Neurofeedback Therapy
for
TBI and Addictions

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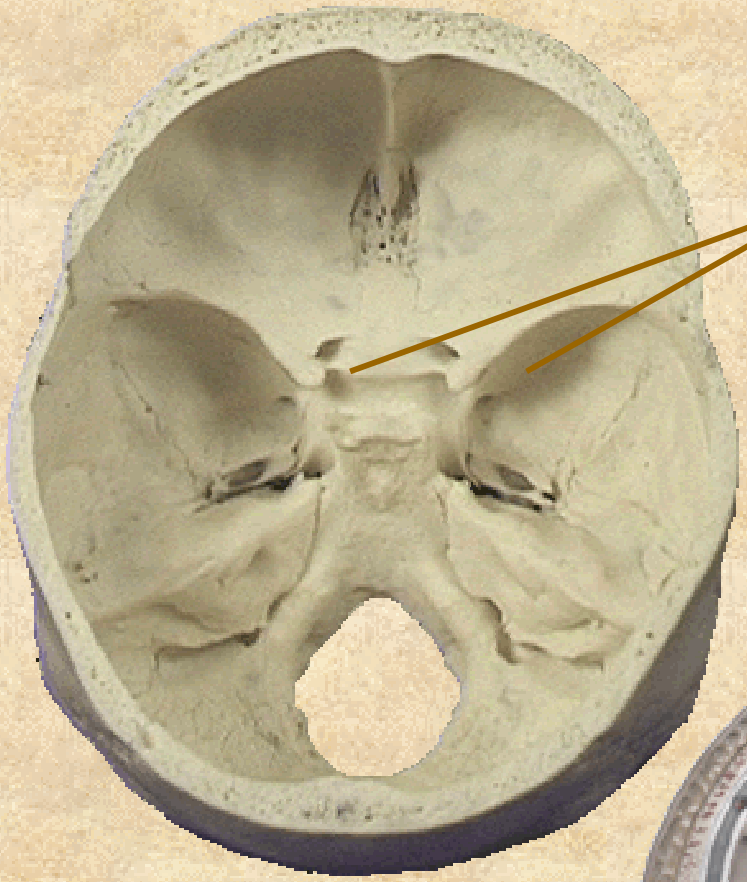
Traumatic Brain Injury

- Acquired vs. Traumatic (ABI vs. TBI)
- Mechanism: TBI, CVA, Anoxic, Toxic, Infection, Tumor, Metabolic, Degenerative
- Severity (GCS, LOC, PTA, Neuroimaging)
- Structural and Functional Neuroimaging
- Functional Impairment
- Cognitive and Emotional Impairments

Occurrence of Brain Injury

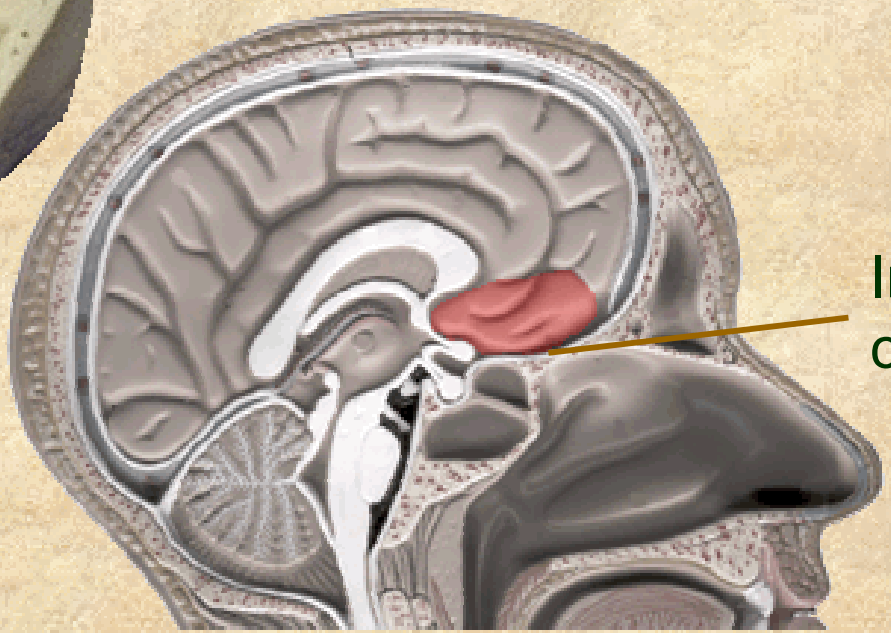
- Various studies show that BI incidence rates range from 92 to 618 per 100,000
- Approx 42,000 - 75,000 people die from acute TBI each year in the U.S.
- Approx 1.5 mln traumatic head injuries occur per year in the U.S.
- **56% of adults had a positive BAC during TBI**
- TBI high-risk groups are: men, ages 15-24 and >64, non-whites, lowest SES
- Estimated direct and indirect cost of TBI in the U.S. is approx $50 billion per year

Interior Skull Surface

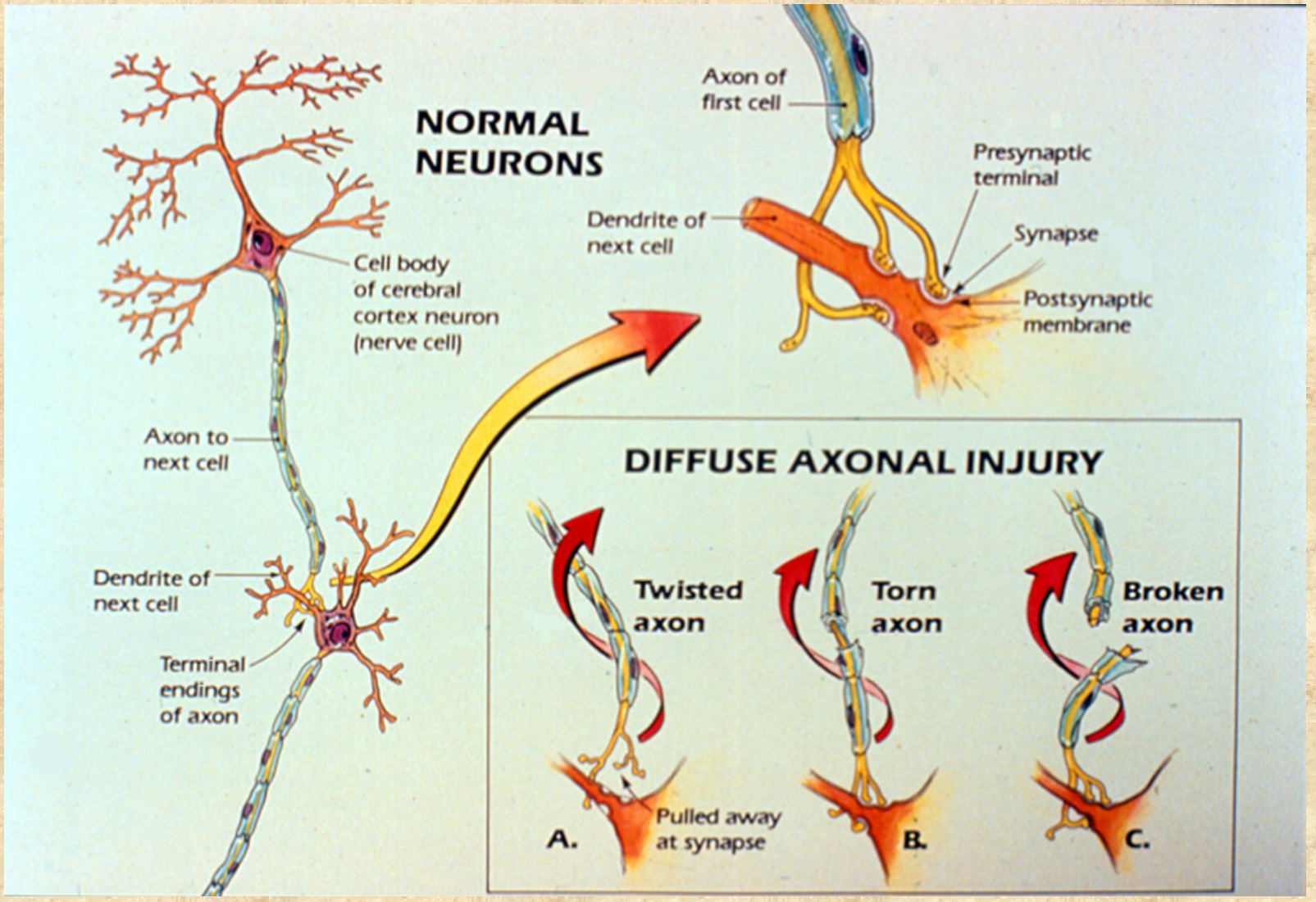


The base of the skull is rough, with many bony protuberances.

These ridges can cause injury to the frontal and temporal lobes of the brain during rapid acceleration.



Diffuse Axonal Injury



- Regular CT or MRI scans are not sensitive enough to pick up this pathology.
- High Res MRI, Diffusion-Tensor Imaging, Tractography or MEG are more sensitive.

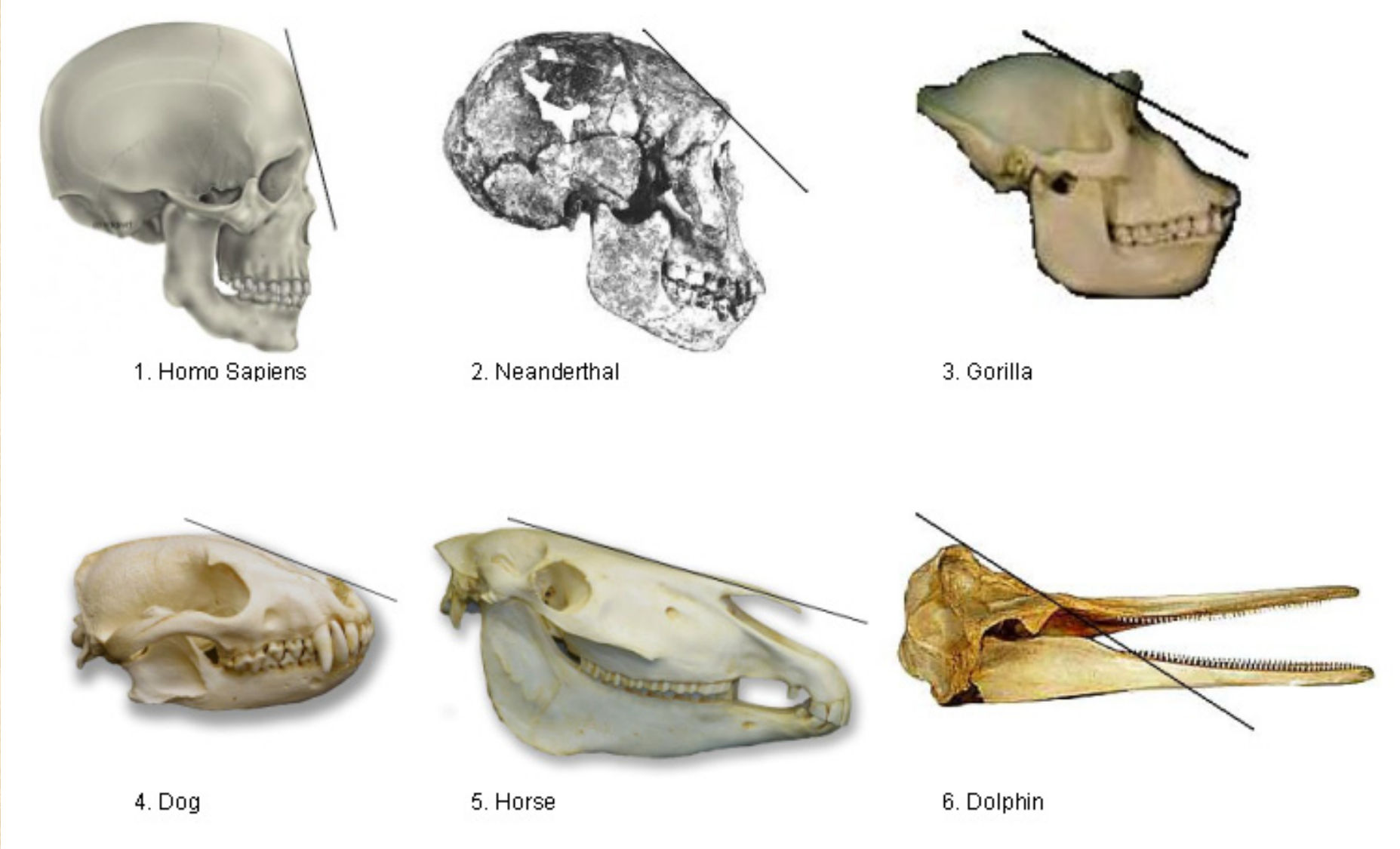
Central Command: The Frontal Lobes

The Frontal Lobes are involved in "higher" cognitive functions:

