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KEYNOTE PRESENTATIONS

The New Psychiatry: Functional Medicine and HYLANE Technology

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The current paradigms underlying the treatment of most chronic or recurrent psychiatric disorders, and most neurodegenerative conditions, has been exposed as largely inadequate. Dr. Abraham Hoffer's pioneering work was extended by Dr. Hedaya through the formalized use of Functional Medicine which demonstrated full recovery in 100% of treatment resistant depression patients (retrospective analysis) in 2004. This is in stark contrast to the STAR-D trial which, using psychotherapy and polypharmacy, demonstrated a 25% long-term remission rate. In 2019, Dr. Hedaya discovered through the use of quantitative EEG, that even after substantial improvement in clinical symptoms with the use of a comprehensive functional medicine treatment, most neuropsychiatric patients continue to have abnormalities in cortical and network functions, which he has learned to correct using a combination of technologies (HYLANE). This has resulted in striking changes (e.g., the reversal of acquired prosopagnosia, MCI and temporal lobe absence seizures, partial reversal of moderate aphasia, reversal of facial distortion in paranoid schizophrenia, and reversal of cognitive decline in early vascular dementia [e.g., restoration of verbal memory from 66th to 95th percentile]. In this talk Dr. Hedaya will provide an overview of functional medicine, its efficacy and limits in neuropsychiatric patients, and the use of HYLANE technology as an effective augmentation strategy.

Multimodal Brain Music Interfaces to Promote Entrainment and Connection

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Music is an important and universal means of communication. The feelings of connection and well-being that music creates are supported by a process in the brain and body called entrainment, in which our natural rhythms (speaking, walking, heartbeats, breathing, and even brain waves) synchronize with the rhythms we hear. The research activities I supervise at the Brain Music Lab at Georgia Tech expand on this powerful process by building software and hardware that translates brain and body rhythms into music and sound. I will review several music technologies that invite beneficial brain and body rhythms within and between listeners, and I will introduce the musical performance and composition practice I've developed in concert with these technologies. For researchers, doctors, and caretakers, this work has the potential to expand our scientific understanding of music's beneficial effects on the brain and body and may lead to new music-based interventions for adults, children, and infants.

The Connectome the Treatment of Behavioral Disorders Psychosurgery, Neuromodulation, Psychedelics, and HBOT

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The human brain is a magnificent tapestry of billions of neurons, trillions of synaptic connections with axons woven into a network of nodes and thousands of fiber tracks or edges. Together, these structures constitute the connectome or "the wiring diagram" of the brain. How the "wiring" occurs is dependent upon neuroplasticity, genetic and epigenetic factors: transgenerational experiences, environment

exposure at all ages, diet, drugs, stress, and physical activity. Thus, our feelings, thoughts, memories, fears, behavior, and who we are are all imprinted in this incredibly complex 3-lb, gelatinous network of neuroplastic nervous tissue.

Traditionally, abnormal behavior or psychiatric disorders have been characterized by symptoms and clinical observations; hence, the *Diagnostic and Statistical Manual of Psychiatric Disorders* (DSM-5). Although diagnostic labels create the illusion of an explanation, they are scientifically meaningless, have no relationship to the actual structure or function of the brain, and can create stigma and prejudice. We now know dysfunction (depression, mania, PTSD, suicide) arises when functional alterations (miswirings) occur between large-scale neural networks. Thus, psychiatric disorders are actually "disconnection syndromes" primarily of the executive, default mode and salience networks.

Therapeutic attempts to structurally rewire or alter the functional connectivity of the brain began with frontal lobotomy (Egas Moniz, Nobel Prize). With elucidation of the limbic or emotional system of the brain, selective ablation of more specific targets and presently deep brain stimulation have evolved. More recently, various energy sources like magnetism (transcranial magnetic stimulation [TMS]) electricity (direct and alternating current stimulation [tDCS, tACS]) and light (photobiomodulation) are currently used to alter brain networks transcutaneously. These techniques selectively inhibit or disinhibit specific synaptic function in networks, which are either hyperactive or under active, and are proving effective for treatment resistant depression, anxiety, and even enhancing memory and cognition.

