

EEG Imaging and Biofeedback in the Traumatized Brain

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Description

- This talk will present current results using a EEG/QEEG-based biofeedback system that takes advantage of sLORETA imaging of regions of interest, in combination with a structured stimulus and analysis procedure. We will present event-related brain activation data from a range of participants and situations including nonclinical, clinical, and forensic populations. The results illustrate instantaneous patterns of activation that are indicative of individual emotional and decision-making patterns.

Capabilities

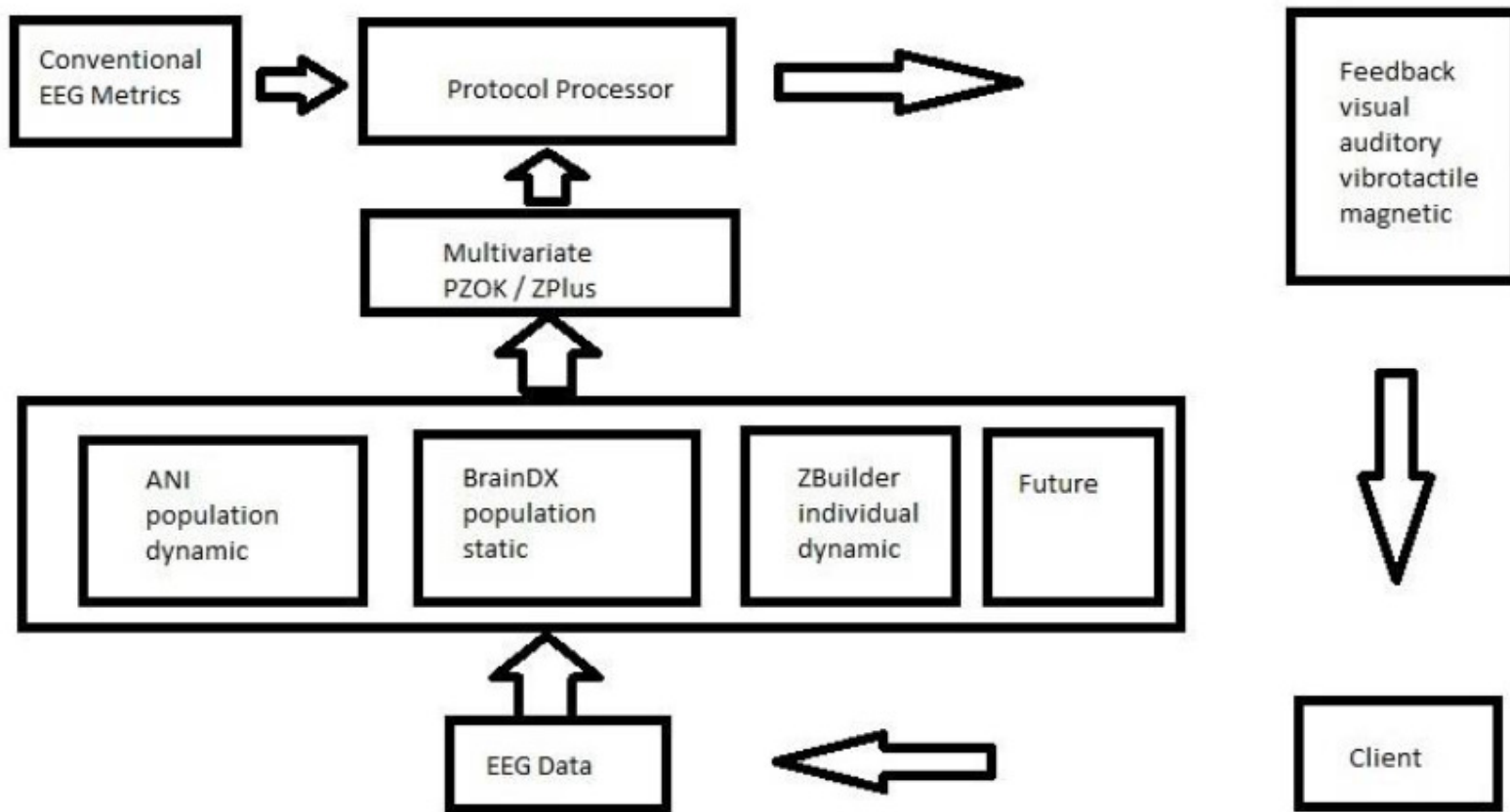
- Assessment
 - Detailed questionnaire
 - Neurocognitive testing
 - EEG analysis
- Instantaneous imaging and summary images
- Detailed brain mechanism determination
- Correlated with symptoms/behavior
- Neurofeedback
- Analysis and reporting
- Treatment progress

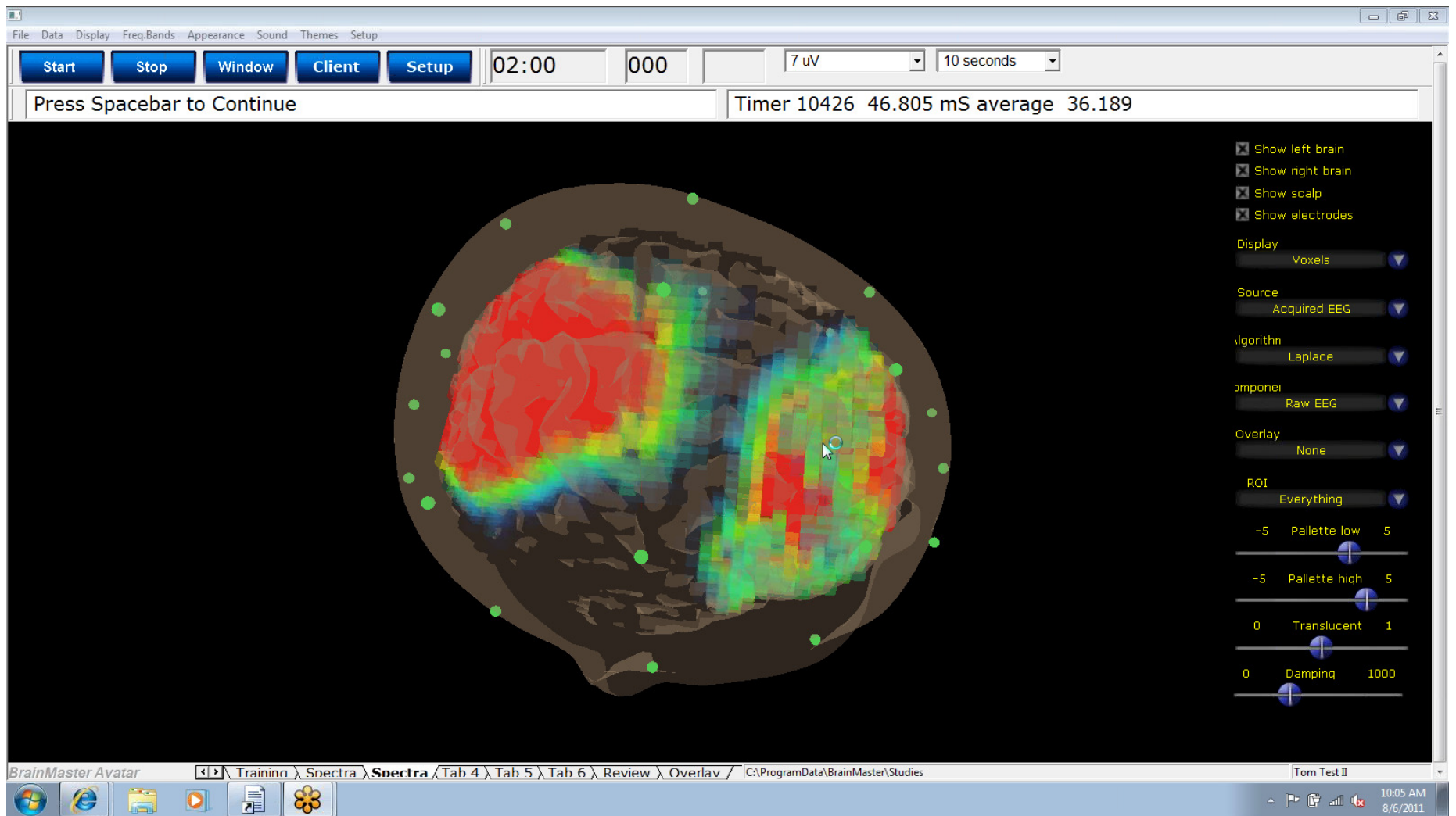
Types of Trauma

- Physical, e.g. TBI, CTE and emotional
- Single incident
- Sustained, e.g. military service
- Chronic, e.g. in home sexual / physical / emotional
- Produces:
 - PTSD
 - Complex PTSD
 - Anxiety
 - Panic Attacks, Panic Disorder

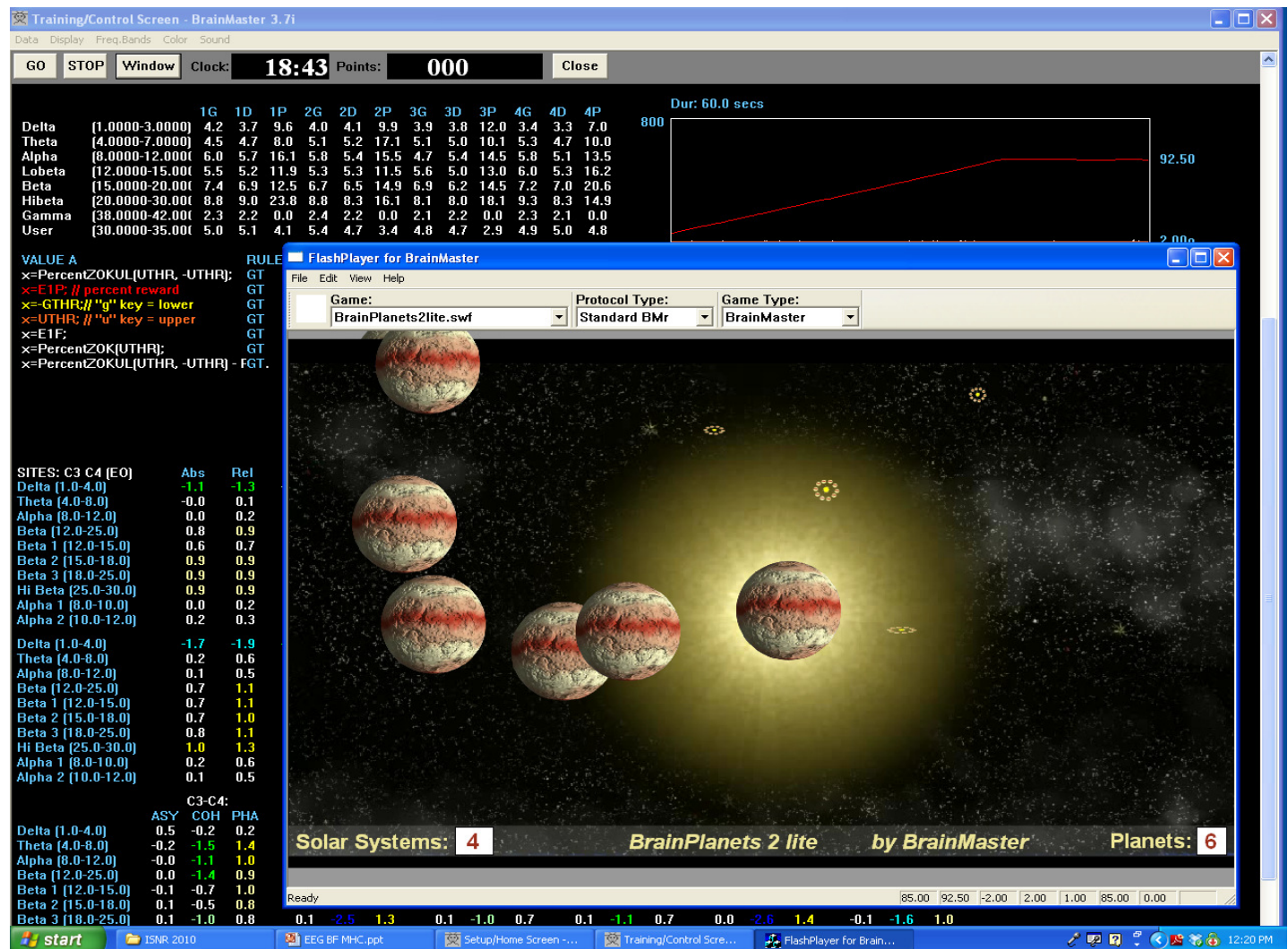
Approach to Neurofeedback

- Identify symptom-related deviations
- Target with neurofeedback and related interventions
- Combine “traditional” and novel neurofeedback
 - Power training
 - Connectivity training
 - Z-score neurofeedback
 - sLORETA region of interest (ROI) power and z-scores
- Monitor subjective, behavioral, physiological progress





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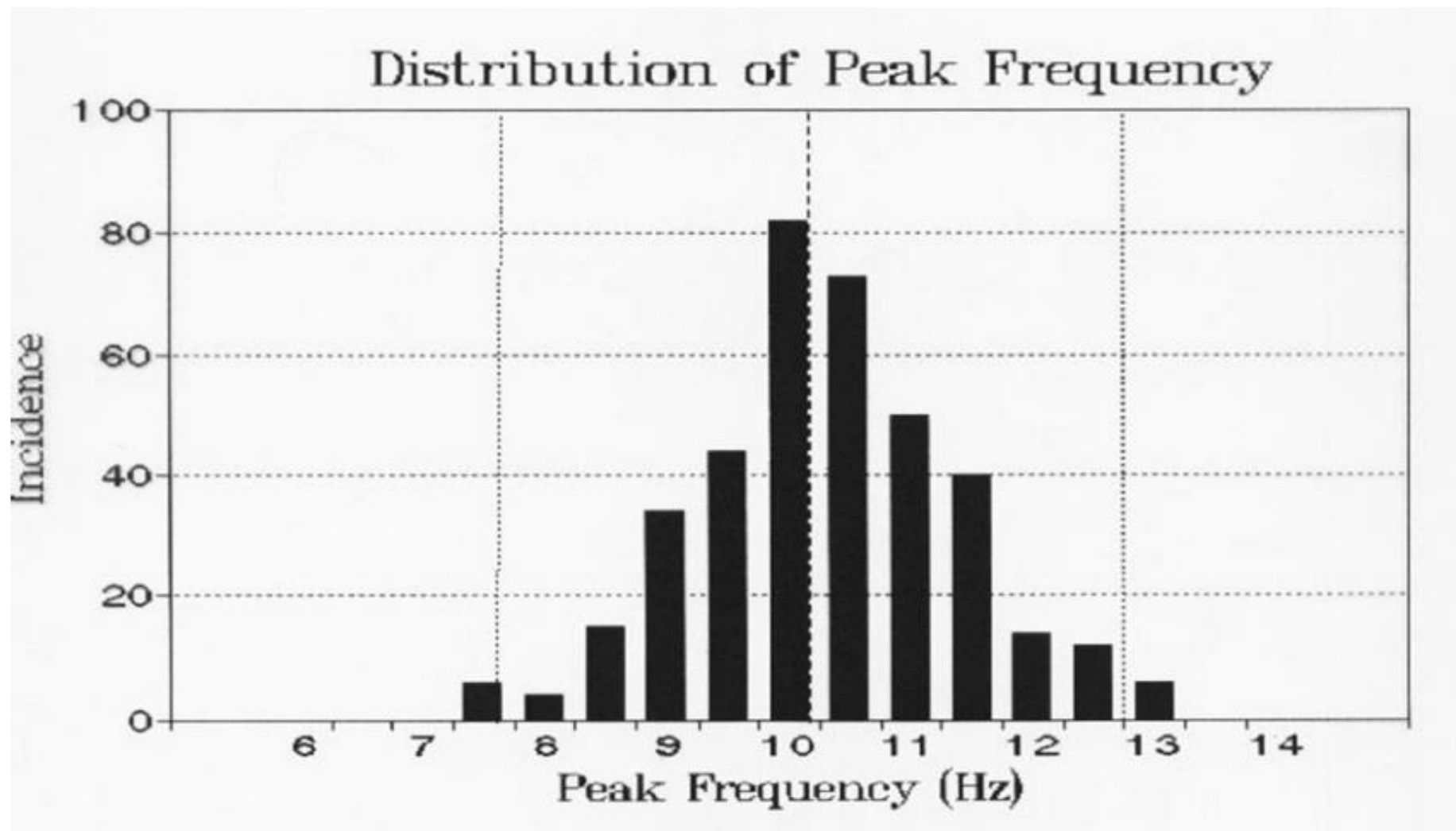
Normal Distribution



Photo by Gregory S. Pryor, Francis Marion University, Florence, SC.

