

# **Six Case Studies Examining the Effectiveness of a Comprehensive Adaptive Approach to Neurofeedback for Attention Deficit in an Educational Setting**

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Six AD/HD elementary school students completed 19 hours of neurofeedback training over six months averaging 45 sessions. Five of the six students measurably improved in parent/teacher report and/or objective data relatively congruent with QEEG analysis.

Improvement seemed related to lower theta/beta ratios. This comprehensive adaptive approach is theoretically based upon restoring neurological flexibility and resilience, allowing circadian rhythms to renormalize and functionality to emerge (Brown, 2002).Method.

Three male and three females, ranging 9-12 years old, attending a private learning center specializing in dyslexia were previously diagnosed with AD/HD. Five out of six were taking 15-20mgs of various psychostimulant medications.

Evaluation measures included QEEG analysis with theta/beta ratios (Monastra, et. al, 1999; Lubar et al, 2001), IVA, Stroop, WISC-III ACID subtests, ADDES behavior ratings and a Likert scale of improvement evaluation.

QEEG data was analyzed in terms of absolute and relative magnitude, as well as in terms of theta/beta ratios. Theta-beta ratios averaged across 19 channels ranged from 1.40 to 7.69. Active electrodes sited at C3 and C4, referenced and grounded on ipsilateral ear lobes, input to two channels of the ProComp+ that fed data to a KeyData laptop accommodating NeuroCarePro software with dual monitor capability.

Approximately thirty-second baselines were recorded before and after each session. Inhibits targeted 2-6 Hz delta/theta, 8-13 Hz alpha under eyes open conditions, and 23-38 Hz high beta at all times, producing visual and auditory feedback when the emergent median remained within a neighborhood defined by no more than 80% divergence.

Feedback for all targets, including augments, was disabled by default if excursions occurred outside inhibit boxes. Visual and auditory information also reflected feedback if the mean of the median remained within 12-15 Hz SMR on the right, 16-20 Hz beta on the left, 21 Hz and 40 Hz, either separately or simultaneously using comprehensive portals.

Excursions outside augment boxes had no effect on other targets. Changes were monitored by NeuroCarePro snapshot spectral analysis comparatives. Results.

Medication titration began within 7-10 sessions. The only child not on medication maintained unprecedented straight A's and is returning to mainstream schooling. One student discontinued medication and four reduced to half the original dosage, two of which demonstrated consistent success in cognitive measures, transfer of benefit, and stabilization of medication reductions.

Two with severe theta/beta ratios were inconsistent in measures and returned to two-thirds and original dosage levels respectively with positive report the last two weeks of school. QEEG analysis echoed other measures in varying degrees consistent with previous findings (Chabot, Merkin, Wood, Davenport, & Serfontein, 1996).

Conclusions. Without a control group cross-validating results, a systematic simultaneous procedure under relatively controlled conditions with single case studies can be regarded as a between-person replication of objective and subjective data (Barabasz, Barabasz, & Blampied, 1996).

The present study replicates findings five out of six times in support of previous results found in neurofeedback research (Lubar & Lubar, 1984; Lubar, Swartwood, Swartwood, & O'Donnell, 1995; Linden, Habib, & Radojevic, 1996; Thompson & Thompson, 1998). That training effects were replicated with varying degrees of severity, on different types of psychostimulants, within a rotating schedule, following an adaptive protocol, increases confidence in the effectiveness of this comprehensive approach to neurofeedback for AD/HD.

One and possibly three-year follow up will assess longevity. Further research may confirm the seeming correlation between consistency of success and degree of theta/beta ratio.