- Executive functions
- Attention control
- Complex Social behavior
- Mental effort & goal pursuit
- Working Memory
- Foresight
- Sequencing
- Motivation
- Judgment
- Impulse control
- Planning
- Emotional regulation

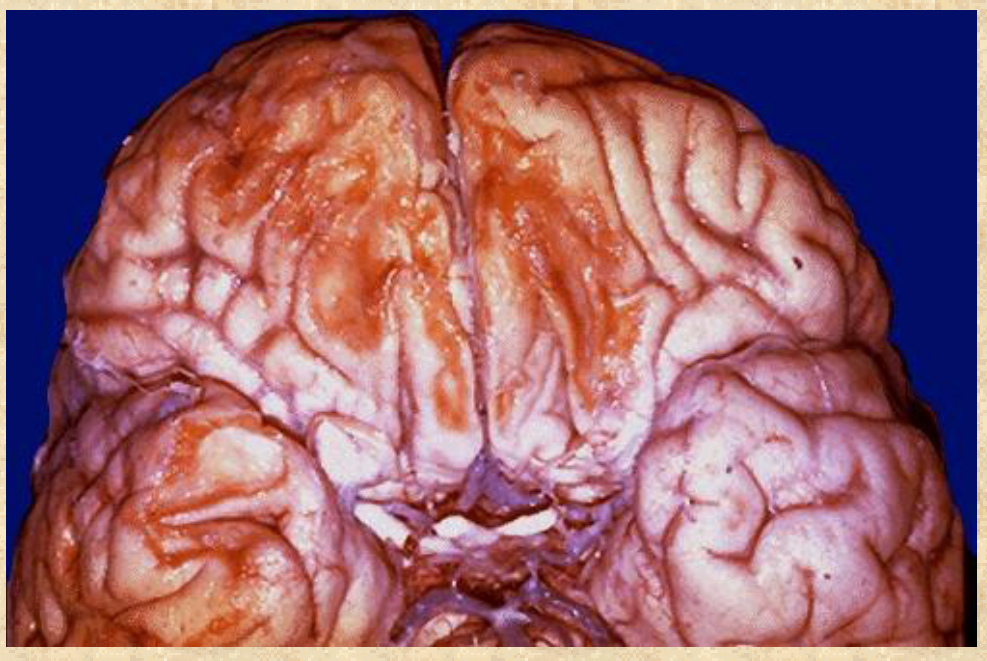
etc.

Making Room for the Frontal Lobes



Traumatic Brain Injury

- Cortical Atrophy
- Encephalomalacia
- Loss of Brain Volume



Severe Alcohol Abuse

- Cortical Atrophy
- Shrinking of the Gyri
- Expansion of the Sulci
- Loss of Brain Volume

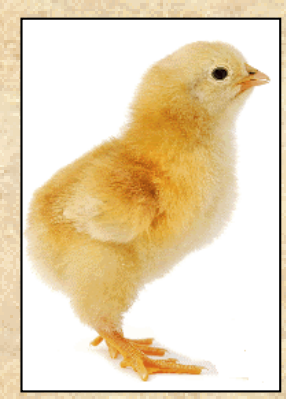
Emotional Deregulation after TBI

Due to Traumatic Experience

- Worry about capacity
- Anxiety about performance
- Social stigma
- Disfigurement
- Physical limitations
- Worry about future
- Worry about relationships
- Loss of identities & roles
- Financial anxiety
- Sexual anxiety
- Shame & guilt
- Etc., etc., etc.

Due to Direct Injury

- Damage to anatomical structures of the brain
- Toxic effects of released neurochemicals
- Reduced cerebral blood flow (ischemia)
- Reduced metabolism
- Increase in extracellular potassium and intracellular calcium



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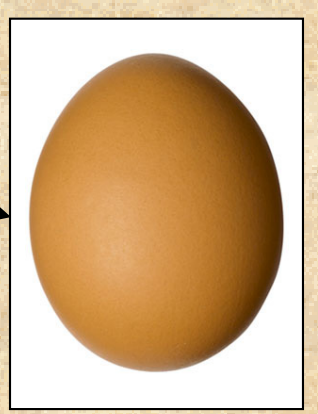
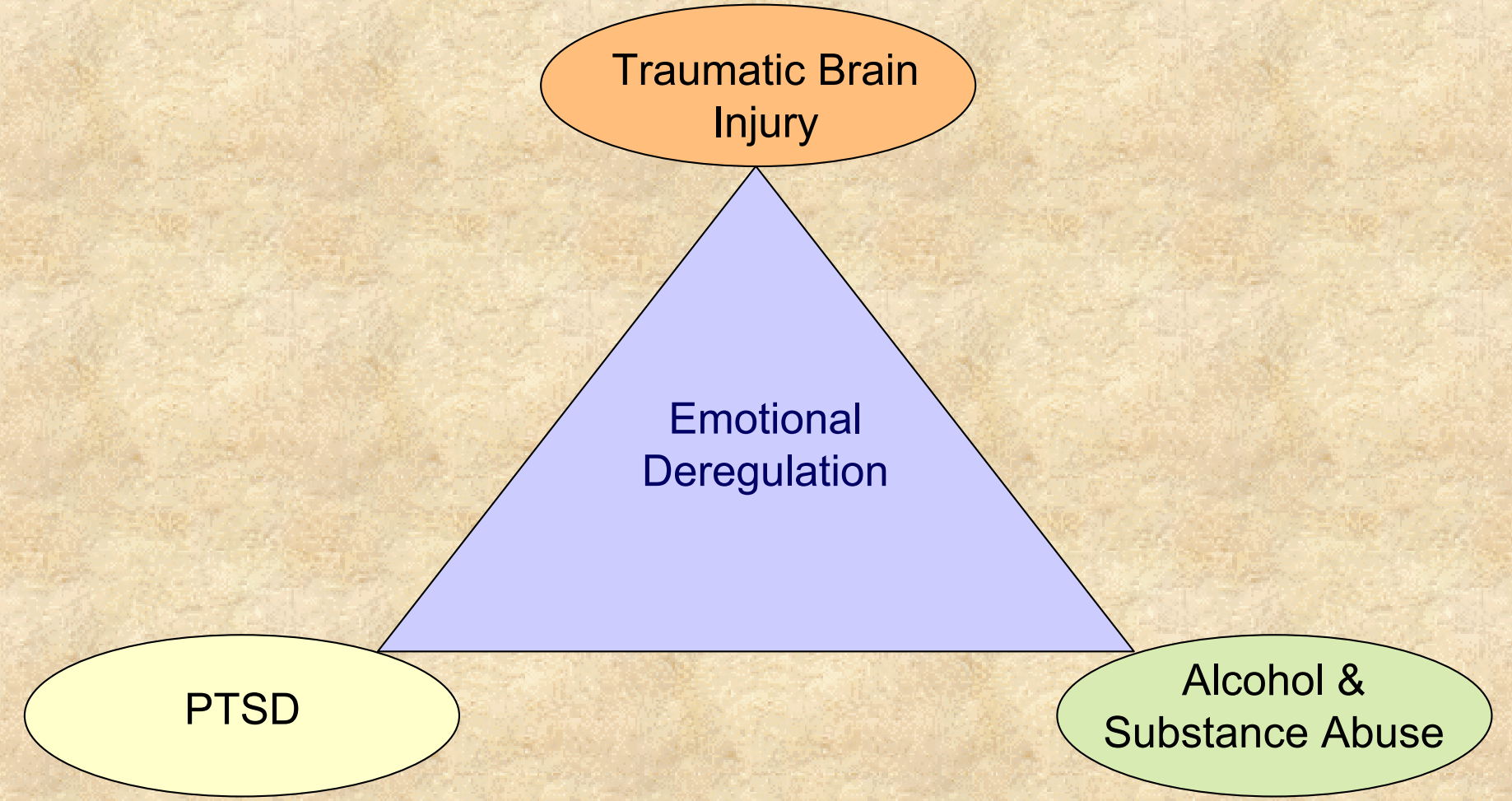


High Rates of Co-morbidity Often Create the Chicken-and-Egg Problem



Core Issues

TBI

↓ Processing speed
↓ Mental energy
↓ Organization skills
↓ Impulse control
↓ Judgment
↓ Memory
Pain

Leads to

Frustration
Feeling overwhelmed
Depression
↑ Risk of alcoh abuse

PTSD

Hyperarousal
Hypervigilance
Avoidance
Numbing
Detachment
Social isolation

Leads to

Alcoh/subst use:
- Self-medicate
- Relieve Anxiety
- Avoid memories
- Socialize

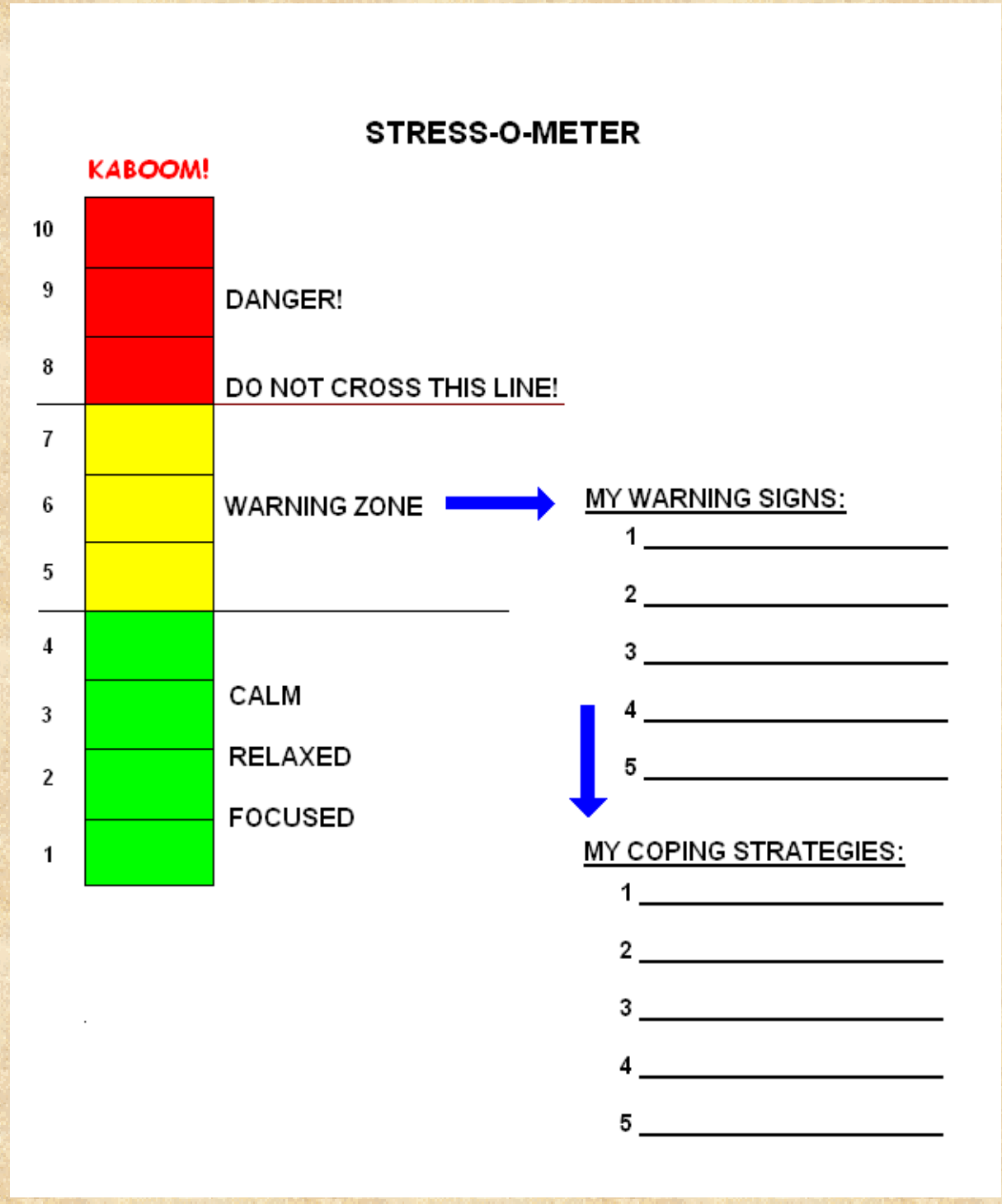
Alcoholism

Compulsive use
↑ Tolerance & use
↓ Impulse control
↓ Judgment
Withdrawal
Failed efforts to control
Increased time using

