Evaluation of the Effectiveness of Neurofeedback in Treating PTSD and Associated Cognitive Deficits in Traumatised Adult Refugees

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Background

Post Traumatic Stress Disorder (PTSD) is frequently experienced among traumatised refugees.

There is evidence for neurophysiological changes in PTSD, including dysfunction in EEG measured 'bioelectrical' activity [1,2] .

Neurofeedback therapy holds a promise as a complementary treatment modality that aims to address neurophysiological dysfunction resulting from trauma [3].

Remediation of PTSD via neurofeedback may involve normalising cognitive control.

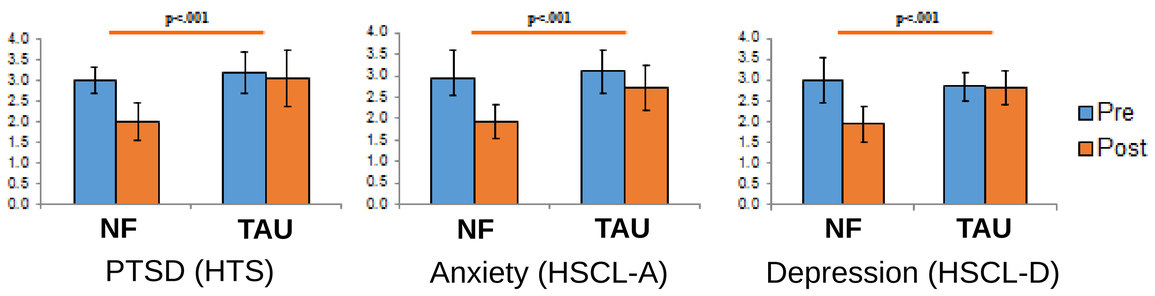
In this study we assess the effectiveness of neurofeedback therapy as an adjunct to trauma counselling for treating chronic PTSD related to refugee experiences.

We predicted a greater reduction in PTSD symptoms pre- to post- neurofeedback in clients receiving neurofeedback relative to counselling alone. In those receiving neurofeedback, we assessed pre to post changes in an EEG measured, P3 ERP reflecting cognitive control and behavioural performance relative to healthy controls.

Results

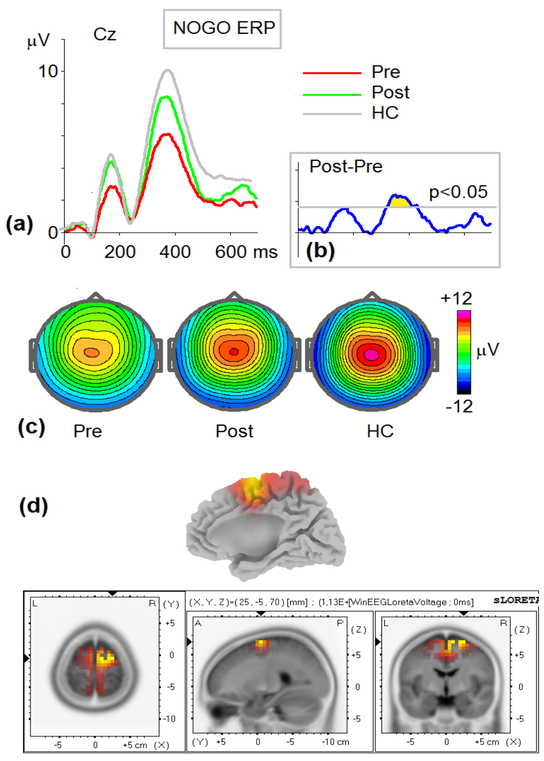
Symptoms

NF had a greater reduction in symptoms of PTSD, Anxiety and Depression pre to post therapy than TAU



Cognitive Control

NF showed significantly increased P3 amplitude from pre (RED) to post (GREEN) therapy (a-b). Healthy controls (HC) are shown in GREY (a). Post therapy, the NF appear more like the HC.



(a) Grand average ERPs at Cz for NOGO stimuli

(b) Post-Pre difference wave with significance threshold of p<0.05.

(c) Voltage distribution at P3 NOGO for NF Pre, NF Post and HC.