And now, with enhanced knowledge of the psychopharmacology of psychedelic drugs, LSD, MDMA, and psilocybin with their neuroplasticity and synaptic-altering effects are used in enhanced psychotherapy to modulate the connectome and human behavior. Hyperbaric oxygen therapy also is assuming a major role in the treatment of PTSD, postconcussion syndrome, and stroke. An overview of how understanding of the connectome and network neuroscience is revolutionizing neural circuit-guided treatment of disorders of behavior such as depression, anxiety, PTSD, schizophrenia, autism, and more will be presented.

EEG Connectivity in ADHD Compared to a Normative Database: A Cohort Analysis of 120 Subjects from the ICAN Study

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Introduction/Background. This study explores how EEG connectivity measures in a group of 120 children with ADHD ages 7–10 inclusive differ from an age-matched nonclinical database. We aimed to differentiate connectivity in specific networks, Brodmann area connectivity pairs, and frequencies.

Methods. Subjects were in the International Collaborative ADHD Neurofeedback (ICAN) randomized clinical trial, which explored neurofeedback (NFB) for ADHD. Inclusion criteria were mainly rigorously diagnosed ADHD and an EEG theta/beta power ratio (TBR) of at least 4.5. Pretreatment EEGs records were cleaned for analysis. Using statistical and machine learning algorithms, connectivity values were extracted in coherence, phase, and lag coherence at all Brodmann areas (BA) within the attention dorsal, attention ventral, default mode, executive and salience networks, and many subcortical and cerebellar locations in these same networks in each of the main EEG frequency bands. These values were then compared with a normative database and validated with Monte Carlo simulations.

Results. Compared to the normative database, the ADHD children had a higher rate of dysregulation (> ±1.97 *SD*), in some cases as much as 75%, of the Brodmann pairs observed in coherence and phase between areas 7, 10, and 11 with secondary connections to BAs 21, 30, 35, 37, 39, and 40. BAs 10 and 11 (L and R) are highly represented with dysregulated connections to each other.

Conclusion: The three most dysregulated BAs in ADHD are 7, 10, and 11 relevant to ADHD executive-function deficits (prefrontal dysfunction) and provide an important consideration when developing interventions for children with ADHD.

Addressing Ongoing Trauma Among Middle Eastern Journalists: When There Is No "Post" to Trauma Stress Disorders

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As a trauma consultant based in Beirut, I worked between 2016 and 2022 with dozens of journalists covering war and violence in the Middle East and

North Africa. Psychotherapeutic interventions, which came as part of regional and international programs supporting Arab journalists, took place remotely in the midst of local and regional conflict.

During the course of my work, I found that notions such as PTSD and vicarious trauma fall short of explaining the particular experience of my patients. Revolving largely around the reprocessing of past memories (e.g., PTSD) or the management of expected dangers (e.g., general anxiety disorders, hypervigilance), these terms, as we traditionally understand them, may not reflect the case of reporters trapped indefinitely in a social trauma in their homelands, even when off duty.

During conventional psychotherapy, sessions often take place in somewhat stable conditions, or at least in a context where traumatic stressors can be isolated. The local journalists I worked with were not only stuck in the battlefield, but they were also emotionally bound to it. The pain they reported every day was their own. Unable to distance themselves physically from the field, even when at home, journalists faced ongoing dangers as our sessions progressed.

During my presentation, I will propose the concept of ongoing trauma and discuss the creative promises of biofeedback in this context. Defined as a life-changing, terror-inducing, and highly stressful stretch of time, ongoing trauma often leads to a destabilized nervous system and eventually to mental disorders and relational tensions. In the case of ongoing trauma, the danger would still be real at the time of the psychosocial intervention, and the person would still fear for their life, unable to escape harm or to stop it.