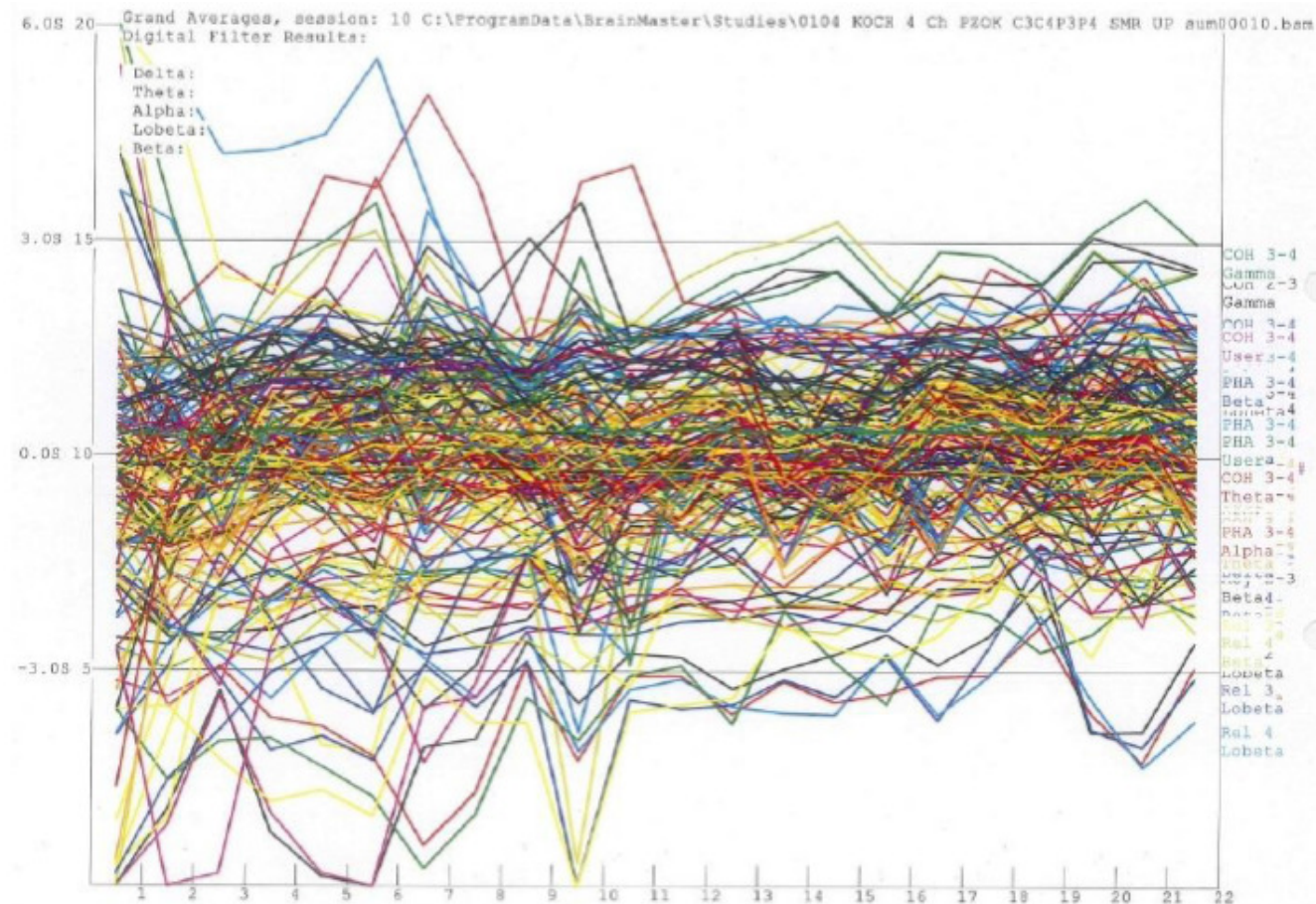
From: (C. Starr and R. Taggart. 2003. *The Unity and Diversity of Life*. 10th Ed. Page 189.)

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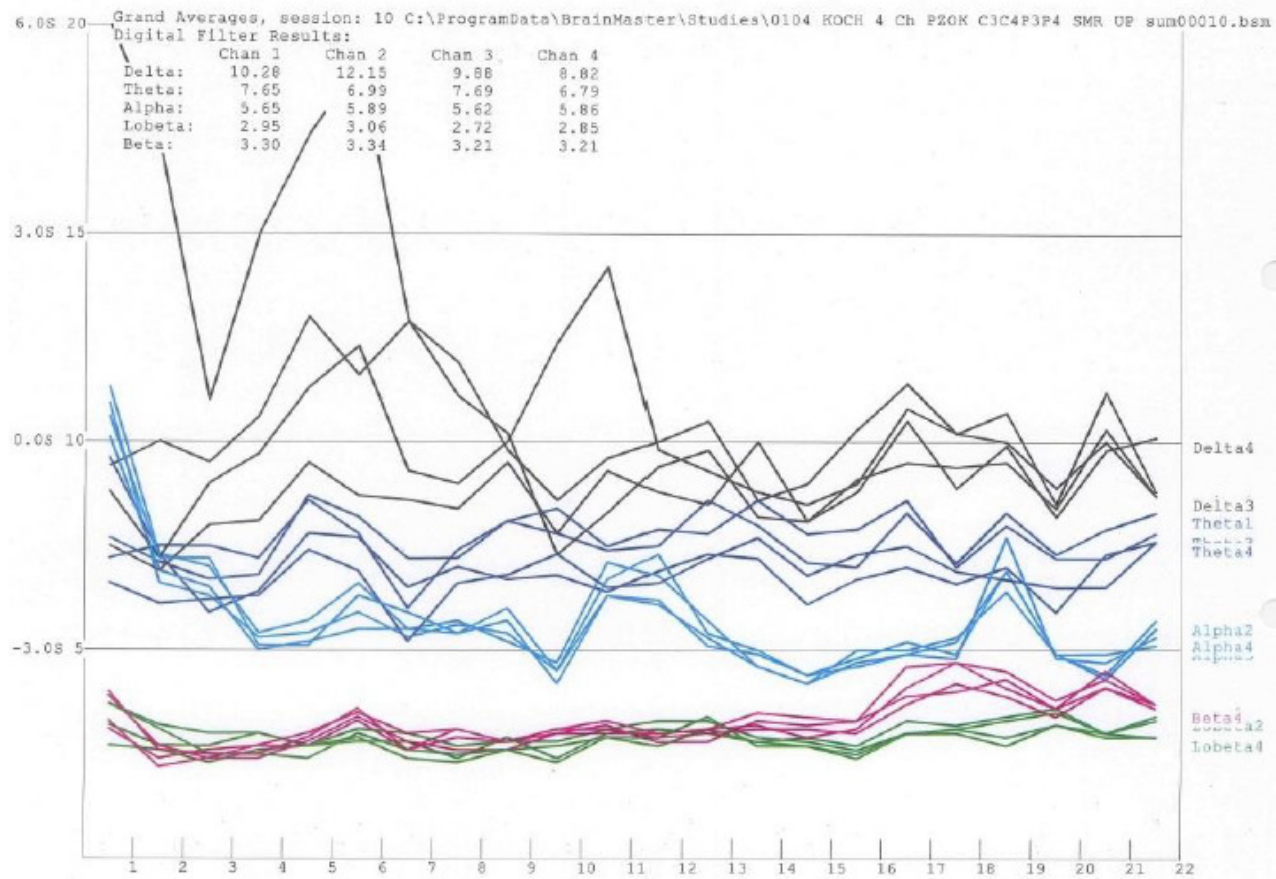
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Progress of Live Z-Score Training



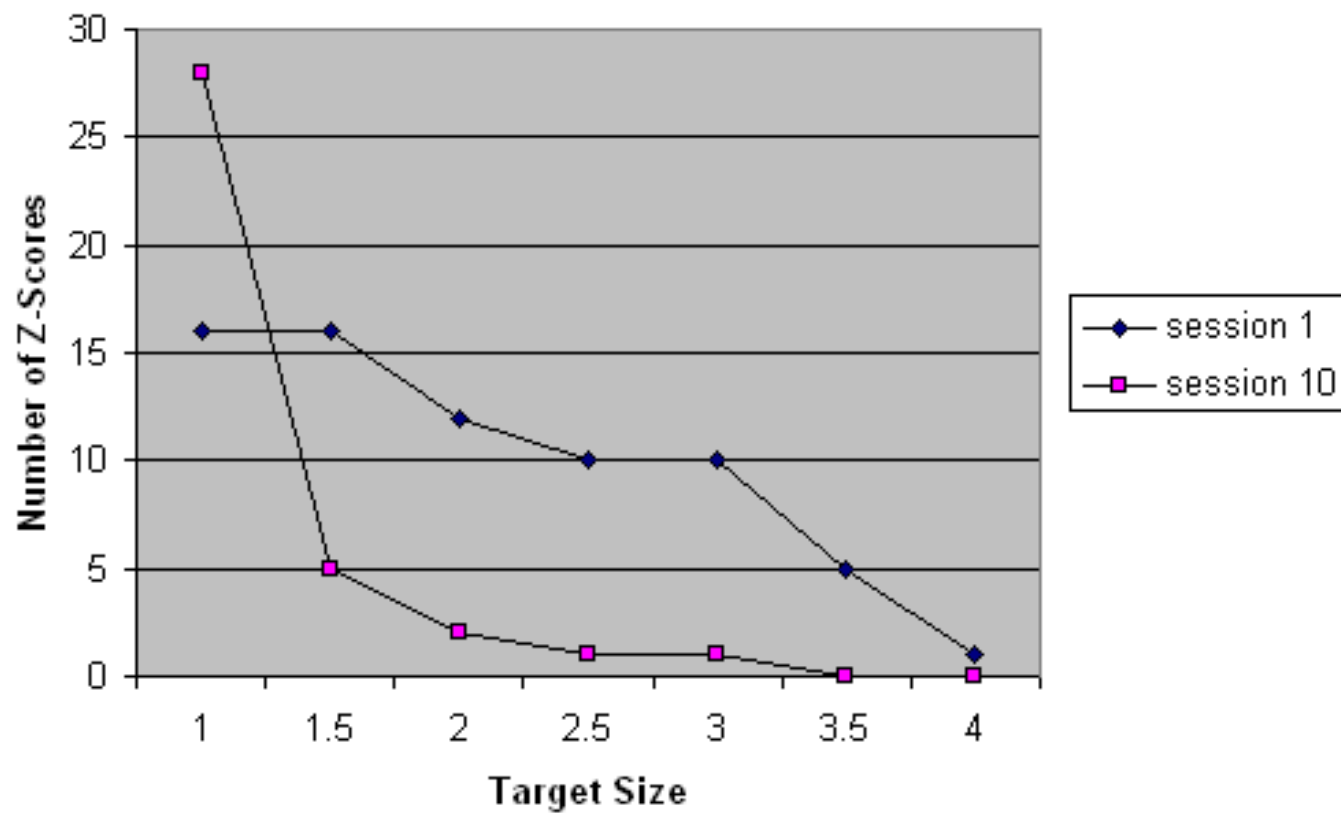
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Power changes during z-score neurofeedback

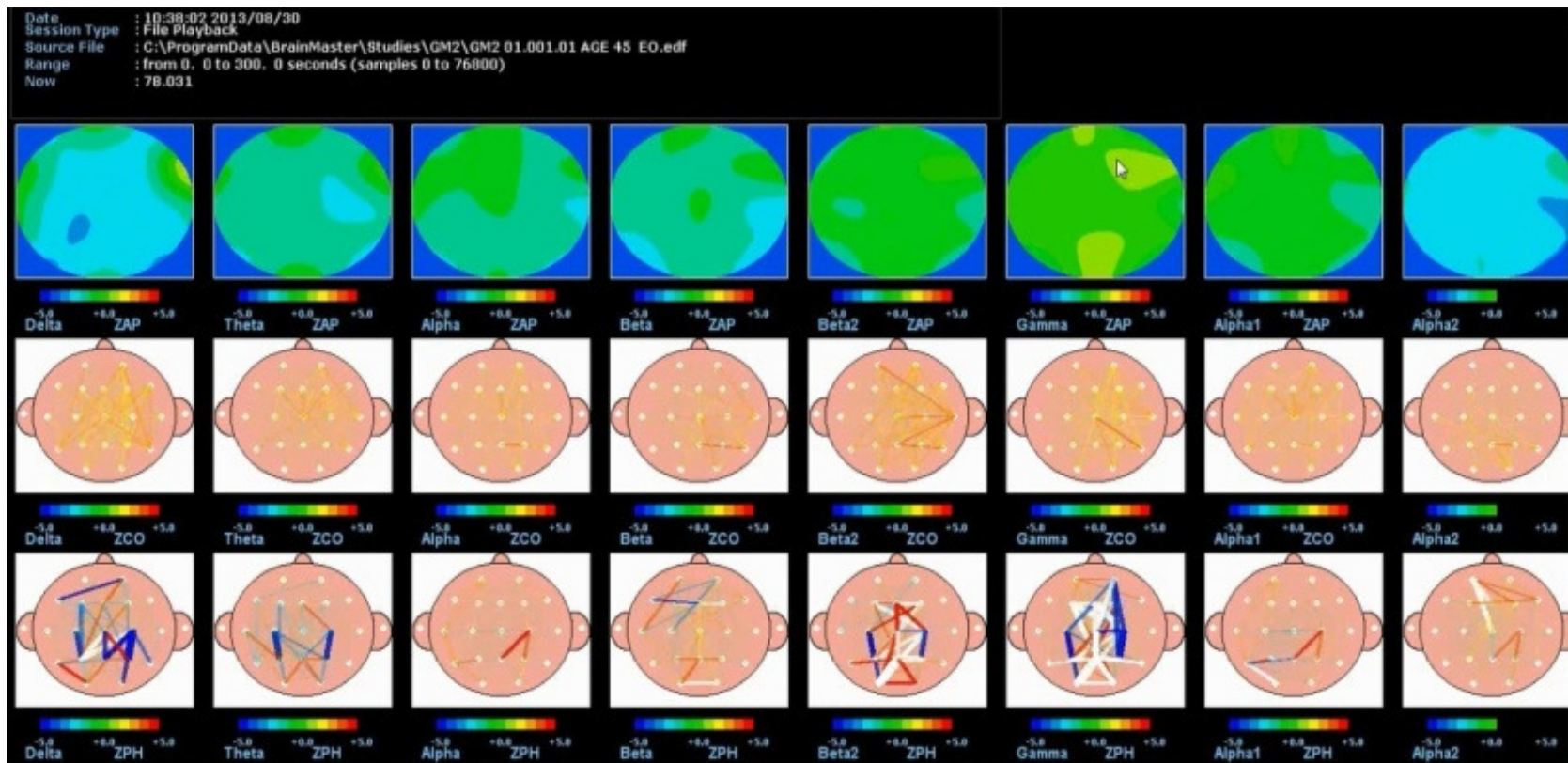


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**Number of Amplitude Z-Scores
outside target range
subject "s"**

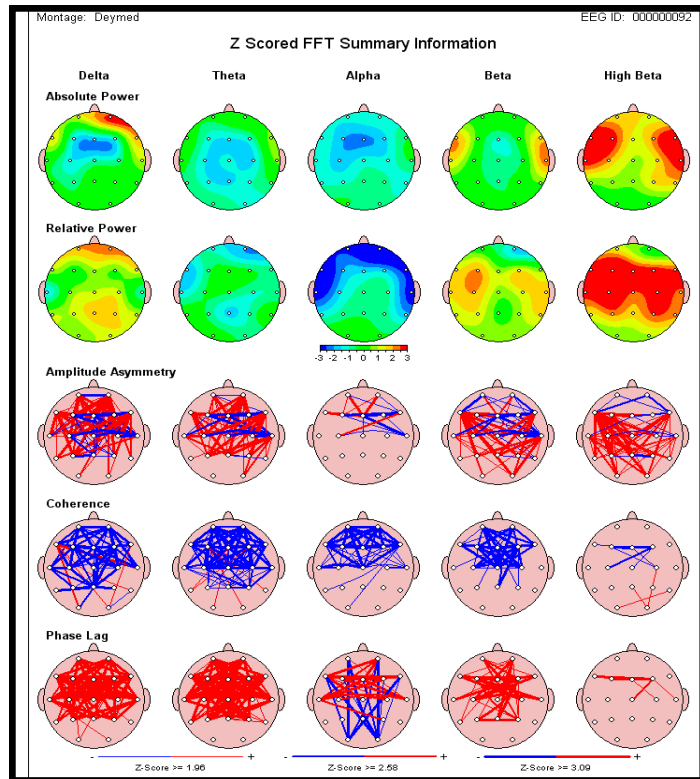


Live surface maps and connectivity maps

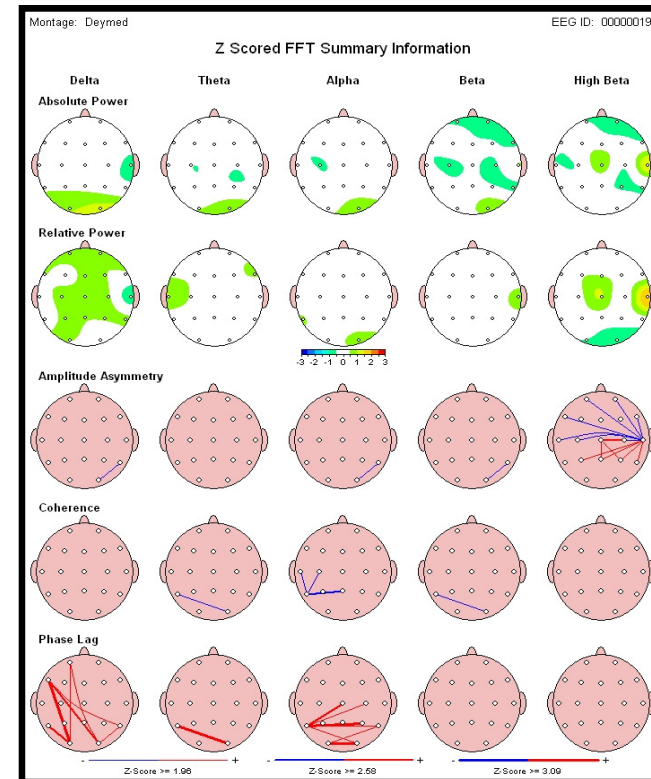


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Comparing the EEG of an individual with clinical presentations to a database of neurotypical recordings can indicate deviations from the statistical average



Brain Maps of 11-year-old Boy
with Severe ASD symptoms



Brain Maps of 12-year-old
Neurotypical Child

Objectives

- Recognize EEG patterns associated with specific emotional responses and states.
- Explain how the frontal cortex participates in the creation of emotional responses to stimuli.
- Describe the brain locations involved in positive and negative emotional responses in normal processes.
- Describe aberrations in normal brain processing, that can lead to abnormal emotional responses or states.
- Explain how different interventions have differing effects on the dynamic control of emotion.

