BCIA-Australia Clinical Interchange
for Neurofeedback Practitioners *presents*

Using ERPs to evaluate neurofeedback for PTSD

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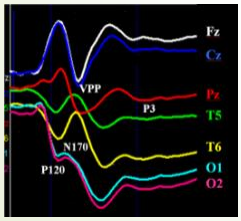
Overview

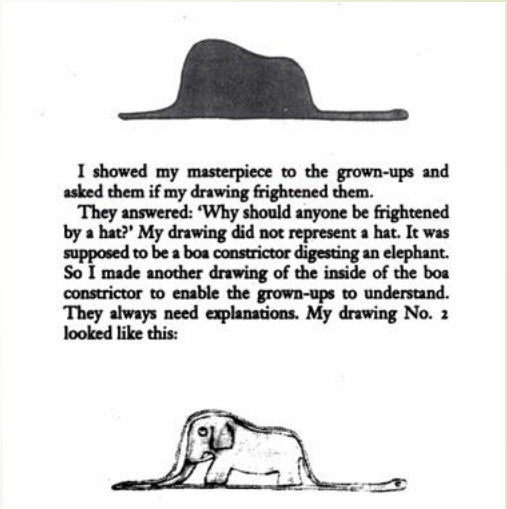
1. What is an ERP?
2. ERP markers of PTSD
3. Neurofeedback for PTSD
4. STARTTS' research
5. Clinical use of ERPs

1. What is an ERP?

Event-related potentials

- Waveform time locked to a stimulus
- Components are peaks and troughs

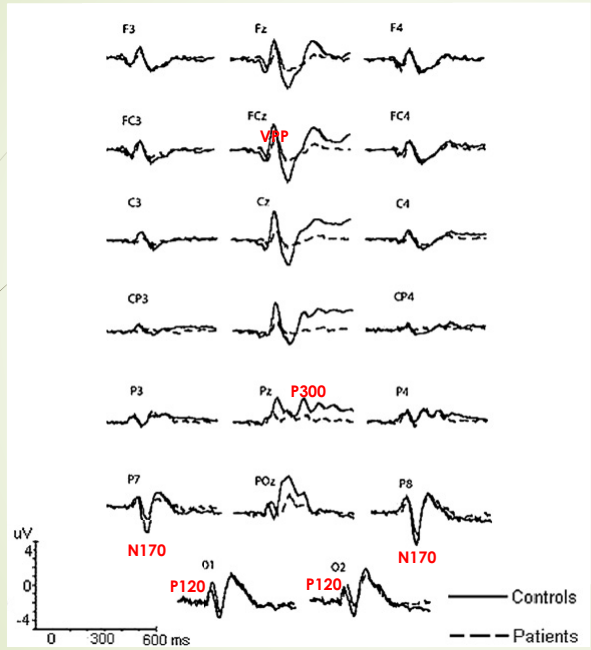




I showed my masterpiece to the grown-ups and asked them if my drawing frightened them.

They answered: 'Why should anyone be frightened by a hat?' My drawing did not represent a hat. It was supposed to be a boa constrictor digesting an elephant. So I made another drawing of the inside of the boa constrictor to enable the grown-ups to understand. They always need explanations. My drawing No. 2 looked like this:

Le Petit Prince by Antoine de Saint-Exupéry



ERP components are defined by:

- When they occur (ms)
- Where on the scalp it is measured from (maximal)
- The direction of the peak - Positive or Negative

ERP components are characterized by:

- Amplitude (microvolts); and
- Latency (miliseconds)

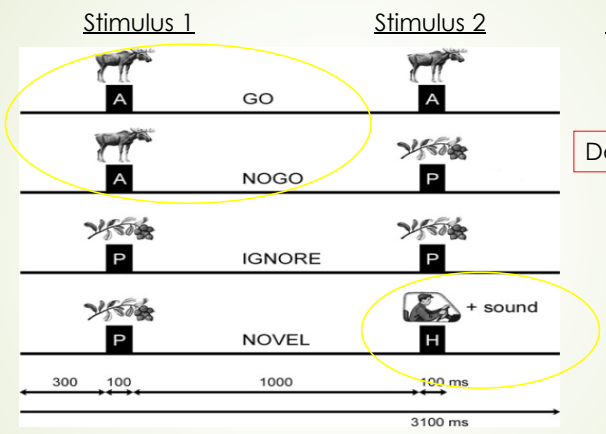
Some components of interest…

Task/Probe	Process	Component	Abnormal in…
Visual stimuli	Perceptual organization	P120	
Facial Expressions of Emotion	Faces, emotional valance	VPP 'Vertex Positive Potential' / N170	Affective disorders
Mismatch Negativity – two auditory stimuli	Habituation or gating	P50/N100/P200	Increased ratio in Psychosis
Oddball – detecting a deviant stimulus	Attention	P300 at Pz	psychiatric populations
Continuous performance task (or n-back)	Working memory or expectancy	P500 ('Contingent Negative Variation')	psychiatric populations