During the talk, I will discuss the data accumulated during 400+ sessions with Arab journalists over the last six years, as well as the results of a trauma screening survey administered separately to 240 reporters in the region. I will present an overview of the key stressors and symptoms journalists in the Middle East faced and continue to face and will then address the challenges of therapy—especially of remote therapy—under these conditions.

More specifically, I will talk about the biofeedback approaches I have devised over time and in response to the extraordinary circumstances during which therapy took place; most journalist sessions were done remotely via Zoom, whereby journalists talked to me from home or from the office. No neurofeedback or biofeedback tools were available to them. Most importantly, many cases presented exposure to severe ongoing trauma, including recurrent violence and war, during the sessions.

In response to these challenges, I had to find creative approaches to biofeedback, improvising tools or exercises to help alleviate these cases remotely (e.g., using diaphragmatic breathing, body scans, body mapping, and tapping/EFT among others). As I shall explain, interventions adopted a multilayered combination of approaches:

- Grounding the body (mindfulness, grounding exercises, sensorimotor)
- Addressing self-appraisal (building agency through self-acceptance, self-efficacy)
- Addressing environmental challenges (finding “a way out” through problem-solving, building social support, career development)

PLENARY SESSION PRESENTATIONS

Freeze! You're Under Too Much Stress: Utilizing Neurofeedback for the Mitigation of Law Enforcement Stressors

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Throughout their careers, law enforcement officers will encounter a variety of hostile and trauma-related situations. Experiences such as assault (Kaminski et al., 2003), interactions with adverse citizens (Violanti & Patton, 1999), and altercations with perpetrators (Arnetz et al., 2009) relate to common stressors officers face. Although recent literature explores the relationship between these stressors with intrapersonal factors (Abdollahi, 2002), research on law enforcement stress is largely categorized within two groups; occupational and organizational (Symonds, 1970). Occupational stressors encompass the range of experiences faced in the field, while organizational stressors involve the internal hierarchical structure of the law enforcement vocation. Unfortunately, these career factors often have psychological and physical consequences (Carlan & Nored, 2008; Kop et al., 1999). The onset and development of stress, anxiety, anger, depression, and posttraumatic stress disorder (PTSD) are not uncommon with this population (Rajaratnam et al., 2011). Also, researchers continue to see neurobiological dysregulation and brain structural differences associated with PTSD and continued exposure to traumatic situations (Bremner et al., 1999; Kimble & Kaufman, 2004; Shucard et al., 2012). Moreover, several studies on occupational and

organizational stressors reveal a correlation with both career burnout and poor decision-making while on the job (Kohan & Mazmanian, 2003). With recent legislation identifying the need for mental health interventions among law enforcement officers (163 U.S.C. § 867, 2017), counselors have the unique opportunity to provide services to these professionals. Because the law enforcement occupation traditionally maintains engrained, protective stigmas and stereotypes regarding mental health (Loftus, 2010; Wester et al., 2010), counseling professionals must also consider these factors in conjunction with physical and psychological concerns when developing treatment plans. In this presentation, we propose the concept of integrating neurofeedback alongside a trauma-informed framework when assisting law enforcement officers. Through this lens, we consider multiple facets specific to this profession as well as counselor implications. Furthermore, this article aims to provide meaningful content promoting both career retention, mental health services, and future studies that advocate for law enforcement individuals.

