

Neurofeedback Training: Outcomes Analysis – 2003

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Two measures of change used; the TOVA (Test of Variables of Attention) and the Perl Child Checklist.

The TOVA is a continuous performance (hands-on) test, involving a simple visual discrimination task. It is a timed test, taking about 25 minutes to complete. The test taker must click or not click a special button in response to visual stimuli presented on a computer screen. The test can accurately measure the presence and degree of difficulty with sustained focus, attention and impulse control. The TOVA is helpful for diagnostics and well as for the accurate titration of medication for ADHD.

TOVA Variables

Inattention – Sustained attention. How often the client did not click when they needed to.

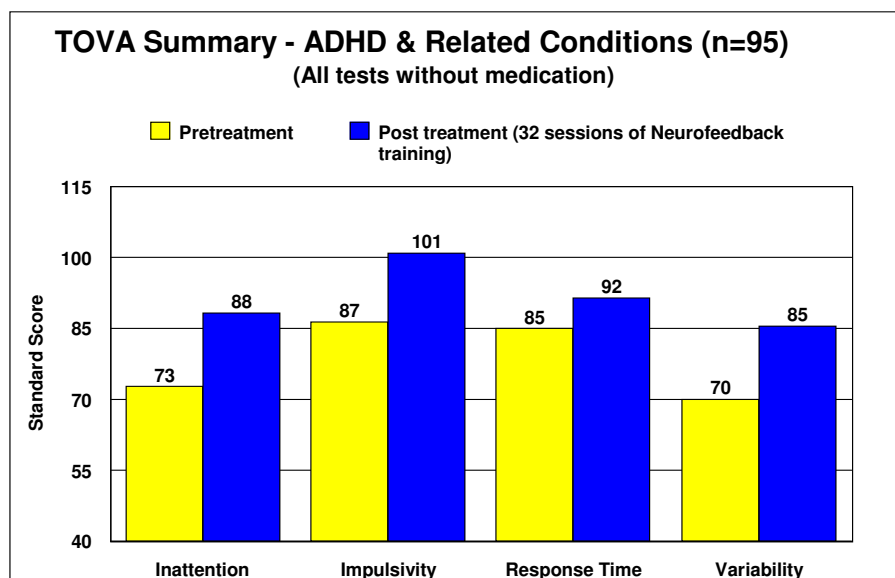
Impulsivity – Impulse control. How often the client clicked when they did not need to.

Response Time – Average response time for correct responses.

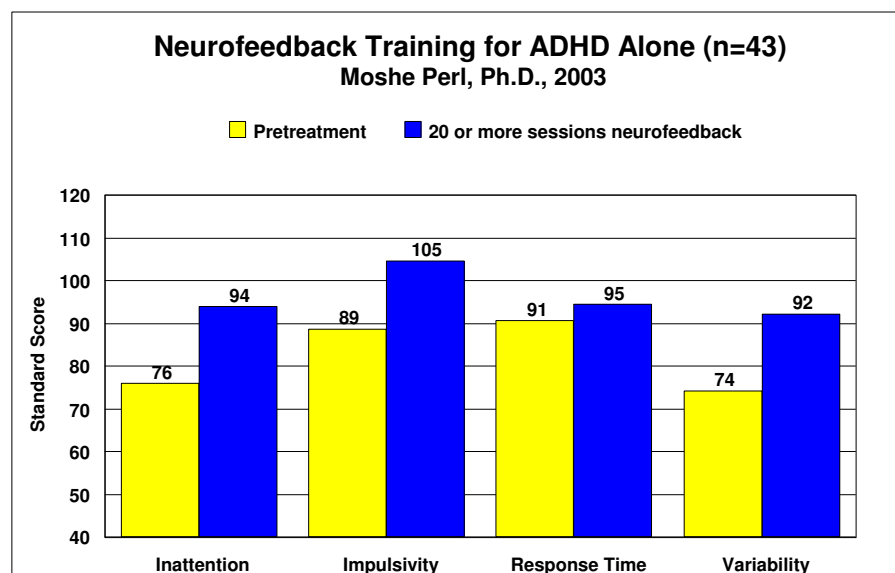
Variability – Degree of variability (inconsistency) in response time (standard deviation).

TOVA Features

The test is normed and reliable, and is a valid measure of inattention and impulse control – the test alone correctly predicts ADHD 80% of the time. Scores are reported in standard score format – the same format used for IQ scores. A score of 100 is average; 115 is better than average; 85 is worse than average; 70 is poor; 55 is very poor; and 40 is extremely poor. An improvement of 8 points, or half a standard deviation, is clinically significant; that is, observable by others.