Visual Continuous Performance Task (VCPT)

Kropotov, Mueller et al., 2011
ERP-Based Endophenotypes

Four trial types:



Task length = 20mins

EEG data was collected on the 19 channel Mitsar amplifier
Presented using PsyTask software
ERP measures were calculated using WinEEG software

ERPs markers of PTSD

Posttraumatic Stress Disorder (PTSD) is characterized by symptoms of hyperarousal, avoidance and intrusive trauma-related memories

Cognition:

Reduced P3 Oddball: controlled attention
Reduced CNV during working memory updating
Reduced P3 to novelty

Emotion:

Increased P3 to trauma related stimuli

- Javanbakht et al 2011 – review including 17 studies of ERPs in PTSD
- Johnson et al 2013 – meta-analysis of P3 components in PTSD

EEG Neurofeedback for PTSD

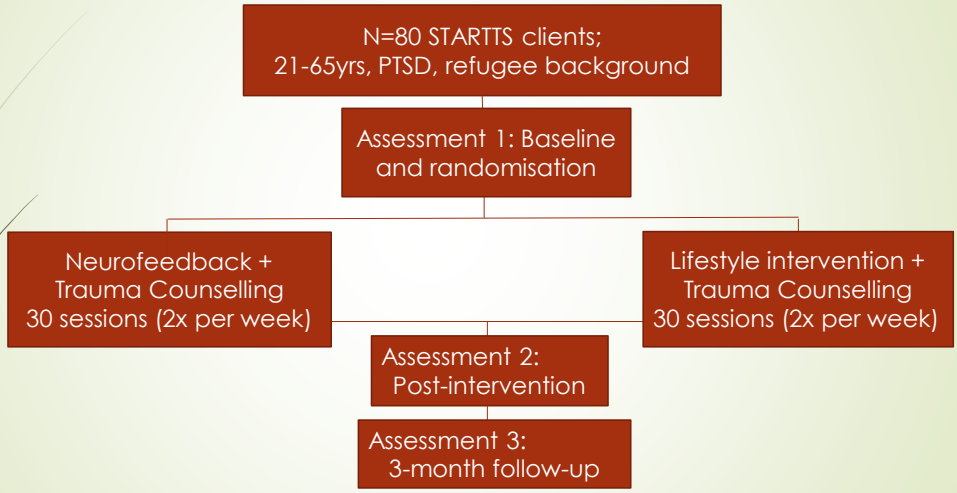
The choice of neurofeedback training protocols is guided by the difficulty of PTSD clients in regulating arousal.

Protocols aim to quieten fear and to improve cognitive clarity.

Fisher, S.F., 2014. Neurofeedback in the Treatment of Developmental Trauma: Calming the Fear Driven Brain, 1st ed. W. W. Norton & Company, United States of America.

These processes can be examined using ERPs during **cognitive control** and **emotional** stimuli.

Proposal RCT of neurofeedback for PTSD in refugees



RCT of neurofeedback for PTSD in refugees

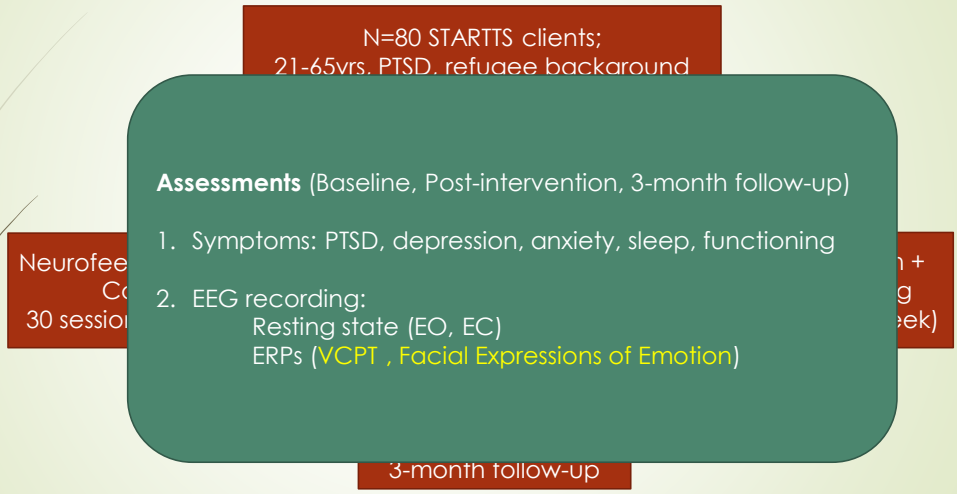
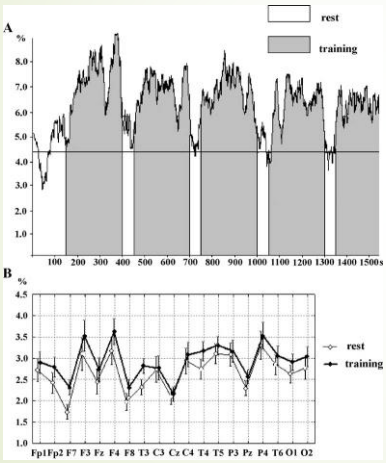