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Determining the Effectiveness of Bioregulation Therapy/Pulsed Magnetic Frequency on the Reduction of Anxiety Symptoms

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Pulsed electromagnetic frequency (PEMF) was approved by the Food and Drug Administration (FDA) in 1979 and has been used to treat various illnesses for many decades. While there are many studies speaking to the benefits of PEMF on various physiological ailments, recent studies are emerging examining the effectiveness of this technology in the treatment of mental illness. This study aims to determine the effectiveness of combined bioregulation therapy and PEMF using the Nesta Bioreg device on symptoms of anxiety when compared to control. This is a single-blind study. A sham device will be used to control for a placebo effect. Adults between 18–65 years of age with a primary diagnosis of anxiety will be randomly assigned to the experimental or control group (n = 30, N = 60). Participants in the control group will go through the same procedural protocol as the experimental group apart from receiving active current. All participants will complete self-report measures at baseline, the beginning of each study week, study completion, and 3-month post completion. The HAM-A, BAI, SCL-90, and GAD-7 will evaluate the participants' level of anxiety and quality of life. When participants complete the baselines measures, they will complete one 30-min session of bioregulation therapy general foundation protocol for acclimation. Participants will receive either active or sham therapy twice weekly for 9 weeks to total 18 therapy sessions of specific anxiety protocols as crated by the manufacturer. Each session lasting around one hour, with protocol times ranging from 40–60 minutes. During therapy sessions, the participants will be asked to turn off electronic devices and remove electronic watches to reduce the electromagnetic interference produced by devices other than the Bioreg device. After completing data collection pretest–posttest scores will be analyzed to make between-group comparisons. Based on previous studies, it is hypothesized the active group will demonstrate

improvement in anxiety symptoms compared to the control group. After study completion, the control group will be offered complimentary active therapy and these results will be further analyzed for effect.

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Treating Acute COVID-19 with Photobiomodulation—Clinical Trial Results and Implications for Long Haul

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Although the concern for the COVID-19 has attenuated at this time, it is widely believed that it will not be eliminated. There is the ongoing concern that variants will continue to emerge, including the possibility of contagious and dangerous ones. While pharmaceutical manufacturers continue to develop vaccines as well as antibodies, there is still a large population that prefers a nonpharmaceutical option if available. In this respect, a randomized clinical trial (RCT) using a photobiomodulation (PBM) device to treat acute COVID-19 is completed with findings to show this potential.

Literature has shown that PBM is antiviral (Liu et al., 2003), anti-inflammatory (Hamblin, 2017), and accelerates the healing of lesions and sepsis (Costa et al., 2017); all are important factors in COVID-19 morbidity. These properties are supported by reports of rapid recovery in several severe hospitalization cases (Soheilifar et al., 2020). These are just a few cases, but the positive outcomes had warranted this RCT.

In this RCT, the patients self-treated at home, electronically uploaded answers to a set of questions daily, and were monitored remotely. The main outcome was the measure of time to recovery from moderate to severe sickness. The Kaplan-Meier method along with the Cox Proportional Hazards model were used.

The study enrolled 294 patients. For the primary outcome, patients who had symptoms for 0–5 days at baseline, the median for recovery in the treatment group was 18 days (95% CI, 13–20) versus the control group of 21 days (95% CI, 15–28), p = .05. Groups with symptoms for 6–10 days or 0–10 days did not show significant difference. The hazard ratio was 1.495 (95% CI, 0.996–2.243), p = .052 for the group with 0–5 days of symptoms.

For secondary outcomes, significant time to recovery were observed in many symptoms. None of the patients in the treatment group suffered death or a severe adverse event (SAE), while there was one death and three SAEs that required hospitalization in the control group. The results showed that the treatment group produced significantly faster time to recovery than the control group in patients with moderate to severe COVID-19 symptoms for 0–8 days before enrollment. When measured for severity of the respiratory symptoms over 30 days, a variety of symptoms also responded significantly better with treatment. There was also no significant worsening of symptoms in the treatment group.

The attention on the pandemic is shifting towards the long-term debilitating sequelae of chronic fatigue, depression, posttraumatic stress disorder (PTSD) on

the survivors, who are commonly known as “long haulers.” Literature suggests that PBM has the underlying bases for neuroregulation to potentially address these.

