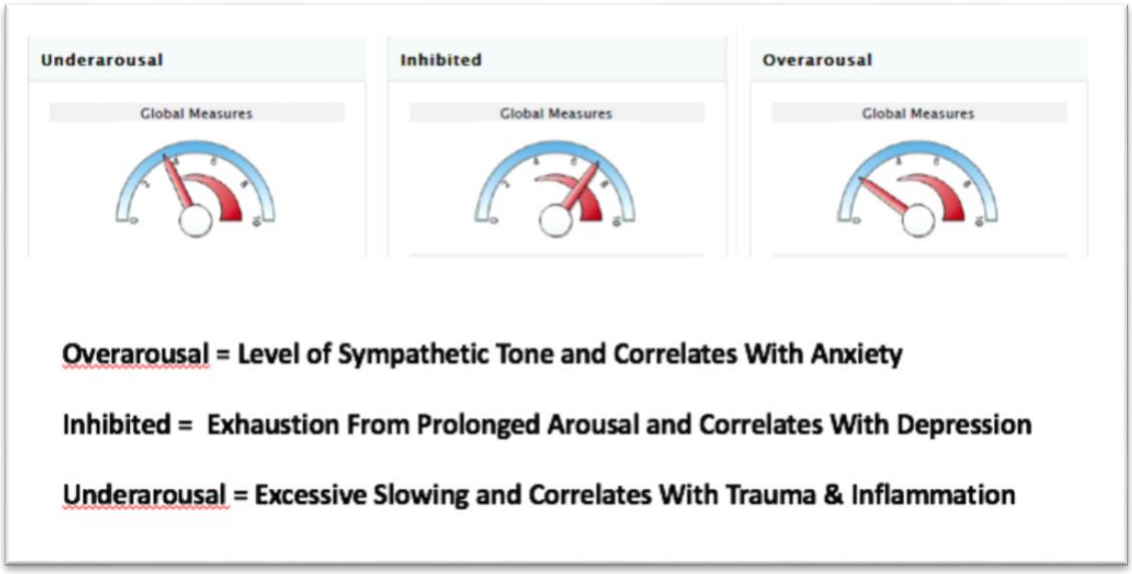


Figure 45 Overarousal, inhibited, and underarousal

Our more recent research shows that anxiety itself involves a large portion of withdrawal behavior that reaches a threshold when beta asymmetry approaches 80-90%. At this point, clients begin to report more depressive behaviors. This connection is indeed a smooth transition supportive of the idea that these two states lie along a continuum. More recent research demonstrating the connection between depression and inflammation further supports our model as well as the idea that this continuum extends even further into theta and delta frequencies and the dimensions of

underarousal. Underarousal, of course, is the point at which energy resources are so low due to damage to the system that it has difficulty strategically inhibiting critical networks for processing, especially the default mode system. This dynamic quite naturally suggests a model of brain too fast, brain too slow, and brain stuck in the middle.

Psycho vs. Neurogenic Dashboard Format

One of the more confusing formats in the default dashboard view is the division of problems or symptoms into the two categories of psychogenic and neurogenic. What has become obvious in both the literature and due to the New Mind System is that disorders can emerge from a purely physiological or bottom up source, or from a top down or psychological source (Dedovic, 2009). The neurology literature tells us that a lesion in the central parietal region typically results in severe perseverance (Kandel, 2000). This region of the brain, posterior cingulum, is significantly involved in the release of the attentional system from a stimulus of interest (Posner & Raichle, 1997). The New Mind System (see Figure 46 Psycho vs. neurogenic dashboard format) shows us that the posterior slowing in this area, beginning with alpha, is highly correlated with perseverance related to bargaining behavior, topical perseverance or positive rumination, task shifting difficulty, and in the beta frequencies negative pathological rumination (Engels et al, 2007). So, excess idling in this region can have a milder but similar effect as a lesion or reduced function.

Rumination is a result of psychological activities starting with chronic fear and anxiety which then becomes routinized in the form of repetitive considerations regarding dangerous behaviors related to past negative experiences. This pattern is similar to the repetition of an activity leading to a learned task behavior (Pascual-Leone et al, 2005). By pairing the frequency of a symptom and its function to its associated location and to that location's range of function, we can discern whether the symptom is likely coming from a severe anatomical deficit or a functional deficit related to the psychological dimension and related social activity of the individual. The brain is a grey area where mind meets matter and plasticity is extreme to accommodate the compromise of a function. At times, the discrimination of location related to a symptom is very fine and difficult to make. The signature frequency allows us to make this distinction. Thus, a client may report perseverance and have no signature of organic damage, i.e. elevated theta and or delta, but may have excessive alpha idling which means reduced activity and function. This combination is indicative of a psychological source. By comparing the qEEG activity with the client's symptom report, we can distinguish with some accuracy between the two dimensions of bottom up and top down, or psychogenic verses neurogenic sources.

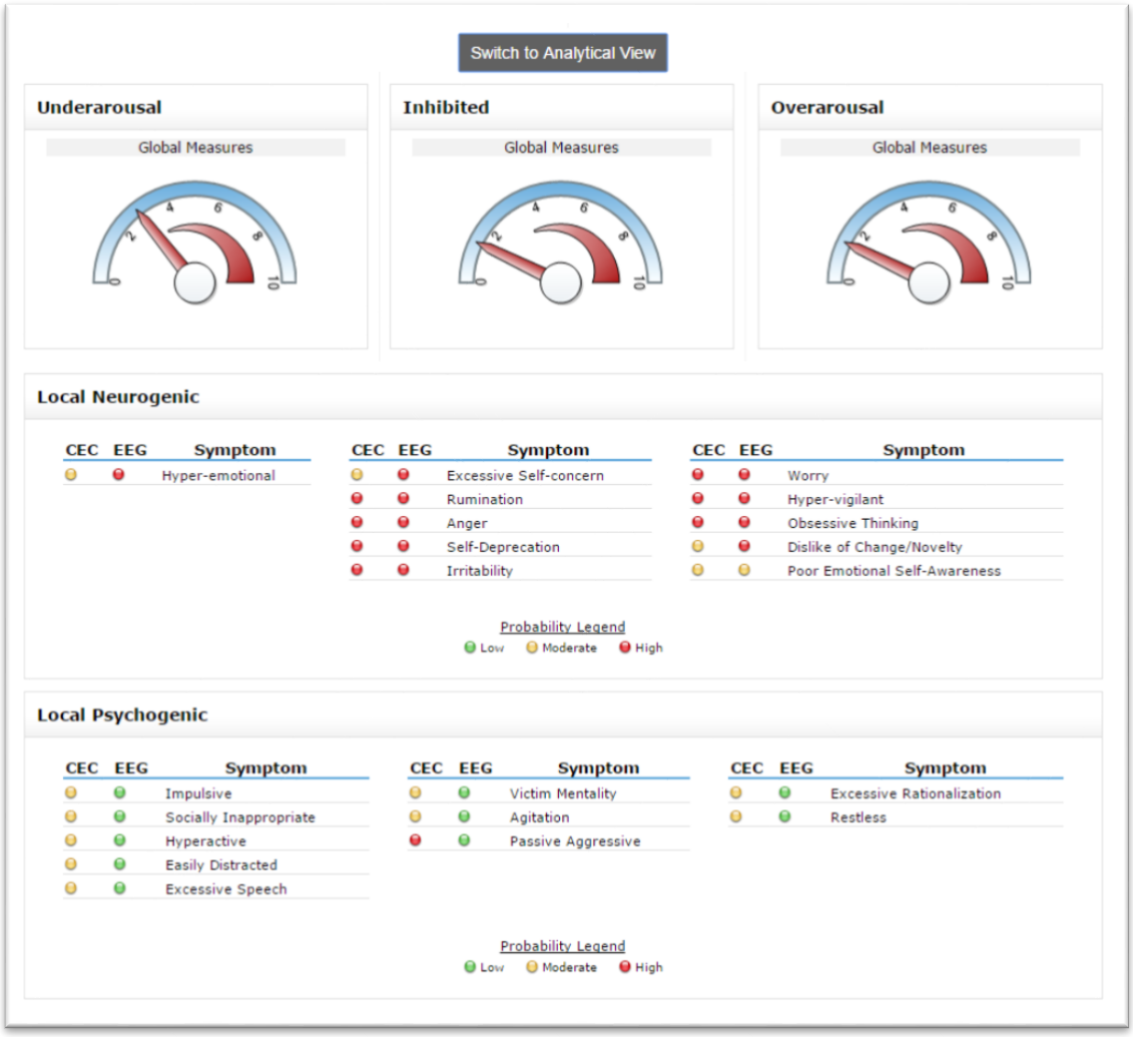


Figure 46 Psycho vs. neurogenic dashboard format

The Normative Component

The New Mind database is based on a predictive algorithm that estimates the average normative magnitude at each 10-20 location. These estimates are periodically reviewed and updated if necessary based on our growing normative sample. We presently have over 200,000 maps in our system and many of them are maps of normal individuals. Using the ISI, CEC, and CPTs to screen for normal individuals who have been mapped and are in the database, we have been able to collect our normative sample from hundreds of clinics around the world. This outcome makes our sample one of the closest to a random sample of any database that we are aware of at the present and ensures that the individuals are functioning normally. The raw data is edited in most cases at present by auto artifacting which standardizes artifacting and provides a consistent high level of quality data. The number in the database is growing daily. Database details related to statistical construction can be found in the help section of New Mind System maps.

Coherence and phase norms are drawn from statistical processing of the normal sample as are frequency norms, and they are then compared to published norms when available as well. The database uses a sliding window where necessary to ensure a smooth transition from age to age. Log transforms are performed, inspected, and implemented where necessary. We also run samples of European Data Format (EDF) data between the New Mind System database and other normative databases for comparison and cross validation purposes. It is not recommended that these comparisons be casually made by clinicians who are not experts in these areas of database construction and signal processing. Differences will be present from other databases because of signal processing differences, component bandwidth selection, and normative colorization scale. We believe our database best measures consistently and reliably what it is designed to measure. It has been very successfully employed in hundreds of clinics for a decade, and we have thousands of excellent documented outcomes. Clinicians constantly report to us regarding how impressed they are with its accuracy. This feedback is one of the most important ways to determine validity.

Reading the qEEG Head Maps

I recommend beginning with an analysis of magnitude or power, depending on the report system you are inspecting. One should assess the overall level of EEG power to determine if the individual is an outlier and may not be easily evaluated by the statistical system. Those with very low power appear as mostly or all blue in the magnitude maps—making them difficult to assess. They can be evaluated for frequency distribution by interpreting the data tables or by shifting the entire map spectrum up using the shift function. This technique allows the clinician to see the contrast between the component bands and determine their relationship. Nunez & Srinivasan (2005) suggest that interpretation of coherence may suffer under these conditions and should be interpreted cautiously as well. According to Neidermeyer & Lopes de Silva (2005), the importance of knowing the distributional dynamics is that they still hold their value under low power conditions even though they are relatively invisible in the head maps. Knowing where delta or theta is high and beta low or high is still important. There are many individuals with low power who present symptoms of ADHD and have relatively high frontal theta. This condition may not be immediately obvious when all the head maps appear blue. In terms of NFB protocols, we may not be able to uptrain all the other frequencies due to metabolic limitations, but we can still downtrain the slow wave activity and generate positive changes. Utilizing this approach to low power, we can still evaluate the relationship of the function of frequency to locations with respect to power or magnitude. Clinicians should be sure to request the New Mind map interpretation guide to help them interpret the magnitude head maps. It lists the significance of changes in activity in the various locations for all component bands.

Asymmetry is a dimension that I frequently inspect next. The work of many researchers over the past two decades, as previously discussed in earlier chapters, suggests that finding high levels of beta in the right hemisphere is likely to indicate an overaroused CNS with chronically high sympathetic tone and symptoms of anxiety while high levels of alpha in the left hemisphere are likely to indicate depressive features. In comparing these features with Beck inventories and the New Mind ISI, we have found these conclusions to be consistent. So, bilateral asymmetry can indicate a general state of the CNS with respect to mood and anxiety. Anterior to posterior asymmetries may suggest problems with attention in delta or theta or features of worry in beta. The significance of theta and delta is still not well understood with respect to asymmetry, but both sides should be close in value. If need be, this outcome can be verified by inspecting the raw data tables.

There is still much to know about dominant frequency, but alpha dominant frequency has proven to be a valuable indicator. We find frequent correlations clinically between elevated slowed alpha and thyroid problems. It is often present in depression as well. When combined with alpha hypercoherence, it suggests difficulty shifting states which can affect task performance. This knowledge is useful when trying to train down high amplitude alpha. If the client's intake indicates thyroid issues, then the alpha may be unresponsive to NFB due to metabolic limitations. Fast alpha, on the other hand has been statistically evaluated with respect to the metabolic reports and consistently is correlated with problems with blood sugar regulation. Either of these events in the dominant frequency will typically trigger a notification on the map report to remind the clinician to inspect the metabolic checklist for correlations.

As time goes by, coherence appears to many of us in the clinical setting as a compensatory dimension where we see the brain's response to dynamic functional stress and how the different regions and nodes are compromised by physical or emotional trauma. Generally significant changes in coherence attend significant changes in magnitude. The brain increases coherence to enhance communication between compromised locations to compensate for loss of processing efficiency in those locations (Pascual-Leone,2005; Alstott, 2009; Turner, 2011; Meehan & Bressler, 2012). For instance, clinically we see frequent reports of difficulty filtering out background noises correlating with coherence problems in the parietal and posterior temporal parietal junction. This symptom makes sense based on our understanding of the network activity in these regions and the functions they perform (Rabinovich et al 2012). The brain is attempting to enhance the management of perceptual inputs to cope with overwhelmed networks downstream. In the case of someone with elevated slowed alpha, it is not uncommon to find increased global alpha hypercoherence as the brain attempts to stabilize resource allocation globally. The consequence of this event is a neural rigidity with respect to the ability of the brain to shift resources with changes of

state demanded by environmental inputs. A left hemisphere asymmetry may also be often associated with this pattern as it results in avoidant behaviors and the emergence of depressive features. Individuals with this type of pattern often complain of a loss of ability to multi-task or issues with task transitions in addition to frequent negative self-evaluations.

Matching symptoms to coherence pairs in different component bands in the head maps may be approached from the same perspective as power or magnitude analysis. Looking at the reported network function that coherence pairs participate in can be associated with the frequency function they show abnormality in. For instance, T3-T4 is associated with a meta-network identified by Laird, et al (2012) and in much of the MRI research associated with declarative memory and auditory processing. By determining that the coherence issues are in theta, we might determine that the loss of function is in memory processing while coherence issues in beta may be related to auditory processing. Thus, function of frequency may assist in discriminating between potential loss of functions in multi-functional nodes.

Although phase is the basis for much of what occurs dynamically in the brain, it operates at time scales that appear to be mismatched to the time averaging done in a typical qEEG. Thatcher (1999) cautions clinicians against attempting to interpret this dimension without expert assistance. Events occurring in seconds become lost in EEG averaged over minutes from selected and discontinuous segments due to artifacting procedures. In this scenario, key shifts in phases that would predict changes in network affiliations are lost in discarded segments or averaged time domains. Some have suggested it is useful to understanding the speed of information transmission, but there appears to be minimal clinical application in this area for the average clinician at present. Many clinicians have told me that it is difficult for them to find correlations between phase and symptomology or psychometric analysis. This issue has also been discussed in relation to coherence but to a lesser degree. Analysis of this dimension clearly requires considerably more sophisticated statistical analysis. Thatcher (2005) has found considerable correlations between phase and IQ and continues to lead the field in the application of phase reset as a method to analyze shifts in state and function as they relate to brain networks. In due course, these efforts may provide considerable clinical insight when properly applied.

The general procedure discussed above is one of many that might be applied. Interpretation tends to vary with background and training. Little standardization has yet to emerge. Aspects of the foregoing analysis are typical of qEEG interpretation at the present clinical level of utilization in the field of NFB. Features of this approach were drawn from a review of the reports of several of the leading qEEG developers in the field. Because of the skill required to interpret head maps, New Mind developed the

dashboard to automatically provide it to clinicians. This feature is a very reliable source of information and can easily be substituted for years of experience.

The qEEG Reports

There are few clear standards in qEEG report writing at present. Many reports provide lengthy detailed technical introductions with 30-40 pages of data and detailed analysis. This technique is the opposite of existing standards in medical EEG, and those in this emerging field must ask themselves if such data density is of valuable in the clinical setting. If we look at written MRI reports, we rarely see such generous portions of detail. Most professionals in other fields are likely to find such arcane reports difficult to interpret and not very informative despite the impressive detail. When discussing the issue with Thatcher, who has pioneered the field of Forensic qEEG, he suggested including in reports only the specific information pertinent to the interpretation. Further detail can always be forwarded upon request. In this model, a brief introduction explaining the equipment used, sampling rate, and brief explanation of the meaning of each section of the report for purposes of orientation is useful. A basic summary page of the EEG head maps and a page or two of statistics is valuable and additional pages specifically depicting the abnormal features reported is all that is necessary. A paragraph on impressions or a more detailed analysis involving a few paragraphs should be all that is needed to provide other professionals with a simple yet clear picture of the issues at hand. With this approach, you are likely to be of more assistance to other professionals and generate a higher estimation of professionalism for our field of endeavor.

The New Mind Maps System automatically generates a general report based upon the dashboard findings. Whenever there is a match between the CEC and the EEG items on the dashboard, a paragraph is generated in the report to indicate that there is a problem area and an explanation is provided regarding the definition of the problem as well as how it might impact the individual in their daily life. Clinicians can then add their own more specific paragraph regarding their impressions of the report. This provides uniformity to reports and saves immense amounts of time for the clinician.

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Chapter 7: The Mechanisms of Neurofeedback

In the field of psychology, as well as psychiatry, the arousal model has been well established for decades. Barry Sterman (Sterman & Egner, 2006) drawing on his own pioneering research adopts this perspective specifically with respect to NFB (1996). Abarbanel (1999) explains it in more extensive detail. He built his perspective on NFB based on the experimental observation that repeated changes induced in the sensory motor rhythm (SMR) activity correlated with important permanent changes in the striatum (Sterman, 2006). In this centrally important article, Sterman concisely outlines the mechanisms through which the regulation of SMR alters motor output and proprioceptive input to the thalamus. Robust repetitive afferent input to cortical and forebrain neurons can promote increased synaptic strength in related network circuits and over time result in long term potentiation (LTP) mechanisms that culminate in synaptic reorganization and consolidated learning. Thus, operant conditioning of the striatum through exomorphic mechanisms of EEG feedback condition the CNS to permanently shift its sympathetic tone and arousal level "resulting in a lasting decrease in sensorimotor excitability." Lasting increases in sleep spindle density also occur. Sterman notes that this learning process is "unconscious" or involuntary which was later confirmed by Birbaumer (2013) using fMRI imaging of NFB sessions.

In his model, Sterman (1996) proposes that three systems of brain activity influence thalamic generation of EEG at the scalp. The vigilance system involves the reciprocal relationship between specific centers in the brain stem and ascending inputs to thalamic, limbic, and cortical regions. The sensorimotor system involves ascending proprioceptive inputs to the thalamus and sensorimotor cortex and related cortical afferents. The cognitive integration systems involve neural centers that process and integrate sensory and motor activity. Alpha appears when cognitive processing is withdrawn. At the same time, SMR appears when sensorimotor inputs are withdrawn. If vigilance is withdrawn, then theta appears. We can extend this narrative with more detail from recent investigations with the observation that when vigilance is withdrawn sufficiently then delta also appears (Knyazev, 2012). In addition, beta in the 15-20hz range is clearly tied to cognitive processing (Meehan & Bressler, 2012). It emerges and disappears in a reciprocal relationship to alpha. A recent review of the literature by Meehan & Bressler (2012) indicates gamma responds to hippocampal theta to initiate cortical network processing in the beta ranges that endure for up to 100 second periods reflecting cognitive processing activities.

Abarbanel (1999) notes that Sterman's theory did not directly include the role played by limbic oscillatory activity in the manifestation of cortical EEG. He does, however, layout how limbic activity may influence attentional mechanisms. Fortunately, Kirk and McKay (2003), outline mechanisms by which low frequency theta activity

related to emotional processing is shifted through arousal mechanisms involving the mammillary pathways into higher frequency theta that results in memory processing. This septal hippocampal (Limbic) theta activity tends to resonate most in temporal regions with respect to emotional activity and to midline frontal theta with respect to memory and cognitive processing. Considering Meehan's narrative regarding theta generation of gamma activity resulting in beta processing, it becomes clear that arousal is also closely tied to both emotional and cognitive processing. In fact, Freeman (2009) notes that the evidence suggests that we are as a species primarily emotional in our processing and secondarily cognitive.

Arousal and Performance

The idea that specific networks become readily available at each unique level of arousal is indirectly well established in the psychological literature. Performance is arousal dependent according to the Yerkes-Dodson law (1908). Sterman's arousal theory resonates well with this perspective. Various tasks call forth different levels of arousal and recruit different networks. Simple or well learned tasks require less arousal while more complex or new tasks require more arousal. The LTP involving dendritic growth in the memory consolidation process is most efficient at moderate glucocorticoid consumption levels and suggests learning consolidation is arousal dependent (Schramek, 2007). A more challenging task recruits more networks and increases metabolic load on the cortical system reducing alpha idling of networks, increasing cell column activity (beta), and elevated hemodynamic response. The hemodynamic response is merely an effort of the astrocytes to provide resources to the neurons as they become progressively active to process the task at hand (Kilner et al 2005; Be'langer, 2011). It reflects increasing capillary action. This outcome has been traditionally observed under the term desynchronization and is a well-established principle of electrophysiology (Neidermeyer & Lopes da Silva, 2005). A high value stimulus triggers complex or automatic responses that in turn increase arousal and recruit networks associated with higher arousal levels. Task expression becomes state dependent calling forth different networks from various regions of the brain. Memory has been generally recognized as state dependent in the field of psychology for over half a century as well.

Recent research in the default mode network (DMN) clearly articulates this process in greater detail (Buckner, 200). The ability to shift task from DMN is related to plasticity, which reflects the resistance of the brain to shift into a task. An overly constrained system may emerge from ongoing efforts of the system to stabilize itself in the face on chronic and overwhelming challenges from the environment, especially trauma. This endeavor is where resource failure or loop demands from excessive internal narratives come into play. Narratives dominated by trauma and through

habituation processes generating firmly embedded habitual defense routines result in automatic emotions and thoughts. These processes constitute the building blocks of trauma-based scripts for the behavioral repertoire. Automatic emotions or thought can inhibit flexibility (Beck, 1995) because they generate system attractor states that dominate the DMN. Rumination consumes resources and the resulting LTP processes grow networks that lock activity into place at a chronically high level supported by limbic activity, especially the amygdala. LeDoux explains that frontal hyperactivity or worry inhibits amygdala inputs to the orbital frontal region and helps limit arousal to defend against the growing impact of trauma on the system. The value of NFB is that it can directly train new attractor states into place through strategic operant conditioning of specific networks that efficiently influence the entire system and increase plasticity with respect to arousal and the DMN. The goal of a protocol may best be to generate the necessary fundamental shift in state.

A more general model that describes the above phenomena from an electrophysiological perspective is one that proposes an optimal performance range within which the brain operates (Nunez & Srinivasan, 2006). This process involves a balance between hypo and hypercoupled states with corresponding arousal levels. This means balancing the brain between underarousal and overarousal. Traumatized systems appear to become stuck in an overarousal hypercoupled state involving excessive cell column activity and corresponding beta asymmetry (elevated right hemisphere beta) as well as excessive frontal or posterior beta activity, depending on level of chronic exposure and whether the response is worry, panic, or rumination (Engels et al, 2007). Exhausted brain systems shift into retreating states of avoidance characterized by elevated left hemisphere alpha that protects the system from further hyperactivity and the resulting effects of excitotoxicity. Serious physical trauma forces the brain into even slower states of function and loss of power resulting in a low voltage (amplitude or magnitude) slow wave profile (Neidermeyer & Lopes da Silva, 2005). Failure of the brain to protect itself through left hemisphere alpha involving social retreat behaviors moves the brain toward the low voltage fast profile. A strategic intervention may best involve attempting to bias the system toward an allostatic attractor basin more centrally focused within the optimal performance zone.

In view of the foregoing discussion, we should review Othmer and Kaiser's (1999) conceptualization of mental disorder as well as David McCormick's work as they assist considerably in integrating electrophysiological and neurophysiological changes with mental disorder. Othmer & Kaiser's proposal is more in line with recent findings and is impressive given it was composed almost 15 years ago. They note that disorders are not very discrete or differentiable and have considerable symptom overlap. The method of categorization of symptom expression into DSM categories was modeled after

Linnaeus's classical scientific categorization of plants and does not lend itself well to describing state patterns of a profoundly complex dynamic system.

Recognizing the decline of the phenomenological perspective of the DSM and its inability to account for growing sophisticated physiological observations from the neuroimaging community, they propose a return to the "spectrum theory" of disorder and to redefining it from a systems perspective. There is a clear trend in the emerging literature toward understanding neural process as self-organizing and autocorrelative with no top down or bottom up directive (Buzsaki, 2006). NFB is conceived as the introduction of a new challenging feedback loop to an ensemble of intrinsic feedback loops operating on different spatial and temporal timescales that struggle to maintain an optimal allostatic set point. This idea is quite consistent with Sterman's physiological model of NFB. Othmer notes that these systems typically fail either by having insufficient gain (likely due in our perspective to metabolic dysregulation) or by not meeting loop stability criteria (likely due in our perspective to psycho-social distress over taxing the system). This "dysregulation model" recognizes that progressive system efficiency degradation results in the generation of symptoms unique to each brain or systems network development and consolidation history. David McCormick (1999) concluded at one point that most mental disorders may be due to thalamic dysregulation. A similar concept of "window of vulnerability" emerged from peripheral biofeedback (Schwartz & Andrasik, 2015). Othmer notes the kindling model of disorder recognizes how repetition of a response to distress generates increasingly defined and intense symptoms. This model echoes Hans Selye's model of physiological response to stress. This perspective has also been confirmed in recent research regarding pain wherein the brain grows networks that increasingly specialize in processing specific pain and that these networks continue to generate pain even after the initial source dissipates or heals (DeCharms, 2005).

It should also be noted that as the brain system degrades, it initially utilizes more energy in managing fear, worry, and the attending chronic hyperarousal in the form of beta activity. It generates fewer periods of post reinforcement synchronization in terms of alpha activity. Sterman's work with Airforce pilots documents the loss of alpha and an increase of error rate as distress increases (Sterman, 1995). It follows that this tendency toward increased rate of errors reduces social accuracy as well as generating more distress through social error and failure to obtain social resources to thrive. Prior to the abdication to the organic failure model of disorder and the over reliance on drugs to manipulate the system forcibly, psychiatric models of the late 20th century saw all disorder as an outgrowth of anxiety (Healy, 2004).

From a metabolic perspective, the high levels of glycogen and lactate reduction due to the neural response to anxiety results in a burden on both neurons and supporting

astrocytes that increases free radicals because of high excitotoxicity levels (Alkadhi, K., 2013; Yeun et al, 2012). Apoptosis and degrading neural function occurs in concert with inflammatory processes in the body and extracellular regions of the brain manifesting as white matter hyperintensities in MRIs (Filley, 2001). Loss of T3, resulting from failure of the T4 to T3 mechanisms in the thyroid and liver as well as the brain, reduces neuronal efficiency contributing to slowing of the alpha rhythm and the high amplitude diffuse alpha of an exhausted brain (Dietzel et al, 2012). Increasing dysregulation of the brain leads to poor energy utilization and even more pronounced slowing resulting in diffuse elevations of theta and delta. These outcomes can rapidly emerge through the physical trauma of exposure to powerful environmental toxicants as well. In short, the system loses energy as it progressively degrades in function.

Early NFB clients utilized protocols that implicitly employed a systems perspective. One electrode location was strategically selected to generate change in the entire system. In fact, Sterman's experiments proved this fact to be the case. Training with SMR in one location such as C3 had an effect in another location in the temporal lobe and the global effect of reducing cortical instability and seizure activity. Over time, however, clinical experience clearly demonstrated that there were distinct advantages and disadvantages in training in different locations. Unfortunately, the rules were not always clear. Both Demos (2005) and Soutar (1999) proposed guidelines for what could be done in each quadrant of the brain in terms of positive and negative outcomes, however the underlying mechanisms that contributed to them were unclear as the research community was still struggling with network theory as it is today.

As clinicians moved from an implicit systems theory approach to a more qEEG or location-based approach, they began to lose sight of the implicit systems perspective. The focus on location in some instances bordered—and perhaps still does—upon electronic phrenology. The idea of localizing a function problem to a small regions of interest (ROI) is problematic when considering the level of connectivity of the brain and the diffuse nature of EEG. We know today that Brodmann areas, which are typically used for ROIs, have multiple network interfaces and are multimodal. It is not possible to discriminate networks at this level even with special EEG localizing methods such as LORETA analysis. In addition, individual anatomy varies significantly, and the 10-20 location system we use in NFB is frequently off by as much as 10% (Homans, 1987). Locations systems such as LORETA may be error free, but the human anatomy is not. Another problem is that the network models are based on adults and do not apply to children.

To date, the majority of NFB clinicians have developed location-based training from decades of clinical experience demonstrating that clients respond differentially to training both different frequencies and different locations. This outcome is consistent

with the above observations in the neuroimaging literature. A unitary vision of timing and timing remediation is too simplistic and ignores local systems dynamics and their influence and contribution to an entire complex system such as the brain. Within any system it makes more sense to assume multiple timing events that are auto correlative (Busaki, 2006). Efficient remediation is frequently local and strategic and often requires tuning several networks. In addition, there is the decision to be made regarding training modality i.e. amplitude versus coherence. Given the compensatory nature of phase and coherence (Pascual-Leone et al, 2005; Alstott, 2009), the established dangers of undermining these mechanisms, and the documented negative clinical consequences associated with training these dimensions (Horvat, 2009), amplitude training is the most conservative approach. Training amplitude alters the other dimensions of measurement but at the brains discretion. Although these measurement domains are mathematically discrete, they are nonetheless interdependent at the neuronal level with respect to the physics of brainwave production (Nunez & Srinivasan, 1996). This result has been reported (Soutar & Longo, 2011) and demonstrated at the clinical level. In addition, any clinician can easily confirm this outcome by reviewing coherence, phase, symmetry, dominant frequency, and amplitude while training. It is simple with today's technology to train any one of these domains and observe the global as well as specific response.

Given the interdependence of these domains and efficacy, reliability, and safety of training amplitude, it makes sense to continue to develop the one channel amplitude perspective into a multichannel amplitude perspective. The work of Peter Rosenfeld (2000) and Elsa Baehr (1999) originally moved robustly in this direction, yet little research or clinical reporting followed. A rapid advance in technology pushed for four channel qEEG dll controlled or 19 channel approaches with minimal exploration of the two-channel approach. In this author's opinion, there were many unsupported though superficially reasonable assumptions made to make this leap. These assumptions include issues regarding the impact of artifact on LORETA accuracy, concerns about disregarding, limiting compensatory responses of full cap training, volume conduction effects on coherence and phase, and the validity of using off task normative Z-scores for on task training to name just a few. This issue is covered in more detail in other presentations. These new possibilities in NFB are important potential advancements to explore, but they should not eclipse a more methodical understanding of NFB that might emerge from greater exploration of what was emerging as the next step. It seems we went from crawling to running and may have missed some important steps. As I mentioned earlier, there are very few supportive research papers on these methods. It seems unreasonable to abandon decades of earlier work with so little evidence. So, we have begun a methodical effort to explore this area more completely.

Benefits and Enhancements of Two Channel Training

With the transition from single to dual channel training, a host of new complexities and advantages appear to emerge that have not been previously discussed except perhaps in limited fashion by Othmer (1999). The rapid transition to IFL frequency training by the Othmers left exploration of the paradigm incomplete. Training amplitude in two locations allows for the strategic inclusion of symmetry and the emergent dynamics in phase and coherence that innately and naturally emerge through co-excitation. If interhemispheric locations are utilized, we also include the compensatory dynamics of transcollosal inhibitory mechanisms (Pascual-Leon et al, 2005). Based on recent research in meta-networks (Laird et al, 2012), it seems more reasonable to train at homologous sites as the meta-networks appear to configure themselves along bilateral patterns. Gomez (2009) and others have noted how effectively bilateral coherence predicts global coherence. It is not unreasonable to assume it may also be a valuable leverage point in training dynamics. This technique also allows us to additionally add asymmetry training and related literature to the protocol. The leap into Z-score training may appear to include these dynamics, but it can be argued that the controlled nature of this approach blindly constrains a system we only partially understand. The two-channel approach includes an appreciation for the natural abnormal excursions and transitions the brain may require as it cycles through successive iterations of self-organization. The Z-score method predetermines the limits of self-organization and diminishes the “self” component from the term. The norms for the present Z-score methods are static norms and not dynamic “on task” norms which also diminishes their validity. For these and other reasons, we have been slow to embrace this new departure from standard NFB methods. What follows is an exploration of the theoretical and clinical advantages of expanding this perspective.

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Chapter 8: The Two-Channel Model

Years ago, the standard model of NFB utilized a single channel mono or bipolar montage and typically trained one component band up and another down utilizing an operant conditioning paradigm. In addition, there was typically a high beta inhibit to discourage muscle tension. A review of the published protocols of the time is instructive in this regard (Lubar, 2007). Dichotomous reinforcement was most common with some clinicians utilizing proportional. Dichotomous training provided one "success" tone whenever the individual met the threshold criteria while proportional training offered a continuous tone that changed in pitch as clients met or failed to meet criteria. A percent of reinforcement was targeted, typically in the 70% range for optimal results (Travis et al, 1974). The length of time a run or trial varied greatly among clinicians but was typically in the 5-10 min range with several runs per session. The advent of DVD training altered this process for many clinicians who began to use 30 min sessions. Monopolar protocols were typically done centrally or in the temporal region with eyes open for underarousal and in the posterior region with eyes closed for overarousal.

The standard model was dominant until Elsa Baher (1997) introduced an asymmetry protocol developed initially by Peter Rosenfeld based on the research by Richard Davidson, as mentioned above. Prior to this development Valdeen Brown began selling software designed to do a unique form of two channel training at C3-C4 as well, but he did not formally publish details regarding the rationale for training this way. The two-channel approach to NFB was introduced by Baher and Rosenfield. It involved training homologous sites, F3-F4, using two channels of EEG (one for each side). Tom Collura and Elsa presented a straight forward version of this training that did not involve Rosenfeld's patented reinforcement algorithm at ISNR. The goal of this protocol was to increase alpha activity in the right hemisphere and decrease it in the left to enhance left hemisphere activation. Davidson's research (1995) indicated this protocol would result in more approach category behaviors and less avoidant behaviors.

The Asymmetry and Affect Regulation Aspect

Although Davidson finds that alpha asymmetry correlates with depression, Heller finds that beta asymmetry correlates with anxiety of various kinds. Her research shows that enhanced right hemisphere beta results in increased sympathetic tone and usually with corresponding anxiety. This increased tone enhances norepinephrine activity and adrenal response as well as upregulating the ACTH system. Over time, the body inevitably begins to suffer the consequences of chronic hyperarousal (Sapolski, 1999) including neuronal death and telomere shortening. Hans Selye notes that this trend leads to exhaustion of the organism and death. An alternative response is withdrawal from stereotypical activities. Since this response correlates in humans with social withdrawal activity, it can be concluded that alpha asymmetry and depression

constitute a protective response. It not only includes a reduction in dopamine but reductions in serotonin. While dopamine levels diminish with activity, arousal continues to be chronically high. The organism is alert to danger and functional but hesitant to engage. This reaction would buy an organism time to incubate novel alternative behaviors and recover some measure of resources. When viewing depression and anxiety from this perspective, they provide a unique balancing act at an elevated level of arousal.

The Hemodynamic Response

Raichle (2002) demonstrates a strong link between EEG activity and blood perfusion, and recent co-registration studies (Kilner et al, 2005) demonstrate the link between slow to fast wave ratios in the EEG and the MRI activation signal. Kandel (2000) notes this outcome was already well understood in his widely used standard text on neurology. Freeman and others propose that it would be prudent to combine fMRI and EEG imaging technologies, and this program has begun to flourish in neuroimaging. Other studies show HEG correlates with theta to beta ratios. These lines of research indicate the strong bidirectional link between NFB and hemodynamics. Training down slow waves and increasing fast waves typically increases demand on astrocytes to increase lactate production for neuronal metabolism which in turn places demand on local capillaries to provide hemoglobin and glycogen. In view of this relationship it makes more sense to increase beta and reduce slow wave activity, delta, theta or even alpha, to enhance perfusion and generate greater activation than to just train alpha down.

The contrary should hold for the right hemisphere. Training alpha or theta up and beta down should more robustly exert pressure to reduce perfusion and metabolic activity. Given this dynamic, it makes sense that there would be increases in arousal with activation of the left hemisphere where dopamine pathways dominate and decreases in arousal with decreases of beta in the right hemisphere where norepinephrine pathways dominate. Reductions in alpha also lead to sleep, but sufficient beta in the RH reduces that possibility. From this perspective, hemispheric balance of activity provides a full range of arousal correlates with a mediating breaking system in the alpha thalamocortical pathways. This complex dynamic integrates emotional spectrum of variation with cognitive spectrum variation. In short, training left right asymmetry indirectly trains arousal.

Cognitive Process and Arousal

As previously indicated, task performance in the cognitive domain is closely tied to arousal. This ability to inhibit the DMN and enhance specialized cognitive networks is partly a learned response to the environmental patterns. Reverie at its apogee often leads to sleep in a brain dominated by theta with minimal slowed alpha present and an

emerging delta. At the other end of the spectrum is cognitive readiness with increased fast wave alpha can cascade into elevated beta involving a task at hand or chronic beta related to the hypermentation associated with anxiety and worry. This aspect of arousal is characterized as cortical inhibitory control by Russian investigators (Pop-Jordanova, 2005).

Compensation Theory & Plasticity

Plasticity is firmly established as a key aspect of healthy neural function. The ability to shift state is crucial for adequate task performance. Severe or repeated trauma tends to reduce resources and the ability to respond to novel challenges. The result is a brain entrenched in over or underarousal states or locked in a chronic inhibited state of depression. These chronic states result in the growth of networks that maintain the status quo. Pain research demonstrates how individuals can grow a brain that generates the experience of pain after the source has dissipated. Many researchers are finding methods to regenerate plasticity. NFB protocols seek to increase or decrease activities in global, regional, or local networks to enhance lost plasticity through methods such as training theta beta ratios in underactive regions showing excessive slow wave activity indicating diminished capacity for functioning.