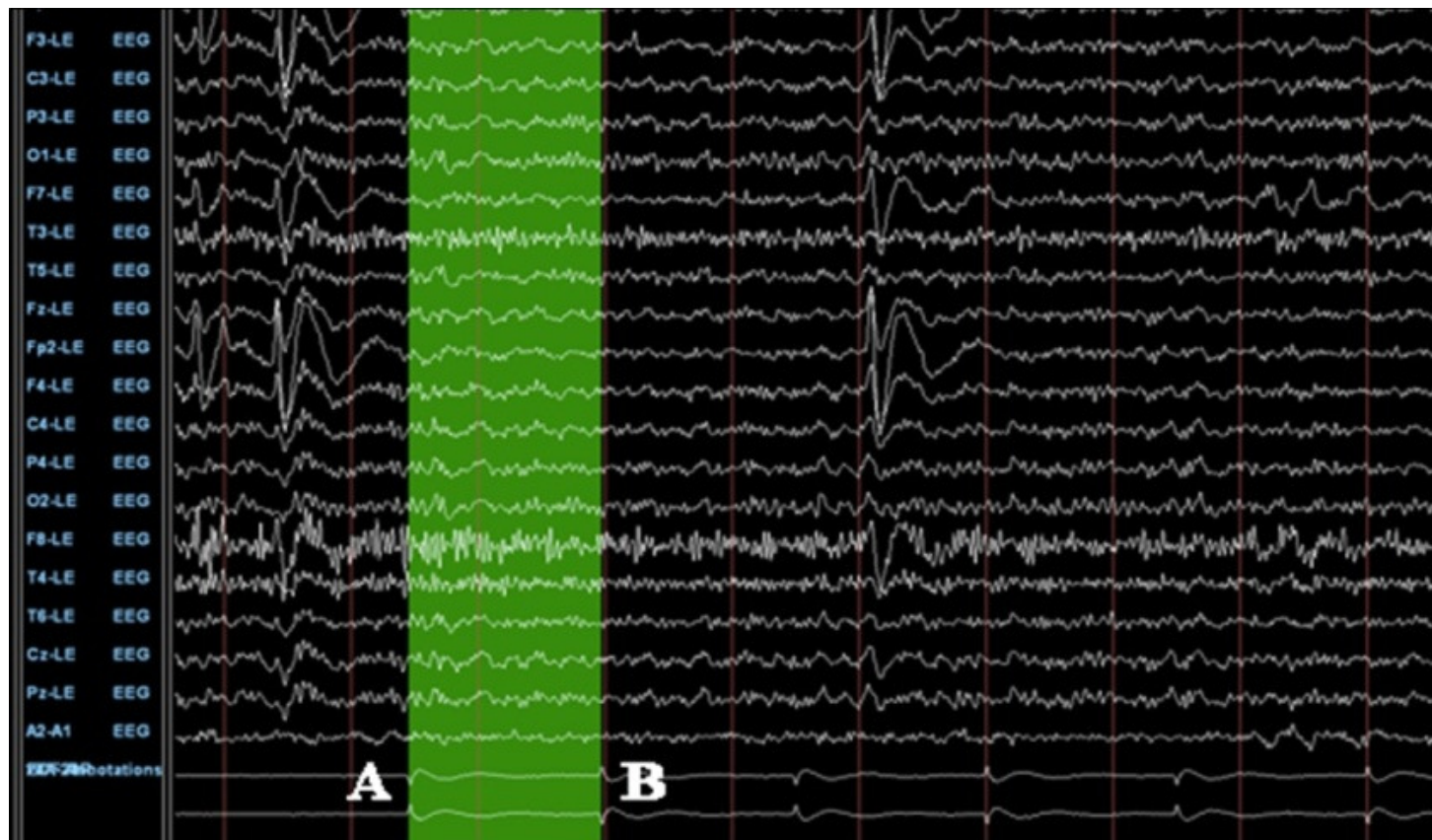


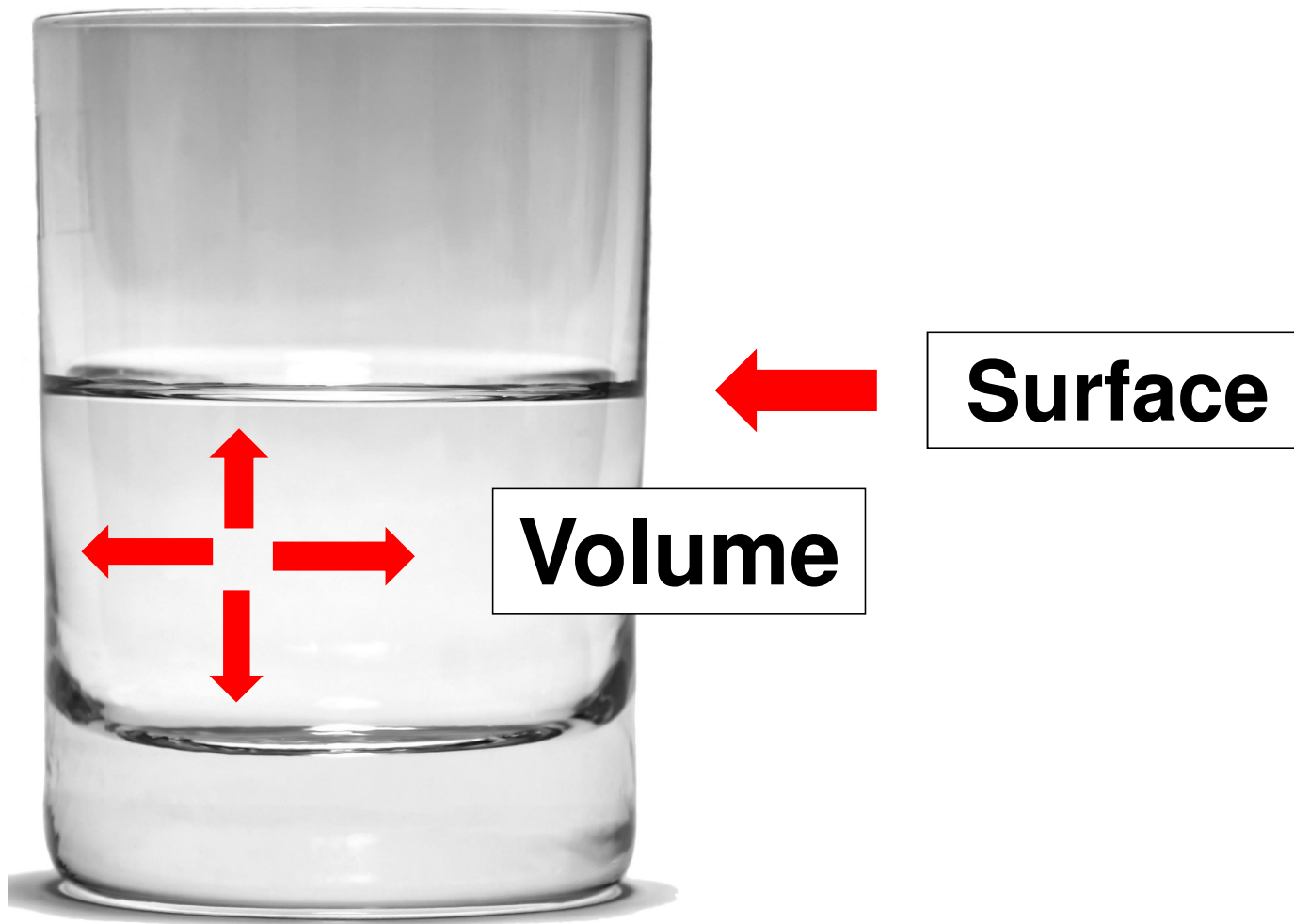
Or is this not a more realistic scenario, with individuals expressing their own individual character strengths, and weaknesses?

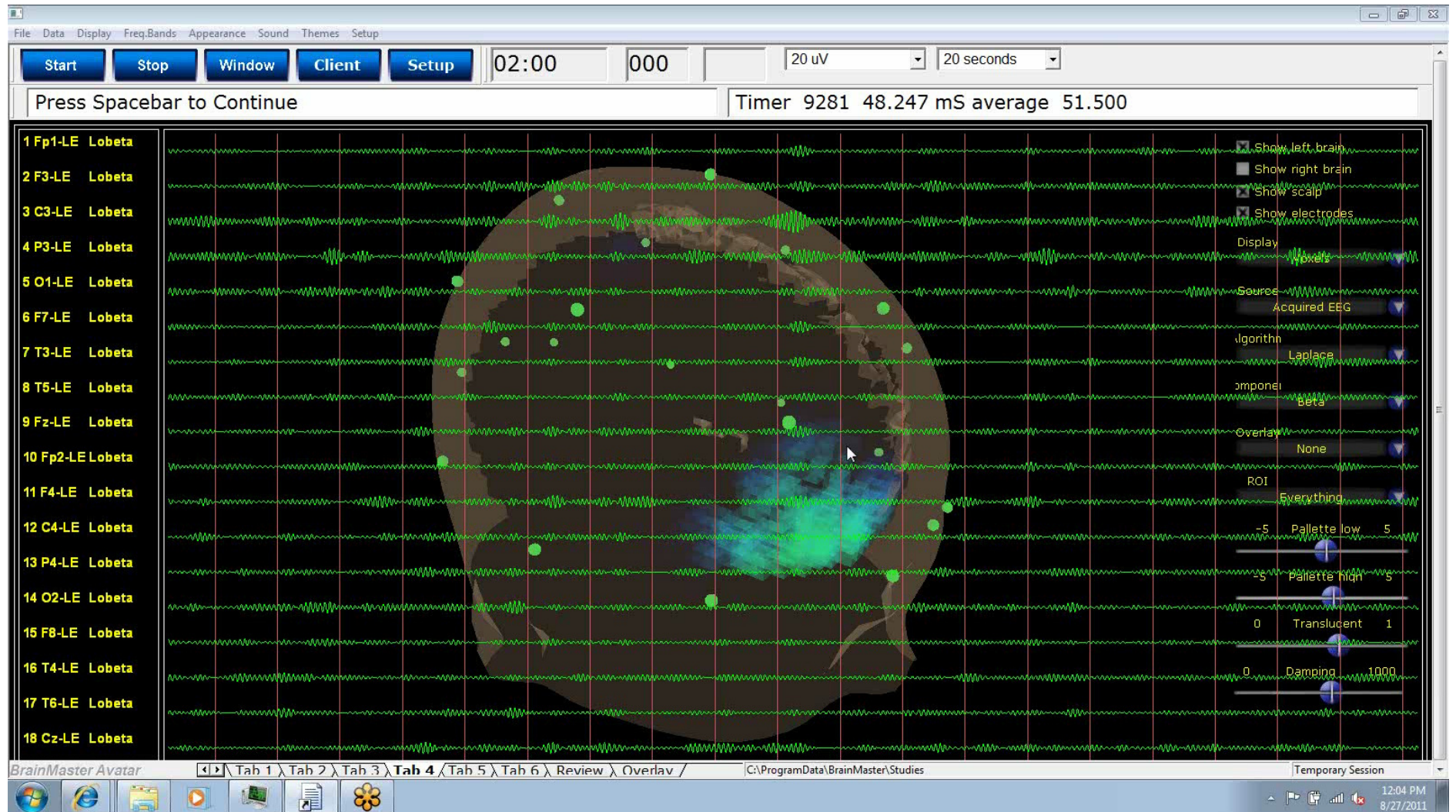


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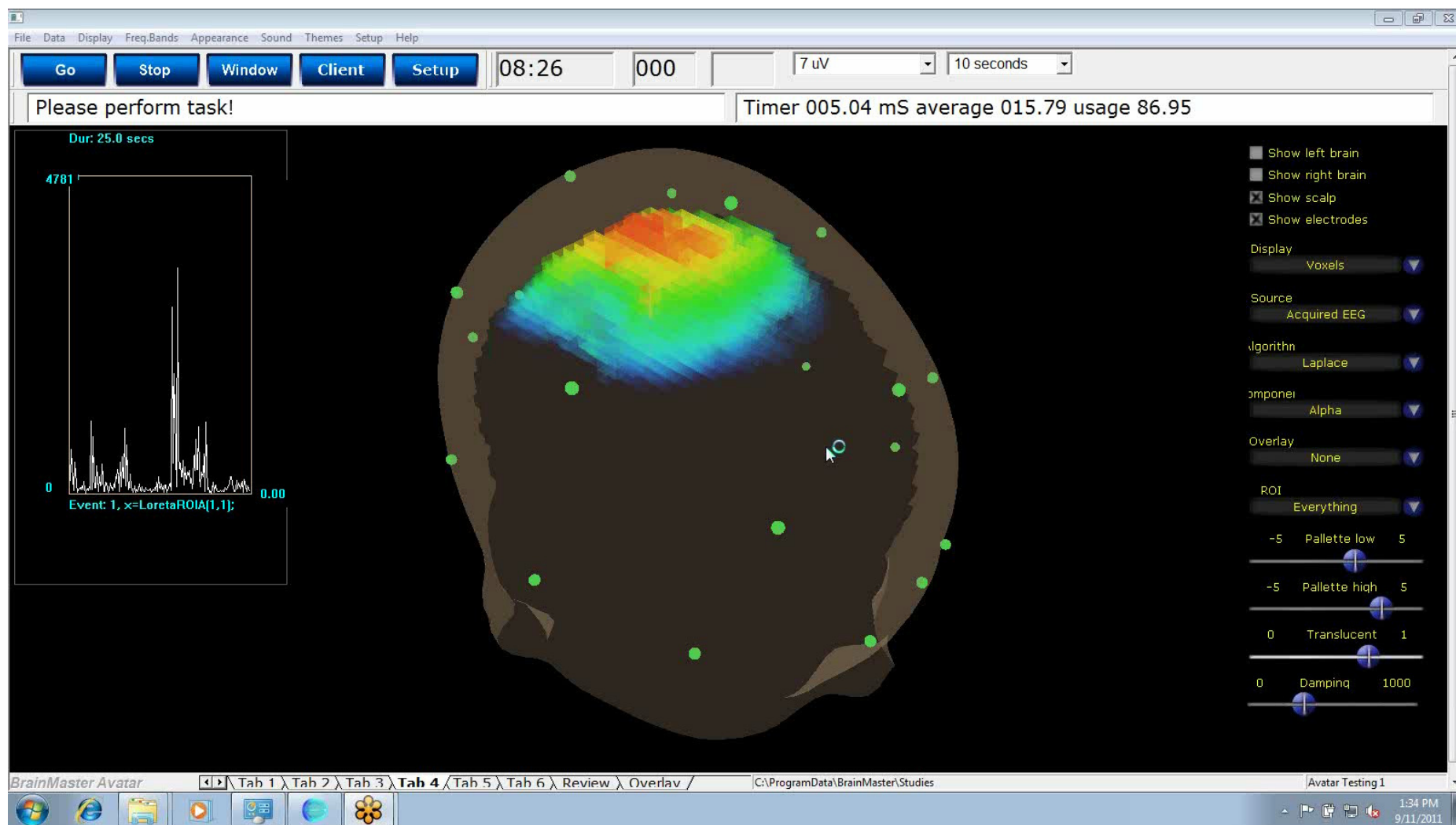
Event-related EEG activation imaging