Leads to

Cognitive impairment
Emotional deregulation
Social isolation
Psychiatric comorbidity
↑ Risk of TBI

Emotional Self-Regulation Model



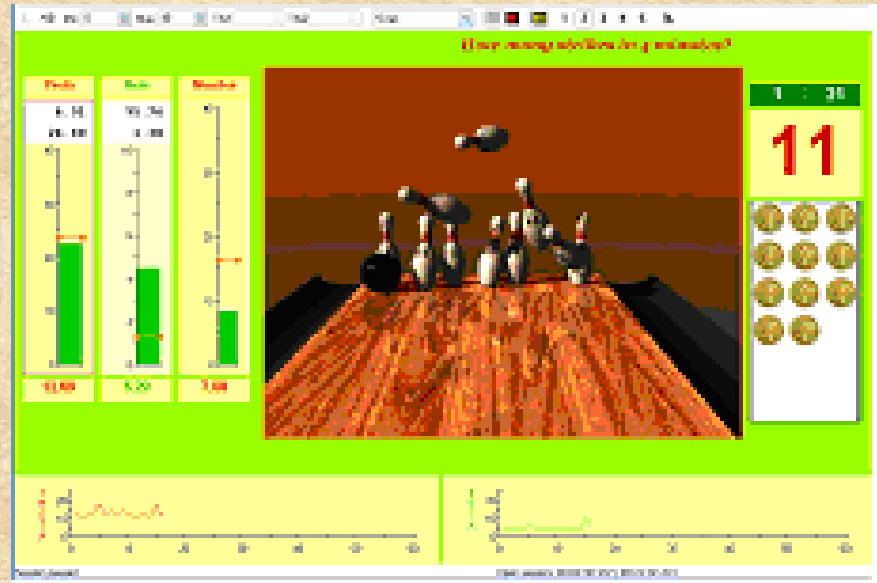
Neurofeedback Is About Self-Regulation

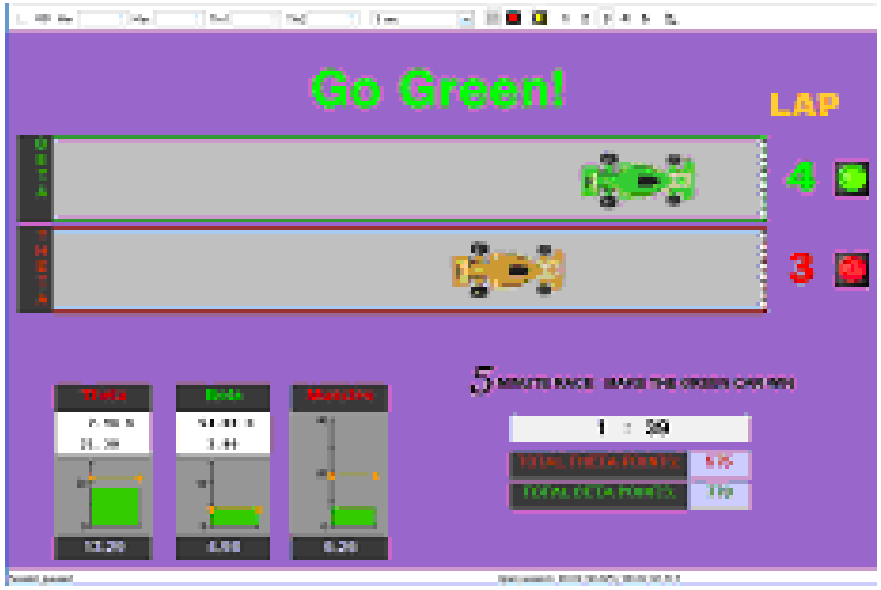
Neurofeedback is a form of biofeedback (it is also known as EEG biofeedback) . It teaches a person to control his/her own mental states by controlling brainwaves.

Other types of biofeedback may help a person to increase hand temperature, reduce heart rate, relax muscles, improve sphincter control, increase blood flow, lower blood pressure or reduce sweating.

Allopathic Medicine vs. Self-Regulation

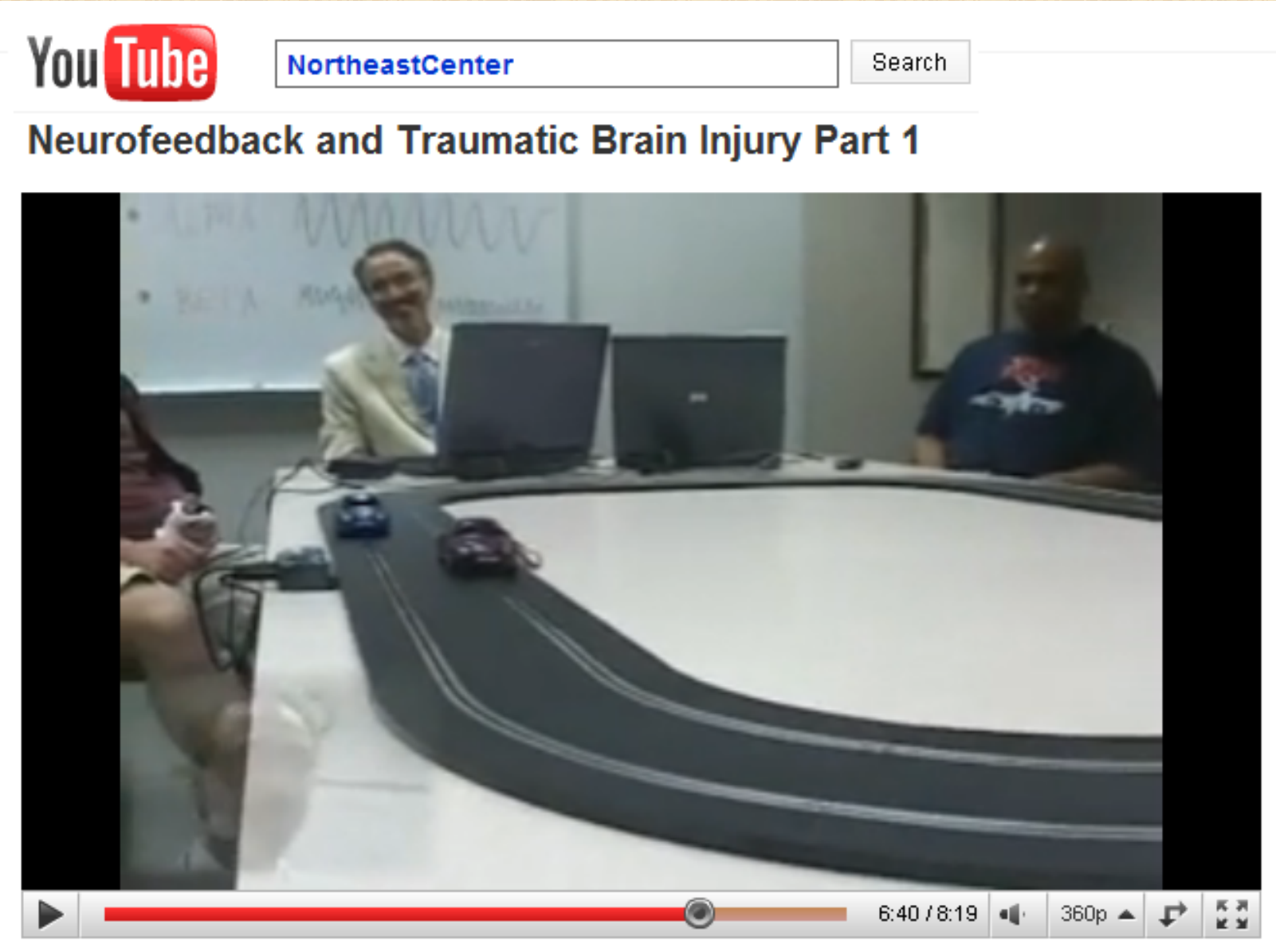
Neurofeedback Training Is Effective **AND** Fun





Neurofeedback Training Is Effective **AND** Fun

Watch on **YouTube** Northeast Center residents race slot cars using their brainwaves



Brief History of Neurofeedback

- NFB evolved from biofeedback
- Alpha wave research in the early ’70s
- Studies of consciousness
- Computer advancements and QEEG/LORETA
- Normative databases
- NFB involves no medications, has no side effects
- Neurofeedback and ADD
- NFB for treatment, peak performance & communication
- NFB treatment for alcoholism was pioneered by Eugene Peniston and Paul Kulkoski in 1989

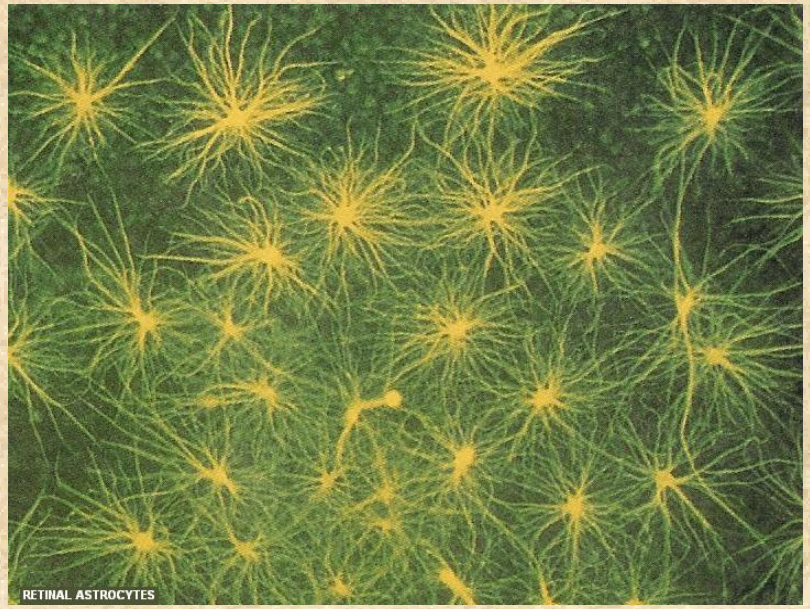
  Peniston, E. G., & Kulkoski, P. J. (1989). Alpha-theta brainwave training and beta-endorphin levels in alcoholics. *Alcoholism: Clinical and Experimental Research*, *13*, 271-279.

International Society for Neurofeedback and Research (ISNR.org) offers a comprehensive bibliography on uses of Neurofeedback for treatment of various conditions.