This presentation will present the underlying mechanisms of PBM that lead to an effective treatment for COVID-19 and other coronavirus infections, and how the thoughtful selection of parameters can bring efficacy. It will present more details that includes those for secondary outcomes. The potential of PBM to treat long haulers will also be discussed, particularly the prospect of a new clinical trial that covers mental conditions.

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Neurophysiological Psychological and Social Assessment to Define an Integrative Treatment of Neurofeedback and Psychotherapy

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This presentation focuses on an integration of neurofeedback and CBT/schema therapy as treating clients as well as combining qEEG and CBT as assessment for the treatment.

The CBT Assessment (Sanavio) is an evaluation of the problem reported by the patient in order to conceptualize and understand the process or mechanism to explain the problem, define the therapy goal, and the treatment strategy. The hypothesis and measurements will be compared in baseline, midpoint, and the end of therapy. The assessment data are collected through three distinct source indices: 1) Subjective Index as recorded by patient counseling, family table, and self-reports test. The patient request of intervention is explained through the life story, measured with standardized test and questionnaire; 2) Behavioral Index reached by observation, role playing, diary; 3) Neurophysiology Index reached by biofeedback instrumentation and qEEG recording.

Conceptualization cases and its interventions are being presented according to these three distinct sources. 1) In the Subjective Index the data is compared to normative population, being evaluated by the schema therapy emotional unmet need and defense modes (Young, Arntz). The family table shows the patient representation of relationships, early maladaptive schemas and modes. 2) The Behavioral Index will be described by a therapy diary and clinical observation would show behavior modification and mode flexibility. 3) The Neurophysiology Index will be measured by qEEG, neurofeedback, and biofeedback.

Treatment is a tailored combination of top-down as for schema therapy and CBT, and bottom-up as for neurofeedback and biofeedback. While the Neurophysiology Index drives the neurofeedback intervention and the Subjective Index is chosen to explain and work with the cognitive parts and the schemas, the Behavioral Index would show the driving process.

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Bang, Bottoms Up: The Complexities of Comorbid Trauma and Substance Abuse

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Recent epidemiological research has revealed that around 57% of individuals with chronic posttraumatic stress disorder (PTSD) also struggle with chronic drug and/or alcohol abuse (Simpson et al., 2021). Rates of substance-related overdoses recently hit a record high of 81,000 deaths in the 12 months leading up to May 2020 (Centers for Disease Control and Prevention, 2020). PTSD and substance use disorders each involve a complex array of physical, cognitive, emotional, behavioral, and social challenges; this combination can make treatment especially challenging (American Psychiatric Association, 2013). As such, traditional substance abuse interventions, such as 12-step programs and psychotherapy, have shown high relapse rates of 65–70% within less than a year (Kadam et al., 2017). Considering these high rates of comorbidity and risk, it is important that neurotherapy practitioners take a comprehensive, integrative approach to give their clients the best chance at success.

Traumatic stress, especially during developmental years, is one of the primary suspects for predisposition toward substance abuse, both in terms of neurophysiological changes as well social and lifestyle variables. Preliminary evidence has also shown associations between adverse childhood experiences and dysregulation with the neuroendocrine, gastrointestinal, and immune systems, all of which have been associated with increased risk of addiction (Horn et al., 2018; Salavrakos et al., 2021). These can further exacerbate mental health symptoms and impair frontal regions required for healthy reward and inhibition, thus further propelling the cycle of substance abuse (Le et al., 2021).

Advances in neuroimaging technology have provided the opportunity to further examine neurophysiological factors associated with substance abuse. For example, increased susceptibility for addiction, whether due to genetic factors, psychosocial variables, or substance use, has been linked to reduced connectivity within frontostriatal networks. Hypoconnectivity of these networks can weaken goal-directed decision-making and control over habitual behaviors (Ersche et al., 2020). Chronic substance abuse can lead to prefrontal cortical disengagement, thus impairing stress regulation and reward processing, and ultimately exacerbating PTSD symptoms while reinforcing addictive behaviors (Le et al., 2021).

