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KEYNOTE PRESENTATIONS

Attachment Shock: Brainstem Reactivity in Developmental Trauma Implications for Neurofeedback and Psychotherapy

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Neglect and abuse in childhood impact every major system in the developing brain and these impacts endure all too often across a lifetime. These enduring effects are now most frequently referred to as developmental trauma. Research strongly suggests that emotional neglect is the core issue in developmental trauma. Research from Lyons-Ruth, et al. has found a particular attachment dilemma, established by the age of 18 months, that predicts “borderline personality” and suicidality in late adolescence (I will explain why I use quotes here in the talk). Lanius et al. have provided the most insight to date on the effects of early childhood trauma. They have done extensive research on the differences between the brains of those who have endured early trauma and those who have not. We will look at many of these findings particularly as they implicate the role of the brainstem in developmental trauma.

The focus in psychotherapy and in neurofeedback has been almost exclusively on top-down, cortical control of subcortical drivers. As we will see, in trauma the driver is the brainstem, more specifically attachment shock that is retained in the brainstem. It is the brainstem that elicits the reactivity of the amygdala and that drives thought patterns in the cortex. Neurofeedback protocols are being developed to quiet reactivity in the brainstem; I will share these, but my primary goal is to encourage clinical neurofeedback practitioners and Q-based researchers to take up this pursuit of quieting the brainstem.

In my pursuit, I met Frank Corrigan, MD, the author of a new therapy called Deep Brain Reorienting and perhaps the world’s foremost expert on the brainstem. It is his contention that the shock of attachment rupture, as well as other traumatic shocks, are retained in the brainstem and, as long as they remain unprocessed, the person who has experienced them is at risk. Frank was a research psychiatrist at the NHS for many years, and he worked almost exclusively with severely traumatized patients. When I asked what motivated him to develop DBR, his response was direct and impassioned: “Too many people were dying.” His approach seems to facilitate a conversation between the patient and her brainstem. It is intriguing and the clinical outcomes, which I will show you, are robust. Presently several neurofeedback practitioners and researchers, myself among them, are meeting regularly with Dr. Corrigan and his coinvestigator, Jessica Christie-Sands, PhD, to see how we might enhance the synergy between neurofeedback and DBR for an even more effective treatment for those suffering with developmental trauma. This talk is your invitation into this very important conversation.

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Affectivism, Components of Emotion, and the Emotional Brain

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What is an emotion? What are its functions and brain substrates? How can we study and measure emotions and other affective phenomena? We will discuss the recently proposed notion of affectivism, the approach in which the inclusion of affective processes in models of mind, brain, and behavior not only explains affective phenomena but, critically, further enhances the power to explain cognition and behavior. This broad approach will be the basis of a discussion concerning the emotional brain and models of emotion. We will present a multicomponential definition of emotion: a particular event is first appraised by the individual according to their current concerns, values, and goals (or, more generally, motivational processes). Then, this elicitation process can trigger an emotional response in multiple components: autonomic physiology, action tendency, expression, and feeling. These processes modulate cognitive mechanisms such as attention, memory, learning, and decision-making. Several models of the emotional brain have been proposed and can be related to the major theories of emotion. For instance, affective neuroscience approaches have been used in reference to the basic emotion theory, to constructionist theories, and to appraisal theories. With respect to the emotional brain, most theories of emotion agree that many cerebral regions and networks are important for various emotional processes and that the amygdala is a key region of the emotional brain, but important debates exist with respect to its specific function. A particular focus of the presentation will review results suggesting that the amygdala is neither specific to the emotion of “fear” nor to the affective dimension of “arousal” but is rather a key region that subserves the appraisal of concern-relevance. We will discuss the idea that this amygdala-based mechanism is a key basis of appraisal effects both on the emotional response and on several cognitive mechanisms such as attention, learning, and memory.