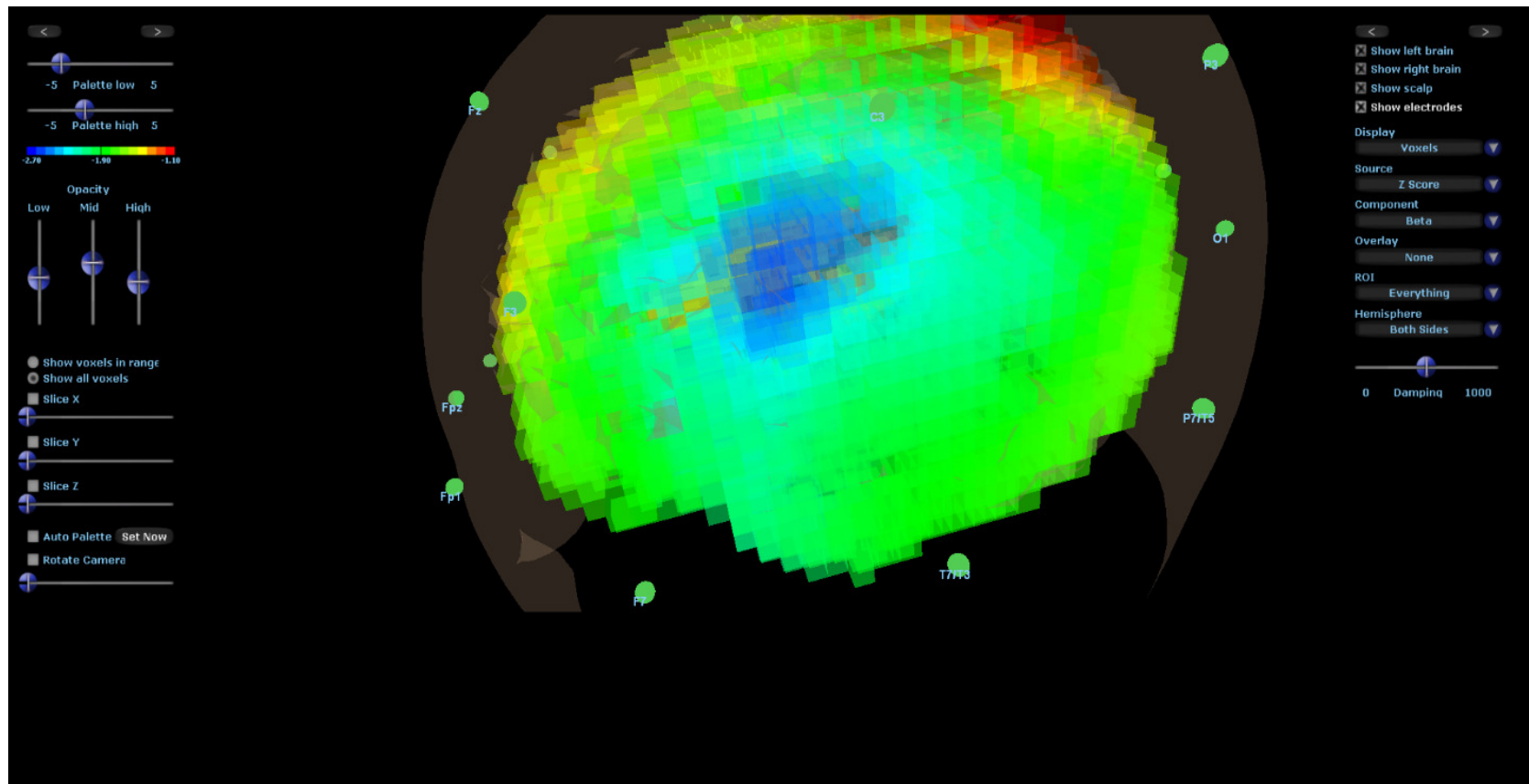


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Speech difficulty

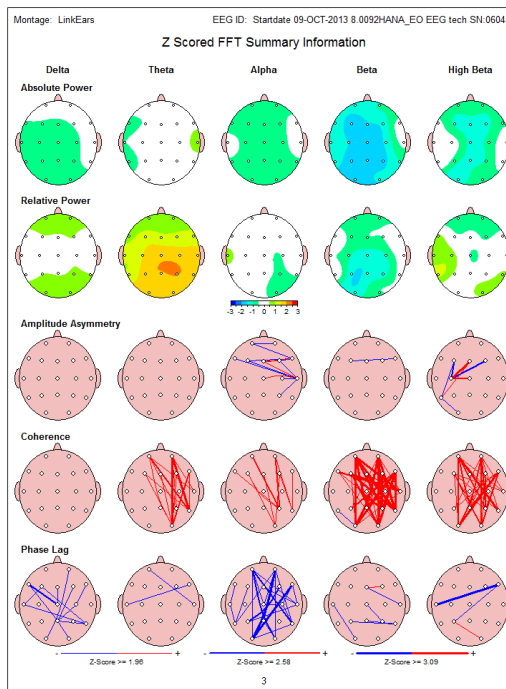


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New Methods

- Use of Gamma (activation) rather than Alpha (relaxation)
- Use of sLORETA (brodmann, ROI) rather than surface
- Use of event-related paradigms
- Separation of state and trait characteristics
- Development of emotional and ethical decision-making methods

Surface – Defiant or Amotivational

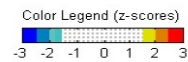
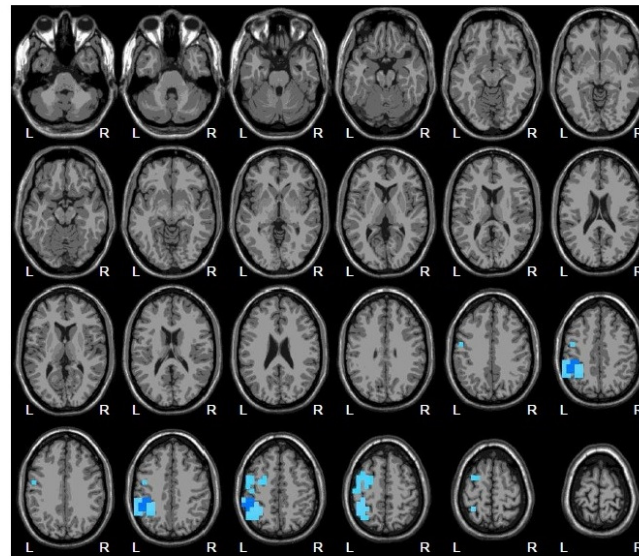


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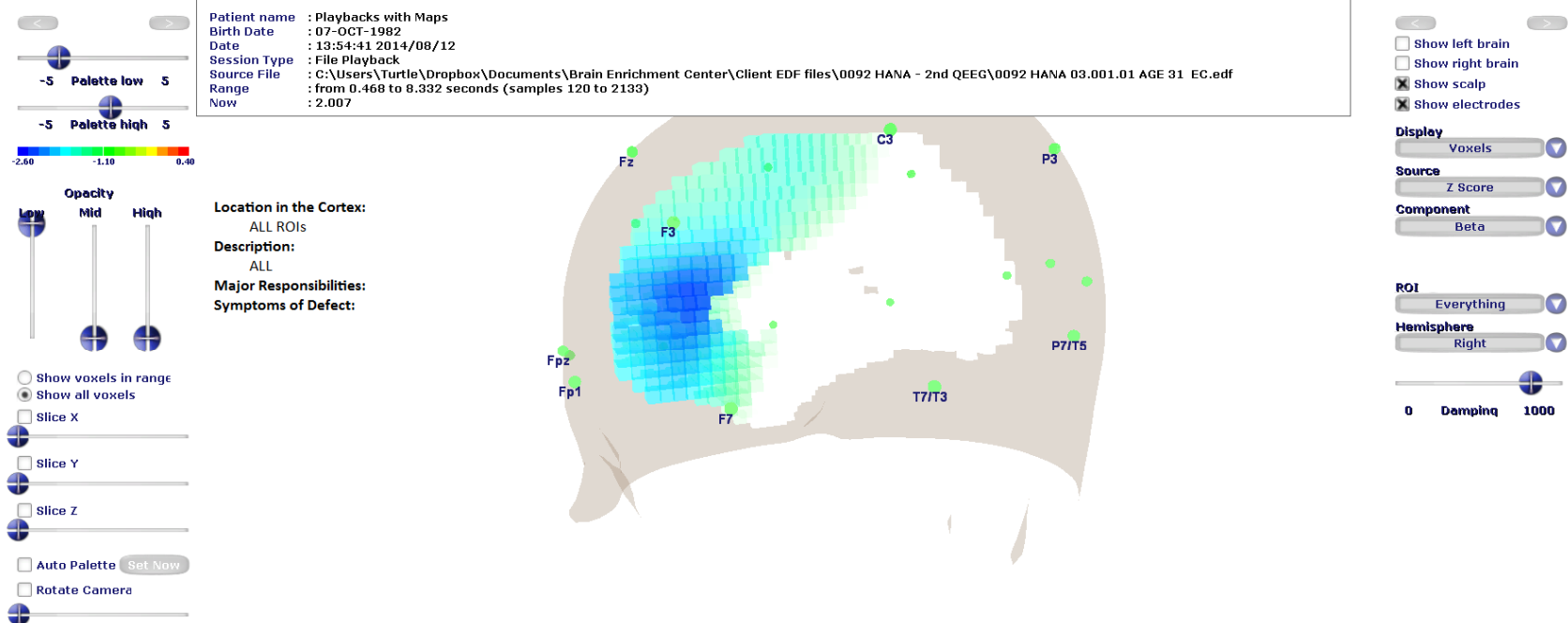
Defiant or bad memory?

Client ID: 0092 HANA
Age: 31.58
Gender: Female
Montage: Linked Ears
Eyes Closed

Neuroguide Loreta Source Reconstruction at 20 Hz

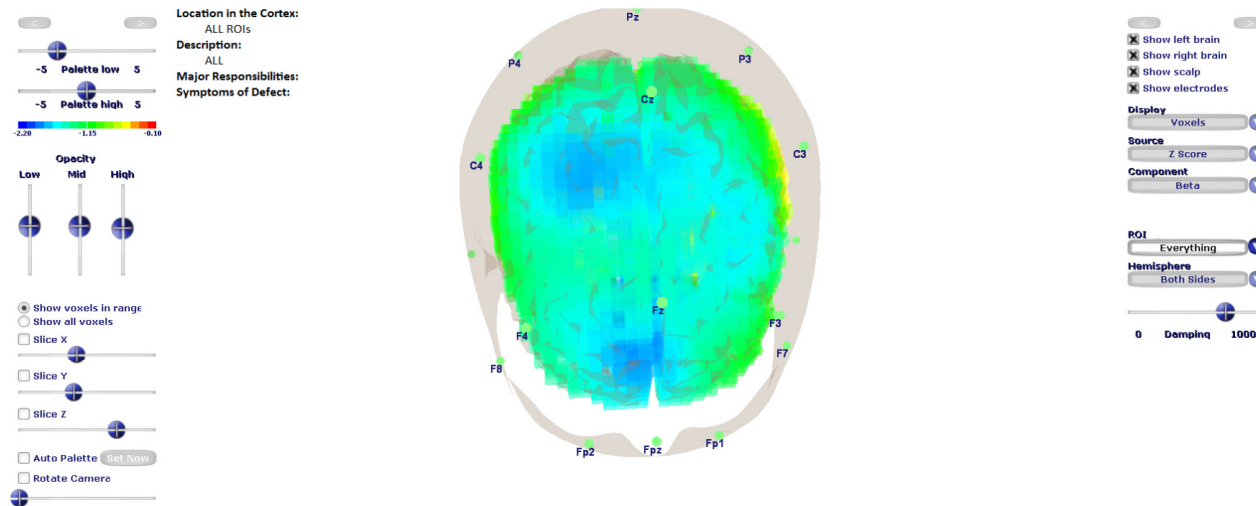


Amotivational



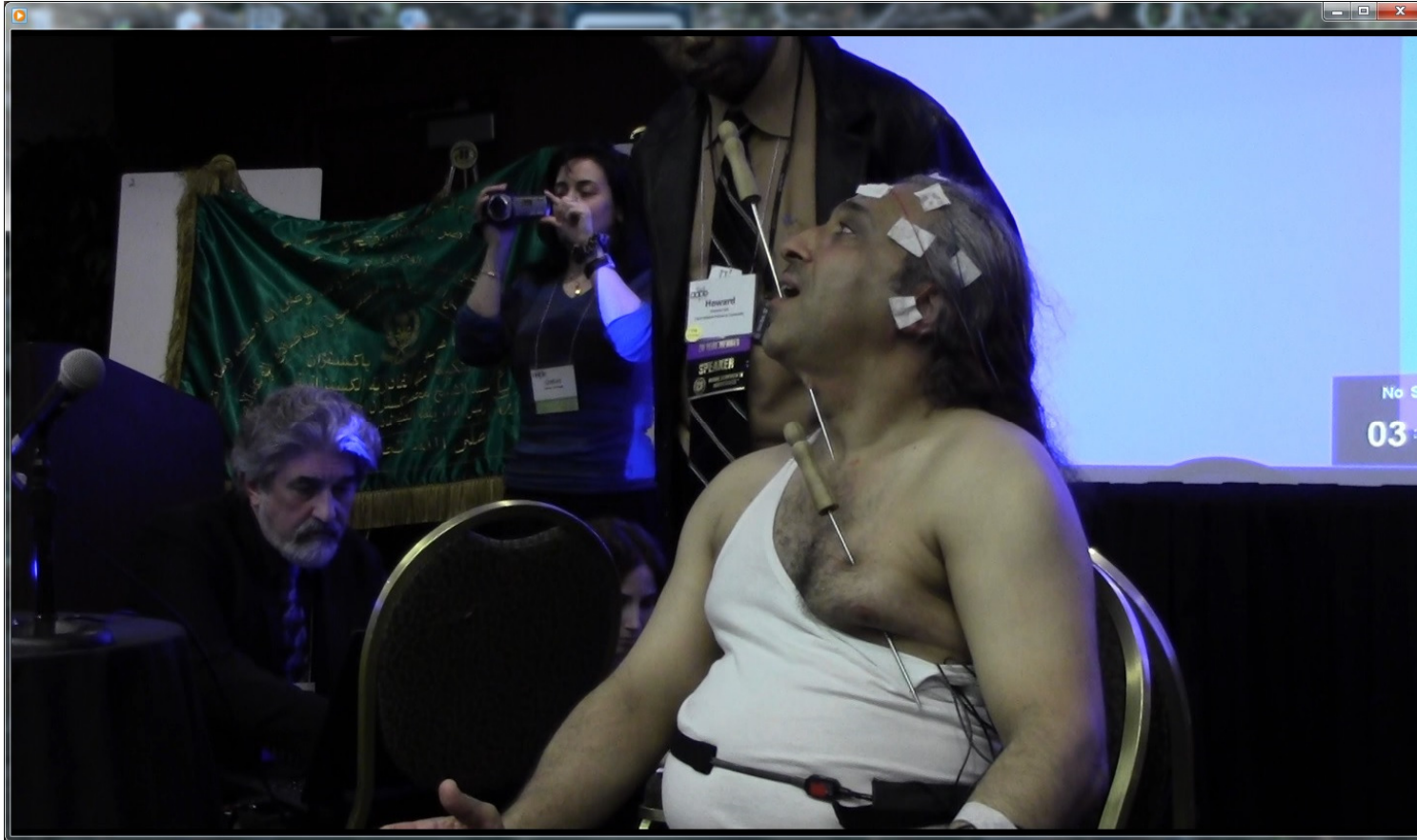
Amotivational and social avoidant

Patient name : Playbacks with Maps
Birth Date : 07-OCT-1982
Date : 14:29:56 2014/08/13
Session Type : File Playback
Source File : C:\Users\Turtle\Dropbox\Documents\Brain Enrichment Center\Client EDF files\0092 HANA - 2nd QEEG\0092 HANA 03.001.01 AGE 31 EC.edf
Range : from 0. 0 to 302. 0 seconds (samples 0 to 77312)
Now : 297.875