Neurotherapy interventions, such as neurofeedback and neurostimulation, have shown promise in their ability to balance dysfunctional brain regions, networks, and activation patterns associated with addiction and posttraumatic stress (Bari et al., 2018). This presentation will aim to summarize the current state of evidence for neuromodulation modalities as an intervention for comorbid PTSD and substance use disorders. We will also discuss the challenges of working with clients who are actively using substances, the effects of common substances on brain regions and activation patterns, and practical methods for effectively helping these clients achieve optimal wellness. Furthermore, we will explore future directions around how such modalities might be used to ease the process of quitting the substance,

reducing cravings, decreasing risk of relapse, and promoting more complete, lasting recovery. Due to the systemic effects of both stress and substance use, we will additionally provide education and recommendations for balancing other body systems. through an integrative neurotherapy approach to promote more complete, lasting healing.

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Is Artificial Intelligence the Answer to More Accessible Neurotherapy? Automating Individualized Care to Meet the Current Mental Health Crisis

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Although mental health issues and other behavioral disturbances do not always rise to the level of medical diagnostic criteria, the qEEG and neurofeedback community has demonstrated that multiple symptoms and behaviors in both clinical and nonclinical populations can be improved by EEG biofeedback. Neurophysiological changes and EEG abnormalities are often nonspecific to symptoms and expressed behaviors due to known confounds such as genetics, life experience, health status, brain injury, and now pandemic-related psychosocial stressors and neurological tissue damage from SARS-CoV2 infection. The traumatic brain injury field is familiar with this problem, widely acknowledging that “no two TBIs are alike.”

Neurofeedback offers compelling potential to improve psychosocial and cognitive-affective functioning for millions who are suffering, without the use of medications, and the need has never been greater. However, despite a half-century of development in the field, neurotherapy has not expanded beyond its status as a “boutique practice,” with only about 7,500 practitioners in the United States at present. A lack of consensus regarding evaluations and protocol development has created confusion and mistrust in the scientific community and the public. Potential practitioners must navigate a steep learning curve and invest significant time and money in training, equipment, and continuing education. Current models are often dependent on complex clinical decision-making to determine which metrics are included in the feedback process. These decisions are in turn dependent on clinician training, equipment capabilities, and experience.

Experienced clinicians continue to debate which “failure mode” in the brain should determine the feedback protocols used on any given subject. Within the last decade the complexity of protocol determination has exponentially increased as new modalities introduced various forms of external stimulation to drive brain processes or interrupt habitual circuit behaviors. Conventional models for assessing the effect of neurofeedback protocols have been insufficient to evaluate the constellation of outcomes reflecting changes in both homeostatic (internal) and allostatic (responses to external stimuli) processes, as can be demonstrated in a recent publication. Many interventions have not adequately appreciated and accounted for the complexity of the systems involved in producing any one component of EEG signal or in allowing for adequate response from a wide range of brain “failure modes.”

A new model of delivery is emerging which can provide affordable, accessible, effective neurotherapy. This presentation will describe an

artificial intelligence-driven approach that can individualize therapy on a large scale. We will discuss the evolution of prior neurofeedback paradigms and review recently published data that support the efficacy and rationale for using an integrated model of allodynamic, multinetwork neurofeedback training. These data will demonstrate that it is possible, using an algorithm-driven systemic paradigm, to individualize results within a heterogenous population of neurophysiologically dysfunctional brains.

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PMS Dysphoria Syndrome: qEEG Correlates and sLORETA Default Mode Network and Implications for Trauma

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Background. Women suffering from premenstrual dysphoria disorder (PMDD) often experience instability in emotions, compromised mental and physical health, and stressed interpersonal relationships, which influence work productivity and, subsequently, financial stability. The present study was the first to utilize archival premenstrual brain data to scientifically examine the differences in ROIs in the default mode network's (DMN) activity in broadband qEEG frequency bands across the follicular and luteal phase in PMDD/Dysphoric premenstrual syndrome (PMS) as compared to asymptomatic women.