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Towards a Road Map for Optimizing Neurofeedback Training Based on Research and Cognitive Neuroscience

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Neurofeedback is a complex learning paradigm that involves a number of neural and psychological learning processes. The dominant view is that neurofeedback learning is based on operant conditioning (Sherlin et al., 2011) and current theoretical work by myself and others has provided deeper analyses and mathematical foundations (Davelaar, 2018; Lubianiker et al., 2022). These advancements help in understanding the dynamics of neurofeedback learning, but they also highlight points of continued confusion shared among academics and clinicians. For example, asking the question of “how many sessions is optimal for learning?” might trigger answers based on clinical experience or estimates based on extrapolations from research. Both approaches are valid but are conditionalized on the technical settings of the neurofeedback equipment (threshold choice, feedback type) and the individual characteristics of trainees. These considerations matter when planning research (Ros et al., 2020) or managing clients' expectations. Therefore, to provide a general answer to the main question, a number of preliminary questions need to be answered. Here lies the catch. In order to generalize, a large amount of data is needed that contains as many of the relevant parameters as possible, but in clinical practice and academic research, wild variations in parameter settings are rare or even impossible (if not unethical). Through collaborative research involving clinicians and academics (and equipment providers), there are ways to explore the large parameter space.

In this talk, I will argue in favor of closer connections between neurofeedback clinicians and academics, whilst acknowledging their different objectives and time constraints. I will start with an examination into the behaviorist foundations of neurofeedback, discussing the particular version of behaviorism, Thorndikean behaviorism, that is explicitly adopted by clinicians. This contrasts with the actual version, Tolmanian behaviorism, being used, as revealed implicitly by the neurofeedback practice of setting thresholds. I then continue with addressing the question space, which demonstrates an appetite from clinicians and academics to understand more about the mechanisms of neurofeedback learning, its relation with other bodily processes, and how this knowledge can be used in a practical sense. Finally, I will present some progress from our lab that have a direct translation into clinical practice without impeding on existing standards. I will close with some suggestions on how clinical practice could feed into research programs and vice versa, opening up a discussion on a mutually beneficial road map that can educate the next generation of neurofeedback clinicians and researchers.

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PLENARY SESSION PRESENTATIONS

Clinical Implications of the Bayesian Brain, the Autonomic Nervous System, and the Triple Network

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To reduce the inherent uncertainty in a changing environment, the brain evolved as a complex adaptive system. It functions as a predictive machine that aids in finding safety and satiation. When neither can be found, the brain seeks information in the internal and external environment to update its predictions. To optimally adapt to changing environments, the brain predicts what the next situation will be based on its intention and the context. It attempts to verify the accuracy of the prediction by using different senses. If no new information can be gained by the senses, the brain will resort to memory. Failure to update our predictive capacity may result in the overreliance on memory to solve life's challenges. This often results in psychopathology, especially when those memories distort current functioning.

The central autonomic network (CAN) impacts this maladaptive process through control of the sympathetic nervous system (SNS), the parasympathetic nervous system (PNS), and the enteric nervous system. Not simply the autonomic nervous system (ANS), the CAN is conceptualized as a combination of the ANS, endocrine, and immune systems. The SNS promotes a state of elevated activity known as fight or flight. The main goal of the SNS is to prepare the body for physical or goal directed activity. The PNS produces the rest and digest process that involves lowered heart rate and blood pressure. The main purpose of the PNS is to conserve energy and to regulate bodily functions such as digestion and elimination.

The control of the CAN is embedded in the central hubs of the triple network. These three networks include the self-representational default mode network, the behavioral relevance assessing salience network, and the goal-oriented central executive network. As such, neurofeedback training of these regions has proved useful for depression, anxiety pain, addiction, and a host of other psychopathologies.

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See Your Brain, Train Your Mind, Change Your LIFE!

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While neuroscience and mental health professionals acknowledge the role of emotions in decision-making, application of this knowledge is hampered by the lack of a common language and a model that illustrates the potential neurological pathways. By better understanding the brain's decision-making process and the role of emotions in those decisions, we can begin to expose the moment-by-moment dynamics of human behaviors and the role played by precognitive thoughts. Armed with this knowledge, we may be able to help individuals recognize and reflect on decisions in a more logical manner.

This presentation will offer insights into how humans react to personal triggers in a conversation, thus, exposing underlying precognitive beliefs and related emotions that ultimately lead to our behaviors and decisions. We will highlight the protocols used to generate these modified event-related potentials with a focus on gamma frontal lobe asymmetry as well, exposing the asymmetry of Brodmann's areas 9 and 10 as primary emotional processing areas and Brodmann's areas 44 and 45 as secondary emotional processing resource. Changes in these Brodmann areas, as a participant processes a new stimulus, will be presented using quantitative analysis and will serve as validation of the resulting parallel sLORETA visual maps.