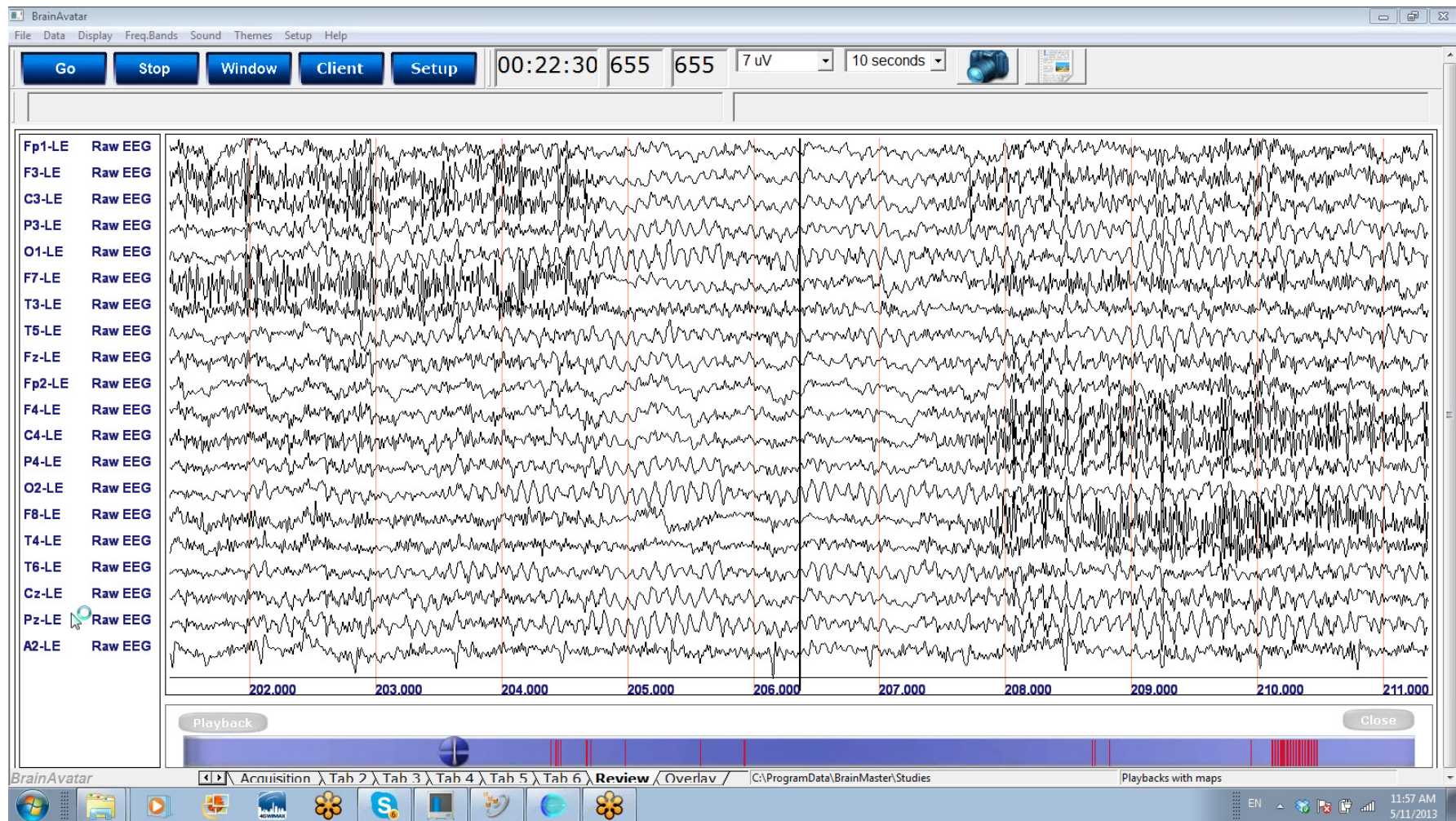


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During piercing

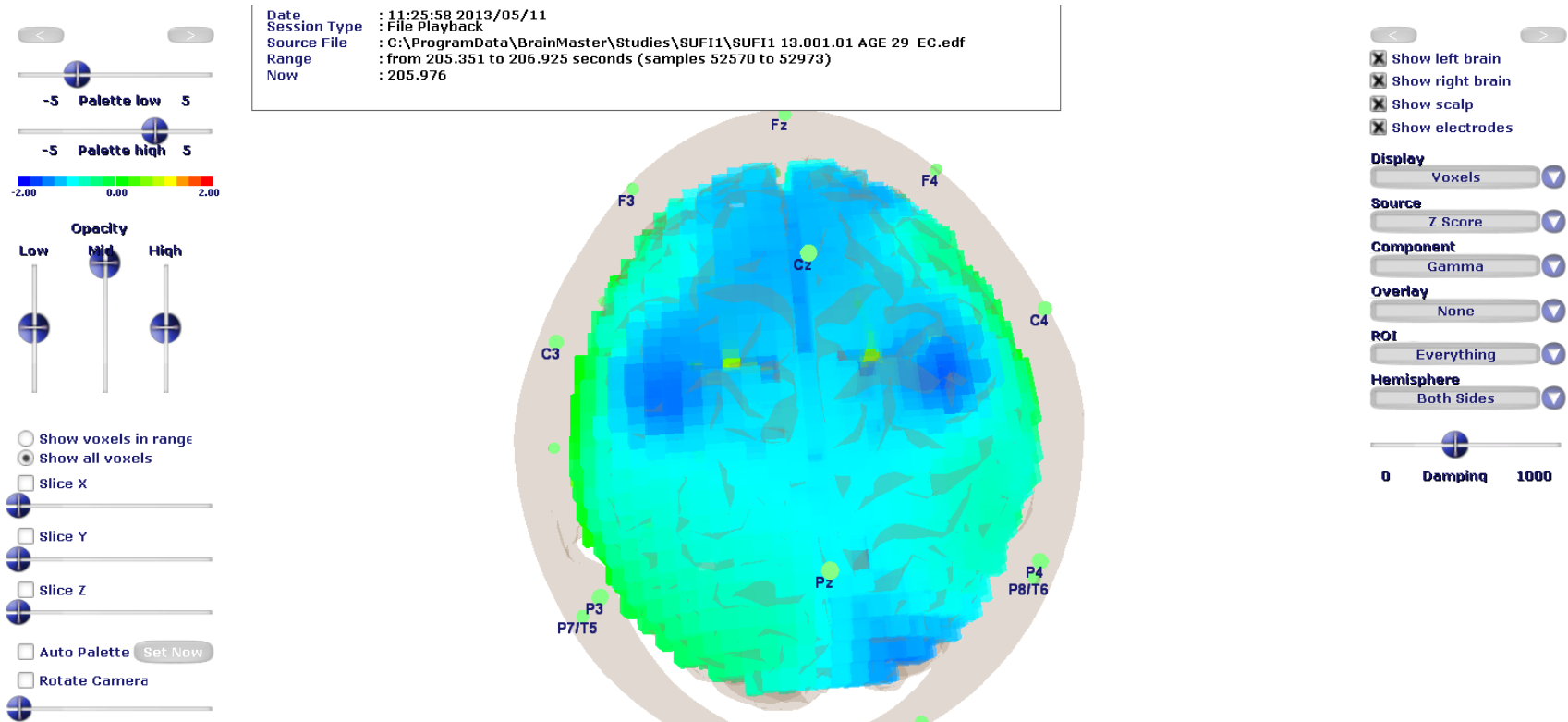


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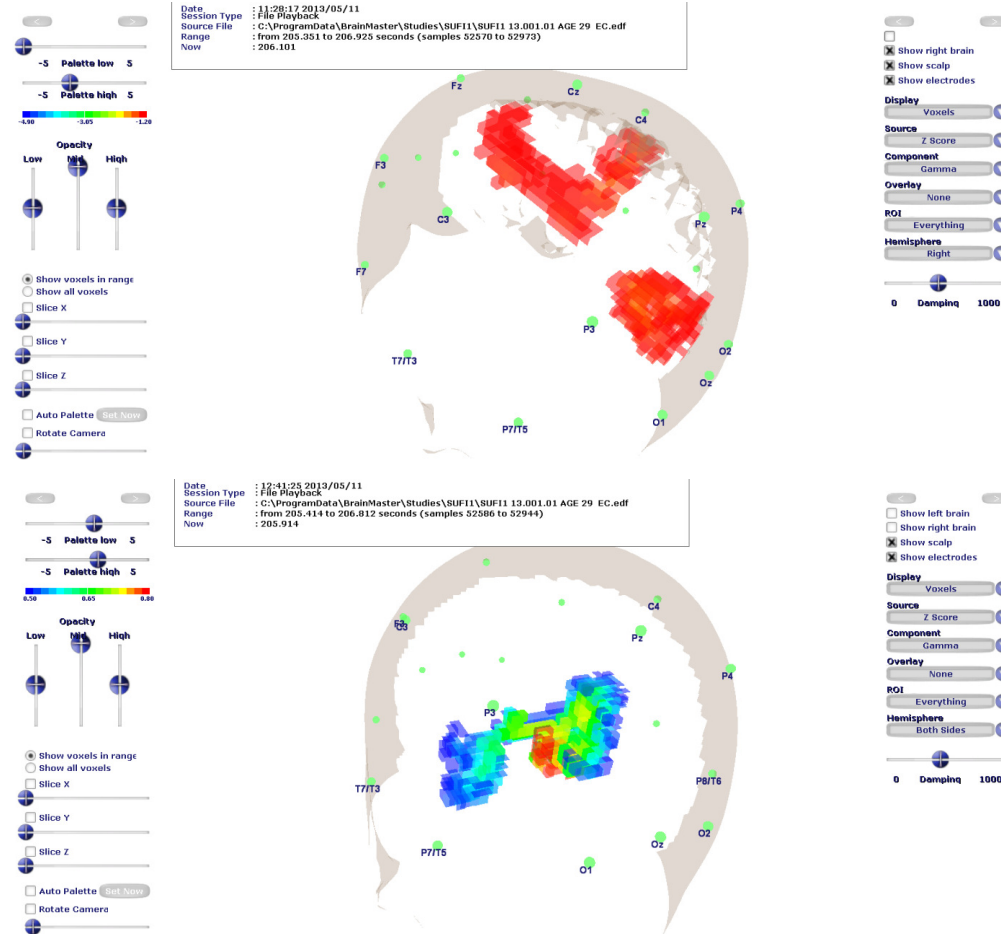


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Pain Network de-activation (gamma)



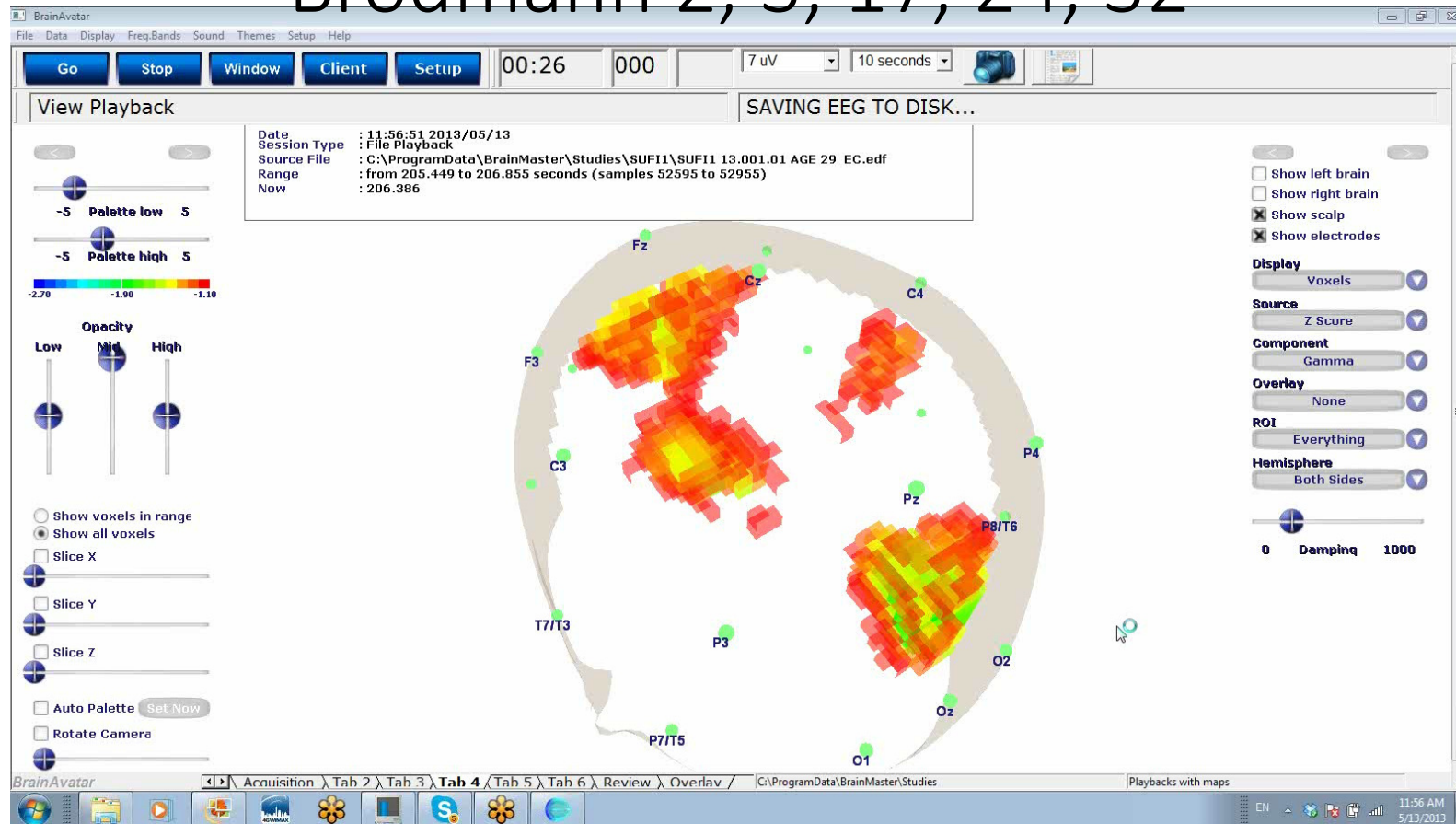
Sufi Pain Hubs and Internalized State



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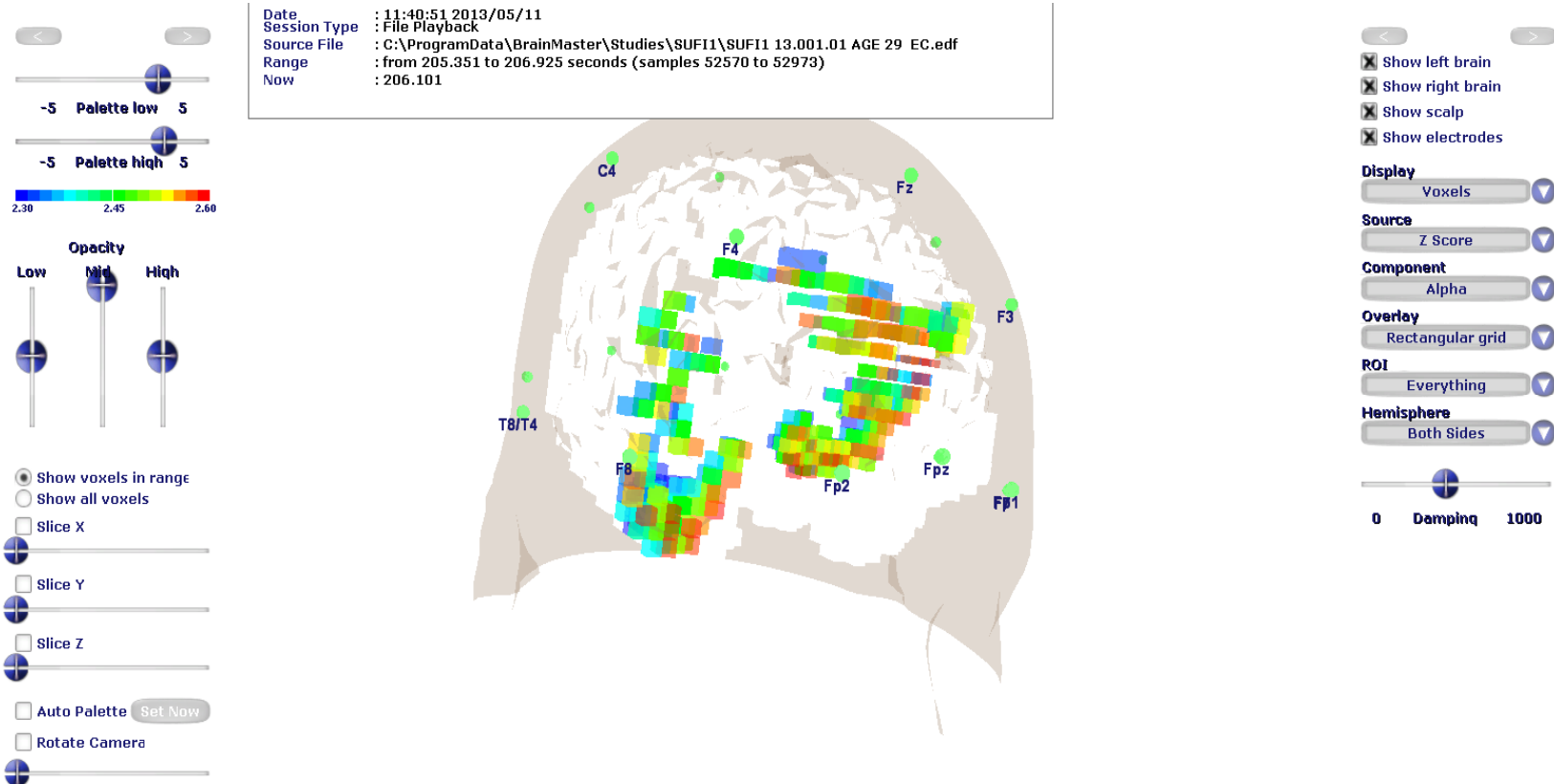
Pain network

Brodmann 2, 3, 17, 24, 32



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Alpha Abundance SM strip & temporal - BDx



Toward an Operational Model of Decision Making, Emotional Regulation, and Mental Health Impact