(d) The location of the pre-post changes in P3 is the prefrontal cortex, as estimated by LORETA (Low Resolution Brain Electromagnetic Tomography)

Cognitive Control – Behavioural

NF made fewer 'false alarm' errors (p=.037) and had reduced variability of response time (p=.003) at post versus pre therapy.

Digit span performance (**total** [p=.012] and **backwards** [p=.017]) also significantly improved post therapy (Fig. 4).
There were no significant changes in performance on the Colour Trail Test post treatment.

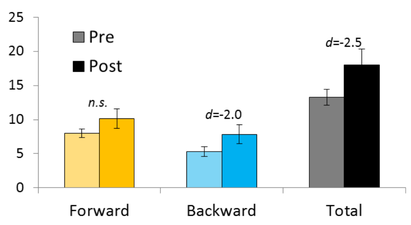


Figure 4. Pre and post treatment scores for digit span (Mean±SE, Cohen's d)

1Jokić-Begić et al. Nord. J. Psychiatry. (2003) 57, 351–355; 2Wahbeh et al. Appl. Psychophysiol. Biofeedback. (2013) 38, 57–69; 3Kluetsch et al. Acta Psychiatr Scand. (2014) 130:123-36;

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The **NSW Service for the Treatment and Rehabilitation of Torture and Trauma Survivors** (STARTTS) runs a neurofeedback program as part of their clinical services available to refugees. This pilot study reports post treatment changes in symptoms across 29 client participants (13 receiving neurofeedback and 16 receiving treatment as usual).

Methods

Participants: 29 clients of STARTTS (mean=44 years, range=21-60). Thirteen received neurofeedback (NF), while 16 received trauma counselling (treatment as usual) while on a waitlist of neurofeedback (TAU).

There were no group differences in symptoms severity at baseline, or in total number of therapy sessions between assessments (Mean[SD]: NF=24[8], TAU=19[17]).

Neurofeedback Treatment Protocol:
Treatment involved teaching clients to enhance alpha activity (8-11hz) and/or sensory-motor rhythm activity (12-15hz), and to suppress theta (2-6 hertz) and high beta (20-30hertz) activity. The protocol is widely used for promoting a calm and relaxed state.

Pre- and Post-treatment Assessments :
Both groups were assessed for changes in symptoms, while neurofeedback group was additionally assessed for changes in brain functioning (ERPs) and cognition.

Symptoms

- The Harvard Trauma Questionnaire (HTQ) for assessment of trauma
  - Based in DSM-IV symptoms for PTSD
  - Scores from 2.5 indicate clinically significant Post-Traumatic Stress.
- Hopkins Symptom Checklist for depression (HSC-D) and anxiety (HSC-A).

Cognitive Control – EEG/ERP

The Visual Continuous Performance Task (VCPT) was used to probe working memory and sustained attention during EEG recording (Fig. 1).

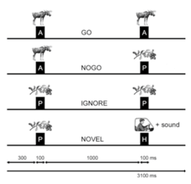

Figure 1. The four different possible trials of the VCPT

Trials consist of four possible pair sequences made from images of animals, plants and humans. When the first image in a pair is an animal, participants prepare either to respond if the second image is an animal (Go) or withhold responding if the second image is a plant (NoGo).

Analysis of Event-Related Potentials (ERPs): Waveforms for P3 NOGO response were averaged across participants for visual inspection of pre-post differences.

Cognitive Control – Additional Measures

Executive functioning was measured using the Colour Trail Test (CTT). In Trial A, participants join dots in order of number (depicted by universal symbols). In Trial B participants join the dots according to both number and colour.
Digit Span (WAIS III) was used to probe *attention* (forwards) and *working memory* (backwards).

Discussion and Future Directions

- The results of this pilot study suggest that neurofeedback may be a promising treatment for PTSD and related symptoms and cognitive dysfunction. Normalization of bioelectrical patterns is also indicated.
- The observed improvements in cognitive functioning (working memory and cognitive control) are consistent with remediation of a deficit in top-down control over emotional pathways, as one of the mechanisms involved in maintaining PTSD symptoms. Further research is needed to investigate other possible underlying mechanisms for change, such as in emotional processing.
- This study contributes to establishing neurofeedback as a valuable therapy to integrate with existing evidence based treatment modalities for PTSD. Analysis in a larger, controlled sample is warranted.