The ultimate takeaway from this presentation is the creation of a model that allows a client to see their thought and feelings (expanded self-awareness) and provide follow up training that leads to self-regulation. The power of seeing one's brain, in real time, cannot be over emphasized. These concrete images have transformative ability. During the presentation, we will show pre–post videos exposing the ability to calm their brain and, as a result, alter their behaviors.

Administering these protocols in real-world contexts, such as during coaching sessions, job interviews, and possibly even in psychotherapeutic milieus (given proper ethical constraints), are promising areas for additional study and promise to impact and potentially expose hidden decision-making mechanisms of the preconscious mind.

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Optimizing Photobiomodulation for Brain Health: Latest Advances in Parameter Settings

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Introduction. Photobiomodulation (PBM) harnesses light energy to achieve therapeutic outcomes, applying transcranial applications for brain health. Despite its potential, the PBM field, including transcranial PBM, relies heavily on outdated research, predominantly derived from cell culture and animal studies, with human clinical trials being relatively rare and heterogenous in methodology and protocols. Moreover, the market has many new PBM devices marketing with poorly supported claims, underscoring the urgent need for updated, evidence-based parameter settings and standardized reporting. This presentation aims to bridge this gap by unveiling novel discoveries that refine these parameters, thereby enhancing clinical outcomes. The knowledge gained from this presentation will benefit neurofeedback practitioners in the use of PBM to complement their practice.

Methods. The research discussed here employs a multifaceted approach mostly used in parts before in the literature, integrating Raman spectroscopy to examine protein and cellular structures, alongside methodologies measuring cellular electrical properties, advanced microscopy, functional magnetic resonance imaging (fMRI), electroencephalography (EEG), magnetic resonance spectroscopy (MRS), and computer modeling. This comprehensive suite enables us to systematically explore the efficacy of various PBM parameters—including laser/LED selection, wavelength, positioning, duration, pulse frequency, phase, coupling, and duty cycle—across proteins, cellular mechanisms, physiological responses, and clinical results. Our findings are extracted from both published literature and ongoing, unpublished studies, providing a robust foundation for our conclusions.

Results. We have identified critical parameters, notably pulse frequency, power density, and light-source positioning, that significantly impact treatment efficacy. For example, pulse frequencies of 10 Hz and 40 Hz exhibit distinct effects on brain function, offering promising avenues for treating conditions such as dementia, traumatic brain injuries, depression, and autism. Similarly, wavelengths of 810 nm and 1060/1070 nm demonstrate unique physiological impacts, and optimal power densities identified at approximately 100 mW/cm^2 for transcranial irradiation and 5–9 mW/cm^2 for intranasal application. Strategic positioning and skin contact during transcranial application further enhance these effects.

Conclusion. PBM stands out for its versatility and potential in brain health interventions. Through our research, we have observed how specific parameter settings can significantly boost PBM's effectiveness. These insights pave the way for more targeted, efficacious treatments, underscoring the importance of continuous research and the integration of new findings into clinical practice for optimal patient outcomes. Practitioners using PBM will benefit from the updated information presented here.

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EEG and the Search for the Buried Message: Application of Homomorphic Deconvolution, ICA, sLORETA, and Machine Learning

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We often think of the EEG as consisting of frequencies, generated by free-running oscillators. However, this belies the truth that the EEG is produced by a multitude of discrete events distributed in time. The classical evoked potential technique is a way of introducing these transients so that they can be measured as single events. The efforts to decompose the resting EEG have met with limited success due to the effects of volume conduction and the presence of many generators at once. The search for a “buried message” has long been deemed without merit, but this is due to the fact that the tools of the time (mathematics and computer processing) were not up to the task of detecting such signals.

This report describes a method that successfully deconvolves resting EEG sources into events and time points, revealing the underlying discrete time structure. By first applying independent components analysis (ICA) to remove the effects of volume conduction, and then using a frequency-domain deconvolution, it is possible to see the morphology of individual brain events and to reconstruct the exact time points at which they occur. The detailed time statistics of each component reveals the pattern of subcortical spiking that elicits each brain event. While the qEEG is like a “blender” that analyzes the entire record without regard to morphology, this method is more like a scalpel and tweezers, that manages to identify and take apart the constituent events.