One aspect of this research is Pascual-Leone et al's (2005) findings on compensatory mechanisms of the brain. TBI in one hemisphere can lead to reductions in transcolosal inhibitory mechanisms that in turn result in one hemisphere co-opting function in the contralateral hemisphere to maintain an allostatic state while the injured region goes offline for repairs. Alstottst et al's (2009) models of lesions predicts this outcome as well. The implication is that training a region of diminished function should take into consideration contralateral inhibitory mechanisms. A two-channel protocol to manage the homologous site would be a minimal requirement for this process. This method should be done in the light of the bilateral nature of major functional networks (Laird et al, 2012). It also suggests that fine tuning of a protocol should consider innate hemispheric norms and dynamics as well as compensatory mechanisms between frequency domains as well as functional domains.

Buzsaki's (2006) work on hippocampal theta has led to a general recognition that theta and gamma are linked in function. Meehan & Bressler (2013) in review of the literature note that gamma in turn triggers beta activity and hence all three are tied. Neurology has long recognized the relation between alpha and beta, and presently it is obvious that the entire frequency domain is interactionally dynamic and that changes in one domain place pressure on other domains to respond.

Dynamics of the Horizontal and Vertical Axis of Arousal

Based on the foregoing considerations, we can place these two aspects of arousal on a dual axis representing two dimensions that provide a more complex model of arousal and more closely agree with observations. Training then has a vertical frequency dimension related to cortical inhibitory control as well as a horizontal dimension related to asymmetry. Each hemisphere should be individually evaluated from a vertical perspective (brain rate, cognitive) and then in relation to the contralateral hemisphere from a horizontal perspective (asymmetry, emotional). Frequency adjustments in one hemisphere can lead to changes in the other that may be more difficult to achieve in that hemisphere alone. Both sides are continually compensating and adjusting in relation to the other. In this process, the trend lines may periodically reflect extreme movements of frequencies in amplitude and coherence.

From this perspective, the issue of "overtraining" is typically misunderstood. This tendency has led to concepts such as Z-score training. Clinicians often mistake sudden shifts in the trend screens that go outside the normal range appearing on their client maps. They attribute it to their efforts rather than the brain's innate ability to "move the furniture around" to accommodate changes occurring due to training. When using the compare tool, they often make the same mistake—thinking that any unexpected increases and decreases in component bands are due to some error in selecting a protocol or training.

Another confusing and related issue for newcomers is why we train beta up in circumstances where beta is already too high. This confusion is due to a naïve understanding of brain dynamics. When training low frequencies down, it is typical for high frequencies to go down as well in a compensatory response. The second issue is that training a frequency down in one hemisphere will reduce it in the contralateral hemisphere. This tendency is why the Othmers were forced to train one side of the brain in part of a session, and then the other side afterwards. When using two channel training, it is crucial to take these dynamics into account. Training beta down in the right hemisphere will usually result in beta going down in the left as well. This reaction can result in a temporary beta reduction in the left hemisphere causing reductions in efficiency in the left side due to a beta deficit. Consequently, it is useful to uptrain beta at a modest percent of reinforcement to offset this net effect.

Training down theta amplitude can result in a general drop in overall amplitude that can be uneven from a hemispheric perspective. Beta may drop more on the left than the right resulting in a net increase in right hemisphere activation and a corresponding increase in anxiety. It is important to keep the hemispheres balanced during training aimed at robust changes along the vertical axis. Training beta up on the left and SMR or lo beta up on the right when reducing slow wave activity is an important way to help

balance changes due to these net effects. Since the brain is autocorrelative and nonlinear in dynamics, it will calculate its own unique and best response in terms of frequency amplitude and distribution.

Protocol Selection Procedures

The first step in our automatic assessment process in the database system is to statistically determine the most deviant locations based on a weighting method that assigns a value for each location based on its Z-score in magnitude, dominant frequency, phase, coherence, and symmetry. The symmetry value is derived from magnitude difference between left and right hemispheres rather than a Z-score value. Each location is paired with its homologous site on the contralateral hemisphere. Frequently, these sites rank next to each other in the list. Eight sites are listed, under the heading "Z-score Locations," in rank order with the top sites selected as the most likely location to generate maximum results.

Once a site is selected, it is evaluated for frequency deviances and an initial training strategy is generated. A typical example would be downtraining theta in the left hemisphere and uptraining lo beta in the right hemisphere. The training strategy is further adjusted by clinical rules considerations based on the quadrant rules (Soutar, 1999, 2011; Demos, 2005) i.e. not to train beta up in the right posterior quadrant. A third stage of analysis is also applied in which typical compensatory dynamics are considered within the existing frequency context in each hemisphere under applied protocol conditions as observed in the past. A final complex three component band frequency approach results typically involving low, mid, and high frequency ranges for each hemisphere. Training is typically done based on separately referenced ears but using linked ears has also generated favorable results.

Each hemisphere uses a monopolar montage and either a one or two channel protocol is employed in each hemisphere. Once the first session has been run, the training graph is evaluated for significant changes in amplitude in the normative direction. The review screen or trend screen is evaluated for compensatory patterns such as theta dropping when beta is down trained in the right hemisphere or alpha decreasing in the left hemisphere and beta increasing in the right hemisphere. In terms of vertical movement, changes of 2 to 5uv are significant for delta, theta, and alpha. Changes of .5 to 2uv are significant for beta. These trends are best considered with regression lines calculated or in artifact free analysis—as with the New Mind trend screen in our training software. These trends can also be visually estimated by a practiced clinician. In terms of horizontal movement, trends showing increases of alpha on the left and beta on the right are monitored. The convergence of each left and right hemisphere combination for each component band is usually a sign of enhanced plasticity and tends to correspond with normalization of amplitude on the vertical plane.

Maximum normalization typically occurs in the first 15 sessions, marking the end of the acquisition period or training. Clients are usually observed to have the most significant symptom changes during this period, but their symptoms slowly degrade between sessions. The consolidation period begins with progressive retention of symptom reduction between sessions until symptoms are permanently diminished. Clients are typically backed off to one session per week to confirm retention. Those clients who can come only once a week for training would be backed off to once every other week.

Symptom tracking is a critical component of the training process as clients tend to quickly habituate to their new level of function and forget their prior level of distress. The cognitive checklist is used to evaluate clients on each dimension for function monitored with EEG map analysis. The checklist provides a series of questions designed to tap constructs utilized in fMRI research and locate regions noted in the research to be hubs and nodes of various networks associated with specific functions such as short-term memory or sequential memory. A projected map of locations associated with client endorsed items indicating problems is generated, and then compared to the EEG generated map for correlations. Correlated items are then sent to an automated symptom tracker, confirmed by the therapist and client as significant. Then they are tracked over time using various graphs. Clients then report the level of symptom changes.

Pre/Post Maps

A typical assumption is that brain changes have a linear function and move progressively toward the normative pattern in steady increments over the course of training. This assumption has never been found to be the pattern in most of cases that we have reviewed over the past three years with approximately 500 clinics. We have seen dramatic cases of rapid shifts in the normal direction, but they are the exception. This difference could be considered a consequence of our training protocols, but we have many clinicians also using LENS, Infra Low Protocols, Z-score, and a host of other methods while conducting pre and post maps. None of these methods has consistently produced linear changes toward the norm across sessions and clients. Claims to the contrary should be met with skepticism.

Our pre/post map method using the New Mind compare tool reviews the changes toward and away from the norm across all dimensions of analysis and computes a percent change as well as an overall percentage of change in any direction. The changes we observe across NFB methods reflect what compensatory theories predict. There is considerable movement in many locations away from the norm as other areas move toward the norm. It is only reasonable to expect a nonlinear dynamic autocorrelative system with a 1/f power function and over 30 billion neurons with 3 degrees of separation to have a complex solution space. As attractor states shift in each network

and allostasis is renegotiated, there is considerable compensatory movement away from normative expectations and back again. We observe several cycles of change with considerable retrograde movement away from the norm during initial acquisition phases of learning. Then we observe progressive movement toward the norm in the consolidation phases. These changes cannot be easily correlated directly with symptom changes and symptom intensity. We typically observe robust changes in the 35% range within the first 15 sessions and exceptional levels of change in 45-50% range. These changes typically reflect dramatic changes in symptomology.

Figure 47 Overall changes

Summary

It should be clear from the preceding material that the efficacy of this method is considerable. Allowing the brain to determine its own limits of deviation during repeated trials rather than using a normative constraint model is clearly as effective as other more complex modalities such as Z-score or whole cap training etc. It does not utilize more intrusive measures such as micro tesla or entrainment, but it could be used in conjunction with these approaches. Early trials are encouraging, and some vendors are using this approach with photic stimulation and with what appears to be greater efficacy. The most important advantage is this training method is grounded in standard

NFB methodology and qEEG research and draws heavily from neuroimaging research. It trains clearly identified meta-networks based on recent research and focuses on training emphasis in a complex nonlinear dynamical process rather than just focusing on regions of interest (ROI) that tend to be hubs or nodes based in Brodmann areas. It does not have the accuracy of LORETA training methods, but anatomical specificity may be of limited value with EEG biofeedback. The resources required to engage this technology is considerably less expensive than more complex approaches and provides a good springboard for learning theory and advancing into these more complex approaches should future research demonstrate superiority. Typically entering clinicians are counselors without technical backgrounds and extensive complexity reduces the potential for expansion into these professional domains.

The bio-psycho-social approach identifies confounds and views these as more critical to outcomes than technical specificity and complexity. Greater outcomes can often be achieved by enhancing metabolic and psychosocial systems in conjunction with NFB than by ignoring them or focusing extensively only on technical approaches.

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Chapter 9: Alpha Theta Training (AT): Trauma Integration

A fair number of clients will not respond significantly to 2 channel protocols targeting anxiety that typically emerges after the first 15 or 20 sessions when the post maps are reviewed. As we have said previously, these are usually the clients suffering from serious emotional trauma resulting in PTSD. This tendency is usually when we introduce AT training to integrate that trauma.

AT training is also sometimes referred to as deep states training. The term deep states neurofeedback originally came out of workshop discussions with Brainmaster Technologies. Clinicians had kept referring to AT training as neuromeditation, another term from the same source, and I felt it was important to make it clear that AT training was technically not the same as meditation. To distinguish it from neuromeditation, I suggested we call the workshop deep states NFB as I had done in my own recent workshops at the time. I was conducting a different workshop titled, *Neuromeditation,* which involved training in alpha states.

During the early part of the last decade, I experienced a peculiar confounding problem in AT training. I had been doing workshops and lectures on AT for a few years at ISNR and AAPB conferences. Bill Scott was starting to do the same and had even shown up in one of my workshops at the Winter Brain Conference in Florida. We quickly developed a good friendship over our similar interest. We both initially became involved in NFB over our interest in AT training and performed many trainings on ourselves and others. There was a very specific screen design format we were all using based on Peniston's research as well as a whole clinical format for conducting a session.

Unfortunately, what I began to see emerge were prefabricated training screen designs in various software for NFB for the purposes of AT training that demonstrated a complete disregard for these aspects of the training and reflected a profound ignorance regarding the method. People were calling me and telling me they were doing AT training and getting hundreds of crossovers in a session, but they had poor training results. Upon investigation, I found the screen designs were totally improper and reflected a complete ignorance of the method. What was worse, is that clinicians thought AT was "just" a protocol or NFB gimmick. The assumption was that anyone could just do it if they picked the right protocol from a list and just ran it on a client. This idea indicated there was a profound confusion and ignorance over what AT training was and where it came from. There were even many trainers—some of them very prominent—talking about it who never used it clinically but had only taken a workshop in it themselves.

In response to this dilemma, I called up Bill and proposed that we create a series of workshops together to help better train the clinicians in the field and raise

consciousness regarding the methodology. We set up workshops in the Netherlands and at Brainmaster in Cleveland, Ohio and began an effort to clue people in.

A Brief History: The Other Half of Neurofeedback

At the time Bill Scott and I had gotten to know each other, AT was the other half of NFB. Adam Crane and I documented much of this history in our book Mindfitness Training (Soutar & Crane, 2000). Eugene Peniston had taken a workshop from Elmer Green who had devised the original method. Green had been conducting research with his wife under a government grant in the 70s investigating the idea of enhancing creativity through brainwave training. When reviewing the history of inventors and innovators, they had found that most of them had access to or consciously developed a method of getting into an altered state from which they derived critical insights. Green designed and built his own NFB equipment and began training individuals in an isolation booth. He was specifically interested in the alpha and theta frequencies. He would train individuals until they were able to double their alpha production with their eyes closed and then train them in producing theta frequencies. The subjects reported extraordinary experiences, often of a life changing nature. When Peniston took one of the workshops that Green provided at the Menninger clinic where they both worked, he had a vision that he could use this technology on alcoholics to assist them in recovery. Peniston then devised the protocol that we use presently in the clinical setting. He published his findings on experiments with both alcoholics and veterans with PTSD in the late 1980s. They generated considerable interest and excitement because of their profoundly successful outcomes. This excitement initiated a long series of research efforts, especially by Bill Scott that culminated in the “Cry Help” study done by Bill at the UCLA Department of Psychiatry (Scott et al, 2002).

The “Cry Help” study was named after a clinic where it was conducted and involved over 100 recovering addicts. The outcome was very impressive. Subjects were intensively trained with eyes open fast wave protocols for 14 days and normed their tests of variables of attention (TOVA). They were then trained for 30 sessions with AT training. Bill had pre/post MMPIs done on the subjects as well. Again, like Peniston’s experiments, the outcome was unusually impressive but with a much larger sample size. Most of the subjects who finished the experiment recovered with minimal recidivism. Our present clinical model of fast and slow wave training still retains many aspects of this research and reflects the methods employed.

The Method: Overview

I think it is important to provide an overall schema regarding AT training at the outset. The method, as we have said, was originally devised by Elmer Green. It evolved under his experimentation and eventually was adapted by Gene Peniston for his research projects. The form it finally took was developed between Bill Scott and

Peniston. Peniston was very clear that AT was not a standalone approach for him, but it was an adjunctive technique to an overall method (1999). Although people have attempted to just "cherry pick" the protocol, they are technically not doing AT when they use it alone without the other associated techniques that we will be discussing. They often may not get the same results.

Peniston developed a preparatory regimen prior to AT training because he saw that it was necessary to assist people in developing the skills needed to achieve the deep states potentially available with NFB. This regimen involved progressive relaxation practice, visualization practice, biofeedback practice, and breath control methods. Once clients were accomplished in all these areas, they would then begin the AT training. They were placed in a silent environment in an isolation room with a single window for watching the client. Clients were hooked up to the equipment and began the session with their visualization. Clients were then instructed to listen to the tones. They were left alone in the room for the training. Afterwards their experience was reviewed, and then they were done with the session. In addition to this procedure, they also went to group counseling and discussed their experiences.

Having taught this method for a couple of decades, I have frequently found many clinicians who think they are doing AT, but who are unaware of this procedure. They just pick the protocol from the manufacturers list, run the client, proudly proclaim, and vehemently argue that they have been doing AT training. Yes, they may be doing NFB, and clients may be having some positive experiences, but it is technically not AT training. When they learn to do it properly, they are surprised at how powerful the method is and how much more effective they are at using it.

My wife, Barbara, and I have evolved Elmer Green's and Peniston's methods over a period of 20 years through clinical application and experimentation. We have presented our discoveries and methods in workshops at Future Health, AAPB, and ISNR over the years. The interest in AT has been modest and varied. I suspect it is because it requires a variety of skills not readily available to the average clinician. It also requires the clinician to do their own training before doing it with others. I think this requirement is the biggest hurdle for most trainers. However, there is emerging renewed interest in it as more and more clinicians run into a roadblock in their NFB training where individuals with severe trauma fail to continue to make progress and resolve their trauma. This outcome is because they are missing the other half of the NFB method. We have evolved the AT method into a sophisticated approach more closely allied with Green's original interests that takes individuals deeply into their collective unconscious and their spirit. It compels them to work creatively with their life and transform it. Not every client is ready for this process.

The Theory

Elmer Green and his wife developed the original theory and technique which was clearly outlined in his book, *Beyond Biofeedback*. As a young man, he learned the basics for the method from an Irish yogi who taught him meditation and concentration exercises. He began to apply the technique in college to help him solve difficult math problems. Later, when he went to India, he found that others knew of the technique. He discovered the same EEG pattern in other individuals that had appeared in his brain when he engaged in the method. This outcome was a liminal state between waking and sleep that allowed for creative solutions to emerge. One of his psychiatrist friends referred to it as "dredging the unconscious." Elmer agreed this "dredging" was partially what he was doing. The key measurement feature of this state was high levels of theta over the area of the brain referred to as O1 in the 10-20 co-ordinate system.

A Liminal State

It requires years of practice of meditation to develop proficiency. One does not just sit down and master the technique in a day, a week, or a month. The idea that it is easy is a western fantasy that is constantly renewed in the spiritual market place in a culture heavily immersed in spiritual materialism. Elmer found that he could create a sort of electronic short cut to achieve a momentary experience of some of the states that were a by-product of the journey to mastery of meditation. He had very developed theories on this idea. Most of these ideas and theories had been ignored or forgotten in the "cherry picking" frenzy in the same manner that the other aspects of AT training had been ignored in the Peniston protocol. This tendency was also reflective of the effort by Westerners to focus on meditation mechanics and ignore the preparatory training and theory associated with it in eastern culture and which was considered crucial to a successful meditation practice. Elmer's concept was, to some extent, part of this cultural drive to strip away everything but the core method. He wanted to develop an electronic shortcut to these deep meditative states.

In his book, *Biofeedback and Beyond*, Green (1992) states: "... my colleagues and I (Alyce Green and Dale Walters) eventually succeeded in instrumenting and generalizing the meditative method through alpha-theta brainwave feedback training. And, we subsequently made it available to everyone, meditator and non-meditator." He trained theta initially to create this shortcut. During his initial research, Green found that after a few sessions most people were able to get into the theta state for several minutes and "interrogate the unconscious for the solution to problems," plant visualizations, or explore higher states of consciousness.

Individuals training in these states often reported intense dream like experiences and visions that were similar to life after death experiences. On many occasions these bled over into real life events and seemed to influence or become a part of daily life.

His goal was to “train them in voluntary control of certain existential states whose central-nervous-system correlates are revealed by the presence of low-frequency alpha and theta rhythms in the EEG record (Green, 1970, pg17).” He further identified the state as “a poised non-drowsy state” that “appears to facilitate recall processes.”

Elmer did not see himself as training people in brain-wave control or operant conditioning as is commonly proposed for fast wave training that is typically pursued for remediation of symptoms in the contemporary NFB paradigm. He was very specific regarding what he was attempting to do and what he thought was taking place from a scientific perspective as a bio-physicist. “In actuality there is no such thing as training in brain-wave control; there is training only in the elicitation of certain subjective states that are accompanied by oscillating voltages in the cerebral cortex, detected through the subject’s skull and scalp. Brain waves, as such, are not known to have any sensory representation whatsoever by means of which they can be detected. What are detected and manipulated in some unknown way are foci of attention, thought processes, and subjective feelings (Green, 1970).”

So, where did the alpha component of AT training come from? Elmer is quite clear on this point as well. He trained alpha because it was an easier frequency to teach people to influence initially. In his book, *Beyond Biofeedback* (1977), he specifically states that in his preliminary study he began to train theta only after the first two sessions, “because the subjects had little difficulty in increasing their percentage of alpha and we were particularly interested in investigating theta.” (Green, 1970, pg137).

During his initial research, Green found that after a few sessions most people were able to get into the theta state for several minutes and, as I have said, “interrogate the unconscious for the solution to problems,” plant visualizations, or explore higher states of consciousness. In this theta state his subjects not only discovered solutions to problems, but they also experienced other features of the state which were “hypnagogic and dream-like images during a state of semiconscious reverie... in conjunction with periods of theta rhythm and low frequency alpha waves (Green, 1970, p10).” It can be deduced from this statement that it appears that Green was not entirely clear whether the correlates of state were theta or alpha as he suggested training in “theta waves or low frequency alpha (Green, 1970, pg16)” or a combination of the two, but he clearly felt the brain could find its own way once it was guided in that direction.

Elmer developed a comprehensive theory of consciousness which he outlined and presented at various conferences. Figure 48 Symbolic interpretation of human substance and perceptual structure is a map of consciousness he used.

The Alpha Theta Environment

Elmer trained subjects in an isolated room with TV cameras to observe and speakers to communicate. Subjects would lay down on a flat table during the sessions. The room was mostly empty and sound proof. Silence was maintained during the session. One exception was a doorbell that was installed to wake clients when they became so drowsy that they entered stage 1 sleep. Elmer felt it was critical to avoid any distractions or intrusions into the session. Based on his research, it can be surmised that a comfortable and quiet room is crucial to the AT process.

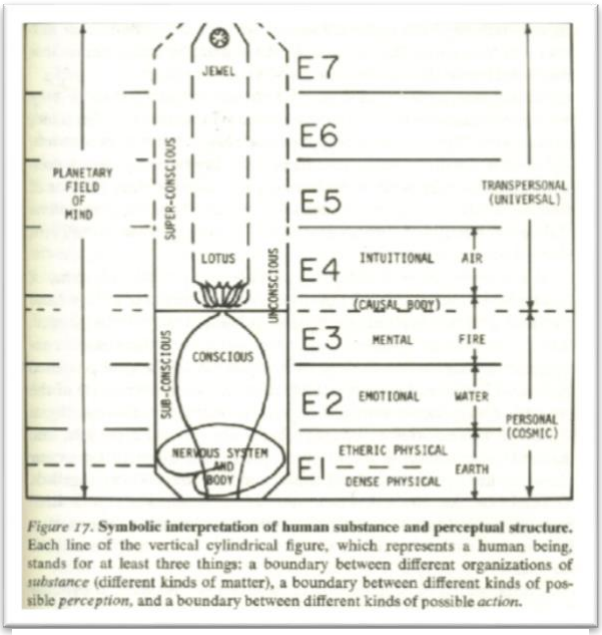

Figure 48 Symbolic interpretation of human substance and perceptual structure

Alternative Techniques

Green tried many approaches to brainwave training. He trained people extensively with alpha and then theta initially. This method was because he felt that the alert calm state generated with alpha training would assist them in maintaining conscious awareness when they entered deeper states close to sleep. Eventually he focused more quickly on getting them to enter the theta state. The initial technique, as mentioned, was to first train one frequency, alpha, and then theta. The idea of combining them apparently emerged during Peniston's experiments as there is no mention of this combination in Elmer's own writings. He also experimented with training frequency instead of amplitude. He would train subjects to lower their alpha frequency until it moved into the theta range. This approach of course confounds his experiments to some degree, resulting in some confusion over whether he was training clients into a state of slowed alpha or theta. He also experimented with different sounds. One of his methods was to convert the lower brainwave frequencies into a band of harmonic frequencies that would be audible. His idea was to provide the ability to hear the movement of their brainwaves in an auditory form.

It should be apparent from the foregoing that Elmer experimented with a far greater variety of methods than anyone in contemporary times has tried. He did not, however, use two channels to train people although he had the ability to easily build as many amplifiers as he wanted. Presently, some people are using two channels to train what they call AT, but they have offered no research or formal explanation for it.

Crossovers

Green noted that when monitoring these training sessions, alpha tended to go up to 12hz and then gradually drop to 8hz. He observed trains of low frequency alpha and theta in the frequency band between 6hz and 8.5hz during periods of deep "reverie" as he called the liminal state that he was trying to achieve. He further noted that the imagery occurred when the alpha suddenly dropped in amplitude and long trains of theta appeared after which a burst of "paradoxical alpha" occurred with the emergence of hypnagogic imagery. This state is dream like state where they would see images. He called this approach crossover.

Their subjects had profound creative insights from their training at this point. Later they would process in a more active conscious state. This process is different and has different goals than meditation pursues. The goal of meditation is not to generate creative solutions to problems. Physiologically the goal of meditation is to achieve an alert waking awareness in a state that is marked by a consistent ongoing manifestation of low frequency alpha waves. It is not to shift in and out of deep dream like states to derive images. To achieve these deep alpha states, meditators practice for years to grow a brain that is capable of achieving these states (Davidson, 2003). Some of the confusion of this approach comes from the fact that alpha can drop into that frequency domain and remain morphologically alpha while theta is a morphologically distinct frequency. It is difficult to separate the two without an expert eye.

The Peniston Procedures

Peniston took a workshop from Green as was mentioned previously. He decided to employ his methods with alcoholics in a what is now a famous experiment. Unfortunately, the methods section of his article was not clearly written and for years there was confusion and arguments over what he did until he published a chapter in *Quantitative EEG and Neurofeedback* (Evans & Abarbanel, 1999). The following is taken from that explanation.

Peniston found that EMG biofeedback reduced depression scores on the MMPI (Peniston et al, 1989) and noted it was closely associated with alcoholism. He felt that that EEG related relaxation techniques would also assist based on the work of Kamiya, Brown, and Green. To make a further impact he decided to combine them with other methods being used at the time including systematic desensitization, TMP biofeedback, visualization training, rhythmic breathing, autogenic training, guided imagery, and constructed visualization.

Patients received an EEG assessment upon admission to the hospital and were evaluated for alpha amplitude, dominant frequency, percent power, and synchrony. They were given Beck inventories, MMPIs, and a Catell 16PF inventory. Autogenic

training exercises were used with temperature training and rhythmic breathing techniques for a period of 30 minutes as pretraining. Each patient received 6-7 sessions. These sessions were adapted from Green's research (Green & Green, 1977). The temperature training was thought to stimulate theta and a reverie state. The visualization training involved seeing themselves physiologically relaxed, as having the personality they would like, and then seeing themselves go through their daily life acting out the qualities of this type of personality.

The sequence

A five-minute eyes closed baseline was set for theta and alpha. A five-minute eyes open baseline was set for beta. The patient practiced his visualization with eyes closed and was instructed to sink down into the theta state. Then the patient was instructed to proceed with the command, "Do it." The volume of theta and alpha were independently set to comfortable levels while beta volume was turned off and the patient was left alone in the room for 30 minutes. The patient then completed a questionnaire. This sequence was done for 28 consecutive days.

Abreactions

Peniston clearly stated that abreactions could occur, especially if theta reinforcement was set too high. They even had a procedure for dealing with it. The beta and theta sounds were turned on and alpha turned off. Theta reinforcement was increased. The patient was trained like this for the next six sessions.

Settings

Peniston only uptrained patients. He set beta at 40-50% reinforcement (this particular beta setting was done over a five-minute baseline with eyes open), alpha at 50% reinforcement, theta at 20-30% reinforcement, and ignored delta. Interestingly, these settings are considered too low for reinforcement by today's standards. Beta was set at 13-16hz; alpha was set at 8-13hz; theta was set at 4-8hz. These settings were very different settings than were used by Green and clearly of their own invention. Hopefully the reader can appreciate that this process was a little more involved than just slapping electrodes on someone's head and running a canned protocol.

Nancy White's Theories

Nancy proposed that an important aspect of the training was programming the unconscious with mental rehearsals of new images and intentions. She also cited the literature on the use of imagination in healing that was used by traditional Shamans and modern psychotherapists such as Dean Ornish, Norman Shealy, Larry Dossey, and others. She identified the procedure as falling into the category of transpersonal psychology and utilized Maslow's paradigm to help explain its mechanisms. Theta waves were identified as internal processes and beta as external processes with alpha as a

bridge. At the time, this perspective was fairly conventional. Anna Wise (1997) developed a whole therapy around this perspective and utilized EEG monitoring as part of her methods in workshops at Esalen. Disorders resulting from physical and emotional traumas could result in low alpha amplitudes and prevent clients from accessing internal theta states. Wise also saw these disorders as a block to integration and healing. (Interestingly high alpha with asymmetry found in depression could have the same outcome.) Training in alpha amplitudes seemed logically to increase internal connectivity. She proposed that the liminal states of consciousness at the "edge" of waking and sleeping were corridors to the unconscious. This idea was of course very established in psychotherapy part of hypnosis theory. Theta was also associated with childhood because it was the dominant frequency. It might provide for state dependent memories to emerge.

Tom Budsynski developed the term "rescripting" for theta state learning (1971, 1997). There was the opportunity to "reassociate and reorganize" Rossi (1986). Survival patterns of childhood could become the foundation for future maladaptive behaviors. Nancy also proposed a neurochemical model to partially explain the effects of AT. (These mechanistic neurochemical explanations do little to further our methods). She also cited the work of Bruce Perry (1997) that promoted the concept that severe emotional trauma in childhood results in altered development of the CNS, and that such changes could bias the system toward PTSD and other disorders when stressed in adulthood. She favored the idea that changing brainwaves could change neurochemistry.

She also explored the idea that the therapist's presence was a crucial feature of the process. Building on theories that all people have core traumas and that these traumas guide future behavior patterns was consistent with the entire theoretical body of knowledge in clinical psychology going all the way back to Freud. When reviewing the work of Stanislav Grof (1976, 1980, 1985), she proposed that flashbacks related to trauma could emerge in the form of hypnogogic images. Grof's COEX system explained memories as thematic systems bound by emotion that are chronologically layered and access these results in catharsis that discharged the memory. Although she did not specifically explore this mechanism, Joseph LeDoux (1996) provided a detailed biochemical and neuroanatomical model to explain and support this perspective.

Finally, she introduced the transpersonal psychology theories and research that began to explain the role of consciousness in this process of uncover and integration. She connected it with more traditional modes of healing found in Shamanism. She cited the work of Bohm (1983) and Goswami (1993) as providing various models integrating consciousness and physics. Additionally, she discussed the value of Campbell's (1988) idea of the hero's journey as a fundamental motif that each person expressed in a

different manner in their life quest to integrate the challenge of life experience. White proposed that the theta state allowed the experience of trauma from a nonjudgmental transcendent perspective that resulted in integration of the traumatic experience. This model is still a very strong integrated model for AT training.

Adam Crane's (Soutar & Crane, 1999) theories of negative rehearsal and trances derived from Wolinnski (1991) fell along the same lines. My own theories outlined in the *Automatic Self* (Soutar, 2015) included all the foregoing and were derived from the integration of many theoretical paradigms as well. Those clinicians engaged in this "process," as Crane referred to it, often emerged with very similar perspectives from their clinical experience. Adam and I explored these similar ideas that we also discovered in our parallel experiences with AT training. So, there appears to be considerable independent agreement emerging from different experiences in time with this process of AT. I will expand and refine these ideas in the section on trauma.

Bill Scott had never formally outlined a theory of AT, but his methods and workshops reflected a perspective very consistent with those outlined in the works of the previous authors cited. Bill's contributed the refinement of this technique through his research. Bill completed several studies which were very valuable in illuminating this method. His work with Native Americans in collaboration with Peniston resulted in the discovery that inhibiting low frequency theta and delta significantly reduced the experience of severe abreactions that were often a part of the AT process. This discovery was very important as these experiences could be quite overwhelming for many severely traumatized individuals and resulted in clients dropping out of the clinical process before they successfully integrated their trauma. His work at the UCLA Department of Psychiatry resulted in the "Cry Help" study (Scott et al, 2002) mentioned previously. It demonstrated that NFB could normalize TOVAs in 14 days when done twice a day. It also showed the power of AT to deal with multiple addiction patients in institutionalized settings, replicating Peniston's work. In addition, Bill was the first to report the dynamics of crossovers and how they related to hypnogogic imagery. These technical findings expanded our techniques and efficacy in AT training a great deal.

A Psychological Theory for Alpha Theta

Currently not everyone doing AT work is a trained therapist. Many clinicians argue that only trained therapists should engage in this kind of work, but NFB is self-regulated. Alpha theta is truly a testimony to the ability of each person to heal him or herself. The fundamental dictum of western healing comes from the authority of the New Testament when Jesus admonished the physician to heal himself before attempting to heal others. This idea is consistent with the experience of every clinician in AT that those clinicians administering AT must experience AT personally first to be truly effective in their work.

In an interview that Bill Scott and I did with Nancy White at the Winter Brain Conference (2000) she explained that she never processed with clients after a session, instead she had them fill out a form in the same manner as Peniston. This procedure was the common method at the time. Many people might ask, "If it is so straight forward, then why should a degree in counseling or psychology be necessary? If a degree in psychology is necessary, then why should physicians be allowed by license to engage in this training." The truth is, that AT is similar to work in hypnosis but even less directed. This idea does not mean that clients won't significantly benefit being trained by experienced and well-trained therapists, but it does argue that AT does not require significant licensure.

It is obvious and well known to any good clinician or counselor that some basic clinical skills are necessary when working to heal the psyche. These skills are often the same skills used in medical or pastoral work. Unconditional positive regard (Carl Rogers, 1961) and a compassionate perspective is the most fundamental feature of the healing environment. Clinicians should not enter this technique without these basic abilities. This approach is the basis of the Christian perspective and forgiveness—a core aspect of compassion—is the universally recognized core of the Christian healing tradition. This same core can be found in the compassion of Buddha or the Tao of Lao Tsu. Both East and West share this fundamental criterion for the healing experience. Those clinicians who are not deeply motivated by this humanistic perspective would do us all a favor by staying out of this theater of activity. This idea is not a purely and mechanistic paradigm enshrouded in the false assertions of scientific positivism where isolated agents of action will fix and repair others. This belief is a holistic integrated paradigm of 21st century science grounded more in the monistic idealism of quantum mechanics proposed by Goswami (1993).

In the hero's journey toward redemption, healing, and transcendence, there are pathways and milestones that can be identified and utilized to enhance and promote the expedition. Those clinicians who have a map are less likely to wander lost in the wilderness, and more likely to find their "pearl of great worth" more quickly. This area is not the realm where the credentialed authority of bureaucratic expertise in policy and procedure reigns, this realm is where individuals with such agendas falter and fall. It is the realm where the unexpected and the unknown guide the way and a realm where the Hayoka rules by the mastery of letting go. The map is the guide that links the collective unconscious to the present reality. AT is the bridge. The journey for each explorer is infinitely unique. The ultimate authority is the individual's own inner guide. No one can take responsibility for the outcome other than the clients themselves. To declare any authority in the process you undermine their process and thereby you "do harm." Clients not willing to accept this fact are not worthy candidates and will be judged and rejected by their own hand. The "therapist" is not doing anything to the

"patient", and this approach cannot be the relationship. Therefore, this process lays outside of the authority of the clinician and the state. AT is not and cannot be psychotherapy. The individual guiding the AT session cannot operate entirely from the traditional therapeutic model.

I will present a basic schema or framework for approaching this expedition into the unconscious mind. This framework is based on the literature in psychology, anthropology, sociology, and personal training in Shamanistic traditions.

The New Mind Theory of Alpha Theta

Liminal States & Arousal

Arousal theory in psychology, sleep research, and meditational research all carry considerable consensus on this topic. A good place to start is to establish a basic schema of EEG patterns as they relate to arousal and the descent into sleep. Barry Sterman was originally involved in sleep research and wrote an article on arousal in the brain (Sterman, 1996). In it he clearly outlines the EEG patterns associated with arousal and the entrance into sleep. The typical normative pattern for entering sleep is not the same for those with mental disorder or trauma because they do not start from a normal distributional pattern of EEG frequencies in the brain. Below is a sample of a normal EEG pattern and then next to it is an abnormal pattern. The eyes closed EEG of a normal waking adult has alpha as the highest amplitude frequency, then theta, then delta, and then beta. When the ratio between these component bands is correct, then a brain map will show everything in the normal range. The abnormal pattern, on the other hand can show up in almost any imaginable way.

When individuals first become drowsy, there is a gradual increase in alpha. The alpha frequency begins to slow (see Figure 49 Arousal shift into sleep).

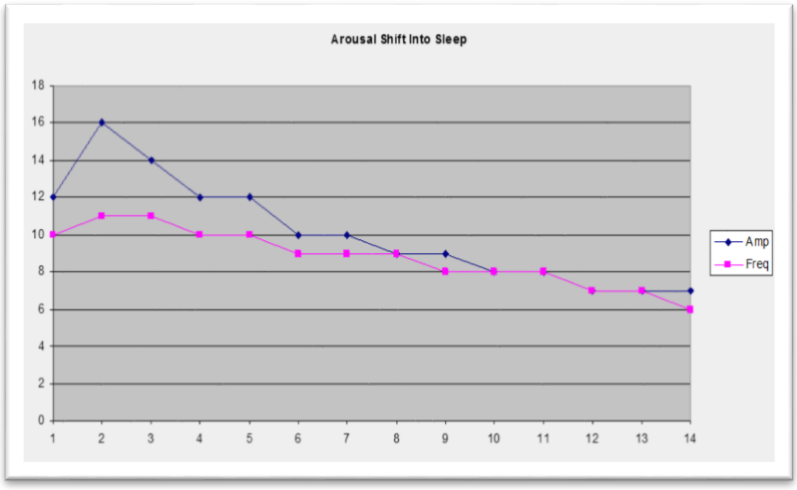

Figure 49 Arousal shift into sleep

As drowsiness increases, the alpha begins to drop in amplitude. Alpha frequency also begins to decline. The two begin a gradual descent and alpha drops in frequency and in amplitude. As shown in Figure 50 Crossover after a significant decline of several microvolts, theta gradually begins to increase until it becomes higher than alpha. The two converge and crossover each other.

At the point where alpha and theta cross, delta will suddenly increase significantly in amplitude. The individual enters stage 1 sleep. Note the precipitous increase in the black delta line the minute alpha and theta crossover.