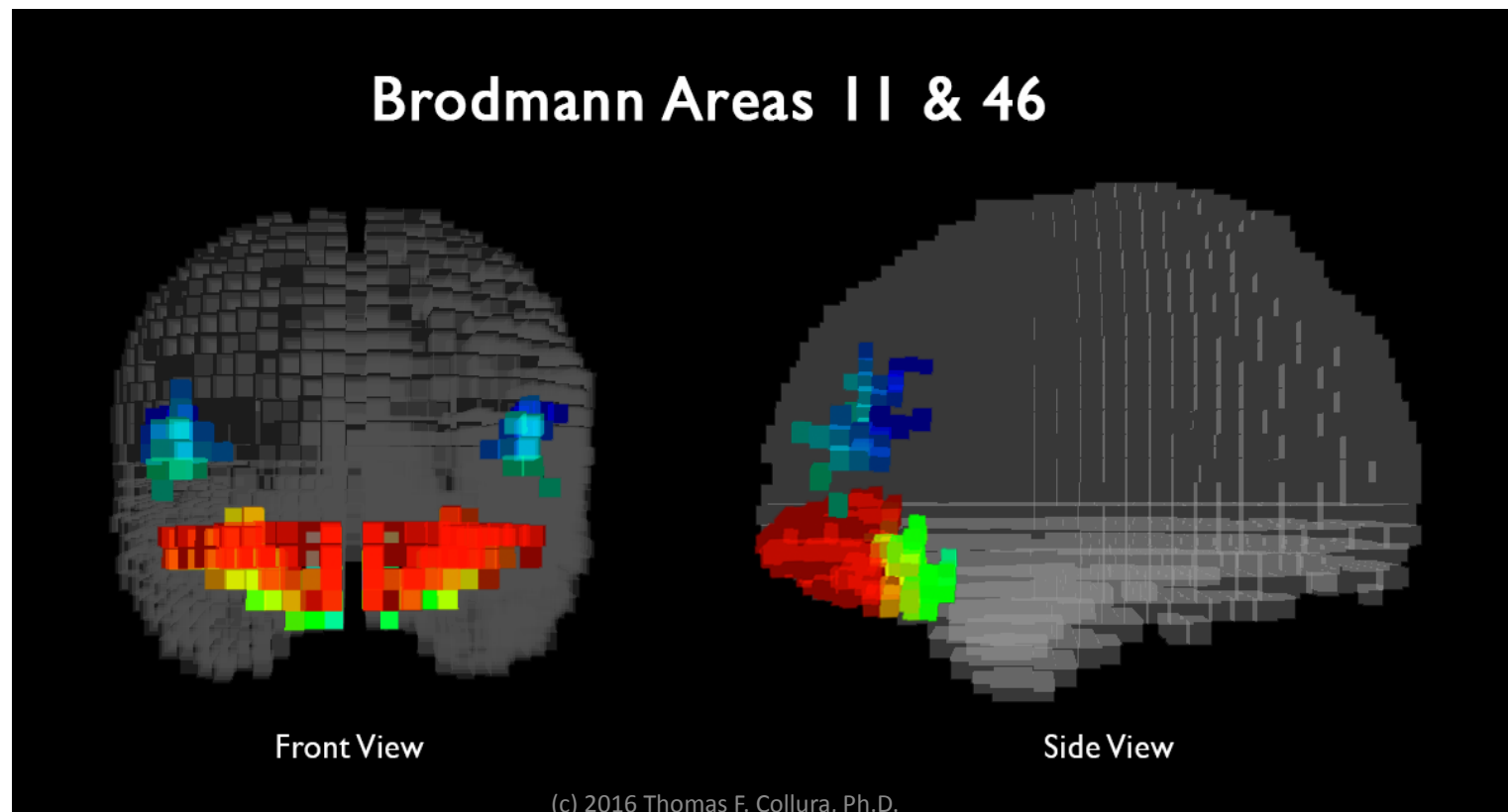
Thomas F. Collura, PhD, QEEG-D, BCN, LPC; Carlos P. Zalaquett, PhD, LMHC;
Ronald J. Bonnstetter, PhD; Seria J Chatters, PhD

ABSTRACT

Current brain research increasingly reveals the underlying mechanisms and processes of human behavior, cognition, and emotion. In addition to being of interest to a wide range of scientists, educators, and professionals, as well as laypeople, brain-based models are of particular value in a clinical setting. Psychiatrists, psychologists, counselors, and other mental health professionals are in need of operational models that integrate recent findings in the physical, cognitive, and emotional domains, and offer a common language for interdisciplinary understanding and communication. Based on individual traits, predispositions, and responses to stimuli, we can begin to identify emotional and behavioral pathways and mental processing patterns. The purpose of this article is to present a brain-path activation model to understand individual differences in decision making and psychopathology. The first section discusses the role of frontal lobe electroencephalography (EEG) asymmetry,

summarizes state- and trait-based models of decision making, and provides a more complex analysis that supplements the traditional simple left-right brain model. Key components of the new model are the introduction of right hemisphere parallel and left hemisphere serial scanning in rendering decisions, and the proposition of pathways that incorporate both past experiences as well as future implications into the decision process. Main attributes of each decision-making mechanism are provided. The second section applies the model within the realm of clinical mental health as a tool to understand specific human behavior and pathology. Applications include general and chronic anxiety, depression, paranoia, risk taking, and the pathways employed when well-functioning operational integration is observed. Finally, specific applications such as meditation and mindfulness are offered to facilitate positive functioning. (*Adv Mind Body Med.* 2014;28(4):18-33.)

Key emotional regulatory centers
primary and secondary emotional response
Emotional sensation -> emotional perception





Emotional Response to Stimuli

A relative balance in **beta** and **gamma** waves creating asymmetry in the activity in the frontal lobes is associated with normal mood and emotional state. Increased activity within the left prefrontal cortex can indicate an elevation in mood and positive feelings. De-activation in the left prefrontal cortex alone or in combination with an increase in activity within the right prefrontal cortex can suggest the opposite, being associated with depressive mood or negative thoughts. Instances in which only the right prefrontal cortex activates quickly with an strong increase in gamma waves suggest a strong dislike or avoidance of a particular exposure.

Example Images:

These example images depict the amount of gamma activity present in subjects frontal lobes as they are exposed to different stimuli invoking neutral, positive, and negative responses.

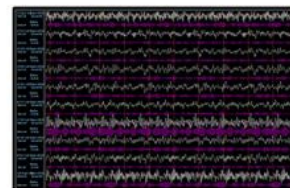
Raw EEG and event markers

The event stimuli being reviewed in this case is:

"A lover's embrace."



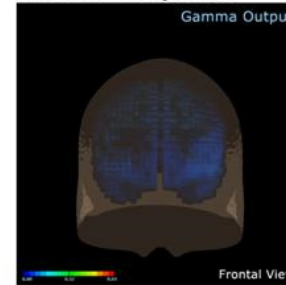
*Each event marker represents a single stimuli.



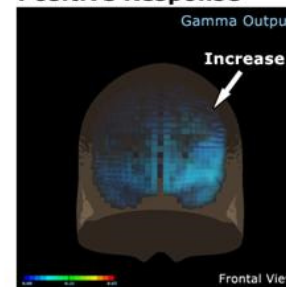
Acquired EEG:

An increase in both beta and gamma waves can be seen when also inspecting the acquired EEG of the event.

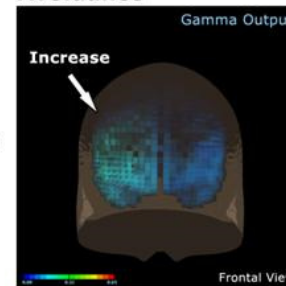
Neutral Response



Positive Response



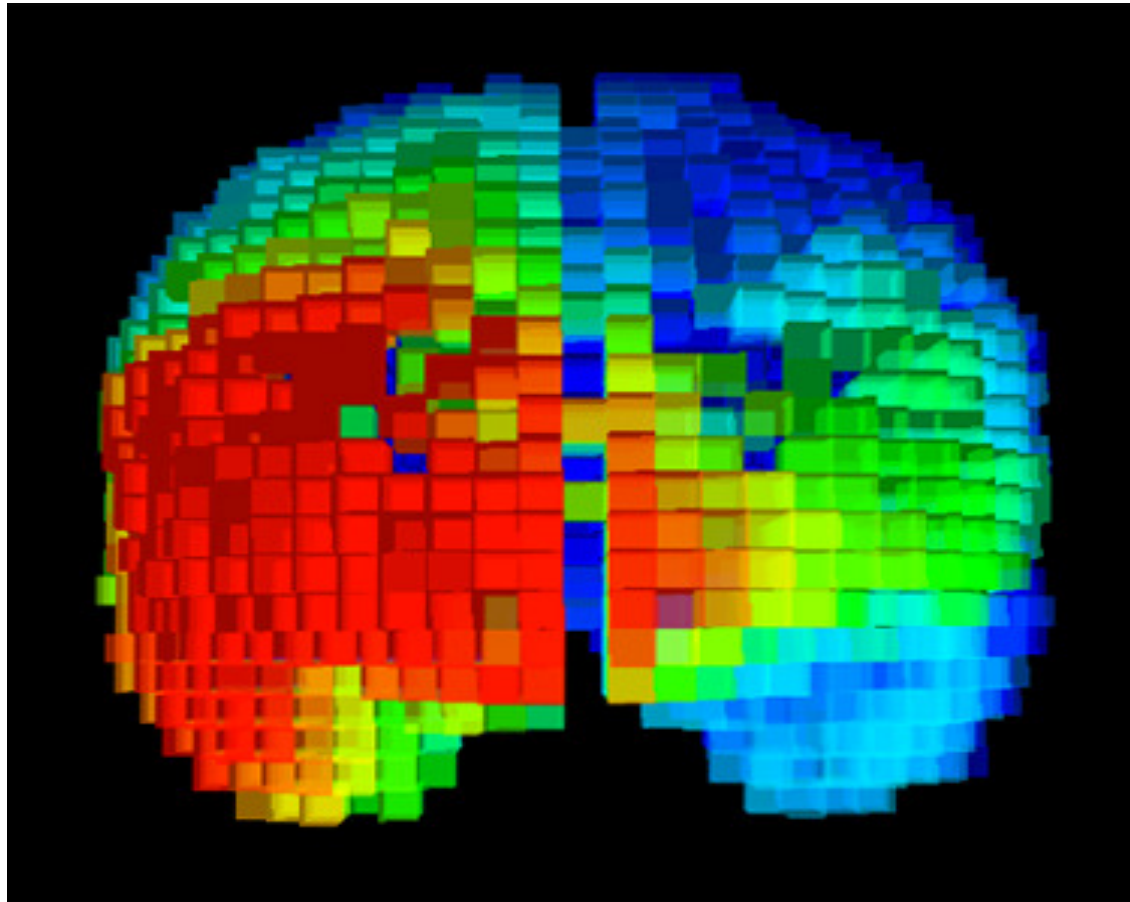
Avoidance



Background

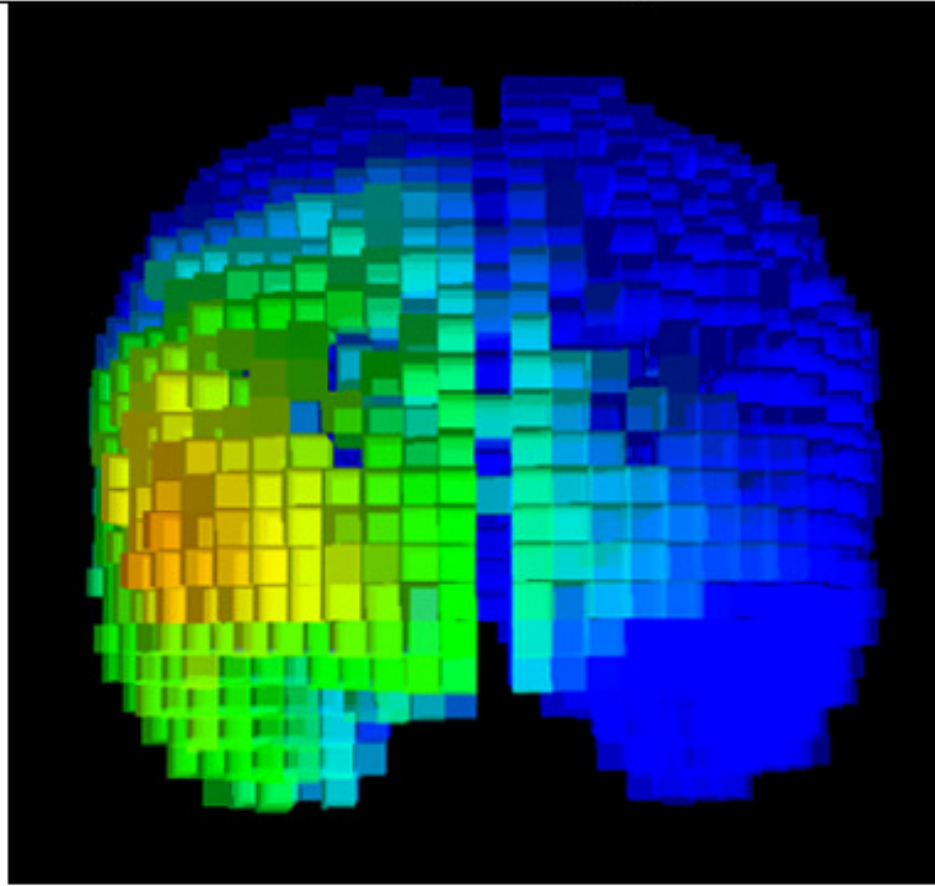
- Frontal asymmetry associated with mood – approach vs. avoid
- Davidson, Rosenfeld, Baehr
- Left = “positive” – employs sequential processing
- Right = “negative” – employs parallel processing
- Past work used alpha asymmetry – now using gamma
- Not trait only – now looking at state responses to stimuli
- Incorporation of decision-making model
- Application to trauma

Baseline Mood State Depressed

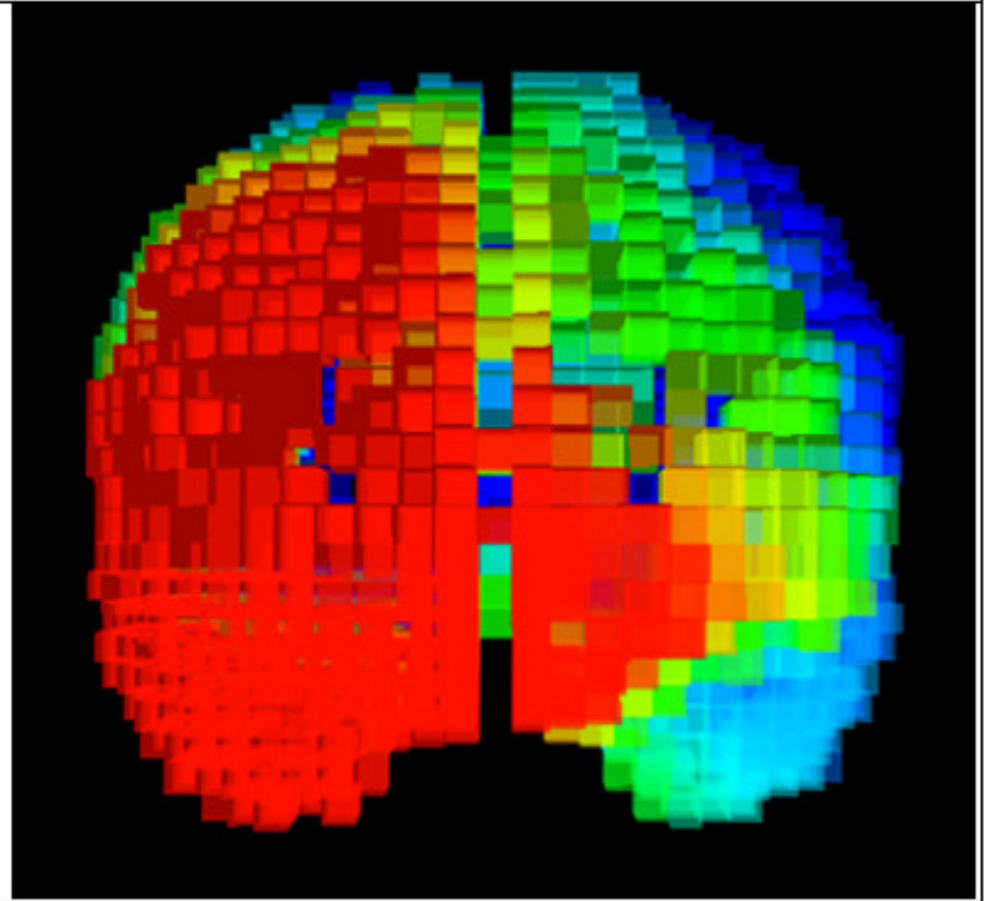


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Reaction to Chocolate Chip Cookies



Aversion to Beer

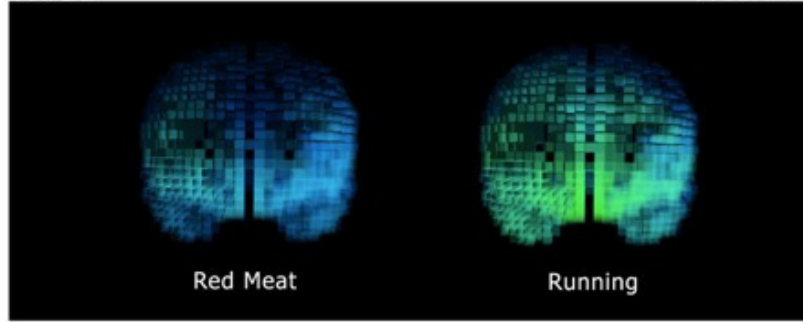


Physical Health Assessment

Initial Results

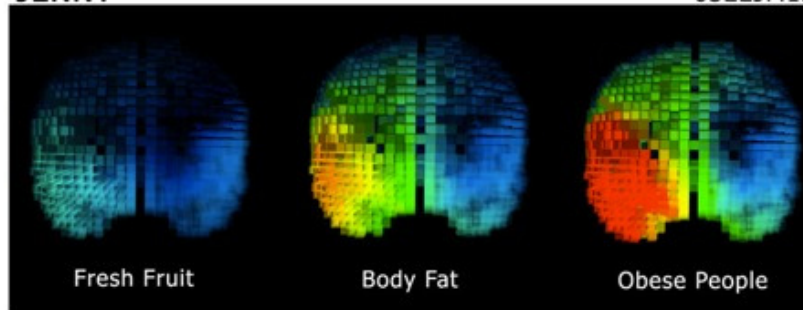
NOEL

0322NH12



JENNY

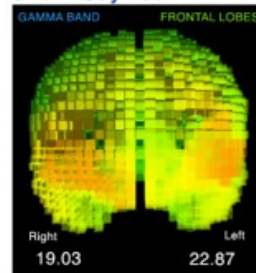
0322JM12



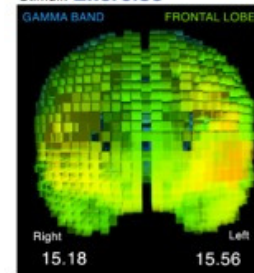
Wellness Results - Alyssa (0625AW12)