In reading EEG, clinicians place high importance on the morphology of the waves and the exact timing, including effects that change across time. The qEEG does not reflect these aspects, as it insists on breaking the EEG into “frequency bands” that have predefined ranges, and it further analyzes the entire recording as one huge sample, albeit broken into segments (“epochs”). The method described here is based on first decomposing the signal into its apparent volume-conducted sources and further processing these components using frequency-domain averaging to produce an estimate of each event wave. The process further matches the signatures against the measured component, to determine the most likely times (“instants”) for the occurrence of each event. These time-point series provide important statistical information regarding the point process that defines the occurrence of these brain events. If this point process is highly regular, then a prominent frequency band may emerge, as well as harmonics reflecting the energy at all frequencies. If it is less regular, the energy will be more smoothly spread across the range. Some often visible components are eye blinks, eye movement, EKG artifact, blood-volume pulse, and similar physiological yet not-brain sources. Remaining sources reflect the commonly recognizes sources (posterior alpha, midline theta, etc.), and show additional detail, e.g., multiple PDR sources, or complex temporal sources.

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App-Based Combined HRV and Frequency Harmonics Training: Quieting Through Both the Central and Autonomic Nervous System(s). Clinical Trial Results

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This plenary session will show in-depth data from the 2024 clinical trials of an integrated app pairing standard heart rate variability resonant frequency training with both subthreshold delivery of specific sound/harmonic frequencies and above threshold delivery of "colored" sound (e.g., pink versus white, green, or brown sound). The intervention was specifically engineered to gain coaccess through both the central nervous system (via auditory mechanisms) and the autonomic nervous system (via breathwork) with the aim of quieting regions/wave frequencies of the brain associated with hyperarousal.

Participants included any individual over 16 years old, currently in treatment for active symptoms and/or diagnoses in the general classification of overarousal. This included poor stress tolerance, anxiety, anxious depression, anger outbursts, panic attacks, brain chatter, addiction/cravings, study/test anxiety, OCD, insomnia and their sequalae (e.g., nonrestorative sleep and fatigue), perseveration, argumentativeness, obsession, compulsion, cognitive rigidity (stubbornness), and eating disorders (and other practice of self-harm e.g., cutting), as well as hypervigilance (associated with trauma).

Results show significant alterations in theta, beta, gamma, and alpha bandwidths at both Fz and O1 (as per the 10/20 international system) associated with quieting. Subjective reporting of participants further aligned with statistical findings.

Discussion will also cover unexpected secondary findings which turned out to be main effects. Specifically, markers of mental efficiency also improved fueling hypotheses regarding the power of an intervention that can quiet without sedative effects.

Further discussion will differentiate universal effects versus gender-specific, condition/ailment-specific, environment-specific, and age-relative subeffects. Discussion will further cover therapeutic limitations and cautions as well as advantages including specific discussion of females (as per gender assigned at birth) and (sexual) trauma as well as gender neutral pedophiliac trauma; high stress/conflict exposure atmospheres and professions/professional stress tolerance, immune function, and toxin effects to name a few.

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Habit Formation and Automaticity: Psychoneurobiological Correlates of Gamma Activity

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Mental health management is an emerging public health crisis (Kohn et al., 2004; Singh et al. 2022), and mental health services are insufficient (Patel et al., 2009), necessitating new effective, affordable, and accessible interventions that lead to sustainable change. To further research interventions to address this crisis, the current work examines the science of habit formation and automaticity as a possible way to create sustainable change and the improvement of mental health by building in practices leading to the discontinuation of detrimental behavior and the growth of practices that improve mental health.

The present study used a unique psychoneurobiological approach, specifically looking at how habits and automaticity form using a whole person context in the hopes of contributing to how habit formation can be used in mental health interventions. While a sizeable body of literature on habit formation and automaticity looking at simple behaviors such as overall activity level and diet exists, few studies have investigated the complex behavior formation needed to instill new beneficial mental health habits. Additionally, limited research has looked at the neurophysiological or biological correlates of these mental processes and changes. Madhavan et al. (2015) proposed that, during active learning or recall, individuals exert more cognitive energy compared to information maintenance, resulting in heightened gamma activity. This new data demonstrates that gamma increases as learning is taking place then decreases once the behavior is learned (habituated), providing evidence of habit formation and automaticity and its nonlinear nature.

The current pilot study seeks to contribute to the field's developing knowledge of habit formation and automaticity as something that can be deliberately and mindfully learned, through a planned and guided approach over a specified time frame, to empower individuals to achieve lasting improvements in mental health challenges. Our research contributes practical strategies to improve interventions and achieve sustainable outcomes for the public health emergency in mental health and build a more gestalt picture of the healing journey (Leaf et al., 2023).

