Controlled Study Assessing The Efficacy of Mobile-based Neurofeedback for Attention Deficit/Hyperactivity Disorder (ADHD)

Introduction

Neurofeedback, or EEG biofeedback, is known for being an additional treatment for ADHD, and several randomized controlled trials showed significant benefits from this intervention. This present study uses a controlled trial to evaluate the specific benefits of neurofeedback done using Techneuro (Myndlift Clinical), a therapist-guided wearable and mobile neurofeedback system.

Nineteen (19) participants (all males, ages 8-15) who were diagnosed with ADHD have been recruited for the study. The intervention group (N=12) received neurofeedback training three to four times a week for 9 weeks, totaling an average of 21 sessions per patient. The control group (N=7) did not receive any treatment during the 9 week period.

Both groups have gone through two assessment tests: pre-treatment and post-treatment. The study used Moxo, a Continuous Performance Test (CPT) that includes visual and auditory stimuli serving as distractors. The rate of omission errors was used as a measurement of difficulty in sustained attention. A Z-score value indicating distance from the norm is reported for attention, impulsiveness, hyperactivity and timing at the end of the assessment. In addition, Conners-3 parents report questionnaire was used as part of the assessment.

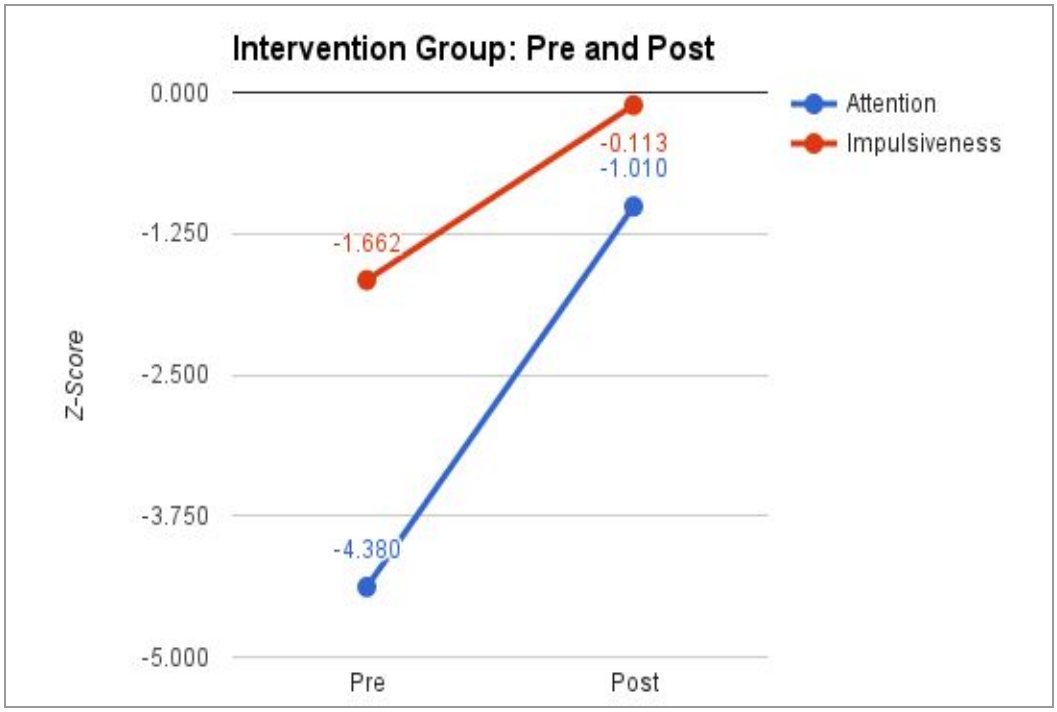
Results

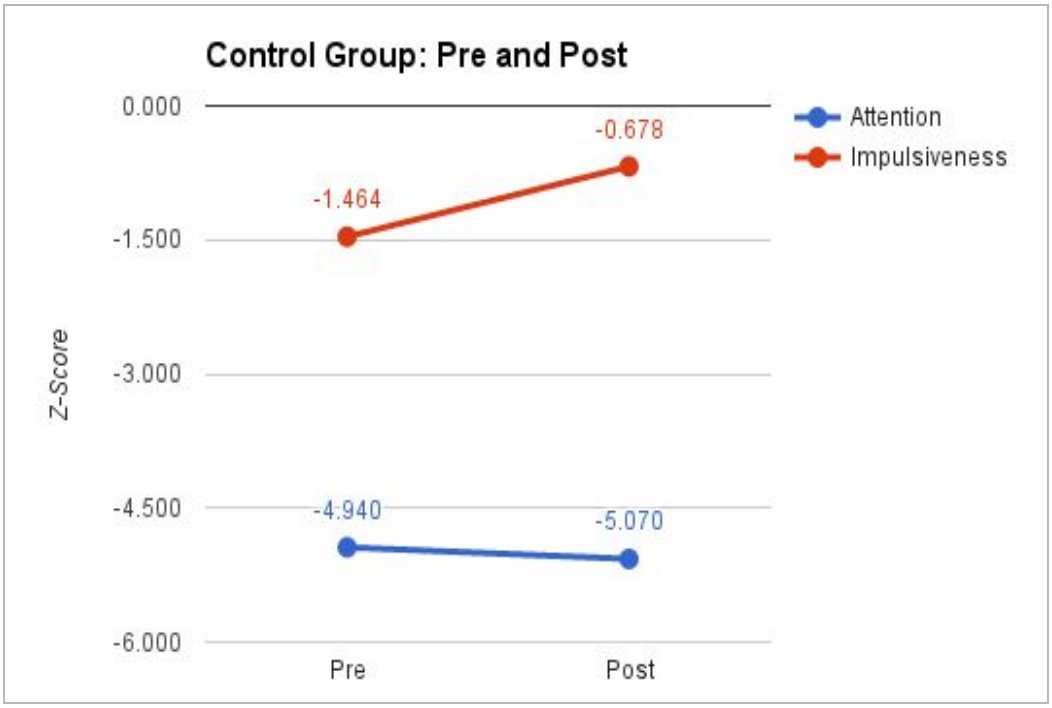
Sixteen out of nineteen participants have completed the study. The results reported that the intervention group (N=10) has had highly significant improvement on the sustained attention measure and also showed improvement on the impulsiveness measure (both in the CPT test).