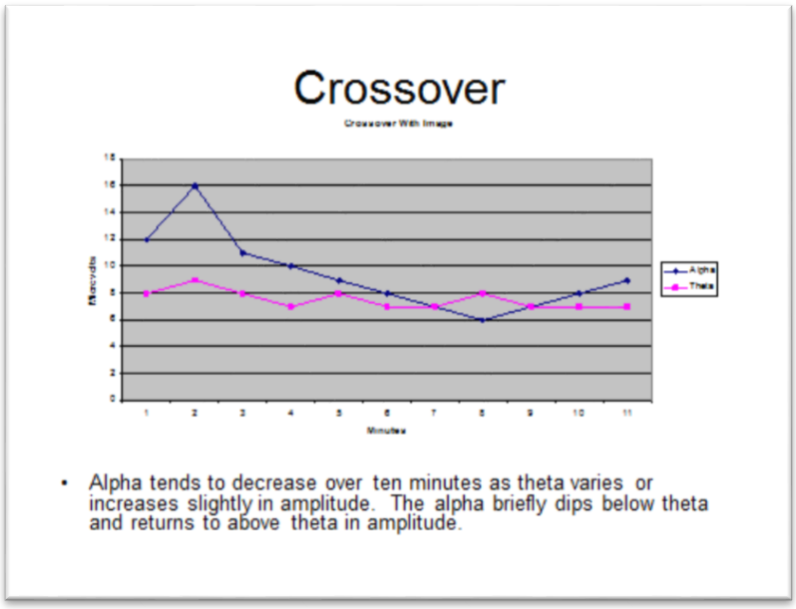

Figure 50 Crossover

The realm between the first increase in alpha amplitude and stage 1 sleep is not well researched and is poorly understood. Several possible states of consciousness appear to exist outside of where we usually spend our time. Most of us don't recognize these states because of our cultural conditioning. For most of us, we just follow path to sleep; but this corridor apparently has several doorways that we never enter. In a sense, we all walk around believing that we live in a two-story house of consciousness with the top floor of "awake" and the bottom floor of "asleep." It is more like a high rise with a dozen or more floors in between, but we always get into our consciousness elevator every night and push the lobby button. We take the express ride down (sharp rise in delta—see Figure 51) and never stop at the floors in between. They are hidden from us by our cultural conditioning.

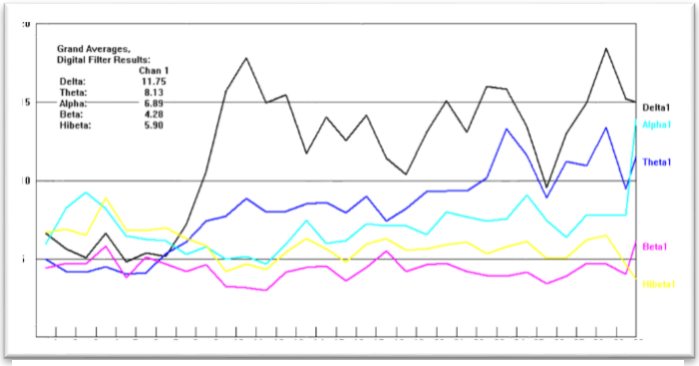

Figure 51 Taking the elevator down to sleep - note the sharp rise in delta

This corridor contains liminal or "in-between" states that can be developed and enhanced. Data from research on mediation shows consistently that advanced meditators using traditional concentrative meditation techniques develop over time the ability to occupy this zone at various levels. The initial work of Maxwell Cade (1987) found that the more advanced the meditator, the lower the frequency of alpha the tended to occupy. Beginners often appeared in the 11hz range while the intermediates

occupied lower 9hz ranges. Advanced clients occupied 8hz or even 7hz. This lower range is on the border between alpha and theta. The extensive and replicated work of Banquet (1973) also had similar findings. In addition, Cade found the hemispheres balanced in power rather than asymmetrical. Banquet found high levels of coherence. The Japanese investigators Kasamatsu & Hirai (1969) who examined beginning and advanced Zen meditators at a monastery found the same pattern. These findings are more extensively discussed in Chapter 14: Meditation & NFB.

Typically, meditators dwell in these states for considerable periods of time ranging from 20 minutes to an hour on any given session. In AT training clients zip through these states into stage 1 sleep and then bounce out in what Green called paradoxical alpha. This alpha is a period of brief consciousness which typically occurs in people before dropping off into deeper states of sleep. It is the period when people experience hypnogogic or hypnopompic images. Green harnessed this phenomenon, so that he sustained the paradoxical alpha response and used it, in a manner of speaking, to bounce individuals in and out of stage 1 sleep. Through this technique, he created the ability to briefly maintain an unstable but persistent occupation of this frequency domain without spending years developing the self-discipline, skill, and brain structure typically required. It is a sort of “cheaters meditation.”

To sustain the levels of consciousness involved in meditation, the brain has to actually grow new networks and change. The work of Richard Davidson (1995) shows that meditators develop thicker areas of the cortex. This research reveals an entirely new dimension of the meditational process; it is not just a state that can be accessed at any time by an individual making the right effort, but it is a mode of consciousness that requires a specific brain structure to access and maintain. This complexity is why long hours of practice over many years is required before it is mastered. AT does not involve this kind of sustained effort. It can provide a brief and distorted glimpse of these states and the benefits they may offer, but it cannot provide permanent access. This news is discouraging to typical Americans who believes it is their natural birthright to have anything they want the minute they put down their money. This belief reflects the “magic bullet” theory which brought us the pharmaceutical epidemic (Whitaker, 2010). We expect for every problem there is just the right pill to quickly fix it if only we can find it. It also explains why some people have these wonderful experiences with AT that are hard to repeat or why they cannot easily return to these states once they leave the clinic. I have had several clients who spent ten thousand dollars or more on special NFB sessions with a renowned expert to generate wonderous states of awareness only to find that they could not sustain them. They found to their bitter disappointment that they had to engage in sustained practice and lifestyle changes to permanently access these states.

This difficulty does not in any way invalidate AT or its effects. For many people the effects are very real and have a permanent impact. Entering these states for a brief period is transformative for many people. If they have already spent considerable time doing inner work, it may provide a tipping point that does lead to permanent access to new levels of awareness. If they have done no inner work, they may experience some modest changes. If they have experienced significant trauma, on the other hand, they are very likely to have powerful experiences recovering lost sensory and emotional information related to the trauma as well as significant relief form its integration. This change may feel dramatic, but it is just a return to a healthy level of consciousness and self-awareness. It is profound relief from sustained suffering.

Rescripting

Tom Budzynski introduced the idea of "rescripting" which was the unconscious using various means of visualization and audio programs, often in conjunction with photic entrainment. It was natural for this nomenclature to migrate into NFB and AT training through the community meetings. Peniston had already introduced the idea of the abstinence script and this idea was just extending the concept into other areas. Adam Crane called it "mental rehearsal". Many professional coaches were starting to use it in sports in the 80s and 90s. The idea is as old as Shamanism (Noll, 1985). Visualization is another aspect of this practice which is more basic and fundamental because it does not use verbal language. This idea is also related to post hypnotic suggestion techniques. In all these techniques, an alternative vision of behavior or life in general is constructed and planted into the unconscious mind (think DMN) in the form of a request or command. Most authors favor the request approach; the only one to use the command version is Peniston. By presenting in repeated fashion an alternative version of to the unconscious, it is expected that it can be programmed or changed to act differently. This technique has proven to be very effective in sports and is still used to day to enhance performance. The shamanic version is more profound.

In the effort to induce change through visualization, individuals will often find that the visualization themes they choose will appear in their dreams. Almost like a response from the unconscious. By picking up the themes of this symbolic thread and reusing them in the next visualization, a cycle of presentation and response can emerge that culminate in a physical event. It may be the appearance of an object or event that moves the individual in the direction of the visualized theme. By working creatively with this method, individuals develop a more integrated rapport with their unconscious as well as lifeworld outcomes that are congruent with their intentions. To learn this method, you must be trained in it and practice it yourself. I teach this technique and rehearse it at our workshops on AT.

State Dependent Memory Theory

The theory that memories are tied to states of arousal or states of consciousness emerged in psychology in the latter part of the last century. A large body of experimental work supported this idea, and it became common knowledge. It is presently part of every undergraduate psychology curriculum. The classic example is the alcoholic who hides his bottle when he is drunk and cannot find it when he is sober, but he remembers where he put it the next time he becomes drunk. This correlation applies to more subtle states and emotions as well. We may remember events better when we are sad or happy. In fact, much of memory is indexed by emotion. Both emotional valancing and declarative memory networks converge in the temporal lobes where limbic process and cortical process meet. The insula is nearby and mediates the intersection of limbic and somatic activity through what is known as the para hippocampal network. These structures and associated networks work together to manage the emotion-memory complex.

Placing in or providing access to deeper and calmer states of consciousness often opens the door to feeling other emotional states and associated levels of arousal that result in the recall of memories which are not typically available to the individual. One of the neurophysiological mechanisms that leads to the loss of access to certain negative feelings and emotions and their associated sensory data that constitutes a memory is described by the work of Joseph Le Doux (1996). Le Doux found that a limbic structure known as the amygdala specifically records and indexes basic sensory data associated with fear. For most humans this sensory data can be generalized to any internal or external events and memories associated with this emotion. When this structure becomes over stimulated through excessive trauma, it may become overactive and dysregulated. This over stimulation results in chronically elevated CNS activity with its associated negative metabolic consequences. The main strategy of the human cortex to protect the CNS from this chronic condition and to increase activation of the orbital frontal lobes where most of the outputs from the amygdala terminate. This activation comes in the form of worry. In EEG terms this manifests as elevated frontal beta (Engels et al, 2007) and beta asymmetry (Avram, 2010).

Any process, like worry that gets repeated in the brain until it becomes routinized creates structural changes through long term potentiation. The brain grows new pathways to maintain the activity. Then the brain places it into an automatic mode of operation that continues below the threshold of consciousness, so that attention and other resources can be diverted to more important immediate concerns. Since many of our thought processes occur below the threshold of consciousness in any case (Koch, 2004), this process is a natural and easy procedure for the cortex to execute. Consequently, large amounts of memories and their affiliated emotions become blocked

and stored by the brain for processing at some later date. This processing never occurs if the new danger to worry about is the awareness of the memory of the trauma itself. This negative feedback loop prevents the review and resolution of the emotional trauma or PTSD.

The emersion of the individual into passive states of awareness that reduce worry and allow them access to the issues and events that are the source of the fear that elicits the worry provides the setting for integration. Previously fragmented memories emerge and are not integrated into the conscious narrative of the individual. Research on memories tells us that memories are not stored as one consolidated record, but they are recreated in real time as the individual engages in the memory and draws on discrete components from each sensory system. This reconstruction requires the individual's memory system to draw upon these components and coordinate them, to integrate them into one consolidated memory process. This process then emerges, as LeDoux indicates, into the conscious narrative of the individual. Memories are, in this manner, derived from an implicit memory system and integrated into an explicit memory system. The implicit system is therefore a non-conscious processing system. The explicit system is the conscious integration system that makes the memory part of the personal narrative. The binding of the memory is a crucial and little understood mechanism. It is central to the entire binding process of the brain which coordinates all activity at every level.

One of the key difficulties of binding a memory due to trauma is the reactivity of the amygdala. As memory fragments begin to merge in real time into a bound memory, the emotional valences they bring with them also build in associated emotional networks. These networks co-exist within the subcortical structures in different frequency strata (Kirk & McKay, 2003). The intensity of building emotional valences typically triggers the amygdala and related fear networks. They in turn stimulate sympathetic pathways. This escalating condition is likely to bring the individual to the threshold of panic. At which point the forming memory collapses into its components and fails to coalesce. This failure is likely to repeat again and again and never complete. The resulting agitation is difficult to cope with and individuals are likely to develop adaptive responses to distract themselves. These adaptive responses can often be in the form of obsessive or compulsive behaviors (not OCD) as well as addictions to block feelings and shift moods. The AT state appears to provide a physiological context that is a "safe zone" for integration of traumatic memories. It may be a natural adaptation that evolved to allow us to integrate socio-emotional trauma and has likely been harnessed through a variety of techniques by healers going far back in time.

The Default Mode Network and The Unconscious.

The individual in the deep AT state is therefore engaged in the process of retrieving, re-assembling, and integrating the lost memories through conscious review. Joseph Le Doux (1996) describes this process in terms of transfer from implicit to explicit memory. Memories, apparently, do not become complete and do not become integrated into the conscious self-narrative until this transfer takes place. This transfer is how we construct meaning out of sensory information. Severe trauma may result in a failure to encode memories or to integrate memories. The events may be so emotionally disturbing that the organism refuses to integrate them to protect itself. Researchers have noted that when mammals encounter life threatening trauma, they shake to integrate the emotional component. If they are prevented from shaking, they may die. This shaking is part of the parasympathetic response to intense sympathetic arousal. Emotional integration is extremely important for a mammal's survival.

Humans both shake and cry. Without this response, they may become very unstable in psychological terms. Early psychiatry observed the importance of emotional integration and that it could result in peculiar responses when it was traumatically challenged in the form of dissociative disorders. Individuals exposed to severe trauma could at times lose the use of a limb or even become blind although there was nothing anatomically wrong with those functions. After the Khmer Rouge violently took control of Cambodia and were defeated, medical teams in Cambodia discovered many individuals who had gone blind after witnessing extreme acts of violence toward their family members. In recent times, this form of PTSD has emerged in many soldiers returning from wars in the Middle East. We now understand that war has always produced casualties of this form that often result in suicide.

Until recently the medical profession did not fully understand the importance of emotional integration for mental and physical health. This lack of understanding was partly because of our Cartesian dualistic system of thought that was so cherished by western science. Neuroimaging has proven this perspective to be as deeply flawed as the traditional positivistic and materialistic bias of the twentieth century that failed to recognize the implications of its own quantum mechanics. Ironically it was hidden emotional bias that prevented the recognition of the importance of emotions to begin with.

Retrieval may generate other related new details of memories as well. As previously mentioned, the body adjusts to both state and location with respect to memory. Memories emerge in these familiar intersections that are typically not available. The salesman who cannot remember the details of his contract until he arrives at the closing location is no different than the alcoholic who cannot find his hidden bottle until he is drunk again. Revisiting the theta frequencies that dominate childhood (Niedermeyer &

Lopes da Silva, 2005) is also likely to provide memories of that period because clients are once again in that state of mind, especially if they begin to visualize the locations of childhood (White, 1999). During these episodes of deep states, many forgotten details emerge that begin to inform the adult mind with a new perspective leading to profound insights into the nature of their childhood. These details are the primitive and generating sources of their emotional scripts and their primal beliefs. These childhood memories may lay dormant and unreviewed for decades, if not forever. The adult never returns to inspect the quality and validity of the assumptions and beliefs that form the foundations of their adult attitudes and behaviors. People act automatically based on emotional scripts forged in the formative years, and then as adults they rationalize and construct narratives justifying their emotional acts. This activity is recorded in the default mode network research. This self-process is often referred to as ego.

We have observed this process clinically, especially in individuals with dissociative disorder as they would recover memories in bits and pieces. As traumatic memories emerged, these individuals often took refuge by literally abandoning their conscious process. I watched this occur while monitoring the EEG of these individuals and having them describe the experience afterward. They “just go away” and yet their eyes remained open and staring. Often, they unconsciously moved themselves to safer locations, such as a closet or under a table. We had one client that would literally drive away in this state unless we took his keys away before the sessions. Antonio Demasio (1999) noted that many of the severely disordered individuals in the institutions where he did his research behaved in a similar manner when in unconscious dissociative states. He noted that the only detail that tipped him off that he was dealing with such individuals was the complete absence of emotion. He concluded that without emotional networks operating, there could be no consciousness.

The memories that do emerge from severe trauma do not typically emerge as one complete memory. They do not require self-narrative activity to surface. Clients tend to remember first a sensation or a smell, and then perhaps a voice or sound. These sensations may seem to be happening in real time during their emergence. Clients may re-experience the touch and smell, even the voice as if it is happening. This response is the brain and the body attempting to access and sort the pieces of memory stored in different sensory regions and bind them into one coherent memory. These old networks are sorting themselves out in real time. This response can happen repeatedly over a series of several sessions until the memory emerges. This process is how lost memories really are recovered, not the pseudo lost memories often elicited in torrents of invented images that have been inadvertently coached out of patients in talk therapy.

This process also relates to the synthesis of new ideas and insights. Without the material that is derived from their suffering, people frequently are unable to synthesize

an authentic narrative of their life that provides meaning. Without this comprehensive narrative, the individual feels fragmented. This fragmentation generates a CNS imbalance that involves chronic anxiety and sympathetic hyperarousal that limits their abilities to integrate new material, self-sooth, and nurture themselves. They often feel agitated and may suffer occasional panic attacks. Many people discover the use of alcohol or drugs early in life to compensate and ease their discomfort and dis-ease. It is, however, the recall, reintegration of the lost memories, and the insights that they require to heal. This necessity is not at all self-evident until reintegration begins to occur. Individuals who have not done this work on themselves including therapists are oblivious to the profound power of this tacit experience. This process is more than just talking it out.

New ideas and insights usually emerge spontaneously. They may occur in the office or they may occur outside the office while the person is driving to work or taking a shower in the morning. Sometimes the AT session will generate hypnogogic images that jog the clients' memories of something in the past. Sometimes they will just spontaneously have a new insight. It is the resulting insight that flags their integration. It is the insight that reflects a new organization in the networks of self-organization. The outcome of this insight is likely to be novel ways of thinking, feeling, and doing. These insights frequently lead to resolution of old patterns of behavior, the initiation of new responses, and patterns of behavior that dissolve barriers to improved functioning in social contexts. The new organization of meaning is derived from a new configuration of the past that redefines the present and possible future. A missing piece that was felt in unsatisfactory experiences of social interaction but not known in the cognitive domain generates a new experiential gestalt.

This pattern of discovery and insight proposes the hypothesis that the integration of experience is crucial to maturation and development stages beyond childhood as Erikson proposes. We have another level of "knowing" than we utilize consciously. This level of knowing involves behaviors that elicit responses from others that are full of emotional friction, generate painful experiences, and usually completely elude us. We reside in the illusion that our conscious self is the determining factor in our behavior. This illusion is a stage of growth that we eventually move through. It informs all the other stages of maturation and is part of a compliment of forces that propel us toward a felt need to integrate with the world around us. As separate selves, we experience a basic valence of incompleteness that social interaction resolves. This sense of incompleteness also has a biological component that goes back to birth. We learn to become separate against a background sense of loss of connection with our biological source and individually with our mothers. From this perspective, we move out of the biological and into the social. We are always thirsty for integration at both the social and biological level, and this need is what motivates us and fulfills us. It is a force as basic

and profound as gravity. The thirst itself becomes another level of inspiration that can drive individuals into addiction or spiritual pursuits, especially if they are frustrated in attaining social resources. Spiritual inspiration draws power from ongoing confirmatory experiences that neither social nor biological experience can permanently resolve the sense of separation that emerges from birth. We are always hungry. This energy propels us through stereotypical stages of development that the boundaries of planetary life define for us.

The Spiritual Component

The spiritual component proposes another level of integration beyond physical experience or social experience. It seeks to understand through direct experience the aspect of reunification beyond the verbal realm of conception, which is still a social artifact. Like the physicist trying to understand through physical experiment the fundamental nature of gravity, the spiritualist seeks to understand the fundamental nature of unity. The understanding of the physicist relies upon the language of mathematics. The understanding of the spiritualist relies upon the more empirical and tacit language of direct perception. In fact, the spiritual student expects to go beyond even the percept until the nature of pure consciousness is experienced as the source of unity itself.

There is in fact a scientific basis for this perspective of consciousness as the fundamental unifying factor of the universe. This knowledge is found in quantum mechanics. Monastic Idealism emerging from the framework of quantum mechanics provides a basic theoretical perspective and mathematics for explaining both consciousness and matter (Goswami, 1996). The theories of quantum entanglement to explain how consciousness itself divides into a self-reflective process that elicits the material perceptual experience from the implicate order. As the Buddhist doctrine of dependent origination predicts, subject, and object co-arise. The wave form collapses whenever and wherever consciousness appears in the time-space continuum. This theory is no longer just speculation. The math has been done. Experiments have been done. The replications of Aspect's experiments, as reported by Goswami (1995), demonstrating the non-locality of consciousness have been replicated many times. It is interesting to watch many scientists try to deny the proofs of their own methodology when they don't like the conclusions.

Synchronicity and Insight

Carl Jung introduced the concept of synchronicity. He and the physicist, Wolfgang Pauli, began to work out a novel model of the universe based in the quantum perspective. Synchronicity proposes that the universe has non-causal mechanisms that generated physical coincidences out of meaning and insight. It has taken us a century to begin to accept that consciousness is an independent component process of physical

manifestation like gravity. It will take even longer to demonstrate that meaning can elicit physical events. However, this realistic proposal has a scientific theoretical basis. We will have to wait for science to shift its center of focus from the domain of time-space in this corner of the universe to the inter-dimensional realms of dark matter and string theory. Again, the math has been done in these areas. It is not pure speculation.

Clients of AT training cannot avoid synchronicity if they are going to heal. Visualizations related to problem solutions will result in clients discovering more novel opportunities and situations to solve their problem. More "physical" solution spaces will occur. Some of these situations will be a consequence of chains of events set in motion by different responses to social events and contexts. A portion of them will not be explainable from this perspective and will be relegated to the realm of coincidence. The number of coincidences and the specificity of their nature with respect to the client's issue, however, will typically be profound. It does not appear to matter whether clients see these as coincidences or not. It is important that the events be acknowledged as significant and that clients review how they relate to a change in the client's attitude and orientation to their problem and possible solutions. As clients see themselves as capable of initiating novel responses and action that result in solution-oriented outcomes, they begin to experience increased self-efficacy, reduced depression, and anxiety. This response in turn leads to more open perspectives with respect to future problems and defining themselves as typically having multiple options and thereby expanding their perceived repertoire of solutions in general. This outcome results in a considerable sense of empowerment and positive affect. It moves their locus of control from external to a more internal orientation and consequently reduces their sense of powerlessness and frustration.

The Role of Dreams

The visualizations used in AT often migrate into dreams. As clients focus on an image, it may occur in their dreams. When reviewing the dreams, powerful insights regarding the client's feelings can be derived. In addition, the location of the emotional drama in their life can be recovered by consciously reviewing where in their daily life they experience that emotion. This enhancement of self-awareness regarding emotion can also increase their general emotional self-awareness as they begin to more carefully monitor their emotional responses to situations to index the emotions in their dreams. Clients begin to interpret their emotional lives with respect to their dreams, and they begin to interpret the emotional content of their dreams with respect to their daily lives. The two become intertwined and integrated. This process results in a dialogue between the conscious mind and the unconscious mind in a novel fashion. They experience an enhanced sense of integration and centeredness.

The emerging dialogue between the conscious and unconscious appears to enhance the synchronicity in the client's life; the greater the exchange between conscious and unconscious, the greater the level of synchronicity. This outcome generates a sense of empowerment and, even more importantly, a sense of connectedness with the self and with the world. Clear themes emerge from the process. Events appear to line up with these themes. The individual establishes a very real internal connection with an older and wiser component that they had not realized was within them. This aspect of their self seems to have greater resources and appears to have influence upon the world at large. It is not misled by the confusing events of daily life and the razzle dazzle of the chattering rational mind. It reads the most intimate emotional core of the individual because it is part of the individual, yet it can provide commentary and guidance of an apparently transcendent character. It is this very wisdom that appears to guide the world forces around the individual.

It is interesting to note that one of the first things to go in mental disorder is the memory of dreams. Also, of interest is the research that indicates that lack of sleep and dreams leads to progressive disorder. If you don't enter REM, you begin to hallucinate. Although the role of dreams in human life is still under ongoing investigation, it clearly has a more important role than previously entertained by the behavioral sciences. Nature does not waste time on useless processes, and arrogant scientists who rely too religiously on established trends have a long history of missing important insights into the world of nature. Scientific revolutions occur because of this narrow-minded focus that often dominates bureaucratic scientists (Kuhn, 1970). Being dismissive regarding the phenomena of dreaming is progressively proving to be a foolish and naïve position.

It has been observed for some time that as clients heal through the process of NFB, their awareness of dreaming returns, and they begin to remember their dreams. Evidence that dreaming is important for the consolidation of learning goes back to research in the 70s (Wamsley, 2014). There is strong evidence that dreamless deep delta sleep may be critical for physiological learning such as motor memory. The entire dreaming process appears to be related to consolidation and integration of learning. The theta frequencies in the 7hz range have also been found to be involved with the REM process, and midline theta is under ongoing investigation for its important role in waking memory processing (Klimesch, 1996; Kirk & McKay 2003). I have proposed the theory for over two decades that dreams, theta frequency images, and emotions are the basis for a fundamental mammalian process of thinking. The verbal overlay is just an artifact of our social nature as human beings. As it turns out, emotion and memory functions tend to occupy the same limbic networks at approximately different but parallel theta frequency bands (Kirk & McKay, 2003). This process is discussed more extensively in the course on qEEG and related electrophysiology. Theta also dominates the mind of children below the age of 5. As Nancy White (1999) notes and as discussed

in previous sections, this information may be difficult to retrieve in normal waking states. Returning to the frequency where they were formed may assist and be part of the state dependent memory process. The most important point in all this data is that considerable processing takes place in these frequencies before information becomes available in networks involving verbal processing and self-conscious networks in the frontal regions. The consequence is that considerable processing can be held up in these network domains because of emotional trauma.

The research on encoding failures and the failure of memories to bind when formed in situations involving significant trauma is becoming progressively more convincing (Samuelson, 2011). This outcome apparently leads to progressive isolation of network groups that draw on similar sources for processing. This isolation can reduce capacity and begin to generate conflicts in resource management that impedes physiological function. Freud became aware of the importance of dreams in the human psychological process as he began his investigations of the mind and worked with mental disorder. Jung made a career out of dreams. Dreams have a long history of being part of mental disorder and recovery. The Egyptians had the Dendara Temple in which priests occupied private rooms where individuals would come for dream analysis and guidance. The recovery of unintegrated information that was a consequence of trauma often emerges at least in part through the process of REM sleep and dreaming. Clinicians should be prepared to deal with this process.

Crossover Theory and Research

Elmer Green felt that crossovers were a critical component of AT because they often resulted in images providing solutions to problems posed in the AT state. The crossover state tends to produce vivid dream like images that flash before the individual's consciousness like an intense memory. They contain fragments of information that are often key to an individual's recovery and integration. They occur when an individual's alpha activity drops in amplitude, and their slow wave activity, usually theta, increases. If too much slow wave increase occurs, the client slips into stage one sleep, or something that resembles it. For an individual with relatively normal eyes closed EEG distribution, the alpha drops and crosses over theta when looking at a trend or session review screen. The theta often increases a microvolt or so, while the delta tends to increase as well but not to the point typical in sleep. The theta then returns to a more normal amplitude and alpha begins to increase again.

The drop out or sudden reduction of alpha amplitude, when it occurs, is fairly rapid for most individuals. There is an initial decrease in alpha frequency from the normal range 9.5 to 10.5 into the 8hz range. Most individuals cannot remain conscious during this brief period of alpha frequency reduction and quickly slide into stage 1 sleep. Practiced meditators, however, can maintain consciousness at this frequency range, but

they begin to move into an altered state that is typical of meditation. This region of neural functioning is what AT targets, but most people can only remain in this region of functioning for brief periods and are only marginally conscious. Instead the average person shifts in and out of this region closer to the border of stage 1 sleep, which is closer to a trance state, but they are in and out of self-awareness. Clinical experience indicates that the level of self-awareness is related to alpha, as Green surmised. So, he called the alpha that pushed people back out of stage 1 and into consciousness every time they became self-aware again "paradoxical alpha."

As we have mentioned, it is this shifting in and out of alpha while dipping into stage 1 sleep that generates the hypnogogic images. Not everyone has them, especially if they are having no dreams that they can remember—which is a common feature of mental disorder. What Elmer did not mention, is that some people have hypnogogic smells, sensations, or emotions instead. These fragments of sensory memories have not been integrated into one memory and consolidated as a conscious explicit memory. These memories tend to be disconnected from their emotional components because they have never been fully formed and "tagged" with emotion by the hippocampus. Joseph LeDoux (1996) uncovered this part of the physiological process of memory formation and integration in his research on the amygdala.

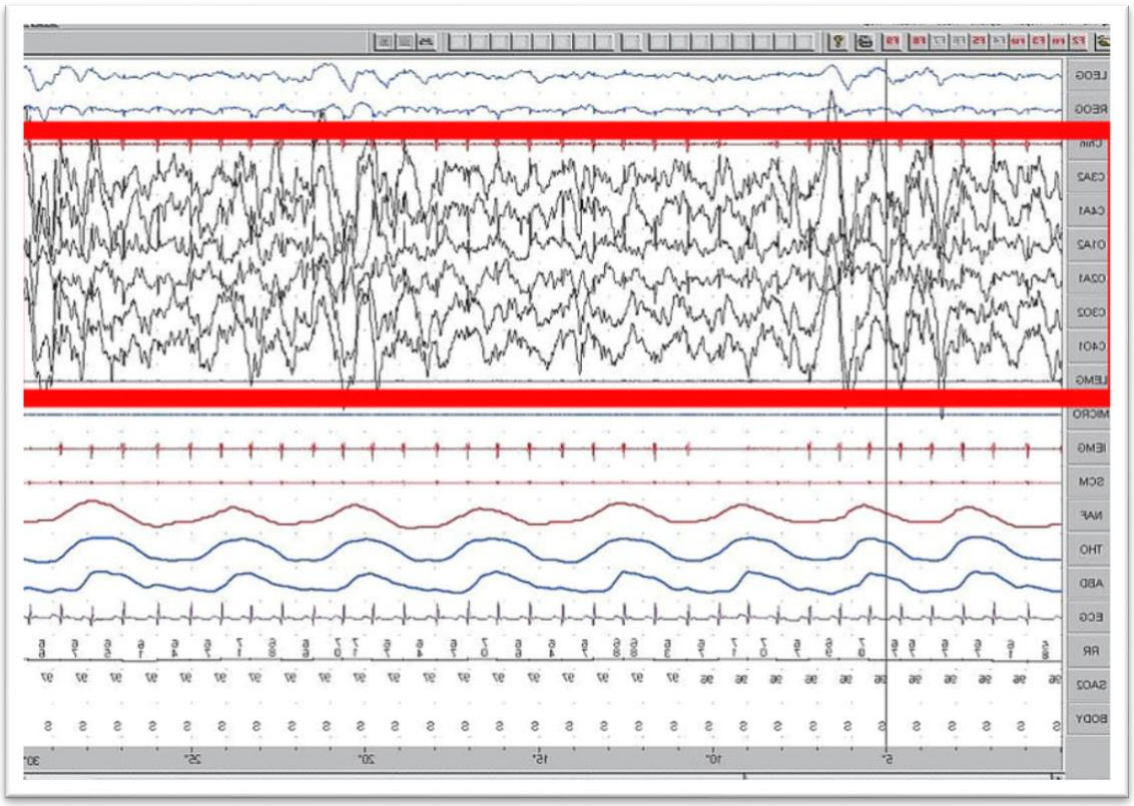

Figure 52 EEG morphology as the brain shifts into sleep

Individuals with abnormal distributions like that shown in Figure 52 often have a very different pattern of "crossover" that initially confounds most therapists. For some people the layering of the EEG can be inverted with beta on top, then alpha, then theta, and finally the beta frequencies. "How can they have a crossover if the alpha is already below the theta?" is the typical response of clinicians learning this process. For individuals with this pattern the same principles seem to apply, but they appear differently. The alpha still drops out, though often not as dramatically, and theta increases mildly while beta remains relatively the same. If they enter stage 1 sleep, then delta increases as well. In this case there is no official crossover to be observed, nevertheless the shift in consciousness is similar and hypnogogic images occur. In general, with most trend screen distributions of EEG, the alpha dropout with increased theta continues to define the AT crossover pattern.

In Figure 53 Entering sleep the alpha is lower at the outset than delta, likely due to a TBI, and almost the same in amplitude as theta. There is a clear drop in alpha until around minute nine when both theta increases slightly along with delta. This result is the only indicator of a crossover, but the basic pattern holds regardless of the relationship or layering of the various component band frequencies on the trend screen at the outset.

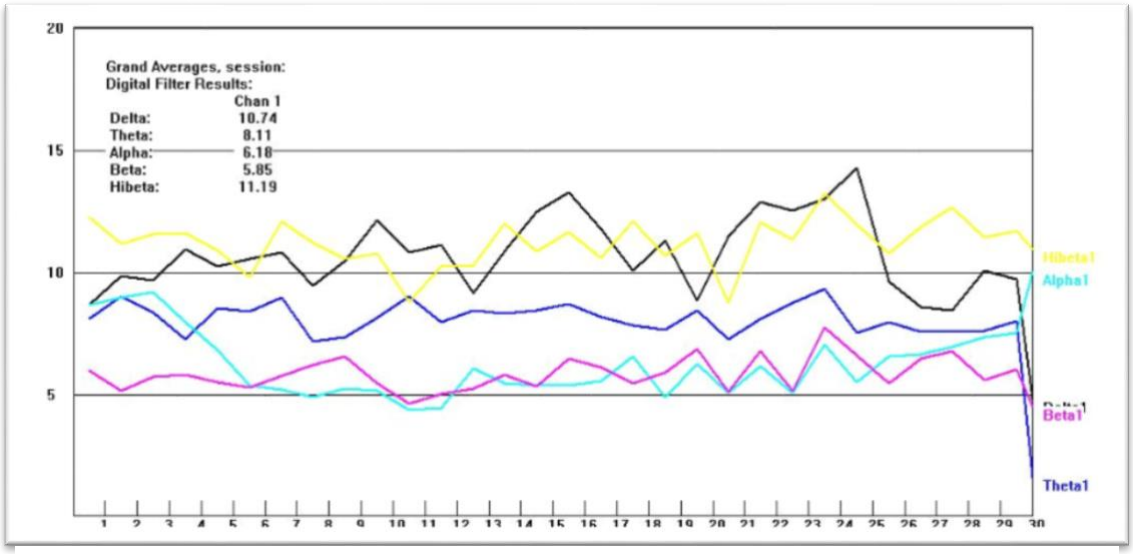

Figure 53 Entering sleep

It is good to be clear on the standard definitions of sleep stages as it helps to assess the clients state during a training session.

Stage 1

Stage 1 is the beginning of the sleep cycle and is a relatively light stage of sleep. Stage 1 can be considered a transition period between wakefulness and sleep. In Stage 1, the brain produces high amplitude theta waves, which are very slow brain waves. This

period of sleep lasts only a brief time (around 5-10 minutes). If you awaken people during this stage, they might report that they weren't asleep.

Stage 2

Stage 2 is the second stage of sleep and lasts for approximately 20 minutes. The brain begins to produce bursts of rapid, rhythmic brain wave activity known as sleep spindles. Body temperature starts to decrease, and heart rate begins to slow.

Stage 3

Deep, slow brain waves known as delta waves begin to emerge during stage 3 sleep. Stage 3 is a transitional period between light sleep and a very deep sleep.

Spontaneous Visualizations

Visualizations can be as valuable as hypnogogic images in AT. Moore et al (2000) investigated crossovers using percent of time the two frequencies converged. This result can be misleading, especially if averaging time is short and quick swings in amplitude in alpha and theta are measured. Particularly interesting is their observation that crossover did not involve an increase in theta and a drop in alpha, but rather no change in theta and a drop of alpha below theta. They found this result consistent with the literature on sleep and EEG and the phenomena called “alpha drop out” (Niedermeyer & Lopes da Silva, 2005). This result is also consistent with our clinical observations as well. In addition, they found a significant number of subjects failed to have hypnogogic images, but clients found themselves in spontaneous self-guided visualizations that were highly pertinent to their concerns. These images often lead to valuable therapeutic insights. Based on these findings, it would seem a good strategy not to designate hypnogogic images as the only valuable feature of AT training with respect to crossovers.

The Standard Alpha Theta Method

Figure 54 on the next page is a review or trend screen of an AT session. It is a classic pattern in that alpha first increases, and then begins its descent until it crosses over theta in the first third of the session—usually between seven and 12 minutes. Alpha then increases in power because of the paradoxical alpha response and the individual often experiences a hypnogogic image. The alpha then begins another descent with multiple short crossover events that generate an appearance of alpha and theta intertwining. Then another burst of paradoxical alpha appears, and so the pattern continues. This pattern eventually emerges after multiple sessions; it may take 15 or twenty to achieve it. The first crossover may often take seven or more sessions. The more trauma there is, the more likely crossover is delayed in its appearance.

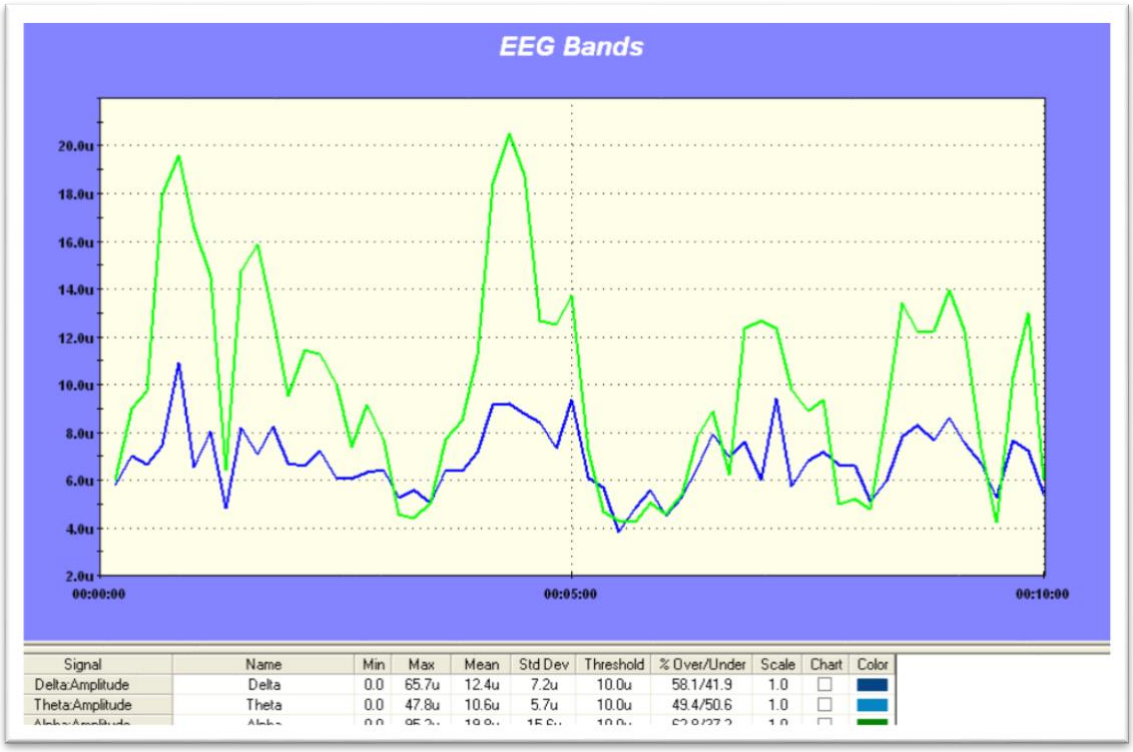

Figure 54 Trend screen of an AT session

The Design Screen

Figure 55 shows a generic design screen with the component bands displayed as bar graphs. Adam Crane built and distributed the first NFB equipment designed exclusively for AT training. Bill Scott, however, was the primary researcher in the field and working with Eugene Peniston eventually defined the standard settings for a modern AT design screen. This design incorporated more than alpha and theta in its implementation. Delta and beta played a role as well. Bill found many clients came into his office with excess beta because they had too much chronic hyperarousal of the CNS. Most clinicians at the time did not have access to qEEG and relied on these types of observations to guide their protocol selection. He set his beta filters to down train the beta frequencies to help these clients to initially calm down, and then he turned off the feedback on it once they achieved crossover. The alpha filters were set at 8 to 10hz to encourage the production of lower frequency alpha that would lead more easily to theta production. Theta was set at 5 to 7hz. Delta was set at 2-4hz to reduce abreactions.