To view the links type in *Comprehensive Bibliography* in the 'SEARCH SITE' box

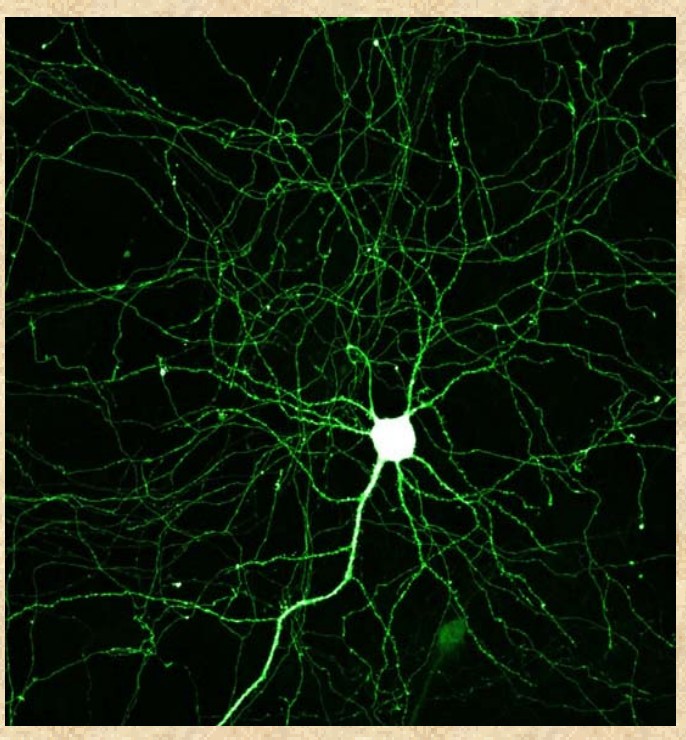
Academic Cognitive Enhancement	AD/HD and Learning Disabilities	Addiction	Adverse Reactions and Side Effects	Anger
Anxiety	Asthma	Autism	Autoimmune Disorders	Brain Injury
Cerebral Palsy	Creatvity	Chronic Fatigue Syndrome	Cognitive Decline	Coma
Criminals & Juvenile Offenders	Depression	Developmental Disorders	Dissociative Disorders	Epilepsy
Fibromyalgia	Headache	Hemoencephalography	Hemispheric Asymmetry	Hypertension
LENS Neurofeedback	LORETA Neurofeedback	Medical Conditions	Obsessive Compulsive Disorder	Optimal Functioning
Post Traumatic Stress Disorder	Pain	Parkinson's Syndrome	Premenstrual Syndrome	Review Articles
Schizophrenia	Sleep	Slow Cortical Potentials	Spasticity	Standards
Stroke	Theoretical Treatices	Tinnitus	Tourette's Syndrome	Withdrawal
Z-Score Neurofeedback Training				
Comprehensive Bibliography in .pdf format				

What Causes Brainwaves?

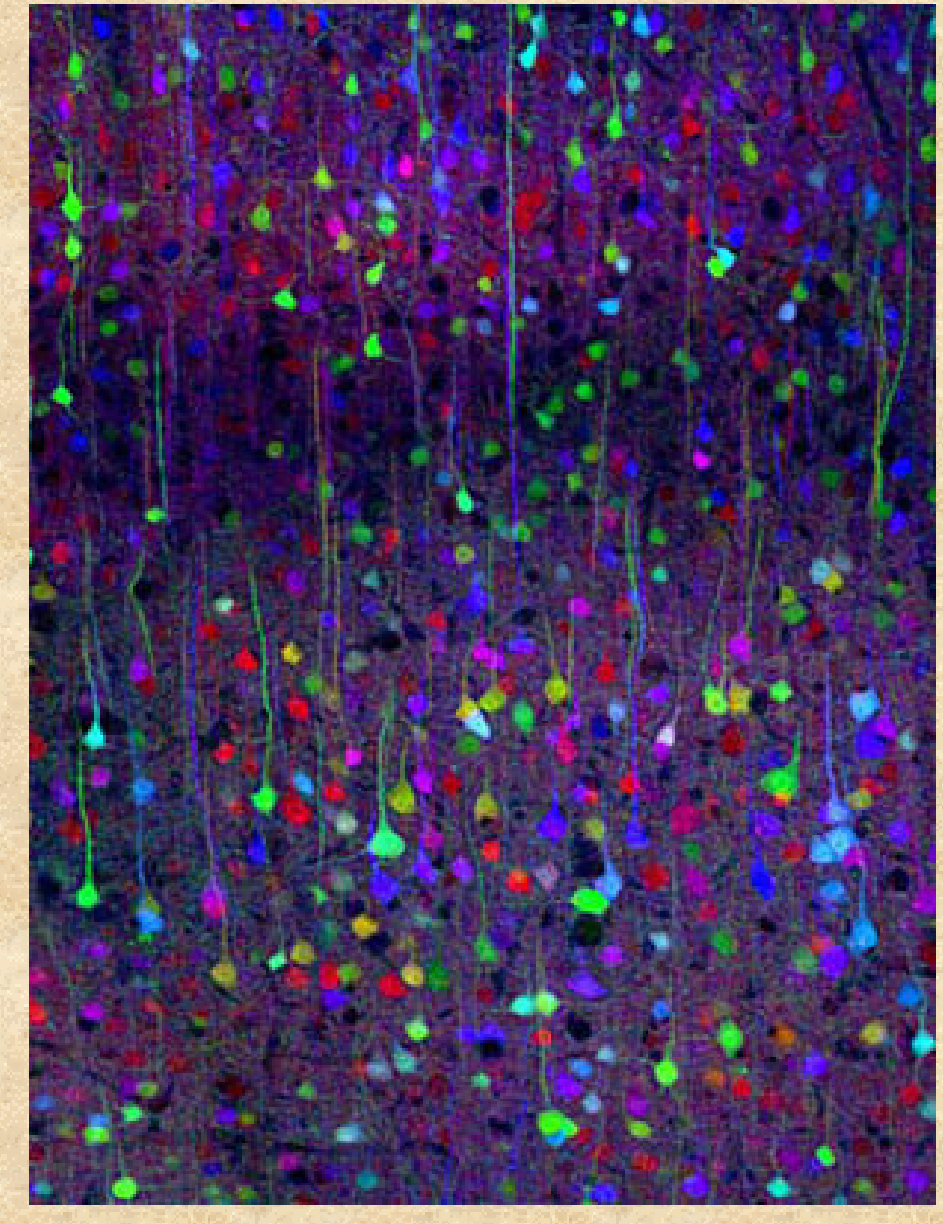


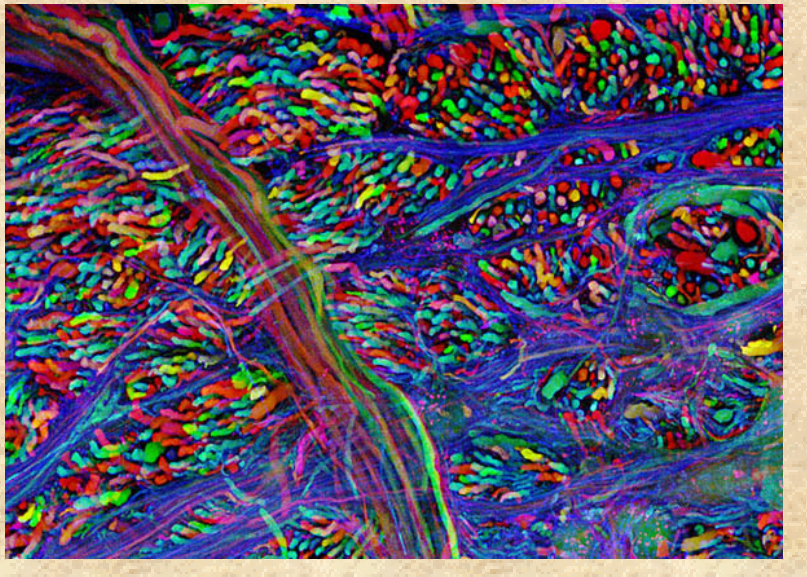
Electrical charges build up on the membranes of neurons, followed by a discharge. These impulses travel down the axons and the dendrites to other neurons.

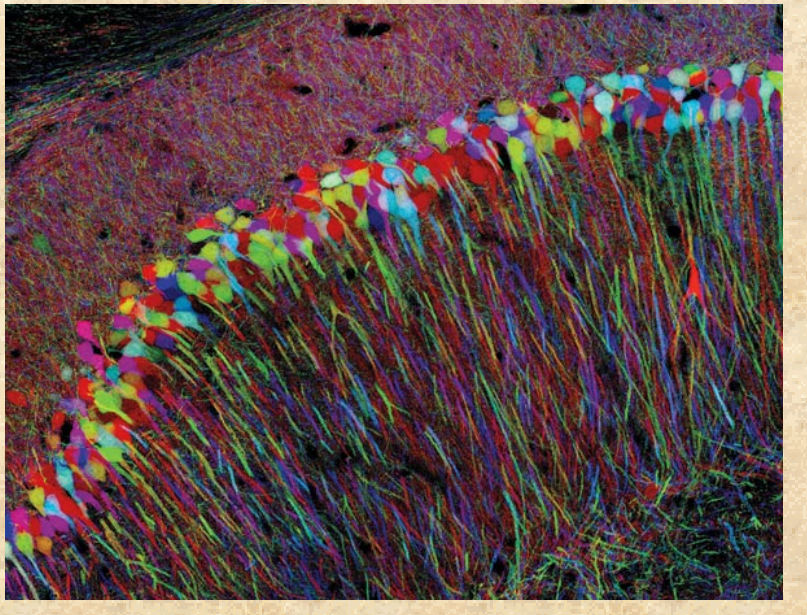
Synchronized discharges of neurons create electrical currents in the brain. These currents, when recorded, are called the Electroencephalogram or the EEG. First EEG was recorded by Dr. Hans Berger in 1925.



Move Over, Hubble



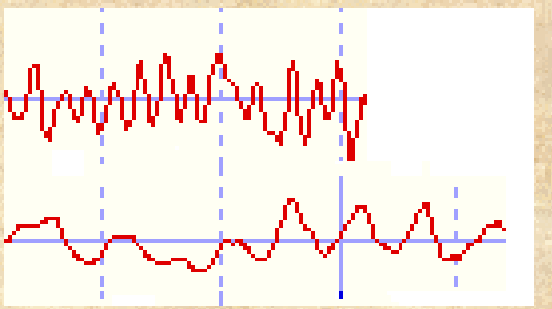




Dr. Jeff Lichtman's fluorescent "brainbows"

Brainwave Characteristics

Frequency

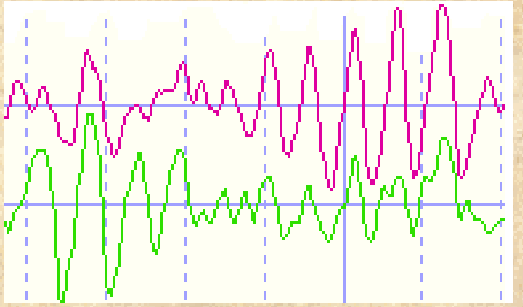


Describes how fast the waves are.
Measured in Hertz (Hz) or cycles per second.

The standard frequency bands are:

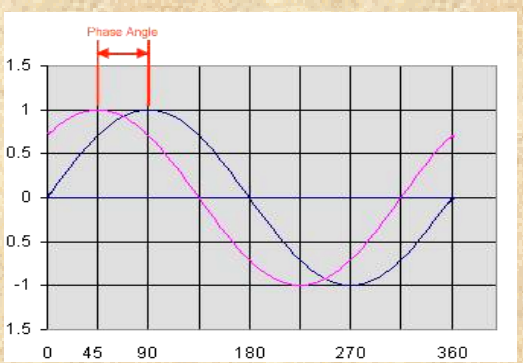
Delta	Theta	Alpha	Beta	Gamma
1-4 Hz	4-8 Hz	8-12 Hz	12-28 Hz	28-40 Hz

Amplitude



Describes how powerful the waves are.
Measured in microVolts (μV);

Coherence



Describes how consistently waves from different locations are locked in phase.
Reflects degree of neuronal connectivity.