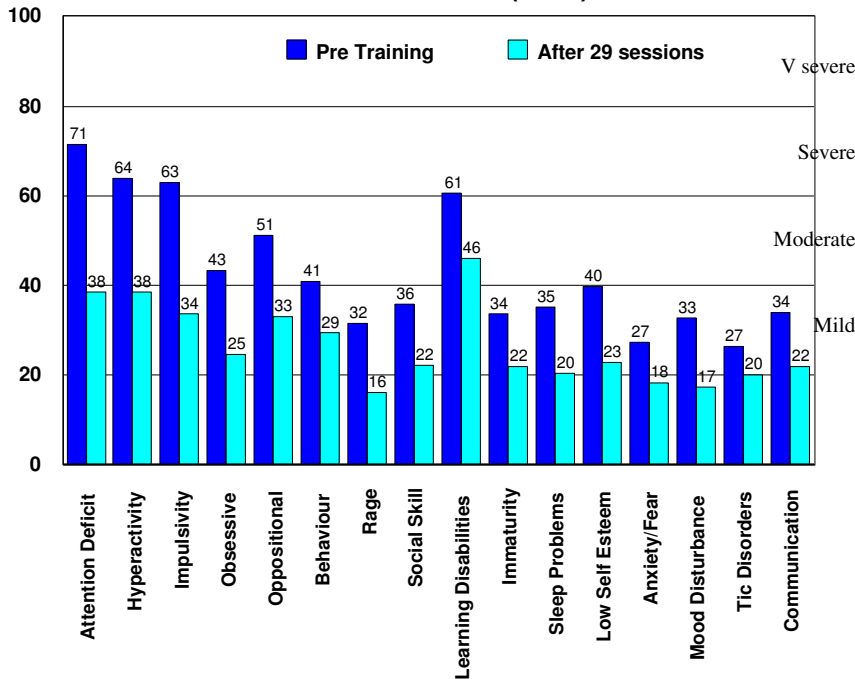
- Subjects had a variety of diagnoses, including ADHD, Oppositional, Aspergers, Tourettes, Anxiety, Conduct
- The overall analysis was statistically significant at $p < .0001$
- Inattention, Impulsivity and Variability were significantly improved at $p < .0001$
- 80% of subjects improved 8 points or more on at least one TOVA variable
- Parent and self-report of improvement mirrored TOVA results



- Subjects were ADHD impulsive and /or inattentive
- The overall analysis was statistically significant $p < .0001$
- Inattention, Impulsivity and Variability were significantly improved at $p < .0001$
- 89% of subjects improved 8 points or more on at least one TOVA variable
- Results compare very favourably with the 50-70% improvement with stimulant medication noted in the literature

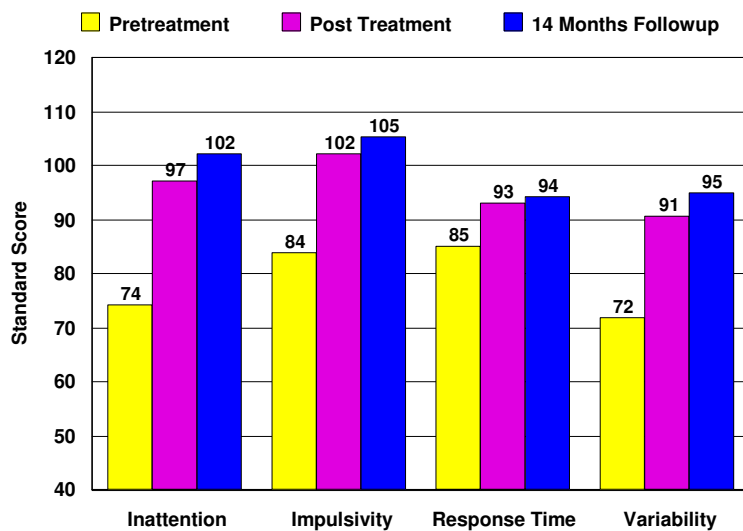
The Perl Child Checklist is a 259 item inventory which the parent/carer rates from 0 to 5 on a frequency or severity continuum, from never or not problematic to almost always or severely problematic. It covers 16 major behaviour and adjustment issues which children face. A rating of moderate to severe on a scale correlates with a significant likelihood that the child will receive a DSM IV diagnosis. A rating of severe to very severe correlates with a high likelihood of a DSM IV diagnosis on that scale.

**Neurofeedback for ADHD & Related Disorders
Perl Child Checklist (n=43)**



- The overall analysis was statistically significant at $p < .0001$. All 16 scales showed statistically significant improvement, most at $p < .0001$
- 86% of subjects were rated improved on Attention Deficit, Hyperactivity, Impulsivity, Oppositional, Learning Disabilities and Low Self Esteem, all of which showed dramatic improvement.
- These results are particularly impressive because the subject pool included children with Aspergers, Tourette's, Learning Disabilities, and Oppositional Defiant Disorder, in addition to ADHD.

TOVA Follow-up Summary - ADHD (n=18)



- Pre-Post improvements were significant ($p < .0001$).
- **Post-Followup improvements were significant ($p < .05$).** Inattention was significantly improved ($p < .05$)
- 14 subjects improved after training and 3 maintained gains made in training.
- Results support the hypothesis that long-term positive changes in brain functioning are produced by neurofeedback training.

Summary

- Neurofeedback is an effective treatment for ADHD and ADHD related disorders
- Both objective (TOVA) and subjective (parent report) measures show improvement as a result of neurofeedback training
- Gains made in training hold over time and tend to improve
- Neurofeedback as the cornerstone of an intervention strategy for ADHD significantly improves long term outcomes in an area where success is often short-lived and limited