Bill related to me that when he was working with a Native American group on their alcohol addiction, he found that they would have intense emotional abreactions due to PTSD that they seemed to universally experience from childhood abuse. They also frequently fell asleep during sessions due to the lack of good sleep. His idea was to inhibit delta to try and keep them more alert. What he found was they had less abreactions and consequently incorporated the delta inhibit permanently in his method.

Bill was devoted to the idea of a painless process. We, on the other hand, found abreaction was an important part of resolving trauma. Our response was a compromise and to initially use delta if individuals displayed the abreactions common to severe PTSD, but we later turned off the feedback from delta as clients progressed. For us the goal was to just utilize alpha and theta as the original research had indicated.

Note in Figure 55 this individual has beta below threshold, so we turn off the beta. The alpha is initially well above threshold. Theta is much lower, with the theta tone only periodically present. The client is listening and feeding back primarily on the alpha tone. In time, as mentioned above, the client begins to experience less and less alpha amplitude. Theta begins to increase as shown in the Figure 56 on the next page.

Eventually the theta dominates and delta begins to increase. Paradoxical alpha then emerges, and the state of the design screen will flip back to the original pattern indicating a shift in arousal based in fundamental attractor basin patterns in the EEG network fields. A successful session will show many of these shifts.

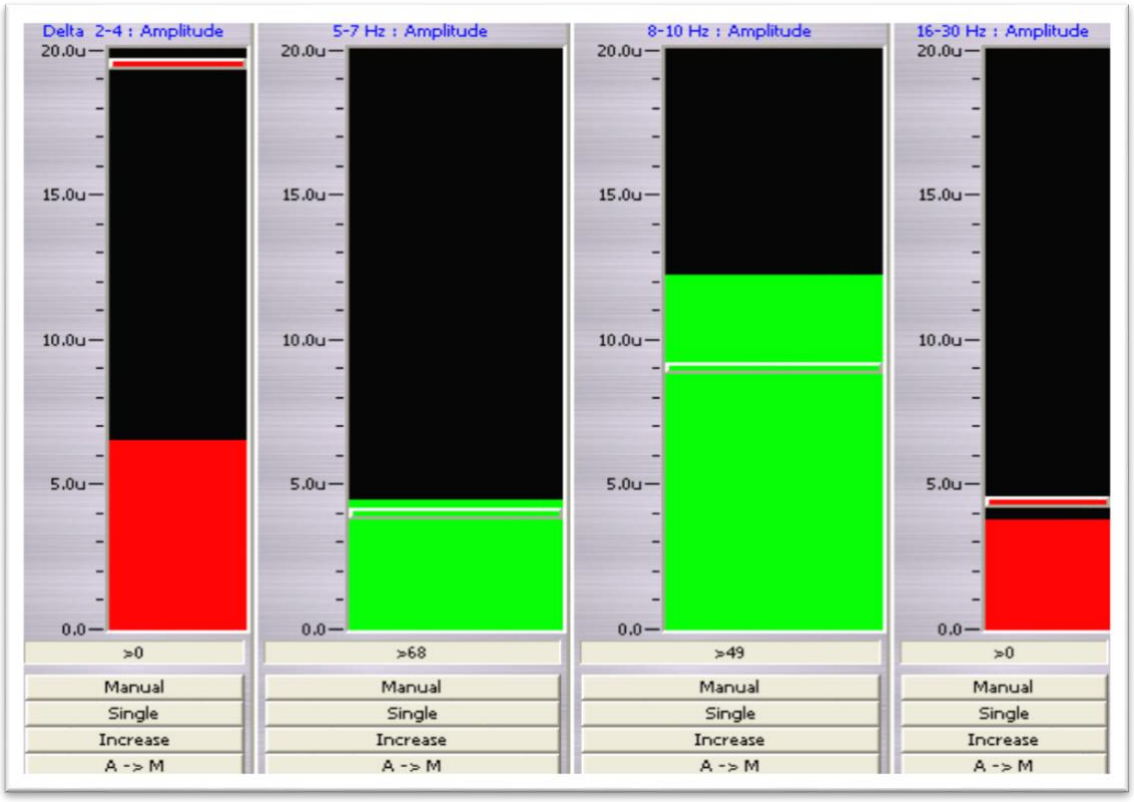

Figure 55 Design screen - initially low beta, high alpha, low theta

Setting up this screen correctly is very important. Using auto threshold to set the initial threshold patterns is one of the easiest ways to start. With alpha set at 70%, theta set at 40%, beta and delta set at 10%. The client closes his eyes; his EEG levels are recorded, so that the thresholds find the correct levels of reinforcement. After this two-minute

baseline, the session is paused and taken off of auto threshold. The resulting threshold levels will remain the same for the rest of the session. What you have done is individualized their thresholds for the entire session.

Figure 56 Theta begins to increase

Sensor Placement

Figure 57 is a picture of the 10/20 coordinate system for EEG sensor placement. The original work by Elmer Green was done at O1 in the occipital region. This location was selected because Elmer's research indicated that this location showed the most unique response during the state he called crossover. They found this state to be most conducive to creative insight. Peniston, however, began to experiment with O2 and Oz during his research with veterans with PTSD. Clinicians, based on this research, began using all these sites. Bill Scott eventually moved to Pz, with Peniston's blessing, because the Native Americans kept knocking the sensor off their

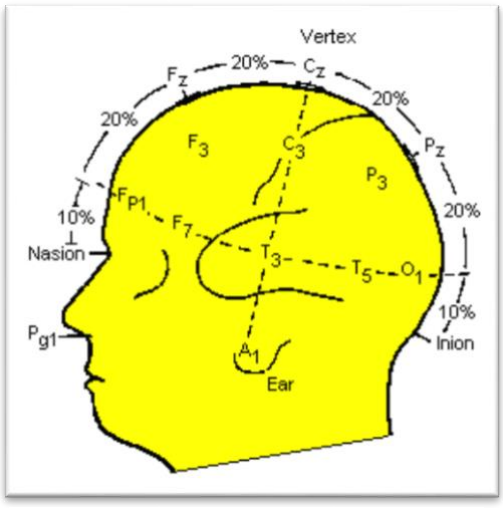

Figure 57 10/20 coordinate system for EEG sensor placement

head when they laid back against the recliner during their sessions. Things still seemed to work well so many other clinicians followed suit. As time went by, Nancy White, who was a major early innovator trained by Adam Crane, decided to use P4 because of research published about the relationship of that area to a sense of expanded self-awareness by Dr. Andrew Newberg in 2001. Matthew Kelly was also doing research with AT with Native Americans. He did his training at Cz and found he had good results as well. Clinicians continued to innovate in all these locations. So where to best place the sensors? There is no research available to sort this out. There is, however, extensive shared clinical experience.

The prevailing clinical opinion is that it is best to train individuals with excess delta or theta in the posterior regions so as not to inadvertently generate too much frontal slow wave during sessions. This result is also one of the reasons for doing initial fast wave training before AT training as well. Individuals with too much beta, on the other hand, may benefit from some more frontal slowing to calm them down faster, so Cz may be a good placement for them. We have found many individuals with excess high amplitude alpha often have difficulty with crossover at Pz, but they are able to do well at Cz. Of course, these decisions are based on the qEEG brain maps. It does not hurt to move around to find what is best for each client.

Dealing with Abnormal EEG Distributions

A significant portion of your clients will come into your clinic with significantly abnormal EEG distributions which make it seemingly impossible to recognize or achieve a crossover on the trend screen. This trend was confusing to everyone at first, but eventually Bill and I sorted it out. Bill had the brilliant idea to "follow the alpha." Barry Sterman (1996) wrote an article describing what happens to the waking EEG distribution as individuals shift into sleep. Everyone has the same basic pattern, but it becomes distorted by emotional and physical trauma. This distortion is why many people have sleep problems. The previously described descent of alpha in amplitude and frequency as we transition into phase one of sleep is key to this pattern. The other key indicators are increasing theta and a sharp increase in delta occurring at the same time as alpha reaches its nadir. Unfortunately, many individuals with head trauma have already elevated delta: people with ADHD have elevated theta, and people with severe PTSD have elevated beta. This reality makes it difficult to look for the standard pattern of changes in the trend screen.

To begin with let's look at someone falling asleep (see Figure 58 on the next page). First, the alpha rises and then begins its descent in amplitude. As it reaches a low point around 7 minutes, theta and delta begin to increase with delta showing a very dramatic increase in amplitude. These patterns are characteristic of a rapid movement into stage 1 sleep. Note that the high beta, which represents muscle tension, or bracing as we call

it in biofeedback, also declines significantly at this point to the normal level of 3-5uv. Individuals with PTSD tend to show either no decline or an increase in this high frequency activity. They involuntarily brace as they reduce their vigilance level and let their guard down. This low amplitude EEG can be seen by the distribution of the first 7 minutes, but slow wave amplitude increases to over 15uv during stage 1. Note the increasing theta as the stage deepens.

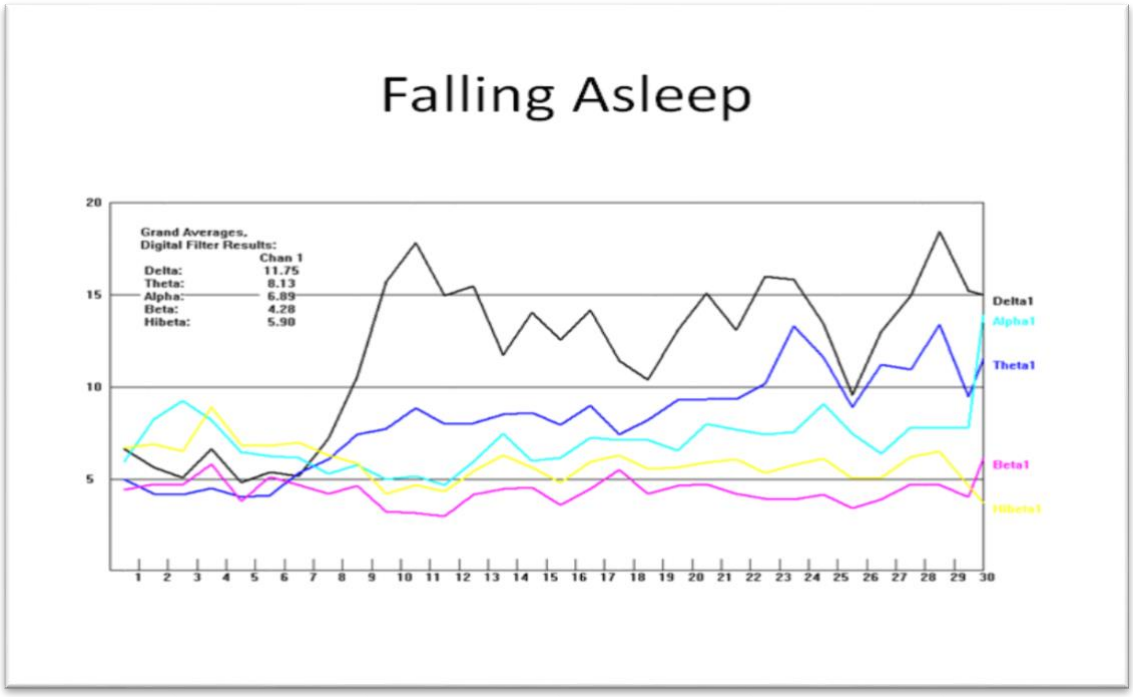

Figure 58 Falling asleep

Another common pattern is crossover adversity due to emotional trauma (see Figure 59 on the next page). Again, this pattern is common with PTSD. This individual also has low power EEG, but the alpha is beginning in normal range around 12uv. It slowly descends until it touches theta around minute 12, but it climbs back up and remains above delta. This individual suffered childhood trauma and was recovering from alcoholic behavior. The reluctance of the client to enter crossover is involuntary. Note high beta starts elevated around 7 or 8uv and diminishes to 5uv, but it begins to increase with alpha amplitude. Alpha represents conscious awareness in this paradigm.

This same client experiences a crossover during the 7th session (Figure 60 on the next page). The seventh session is noted in the original literature as a typical point for first crossover when dealing with significant emotional trauma. Note the crossover is again around minute 12 and is very brief with an immediate increase in alpha indicating the client shifted in and out of self-awareness for a moment. It was typical for this client to demonstrate an involuntary exaggerated startle response just as he approached

crossover. This response is related to his resistance to experience and integrate the emotional trauma. We eventually had to enroll the assistance of an EMDR therapist to get past this point, which was unusual but does on occasion happen with severe cases.

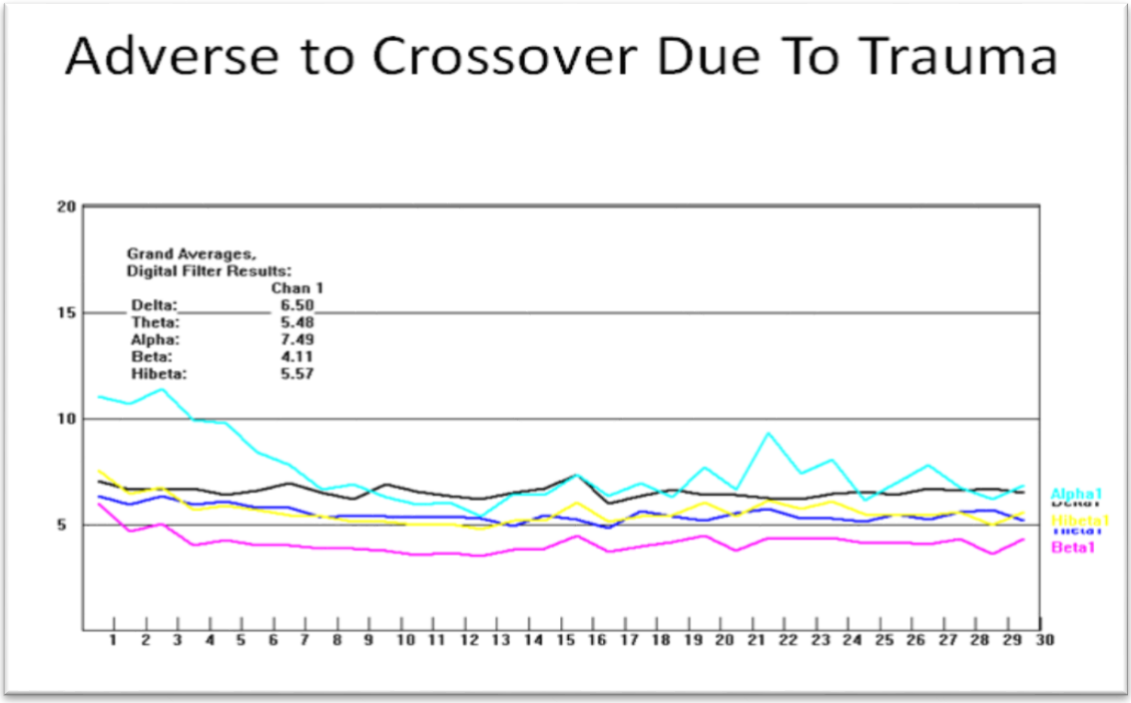

Figure 59 Adverse to crossover due to trauma

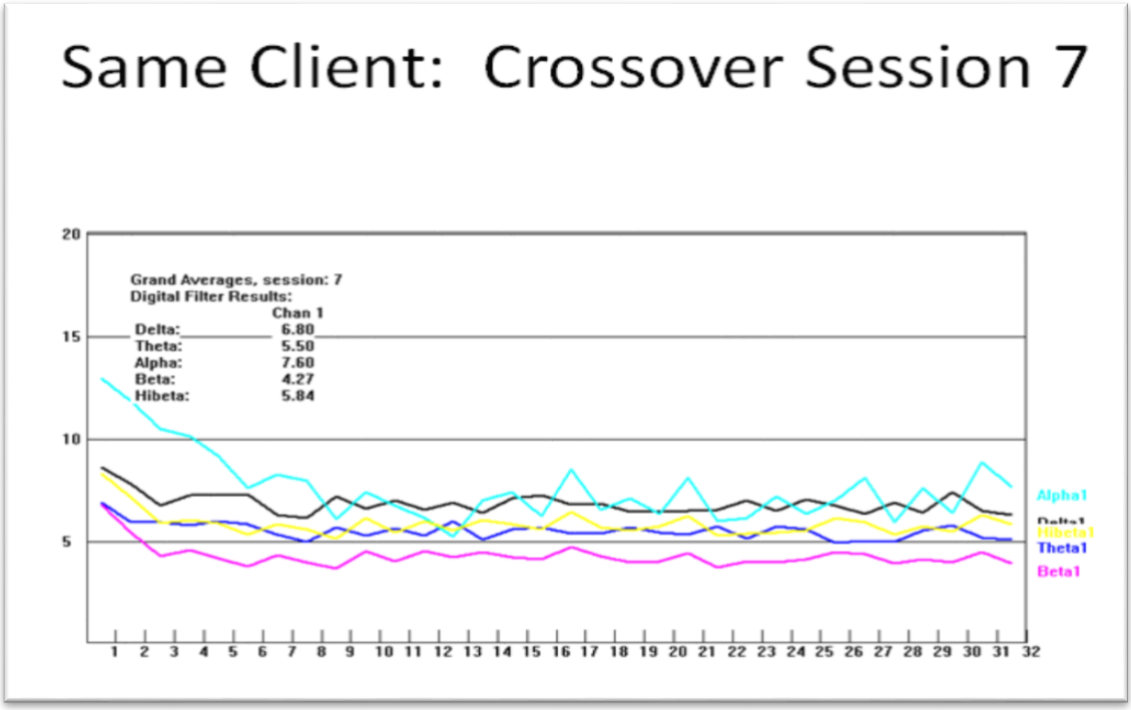

Figure 60 Same client: crossover session 7

The next example (Figure 61) shows and individual starting in the normal range with delta, theta, and beta but a very high alpha. In the 20uv range this example is at least one standard deviation too high. On this client's brain map we could see that the dominant frequency was in normal range. They had a strong beta asymmetry, so we know that this person had metabolic issues relating to anxiety. They also scored very high in the ISI in dimensions of anxiety but low on inhibited, impulsive and perfectionism, all common features of chronic psychological anxiety. Note the high amplitude of high beta around 9uv indicating intense bracing.

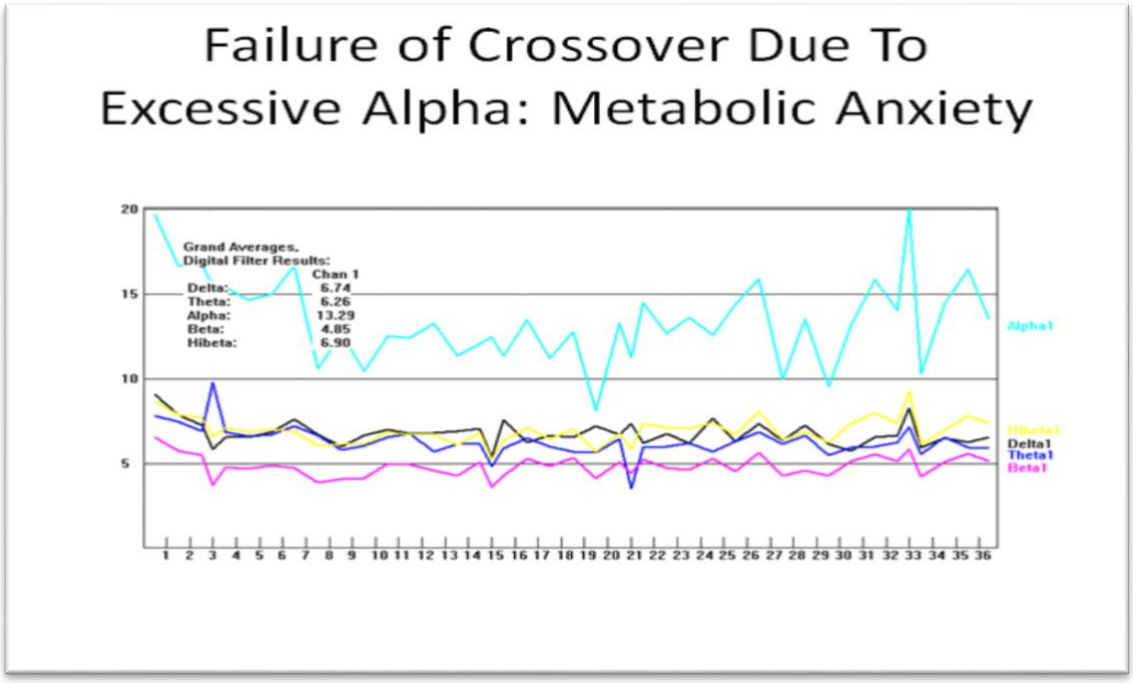

Figure 61 Failure of crossover due to excessive alpha: metabolic anxiety

These individuals often experience a physiological anxiety due to exposure to industrial toxins or molds. They have large regions of networks idling but not desynchronizing into functional activity because there is insufficient mitochondrial energy to run the sodium pumps due to exhaustion. Extreme sleep deprivation and physical agitation are usually common with this profile as well. The alpha does come down in this session. Unfortunately, we see no significant increases in theta or delta. No crossover experience is accessible in this case. Sometimes we use photic stimulation in the theta frequencies to assist in increasing theta, but the individual should have a hair analysis for heavy metal or aluminum detection and possibly and organic acid test to look for mold or fungus.

The next case (Figure 62) is like the last except in this instance we know from the metabolic checklist and lab reports that this individual has low TSH and especially low thyroid T3. These levels result in a lack of available T3 for enzyme production and

consequently a diminished efficiency of sodium pumps according to the literature. It leads to excessive network idling resulting in diffuse high amplitude alpha, but this time it is slowed alpha with a slow dominant frequency between 8 and 9hz. Photic stimulation during the session might help, but thyroid support may also be important.

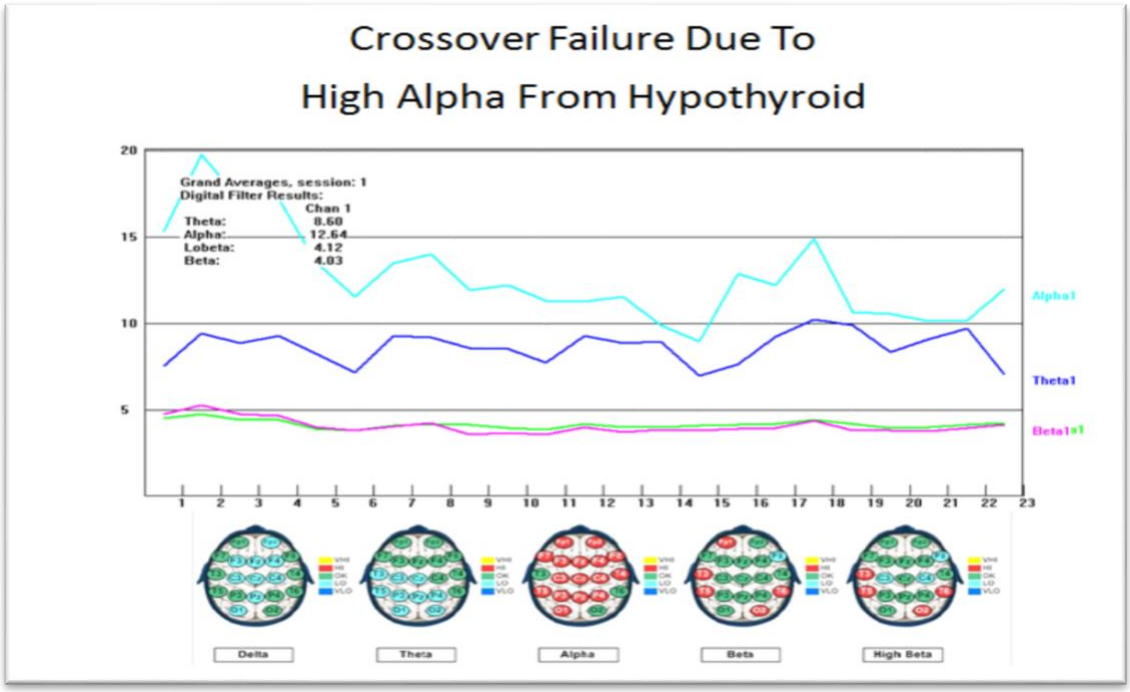

Figure 62 Crossover failure due to high alpha from hypothyroid

Note that in the next session trend screen (Figure 63 on the next page) we utilized photic stimulation at 7.8hz and were able to precipitate a crossover event. The client also reported a hypnogogic image which confirmed our success. We have several other documented cases where this approach was very effective.

The next client is a classic map found in individuals showing many of the features of ADHD (Figure 64 on the next page). Excess elevated diffuse theta suggests globally diminished cortical blood perfusion. This happens when oxygen is low as well, except alpha is also usually elevated in that case and somewhat here as well. Note that posterior beta is elevated, indicating significant rumination activity typical with anxiety and developing depression. Neither the alpha goes down nor does the theta increase showing no crossover. However, if alpha had declined significantly and the theta increased at the same time, then we would suspect a crossover event.

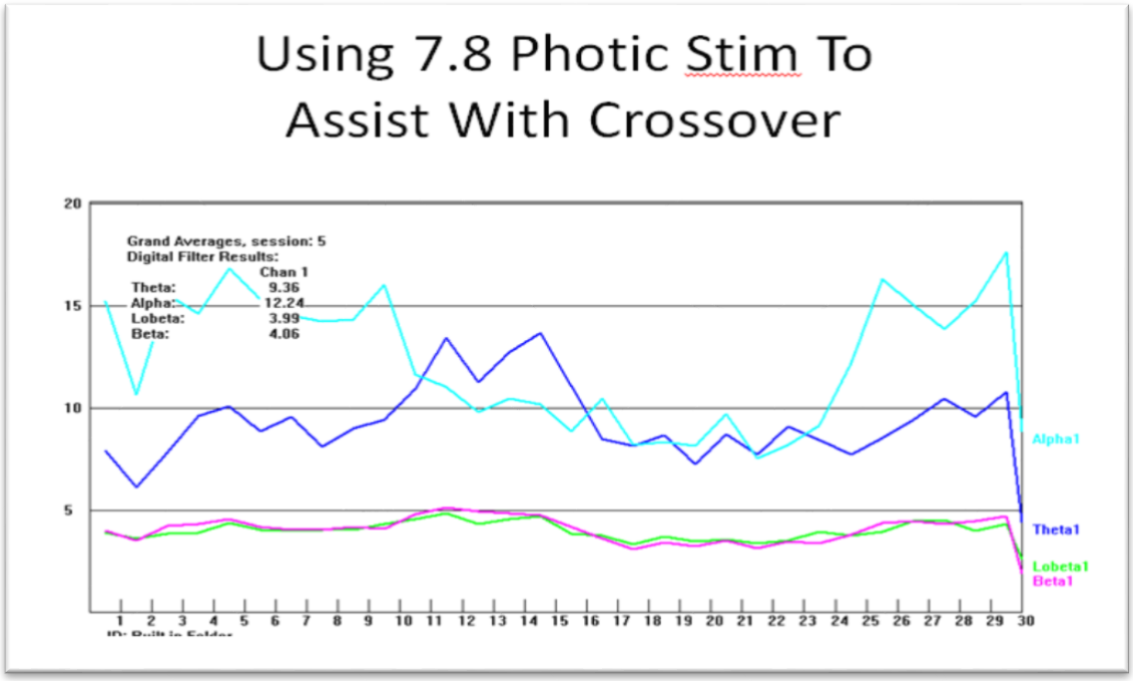

Figure 63 Using 7.8 photic sim to assist with crossover

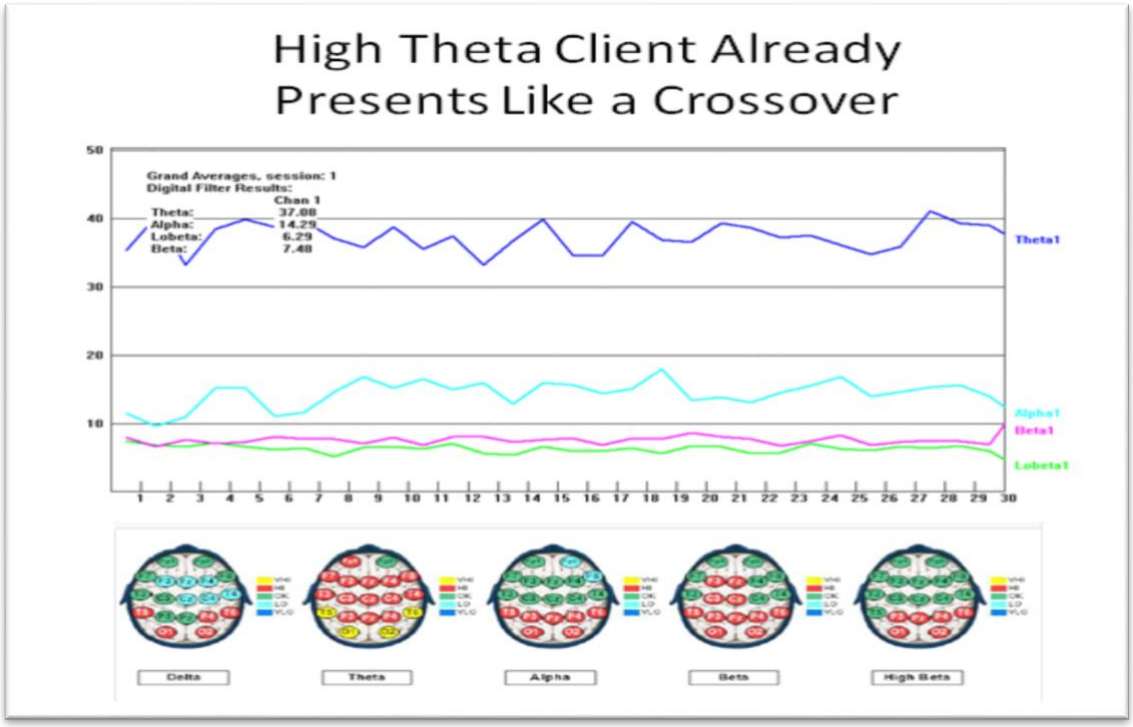

Figure 64 High theta client already presents like a crossover

The next case is a good example of this phenomenon (Figure 65). This is a typical profile of an individual with head trauma, and the elevated delta is a proxy indicator of underlying inflammatory process. There is very elevated amplitude of high beta. This elevation could only be possible if the individual was clenching his jaw tightly. Alpha and theta begin at almost the same amplitude. Note that alpha goes very low between 7 and 11 minutes. Theta and delta show simultaneous increases. Note also the mild decrease in high beta and muscle bracing. This likely crossover could be confirmed by asking the client about hypnogogic images.

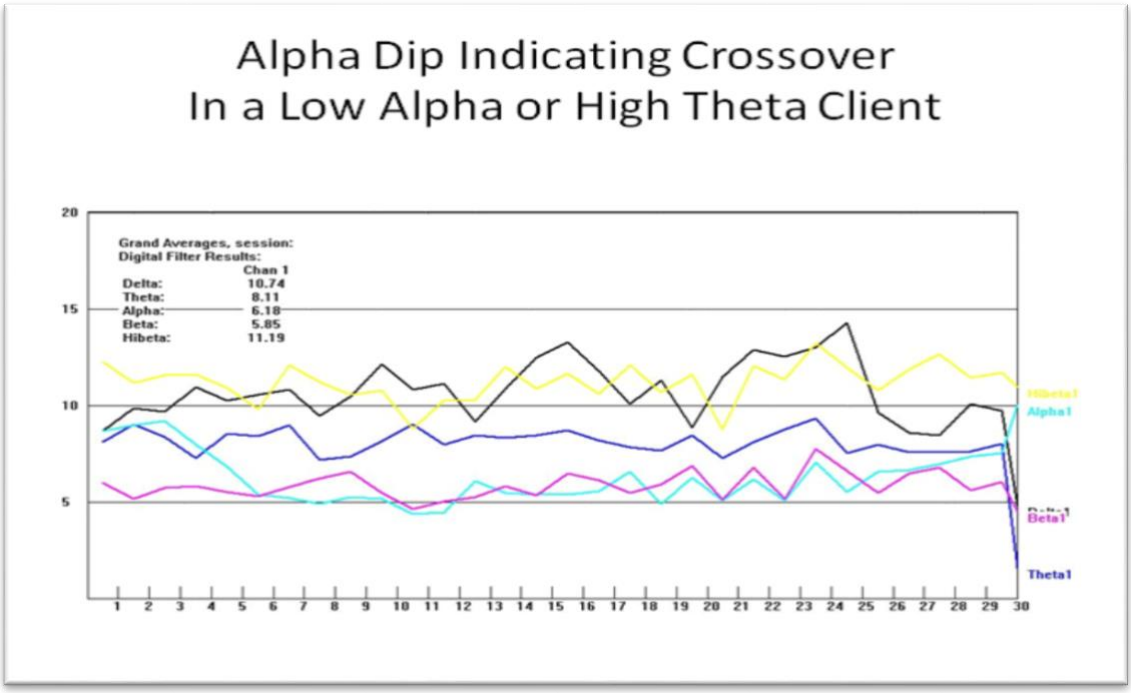

Figure 65 Alpha dip indicating crossover in a low alpha or theta client

In Figure 66 (on the next page), we can see that we are starting with higher than normal delta and alpha descending from 10uv to around 5uv with a drop in high beta, no change in delta, and theta increasing only before and after the drop. No crossover with theta. Finally, around minute 29 and 34 we have very brief but superficial crossovers.

The next example (Figure 67 on the next page) shows high beta that could only issue from chronic jaw tension related to TMJ and no changes in theta and alpha that would indicate a crossover even though they do crossover due purely to the fact theta they are so close in amplitude. These patterns would be false crossovers. Note also that the very high amplitude beta is an artifact of filter skirt leakage of high beta frequencies into the beta frequencies due to signal processing artifact. This beta is not real.

Finally, we see an optimal session with multiple crossovers occurring after this client had 30 or more AT sessions.