Quantitative EEG (QEEG)

QEEG is an imaging technique used to visualize electrical activity in the brain.

Recorded the same way as the regular EEG.
The data acquired are used to compute brainwave power, ratios, symmetry, phase lag and coherence.
It is also used to create topographic color-coded maps of brain activity;

The QEEG findings are compared to a normative database, which consists of several hundred normal individuals;

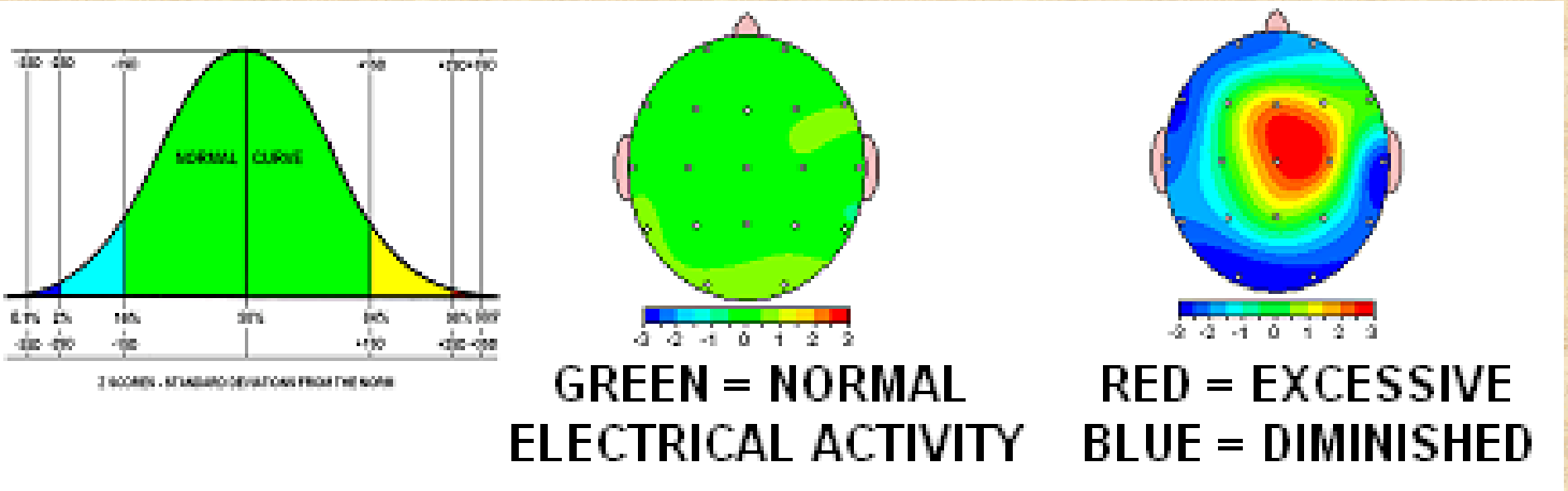
QEEG results are often displayed as Z scores, which represent standard deviations from the mean.

Reading the Maps

The QEEG results are displayed as Z scores (standard deviations from the mean) and span from –3 to +3;

A Z score of 0 represents the norm and is color-coded green;

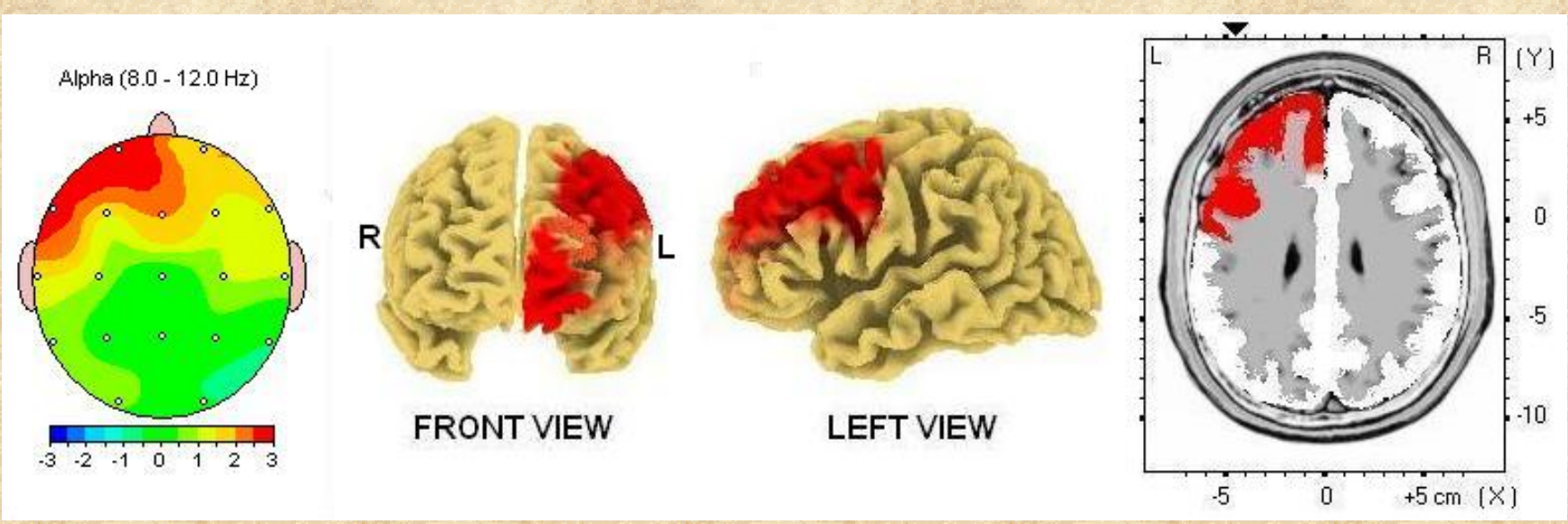
When it comes to brainwaves, higher is not better: Electrical activity that is too high or too low may be equally problematic.



QEEG and LORETA

LORETA (Low Resolution Electromagnetic Tomography Analysis) is performed using data obtained in the QEEG recording.

LORETA employs standard MRI atlas images with anatomical Talairach coordinates for 3-dimensional gray matter modeling.

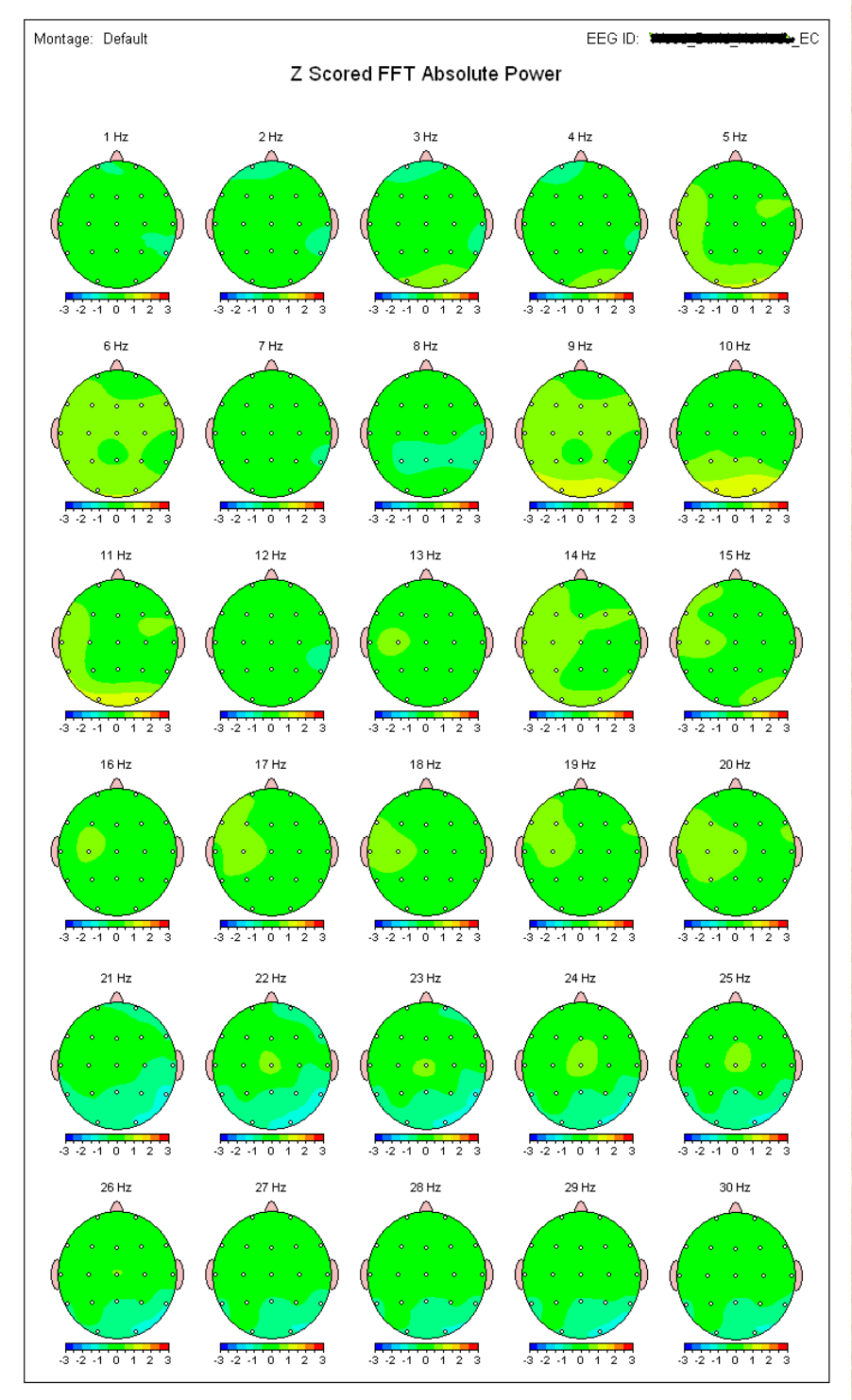


Example 1

Normal QEEG.

The obtained EEG data are compared to the normative database (*Thatcher's Lifespan Database*) and presented as color-coded maps.

