LORETA Z SCORE BIOFEEDBACK CONFERENCE

Cancun – Mexico
May 2012

History, Principles and Future Perspectives
Z Score EEG Biofeedback – History and Future Plans

ANI
1994 – Concept
2003 – 1st DLL
2006 – 1st distribution
2009 – SCL-(linkage)
2010 - LORETA Zs

BMr 2006
TT 2006
Deymed 2007
Mind Media 2008
Neurofield 2011
Neuroguide 2009
Others
Others

Others

Neruonspec Mitsar ANI Others
Z Score Biofeedback Clinicians - Total = 1,255

- 1 to 19 channels
- 1 to 4 channels
- 1 – 19 & LORETA Z Score NFB
- 1 – 4 channels
Complex Demodulation

\[ \sqrt{a_1^2 + ib_1^2} \]

\[ \sqrt{a_2^2 + ib_2^2} \]
Difference Between Standard EEG Neurofeedback vs Z Score Neurofeedback

**Standard EEG Neurofeedback**
1. Apples & Oranges
2. Arbitrary Threshold
3. No reference to Guide NF

Raw or Processed EEG values
Threshold is ‘Unknown’

**Real-Time or “Live” Z Score Neurofeedback**
1. Metric, i.e., a ‘Z’ Score
2. Threshold toward ‘0’
3. Instantaneous Comparison to a normative database

Move Z toward 0
Seamless QEEG and Neurofeedback – approx. 50 – 60 minutes for a single Session in four Steps from Clinical Interview to QEEG to Neurotherapy

#1
10 min

Interview
Symptom
Check List

#2
30 min

Record EEG
Edit &
Symptom
Check List
Match

#3
20 min

Neuro-
Feedback

Clinician
Better Clinical Outcome & Fewer Sessions

Conventional Non-QEEG Guided NF

QEEG Guided NF
Link Symptoms to Functional Systems in Brain

Future
EEG & Adherence of Operant Conditioning Rules

Dark Ages


Thorndyke  Skinner  Knox  Jasper  Fox & Rudell  Rosenfeld & Fox  Rudel & Fox  Sterman  Wyrwicka  Kamia  Othmer

Grey Ages

QEEG Z Score Norms 1994

Live Z Scores 2006

LORETA Z Score NFB

Renaissance Age
Principles
1- Specificity of EEG Event (E) = Neural State Interval (I)
2- Contiguity Window (C) = Time period preceding and following a E
3- Contingency of Reward Signal (S) = Feedback signal time locked to E
4- Reward Strength (R) = Value of the reward if N successes occur in an interval of time, e.g., toys, candy, cookies, money, etc.

<table>
<thead>
<tr>
<th>Category</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specificity of EEG Event (E)</td>
<td>Z Scores and Brodmann areas linked to symptoms</td>
</tr>
<tr>
<td>Contiguity Window (C)</td>
<td>Time preceding/following E (msec – sec)</td>
</tr>
<tr>
<td>Contingency of Reward Signal (S)</td>
<td>Feedback signal time locked to E (msec)</td>
</tr>
<tr>
<td>Reward Strength (R)</td>
<td>Ordinal or Nominal measure</td>
</tr>
</tbody>
</table>
Six Functional Modules as Measured by fMRI
Symptoms, Electrodes & Brodmann Areas

Frontal Lobe (Fp1/2, F3/4; F7/F8, C3/C4)
- Thinking, Planning
- Motor execution
- Executive Functions
- Mood Control

Temporal Lobe (T3/5)
- Language function and auditory perception
- Involved in long-term memory and emotion

Anterior Cingulate Gyrus (Fz, Cz, C3/4)
- Visceral movement, attention, long-term memory

Parietal Lobe (P3/4, Pz)
- Somatosensory perception integration of visual & somatospatial information

Occipital Lobe (O1/2, T5/6)
- Visual perception & Spatial processing

Posterior Cingulate (P3/4, Pz)
- Attention, long-term memory

Parahippocampal Gyrus (F3/4, T5/6, Pz)
- Short-term memory, attention
Increased Specificity = Improved Clinical Outcome with Fewer Sessions

LORETA Z Score *
Single Session Capability

Medication

2-4 Channel Z Score NF

Standard Surface NFB

* Combine with Neurofield in cases to reset or “unstick” the brain
Spatial Heterogeneity of Source Correlations

Y-Axis - Ordered Distance mm

Z-Axis - LORETA Source Correlations

X-Axis
Frequency 1 to 40 Hz

Cuneus 62.75 mm
Post Central Gyrus 0 mm

Hypothesized 'U' Shaped Connections
Consciousness vs Anesthesia Unconsciousness
Wake State & LORETA Coherence
Sleep & LORETA Coherence

Z Scored LORETA Coherence

Left Brodmann Area 13

Right Brodmann Area 13

Hippocampus

Amygdala

T, A1, A2, R1, B1, B2, B3, H3