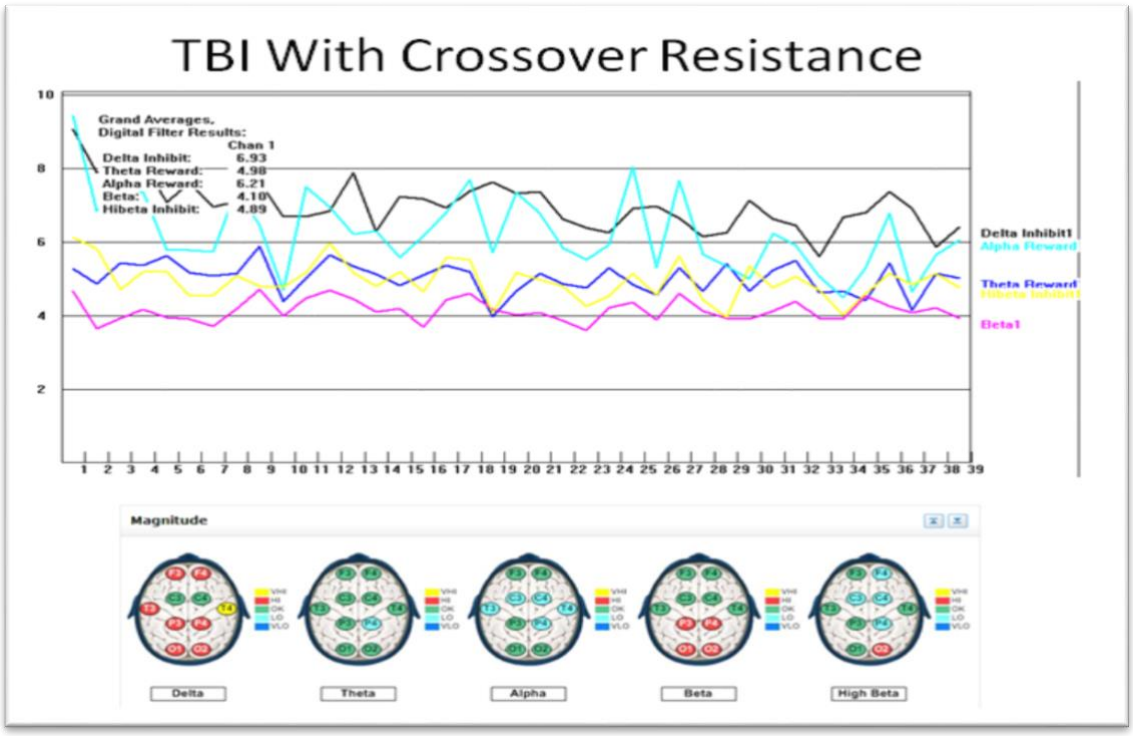

Figure 66 TBI with crossover resistance

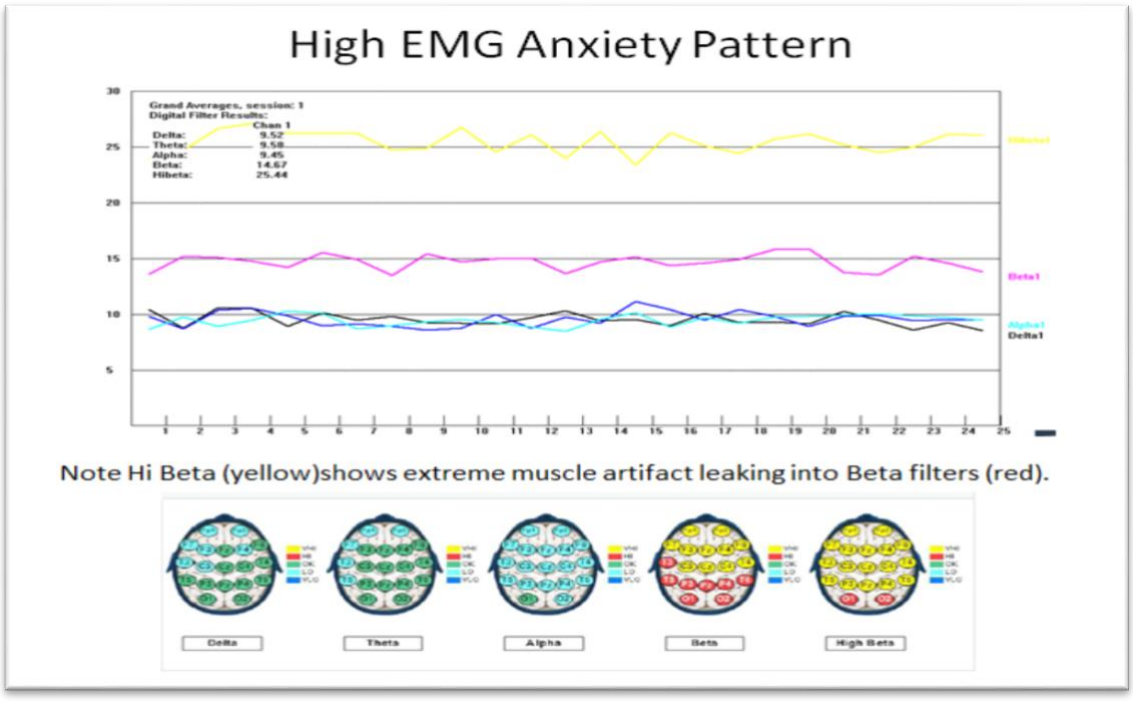

Figure 67 High EMG anxiety pattern

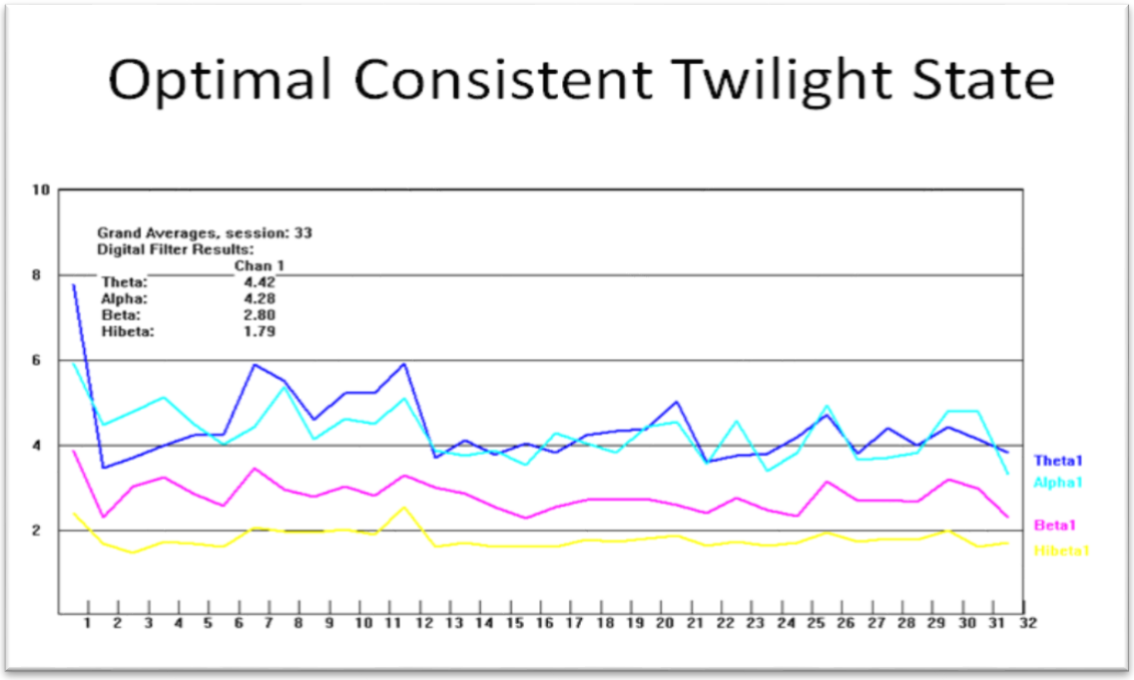

Figure 68 Optimal consistent twilight state

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Chapter 10: A Psychology of Neurofeedback

This chapter provides an integrated theoretical perspective of psychology that can be used in conjunction with NFB. It is derived from decades of teaching, research, and direct clinical experience.

Psychological Theory

This theory is based in part on traditional theories taught in psychology today, yet it is tempered and guided by findings in contemporary electrophysiology and neuroimaging. This theory is shaped by social psychological and sociological considerations. It is interdisciplinary in nature because in order to perform well in NFB, information from a variety of fields is required. The health field in general is presently moving in that direction and recent models being proposed in some medical journals reflect this emerging trend (Shonkoff & Garner, 2011). The difference between this new medical paradigm and NFB is that NFB is emerging from the tradition of an operant conditioning model in behavioral psychology and not from the medical school models of medicine. The two are responding to new insights in the field of healthcare along with emerging wellness models, and the increase in chronic health problems in the population. Obtaining optimal results in the clinical setting with NFB has forced us to look at confounds outside the operant conditioning setting and expand our model of variables that require management to obtain optimal results.

The New Mind System is the culmination of this theoretical perspective and stands as a statistical support for its validity and justification for its implementation. It combines a metabolic questionnaire, socio-emotional questionnaire, a cognitive questionnaire, a qEEG map, and cognitive testing to confirm findings in the cognitive component of the system. It is an integrated multidisciplinary system for assessment. It has emerged in response to clinical needs associated with successful outcomes in NFB at the request of clinicians utilizing it. It is the product of multiple weekly meetings with clinicians over a period of eight years and at this point involves over 500 participating clinics. It has an optimal clinical interface because the participants are continually redesigning it for ease of use through a form of selective crowd sourcing.

The database contains over 200,000 subjects and is growing exponentially. It was designed for research as well as clinical work, and we are currently participating with many research projects. Presently we are working in partnership with the UNC Greensboro Department of Counseling. The research component is specifically designed to enhance the quality and efficacy of the database system and consequently does have limits with respect to its utility outside the system. These limits are in part due to the proprietary nature of the database norms. However, this private model of research and development has allowed us to rapidly implement and test findings at the clinical level. These findings can then be confirmed through public research projects, as well using the

slow and methodical methods of the research bureaucracy. In the meantime, the field moves rapidly forward, and suffering people begin to recover. This model also challenges other vendors and researchers in their assumptions and in their implementations of the technology. It keeps them oriented toward the needs of the clinician and not the narrow interests of the isolated research community.

Social context has a profound effect on human behavior as it elicits responses and shapes them whenever the individual is engaged with other people. Successful social interaction is a function of learned and practiced responses and perceptions. Determining the strength and weaknesses of social interaction patterns accurately can provide feedback to individuals regarding what areas of social behavior are producing friction and conflict for them and undermining their relationships. It can help them determine what areas of social interaction require increased awareness from them and what goals they can focus on during specific interaction activities. For instance, individuals with high levels of perfectionism are often excessively controlling in key areas of their relationship. This control is usually in response to anxiety based on fears and concerns of possible negative outcomes. This controlling behavior can frequently undermine negotiations with others when mutually determining lines of action toward a future goal and increases friction and conflict in their lives.

By identifying this problem area, people can begin to focus on situations that inspire controlling behavior and begin to compensate for it. As they produce successful outcomes, their locus of control moves from being a possible victim to being an effective actor who can institute changes without suffering excessive conflict. NFB tends to reduce anxiety as well as increase awareness. When NFB is used in conjunction with this type of assessment and focus on problem behaviors, novel and more effective behaviors tend to emerge. Individuals begin to develop and learn new strategies and responses that make them more successful in social relations.

The ISI was developed to assist in this uncover and discovery process. The ISI is used as part of our assessment in our database system and was built specifically to be correlated with qEEG findings. It was constructed using decades of research findings correlating EEG with behavior. It is based on the theory that anxiety and depression are ubiquitous components of mental disorder, and that anxiety is the key dimension underlying all disorders. This concept is not necessarily new, but it is a radical departure from the present psychiatric model based on the narrow and flawed findings of the drug companies which define the field. Most of their research has been proven to be fatally flawed and up to 70% of their findings are highly questionable (Ioannidis, 2005). Part of this problem is due to the failed implementation of the double-blind study—aptly named because it doubly blinded the research community and the policy makers. The traditional model of psychiatry also saw anxiety as the key underlying dimension of

mental disorder prior to the advent of the presently confused research disorder (Healy, 2004). Our research and clinical experience fully supports this perspective, and it is the basis for our entire assessment system.

Anxiety and depression reflect fundamental states of the CNS when reviewing the past research in psychology and electrophysiology (Davidson 1995, Heller, 1997). The basis for this theoretical perspective appeared first in Nunez's (1995) first book on neocortical dynamics. The model proposes that disorders occupy a continuum ranging from extreme states of arousal dominated by hypocoupled slowing in the EEG to hypercoupled fast wave activity. The slower states reflect disorders such as MCI, ADHD, lesions, and negative schizophrenia while the faster states are characteristic of OCD, mania, and positive schizophrenia. This EEG spectrum theory is supported in part by earlier findings by E Roy John (1988) using qEEG neurometric analysis in which he finds such patterns and additionally discovers multiple subtypes within many of the diagnostic categories. These findings suggest that the categories are very fuzzy and should be re-evaluated. Within the field of NFB, Siegfried Othmer took notice and wrote and lectured fairy extensively on the value of looking at disorder from this perspective.

Around the same time Othmer's position was being elaborated, Richard Davidson published his results from years of investigating the relationship between depression and EEG. His findings indicate that the tendency to display withdrawal behaviors associated with depression is highly correlated with left hemisphere slowing as measured by increased left hemisphere alpha (Davidson, 1995). Davidson proposes a theory of affect regulation based on hemispheric activation. This dynamic resulting in either approach or withdrawal behaviors, as defined by Richard Davidson, ultimately determines the level of successful participation in social activities. Peter Rosenfeld and Elsa Baher (1997) followed up on this research with their own findings that training alpha asymmetry with NFB could significantly reduce the symptoms of depression.

In contrast to Davidson's research, Wendy Heller (1997) published her findings regarding the relationship between anxiety and beta asymmetries. Her findings indicate that elevated beta in the left frontal region and right frontal region correlate highly with the symptoms of anxiety. Left frontal beta correlates with worry and right frontal beta correlates with physiological symptoms associated with anxiety as well as tendencies toward panic. Alan Shore (1994) notes that the primary norepinephrine pathways associated with fear are found to be dominant in the right hemisphere. Joseph LeDoux (1996) finds that similar dominance in the right amygdala is especially associated with fear responses. This trend in research findings suggests a model of hemispheric dynamics that reflects the development of anxious and depressed states that are so often a basic feature of most mental disorders.

As I have argued, successful participation in the social order is one of the keys to being rewarded with access to resources to thrive. Those with good asymmetry patterns are more likely to engage in approach behaviors that result in social rewards while those with poor asymmetry patterns are more likely to withdraw from positive social interaction. These patterns of approach and avoidance are driven by prior socialization that organizes perception and responses to the environment at the emotional and cognitive level resulting in various levels of social accuracy. A third contributor to psychological disorder however must be recognized. This contributor is the impact of physical and emotional trauma on specific structures of the brain that fundamentally alter its ability to process effectively.

The Impact of Emotional Trauma on the Psychophysiological Realm

Any event that degrades neural function results in either transient or permanent behavioral disorder. By disorder, I mean aberration of the typical patterns of behavior that support social norms and mores. Traumatic events are a major source of the disruption of neural function. When sufficiently severe, the stress of daily life becomes a toxic stress (Shonkoff & Garner, 2011) and has a similar effect on the brain as severe emotional trauma which may come in the form of an event or series of events. There is a parallel in physical terms when we talk about multiple sub-concussive events having the same impact as a single concussive event (Shruti, & Faden, 2014; Wang & Michaelis, 2010). Research over the last decade indicates that these different kinds of events have similar consequences and result in inflammation and lesions although the pathways are slightly different for the brain. This causality has been invisible in our society until recently. The consequences of this invisibility have resulted in inflexible policies that have aggravated and compounded the problem. Healthcare coverage has been generous for one and not the other. These invisible causal sources of functional loss frequently result in disorders and aberrant behaviors. As a society, we have been reluctant to acknowledge this problem.

The NFL is one of the more highly visible areas where this problem has occurred. Concussions occur frequently in the NFL and multiple sub-concussive events are relentless for football players. Autopsy studies over the last decade have shown permanent damage that continues to escalate long after the initial traumas. Growth of proteins known as Tau proteins in response to the traumas culminates in lesioned areas of the brain—especially in the posterior temporal regions—that profoundly reduce the ability of these individuals to conduct themselves in social situations in a successful manner (Shruti, K, & Faden, A.,2014). The NFL fought for years to deny the legitimacy of these studies and other more recent studies for fear of how it would impact the sport. Most sports fans were reluctant to consider the issue as well. Football is an American institution and deeply embedded in the rituals of our national life. Eventually, however,

the scientific data became overwhelming and many of the institutions are beginning to adjust.

Unfortunately, this acknowledgement of the unseen impact of social events on the brain is even less common in the case severe emotional abuse. However, a growing body of research is emerging that provides new and unexpected insights into how prolonged emotional abuse and stress can alter and damage the human brain. As the research of Robert Sapolsky (Sapolsky, 1999) has made abundantly clear, stress kills brain cells.

Toxic Stress and the Impact of Emotional Trauma

The American Academy of Pediatrics (2011) recently has released a position paper recommending an overhaul of the present medical perspective. They introduce the construct of toxic stress into their newer more holistic perspective of medical care and acknowledge that extreme emotional distress in an unsupportive environment can result in serious mental and physical health consequences. They report that up to 40% of all adult health problems and perhaps as much as 60% may be due to the experience of toxic stress in childhood. These findings are based on the Adverse Childhood Experiences Study (ACE), which is one of the largest and longest longitudinal health studies in modern history conducted by Kaiser Permanente and the Centers for Disease Control. An important outcome of this study is the realization that socio-economic status and community environments play an important role in how families manage the stress of daily life and how these management techniques translate into toxic stress for children. For the medical community, this study provides a deeper understanding of one of the invisible causes of disease and how to prevent it as well as new insight into how to manage healthcare. This new model health is viewed as an evolving process that involves the whole individual and which requires maintenance at multiple levels including diet, exercise, sleep quality, and stress management. Stress management in this model takes on a whole new level of importance.

PTSD & Toxic Stress

Post Traumatic Syndrome (PTSD) has a strong metabolic component as well as physiological features that are well documented. The actual sources of PTSD are still not well understood, but toxic stress and prior emotional and physical trauma may generate high levels of susceptibility. This susceptibility makes sense when we look at PTSD from an oxidative stress model, as discussed elsewhere in this book. Those people who have experienced toxic stress in childhood are more at risk for increased blood-brain barrier permeability as well as excitotoxicity from excess glutamate resulting in chronic low levels of neuro-inflammation (Perlmutter, 2016; Wang, 2010; Soutar, 2016). When exposed to extreme stress as adults, they are more susceptible to increasing inflammation and excitotoxicity since it is already an established pattern. Coping

mechanisms are less developed. They have poorly developed adaptive social behaviors. These individuals are slow to respond to talk therapy and frequently require high doses of multiple psychotropic medications. PTSD generates high levels of fear and excessive activity in the amygdala which in turn reduces communication between the cortical and subcortical emotional centers (Le Doux, 1996). This activity tends to either increase alpha idling or decrease theta inputs. Through AT training, we are often able to re-integrate these brain areas through mechanisms described in Chapter 9: AT Training (AT): Trauma Integration. The mechanisms involved are discussed in detail in the chapter on AT training.

Physical Trauma

Social Accuracy Theory: Approach & Avoidance

The scientific analysis of human behavior has evolved over time into two fundamental domains of analysis: the sociological and the psychological. In the 1930s several theorists began to identify problems with confining analysis to either domain and began a synthesis of these domains in the form of social psychology. This synthesis has resulted in a more satisfying hybrid of theories. The theoretical basis for the ISI is expanded here to embrace the concerns of clinical application.

In psychology, John Watson and B.F. Skinner define the powerful research tradition of behaviorism. Behaviorism proposes that rewards and punishments in an environment predict behavior. This paradigm focuses on the reinforcing properties of the environment and discounts subjective states as unimportant. Personality theorists, on the other hand, look for consistency of behavior over time across situations. One group, including Hans Eysenck and Raymond Cattell, sought to identify traits that could be measured to define and predict personality. The source of these traits was the English language and not a comprehensive theory of personality or behavior. They relied on statistical models to derive predictable dimensions of behavior. Consequently, these personality theorists tended to discount external rewards and punishments. Personality theorists, such as Freud, Adler, Horney, and Maslow in contrast attempted to devise theories to explain how personality emerges from internal drives as well. These theories, although useful clinically are difficult to verify empirically because of the nature of their theoretical constructs.

In Sociology, structural theorists such as Durkheim define behavior as originating from social environmental forces that were external and coercive. The symbolic interactionists in contrast, initially defined by Mead, proposes an alternative social-psychological tradition that identifies the personality or “self” as a process that emerges from the interaction of the biological and the environmental forces resulting in a self-society dialectic. Objects are always, by definition, social, and the self emerges from social interaction, whether imagined or real. Parsons later attempted to synthesize

these perspectives into an integrated systems theory perspective. Leon Festinger, one of the first social psychologists, was dissatisfied by both psychological behaviorism and sociological structuralism and developed theories such as social comparison theory that moved beyond behaviorism and structuralism as well.

Another of the first social psychologists, Kurt Lewin, looked at the impact of processing on behavior in his formulation of social-psychological analysis. This study of the perception of social objects, rather than just physical objects, reflects the work of Mead and others in sociology. Gestalt contains the concept of self as process, like Mead's theories. This self-process is derived from interaction. From this perspective, how social environments are "construed" defines the identity of rewards and punishments studied in behaviorism. Therefore, how social environments are construed (perceived, interpreted, and distorted) is critical to the formulation of human response.

People form construals (Ross & Neisbett, 1991) of their social environment as a basis for behavior. Construals are based in two fundamental motives: "the desire to maintain self-esteem and the desire to form an accurate picture of oneself and the social world" (Aronson, 1998). Social cognition theory proposes that social behavior is driven by expectations involving self-fulfilling prophecy (Rosenthal & Jacobson, 1968) and is based on construals. Social cognition is defined as how people select, interpret, remember, use social information to make judgments/decisions, and then act. There are many basic components to the process of social cognition. For instance, individuals use schemas as theories on how things work as a basis for evaluation and action. Schemas can distort what we see perceptually and what we remember. Schemas persist when discredited in the form of perseverance effect. Self-fulfilling prophecy occurs when our schemas influence behavior and reinforces ideas by eliciting behavior in others that reinforces our expectations. Judgmental heuristics are processing patterns or mental short cuts that we use to process vast amounts of information. All of these can be greatly distorted by network dysfunctions. Neurologists have noted for over a century that damage to temporal lobe networks can lead to confabulations that distort the employment of schemas and judgmental heuristics (Demasio, 1994). Yet, this source of behavior is a missing dimension of influence not included in the analysis of social-psychologists.

Cognitive dissonance is a social psychological theory that Leon Festinger proposed that is also associated deeply with self-esteem. This theory reflects a trend in thinking about the sources of human behavior. In psychology, Albert Bandura's, *Social Cognitive Theory,* connects learning to behavioristic theory and personality theory through the medium of self-efficacy and provides a parallel theoretical picture. Self-efficacy is like self-esteem theory. Julian Rotter's theories of expectancies mirror expectation theory in social psychology.

These theories emphasize the importance of emotion and self-evaluation in the determination of human behavior. This theoretical approach also more specifically reflects the anatomical development and physiological dynamics of the human brain. Human behavior is profoundly influenced by emotional processes (Goleman, 1995). There is a human need to maintain a positive view of ourselves according to the self-esteem approach (Aronson, 1992). From the social-psychological perspective, the psychological dimension of denial stems from the desire to maintain one's self-esteem (although it may emerge from confabulation). The perspective behind the ISI proposes that self-esteem is dependent on social accuracy, which can derive from either socialization or from the processing efficiency of neural networks. Both positive and negative emotional valancing (Demasio, 1999) provide individuals with important feedback regarding the success of their behavior.

Another key mediating variable, proposed by this author, in the process of achieving social accuracy is effective cognitive processing. When we are not accurate, we engage in denial and rationalizations to sustain self-esteem. Accuracy tends to be a more cognitive process while self-esteem tends to be a more emotional process that is valancing our accuracy. Individuals engaging in approach behaviors are more likely over time to refine their interaction techniques and gain access to social resources such as attention, status, power, and money. Their ability to maintain a dominant "approach" style of behavior is a measure of their success at interaction and indirectly a measure of the social resources they have accessed. Individuals engaging in avoidance behaviors are more likely over time to fail at practicing and refining behaviors and poorly access social resources.

Approach and avoidance have a typical EEG signature. The amygdala and the nucleus accumbens play key roles providing emotional valancing to networks, guiding attention, and cognitive processing as well as primary bottom up sensory processing (LeDoux, 1996; Chow and Cummings, 1998). Negative interactions, both internal and external, tend to increase right hemisphere activation and anxiety (Davidson, 2000). Continued negative interaction results in withdrawal behaviors and depression (Davidson, 2000). These interactions provide a starting point for correlating behavior with neurophysiological activity. Individuals with a dominant approach behavior pattern will consistently demonstrate a stereotypical EEG pattern in which the left hemisphere is more activated than the right hemisphere (Davidson, 2000). Other patterns that correlate behavior with neurophysiology are likely to emerge as well.

Many researchers and authors in neuropsychology (Sacks, 1985; Ramachandran, 1998; LeDoux, 2002; Demasio, 1999; Davidson, 2000; Cozolino, 2002) have provided a new window into human behavior exposing a dimension previously ignored or discounted in the behavioral sciences—the physiological. Based on their findings, there

are distinct correlates between human behavior and electrophysiological events. These findings suggest that processing and the resulting construals can be profoundly altered and that the resulting behavior will be novel and socially inaccurate. A consequence of this finding is the implication that an additional causational link, among several mentioned above, exists between behavior and physiology that can provide cause and effect consequences in either direction between the correlating factors. This hypothesis further implies that any event which disrupts, disturbs, or profoundly alters physiology can also alter human behavior. These events include drugs, trauma, intense emotional states, viral infection, and toxins. The enduring consequence of trauma can result in unanticipated subtle social consequences with respect to human behavior. These consequences can be socially destructive particularly if they occur in individuals who reside in key hubs of power; in which case, they are likely to have extensive negative consequences for the social order.

Anxiety: A Fundamental Dimension of Disorder

Anxiety can change structure and function in the brain and result in profound distortions of perception and behavior. Until the 70's psychiatry was guided by the assumption that most disorders emerged from anxiety (Healy, 2004). It was the rise of "big pharma" and its marketing efforts that submerged this very well-founded perspective. The non-pharmacological funded research, however, continues to be profoundly supportive of this hypothesis. It also agrees well with research from across many paradigms. The most fundamental of these paradigms is that of Hans Selye. His basic concept is that an organism's initial response to stress is an alarm reaction that results in the mobilization of the entire body's resources to deal with crisis. Over time this mobilization, if it is constant, results in the exhaustion of its resources and death.

Research in the 70's conducted by many noted behaviorists demonstrates the catastrophic consequences of long term exposure to stress. They found that most of the test animals died of gastrointestinal lesions. This research suggests the breakdown of intestinal integrity and the ability to absorb nutrients. More recent investigations indicate that this process alters intestinal flora populations and degrades the ability to produce some neuromodulators resulting in anxiety and depression in many individuals (Perlmutter, 2015). In a parallel line of investigation when looking at how stress impacts biology, Robert Sapolski finds that chronic exposure to stress can result in neuronal death. As mentioned in previous chapters, models of excitotoxicity emerge along with supporting research that lend strong validation to this hypothesis. The outcome of this accelerated oxidative stress is elevated levels of inflammation and reduced levels of neuronal function. Emotional trauma and toxic stress impacts white matter integrity and development as well astrocyte health as described in the previous chapters.

It is important to acknowledge and keep in mind that stimuli that generate alarm reactions in humans can be internal or external in nature. In the last two decades, studies on fear suggest that there are two different fear networks. One network is anterior and conscious. The other network is posterior and unconscious. This finding supports the observations of Joseph Le Doux (1996) that implicit memories need to be integrated into an explicit memory system for individuals to process fearful experiences. Recent research by Engels, Heller, and others, as previously mentioned, provides evidence that there are at least three cortical patterns that define three different aspects of anxiety. The work of Porges (2007) and his Polyvagal Theory clearly outline with excellent support the existence of a three-part arousal system which is more complex than the simple sympathetic parasympathetic theory of Cannon-Bard and others in the 20th century. Together these paradigms argue for a more subtle and complex picture of how emotional trauma impacts the brain than is presently used today.

Presently it is understood that trauma results in the fragmentation of sensory information, so that it that does not get bound into a complete memory process or it may result in a failure of encoding entirely. Consequently, this failure of encoding impedes the retrieval and integration of memory related to the trauma. To make things more complex, memories are also arousal or state dependent. Revisiting different states of arousal can invoke different memory sets. Access to memory is modulated by the state of arousal that the individual is in as well as the quality and extent of the original information encoded. Anxiety therefore has a profound impact on memory access, memory processing, and memory formation.

How one responds to social contexts can also alter the dynamics of a situation. Anxiety can result in impulsive responses. In young children this can also show up as inappropriate silliness. A third response is masking emotional response with a flat affect. The work of Le Doux indicates that the right hemisphere is particularly sensitive to danger and that the right amygdala is an especially important player in this process. Alan Shore proposes that part of this sensitivity is since the right hemisphere in mammals is especially dominated by norepinephrine inputs while the left hemisphere is dominated by dopamine. This sensitivity makes the right hemisphere more responsive to alarm reactions.

Depression

The research of Richard Davidson pioneered the concept that depression has a distinct cortical correlate as well as a social correlate resulting in behaviors related to withdrawal from social participation. If the work of Heller (1998), Engels et al (2007) and others demonstrates that anxiety is marked by increased arousal in the right hemisphere, then Davidson's work has shown that the slowing of the left hemisphere as

marked by increasing alpha activity typically results or is correlated with withdrawal behaviors. This slowing suggests that a dialectic is present in which the alarm reaction begins in the right hemisphere and results in increased sympathetic tone which eventually leads to withdrawal response because of growing reductions in resources due to prolonged hypervigilance of the system which consumes excess resources.

Sapolsky notes that the alarm reaction or stress response originally emerges as an emergency measure mobilizing an excess level of resources that typically is only brief. In humans, this condition is often fatally extended over prolonged periods of time due to the emergence of social contexts that are chronically traumatizing. The consequences have been well documented. Herbert Benson (2000) confirms the same patterns in his research. It can be easily argued that depression is a natural response of the organism to conserve resources and recover by progressively downregulating the system and encouraging withdrawal from chronically traumatizing environments. This concept also allows for intuitive reassessment of circumstances and the potential for developing novel behaviors to resolve the social conflict or friction. This dialectic can be observed at electrophysiological level.

While performing qEEGs, and measuring clients with Beck inventories, it becomes clear that alpha asymmetry is commonly associated with depression as reported. What we also note is that during asymmetry training alpha decreases in the left hemisphere while increasing in the right hemisphere. After repeat sessions, the Beck scores change indicating reduced depression additional mapping confirms an emerging and permanent change in asymmetry. In addition, and just as important, we note increased anxiety emerging. Clients also become more introspective and aware of their feelings and more verbally interactive. They report behaving or responding in a novel fashion to stressors that typically results in a stereotypical response. Outcomes change due to the new responses. Anxiety and arousal decrease. This reaction is confirmed by the observation of reduced beta activity in the right hemisphere and diminishing scores in the Beck anxiety inventory.

This second phase of anxiety reduction is far longer than the depressive reduction phase, and there is high inter client variation in reduction of physical verses psychological features. At this point, we utilize peripheral biofeedback, photic stimulation, and counseling (EMDR) to accelerate the calming of the sympathetic tone and shorten this period. It has become apparent over time that other confounds are at work and that often the physiological component lags behind the psychological work as we relieve trauma. This outcome suggests a physiological mechanism is operating at different time scales, and it is more entrenched. We now suspect that as the brain grows networks of anxiety, the body grows endocrine networks of anxiety and chronic hyperarousal.

Top Down Sources vs Bottom Up Sources.

Anxiety and depression typically are considered the consequence of psychological processes. Since most of disorders appear to be based in these two phenomena—especially anxiety—most mental disorder is considered a result of the same sources. However recent research from the past decade has made it abundantly clear that TBI can generate changes in endocrine function that result in a wide variety of features consistent with many mental disorders (Wang & Miachaelis, 2010). As mentioned, research has clearly demonstrated that enteric problems such as leaky gut and dysbiosis can result in anxiety and depression. The over use and abuse of antibiotics and its effects on intestinal flora and the microbiome as well as the impact of food additives and pesticides (Enciu et al, 2013) have a profound impact on the body as well as the brain and its functioning. Additionally, viral activity, such as Lyme disease, can pass the brain blood barrier. These pathways of impact on the brain can be characterized as bottom up as they are non-psychogenic in nature and issue from physiological sources.

As already noted, research shows that mammals exposed to severe chronic stress die from gastro intestinal lesions. Stress alters enteric acidic levels and generates inflammation. This inflammation weakens the T Joints or interstitial borders between cells in the intestinal lining. Proteins leak out of these openings and are foreign bodies by the body's immune system. This leakage results in an auto-immune response that often spreads over time involving many organ systems. Food additives and food sensitivities can also trigger this process. Recent research indicates that this inflammation can travel up the vagal nerve pathway, enter the brain, and result in Parkinson's Disease (Mulak & Bonaz ,2015). Other research indicates there is a direct connection between white blood cells in the intestinal walls and enzyme activity in the brain. Inflammation in the gut can trigger a pro inflammatory response in the brain. Pro-inflammatory responses can reroute serotonin production into quinolinic acid production increasing neuroinflammation. This inflammation typically results in depression.

Dedovic et al (2009) have proposed a two-part model of anxiety with respect to the brain: top down and bottom up. Top down issues tend to be from dysregulation of the frontal lobes because of psychogenic processes and bottom up issuing from brain stem and limbic system. Whether this model can be reconciled with Porges (2007) and Engels et al (2007) will be an issue for future research. However, these investigations clearly outline the importance of a multifactorial model of anxiety and depression as well as other domains of disorder that transcends the present narrow perspective in actual practice in the medical and psychological field today.

The Third Source: Neurological Domain

In addition to the top down and bottom up model there are considerations that include the neurological domain or what happens when the brain is damaged from factors such as pathogens, stroke, or TBI. Focal lesions of the brain can result in specific symptoms that are typically associated with a specific diagnostic label, yet they arise as a single unique phenomenon. For instance, a focal lesion in the parietal region can often result in obsessive behavior but without the other features of OCD. Yet individuals with this behavior can easily be diagnosed with OCD by a psychologist or psychiatrist who are not familiar with the new findings regarding neurological phenomena. OCD like behavior may result from an auto accident and yet not be the classic version of OCD.

TBI can result in a very wide variety of symptomology that continues to escalate post trauma (Shruti & Faden, 2014). These outcomes can transcend the initial symptomology of the trauma. Initially these symptoms were interpreted as psychological side effects that escalated after initial healing from the trauma, but recent research has discounted this explanation. The initial impact usually involves mechanical damage to neurons, astrocytes, blood vessels, as well as axonal twisting and shearing. The secondary consequences are more complex:

> *"Such events pave the way for secondary pathophysiological cascades that include biochemical, metabolic and physiological changes such as spreading depression, ionic imbalance, release of excitatory neurotransmitters, mitochondrial dysfunction, and activation of inflammatory and immune processes [8–10,15], among others. Some of the more important secondary injury mechanisms involve activation of neuronal cell death pathways, microglial and astrocyte activation, and neurotoxicity. (Shruti & Faden, 2014, pg 1218)"*

The lesson to be learned from all this research is that trauma in general must be more broadly redefined. Trauma to the brain can come from a wide variety of physical and psycho social stressors with similar impact.

A brain that is dysregulated from trauma cannot recall, evaluate, explain, plan, or coordinate complex cognitive and emotional processes. Social accuracy declines dramatically in many cases and activities of daily living may suffer. Relationships may unravel, and features of serious mental disorder can emerge. At the time these difficulties occur, the changes can be subtle and blamed on other events. Peoples' experiences are gradual and confusing—often unraveling their lives. Demasio (1999)

describes how highly successful individuals with developing brain tumors can pass all psychological and neurological batteries while demonstrating an incapacity to conduct their disintegrating business and social lives. If this reality is so well documented from a well-defined anatomical problem, then why would we expect less from head trauma? If the traumas are sub-concussive and serial over a large expanse of time, the cause may go completely unrecognized. The recent reports of this pattern in high profile NFL players emphasize how Tau proteins developing from trauma can mimic dementia (Oste et al, 2014) and destroy a previously high performing individual's life.

At this point, it should be obvious that mental, social, and physical factors can all result in trauma that directly influences brain physiology over time; and behavior is redefined in a manner that is maladaptive and destructive to the individual at all levels because of these factors. The impact of these events upon the brain's capacity to produce energy and maintain order can be clearly discerned in qEEG brain maps as described in The Oxidative Stress Model (later in this chapter). The qEEG, however, also provides us with a way to link physiology with behavioral consequences. The brain deteriorates in a stereotypical pattern that reflects its structure and dynamics. This pattern is predictive of different general deficits at each stage of deterioration. The specifics of course vary from individual to individual.

The Default Mode Network (DMN) and The Ego: Psychodynamics and Electrophysiology

At this point, we are beginning to gain a better understanding of qEEG imaging because we are gaining more clarity in fMRI research on this topic. The research on the DMN demonstrates stereotypical patterns of activation related to key activities traditionally associated with the ego in psychodynamic theory (Carhart-Harris, 2008). At this junction personality, ego, and neocortical dynamic converge. The activation patterns in the DMN are highly correlated with several dimensions of activation independently confirmed in prior research involving envisioning the future, theory of mind, moral decision making, and autobiographical memory (Buckner, 2008). These basic activities are involved with the ongoing construction of the self or ego.

The typical percent of thought activities during the day has been researched and falls roughly into these dimensions (Csikszentmihalyi, 1991). Beck and others establish the role of automatic thoughts in ego function and in disorder (Beck, 1995). He identifies twelve key patterns characteristic of anxiety and depression. These activity categories increase in number, frequency, intensity during anxiety, depression, and recruit automatic emotions associated with them. Many of these patterns are based on fear and worry. The research of Joseph Le Doux provides evidence that worry—which takes the form of excessive orbital frontal activity—helps to inhibit ascending inputs from the amygdala to the frontal lobes and diminish the experience of fear. This outcome

matches the findings of Heller showing excess activation of the left and right frontal lobes in anxiety. Rumination, which according to Engels & Heller is a parietal process, coincides with findings that the DMN is the central hub in the brain and is in the central parietal region. The replication of this research over the last decade confirms that the DMN plays a key role in ego function and in mental disorder.

The brain of an individual with excess anxiety shows excessive cortical activity. The regions where these activities typically occur matches the locations of the DMN. The qEEG patterns of excitation and activation match these patterns as well. We can presently observe the level of anxiety and depression of individuals with qEEG in considerable detail. Consequently, the patterns of mental disorder. E. Roy John had already begun to establish this point decades ago (John et al, 1989). With the help of NFB, we can train these regions into a more normal level of function if the socio-emotional environment is potentially capable of supporting normal function.

The Process of Trauma and Integration

Memories are not stored and recalled in a whole form and then played back as in modern video formats. Instead each time we recall an event, we reconstruct it in real time from components sorted in different sensory modalities. Each sensory system apparently contains its own memory stores. When we recall an event, each sensory system contributes its component of the memory. Exactly how the brain sorts and binds this action in real time is not well understood at this point, but awareness of the nature of this process has important implications for understanding trauma and PTSD. Information that the brain encodes from any event has associated emotional aspects. This association is often termed emotional valence in the research literature. It stands to reason that if an event has emotional valences which result in too high a level of arousal, such that it would manifest as panic, then the memory would never complete its binding process when recalled. This incomplete binding apparently generates a tension in the system that continually drives the system to resolve the memory, but the memory cannot be resolved.

Joseph Le Doux (1995) provides us with a model from his research on fear conditioning that supports the notion of a dual system of memory involving an implicit system and an explicit system. The implicit system appears to be subcortical, and generally employed in initially binding memories upon first encoding. The explicit system appears to be more cortically based and contains constructed narratives. Narrative is a critical component for conducting and maintaining the ego. It is the primary routine task that engages the DMN of the brain. The brain appears to continually process memory information to maintain it. This narrative is one of the key tools it uses to coordinate this information. When it encounters a memory that cannot be resolved because arousal levels are too high, an anomaly in the system occurs. This

anomaly generates progressive levels of tension and may act like a virus that progressively eats up hard drive resources in a computer.

One patient who had a dissociative disorder due to severe trauma and abuse in childhood reported strong smells occurring during AT training. Several sessions later she reported hearing voices and then strange tactile feelings in different areas of her body as if someone were touching her. After a few sessions, a visual image emerged along with the other perceptions. These items converged into a terrifying memory of abuse. Then pieces of an entire scene and series of events developed, and she was able to recount the incident. From that point we were able to assist her in integrating that memory into her other memories of childhood. This pattern became typical of what we observed often in cases of childhood trauma resulting in PTSD. It also matches what Le Doux's research predicts.

If depression is like being stuck in the belly of the whale, the consequences of pharmaceuticals are like having the whales mouth permanently closed with no escape and being given a couch and a TV for company. The individual becomes a spectator in his or her own drama. The receptor levels in the synapses depopulate to a level that adjusts for the effect of the drug. Emotional development diminishes because access to emotions is permanently limited. As we train individuals suffering from depression at New Mind with NFB, we find they become progressively irritable and restless as they begin to move out of the depression into the original fear and anxiety that resulted in the depression. If medication is not reduced, they become stuck. Unfortunately, the response of most psychiatrists who do not understand this process is to prescribe more medication.