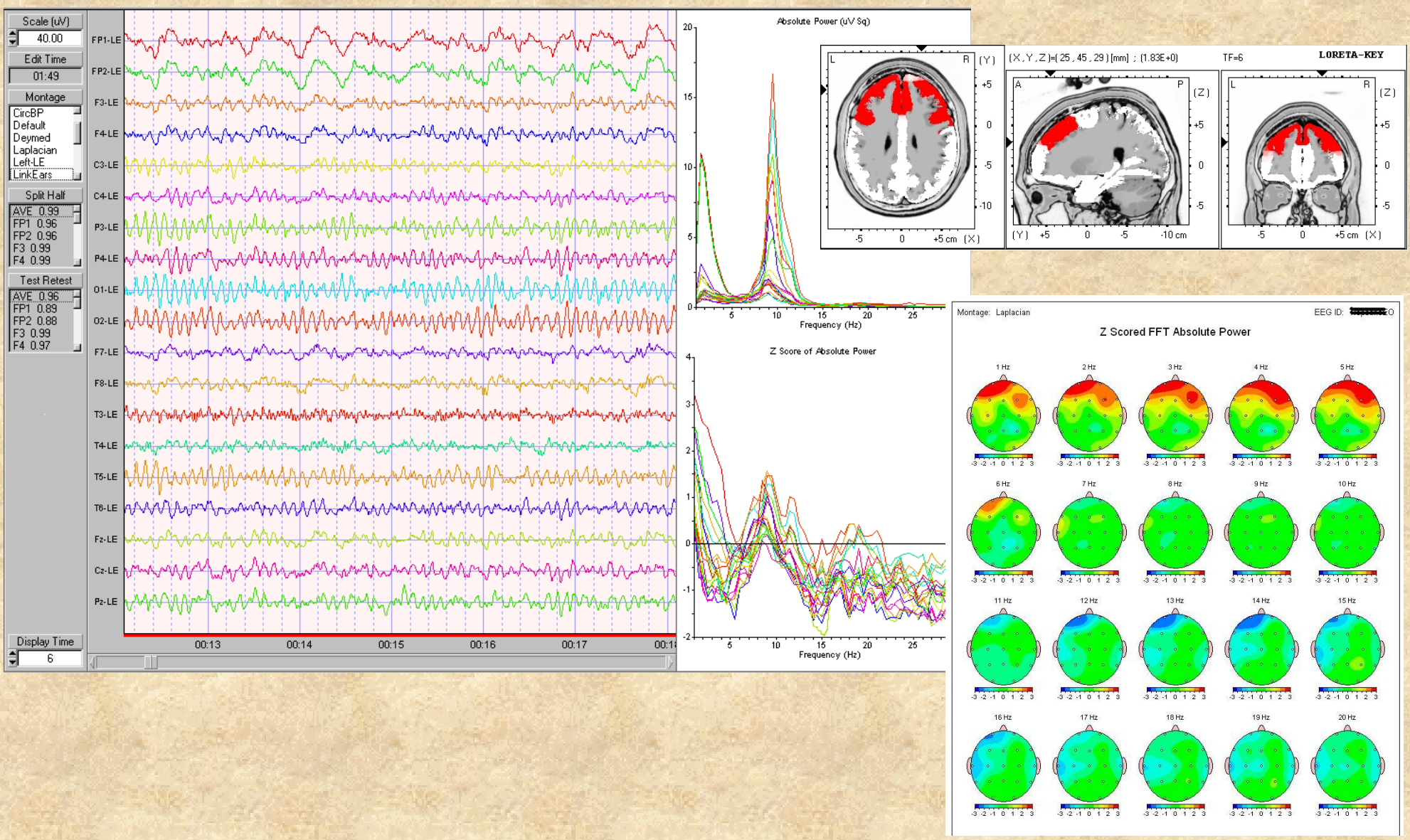
The variability of brainwave power seen here does not exceed 1.5 Standard Deviations above or below the mean.



Example 2

Raw EEG tracings and QEEG.

27-year-old man with frontal TBI and depression.

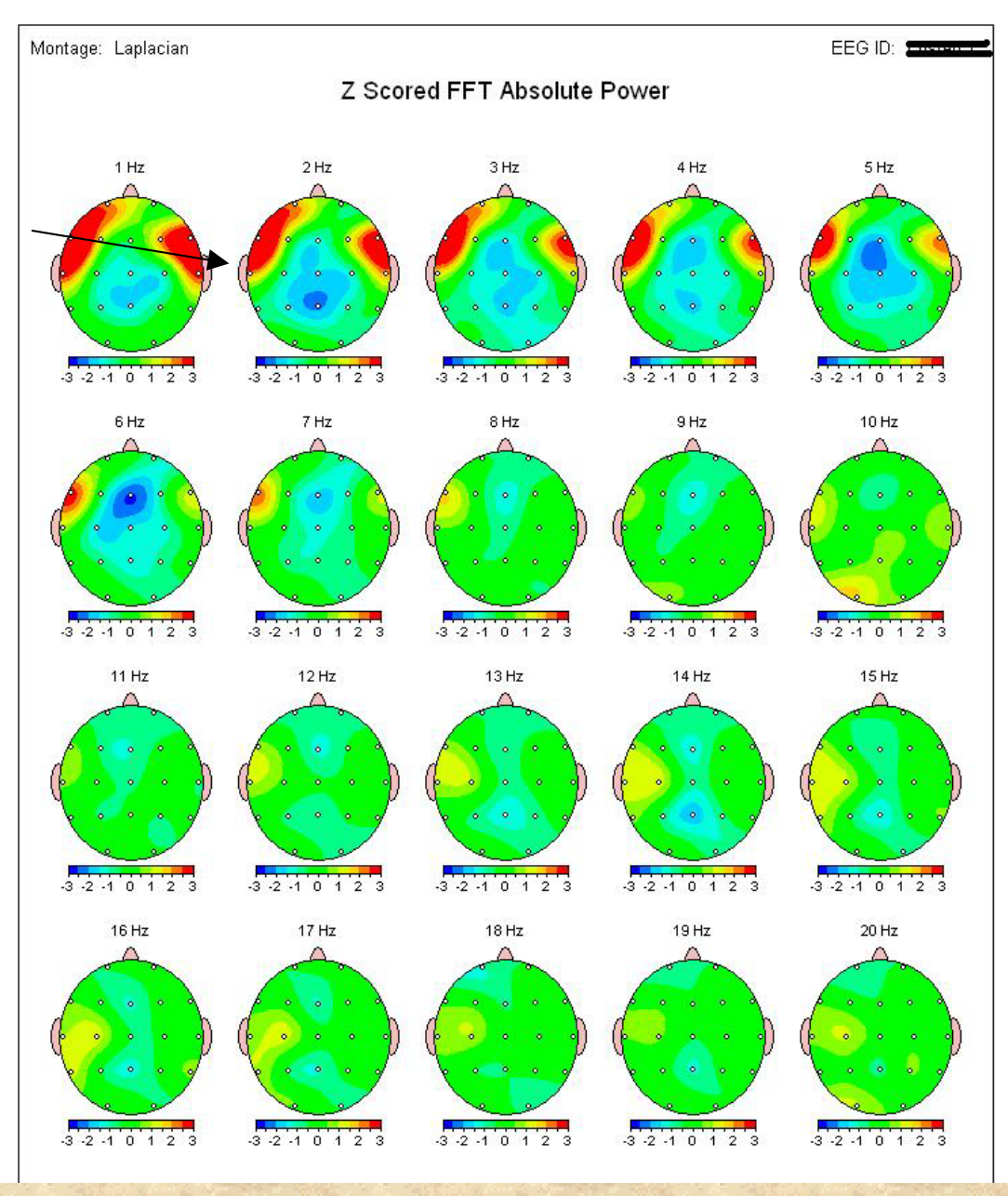


Example 3

This person sustained a typical *Coup-Contrecoup* TBI in a car accident 6 months ago.

The initial impact was to the left frontal area; it knocked the brain against the opposite side of the skull and caused bruising in two places.

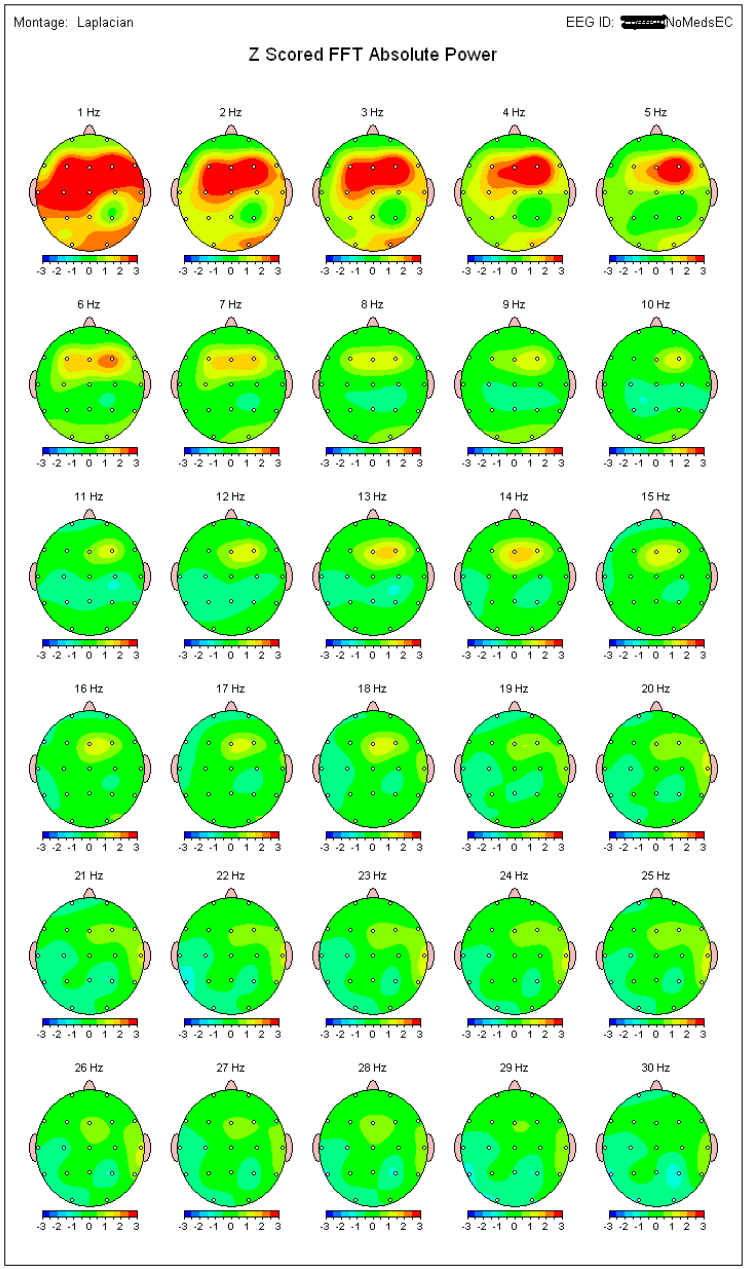
Red color in the maps indicates significantly increased <u>slow wave</u> activity (Delta and Theta) in the Frontal regions. This slow wave activity is elevated more than 3 Standard Deviations above the norm.