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EEG in Depth: Seeing Psyche in Brainwaves

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This presentation is of my dissertation work and a chapter published in the 2023, *Introduction to QEEG and Neurofeedback*. A theoretical interpretation of an EEG-based psychophysiology. The exploration to unfold in the presentation is the linking of Sigmund Freud's and Carl Jung's respective models of the psyche with electroencephalographic phenomena, neuroanatomy, and neurodevelopmental findings. This union is a marriage between star-crossed lovers: Romeo, being the brain's electrical EEG patterns, from the family of objective, quantifiable and empirical physiology, and Juliet, as psychodynamic psychology, from a family of subjective, qualitative, and humanistic perspective. The progeny of these two camps is psychophysiology, which we will define as the interrelatedness of the third-person body/brain and the first-person mind/soul. These fields of neurology and psychology have historically been kept apart by the authorities of their respective academic and clinical circles. The loyalties of their respective camps have endowed their union with entanglement, rivalry, and disregard.

The thesis we embark on in this presentation is as follows: the EEG spectrum covers the gamut of consciousness, from the recesses of the deep and primal unconscious (delta), through the waters of the personal unconscious (theta), into states of flow, trance, and meditation (alpha/theta and alpha), bridged to the ego states (beta); in pursuit of the self-actualized individual (gamma). The psychodynamic model of the psyche contains these same elements, in the same order: collective unconscious, personal unconscious, the cusp of unconscious and conscious, and ego; all of which, when integrated, lead to the capital "S" Self, the actualized individual. This chapter serves to define how the brain and the mind marry, via a psychodynamic lens.

This talk is meant for an audience of mental health care practitioners who have ties to the field of psychology. It is not meant to be a reduction of the complexity and beauty of the empirical and neurological findings of EEG, but an interpretive lens, backed by tomes of research, into the deeper recessed of the human experience.

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Can Mind-Matter Interactions Be Influenced by Low Power PEMF and Heart Rate Variability?: A Pilot Study

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While psi-related abilities such as mind-matter interactions (psychokinesis; PK) are often considered controversial topics, there is a well-established literature exploring the empirical evidence for these experiences. The most extensive number of experiments on PK have focused on attempts to mentally influence output of electronic, binary-bit random event generators (REGs), referred to as micro-PK.

One of the most extensive and well-known efforts to experimentally study micro-PK using REGs was conducted by the Princeton Engineering Anomalies Research Lab (PEAR; Dobyns, 2015; Jahn & Dunne, 2011). Over the course of a 12-year period, this lab studied 91 volunteer participants, each making multiple attempts, resulting in nearly 2.5 million trials. The results clearly showed that trials involving mental influence deviated from mean chance expectation to a significant degree (Williams, 2021).

Other examinations of micro-PK effects have focused on the potential role of brain activity. For example, two studies have found a correlation between success on REG tasks and frontal lobe damage (Freedman et al., 2003; Freedman et al., 2018), leading the researchers to suggest that the frontal lobes, and in particular the left middle frontal region may act as a filter to inhibit mind-matter interactions (Freedman, 2018). Supporting this notion, a recent article published in Cortex, found a significant micro-PK effect following rTMS inhibition of the left medial middle frontal lobe (Freedman et al., 2024).

The current study sought to examine if the results above could be replicated with a low power PEMF device. Each participant engaged in three sessions/conditions, using counter-balanced methods along with heart rate variability recordings synchronized to the REG output. In each session, three microtesla coils (BrainMaster Technologies) were attached to the scalp in positions targeting either the left frontal lobe (Fp1, F3, and F7), the right frontal lobe (Fp2, F4, and F8), or the entire frontal lobe (F3, FZ, and F4; placebo condition). During the left and right conditions, the participant received 20 min of randomized stimulation between 3 and 5 Hz. During the second half of each session the participant completed a series of three REG runs, each consisting of 200 trials, attempting to increase the output of 1's rather than 0's. Following stimulation, each participant completed an additional two REG runs.

Data collection for this study is currently underway and will include approximately 12 participants. Data will be analyzed to test for condition, order, and time effects as well as any changes in HRV metrics related to REG success. Preliminary analyses suggest that the stimulation conditions result in more significant deviations (higher success) than the placebo condition, although there does not appear to be a significant difference between right or left hemisphere stimulation. The results will be discussed in relation to physiological mechanisms potentially related to mind-matter influence as well as implications for the argument that consciousness can influence structures outside of the physical body.

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