At this point in the NFB process, clients begin to have vivid dreams and sometimes nightmares. This stage marks the beginning of integration of the whole memory segment into the explicit memory system. Early studies in learning show that rats consolidate learning mazes when a 7hz signal couples the hippocampus and the frontal lobes during sleep (Buzsaki, 2006). If this part of their sleep is blocked, they cannot learn the maze. Further studies suggest that theta plays an important role during REM sleep in the integration of new learning comprised of associated memories. This integration demonstrates the importance of dreaming and REM sleep in the learning process. What is rarely commented on is that most individuals with a mental disorder do not remember their dreams and that medications appear to aggravate this condition. Given these findings, we expect that depressed individuals are not likely to be able to integrate memories and their associated emotions if they cannot feel the emotion.

Emotional valence is a key component of memory processing. Drugs like Prozac and other SSRIs are known to mute emotion and consequently block the oscillatory shifts between overarousal and the inhibited state of depression that modulate the gradual

effort of an individual to process trauma and tragedy. This process leaves clients stuck. Gradually reducing the SSRI during this phase allows the individual to dream and process more freely to integrate trauma. We have seen this process repeatedly in thousands of cases over the last decade.

The importance of sleep for mental health and recovery cannot be overstated and is perhaps one of the continually most underestimated sources of disorder in the brain. Once the individual begins to normalize sleep, begins dreaming, and shows signs of lifting mood with episodes of irritability, it is time to shift to fast wave training aimed at reducing arousal or AT training to target trauma. The electrophysiological marker for this change is the shift of alpha dominance to the right hemisphere and beta dominance to the left hemisphere. With two-channel bi-hemispheric training, this result is easy to observe with a good trend screen. The trend lines on the review screen appear to merge closely together and with some clients there is a clear shift. This shift indicates increased plasticity, improved emotional flexibility and resilience, and increased communication between hemispheres as well as between cortical and limbic processing.

The client begins to emit novel behaviors in social contexts that previously would have elicited stereotypical and automatic responses that lead to social error and inaccuracy resulting in distress and conflict. These new responses result in innovative interactions with others leading to more positive outcomes. It is also usually a period of increased anxiety and agitation. This period lasts a week or two. If it lasts longer, it indicates more pronounced chronic underlying anxiety based in unresolved trauma. At this point, AT training is initiated to calm the CNS and uncover and integrate deeper and older traumas.

AT training is a misunderstood process in NFB; the details are covered in the AT chapter. Many see it as simply another form of operant conditioning that magically calms people. In truth, it is a method of using EEG to guide an individual into a specific state. According to Elmer Green, this state was one that he learned from his yoga instructor while studying yoga. It was one of many meditative stages that students cycled through during their yogic training. He found it especially good for developing creative solutions to problems (Green, 1970). Green found that the key signature of this state when monitoring the brain with his EEG equipment was very high amplitude theta frequency in O1 in the left occipital regions. This outcome was perplexing from an anatomical perspective because O1 was part of the Brodmann areas 18 and 19. Its cell architecture developed around visual processing. In contrast, the God Spot which was observed by Newberg (2001) was at P4—a region which processed the boundaries between physical self and other—seemed a more likely candidate. Nevertheless, Green recorded this phenomenon among many of those trained in yoga on his visit to India. His goal with AT was to provide a more technologically measurable way of achieving this

state with minimal training, so the average person had easy access. Green initially utilized this state often to solve math problems in physics in graduate school but later for more spiritual experiences including out of body experiences.

At times people he trained had intense experiences often similar to life after death experiences including tunnel with light and angelic beings. The workshops he conducted at Menninger Clinic in Topeka, Kansas attracted the attention of a key administrator, Gene Peniston. Gene participated in a workshop and had a vision that it would be effective with alcoholics. Gene developed an in-house program that utilized AT along with other modalities of treatment including progressive relaxation, visualization, and group meetings. The published outcome was impressive with most of the participants abstinent in a 10 year follow up review. He used it on veterans with PTSD and got similar results. For his efforts, Gene got backwatered by the administration which, as usual, did not like rate busters who attracted attention and threatened sweeping changes.

Despite this, a small emerging community of clinicians adopted this approach and Sterman's training methods, while other clinicians at Menninger, such as Dale Walters, continued to conduct workshops. Walters utilized a full peripheral biofeedback hook up as did Green and many of us continued that tradition. With the passage of time, we found that the NFB component was the critical factor. Adam Crane built his equipment and his workshops as well as his company around this technology and trained and sold equipment to Nancy White in Texas who eventually wrote the first published chapter on the topic (White, 1999).

Using abstinence visualization with AT training proves effective only with the addition of group meetings such as AA, but those with PTSD respond well in the usual clinical setting. It is so effective that it has a profound impact on trauma integration in general and is very effective in reducing the startle response and general sympathetic tone. This reduction in sympathetic tone contributes to reductions in insomnia and anxiety. It also has an impressive impact on a suppressed immune system and the hypothalamic pituitary axis (HPA). Normalization of menstrual cycles and hormonal issues is not uncommon, and it can have a strong impact on PMS. With the increased immune function, many people experience increased energy and relief from a variety of symptoms with unidentified sources.

The ability of AT training to guide clients into a unique twilight state allows them to remain at a very reduced arousal level that appears to facilitate the integration of memories in the implicit system that would typically result in such high levels of overarousal and panic that they cannot be consolidated and integrated. The integration of these traumas in the long-term results in increased integration of neural networks and facilitation of neuronal function. The partitioning of these networks due to trauma appears to diminish the functionality of the system by blocking access to processing

resources in limbic structures due to gating in efferent and afferent pathways between the cortex and the limbic system. The suppression appears to be along the lines described by Le Doux (1996) in which worry functions as a gating mechanism between the orbital frontal regions and the amygdala. Individuals then have minimal access to their full emotional resources and are not as efficient at emotional valancing. Decoding social contexts becomes more challenging. Their rate of behavioral error increases generating even more distress. This escalation of distress then elicits more emotion which in turn places pressure on the system to respond emotionally. The limbic response begins to assemble the traumatic memory again and panic ensues. This vicious cycle continues indefinitely until the trauma can be resolved. In addition, any event that is like the original trauma can also induce the same process and consequently minor events can be a trigger for this process.

For the average individual, lower levels of trauma appear to have a less intense cycle. More manageable but still significant traumas occurring during the socialization process trigger stereotypical and scripted responses that induce stereotypical counter responses based on violations of social norms and mores regarding appropriate conduct. A cascade of automated responses and counter responses results in escalating emotional tension which ends with shouting or escape from the context i.e. fight or flight.

What binds individuals to these scripted responses is the constant conditioning that shaped them in the family of their origin. At another level, they are based on expectations and erroneous untested predictions about the world and how it functions. The predictions reinforce their view model of their “lifeworld” and in a sense, provide a false comfort that the world is as expected and predictable. This sense of security is what maintains their trances or ongoing self-talk which in turn continually defines their lifeworld. These trances are also sustained by their routine maintenance involving repeated imaginary scenes which can escalate to constant negative ruminations. Another method of maintenance is repeated behaviors which can involve subversion of self-awareness into tasks such as work or in the extreme repetitive tasks such as checking in OCD or trichotillomania.

A Socialization of Trauma

When reviewing the research along with our clinical records, a pattern emerges. There appears to be several basic developmental dimensions that are at play in the transformation of toxic stress into destructive socio-emotional patterns of behavior. These dimensions are emotional scripts, core beliefs (schemas in Beck), core dramas, core roles, scripts, trances, and rationalizations. The family, as the historically central unit of social organization, from both an anthropological and sociological perspective, is the context for the incubation of these factors into the self-system that projects itself

into the larger social context. Everyone develops a repertoire of routine or automatic responses to stereotypical social situations and attempts to negotiate successful outcomes to the problems that arise from their interactions. The goal is to access social resources to thrive. This behavior in turn is expected to support wider social patterns of behavior that sustain norms and mores that in turn define and support the larger ongoing social process. Key underlying skills employed in the expression of these behaviors are self-control and deferment of gratification (Gottfredson & Hirschi, 1990). At the neurological level Peterson and Posner (2012) have recently pointed out that the facility of attention is a key factor in being able to carry out these skills.

Emotional Scripts

As Alan Shore notes, most of the family's emotional scripts are absorbed before the age of one and a half. Children begin imitating those patterns within the family context and by age 2 begin becoming aware of themselves as separate individuals and developing their own narratives. This is the point at which childhood memories become more enduring. The EEG pattern of parents is highly heritable (Peterson & Posner, 2012) and approximately 70% gets passed on, but the strongest and most enduring patterns are in the posterior region. The frontal patterns seem more susceptible to ongoing socialization. This outcome matches the fifty percent nature vs 50% nurture model used in psychology to describe the contribution of genetics versus socialization to human psychological behavior. This outcome would reflect physiological patterns that support the transference of behavior through vicarious learning and operant conditioning that occurs within the family system during the socialization process.

Core Dramas

During childhood, we see the emergence of individual core dramas that are forged out of the conditioning of the family context during the expression of the repertoire of family emotional and behavioral scripts. Over time, unique patterns of response to different family scenes develop. The successful ones leading to attention or other rewards become well developed and consolidated into a group of automatic scripts that get enacted in response to each scene. The more traumatized the family, the more stereotypical and repetitive the scenes enacted. In a sense the family becomes trapped in its own repeating patterns as the family system tries different iterations of enactment to resolve the trauma of each individual. The core drama becomes the central solution to resolution that never actually resolves. This same drama is triggered by situations outside the family and the individual is attracted to these triggers to find a unique solution. The only way out is the emission of a novel response. In addition, they are attracted because the triggers are familiar patterns that elicit behaviors that are well rehearsed and the repetition of emission of their responses reinforces their sense of identity. Most individuals prefer a defective identity rather than no identity which can lead to anomie and suicide due to progressive social isolation and which one of the

founders of sociology, Emile Durkheim, demonstrated in the first social statistical study ever conducted and published.

Core Roles

As individuals become socialized into the family system, they tend to take on various roles in response to other dominant roles and to accommodate those dominant roles. In time, they gravitate toward one dominant role more than the others and consolidate their identity, including scripts and stereotypical behaviors associated with those scripts. Researchers have identified the most typical roles that emerge, especially in dysfunctional family systems. These include the hero, the scapegoat, the rescuer, the mascot, the enabler, little mom, the lost child, and the saint. The older child is often the hero and always does the best and what is right. The hero always follows the rules and is the center of the family's positive attention. The lost child is typically the middle child who is always in the background of family activity and receives the least amount of attention. The scapegoat is always the center of negative attention and often competes with the hero. Sometimes these roles can be equally split by twins. The scapegoat always distracts members from family activities with disruptive and oppositional behavior to garner attention. The characteristics of these roles are too complex to fully review here, but there is extensive literature on this topic in family systems theory.

Scripts

The repetition of scripts and related behavior confirms role identity and hence group identity. Scripts are automatic and effortless, and this routine generates a false feeling of authenticity. This false authenticity arises because the individual has not experienced an adequate number of events where they emitted spontaneous novel behavior based on their feelings and from their own creative source that resolved tension, friction, or conflict. Their responses are always highly conditioned, automatic and stereotypical. They become dependent on automatic family repertoires that result in stereotypical responses that are familiar and expected rather than relying on novel action based in self-awareness of feelings. Their hypervigilance results in global somatic bracing that reduces emotional self-awareness and access to their somatic landscape (Demasio, 1999). This lack of access to a full emotional repertoire also continues to make them reliant on automatic scripts. The lack of encounters with evoked novel behaviors resulting in successful interpersonal negotiations results in a lack of experience with the sensation of self-efficacy and self-empowerment that successful encounters resolve in. This results in a growing sense of frustration and disempowerment. If the familiar outcome of an automatic behavior is traumatic, then they may develop panic and rage to protect themselves.

Trances

Trances are like themes that people base their behavior on (Wolinsky, 1991). They are automatic behaviors stemming from fundamental beliefs about themselves. They may see themselves as a "loser" or believe they are a "good dresser." From these themes, they acquire a group of behaviors to compensate for or enhance these themes. These conditioned automatic behaviors are emitted in cycles that involve them with other individuals and institutions that can either be adaptive or maladaptive. From a psychological perspective, they are partially dissociated. From electrophysiological perspective, they tend to produce excess theta waves. This cycle is because their awareness is grounded in limbic functions more than cortical functions. They are in a daydream state similar to childhood consciousness before the brain increases its dominant frequency and begins to operate more cortically. This state is highly auto-suggestive and has a hypnotic quality to it. Alcohol and THC can enhance this state. People shift into this state typically in response to stress, and it can lead to intense episodes of daydreaming and eventually dissociation. The adaptors they engage in once they access this state are often self-soothing and may include many compulsive patterns such as gambling, shopping, eating, sexual ritual, etc. They can also involve violent activities.

Trances vary in intensity and frequency. They may be aggravated by TBI and emotional trauma. People often look back at their behavior and comment, "I don't know what I was thinking," because they were engaging in behavior that is not rationally based. On the positive side, the ability to enter these states allows us to engage in play and pretend as well as cooperate in drama and the arts. On the negative side, they can lead us into self-destructive behavior that is irrationally based and difficult to overcome. NFB can be especially effective at mitigating these negative psychological states and decreasing the automatic component that can become self-limiting and self-destructive.

Rationalizations

As Bradshaw (1988) notes, family and social contexts where continual violations of boundaries and failure occur generate high levels of shame and guilt in family members. The attending high levels of frustration and suppressed emotion result in disengaged family systems. Rationalizations and defensive responses tend to dominate exchanges. Negotiations tend to result in a failure to compromise and find solutions. Automatic thoughts tend to dominant thought processes and distort the contexts of social exchange. This distortion in turn biases perceptions, decoding of body language, and facial expression. Feelings are hidden to protect the individual from negative responses and contribute to practiced self-unawareness. Boundaries are less defined, protected, and honored. Family members may avoid exchanges and remain isolated in separate activities. Children fail to witness encounters that model the proper use of anger and frustration as well as the repair of frustrating encounters by adults. Vicarious learning of

these solutions does not occur. Instead they witness strategic methods to hide feelings and avoid encounters that lead to goal fulfillment in the form of short term gratification. Since conflict resolution takes time, negotiation, and multiple encounters with exchange of authentic emotion is not modeled, angry responses that halt negotiation and reward the individual with the greatest power with immediate gratification becomes the identified preferred method of negotiation. These behaviors are often repeated in school which results in bullying and affiliation with others with similar norms as well as the formation of identity groups of cliques that engage in deviant behavior.

Rationalizations allow us to repeat ineffective behaviors because they minimize the negative impact they have on relationships. The rational becomes more important than the relationship and evolves into a trance. Others become altercasted into identities that do not actually fit, but they justify the response to their altercasted role. “Jimmy is stupid, and so he should be treated accordingly. Someone has to wake him up, so he can see how stupid his behavior is; and I certainly shouldn’t have to put up with it.” In this circumstance, Jimmy is altercasted into the role of the village idiot. Everyone knows he deserves what he gets. This rationalization generates the scapegoat role in children subject to this type of rationalization coming from other family members.

Sociological Contexts

Social forces are external and coercive. They exert pressure on social players in any context in a fashion that has both psychological and physiological effects through the mechanisms of social distress (Alkadhi, 2013; Yuen, 2012). This includes the often-overlooked dimension of occupational stress (Savic, 2013). These effects are often minimized by those who are unfamiliar with the sociological literature despite over a century of detailed analysis, experimentation, and documentation. Events such as divorce or the addition of a new family member to a home are among the most stressful in this category (Holmes and Rahe, 1967). These events have a very real effect on physiology and can result in stress leading neuronal death (Sapolsky, 1999), unhealthy patterns of fat distribution and arterial deposits (Moyer et al, 1994) or telomere shortening and the consequent reduction in life span (Epel et al, 2004). Parenting style has even recently been demonstrated to have a significant effect on RNA and DNA (Posner & Peterson). It has been more than convenient for policy makers in our social order to ignore and minimize these facts and exert pressure on others to ignore them (NFL). This pattern of ignorance has been epidemic in psychology, medicine, and psychiatry until recently. The focus has instead been upon interpreting social distress and the resulting psychological issues as purely chemical cascades gone awry that can easily be managed with the appropriate magic bullet in the form of modern pharmacology (Whitaker, 2010).

The oldest social group in our species recognized by anthropology is the extended family or clan. We have come to recognize the family as a complex system of ongoing interactions among individuals that has a dynamic of its own. The family shapes the individual as much as the individual shapes the family. Among the most powerful forces at work in the family is the socialization process that over time defines an individual's habitual responses to a given social environment. Forces such as operant conditioning, classical conditioning, and vicarious learning have been documented as mechanisms of action in this process (Bandura). Up to the present the contributors to this shaping of the individual's collective repertoire of responses has been considered half nature or genetic and half nurture or learned. The famous concordance studies of the twentieth century are among the many investigations that continually affirm this estimate. As previously mentioned, it has been reported that perhaps 70% of the EEG pattern that individuals display, is heritable (Zietsch, 2007). It is interesting to note that the posterior region—most active in childhood—is most heritable. While the anterior region—most active in young adults into adulthood—is less heritable and more acquired. It is also well established that the pre-frontal lobes, most dominant in socio-emotional processing, are the last regions of the brain to myelinate. It is now recognized that most individuals have established the familial patterns of emotional scripts before the age of one and a half (Shore, 1994) and that most individuals do not begin a self-narrative pattern until the age of two and a half, usually commencing with mastery of the word "no." This emergence of such a self-reflecting individual is in a sea of mores, norms, and emotional currents that are profoundly complex. To cope with the complexity is apparently why we have evolved such large frontal lobes.

Children developing in families under the burden of profound social distress and or poverty, have deficits in both structure and function of their brain. The two are most commonly confounded according to a century of demographic analysis. They have smaller brains that are slower to myelinate (Kang et al, 2012). This reduction reduces processing speed for starters. They may have over sensitive amygdalae and an exaggerated startle response from trauma. They are often provided a narrow diet that is impoverished from a nutritional perspective which tend to contain more contaminates and pesticides. They may grow up in geographical locations that are more exposed to environmental toxins. They are more likely to be exposed to drug addiction, alcoholism, and physical trauma. They are more likely to come from broken families and rigidly disengaged families (Soutar, 1989)

In terms of behavior, children from dysfunctional families are likely to learn emotional scripts involving transgenerational behavior that is maladaptive. They are not tolerant of delayed gratification and have low frustration levels. They are likely to anger more quickly, more likely to escalate to rage, and slower to self-calm. They are not

practiced or aware of how to repair relations. It has not been modeled well in most instances.

The inability to delay gratification has been the focus of very interesting research regarding social deviance (Gottfredson &Hirschi, 1990). Individuals who are emotionally traumatized by dysregulated family systems find it very difficult to delay gratification. Providing a family with steady emotional environment that is predictable based on clearly stated family rules helps to emotionally support children through moments of frustrating challenges and ensures them that their efforts will be accepted with patience but within well-defined limits. Knowing that there are consistent limits provides a sense of security especially if there are well-modeled guides to alternatives to action that can result in more successful outcomes. All these aspects of a healthy family contribute to the ability to patiently delay gratification with a believable expectation of eventual reward and closure related to any effort. Knowing that failure will not result in a case of "sudden death" due to an adult over reacting also aids in allowing children to understand that short term failure does not lead to long term failure but to adaptive responses resulting in long term success. It's not falling that is the concern but picking yourself up and adjusting your behavior that should be the focus.

Outside the family, school and work have profound impact on the individual. We have seen cases of children emotionally traumatized by teachers resulting in a global failure of academic performance. We have documented its impact on the EEG. Using an ABA case study design, we have shown the changes in EEG resulting from removal of the child from the teacher's class and the positive emotional changes from NFB resulting in recovery of academic performance.

The impact of abuse of authority in the workplace is also very well documented (Sapolsky, 1999). Depression is a common outcome. The impact on health is profound. Yet, again, it is largely ignored at the public policy level and especially minimized by corporate organizations. Nevertheless, it is a very real problem at the clinical level. We have many documented cases of severe depression arising from abusive bosses in circumstances where individuals feel they do not have economic alternatives with respect to employment. These cases have abnormal qEEGs that respond to NFB training as well.

In all these circumstances, including family crises, brainwave training was confounded to a significant extent until the source of trauma was uncovered. Judith Lubar (1999) was among the first to document this effect at the Lubar's clinic in Knoxville, Tennessee. Her records clearly show deficits in the NFB training records that coincide with family trauma. These cases frequently involved events such as the death of a beloved grandparent and even abusive or alcoholic behavior by a parent.

We have found that professionals, such as chiropractors, who are not trained in psychology, are often blind to this confound and typically overlook it as a source of diminished efficacy with respect to NFB. This disregard may result in an endless search for protocols or equipment to "fix" the problem without due regard for the real source. By the same token we have found that psychologists and counselors frequently fail to recognize the impact of physiological and metabolic constraints on the brain and their impact on mental health. In response to the need to raise awareness regarding the impact of socio-emotional variables on mental health and NFB, I developed the ISI to measure key dimension of socio-emotional behavior.

Emotional Trauma and Brain Development

As mentioned earlier, there is extensive peer reviewed literature on the impact of physical trauma upon the brain, but in the last decade a fast-growing mass of evidence that shows how emotional trauma also deeply impacts brain structure and function has emerged. Volumetric studies of emotionally abused children indicate significant reductions in brain mass develop over time. Changes in the structure of the cortex and limbic system also have been documented. Emotional trauma impacts microbiome populations and consequently can result in enteric inflammation. Recent studies show that this pattern in turn leads to exchanges between enteric and cortical structures that lead to pro-inflammatory responses involving the kyneuretic pathway (O'Mahoney, 2014). This pro-inflammatory response also results in deficits in serotonin.

Trauma also impacts the brain in another indirect fashion. This impact is through oxidative stress and the resulting excitotoxicity. Individuals who live constantly in fear have chronically elevated cortisol levels and experience significant sleep disruptions. The constant fear generates excessive activity in the amygdala, and the brain responds to this excessive fear input through cortical activation in the form of worry. This activity helps reduce fear inputs to the cortex from the amygdala. The worry, however, generates chronic overactivation of the cortex resulting in excessive buildup of a neurotransmitter metabolite known as glutamate. Sleep is one of the ways the brain clears itself of metabolites and byproducts of inflammation. The buildup of excessive glutamate and the reduction of pathways to reduce its presence results in a toxic environment for neurons that frequently results in death.

It is not hard to conclude from the foregoing that emotional stress leads to functional and sometime organic losses in the brain. Exercise, sleep, and good nutrition along with recreational activities are key elements of reducing the effects of emotional stress.

Metabolic Limitations

Over the past decade, I have presented workshops on "metabolic limitations" that can confound NFB. My first official workshop at ISNR in the first decade of the 21st

century had only eight skeptical attendees. My most recent workshop had almost forty very interested attendees, which for ISNR is above average, and there is a DVD that is selling well enough that I still get emails about it. This change reflects the slow but growing awareness in both the clinical and public domain of the importance of nutrition. It also reflects the growing awareness among NFB clinicians that there are many physical disorders that profoundly affect mental functioning and limit the impact of NFB because the brain does not have the appropriate resources to respond to training.

A prime example of this conundrum is hypothyroid function. It is a good example because it is so common at present. It has a clear qEEG signature and results in symptoms similar to depression. In fact, there are many counselors and psychologists trying to overcome it through talk therapy, little realizing that the depression is physiological in nature. To confound the problem even more, it is well recognized in research circles that the present test for thyroid function is very inaccurate. It is equally as well covered up or ignored by the medical community. I routinely find the correlates of thyroid dysfunction in qEEGs and recommend a visit to a specialist only to be firmly told that the client had already been tested by their doctor and been given a clean bill of health. The ones I can convince to go to a specialist are always very surprised to find they do have a modest deficiency and pleased with the changes that treatment brings. The ones that do not go either need to be convinced during training or sent on their way because they cannot physiologically respond to training.

The thyroid is one of the many indicators that inflammation is developing. The inflammatory response is epidemic in our population at present. Both adrenal and thyroid function are confounded by developing inflammation. Their lines of communication with the rest of the metabolic system are disrupted by it. The result is thyroid dysregulation where there is a decrease in the production of thyroid T3 which is critical to neurodevelopment and function. Thyroid T3 is produced by a natural metabolic reduction of thyroid T4, which is typically what is tested for in acute care medical practices. The tests for T4 levels are very insensitive and consequently inaccurate (Dietzel, 2012). The test for T3 are rarely carried out but starting to draw more medical attention. Deficits in these hormones have been closely tied to exposure to pesticides by the neurotoxicology research community, especially at levels found in the food supply. The resulting deficits in T3 in pregnant mothers can result in profound effects on neurodevelopment of the fetus with respect to structural differentiation and growth of neural tissues. In adults, the reduction of T3 and T3 transport mechanisms overseen by astrocytes in the brain results in a deficit at the neuronal level. Thyroid T3 is critical for DNA synthesis and enzyme production in the neuron (Scicutella, 2007). A deficit in this cascade results in diminished output that appears as elevated slowed alpha on a qEEG and in the raw EEG morphology as well (Neidermeyer, 2005).

The symptoms of this deficit are sleep disruption, low motivation, mental fogginess, moodiness, low energy, and irritability. Thyroid dysregulation contributes to reduced myelination and a decrease in voltage-gated sodium current density reducing conduction velocities (Dietzel et al, 2012). Changes in speech, hearing, smell, and memory are consequences of latencies in visual auditory and somatosensory process that have been documented along with the general slowing of the alpha rhythm. It is interesting to note, as a major trainer in the field, how many clinicians I have encountered who are trying to train away this basic metabolic problem with operant conditioning of the EEG. It cannot work because the body does not have the resources to respond to training. It is like asking a sedentary business executive to run the marathon.

Another key area of impact on mental function is enteric integrity. Various compounds irritate and inflame the intestinal walls resulting in opening between cells in the intestinal walls called T Joints. This “leaky gut” syndrome results in the passage of large proteins into the blood stream which results in a strong cytokine response from the immune system. Over time, this leakage can result in considerable inflammation throughout the body affecting general organ function and burdening the liver with detoxification efforts. In addition, a breakdown in the flora population of the intestines results in reductions in amino acid synthesis. This reduction in turn affects the production of neurotransmitters critical for brain function. In the long term, research shows this deficit can lead to anxiety and depression that is non-psychogenic in nature (O’Mahoney, 2016). In these circumstances, NFB alone is not likely to resolve an anxiety or depression. This outcome is typically a case of trauma due to environmental toxins found in foods. Food additives and preservatives such as BPA, trace pesticides, and GMOs as well as food container contamination can all contribute significantly to this problem.

These sources of trauma are the result of physical initiation of trauma, however, psychogenic trauma can impact intestinal function as well. In the initial stages of psychogenic trauma, reductions of psychological distress can alleviate the inflammation of the intestines and move the client back to a normative allostatic balance. Once a certain threshold has been crossed, it becomes more difficult. The body at a certain point in the process becomes a repository of distress and begins to generate further distress in the system because the balance has been tipped too far in the wrong direction. The psychological precipitates a physiological problem which in turn aggravates the psychological even further. A dangerous feedback process begins that progresses in a destructive fashion and system entropy begins to prevail. This chronic phase is more complex and far reaching in its ramifications and requires a more comprehensive response than a unidimensional approach such as psychotherapy or NFB alone. This problem is why we emphasize a bio-psycho-social approach. NFB works

extremely well with individuals using a multimodal approach to recovering health, but it is muted in its effect if the entire physiological system is too far out of balance.

The Oxidative Stress Model

While observing and documenting this pattern of psycho-physiological distress, we have encountered an emerging model of physiology that very effectively organizes our observations and harmonizes them with our qEEG mapping system. This model is known as the oxidative stress model and has found considerable favor with the research community investigating the impact of stress on the physiology of the body.

Oxidative stress occurs when external agents interfere with the redox aspect of cell respiration. Excess peroxides and free radicals are generated that damage lipids, proteins, and DNA producing toxic effects and contributing to the degeneration of cellular processes. Oxidative stress can also result in the disruption in the normal mechanisms of cellular signaling as well. Oxidative stress can contribute to the emergence of cancerous cells as well as shortening of telomere length leading to premature aging. Glutathione is the key antioxidant in the body.

Oxidation rate measures the allostatic state of the whole human metabolic system. The blood pH of fast oxidizers is slightly more acidic than normal. One very effective method for gauging oxidative stress is through hair mineral analysis. A recent development in testing has resulted in the use of this method to assess cortisol patterns with a very high degree of accuracy (Wright et al, 2015). Fast oxidation is defined on a properly performed hair mineral analysis when the calcium/potassium ratio is less than about 4 and when the sodium/magnesium ratio is greater than about 4.17. The lower the calcium/potassium ratio or the higher the sodium/magnesium ratio, the faster the oxidation rate. Slow oxidation is defined as a calcium/potassium ratio greater than about 4 and a sodium/magnesium ratio less than about 4.17. The higher the calcium/potassium ratio or the lower the sodium/magnesium ratio, the slower the oxidation rate.

Ecological Trauma; A Fourth Dimension of Trauma?

The ecological system has a profound impact on our biology and presently our social systems generate tremendous levels of toxins which are dumped into our ecology. Billions of tons of pesticides that were originally designed to be nerve gas in World War II are sprayed on crops in addition to herbicides such as Round Up (Seralini et al, 2013). Toxicologists have consistently documented their negative effects on our biology through careful experimentation for several decades (Pruss-Ustum, 2006). Millions of tons of coal and gas are burned each year releasing large amounts of lead into the environment. Mercury and fluoride are used industrially at high levels including in makeup. Plastics are ubiquitous in our environment as are toxins such as dioxin. Our

adipose tissue has been documented after decades of research to be highly contaminated with all of these substances. The American Academy of Pediatrics has recently warned pregnant women and young children to eat only organic fruits and vegetables because of the recognized levels of toxicity of pesticides in the food chain (Foreman & Silverstein, 2013). Food additives are another aspect of this assault on our system. All of this contamination constitutes another dimension of trauma for the metabolic system and has a strong and enduring impact on the brain. Many of these substances have been documented to penetrate the brain blood barrier and the majority have never been tested.

One prominent and well documented example is a pesticide widely used for decades such as Rotenone. This chemical has been shown to interfere with thyroid T3 transport mechanisms in the brain (Ottiner et al, 2010). It is critical for the formation of the fundamental architecture of the brain and differentiation of stem cells into the various unique cell structures that coalesce into structures such as the cerebellum. It is also essential to the production of enzymes within the neuron itself. The brain has a specific transport system to move T3 into the nucleus of the neuron, so it can be utilized for enzyme synthesis as mentioned above. These deficits can result in a wide variety of symptoms including slower processing, brain fog, depression, insomnia, and weight gain to name a few (Dietzel et al, 2012).

It is quite evident from the existing research that these substances significantly impact neural structures and processes by impeding the flow of basic peptides and other hormones into the cell itself as well as adversely affect the flow of nutrients into the neuron.

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Chapter 11: Paper on "The New Mind Research on Asymmetry and Depression & Anxiety"

qEEG Asymmetry as A Reliable Measure of Adult Anxiety and Depression

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Jan 15, 2016

Abstract

Ninety subjects with depression and anxiety were examined using a depression and anxiety inventory in conjunction with qEEG asymmetry measurements to determine if linked ears measurements of beta and alpha amplitude asymmetry were a reliable and valid measurements of anxiety and depression respectively. The resulting analysis supports the theory that linked ears amplitude asymmetry is a reliable measure of anxiety and depression and that qEEG is a valid measure of anxiety and depression in adults.

Keywords: qEEG, Asymmetry, Anxiety, Depression

Henriques and Davidson (1991) and Davidson (1995;1998) reported on a series of investigations which consistently found that hypoactivation of the left hemisphere was a marker for a predisposition for depression. They specifically found activation related to the alpha frequency differences between hemispheres. In response to this research Rosenfeld et al (1995; 1996; 2000) developed a protocol to alter alpha asymmetry related to hypoactivation. His interpretation of asymmetry was based on a ratio (Rosenfeld et al., 1996; 2000; Baehr and Baehr, 1997; Baehr et al., 1998). The ratio used an asymmetry ratio = A2= (R — L)/(R + L) with Cz as the reference site. Baehr et al (1997) published a study involving two cases of depression which she significantly resolved, as measured by the MMPI, using an alpha asymmetry protocol. Choi et al (2011) more recently used NFB and the Rosenfeld alpha asymmetry protocol with a randomized design and control group involving 24 subjects. They employed the Hamilton and Beck depression inventories as pre/post measures of depression and significant changes were observed. Gold et al (2012) also found alpha asymmetry as a reliable marker for depression. It should be noted that these other studies ignored the fact the Davidson et al (2000) found similar asymmetry patterns between three different montages used to measure alpha power. If this is the case, it is proposed that linked ears may show the same asymmetry patterns. In addition, it is proposed that total left hemisphere alpha greater than total right hemisphere alpha may also be related to depression. In addition, the amount of alpha left as compared to right may also reflect intensity of depressive features if hypoactivation is indeed a key feature of depression.

Subjects

Ninety subjects ages 21 to 74 were selected from the clinical database. Each subject took the ISI assessment for anxiety and depression as well as receiving a qEEG to determine percent asymmetry.

Methods

Percent asymmetry was based on the number of locations higher in one hemisphere than in the other. Those with 50% or more beta locations in the right hemisphere were deemed as physiologically anxious. Those with 50% or more alpha asymmetry were deemed as physiologically depressed.

Those subjects with ISI scores 11 and below were considered in normal healthy range and excluded from the sample, leaving 53 subjects. This change was based on prior studies showing the scores of peak performers on the ISI dimensions of anxiety and depression were all 10 or less. In addition, the ISI was cross-correlated with the Beck inventories to establish clinical and subclinical cutoff values.

A further analysis of asymmetry parameter definition was conducted by determining the point in the ISI depressions scores at which asymmetry scores began to increase beyond 50% alpha in the left hemisphere. Data inspection indicated that most of the subjects with ISI scores of 12 and 13 had less than 50% alpha asymmetry but greater than 50% beta asymmetry. Most of those subjects with ISI scores 14 or greater had alpha asymmetry greater than 50% while beta asymmetry remained stable and increased slowly with depression scores. This result suggested that beta asymmetry preceded alpha asymmetry as a physiological response to stress and was consistent with arousal theory. Consequently, subclinical depression was determined to begin around the score of 15 on the ISI depression scale and the average alpha asymmetries began to manifest consistently at the 50% level. Clinical depression becomes evident on the Beck inventory at an ISI score range of twenty.

If both anxiety and depression asymmetries were low, then subjects were disqualified as this amount was considered a medication effect or underreport of symptoms since only two of these were found in the entire subject dataset. This change was also partly in consideration of the rule employed that alpha and beta asymmetries below 50% were likely indicative of subclinical symptoms. A value of below 20% asymmetry for depression and 40% for anxiety was used to define the upper limits of asymmetry related to subclinical manifestations of anxiety and depression.

The ordinal level categories derived from this preliminary data analysis are as follows:

- Depression Score ISI 14 and below but no asymmetry- depression no / asymmetry no
- Dep ISI score 14 and below with asym- dep no / asym yes
- Dep ISI score 15 and above with no asym- dep yes / asym no
- Dep ISI score 15 and above with asym- dep yes/ asym yes

A chi square statistical analysis was employed to determine if the anxiety and depression groups are correlated with asymmetry and independent of each other. Table 6 Two X two contingency is listed below. The calculated chi-square statistic was 6.6681 with a critical value of 3.8415 and 1 degree of freedom. Significance level was .05, p = .009815. This outcome indicates clearly that asymmetry is an accurate marker of anxiety and depression when the correct parameters are used.

Table 6 Two X two contingency

	Depression Yes	Depression No	Total
Alpha Asymmetry Yes	33	6	39
Alpha Asymmetry No	7	7	14
	40	13	53

Discussion

Part of the main difficulty of this investigation was determining valid cutoffs for anxiety and depression with respect to asymmetry. Fortunately, this determination became obvious in the preliminary data analysis when comparing client self-report of symptoms with percent asymmetry for beta and alpha. The fact that only 1 out of 5 subjects scoring 12 on the ISI depression scale had over 50% alpha asymmetry while the others had very high beta asymmetries of 80% or higher made the decision clear. The same pattern followed for subjects scoring 13 and 14. At an ISI depression score of 15 and higher, almost all subjects showed alpha asymmetries greater than 50%. This also suggests that not only does beta asymmetry precede alpha asymmetry in manifestation but also that anxiety precedes depression in its development. It is strong support for the argument that depression is “end state anxiety” resulting from metabolic exhaustion of resources over-utilized in the highly aroused anxious state. Depression may then be a metabolic protection mechanism that reduces social interaction resulting in withdrawal behavior to allow the organism to recover resources and reassess behavioral options.

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Chapter 12: Neurofeedback Peripherals: Photic & HRV

Heart rate variability training (HRV) has become the preferred mode of biofeedback in most of our affiliated clinics and is a critical component of treatment. Biofeedback has always been an important part of the NFB training process, but over time HRV has progressively demonstrated itself to be generally the most effective and user-friendly modality. One of its most important features is that clinicians can see both sympathetic and para sympathetic response in the feedback. We tested it against all other modalities and found it to be one of the most consistently effective systems across all clients. This consistency is important because many biofeedback modalities are only effective with one subset of the population (Schwartz & Andrasik, 2015). One example of this success is hand temperature training. Additionally, it is very user friendly. It only requires placing an ear clip on the client's ear lobe and involves no paste or special electrodes. Clients can purchase their own version for home use fairly inexpensively. Clinicians can take Internet courses on how to optimally use their HRV. We teach basics in our New Mind workshops. To learn about the research behind HRV please visit our New Mind YouTube Channel and view some of the many videos on the topic from some of the best experts in the country.

Clinics utilize this modality of feedback in many ways. Our primary approach has been to teach individuals how to breathe properly using the feedback from HRV. We have learned that tidal CO_2 is a crucial measure of proper breathing and HRV is an excellent proxy measure of this variable when breathing is done properly. The out breath should be a little longer than the in breath to get the correct balance and many clients do well counting to themselves while breathing with 4 counts on the inhale and 5 counts on the exhale. We have tested this technique with a capnometer device which measures the actual gas level in the nose. It is also important to emphasize diaphragmatic breathing and remind clients not to exaggerate their breathing. Most individuals with anxiety, engage in chest breathing with short shallow breaths at a rate greater than 15 breaths a minute. When they are relaxing, we want them below ten breathes per minute. Their heart rate is often in the 90s as well. We need to have men's rates in the 70s and women's in the 80s. Lowering the breath rate down as low as 65 is even better.