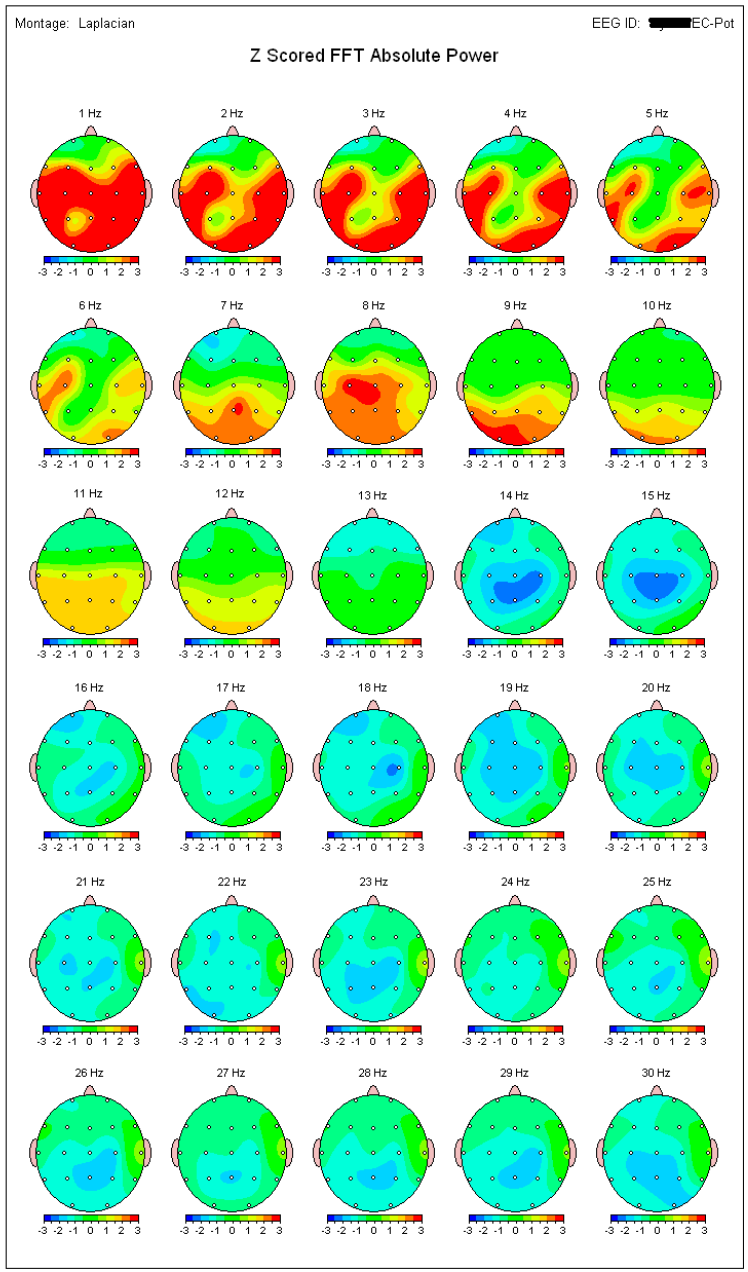
Example 4

20-year-old college student with ADD – before and after smoking marijuana

D.H., 20 y.o., no medication **Dgn: ADD**



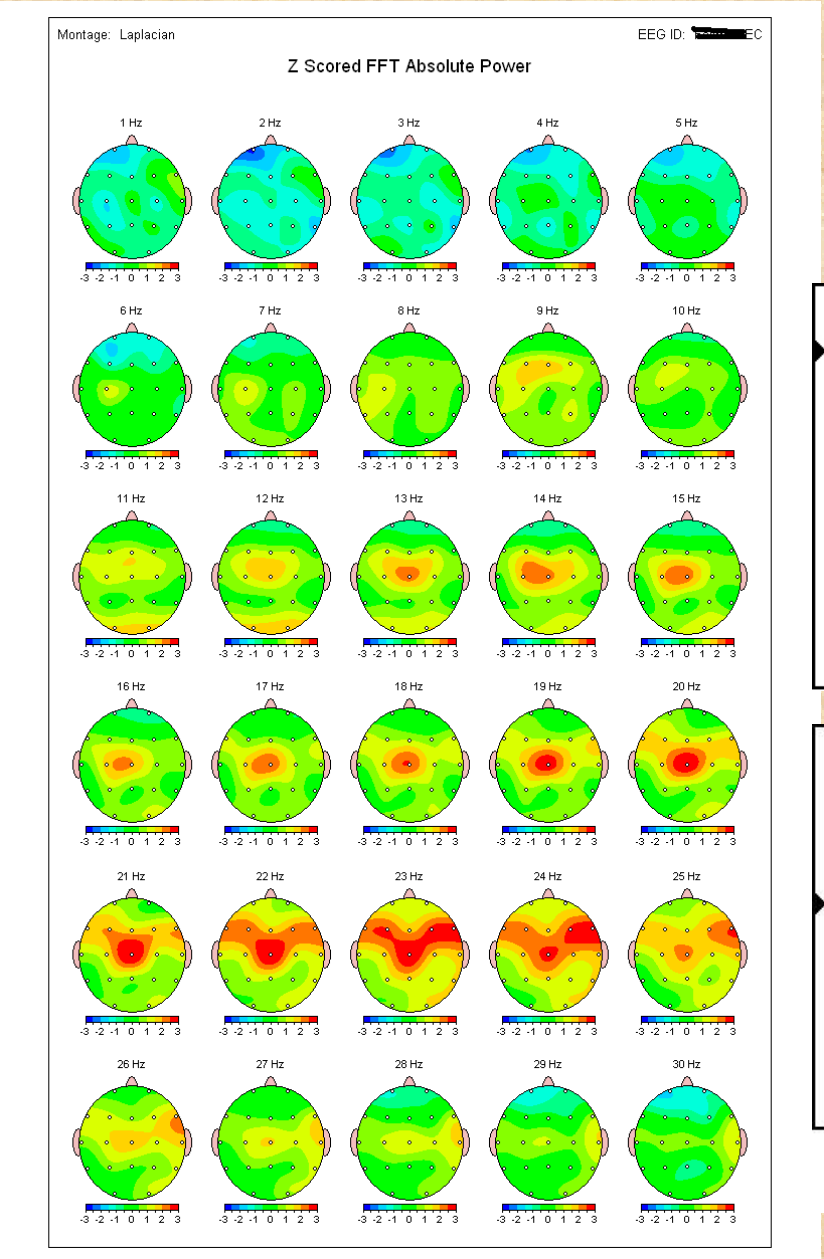
ADD, 2 hours after smoking marijuana

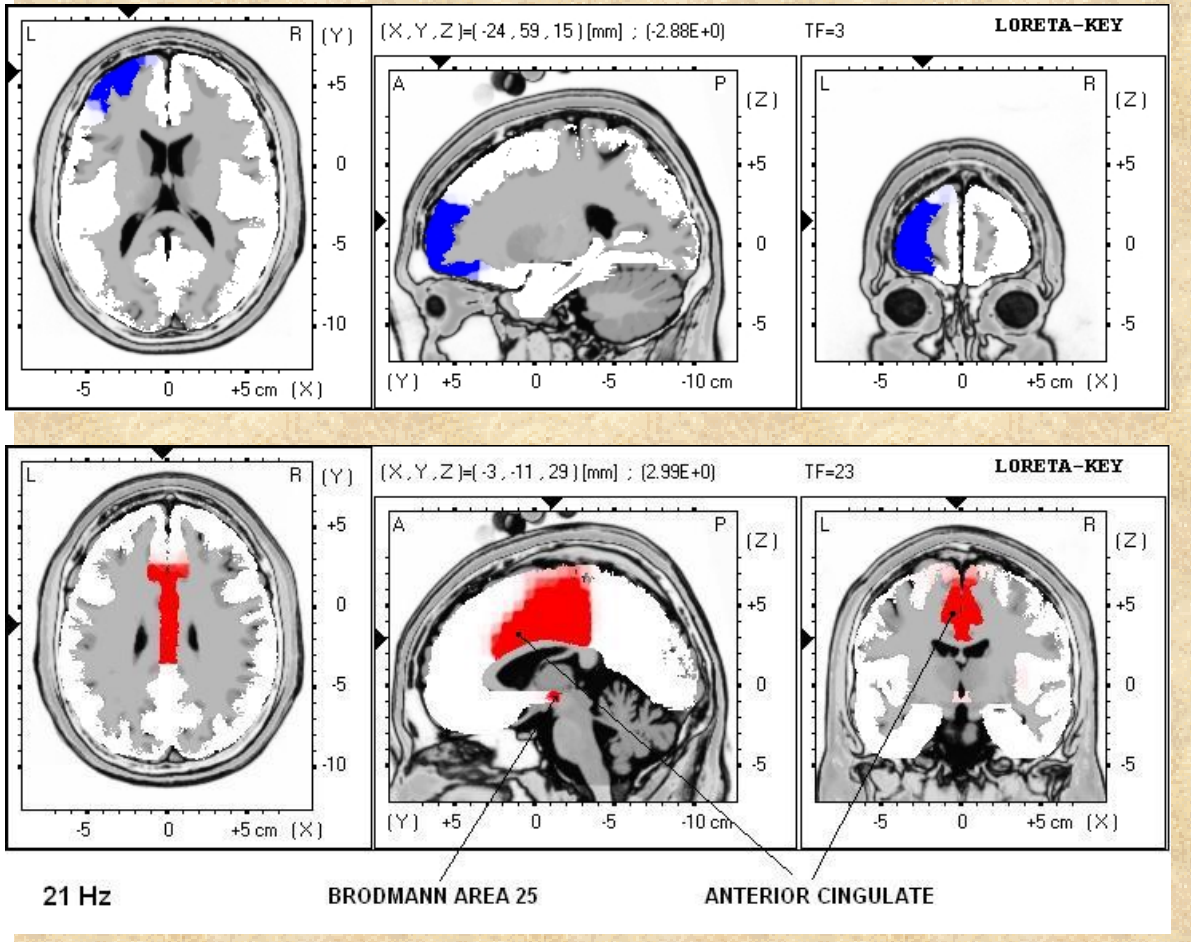


Example 5

JEAN: a 49-year-old woman with severe depression, anxiety and alcohol/opiate abuse.

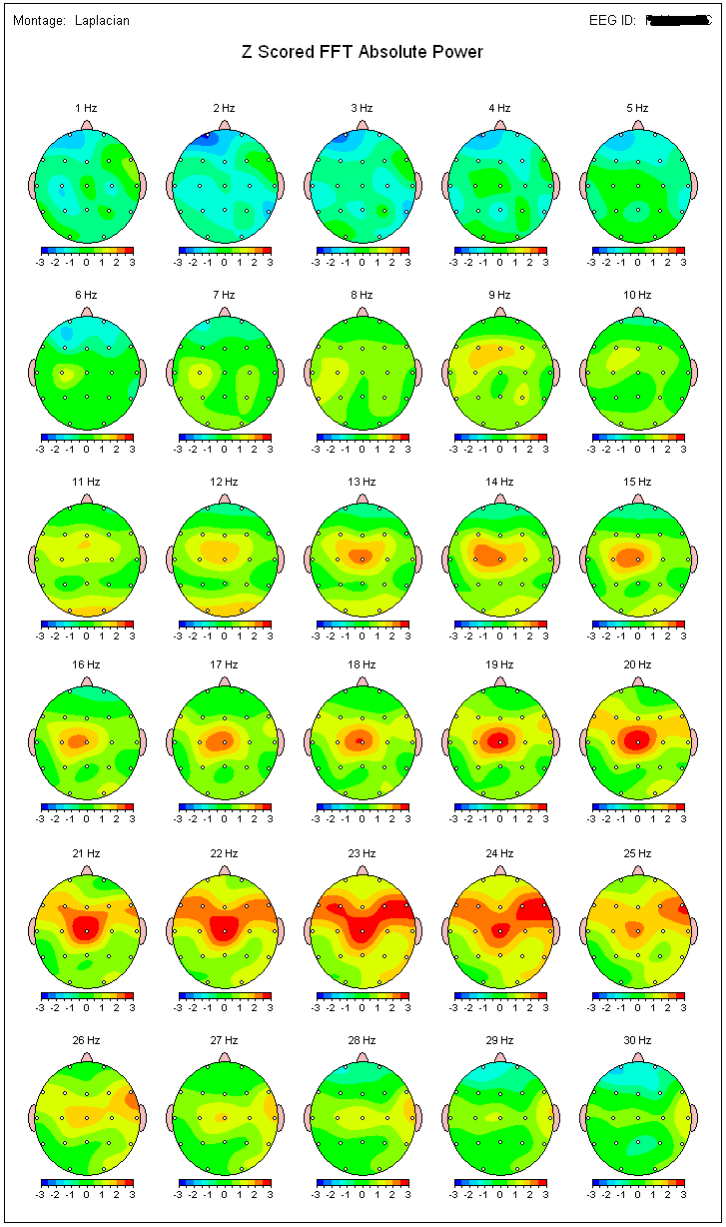
Reduced activity in the <u>left Frontal Lobe</u> and elevated activity in the <u>Anterior Cingulate</u> (especially in the *Brodmann area 25*) are commonly seen in depression.