RESEARCH
and DEVELOPMENT

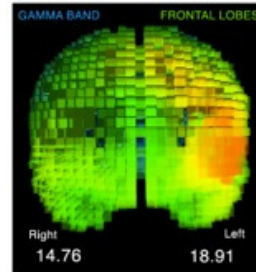
Stimuli: **Body Fat**



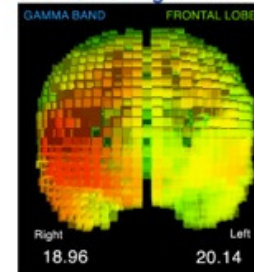
Stimuli: **Exercise**



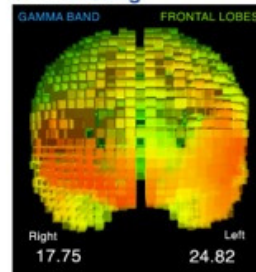
Stimuli: **Thin**



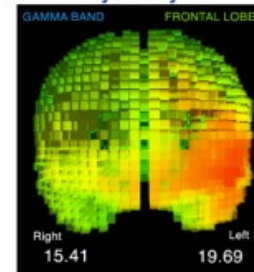
Stimuli: **Smoking**



Stimuli: **Dieting**



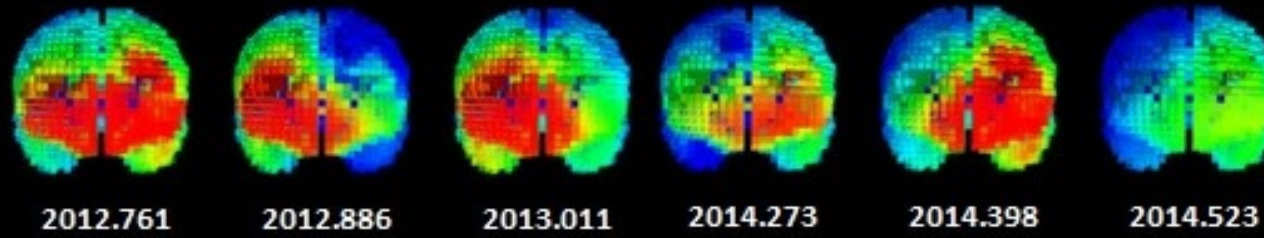
Stimuli: **Physically Fit**



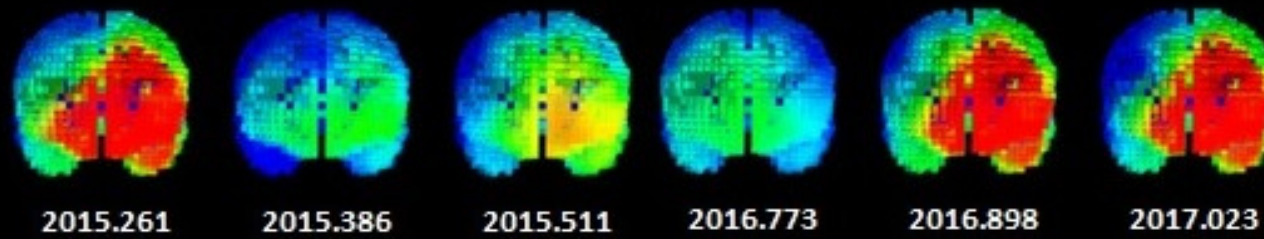
Target Training International, Ltd.

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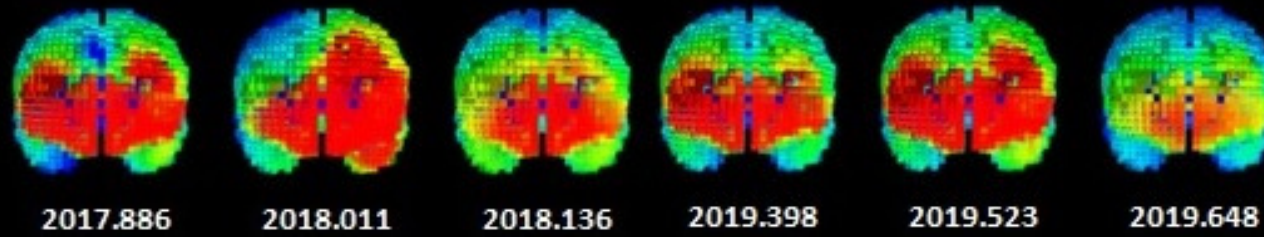
Honeywell



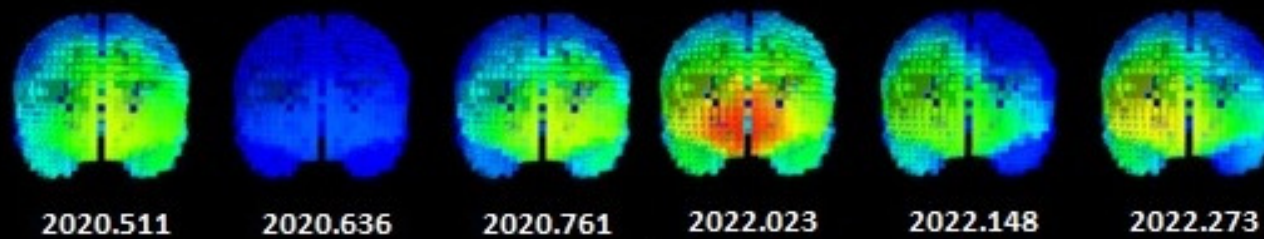
Mike



Dad



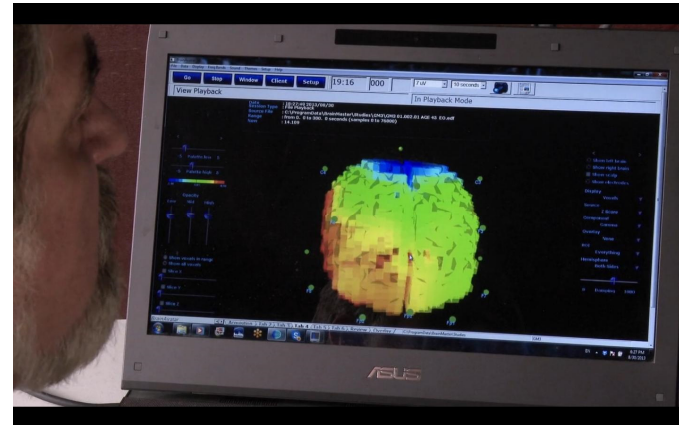
Exercise



Corvette StingRay “Reverse Test Drive”

Attributes Identified:

- Fear, Anticipation
- Scanning Environment
- Decision-Making
- Relaxation
- Excitement
- Approach
- Withdrawal
- Automatic Control



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Left-Right Functionality

Mechanism	Parallel	Serial
Hemisphere	Right	Left
Data Representation	Holographic	Sequential
Perspective	Visuo-spatial	Temporo-linguistic
Analogous to	Pictures	Music, speech
Context	Global (this always...)	Local (in this particular case,...)
Orientation	Patterns	Lists
Tasking	Multitasking (may be stressful)	Single-tasking (focused, calm)
Perspective	Past	Future
Dimension	Space	Time
Attribute	Patterns (spatial)	Causality
Memory	Past patterns, “punishment”	Cause/effect experiences, rules
Mode of analysis	“the last time...”	“what if...”
Result	Avoid / Attack	Approach / Remain

Left-Right Mood Regulation

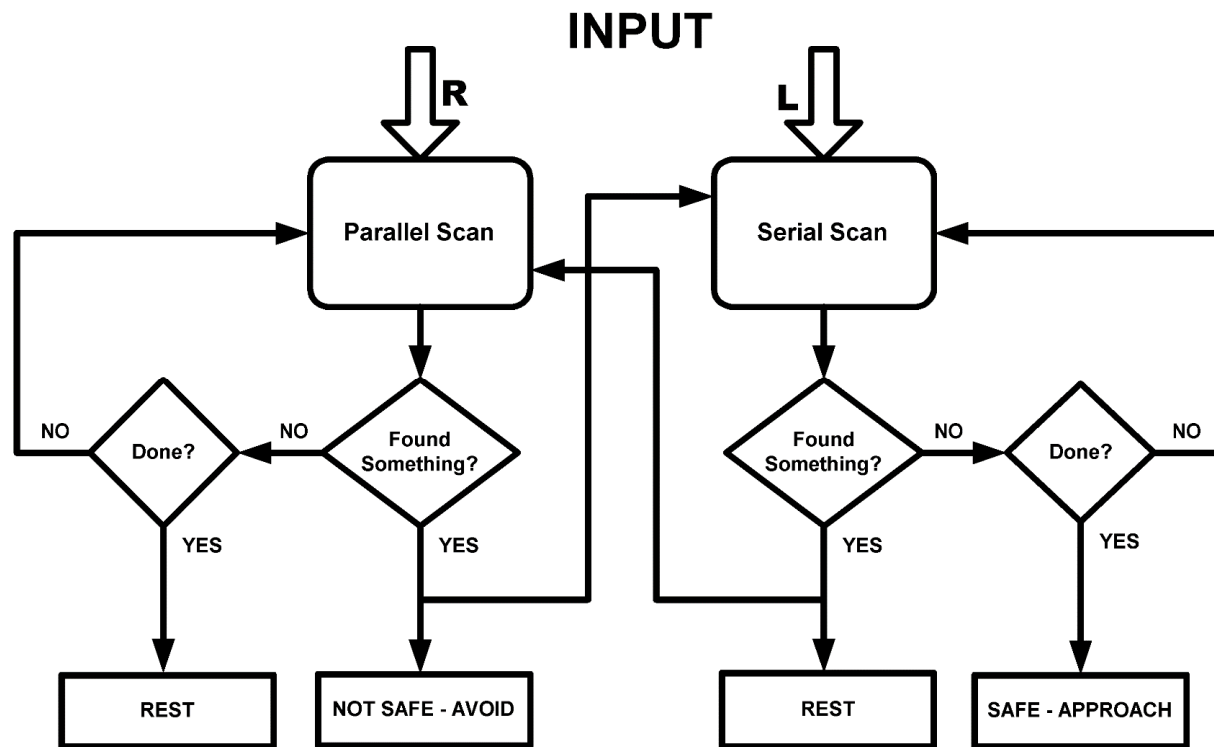
Emotion	Negative	Positive
Decision cycle	1 analysis	Sequence of n analyses
Activation sequence	1 “found”	N “not founds” then done
Priority	Detecting danger	Ensuring safety
Decision priority	Immediate	Long-term
Approach	Tactical, here & now	Strategic, future outcomes
Equation parameters	$Pp+=1$, $Ppf=1$	$Ps+=1$, $Psf=1$
Associated behaviors	Run; fight	Breathe; build
Neurotransmitter	Adrenalin	Serotonin

Mesial – Dorsolateral distinction

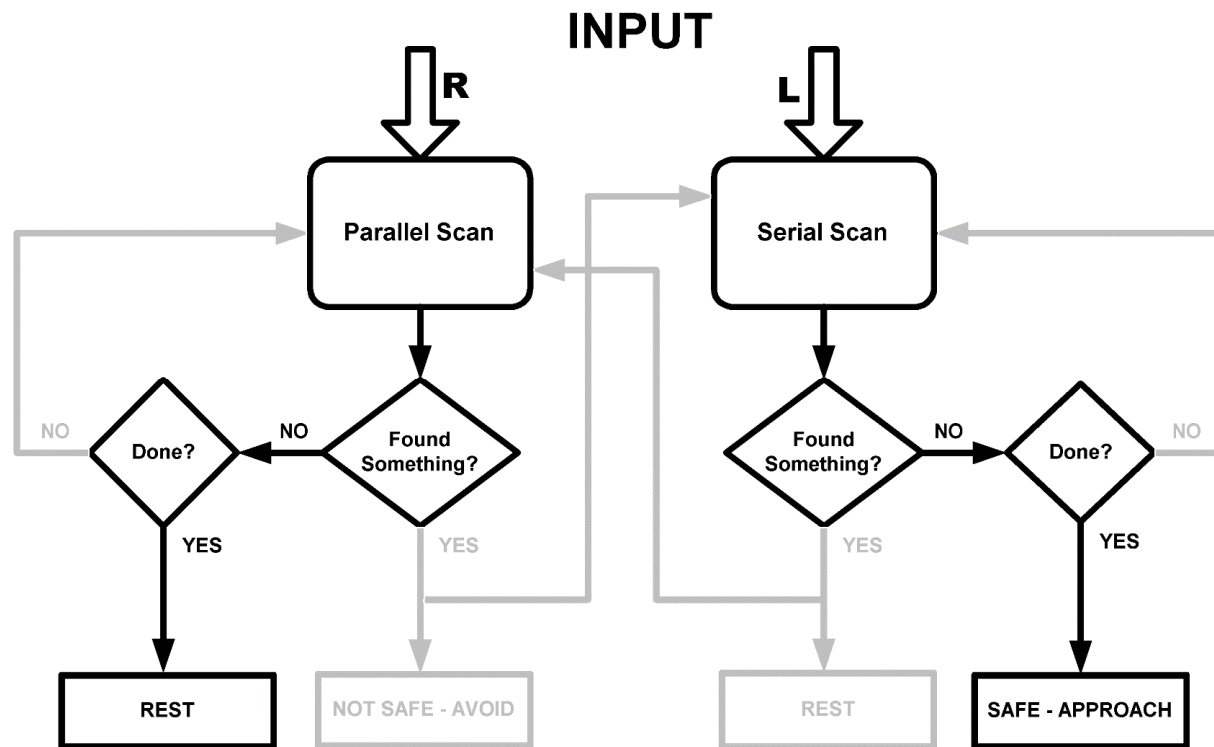
- Mesial – primary emotional sensation
 - Fundamental, initial sense – “nice” or “not nice” – “like” vs. “don’t like”
 - Primary sense of the feeling “feels good” or “feels bad”
 - Trauma may precondition for “danger” response
- Dorsolateral – secondary emotional perception
 - Integrated with memory, imparts meaning
 - Puts feelings into context, “what do we do about these feelings”
 - Can turn interpretation “around”
 - Directly influences decision-making & behavior

Emotional Decision Making Model

(why we downtrain alpha on the left dorsolateral frontal lobe)