We typically train individuals for 10-15 minutes at the outset of each session. Then we begin the NFB session. At that point, we turn off the HRV feedback sound and remove the HRV video feedback screen from the training monitor. From that point on we continue to monitor their HRV while they are training to assess how well they have learned and generalized the training. We ask them to do homework and to practice, without equipment, several times a day for five minutes to help generalize the effect of the training. This technique works well and results in better compliance than asking

them to do one extended practice. As sessions progress, we test them without feedback to see how well they can do it on their own.

This process has the effect of damping down the chronic hyperarousal that most individuals with disorders experience. It also helps to reduce agitation and anxiety when we lift their initial depression with the first 15 sessions of NFB. We believe that it also accelerates and enhances their NFB performance during regular NFB sessions.

This protocol is even more useful with AT training. By the time we get to the AT training after 15 or 20 sessions of NFB, they are usually fairly accomplished at HRV. We can use this technology to relax them, so they get an optimal AT session experience. It is also an excellent indicator of how well they are doing with integrating trauma from crossovers and provides notice of any trauma that may be emerging as they approach crossover. There is more on this protocol in Chapter 9: Alpha Theta Training (AT): Trauma Integration.

Photic

Photic training is an important adjunctive method that we use at New Mind. Our database protocol output provides the photic frequencies that can be used during a session with each protocol. Each of these recommendations is based on extensive clinical experimentation over a period of more than ten years that involved qEEG brain mapping clients and running different photic protocols on them to determine which protocols had the most impact on which type of frequency distribution that was present in the map. It is important, because of individual differences, to monitor clients with the trend screen to review their response to photic in real time to confirm that their response is the expected one and that their component band trends move in the direction anticipated.

Photic training while doing NFB enhances the training of many but not all clients. Some people are more responsive than others. The effectiveness can easily be determined by watching the trend screen while training with NFB with photic, and then training without photic intervention. For those clients who are responsive to it, units can be provided for them to use at home to manage anxiety, depression, and insomnia. This technology is very underutilized in many NFB clinics. Standalone units can be purchased from Mind Alive, and they are very client friendly. The stand-alone units can also be used for clinical training. New Mind provides workshops to learn how to best implement this technology in your clinic. It is an important part of our clinical toolbox. Below is a comprehensive overview of the research on this technology and its effectiveness.

Photic Neurofeedback: An Underused Modality

Entrainment is often defined as a method of producing a frequency following response in the EEG that matches the applied rhythmic pulses of light and or sound.

Photic entrainment typically uses LEDs embedded in a pair of glasses to pulse light at a specific brainwave frequency and elicit a response in that same frequency. Light can be pulsed at the same frequency to both visual fields of the eyes, but it can also be pulsed independently at different frequencies to the left and right visual field to influence the left and right hemisphere independently. For instance, clinicians can pulse alpha to the right hemisphere and beta to the left hemisphere.

Auditory entrainment utilizes sound pulses to accomplish the same effect as photic impulses and can be monaural, binaural, or isochronic in nature. Monaural presents the same tone to both ears. Binaural presents a tone of different frequencies to each ear. The brain hears a beat that is the difference between the two. Isochronic tones are generated by using a single tone that is presented in sharp beats due to major shifts in volume from minimum to maximum. When used together at the same time, these two methods are referred to as audio visual entrainment. They are commonly used as standalone technologies to improve attention, cognitive function, mood, anxiety, headaches, insomnia, PMS, and stress in general.

History

Photic stimulation or audio-visual entrainment has a longer history than NFB. The first scientific investigations with photic stimulation began back in the 1940s. Since that time there have been dozens of studies done on many aspects of this technology. Dave Siever wrote a comprehensive text, *The Rediscover of Audio Visual Entrainment Technology*. It includes an excellent introduction to the technology that includes a catalogue of the research, the details of the technology, and its application. Rob Longo and I included a chapter on the use of visual entrainment with NFB in our book, *Doing Neurofeedback,* as well.

I tested out my first AVE unit, a David Paradise AVE device, in 1998 which I purchased from Mind Alive. Dave Siever accepted an invitation to come down to our office to run clinical trials with us while using it with NFB. At the time, there were several other manufacturers producing such devices, such as Photosonix, but there was little information on the devices and how to use them clinically. To the casual visitor at the professional meetings back in the late 90s, they seemed to be more of a novelty or a curiosity. Tom Budzynski appeared to be doing most of the research and presentations about this technology at the ISNR and AAPB meetings. Dave Siever was starting to make appearances as well. Chuck Davis could be found demonstrating his Roshi device regularly at the meetings and not long after Ray Wolf had a booth for Photosonix as well. There were also dark stories surrounding the devices, such as the one about the FDA removing them from a retail franchise known as the Sharper Image following several reports of seizures resulting from their use. There were even people literally whispering warnings in my ear as I inspected units for sale at some of the conferences.

As it turns out, this seizure phenomenon is very rare unless you already have a history of seizure. It is more likely to occur with red LEDs flashing at 15hz. Since 1998, we have not had a single seizure incident once we considered these two simple limitations of the technology.

I have done numerous workshops since the 90s on this topic at ISNR meetings as well as privately. I continue to conduct them annually. We use photic in the office frequently in conjunction with HRV and alpha training or alph theta training to assist clients in learning to calm their CNS. It is highly effective in altering brainwave patterns and has an immediate impact on EEG distribution when tracking changes with a qEEG, but unfortunately, from a clinical perspective, its effect wears off quickly. Many people experience a post training euphoria or improved focus that lasts for several hours depending on the frequency used in a session. Research discussed below suggests that it increases blood flow. When Hershel Toomim developed his first HEG device, we tested it with a photic device at his lab and found that the photic enhanced blood flow as recorded by HEG in all the individuals we tested.

Photic Research

What does the research tell us about photic in general? How responsive an individual is to photic stimulation has been an important topic for researchers. Individuals vary in response to photic driving and resistance (or lack of responsiveness) to photic driving (Kawaguchi et al, 1993). This resistance was found to be usually due to a blocking effect of internal or external stimulus (Iwahara et al, 1974). This data suggests that individuals preoccupied with thoughts and worries might be less responsive. The driving response of the photic stimulation also varies daily based on mood and indicates extreme emotion may also interfere with the effect (Ulett, 1957). Sleep deprivation will alter an individual's responsiveness as well (Ulett, 1957). Individuals with low amplitude alpha are less responsive to photic which seems to agree with the observation that preoccupation with internal stimuli has a dampening effect on photic stimulation (Rosenfeld et al, 1997). Rigidity of personality is correlated with a reduction in the color and pattern movement response that usually accompanies photic stimulation (Ulett, 1958). This outcome may be related to anxious behavior and hyperarousal of the CNS as reflected in the other research mentioned here. If nothing else, clinicians might expect that the level of response of an individual to photic driving might be a good indicator of anxiety and depression if not disorder in general. Additionally, meditators are more responsive to photic driving (Williams, 1975) and this result implies that those with anxiety might be identified with this technology.

The technical aspects of photic entrainment are complex but interesting as well. Photic entrainment has the strongest measurable effect in the eyes closed state and using sine wave photic stimulation elicits endogenous EEG that is different from the

driving effect of square wave photic (Townsend, 1975). Of interest is the finding that the level of entrainment elicited in an individual correlated with the proximity of the driving frequency used to the dominant EEG frequency of the individual being entrained (Townsend, 1975). Optimal entrainment occurs at the alpha frequency which is the dominant eyes closed frequency in the EEG spectrum (Townsend, 1975). The optimal session length to elicit a robust response is 20-30 minutes (Shealy, 1990). Photic theta generates altered states and hypnogogic images which indicates that it may assist in AT sessions when individuals have difficulty generating crossovers (Deiter & Weinstein, 1995). In fact, I have used it clinically in this manner for years; it has consistently proven very helpful.

The mechanisms of action of photic driving have only been investigated at a very general level. Once it leaves the optic nerve, the initial response to photic driving is in the lateral geniculate nucleus and cuneus (Kawaguchi et al, 1993). The photic driving response increases cortical and striatal blood flow which may explain some of the findings regarding improved mental function. (Mentis et al, 1997; Diehle et al, 1998). Spontaneous rhythms and photic driven rhythms are different and unique in nature. This difference may explain why it helps with NFB training initially and later in some cases appears to interfere with it as we shall discuss later (Gastaut & Hunter, 1953; Iwahara et al, 1974). One of the most important findings regarding the application of this technology is that using 15hz photic stimulation with red lights is the situation most likely to produce photo-convulsive response more than any other combination (Takahashi & Tsukahara, 1976). Since many of the early devices used this combination as a preset, it is clear why photic received its early reputation for being unpredictable in its effect.

Frederick & Lubar (2002) were interested in exploring whether AVS would be useful in assisting NFB training for ADHD. When combined with NFB, they found that stimulating 18.5hz for seven minutes in the eyes closed condition was more effective than eyes open and was very specific in having its greatest effect at the specific frequency of photic stimulation. The authors suggest that perhaps stimulating at each frequency of interest might be a better approach than to expect the effect to generalize across adjacent frequencies. While training beta, theta increased somewhat but based on what we presently understand about the co-modulatory relationship between theta, gamma, and beta (Meehan, 2012) it is likely that this is a compensatory response. They concluded that the eyes open condition was too weak to be of use for enhancing NFB and might even conflict with the visual stimulus process of eyes open NFB. They did not however do longer sessions or repeat sessions over time. This research still leaves the question open as to whether this technique would make a difference. (We have noted a possible interference pattern).

Frederick et al (2005) also looked at AVS and coherence. He stimulated individuals at their dominant alpha and beta (in the twice dominant alpha harmonic) frequencies and measured their coherence changes. He found significant changes in hyper and hypocoherence. Of most interest, he found dominant alpha training showed greatest changes, especially in interhemispheric synchronization. The greatest changes were noted in the first 10 minutes of a 20-minute session with few effects persisting into the post stimulation baseline. Interhemispheric coherence increased in the posterior in higher frequencies and decreased in the frontal regions in lower frequencies. AVS apparently does not globally synchronize brainwaves as often advertised. The authors acknowledged that lack of persistence of photic effect after a session may be offset by repeated sessions over time. The effects over time in terms of behavior changes and changes in qEEG maps, however, has been documented by Cantor and Stevens (2009). It has been hypothesized by one pair of researchers that changes in plasticity might be achieved by this steady state stimulation of electrical activity through secretion and actions of neurotrophins which promote synaptogenesis (Schindler and Poo, 2000).

Published Photic Research on Disorders

Huang & Charyton (2008) reviewed the entire published literature sorting for the best research designs investigating the use of photic for remediation of disorders and came up with the following list. In their review, they used mostly controlled group designs and left out investigations that used only a single session, which as would be expected typically showed minimal effects.

Patrick (1996) showed improvement on WISC-III arithmetic measures by training with 12 sessions over 6 weeks using 12-14hz for 40-50min (n=31). The results also showed improved TOVA and WISC-R processing speed scores and improvements in the WIAT. Budzynski (1999) did 30 sessions over six weeks alternating 14 and 22hz for 15 min (n=16). He observed improved GPA scores. The sessions included EDR training. Joyce & Seiver (2000) did 31 sessions over seven weeks training 16-18hz in the left hemisphere and 15hz in the right hemisphere for 20-25 minutes. They found improved attention and reduced impulsivity as measured by the TOVA as well as improved academic performance (n=20). All were control group designs.

Additionally, Olmstead (2005) trained for 12 sessions of 35 minutes each over 6 weeks and found improved WISC-III arithmetic scores (n= 30). Noton (2000) trained for 30 sessions of 15 minutes each over 30 days and decreased migraine frequency by 44% and aborted migraines 53% of the times if symptoms had already set in (n=55). One of the most convincing pieces of research done with photic was by Dave Cantor and Emily Stevens (2009). They trained individuals with refractory depression with photic using 14hz and did pre/post Beck inventory measures. Results showed significant changes. It was a crossover design with 8 individuals in each group. They found changes were

significant after 4 weeks that were reflected in pre/post qEEGs as well. Since depression often involves slowed alpha EEG, this result makes sense.

A few experiments on stress and anxiety which were not as well designed showed some effect using photic stimulation, but investigations using auditory entrainment that were well designed showed no effect over time (Huang & Charyton, 2008). A study by Carter & Russell, 1993 found it effective with learning disabled boys. Anderson (1989) found it effective with headaches. Siever (2000) reports several studies that were not published in peer review journals suggesting effectiveness with a variety of disorders. AVE was found effective with attentional disorders (Budzynski & Tang, 1998). AVE was found to be more effective than psychostimulant meds such as Ritalin & Adderall (Micheletti, 1998). Fibromyalgia was responsive to AVE (Berg et al, 1999) as well as Seasonal Affective Disorder (Siever, 2004). Cognitive decline was reduced in a study by Budzynski (2002) and reduced falling in seniors was observed by Berg & Siever (2004). TMD was responsive to AVE (Manns, et. al., 1981; Thomas & Siever, 1989) and symptoms of hypertension were diminished (Berg & Siever, 2001). Tom Budzynski trained (N=15) 14hz for 15 minutes and monitoring for 20 minutes after training and found peak alpha frequency increased slowly and normalized over that time.

How we have applied it clinically

Training based purely on symptom presentation or using frequencies based purely on their supposed specific effect with respect to a symptom has not shown consistent results in our clinical experience. I believe this clinical approach to applying photic technology is based on a simplistic view of the brain and disorders in general. It is similar to early NFB categorical analyses of disorders and protocols. What has worked better for us clinically is basing frequency selection on single or multichannel qEEG analysis, then watching the response of the brain based on the same analysis method. The example below (see Figure 69) shows the change in qEEG in a client responsive to photic after 6 min of photic stimulations alone at 10hz. Power and coherence measures change considerably.

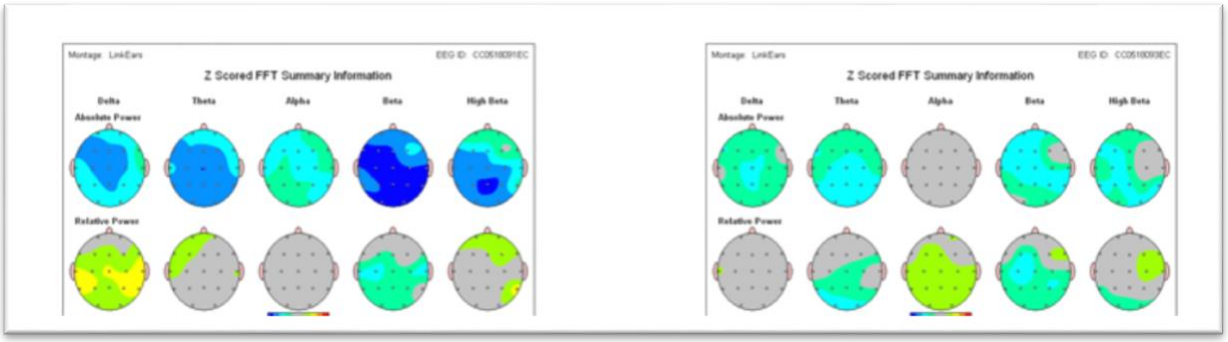

Figure 69 Change in qEEG after 6 minutes of photic stimulation

Figure 70 Change in qEEG coherence after 6 minutes of photic stimulation

Another qEEG shows changes in asymmetry of a depressed client using 10hz. Note that the red in the left hemisphere in alpha shifts to the right hemisphere (see Figure 71).

Figure 71 Changes in asymmetry of a depressed client

I ran some clinical trials with the device for a year with about 20 clients in 1998 and made many interesting observations which I reported in a workshop at ISNR that year. We trained clients mostly using photic while doing eyes closed alpha NFB training and quickly discovered that the audio component of the training had minimal impact compared with the visual component, so we dispensed with the audio and replaced it with sound reinforcement from the NFB training. Some of our first observations were that people varied quite dramatically in their responses to the photic. We tried several patterns of training. One was 10 minutes of NFB, then 10 of photic, and then 10 of NFB. We then altered it, so the second run of the trial included both photic and NFB at the same time instead of photic alone. The graph on the next page (see Figure 72) shows a typical pattern that we encountered. The third run of each trial showed an improvement in ability to generate alpha within each trial that also increased across trials.

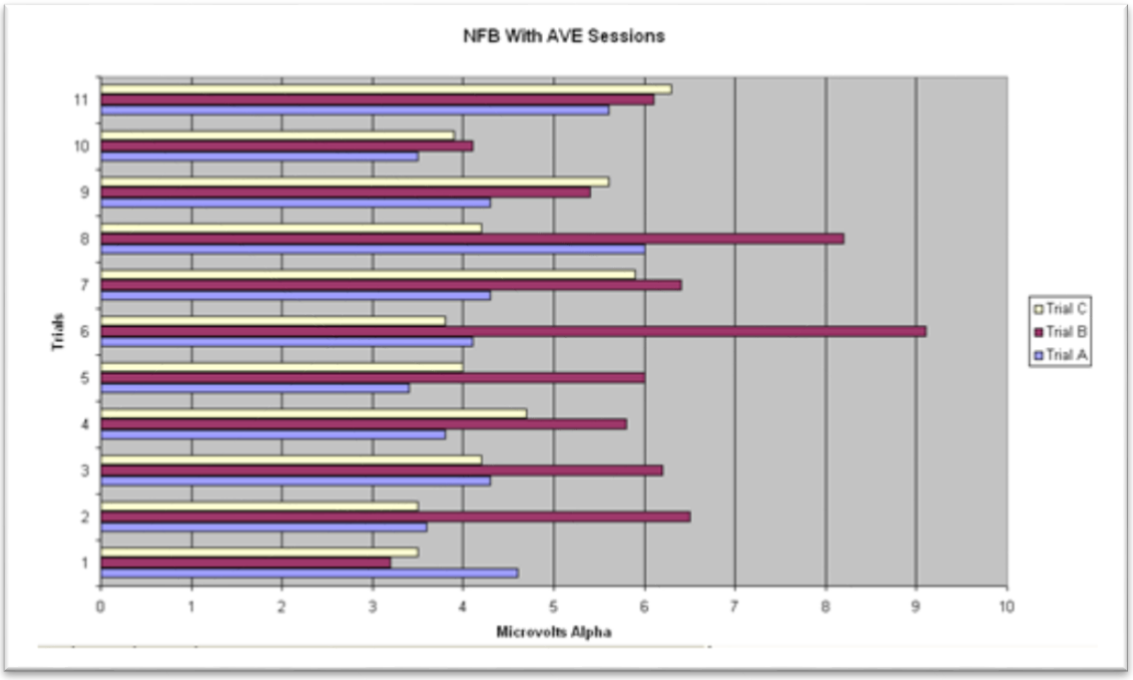

Figure 72 NFB with AVE sessions

Our research showed that photic frequently accelerated NFB outcomes. It appeared to us that the higher clients scored on the Beck inventory, the less their EEG responded to the photic. However, combining the photic with the NFB improved their training numbers over using either technology alone. So, I introduced the idea of photic as training wheels for NFB at the 1998 ISNR conference workshop, but there was not much enthusiasm for the technology at the time.

One curious aspect we continually encountered using these methods was that after most clients dramatically increased their alpha, the photic began to interfere with their NFB performance, and we removed it from the session. Their alpha amplitude values decreased when using photic past a certain point in the training. Our conclusion was that the growing strength of their endogenous alpha rhythms could have generated phase cancellations with the exogenous driving effect of the photic.

We also used photic for inhibiting theta with similar varied results. Rosenfeld's (1997) research suggested that training at a slight offset from the dominant frequency might inhibit that frequency. Our experiments indicated this outcome was more often not the case. Uptraining with SMR seemed more effective at contributing to theta inhibition until we tried training the offset of the third harmonic of the theta dominant frequency (yes, we did try the second). This approach worked effectively quite often.

Another method we experimented with was to train each hemisphere separately using different frequencies in each eye field while also training with NFB. Dave Siever obtained a patent on this method and was the first to promote it. We used his

equipment for this research as well. The idea was to try asymmetry training by training beta in the right eye field (left hemisphere) and alpha in the left eye field (right hemisphere). It did help many people improve their moods as measured by the Beck inventory, but it did not appear to have as dramatic and consistent effect on the measured asymmetry as did simple alpha training with 10hz photic stimulation.

Since that time, we have switched to using photic driven alpha EEG with eyes closed in conjunction with HRV to reduce arousal related to anxiety. When clients generate the target frequency above threshold, it triggers the photic to begin pulsing. Then it goes off when they drop below threshold. When the photic driven method fails, and amazingly it does sometimes despite all the technology, we resort to continuous photic stimulation. Why one works better than the other with different individuals remains for future research to reveal. It has been difficult to find equipment capable of performing photic driven EEG independently in both hemispheres as well as other innovative functions, but both features are now available on some equipment presently in the market.

Photic Driving

Len Ochs was reportedly the first one to use a form of NFB driven photic technology and market a device for this purpose. He called it the Flexyx EDS system. It was a version of EDS or EEG driven stimulation that flashed light just off the dominant frequency. This device changed in response to changes in EEG dominant frequency (1-40hz) due to photic entrainment. It flashed at a rate that either led or lagged the dominant frequency. Variables that could be modified in a session were the amount of frequency lead or lag in each of 4 periods per cycle, the length of time per period, the duty cycle of lights in each period, the percent synchrony/asynchrony of light flashes to right versus left eye, the number of cycles per session, the color of the strobing light, and the light intensity in each period—that's a lot of variables to explore. I spoke with a clinician in Tucson back in the 90s when I began exploring this technology. He had purchased one of these devices and used it in his clinic. He reported that it was a bit tricky to operate. He got mixed results but often found it effective. Len Ochs appears to have abandoned this project in favor of LENS, but there is still a website on it.

Roshi was another device used to combine NFB and photic. It was a black box affair. Chuck Davis was the key developer and marketed the product. He called it complex adaptive audio-visual entrainment and the strategy was to inhibit or disentrain (but the device could also entrain) abnormal elevations of the EEG by following and generating phase differentials between peak frequencies in the various component bands. The photic entrainment frequency used his "discrete" setting. It apparently considered the phase differences between the two hemispheres as well. Cory Hammond conducted clinical research with individuals with treatment resistant depression and found significant changes in anxiety and depression scales on the MMPI after 15 sessions. He

also published a case study in the *Journal of Neurofeedback* showing efficacy with depression (Hammond, 2000). Davis went on to develop the pRoshi which was the next generation of his concept, but it did not include the EEG component.

Overall, this technology is still a fascinating area with many potential developments. This chapter only samples a small percentage of it. Audio visual entrainment is highly underutilized clinically, yet it shows considerable promise. What is needed, of course, is more experimentation, especially with respect to using it in conjunction with NFB. Part of the problem with the latter is that in the past there was a lack of the right kind of equipment available to conduct clinical trials. Fortunately, that is no longer the case. Photic stimulation is a benign technology to work with, like NFB. I would encourage clinicians to give it a try.

New Mind Technologies presently offers the ZION xl designed specifically for clinical work. It produces pure and unvaried frequency output in frequency ranges proven to be clinically effective. We provide units for clients to take home to aid them in managing anxiety, depression and insomnia while we work with them clinically using NFB. Our clinical units also have built in photic capability to use during NFB sessions to enhance NFB efficacy. We offer workshops as well on how to implement this technology once or twice a year.

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Chapter 13: Managing Clients

Neurofeedback draws a widely varied clinical audience and a large percentage are individuals who have already sought relief from their problems using mainstream approaches. They have often drained their financial resources and your NFB clinic may be their last resort. They have been taught as consumers that a good solution is a quick solution. If they do not feel a big change right away, then they move on looking for the magic bullet they believe is out there somewhere. The idea that a healing intervention can take a long time involving consistent effort is difficult for them to accept. Furthermore, the idea that they might need to make radical changes in their lifestyle is marginally if not completely unacceptable. This idea is often the reason they cannot move forward in their healing process. Today, more and more health professionals are telling their patients that if they do not eat properly, get adequate sleep, exercise, and better manage the stress in their lives, then they are unlikely to really solve their health problems. These adjustments are the fundamentals of healing; and without a strong foundation, it is difficult to recover health regardless of the intervention. The American Academy of Pediatrics has a position paper informing the public that most of adult health problems arise from toxic stress in childhood and the unhealthy ways that individuals grow to manage it (Shonkoff & Garner, 2011). For decades, the AMA has been telling the public that up to 70% of medical visits are related to stress.

People who are highly distressed are likely to seek relief by eating foods heavy in refined carbohydrates and sugars. They typically do not get enough good quality sleep. They avoid exercise and sit around watching TV. They eat more and drink more alcohol than they should. They more easily become dependent on pharmaceuticals or are even addicted to drugs. They are more likely to gamble, engage in extramarital affairs, develop destructive relationships, and spend money they do not have to distract themselves from discomfort. The list of distractions is quite long and self-destructive. The consequence of this behavior is failing health.

The Meet and Greet

From the very beginning, our clinic tries to educate potential clients about both the advantages and limitations of NFB. We explain that we do not diagnose or cure anything. We inform them that we identify irregularities in the electrical activity in their brain, relate them to their symptoms, and attempt to alter those activities in a manner that provides significant relief from their suffering. We tell them this process is gradual that takes at least 40 sessions. We also impress upon them that they are not likely to notice any changes in symptoms for at least 15 sessions to discourage them from having any high expectations of immediate relief. On the positive side, we share the testimonies of other individuals suffering from problems and how they found relief and

to what degree they typically find relief. By having this discussion at the outset, we generate realistic expectations and avoid future disappointment.

The Importance of Initial Assessment

The initial assessment involves a complete bio-psycho-social review of the client's condition. We begin with the ISI and identify social behavior patterns that are contributing to their health conditions. Next, we review the CEC with the client to determine their self-identified cognitive issues. For children and young adults under eighteen years of age we do not use the ISI, but we rely on the child and adolescent version of the CEC. During this period, we review clients' personal histories and look for factors contributing to their condition. At this point, we begin the map review and discuss what characteristics correlate with their condition. This technique involves a review of the physiological checklist and their physical health history.

Clients are usually impressed with what we uncover and the picture we develop with them, and they consequently demonstrate an interest in training with NFB. Again, we review with them the importance of sleep, diet, and exercise during the process. We inform them that they will likely need to reduce medication dosage as the sessions progress if they are on any psychotropic pharmaceuticals. We encourage them to review the side effects of their medications and post them on their refrigerator in order to remain aware of their potential effect on their symptoms. Clients are additionally informed that we may ask them to do further physical testing—such as hair analysis or organic acid testing—if they show slow progress by the fifteenth session. With the client fully prepared and informed, we provide them with a checklist reviewing these points and have them sign it to be able to provide them at a later point with evidence that they have been informed. This precaution is because clients often quickly forget the conditions that we outline and develop their own—often unrealistic—expectations of the training process. In addition, we review the risks and benefits training section of their paperwork, so that they are aware that in some cases they may temporarily experience increased anxiety and agitation during the training process.

The Importance of the Symptom Tracker

The New Mind system assessments will automatically select a list of symptoms to track based on correlations between clients endorsed symptoms and the map findings. We review this list and select the items of most concern to them. Once a week, we provide them with a tablet which pulls up their checklist and have them rate themselves on their symptom levels while we attach the sensors to their head. Over time, this technique is one of the most important tools at our disposal for maintaining client retention. The effects of NFB on people is so gradual that it is necessary to provide clients with periodic feedback on their progress with respect to their symptoms. Despite the changes in their trend screens which they see each session, they often remain

skeptical of their symptom progress until they are presented with a month or two of their own self rating of their symptoms. Typically, they have a 40% or more reduction in symptoms over that time, but it is so gradual that they habituate to their condition; it becomes the "new normal." Prior to using this instrument, we have clients occasionally report no changes and leave prematurely only to backslide in their symptoms and become shocked at how much they had improved. This tendency is why we urge clinicians to utilize this tracker consistently. Once clients begin to feel the changes and see their own progress on the tracker, they are most likely to follow through with the training and fully experience its benefits.

The New Mind Trend Screen

We have developed the New Mind trend screen after decades of clinical observation and over a decade of clinical implementation. With hundreds of clinics reporting back to us, we can utilize the standardized data to enhance the system's efficiency. The trend screen is designed to easily switch back and forth between trends lines of frequencies that are being trained and the full spectrum of trend lines being monitored. The best information is found in monitoring all the frequencies. This outcome can be confusing to the client, so we show them the key trend lines of interest such as beta or alpha trends in the left and right hemisphere. We explain simply that we watch for convergence of the two lines or a positive score in the asymmetry values. This explanation helps them follow along. In addition, our trend screen filters out artifact as they train, so the trend lines tend to be cleaner and easier to follow. Clients often mistake movement artifacts for something wrong with their EEG trend. It helps to reduce this concern by removing the artifact. With this approach, clients can become more involved in the training process and follow along with their weekly progress.

The Highly Sensitive Client

Periodically clinicians encounter highly sensitive clients. Some of them will have dysautonomia which results in a highly oversensitive CNS. These individuals are typically very sensitive to all changes in the environment including smell, electrical fields, and barometric pressure. Other individuals will have undiagnosed PTSD and experience strong side effects due to relaxation. These side effects are well documented in the psychological literature and the FDA even posts them on their website. They will all attribute their side effects to some magical effect of the EEG rather than attribute operant conditioning and the reduction of CNS arousal. For this reason, we inform all clients of this risk in our "Risks and Benefits" section of their initial paperwork. The FDA indicates that once this information has been given, then the onus of the results is on the client and not the clinician. In addition, the FDA definition of 'harm" does not include discomfort related to relaxation procedures.

Clients who may be sensitive should only receive two to three minutes of SMR training at Cz and should not be charged for the procedure. They should be informed that this test will determine their sensitivity level and determine if they are acceptable candidates for the training process. If they have a reaction, it typically will not last longer than 48 hours. It is helpful to reassure them. If they do not experience a side effect, then the next session would be seven to ten minutes long. From that point on, their sessions should be gradually increased until they can do a full twenty or thirty minutes. It is recommended that they do ten to fifteen minutes of heart rate variability training prior to each session to help reduce their autonomic arousal and stabilize their CNS from the very start. Once they can tolerate a full session, it may be possible to start them on a two-channel protocol.

Dealing with Parents

Parents are often a special challenge because they cannot directly experience the changes from training but can only watch for behavioral changes. Make sure one parent is the designated person to fill out the progress tracker. The symptom tracker will be the key item in keeping them on board with the sessions. Sometimes one tracker for each parent is needed. Because progress is often incremental with the children as well, parents often fail to notice progressive subtle changes. They are often surprised when reviewing the tracker how much their own rating of their child has changed over time. Be sure that they are aware of the side effects of all medications being used and that they watch for changes in behavior that might indicate their child is overmedicated. Backing off medications is important as children progress; otherwise they begin to look worse in their behavior, and parents interpret this change as the NFB causing the problem or worse yet that the NFB is failing to have the right effect. Showing parents changes in the trend screens and explaining the changes that are present also helps keep them enrolled in the process.

The Fifteenth Session Anxiety Phase

It is very common when training that clients begin to feel some agitation and anxiety increases around session fifteen. As they shift out of negative moods and depression, they experience more energy but also the underlying anxiety that led to their moodiness and depression. We often tell clients this possibility in advance, so they know that it is a typical effect of the NFB and that it will usually wear off in a week or two at which point they will feel significantly better overall. For those clients who do not experience a reduction in anxiety, the next step is AT training as it is likely the anxiety is being driven by significant emotional trauma or PTSD.

Finishing Up

Toward the end of their training, symptom changes tend to level off on the symptom tracker. Frequently percentage of change in pre/post map comparisons decline.

Changes tend to increase in normalization and decrease in reorganization. As the brain reaches its upper limit of potential change, clients plateau in their progress. At this time, it is useful to drop sessions from twice a week to once a week, and then eventually drop to once every two weeks. If symptom changes are sustained during this weening period, then clients can discontinue training with the confidence that learning consolidation has taken place and symptom changes will be permanently sustained.

Chapter 14: Meditation & Neurofeedback

Training Meditational States with Neurofeedback in A Clinical Setting

The definition of meditation is problematic. Various authors in the West use the term without defining whether it is based on the Western or Eastern meaning. The meaning of "meditation" used in this chapter will come from the Eastern concept of the term as it has manifested in Western experience. In the past, some have argued that the West doesn't understand the writing of the East. We misinterpret meanings and definitions. However, I believe that enough Westerners have studied and meditated under Eastern masters to have a clear understanding of the basic terms and meditation techniques. In addition, a considerable amount of scientific data has been acquired on both Eastern and Western meditators to provide an objective framework for a fine analysis of the reported tacit experiences of both cultural paradigms.

Meditation is usually associated with a religious tradition of some kind, although there are arguments regarding whether Zen is technically a religion (Austin, 1998). It is interesting to note the pattern of development of Buddhist meditation techniques and styles as it moved through various cultures over time. Although the symbols and terms often change, the technique remains essentially the same. In fact, a close analysis of Hindu meditation techniques, which predate Buddhism, reveal profound similarities. Many authors such as Daniel Goleman (1988), who surveyed the variety of religious techniques called meditation, found they all have a great deal in common. Herbert Benson (2000) employed physiological measures to observe meditative techniques of a variety of religions and found a common physiological pattern as well as a common technique.

The most highly refined ancient system of meditation that we have records of emerged first in the Hindu tradition (Mascaro,1965). These techniques were well established prior to the advent of Buddhism or Christianity. The culmination of this tradition was consolidated in the yogic aphorisms of Patanjali in the first century (AD). The Buddha, Siddartha Gautama, studied these techniques in depth, found them unsatisfactory, and refined them in a manner leading to his enlightenment in the form of a special state of consciousness he named Nirvana (Rahula, 1959). The Buddhists developed several documents or scriptures around the theory and practice of meditation. These ideas migrated into most of the Asian cultures, each of which added its own symbols and refinements. It may have found its purest form in the Japanese form of Buddhism known as Zen. This religion, if we can call it that, eschews all written scripture and focuses entirely on techniques supported by oral tradition. This practice appears to be due more to the fact that it is almost impossible to teach meditation through written instruction then to any secrecy issues or lack of literacy.

Herbert Benson (2000) may be our modern western version of Bodhidharma in that he has scientifically studied these techniques, stripped them of their cultural trappings, provided scientific measures to explain the mechanisms behind them, and clearly and simply operationalize his findings. In a similar manner, Banquet (1973) also has studied the modern Hindu version of meditation as it has migrated west in the form of the Marharishi Mahesh yogi's transcendental meditation, or TM as it has become known. When compared, these various Hindu and Buddhist techniques, as they have filtered into the West, are at root almost identical. It is clear, however, from the extensive translations on meditation that these techniques are in many cases only the fundamentals. There are clearly many more techniques, some claiming to be advanced methods for achieving states of awareness for which we have no comparable categories or words in the West (Goleman, 1988; Austin, 1998).

The goal of meditation has been defined differently for the various traditions it is embedded in. The Hindu perspective presents meditation as one of the key methods for achieving transcendence of the human experience and union with the fundamental source of the universe (Noss, 1968; Mascaro, 1965). The Buddhist goal is more in accord with modern psychology in that it seeks to reduce suffering and dissatisfaction. This goal is arrived at not by achieving a normal state, but a supernormal state called Nirvana. This is because Buddhists are not just interested in reducing suffering, but in the cessation of all suffering. To accomplish this goal requires a fundamental experience and insight into the nature of existence (Rahula, 1959; Kamalashila, 1995, Dali Lama, 2001). Psychologists are not so ambitious in this area. The key issues in the Diagnostic Manual are level of suffering, statistical rarity of behavior, and interference of the behavior with daily life (DSM IV). Psychologists are interested in integrating individuals back into the social mainstream, whereas the Buddhists are unconcerned with this dimension of remediation. Nevertheless, the mutual goal of understanding mind and the reduction of suffering suggests some value may be mutually discovered between approaches. This has been clear to hundreds of researchers and specialists in these areas. More recently and toward this end, Richard Davison at Keck Laboratory for Functional Brain Imaging and Behavior at the University of Wisconsin has been investigating various states achieved by Tibetan clinicians of meditation with considerable success.

The movement of western science into the domain of meditation holds great promise. Physiological states that confer considerable mental and physical benefits on clinicians have been identified. The possibility of identifying specific states and their EEG correlates holds the potential promise of being able to train these states more clearly and effectively utilizing modern technology.

The Features of Meditative States

Two of the best models of the progression of meditative states are the Buddhist and the Hindu (Goleman, 1988). In the Buddhist tradition, there is an emphasis on extending the meditative experience into everyday life. This state is achieved through a technique known as mindfulness. It was this feature of Buddhist practice that offset it from the Hindu approach. Siddartha reportedly found that the achievement of the states his Hindu practice culminated in were wanting in that the individual found himself right back where he started once the state was exited (Goleman,1988).

The Hindu model is best demonstrated in the Aphorisms of Patanjali (Isherwood & Prabhavananda, 1969)—sources date it somewhere between 4th century B.C. and 4th century A.D. This collection is a codification of techniques and theories regarding how to achieve various states of consciousness leading to the ultimate state of being.

The Aphorisms begin with discussions regarding physical health practices and moral conduct which are essential to achieve stability in the physical world that is conducive to the practice of exercises and techniques leading to these altered states of consciousness. Once this daily continuity is established, the goal is to practice and gain control over the five basic kinds of thought waves. This technique is done in stages starting with concentration and progressing through Samayama, Savitarka Samadhi, Nirvichara Samadhi, and finally Nirvikalpa Samadhi.

According to Goleman (1988) the Visuddhimagga is “the traditional recipe book for meditation” in the Buddhist tradition. Although Buddha lived in the 6th century B.C. Oral tradition sustained his teachings until they were first committed to writing in the 1st century B.C (Rahula, 1959). The Visuddhimagga is part of this written “Pali” tradition and describes the techniques and details relating to Buddhist meditational technology. In this text, the principles and practices are described in fine detail. Nevertheless, a guide who has first-hand experience navigating this journey is essential.

