



Brainwave Neurofeedback Improves Selective Attention and Alertness in ADHD

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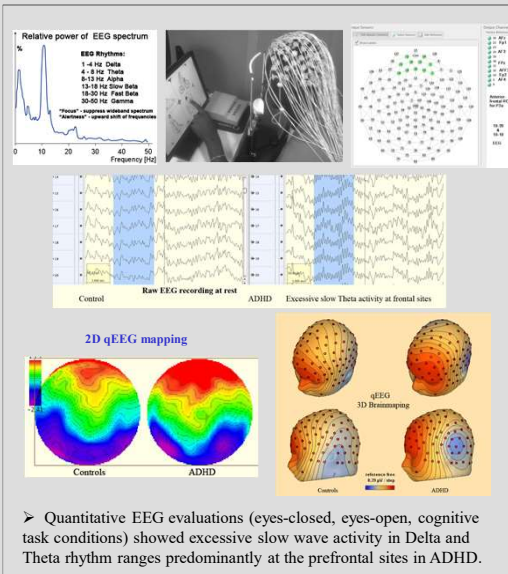
Introduction & Background

- Electroencephalographic (EEG) biofeedback training (so called brainwave neurofeedback) is defined as an efficacious and specific treatment of Attention Deficit/Hyperactivity Disorder (ADHD) according to recent meta-analysis (Arns et al., 2009; Gevensleben et al., 2009; Sherlin et al., 2010).
- The neurofeedback training to self-regulate brainwave patterns can be used not only with the aim of recovering function (e.g., attention in ADHD) but also for optimizing cognitive functioning and increasing behavioral performance in non-clinical population.
- In this pilot study we investigated effects of 12 sessions of the prefrontal neurofeedback on behavioral performance in the audio-visual selective attention task (IVA+Plus, Brain Train Inc., VA) in 11 patients with ADHD.
- Patients with ADHD diagnosis were referred from the Weisskopf Child Evaluation Center (Dr Sears) and from the Health Care Outpatient Center (Dr Stewart). Diagnosis of ADHD/ADD was confirmed by adequate clinical evaluations.
- Neurofeedback training was conducted weekly with 30 min long sessions using 12 different fragments of documentary films depicting nature scenes (BBC "Planet Earth" and "Life" series).
- The EEG was recorded from the prefrontal site (FPz according to International 10/20 system) referenced to the left earlobe.
- To enhance "focus" subjects were trained to suppress wideband spectrum, while "alertness" parameter was a wideband measure of the upward shift of the frequencies in the EEG.
- Visual feedback was arranged in a form of control of brightness, size and continuation of the documentary by the "focus and alertness" measures

- Auditory feedback was used to inform subject when these measures were under the threshold level.
- The continuous performance IVA+Plus selective attention test was administered before and after 12 session neurofeedback course.
- Another clinical behavioral outcome in ADHD patients included measures from the **Aberrant Behavior Checklist (ABC)** (Aman & Singh, 1994).
- The brainwave neurofeedback can be used both in ADHD and healthy subjects to improve behavioral performance, focused concentration, vigilance, and alertness.
- Neurofeedback training can be used in individuals with attention problems to develop and control peak mental function capacity, to increase focused concentration and sustained attention, maintain alertness, and thus become more productive in all areas of life, including activities at school or at work.

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Baseline qEEG profiles (ADHD vs. Controls)



Method: Equipment

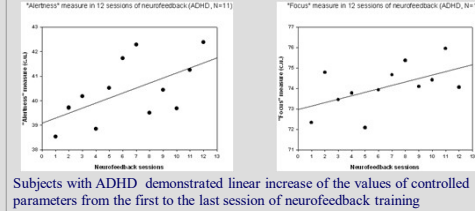
PAT neurofeedback device : feedback screen and EEG sensor position



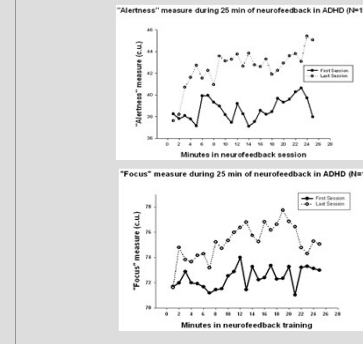
Subjects

- We enrolled 13 children and adolescents with ADHD (range 7-18 years old, mean age 14.1 years, SD=4.1, all of them boys). 11 completed course. Six subjects were taking stimulant medication.
- Participants with ADHD were recruited through the University of Louisville Weisskopf Child Evaluation Center (WCEC). Diagnosis was made according to the DSM-IV-TR and further ascertained by Dr Sears using clinical interview.
- Dr Sears also did pre- and post-neurofeedback clinical evaluations and the ABC scoring. Neurofeedback sessions were conducted by Dr. Tato Sokhadze.
- Participating subjects and their parents were provided with all information about this pilot study purposes and the consent/assent forms were signed.

Results: Changes across 12 sessions



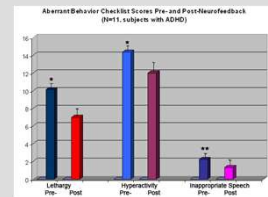
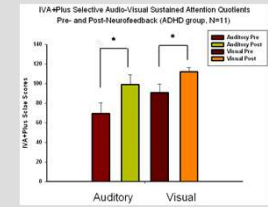
"Alertness" and "Focus" changes during 25 min long session



Statistics

- Retention:** From 13 initially enrolled subjects with ADHD 11 completed 12 session long course (~85%)
- IVA+Plus outcomes:**
 - Sustained auditory attention quotient increased from 69.3 (SD=36.0) to 99.8 (26.4), $t=2.32$, $df=10$, $p=0.029$;
 - Sustained visual attention quotient increased from 91.4 (26.4) to 113.8 (13.7), $t=2.42$, $df=10$, $p=0.025$;
- Aberrant Behavior Checklist outcomes:**
 - Lethargy/Social Withdrawal score decreased from 10.1(7.4) to 7.0 (6.9), $t=2.48$, $df=10$, $p=0.021$
 - Hyperactivity score decreased from 14.3 (14.6) to 12.0 (11.1), $t=2.21$, $p=0.041$;
 - Inappropriate Speech score decreased from 2.25 (2.4) to 1.3 (1.8), $t=2.96$, $df=10$, $p=0.009$.

Behavioral and Cognitive Measures Pre- and Post-Neurofeedback



Summary

- Neurofeedback training aimed at enhancement of the "focus" and "alertness" measures in ADHD group was accompanied by improved in performance on IVA+Plus selective attention test and lowered Lethargy, Hyperactivity, and Inappropriate Speech scores of the ABC inventory.
- Self-regulation of prefrontal EEG measures of "focus and alertness" using protocol with DVD-control as a visual feedback was effective in maintaining interest and motivational engagement of children with ADHD.
- Twelve 30 min long sessions of neurofeedback were sufficient to achieve ability to control EEG parameters of interest in most of ADHD participants.

References

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- Arns, M., de Ridder, S., Strehl, U., Brethler, M., & Coenen, A. (2009). Efficacy of neurofeedback treatment in ADHD: The effects on inattention, impulsivity and hyperactivity: A meta-analysis. *Clin EEG Neurosci*, 40(3), 180-9.
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- Sherlin, L., Arns, M., Lubar, J., & Sokhadze, E. (2010) A position paper on neurofeedback for the treatment of ADHD. *Journal of Neurotherapy*, 14, 66-78.