Method. DMN neuroanatomical structures, Brodmann areas, hubs, and underlying cortical areas were established based on a review of the literature and the International 10–20 system. Brain activation patterns were measured by metrics of qEEG and standardized low-resolution electromagnetic tomographic analyses (sLORETA). A total of 157 women were classified by symptom category to include Asymptomatic/Control (70 women, M = 34.4, SD = 7.8) and PMDD/Dysphoric PMS (87 women, M = 35.0, SD = 5.4) where the categories depict the presence of heightened symptomatology. Asymptomatic women reported no or very mild premenstrual symptoms; PMDD women reported moderate to severe emotional and physical symptoms in the premenstrual phase.

Results. Statistical ANOVA and Median Tests using a minimum of $p < .02$ was used to determine significant findings. Significant differences in brain activation patterns were evidenced in key regions of interest on the DMN. Asymptomatic/Control women showed significant changes in the cingulate gyrus and the insula and showed changes in the percent of voxels from the follicular to luteal phase in the anterior cingulate, cingulate gyrus, insula, and the precuneus. Significant differences in the luteal phase mean-*z* (medians) between the PMDD group and the Asymptomatic group were reported in the subcallosal gyrus. Further analysis of the percentage of abnormal voxels revealed PMDD women with 19% abnormal

voxels as compared to 4% abnormal voxels for the Asymptomatic/Controls.

Discussion. Abnormal brain activity in PMDD women may implicate imbalanced neuronal activation patterns and the recruitment ability within specific DMN regions responsible for or intended to support affective processing and emotion regulation occurring with hormonal changes. These findings provide further insight into aberrant neural activation patterns within the DMN that can develop potentially from forms of trauma in the population of PMDD. Future research should address the psychophysiological interventions available to ameliorate dysregulated aberrant neural activation patterns in PMDD women. The findings will also be discussed in the context of prior analyses looking at the role of trauma in these subjects and the implications of trauma on neural receptor sensitivities and DMN functional reorganization.

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Frontal Gamma Microstates in Addiction and Recovery

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This report describes the basis for using sLORETA frontal gamma activation images in conjunction with automated clustering to identify microstates in a case of addiction and withdrawal. The gamma for ipsative validation using electroencephalography (GIVE) process accesses asymmetric gamma wave bursts in the prefrontal cortex to validate the underlying preconscious decisions behind these self-report responses at the very moment of decision-making. The process uses asymmetric wave analysis resulting from stimulus to validate the underlying mental decisions behind these reported responses, at the very moment of decision-making, thus exposing the true thoughts behind the responses and documenting potential abnormalities between their preassessments and their actual brain activity. This process provides evidence that an evoked emotionally laden response results in corresponding brain activity and documents both the intensity of human emotional responses and the directionality of the response.

We have also applied *k*-means clustering to EEG data gathered during test conditions, using the sLORETA-derived gamma (35–45 Hz) current source density magnitude as a metric. We chose Brodmann's areas 11 and 46, left and right, as indicators for relevant cortical processing. We chose $n = 16$ for the clusters, and watched for clusters that appeared to be repeats, or overlaps, as evidence that this number was sufficient.

We have demonstrated that the use of brain microstate analysis can be used to identify and quantify individual responses to material that has emotional or contextual meaning. We have described a model for human brain microstates that extends the concept of microstates from resting states to states associated with emotions and decision-making. It is shown that the instantaneous processing of words presented on a screen produces a stereotypical response that can be captured in sLORETA gamma activation measures taken 8 per second, for 1.5 s following the stimulus. This provides a promising

avenue for the study of individual responses to emotionally charged material.

The method of measuring instantaneous magnitudes and applying *k*-means clustering to the resulting distributions appears to be a useful and robust method for assessing the states that exist, and their relationships in time.

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