Buddhist approaches to meditation revolve around a dual approach of utilizing both concentration techniques and insight techniques (Rahula, 1959; Goleman, 1988; Kamalashila, 1995; Dali Lama, 2001). The concentration techniques are very similar to and probably derived from ancient yogic techniques as eventually defined in the work of Patanjali. The stages in these techniques are referred to as “Jhanas.” There are eight levels of Jhanas after access state. Access state is like the achievement of Dhyana in Patanjali’s approach.

The path of insight in Buddhist tradition is meant to take concentration and focus it on the dilemmas of outward everyday experience. Mindfulness is the first step in which the clinician applies concentration to perceptual experience. In mindfulness the clinician develops self-awareness to a point where he is constantly aware of all thoughts and

feelings from moment to moment. With the guidance of traditional Buddhist wisdom, he is able to gain insight into the dilemma of suffering and human existence. These insights occur in categories comprising rough stages of development extending through reflection, pseudo-nirvana, realization, effortless insight, nirvana, and finally nirodh.

In both traditions, it is essential to understand that attachment to sense objects and thought objects is a major impediment to liberation and that disengaging from these attachments is the key to full enlightenment (Rahula, 1959). This achievement requires conscious and intentional confirmation through direct experience of the lack of fulfillment that results from pursuit of these attachments. Discussion regarding attachment, karma, bondage, and liberation is useful, but primarily inspirational in function. One may commit to memory and master the meaning of the sutras but remain deluded and ignorant from this perspective. It is through direct tacit experience of the fruitlessness of pursuing a path of thought or worldly action to obtain some type of salvation that an individual begins to experience the truth of the matter. This tacit truth leads to a new understanding or insight regarding the nature of being in this dimension. This approach leads intuitively to concentration and mindfulness. As it turns out, these are distinct categories of psychophysiological states with specific neurophysiological and electrophysiological markers (DeLuca & Daley, 2003; Banquet, 1973; Dunn et al, 1999; Goleman, 2003; Benson, 2000).

Herbert Benson (1975) was among the first, and certainly the most aggressive, researchers to investigate the phenomena of meditation in a consistent transcultural manner utilizing a scientific approach and modern instruments of measurement. The field of psychophysiology owes a huge debt to him and the risks he took regarding his career as a Harvard academic. As he measured the EEG and took peripheral measures of autonomic function, Benson discovered that there was a common signature to these various diverse religious approaches to meditation and prayer. He referred to it as a hypometabolic state. The unusual ability of humans to achieve this state with clear psychophysiological markers had profound implications for physical and mental health. As an M.D., Benson immediately recognized the potential significance of this discovery for society. Benson extracted the basic techniques required for achieving this state from their religious and cultural trappings and presented it to the west as a solution to psycho physiological disorders, which the AMA by its own reckoning had determined were responsible for 60-70% of all doctor visits.

Benson apparently had not fully realized that he had only scratched the surface and had presented a means to achieving an access state. This conclusion, however, was still a tremendous achievement. Unfortunately, the social order latched onto it as another brief fad reported in the media, although his books still sell well. As those of us in the field of psychophysiology know full well, anything that takes practice will always fall

short when in competition with the drugs that are the quick path of salvation in our modern society; even if that salvation is only temporary.

In summary, there is a common underlying group of techniques that leads to specific psychophysiological states that are not necessarily fully contingent upon a religious and cultural perspective to be achieved. The techniques are easy to practice, and the psychophysiological consequences are clearly observable and measurable. The benefits—in terms of both physical and psychological consequences—are also easily observable and measurable. Meditation has been more researched than many realize. TM, the group Benson had originally studied and out of which his relaxation response techniques were developed, has been the subject of over 400 scientific studies from international sources. All these studies conclude that the mental, physical, and psychological changes that occur in people from engaging in this process are profound. Research grants for this area have been surprisingly lacking, but given our cultural bias for quick and easy solutions to our problems, this shortfall should not be that surprising. In the next section, we will explore what researchers have found regarding the measures associated with these states and the benefits uncovered by research to date.

Research on Meditation

Although the more advanced meditative states may still be beyond the measurement capabilities of our present technology, past research has made it clear that we can measure these states very well up to the point of access state or Samadhi (Austin, 1998). The achievement of these basic meditative states is significant enough in their ramifications for mental and physical health as to make them worthy of measuring and operationalizing. In fact, Benson (2000) found that just entering a basic hypometabolic state daily had profound effects on mental and physical health. So, let us review the basic markers or features of these hypometabolic or meditative states and discern what to look for in those clients. We might want to introduce clients to this technology as we train them to enter these states. This technique will help determine the methods that can be employed to teach clients these states.

Some people think the importance of correct posture and breathing is vital to achieve deep meditative states in the Buddhist and Hindu tradition. However, some of the requirements and claims are exotic and based on superstitions. James Austin (1998) finds that assuming a lotus position verses sitting in a chair does not make a difference regarding achieving the states that we can measure. He further notes that focusing the attention on a repetitive stimulus facilitates the production of alpha. So, sitting quietly in a chair and focusing the attention on the same stimulus over and over will generate higher levels of alpha than engaging in other activities. Benson confirms this finding and indicates that sitting quietly in a chair and counting breaths is fundamental to achieving the relaxation response.

When reviewing the research on meditation and breathing, James Austin (1998), also notes that breathing rate slows from the norm of 12-18 breaths per minute to 4-6 breaths per minute. There is a lengthening of the exhalation period and the inhalation period drops from 43% to 25% of the breathing cycle. An important part of the exhalation extension is an increase in the pause between exhalation and the next inhalation. During this period, the breath may become briefly suspended. In some cases, for several minutes with advanced meditators. This process is interesting as Austin notes that breathing out quiets the activity of brain cells while breathing in increases activity. This tendency suggests a form of neural silence is being cultivated. (Adam Crane and I discussed this idea in our book, *Mindfitness*). There is an overall reduction in oxygen consumption which is different from sleep. Consumption drops 8% after several hours of sleep and drops 10-20% after the first three minutes in meditation.

Wallace (1970) was the first to comprehensively investigate and report the physiological aspect of meditation. He notes a decreased oxygen consumption as well as a decreased carbon dioxide elimination process. He reports decreased respiration rate, decreased heart rate, increased basal skin resistance, increased intensity of alpha activity in the frontal and central regions, episodes of rhythmical EEG theta activity in the frontal region, and decreased arterial lactate levels. Benson (1975) observes overall reduced autonomic arousal as well and stresses the significance of a reduction in blood lactate as it is considered an index of overall autonomic distress. This later measure is important because high amounts are correlated with anxiety. Benson (2000) and Cade (1989) both report reduced skin conductance (SCR), a measure of galvanic skin response and reduced EMG, a measure of somatic tone or muscle tension. These measures are also greater in higher states of arousal and anxiety. Green (1970) notes increased peripheral vascularity, also a measure of relaxation. Austin (1998) reports serotonin increases.

Changes in EEG are also striking. Kasamatsu & Hirai, (1966) measured the EEG of a group of Zen monks with a variety of meditative experience who were defined in terms of years meditating. They find the first important change is a dramatic increase in alpha amplitude 60-70uv. (This is with eyes open). This alpha is highly synchronous. Over the course of the meditation period, this alpha increases in amplitude and slows in frequency. Initially this alpha is dominant in the posterior regions but becomes progressively more prominent in the anterior region as the meditation continues. In advanced meditators, the alpha reaches very high amplitudes and slows into the theta frequencies (6-7hz). Then rhythmical trains of theta come and go. In comparing these patterns to controls who are drifting into sleep or in a hypnotic trance, the pattern is found to be uniquely different. The authors divided the phenomena of meditation into four categories reflecting deeper levels of attainment.

Studies of eyes closed TM meditators have uncovered another interesting EEG component of meditation. Banquet (1973) finds similar patterns to the Japanese study with increased alpha amplitudes and slowing followed by rhythmic trains of theta. These patterns are highly synchronized across the scalp. Rather than coherence dropping as occurs in sleep, coherence increases—especially in the frontal region. Banquet also notes the theta is very regular, not the usual irregular theta of drowsiness. What is of interest in Banquet's study is that during the third stage of meditation (Banquet also identified four levels) smooth 20hz beta spindles begin to appear. These spindles are distinctly different from the spindling that occurs prior to sleep. This outcome is identified in other studies in adepts prior to their entrance in to Samadhi. The beta shifts to continuous 30 and 60hz sinusoidal waves rippling over the rhythmic theta. This beta pattern emerges from the left anterior region.

Symmetry and coherence are also important measures of EEG that reflect changes in the brain with respect to time series analysis. Both Westcott (1973) and later Cade (1989) report from England that individuals engaged in meditative states demonstrate balanced levels of power across the spectrum with respect to both hemispheres. The progressive increases in coherence as meditation progresses that is noted by Banquet and others are synchronized with the breath suspension periods characteristic of deeper theta stages (Badawi et al., 1984). Recently phase was also investigated by Herbert et al (2003). They report enhanced long-range EEG alpha phase synchronization during meditation. This indicates that not only was coherence high, but that there is zero phase angle between sites and confirming that global phase synchronization is a unique feature of this state. Furthermore, this same level of synchronization is not noted in other frequency bands.

Another study done by Dunn et al (1999) indicates that there is a distinct difference between the EEG of individuals who are relaxing versus individuals who are meditating. This study indicates that the key difference is high levels of alpha activity focused around the parietal region at Pz. Individuals in a relaxed state have no such EEG pattern. Some yet unpublished research done by Richard Davidson and reported by Daniel Goleman (2003) done at Keck Labs at the University of Wisconsin also indicate meditative states have unique signatures. An advanced Tibetan Buddhist meditator approved by the Dali Lama as representative of the Tibetan tradition was recorded performing three different types of meditation using (f)MRI and qEEG. Results indicate that measurements show that each technique results in a unique state that has a distinct metabolic and qEEG signature. Another recent study supportive of this idea is a qEEG and LORETA analysis of another Tibetan monk which indicates that three types of meditative techniques like the ones reviewed at Keck also have distinct signatures (DeLuca & Daly, 2003).

Finally, Newberg and D'Aquili (2001) report SPECT scan analysis of an advanced meditator showing significant hypofusion of the parietal region around Pz during advanced meditative states as well. All these recent investigations indicate that meditative states are clearly distinct from relaxation and distinct states. In addition, these studies determine that concentrative meditation shows a unique EEG and blood perfusion pattern at Pz. This area, according to Newberg is the orientation association area that has the key function of discriminating self from others. Both the EEG and hypofusion measures indicate that this area is highly under-activated in meditation and may in part explain the profound sense of oneness that is common to this experience.

The benefits of meditation are diverse and well established at this point. Much of the research comes from a great variety of studies (Benson, 2000). Meditation reduces state and trait anxiety, enhances serotonin levels, reduces blood lactate levels, hypertension, insomnia, improves cognitive performance, enhances memory, results in reductions in moodiness, and diminished cravings for food as well as other mediums of the addictive process. Regarding the last item, it should be noted in passing that Peniston derived his AT protocol for dealing with addictive disorders from workshops presented by Elmer Green (Kulkosky, 1996). Green utilized theta training at O1 as a protocol because he learned from laboratory experiments that high theta at this location was a unique signature of a meditational techniques he had learned in graduate school (Green, 1993). In other words, we are already using this technology in NFB without openly acknowledging its source.

Cognitive Changes and Therapeutic Applications

The work of Aaron Beck and Martin Seligman is widely appreciated in psychology today and can be found in every Psychology 101 textbook in publication. Yet it is amazing how poorly this research has been applied until very recently. As it turns out, meditation is an excellent vehicle for application of these principles. In addition, NFB can effectively combine both paradigms in a manner that makes them easier to operationalize in a clinical setting. In fact, many forms of NFB can be interpreted as a form of meditational training, especially AT training. As is pointed out above, AT training is indirectly derived from meditational training. The details of this dimension of application of NFB can only be briefly summarized and superficially covered within this chapter, but it will be further explicated in a forthcoming book.

Martin Seligman's (1975) research uncovered the fact that mammals begin to destabilize physiologically when exposed to double-bind situations. They begin to behave like depressed human beings and frequently die if not removed from the double-bind. Aaron Beck (1979) took this insight one step further and applied it to the cognitive realm. Neo-behaviorism and the cognitive revolution soon followed in psychology. Beck found that humans responded to cognitive double-binds as well as

situational ones with depression and a unique pattern of "automatic thinking." In addition, Beck found these patterns of thinking in individuals with anxiety as well. What is of even greater interest is that recent research suggests that depression may be an end stage to chronic anxiety (Davidson, 2000). The implication of this finding is that individuals respond to double-bind situations, both physical and cognitive, with growing anxiety.

This anxiety over time often triggers a protective response in the organism that comes in the form of depression (Zacharo, 1991). There is considerable clinical research to support this perspective (Beck, 1979; Davidson, 2000; Davidson et al, 2000; Kaplan, 2002). It has been suggested that this trigger is a consequence of the exhaustion of the CNS. I can recall John Gilbert having worked with 114 cases of depression and reporting at the SNR meeting (2000) that the lifting of the depression in all cases resulted in the manifestation of either severe anger or fear (anxiety). In almost every clinical case we have had over the past eight years, we have seen anxiety emerge as depression lifts both in terms of symptoms and in the qEEG analysis. There is insufficient room in this chapter to explicate the details, however, we usually see a shift from excessive slowing in the left hemisphere to increased activation in the right as well as a drop in slow wave amplitude as the Beck inventories indicate a reduction in severity of symptoms. This outcome can manifest in many patterns in the qEEG and is easily missed unless the clinician is looking for it. Based on the research of Davidson et al (1999) and others, this result is exactly what we should expect to see.

Recently the work of Jeffrey Schwartz (2002) has indicated that worry associated with OCD can be reduced or eliminated using techniques drawn from Buddhist meditation. The key feature is disengagement from discursive thinking involving fearful thoughts. It is well known that individuals with OCD engage obsessively in specific categories of disturbing thoughts. These automatic thoughts are in an extreme form. Schwartz has even identified the "worry circuit," an anterior cingulate network interfacing the orbital frontal region with the amygdala, in the brain that is responsible for this loss of control over thought. It is interesting to note that Demasio (1999) reports that automatic thoughts can operate extensively below the threshold of awareness. In fact, a great deal of the thought process occurs below the threshold of awareness. This lack of awareness makes sense from what we know of the pattern of learning in humans. We tend to routinize any learned sequence and perform the routines with a minimal conscious effort (Posner & Raichle, 1994). Repetitive patterns of thought consequently become background neural activity.

When alpha training individuals, it is common to see them desynchronize into beta and report initially that they did not know what they were thinking. This tendency is because discursive thought often involves a loss of self-awareness. In fact, it is this loss

of awareness that meditation seeks to resolve. With further practice, individuals begin to become aware of these thoughts. They are in fact automatic thoughts that fall into the categories described by Beck. They are triggering amygdalic responses in the limbic system that result in chronic autonomic arousal. This triggering is because the amygdala cannot distinguish external threat stimuli from internal threat stimuli (Le Doux, 1996).

According to LeDoux, the frontal cortex's primary response to the amygdala's stimulation is increased activity in desynchronization and increased beta due to higher levels of arousal and processing. Of course, the hallmark of individuals with anxiety is elevated beta. In fact, over-activation of the left frontal region has been associated with worry, the right frontal region is associated with high arousal and panic (Nitscke al, 1997); and the right parietal is associated with rumination (Davidson,1999). Le Doux observes that the left dorsolateral frontal increases in activity are likely related to short term memory networks over-engaged in the worry process. He notes this increased activity may be one way of gating the short-term memory area, so that the driving conditioned fear stimuli in the para hippocampal regions cannot enter conscious awareness and generate panic states. Sterman (1995) demonstrates how this pattern of desynchronization without sufficient resynchronization between tasks can tire individuals and reduce performance levels. Memory and problem-solving skills degrade resulting in less effective interactions with the environment. Over time, this degradation results in reduced social accuracy and reduced access to social resources as well as increased avoidance behavior.

The consequence of excessive and chronic overarousal and worry also increases in cortisol levels in the bloodstream that damage the hippocampus (McEwen, 1987; Kaplan, 2002). Not only does this overarousal result in loss of short term memory function, but it also depresses immune function since the hippocampus is a key switching mechanism for global immune system function. In the past, research established significant reductions in immunoglobulin A (Stone et al, 1987; Cohen & Herbert, 1996), the first line of immune defense, in the face of even moderate distress. More recently the work of Davidson et al (2003) continues to support these findings. Fortunately, withdrawal from stressful stimuli also results in neurogenesis in the hippocampus, a return of memory, and immune function. This observation also supports the notion that the body has intrinsic mechanisms to reduce exposure to excessive negative stimulation and avoidant behavior due to left frontal slowing. Depression may be a primary mechanism for this protective process.

Given the above considerations, it makes sense that engaging in exercise that reduces activity in the worry circuit and calms the CNS would be as effective as any medication if clients learn to control their CNS through this exercise. The primary technique in meditation is the continuous observation of a stimulus without digression

into discursive thinking. This technique results in growing synchronous alpha amplitudes across cortical networks. If this activity is practiced long enough, a growing neural silence begins to emerge which Adam Crane (2000) appropriately refers to as profound attention. The brain becomes increasingly hyper coupled and begins to drift into sleep. However, with efforts to maintain significant levels of arousal, for instance by maintaining an erect posture, sleep spindles fail to emerge, and alpha power increases. The individual maintains awareness at increasingly lower levels of arousal.

Demasio (2002) hypothesizes that consciousness emerges in layers, like an onion skin, as arousal (the RAS networks) energizes layers of brain networks from the brain stem upward. He believes that the most primitive levels of awareness begin in the trigeminal plane. This region is just above the brain stem. It is likely that generators in these regions operate in the delta frequencies. John (1999) finds that consciousness seems to emerge around 3-4hz in individuals waking from anesthesia. It may be that maintaining enough arousal to experience these more primitive levels of consciousness can result in novel experiences of more basic forms of awareness covered up by a more normally active cortex. Consciousness at this level may interact with the implicate order in a different way than we are used to experiencing. This primitive experience of awareness may be more unitive in nature. The ability to consciously access it may indicate a new level of organism self-regulation that involves greater top down integration.

Clinical Implementation

Regardless of the true mechanisms and metaphysical implications of the meditative process, 40 years of research has clearly established its validity as a unique state of hypometabolic functioning distinct from sleep or hypnotic trance and having a unique set of associated states with unique EEG signatures. This research suggests that NFB should be an effective way of training these states and verifying their attainment. In fact, several people have been doing this technique for over a decade including Adam Crane, Les Femi, myself, Anna Wise, and Maxwell Cade to name a few. I have used EEG biofeedback to train individuals with mental disorders to meditate for over half a decade utilizing the research mentioned in this chapter with excellent results. I would argue that those who use AT training have been doing it as well. I have found that this type of training is especially effective with individuals with anxiety, depression, headaches, and fibromyalgia. It is often more effective than NFB alone.

In my extensive dealings with individuals with anxiety disorders, I found that the most difficult cases could train their alpha up to some degree. Their beta went up as well, and they could not train their beta down. This lack of plasticity is interpreted as a consequence of a long standing neural habit grounded in a physiological pattern resulting in a structural change. Such patterns have emerged in other research

(Schwartz, 2002). This neural neohomeostasis requires time. The exercise of new inhibitory patterns to alter. LeDoux (1996) notes that fear response does not extinguish because the responses are lost, but rather because new inhibitory networks develop to control them. Despite extensive practice, many severely anxious clients develop this ability to inhibit beta very slowly. I have found that teaching them the relaxation response techniques while monitoring them allows me to better direct the instruction and outcome. In most cases, clients can reduce their beta and increase their alpha more effectively with neuromonitoring of their EEG during relaxation response training than through EEG biofeedback alone. In fact, the two techniques appear to be synergistic.

Because of this connection, I asked Dave Siever at Mind Alive to build me an inexpensive hand held analogue alpha trainer for clients to take home with them. Richard Glade found out about the device and began successfully using it to help train novices in Tibetan meditation techniques. Since that time, interest has been growing. Unfortunately, this wonderful device was discontinued.

Anna Wise developed extensively the technique of neuromonitoring. Using Cade's mind mirror, Anna conducts group workshops where individuals are hooked up to the mind mirror. She switches from participant to participant as she takes them through exercises meant to generate specific component bands of frequencies. In this process, she helps teach them how to access different levels of consciousness and shape their brainwave patterns into an awakened mind state like the one Cade (1997) found in his research. Anna can harness group dynamics to help individuals past barriers to growth they might not normally be able to overcome as quickly working on their own. This growth is somewhat reflected in Buddhist tradition where meditators frequently practice in groups because it is felt that the resulting atmosphere aids the meditation process.

Clients can be trained to meditate using NFB and more traditional techniques. They can reap tremendous benefits from the process. The two approaches appear to be synergistic and often work better together, especially for Westerners who appear to need external aids to assist them in understanding the process and how it impacts them. Finally, this approach can be harnessed for group work in a very powerful way that helps individuals overcome difficult blocks to growth as well as give therapists a means of monitoring how effective their group process is from moment to moment.

More on Clinical Implementation

Assessing clients to determine if they are appropriate for this approach is a crucial first step in employment of this technology. There are many cultural and superstitious barriers to using these technologies in a therapeutic setting. Many individuals from various conservative religious backgrounds define meditation as distinct from prayer and as either suspect or dangerous to engage in. They may have the same perspective

on brainwave training. Usually it is not worth the effort to attempt to engage them in either approach. On the other end of the spectrum are individuals who assume either approach is silly and pointless. They consider themselves very practical people who stay close to the facts and "know better" than to waste their time on such an intangible process. This latter category often includes many "hard-nosed" professionals who are quick with opinions and slow to read the research. We have found it equally a waste of time to attempt to gain their interest. The type of client most suitable, unfortunately, are intelligent, educated, and open-minded people who are generally open to novel approaches to problem solving in most areas of their lives. It is extremely helpful if they have any prior exposure to yoga, the experience of meditation, or altered states. Even if their disorder is extreme and long standing, we find they respond to these technologies very well.

Initially we have clients undergo a qEEG to examine the distribution of their EEG and determine if NFB alone or NFB guided meditation is a better approach. We avoid using the latter approach on individuals with indications of TBI, ADD, or similar disorders involving excessive slow wave activity. Pure unipolar depressives are rare, but they constitute another category to avoid. Since most individuals with depression also have active or latent anxiety disorders underlying the depression process, they are acceptable candidates.

During the first training session, we establish baseline measures of EEG amplitude in the various frequency bands that we plan to work with based on their brain map. We also select the initial site of training. Often, we train along the midline somewhere to avoid asymmetry issues and allow the brain to make its own decisions during the training process in matters of coherence and symmetry. Since the research suggests that access state involves an equal distribution between hemispheres of component bands across the frequency spectrum, the midline is a good selection. Much of the research suggests Pz as an important site. Consequently, we begin there unless there are contraindications. This site is also where Bill Scott does most of his AT training. Another reason to choose this site is that the research suggests that the initially emerging global EEG patterns first appear in the posterior region at each stage and move forward to the anterior region.

Considering the foregoing, we begin training individuals with a 9-11hz band of alpha and attempt to get the clients to exceed their baseline readings with respect to magnitude. We train them to breath from their diaphragms and monitor their breathing. As they become acclimated to this over several sessions, we begin to teach them to increase the duration of their exhalation phase and to focus particularly on the space between in breath and out breath. However, this is an initial phase in the training process. We do not heavily emphasize the breathing until the neuromonitoring phases.

We initially use proportional feedback as Kamiya's research (1969) indicates it is most effective for training alpha. Once they have achieved sufficient amplitude of alpha, we may switch over to dichotomous feedback and a broader band of 8-12hz. We train in ten-minute intervals initially, based on Kamiya's findings (1969) and the general learning literature which suggests most people have difficulty sustaining focus after seven minutes. Over time, we extend that period to twenty minutes as the client demonstrates extended capacity to focus. During this period, there is usually much discussion on the nature of discursive thought and the many topics on their minds that leads them into it and away from focusing on the training. We also point out constantly during their training how their alpha amplitude falls when they engage in discursive thought.

Once the client can exceed baseline, we focus progressively on posture, muscle tone EMG, SCR as necessary, and heart rate. This focus often assists them in achieving higher amplitudes of alpha. Clients can see from the training graphs the impact these other domains of practice have on their overall performance and are often inspired to practice them more in their daily routine. Eventually, we begin five-minute trials with the feedback turned off. These trials are the neuromonitoring phase. During this period, we review and emphasize the relaxation response techniques developed by Benson. As clients demonstrate a greater capacity to increase alpha and reduce beta, we focus progressively more on their breathing pattern, and get them to focus on the space between their breathing. Next, we expand to ten-minute trials and begin them on training at home once a day for ten minutes.

During the neuromonitoring phase, it is possible to sculpt the EEG patterns using techniques developed by Anna Wise or add visualizations practiced in Tibetan Buddhist traditions. Knowing the client's history is useful here. A clinician can implement healing visualizations for those with somatic problems, compassionate visualizations for those with anger issues, etc. Many of the Tibetan techniques use the period toward the end of the meditation to implement these visualizations as it is a period of peak concentration. Recently in France, a research project directed by Benson has begun exploring the extraordinary amount of physical heat that meditators are able to generate using this technique. Tibetan meditators can dry out wet sheets of fabric placed on their bare backs while sitting outdoors in freezing temperatures. Clearly this ability indicates it is an effective point during the meditation to focus on other visualizations.

During the neuromonitoring period, clients tend to experience successive insights into their own attachments or life agendas. One client from our clinic suffered from panic attacks and realized that she was always trying to make things come out perfectly. Once this insight emerged, her training abruptly improved. She discontinued having panic attacks. Like this woman, as clients progress, they may have more and more subtle

insights. As they become more self-aware, they recognize that they are entertaining automatic thoughts without realizing it. These thoughts are often key to uncovering their personal agendas. These agendas are often grounded in childhood conclusions regarding fundamental issues of life which have never been reviewed with adult awareness (Cozolino,2002). Once they come into awareness, they can be uncovered in many compartments of everyday life and inhibited. This reintegration process takes continued mindfulness throughout the day. In this way, the individual's life is progressively transformed. As they learn this technique, they can begin to do it on their own without clinical support. The stuff of everyday life becomes a vehicle for ongoing insight.

The release of energy bound up in cortical processing involving worry, rumination, and hyperarousal is considerable. Clients begin to feel physically more energetic, lighter, and stronger. Health improves as previously suppressed immune functions come back on line. Memory begins to return as neurogenesis occurs in the hippocampus region. Clients sleep better as circadian cycles normalize. They begin to report that they are less reactive to stimuli that they usually consider dangerous or negative in some manner.

Recent comments in the field of psychology (Elkins,1999) show that clinicians often find clients becoming more spiritually oriented as they come to the end of their therapy sessions. In view of this scenario, many therapists direct their clients to other faith experts. For those neurotherapists who have the inclination and resources, this situation is an opportunity to harness the latest scientific insights into the neuropsychological of behavior and consciousness to work with the client who wishes and explore beyond the average level of integrative functioning. Clients that come to our office specifically for meditative training will often be engaged to pursue this "process" deeper with us as clinicians. During this period, we begin to explore more fundamental issues of suffering and attachment. These techniques may include closer examination of the thoughts that still intrude during meditation, the finer points of managing destructive emotions, fundamental issues of attachment surrounding pleasure, fear, and death. Once they become skilled at this process, they will go on to continue it naturally and seek to share their insights with others also engaged in the process. Ultimately this community engagement leads to integration with a loose community of friends dedicated to higher goals relating to the most fundamental insights regarding life and the human condition.

In Conclusion

Adam Crane and I met because we had read much of the same literature and through our life experiences came to the same conclusions regarding meditation, EEG biofeedback, and higher state of consciousness. We wrote our book, *Mindfitness* to express our view point. One of the most important segments is on the Newtonian causal bias, often referred to as scientific materialism, that still pervades science even though it

has been established as erroneous (Soutar, 1996). Stanislove Grof (1993) devotes a good portion of his book, *The Holotropic Mind*, brilliantly to the same issue. This erroneous perspective limits the questions we ask in research and impedes science. Science is the search for scientific truth and holds all scientific truth to be temporary. Unfortunately, many scientists never learned the difference between scientific truth and absolute truth in their college methods class. They believe scientific truth can replace absolute truth. There is little support for that conclusion. According to all the most recent thinking in the field of the epistemology of science, we can only conclude that a hypothesis (a tentative axiom or postulate) is probably not wrong.

When scientists like Tim Leary, John Lilly, Richard Alpert, and Elmer Green encountered tacit metaphysical truth, they often abandoned science in the pursuit of their own vision. Science provided them a springboard for their plunge into this arena, and they were aware of the consequences of the transition they made in moving from the domain of scientific truth to the domain of absolute truth. I believe they saw themselves more as point men trying to send back advanced notice of potential domains for exploration. Their scientific peers saw this movement as a fall from grace rather than early retirement. All scientists are driven by the pursuit of truth. There is a fear in the scientific community of flying too close to the sun and engaging metaphysics again. Unfortunately for those of weak heart quantum mechanics has already thrust us back into metaphysical debate (Hawking, 1988).

The field of neurotherapy feeds off the latest research in neuropsychology and physics. This relationship is our dilemma. We apply the latest research in a manner which most of the researchers providing us with this information have not even seriously considered. They cannot see us or hear us. We exist in the liminal realm of the cutting edge. What is most difficult is that this realm now embraces the point where science is trying to determine if the boundary between scientific truth and absolute truth is truly asymptotic. In our clinics where we walk this razor's edge and the impossible seems to happen every day, it requires great honesty and courage to continue the work. It may still be a hundred years before we begin to fully understand the mechanisms we are just beginning to employ.

The circumstances force us to consider how far we can take our clients with this technology. This circumstance is the dilemma that faced Elmer Green and John Lilly. Peniston, and Kulkosky have already crossed the line. We can hide the facts, but we cannot take that back. Other civilizations have explored the realms we are encountering without benefit of the scientific process. This oversight does not entirely disqualify their observations. Green, Peniston, and Kulkosky, perhaps not entirely with full intention, have already proved the point. The most evolved and codified traditions of investigation in this realm can be surprisingly sophisticated at times. Benson, Davidson, Ekman, and

others are already establishing this empirically. I believe it is our job to pay close attention to their work and do what we do best—operationalize their findings for the benefit of those people who suffer in our social order. We have the research, technology, and moral imperative to propel us along this trajectory.

Employing a meditational model for neurotherapy has powerful support in the research to date. It is one of many competing models. In my opinion a good neurotherapist has many tools in his bag, has learned how to use them, and employs them with the intent of "doing no harm." This chapter has attempted to provide a scientifically supported rational and method for employing a meditational model in the clinical setting. It is not always appropriate with all clients and with all situations. When the right occasion arrives, however, it is a very useful method to have at hand.

At the New Mind clinics, we have often found that after clients resolve many of their issues and become more psychologically integrated, they begin to explore their spiritual potential and at times move on to other sources. Many of these sources do not have the training and resources that a properly trained biofeedback professional can offer. As experts in reading biosignals, we are in a superior position to objectively determine how well individuals are performing in the spheres of meditation and mindfulness practices as well as in proper breathing associated with these practices. It is important, however, that clinicians themselves engage their equipment and practice until they achieve a significant level of skill before training others.

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Appendix

Interactive Self-Inventory

Rate each statement on a scale of 1–5 according to the following key:

1 = Never 2 = Sometimes 3 = Often 4 = Usually 5 = Always

1 2 3 4 5	I avoid talking to people unless I know them well.
1 2 3 4 5	I am nervous with people unless I know them well.
1 2 3 4 5	Being introduced to people makes me tense and nervous.
1 2 3 4 5	I avoid walking up and joining a group of people.
1 2 3 4 5	I feel on edge when I am with a group of people.
1 2 3 4 5	I think up excuses in order to avoid social engagements.
1 2 3 4 5	I jump at the chance to meet new people.
1 2 3 4 5	I am relaxed when I am with a group of people.
1 2 3 4 5	I don't mind talking to people at parties or social gatherings.
1 2 3 4 5	I find it easy to relax with other people.
1 2 3 4 5	I look forward to my social engagements.
1 2 3 4 5	I enjoy introducing people to each other.
1 2 3 4 5	I do my best work when I know it will be appreciated.
1 2 3 4 5	Disapproval of someone I care about is very painful for me.
1 2 3 4 5	I easily get discouraged when I don't get what I need from others.
1 2 3 4 5	I must have one person who is very special to me.
1 2 3 4 5	I need to have one person who puts me above all others.
1 2 3 4 5	I enjoy being by myself.
1 2 3 4 5	I don't depend on other people to make me feel good.
1 2 3 4 5	I like to rely on myself to get things done.
1 2 3 4 5	I don't need much from people.
1 2 3 4 5	What people think of me doesn't affect how I feel.
1 2 3 4 5	What other people say doesn't bother me.

1 2 3 4 5	Winning in competition makes me feel more powerful.
1 2 3 4 5	I become competitive even in situations that do not call for competition.
1 2 3 4 5	I tend to turn a friendly game or activity into a serious contest.
1 2 3 4 5	I feel envy when my competitors get rewarded.
1 2 3 4 5	I am very unhappy when I lose in competition.
1 2 3 4 5	I can't stand to lose an argument.
1 2 3 4 5	People who quit during competition are weak.
1 2 3 4 5	Competition inspires me to excel.
1 2 3 4 5	I get useful information from others.
1 2 3 4 5	When a person gets upset, he or she should talk it over with others.
1 2 3 4 5	It's important to ask for help when you need it.
1 2 3 4 5	It's fairly easy to tell who you can trust and who you can't.
1 2 3 4 5	I enjoy working with others to solve a problem.
1 2 3 4 5	Two heads are better than one.
1 2 3 4 5	I hate being less than the best at things.
1 2 3 4 5	People will probably think less of me if I make a mistake.
1 2 3 4 5	People take advantage of my mistakes.
1 2 3 4 5	There is a right way and a wrong way to do things.
1 2 3 4 5	I pay very close attention to details.
1 2 3 4 5	I make sure I don't make the same mistake twice.
1 2 3 4 5	Either I do something well, or I don't do it at all.
1 2 3 4 5	I make sure there are no loose ends.
1 2 3 4 5	I learn new things when I make mistakes.
1 2 3 4 5	It's good to hear a fresh point of view.
1 2 3 4 5	I make room for the unexpected in my projects.
1 2 3 4 5	I make it up as I go along.
1 2 3 4 5	It's important to be patient with the mistakes of others.

1 2 3 4 5	There are several effective ways to achieve the same goal.
1 2 3 4 5	At times a sudden change of plans is necessary.
1 2 3 4 5	I enjoy trying out new things.
1 2 3 4 5	I am open and honest about my feelings.
1 2 3 4 5	I enjoy meeting and talking with people for the first time.
1 2 3 4 5	I complain about poor service when I encounter it.
1 2 3 4 5	When I am asked to do something, I always want to know why.
1 2 3 4 5	If I don't like something, I say so.
1 2 3 4 5	I don't mind confronting others when they are out of line.
1 2 3 4 5	I have a hard time saying no.
1 2 3 4 5	I tend not to show my feelings rather than upset others.
1 2 3 4 5	I avoid complaining about things I don't like.
1 2 3 4 5	People should be nice to each other no matter what happens.
1 2 3 4 5	I avoid arguments of any kind.
1 2 3 4 5	I don't ask questions for fear of sounding stupid.
1 2 3 4 5	I don't plan things as carefully as I should.
1 2 3 4 5	I find it hard to sit for long periods of time.
1 2 3 4 5	I solve problems by trial and error.
1 2 3 4 5	I am restless at lectures or talks.
1 2 3 4 5	I don't always finish what I start.
1 2 3 4 5	I act on the spur of the moment.
1 2 3 4 5	I let the details take care of themselves.
1 2 3 4 5	I say things without thinking.
1 2 3 4 5	I have difficulty staying focused.
1 2 3 4 5	I like to get the job done quickly.
1 2 3 4 5	I plan things carefully.
1 2 3 4 5	When I get angry, I wait for a while before I respond.
1 2 3 4 5	I like to think carefully before I make a decision.

1 2 3 4 5	I plan each day with a written list.
1 2 3 4 5	I avoid excess in anything.
1 2 3 4 5	I set aside time for myself each day.
1 2 3 4 5	I become very upset when things don't go my way.
1 2 3 4 5	I tend to keep things well organized.
1 2 3 4 5	My worries overwhelm me.
1 2 3 4 5	I feel tense and uncertain.
1 2 3 4 5	I wish I could just be myself.
1 2 3 4 5	I am concerned about what others think.
1 2 3 4 5	I freeze up in certain situations.
1 2 3 4 5	I feel less than adequate.
1 2 3 4 5	I'm afraid of sounding stupid.
1 2 3 4 5	I'm not sure what to say.
1 2 3 4 5	I get embarrassed easily.
1 2 3 4 5	I worry about making a good impression.
1 2 3 4 5	I can usually solve most problems if I just keep trying.
1 2 3 4 5	Things work out okay.
1 2 3 4 5	Generally I trust people to do what's right.
1 2 3 4 5	I get along well with people in general.
1 2 3 4 5	A little friction between people is normal.
1 2 3 4 5	I subscribe to the idea of live and let live.
1 2 3 4 5	I don't get hung up on things for long.
1 2 3 4 5	I like to take my time and do things right.
1 2 3 4 5	I feel tired and have low energy.
1 2 3 4 5	It's very hard to get motivated.
1 2 3 4 5	Things look hopeless.
1 2 3 4 5	I feel very sad these days.
1 2 3 4 5	I feel worthless or guilty.
1 2 3 4 5	I feel like a failure.

1	2	3	4	5	I seem to cry for little or no reason.
1	2	3	4	5	I am sleeping in a lot.
1	2	3	4	5	I am more irritable than usual.
1	2	3	4	5	I am eating more or less than usual.
1	2	3	4	5	I have lost interest in things that I used to enjoy.
1	2	3	4	5	I have a lot more negative thoughts about myself.
1	2	3	4	5	I have trouble going to sleep or staying asleep.
1	2	3	4	5	I feel restless and agitated.
1	2	3	4	5	I worry constantly.
1	2	3	4	5	Things feel out of control.
1	2	3	4	5	My heart feels as if it is racing or pounding.
1	2	3	4	5	I feel light-headed, faint, or dizzy.
1	2	3	4	5	My hands shake.
1	2	3	4	5	I feel short of breath or tight in the chest.
1	2	3	4	5	I sweat a lot.
1	2	3	4	5	My hands or feet feel cold.