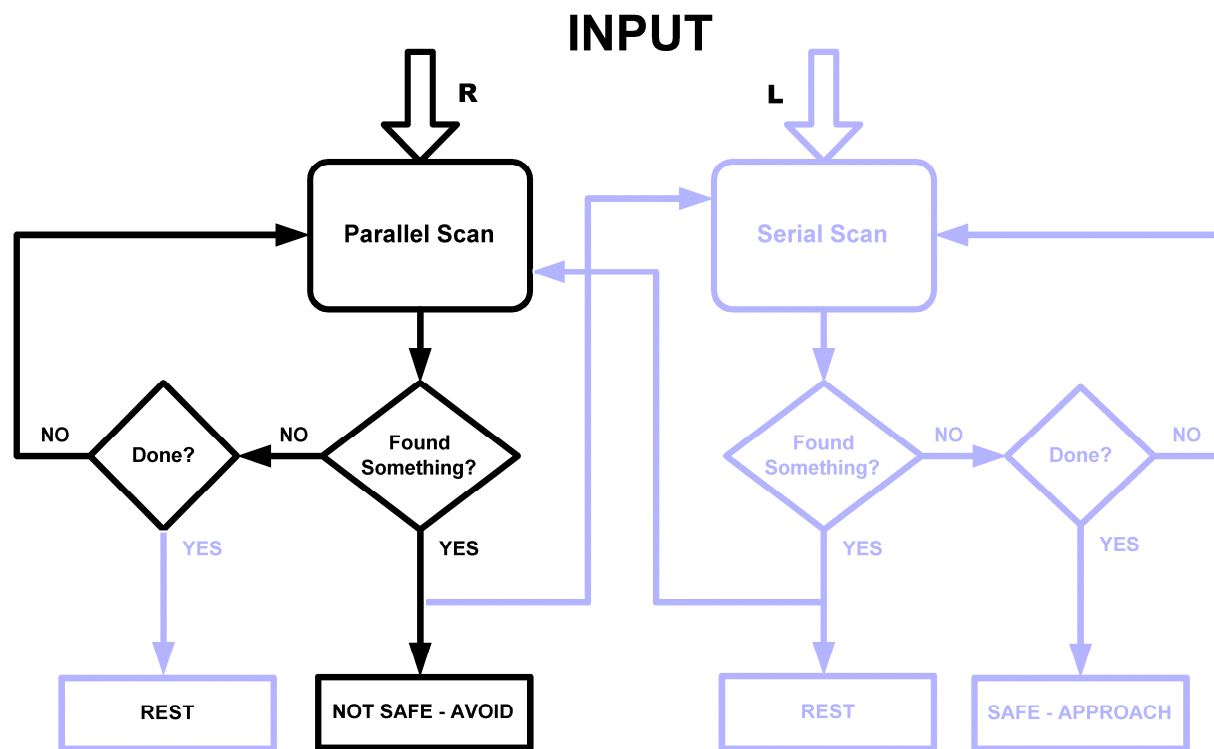
Happiness as a process



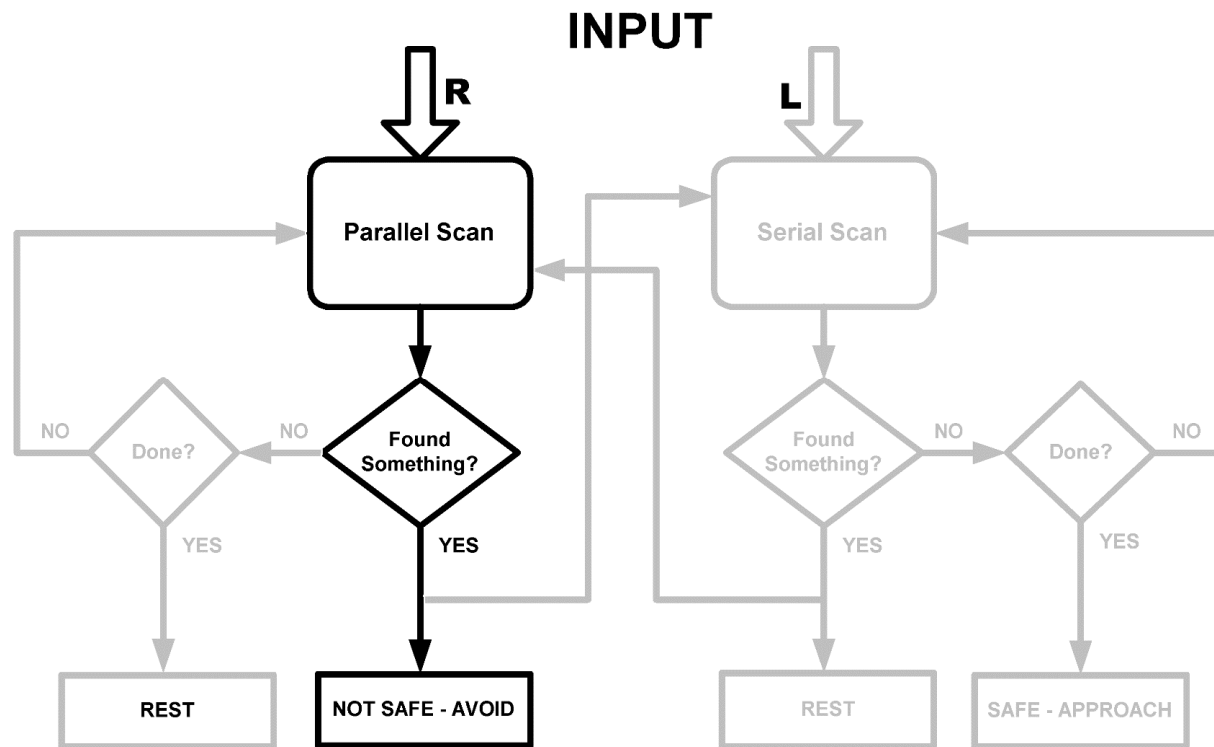
Effects of Trauma

- Local Optimization
- Survival strategy
- Nash Equilibria
- Brain goals vs. individual goals
- Brain plasticity
- What has been learned can be unlearned
- “I’d like to help you out – which way did you come in?”

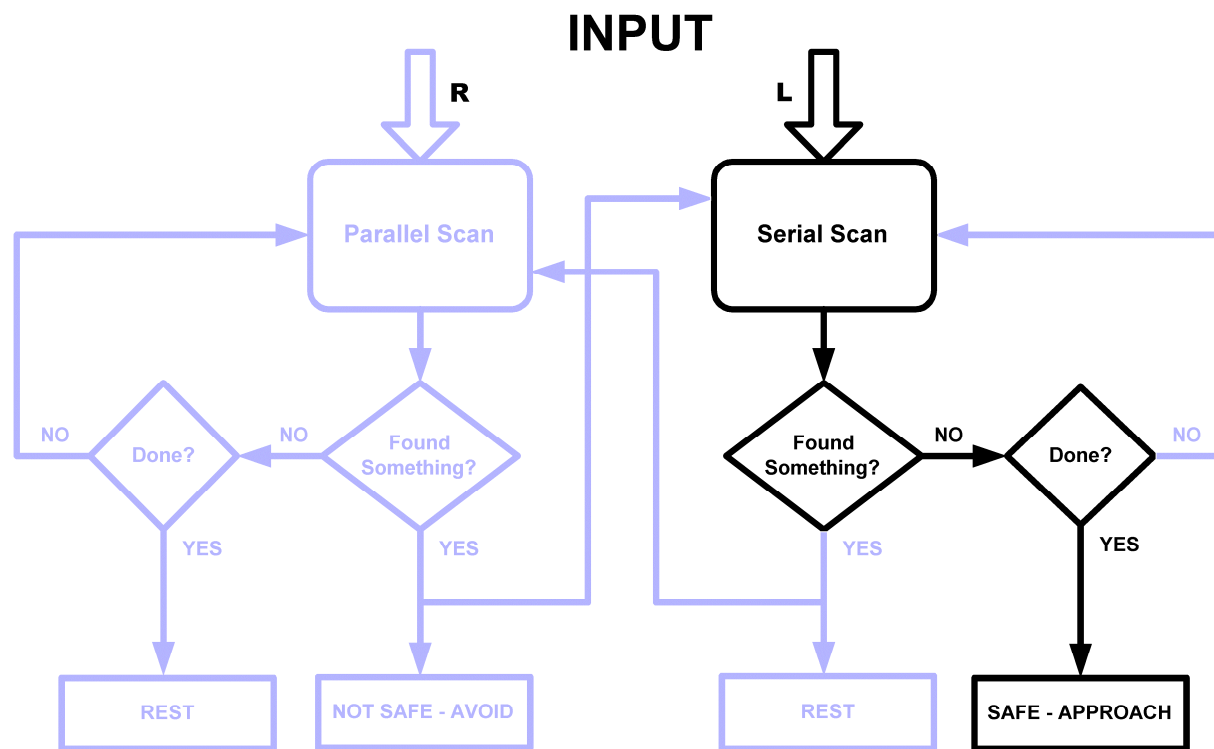
Depressed



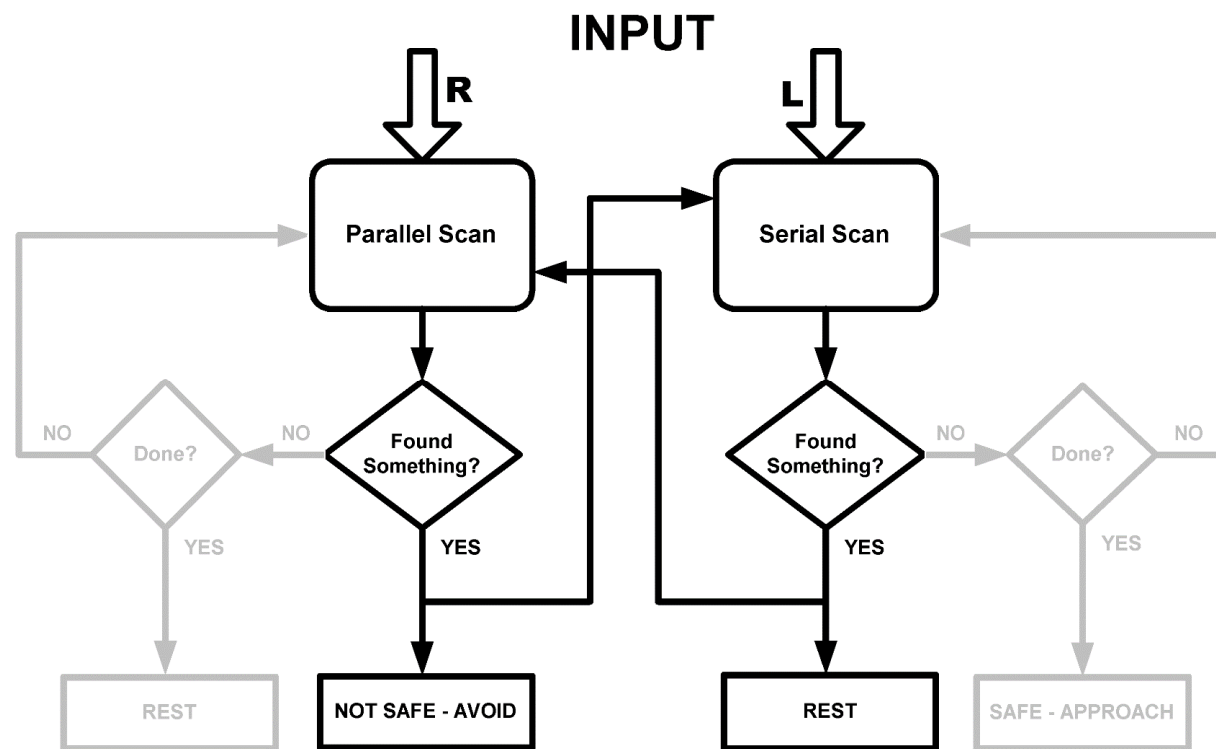
Paranoid – nothing is safe



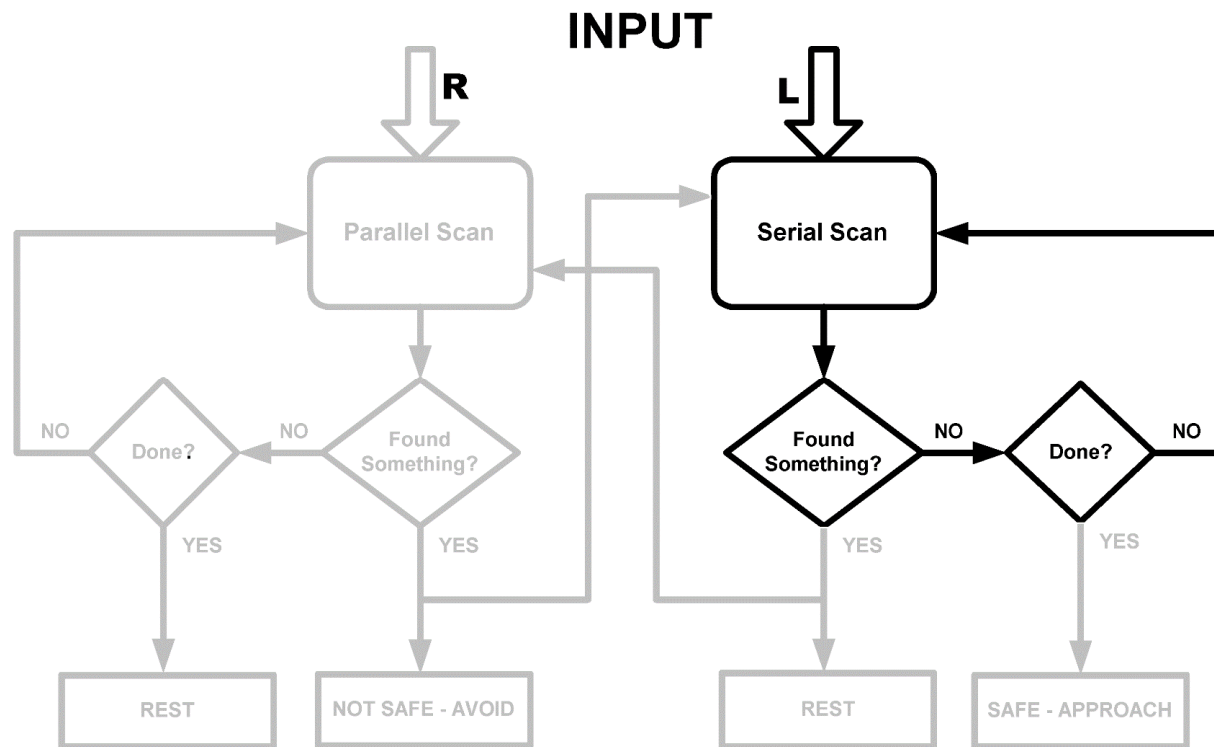
Risktaker



Chronic Anxiety – anticipating problems



General Anxiety – post trauma

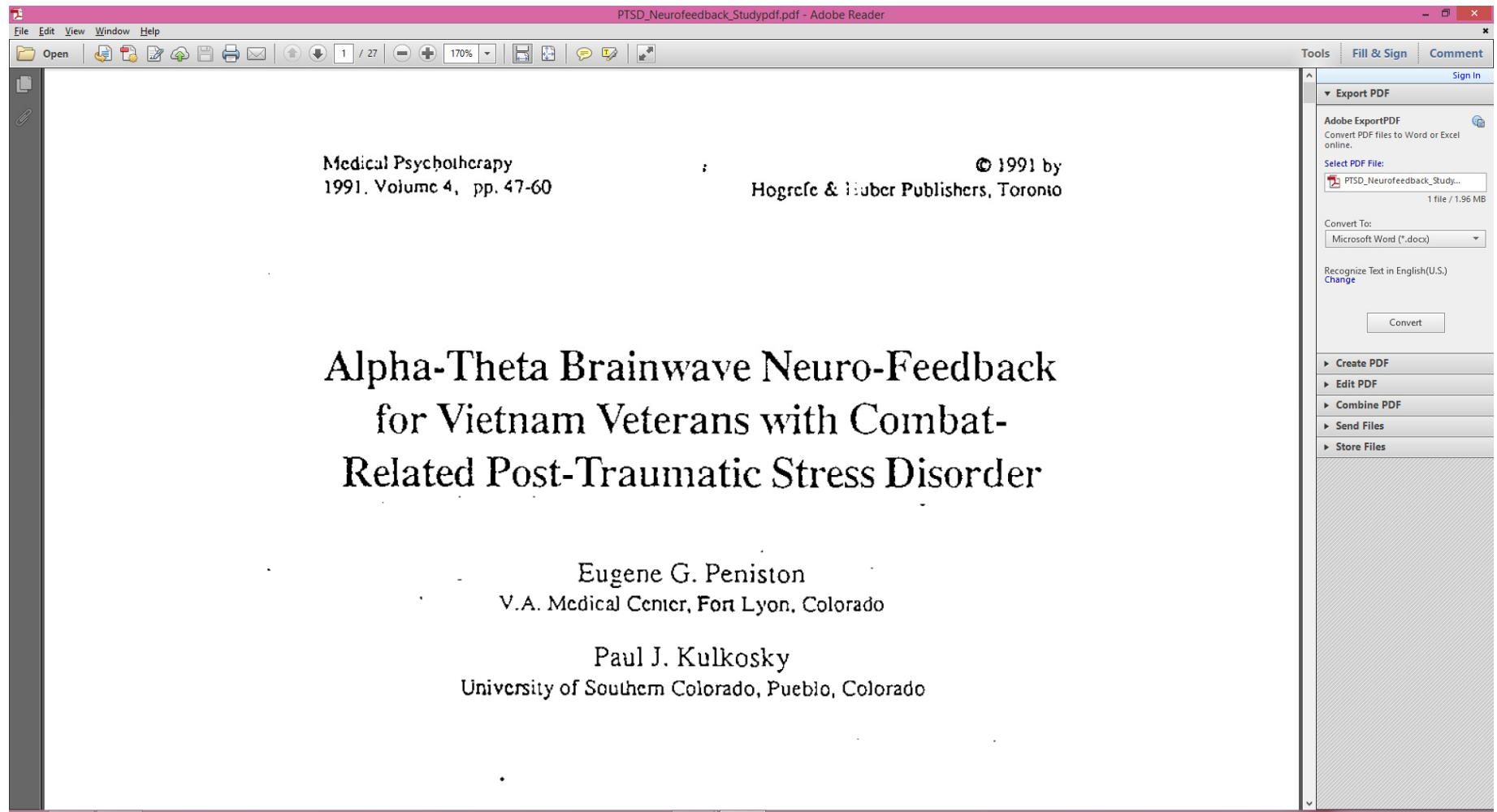


EMOTIONAL DECISION MODEL

EDM-2

4 COMPONENTS - S4

		Ls Lp			
		00	01	10	11
Rs Rp	00	NOT ACTIVATED 0000	PRIMARY + PLEASURE "Like" 0001	SECONDARY + SAFE "Good" 0010	FULL + APPROACH "Like+Good" 0011
	01	PRIMARY - "Don't Like" UNPLEASANT 0100	PRIMARY +&- "Suspend Feeling" 0101	PRIMARY+ SECONDARY+ "Don't Like" + "Good" (DIETING) 0110	PRIMARY+ 8- SECONDARY+ + "Mixed Feeling" + "Good" FOLLOW HEAD 0111
	10	SECONDARY - "Not Good" UNSAFE 1000	PRIMARY+ SECONDARY+ "Like" + "Not Good" (NAUGHTY) 1001	SECONDARY +&- "Suspend Judgement" 1010	PRIMARY+ 8- SECONDARY+ + "Like" + "Mixed Judgement" FOLLOW HEART 1011
	11	FULL + "Don't Like" + "Not Good" AVOID 1100	PRIMARY+ 8- SECONDARY+ + "Not Like" + "Not Good" FOLLOW HEAD 1101	PRIMARY+ 8- SECONDARY+ + "Don't Like" + "Mixed Judgement" FOLLOW HEART 1110	FULL ACTIVATED +&- 1111



Summary

- Dynamical model of mood regulation and emotional decision-making
- Multicomponent model, distributed functions
- Identification of specific excesses/deficits
- Activation / deactivation
- Connectivity / isolation
- Correlation with EEG parameters, power, connectivity
- Methods for assessment, treatment, treatment effectiveness
- Recognition of trait and state individuality