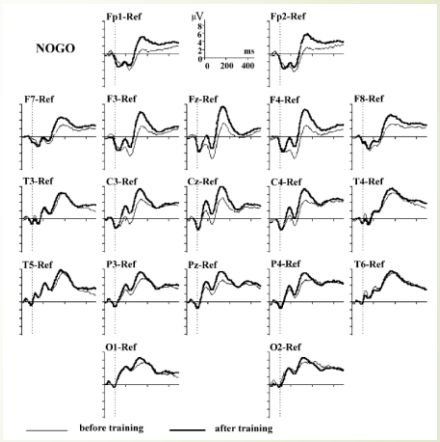
Table 1. Previous trials evaluating neurofeedback interventions for PTSD

Study	Population n=NF/Control	Neurofeedback Protocol	Control intervention	Outcomes*
Peniston & Kulkosky, 1991	army veterans n=15 /14	30 sessions Occipital, Alpha (8-12Hz) /Theta (4-8Hz)	trauma counselling	↓ PTSD symptoms, depression and nightmares; Even at 30 month follow-up
Peniston et al., 1993	army veterans with comorbid alcohol abuse, n=20/-	20 sessions Alpha/Theta and 'abreactive therapy'	-	↑theta ↓alpha synchrony; no relapse after 26 months in n=16
Van der Kolk et al., 2016	community treatment resistant n=28/24	24 sessions Right temporal (T4) Alpha (13-15Hz)	waitlist (TAU)	↓ PTSD symptoms
Gapen et al., 2016	community treatment resistant n=17/-	40 sessions T3-T4 or T4-P4 Alpha (12-15Hz)	-	↓ PTSD symptoms; Improved affect regulation (questionnaire)

"n": number in group; "NF": group receiving the neurofeedback intervention; *Outcomes describe NF group post intervention relative to pre-intervention or control group where relevant; "↓": decrease in; "↑": increase in

Beta NFB training for ADHD enhances P3 NOGO (cognitive control)





J.D. Kropotov et al. / International Journal of Psychophysiology 55 (2005) 23–34

NFB induces enhanced P3 NOGO in n=13 refugees with PTSD

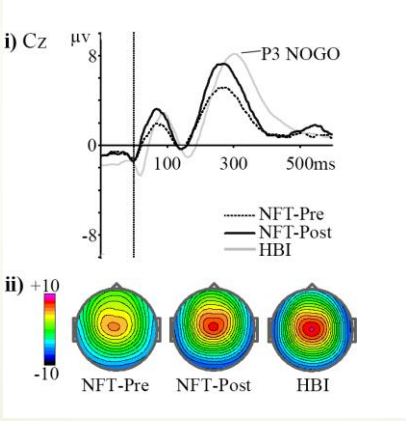
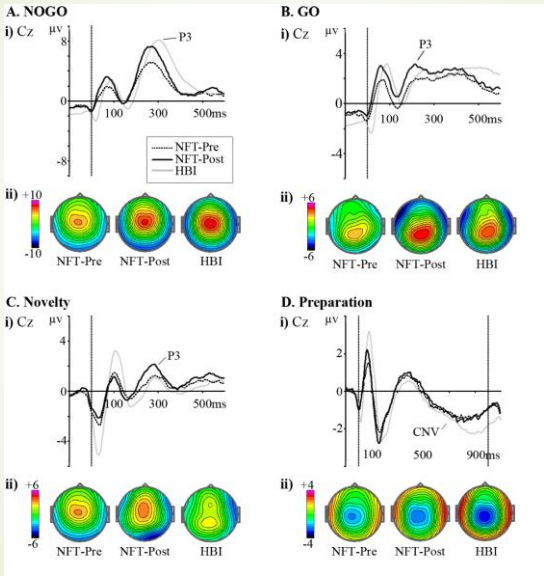


Figure 1. Normalization of P3 NOGO wave of Event-Related Potentials (ERPs) in the treatment group. i) ERPs for NOGO trials of the GO/NOGO Visual Continuous Performance Task for 13 clients pre-(dotted line) and post-(black line) neurofeedback therapy (NFT) and in healthy controls (grey line) from the Human Brain Institute's (HBI) normative database. ii) Maps for the P3 NOGO component peaks for NFT pre- and post-therapy, and HBI. This figure is available in colour online.