The control group (N=6) did not show any improvement on the sustained attention measure, and did not have significant improvement on the impulsiveness measure (both in the CPT).

Moreover, the intervention group’s Connors-3 parent questionnaires showed a significant improvement in scores, with a 0.62 effect size for fathers’ reports, and 0.43 effect size for mothers’.

The following figures show the mean attention and impulsiveness Z-scores in the Moxo test for pre and post assessments in the intervention (N=10) and in control (N=6) groups. Sustained attention for the intervention group improved by 3.371 Z-score points ($p < 0.01$) and impulsiveness by 1.549 Z score points. Control group had no significant changes.

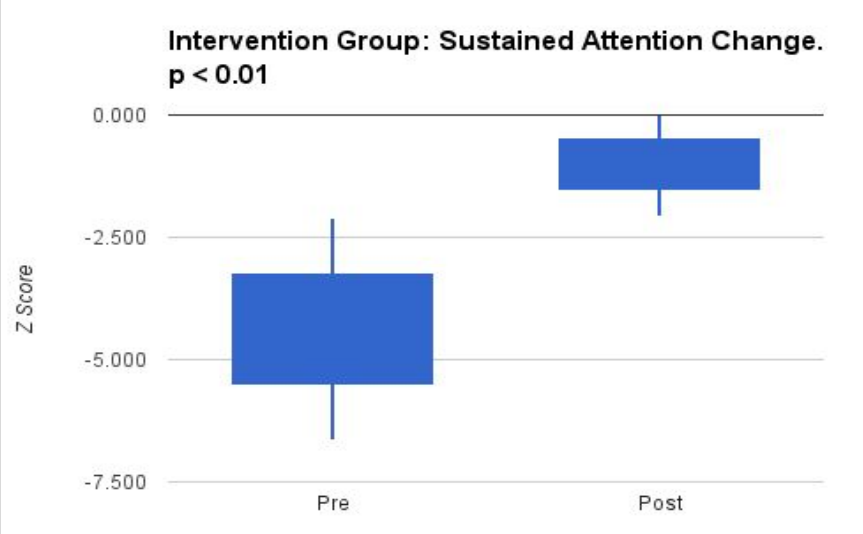


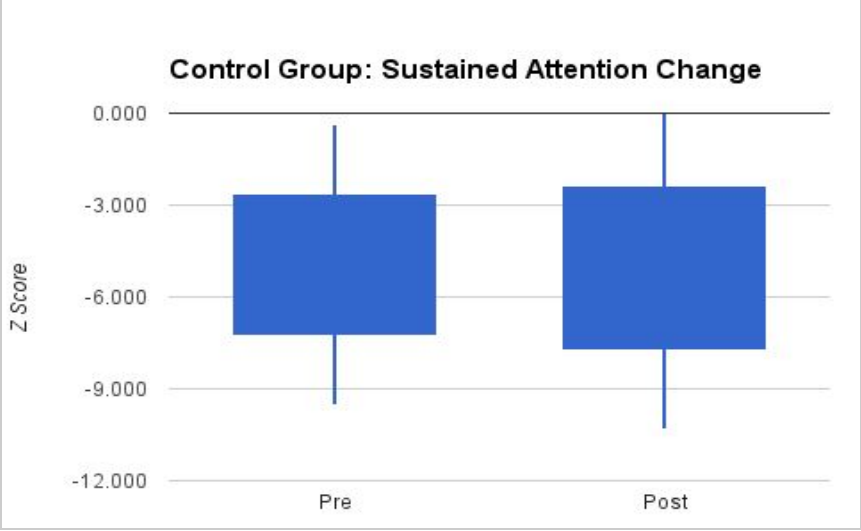


The following table shows the comparison between mean attention value in pre and post assessments for control (N=6) and for intervention (N=10).

CPT attention Z score results	*Intervention group (n=10)*			*Control group (n=6)*		
	Mean	*SD*	*SE (1.96*SE)*	*Mean*	*SD*	*SE (1.96*SE)*
Pre	*-4.38*	*3.68*	*1.16 (2.27)*	*-4.94*	*5.71*	*2.33 (4.57)*
Post	*-1.01*	*1.72*	*0.54 (1.06)*	*-5.07*	*6.56*	*2.68 (5.25)*

*The following graphs illustrate the table values (mean, SE, 1.96*SE):*





The following table shows the comparison between mean Connors-3 ADHD assessment score in the pre-assessment pre to the one in the post assessments. It was done solely for the intervention group (N=10).

Conners-3 Scores	*Pre*		*Post*		*Effect Size*
	Mean	*SD*	*Mean*	*SD*	
Pre Fathers	44.67	17.23	*21*	*12.08*	*0.62*
Pre Mothers	42.44	15.03	*26.22*	*18.48*	*0.43*