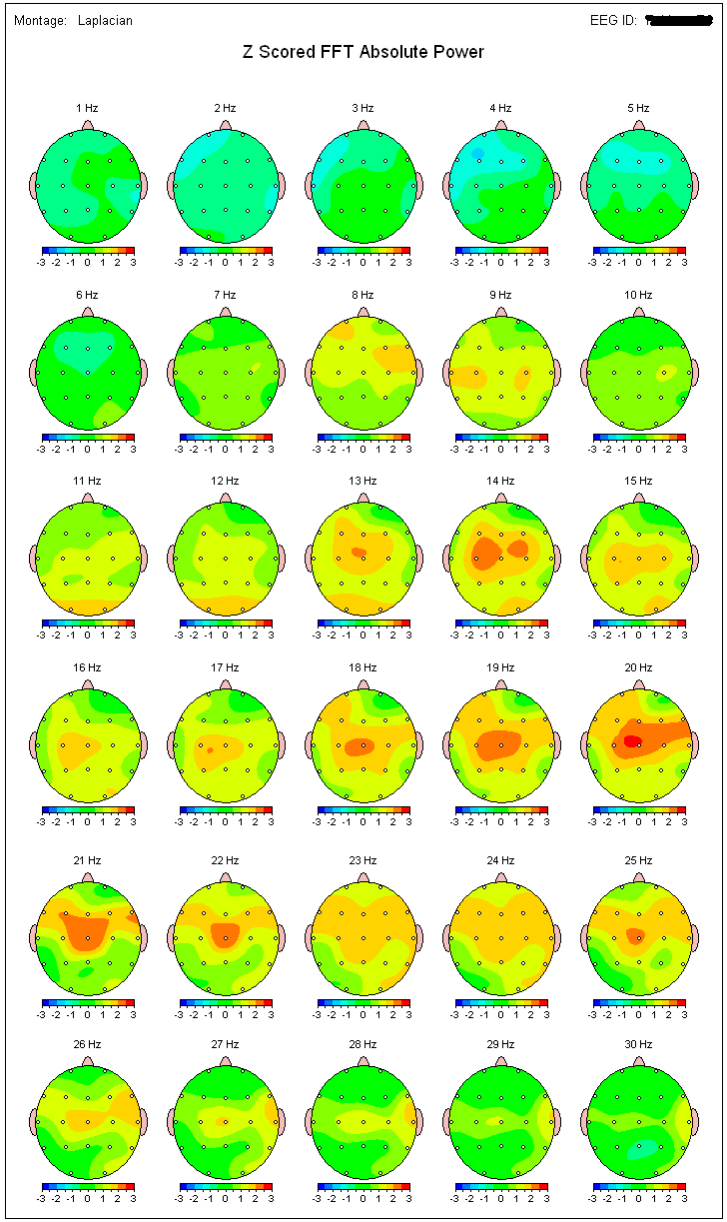




Example 5a **JEAN**: Nine Months and 20 NFB Sessions Later

Before and After Neurofeedback Treatment

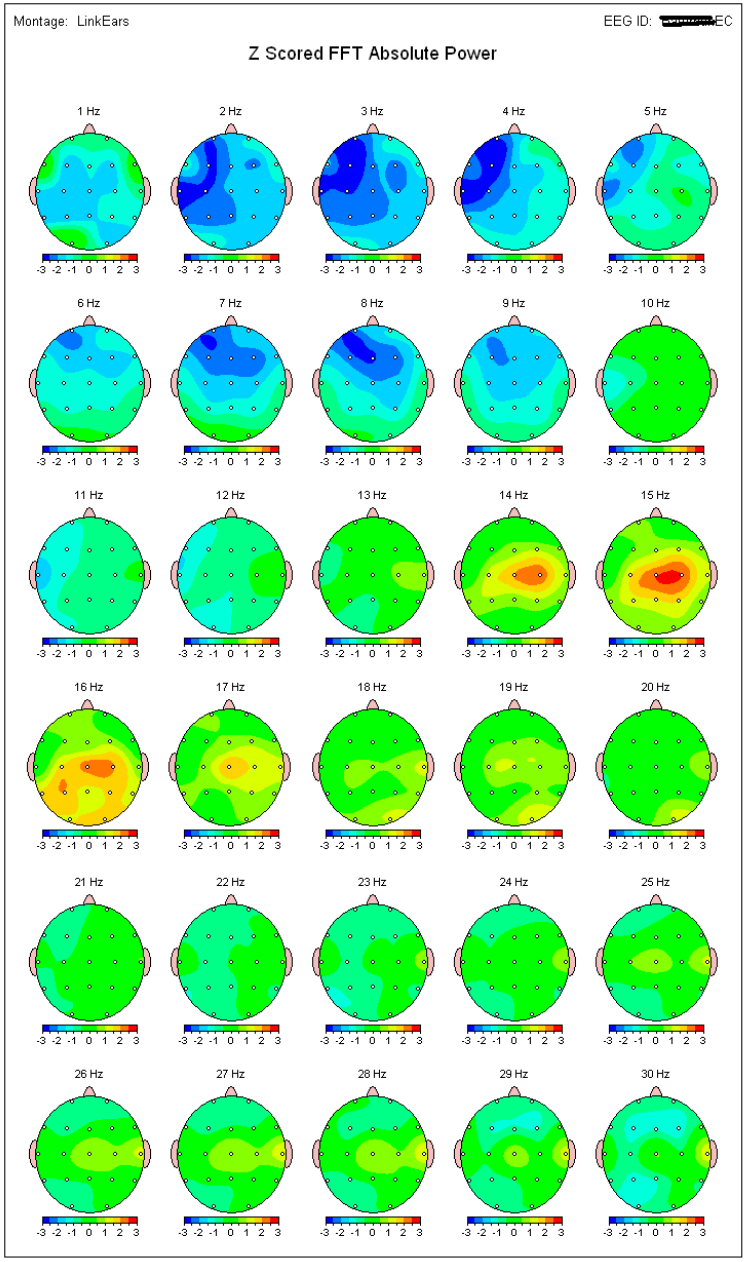




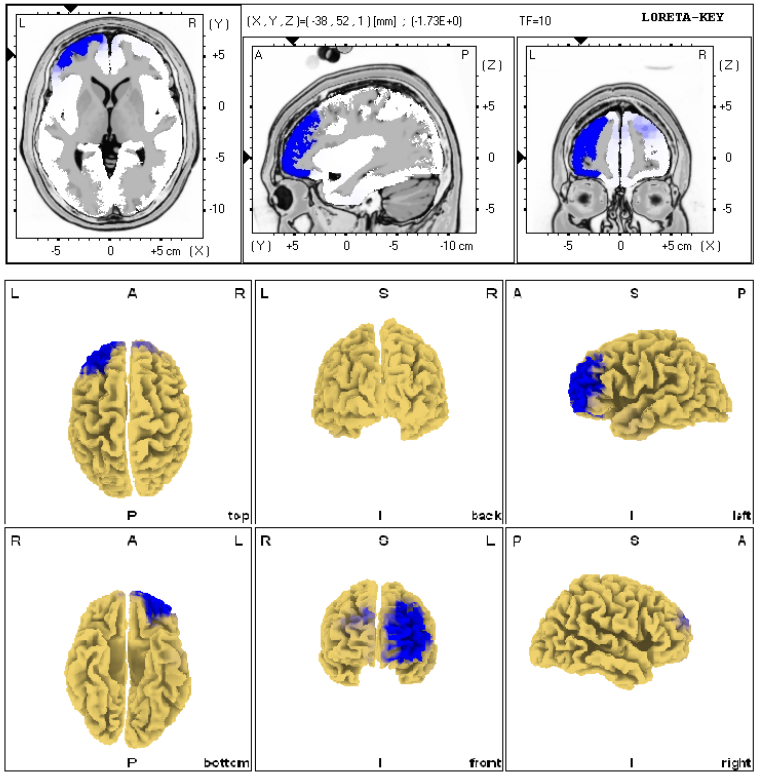
Example 6

48-year-old man with severe depression and cocaine addiction.

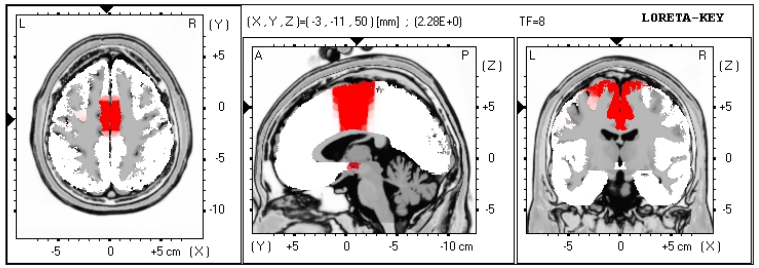
O.B., 48 y.o. **Depression, cocaine addiction**



LORETA at the 3 Hz frequency

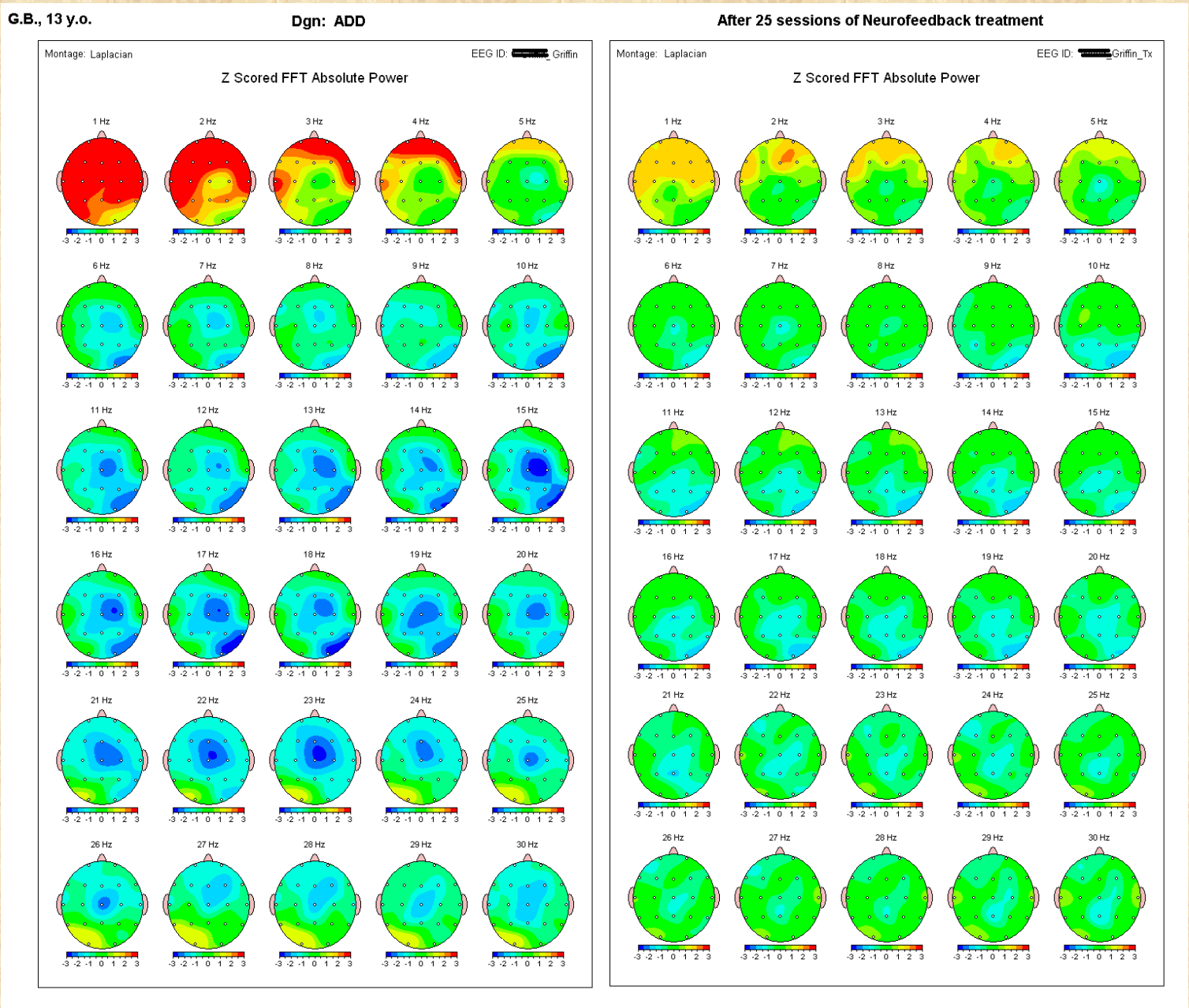


LORETA at the 15 Hz frequency



Example 7

13-year-old boy with ADD: Before and after 25 Neurofeedback sessions



Criteria for Successful Neurofeedback Training

- Clear understanding of how it can help and how it can't
- Sufficient level of cognitive ability – arousal, attention & memory (however, some argue that it's not required)
- No psychosis (delusions, hallucinations)
- Motivation and time to practice and learn a new skill
- Measurable criteria for tracking progress
- Ability to find insurance coverage or to pay for it
- Properly trained and certified Neurofeedback provider
- Treating the person, not the brainwaves

The End

Thank you!

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