M. Askovic et al. / submitted to Clinical EEG and Neuroscience



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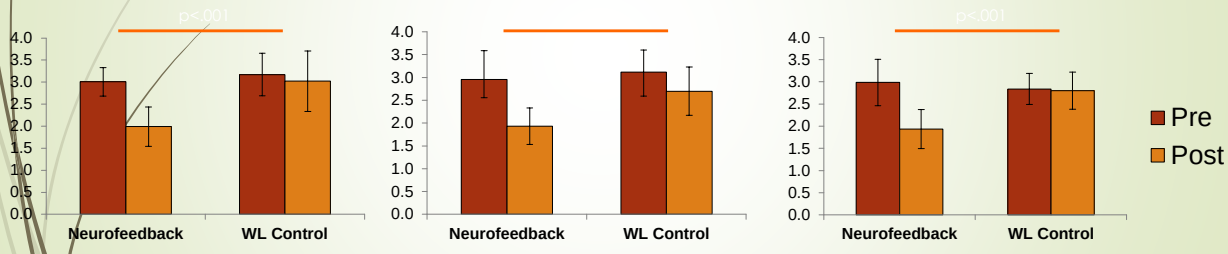
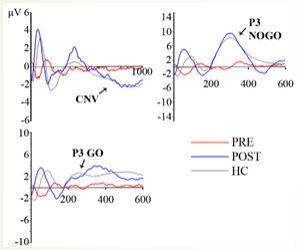
The Neurofeedback group had reduced symptoms of Trauma, Anxiety and Depression from Pre to Post assessments compared with the waiting list control group.



Trauma (HTS) Anxiety (HSCL-A) Depression (HSCL-D)

M. Askovic et al. / submitted to Clinical EEG and Neuroscience

Case Study



Demographics: 54 year-old male
Country of Birth: Iraq
Diagnosis: PTSD, Major Depression
Symptoms: headaches, back pain, insomnia, rumination
Trauma History: torture and war trauma
Neurofeedback: 36 sessions focusing on mood stabilization, tension reduction and sleep enhancement; included frontal downtraining and temporal enhancement of alpha

Askovic M, et al 2017, Neurofeedback as an adjunct therapy for treatment of chronic Posttraumatic Stress Disorder related to refugee trauma and torture experiences: Two case studies. *Australasian Psychiatry*, 25(4): 358-363

Interindividual Variability

Human Brain Indices (HBI) reference database:

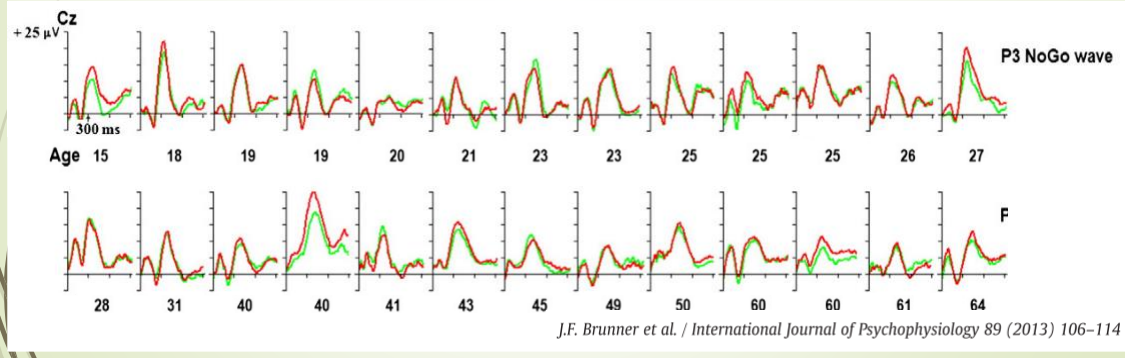
- 1000 healthy control, 7-90 years of age (43±12 per age window of ≤5 years)
- Individual compared to group through estimation of p-values and z-scores

ERPs vary substantially from person to person

- Anatomical folding patterns
- Differences in information processing

ERPs are 'quite' reliable measures of brain functioning

- P3 auditory oddball: Test-retest reliability of .50 to .86
- Brunner … Kropotov et al. 2013. P3 NOGO: 0.8



Clinical Utility of ERPs

- Diagnosis and identification of subgroups
- Determining targets for an intervention, or predicting the suitability of an intervention
- Determining whether a therapy influences a specific process

Thank you!

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