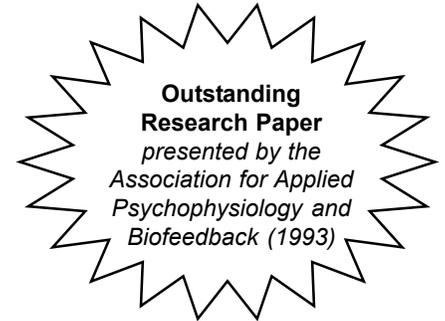




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**A CONTROLLED STUDY OF THE EFFECTS OF  
EEG BIOFEEDBACK ON COGNITION AND BEHAVIOR OF CHILDREN  
WITH ATTENTION DEFICIT DISORDERS (ADD)  
AND LEARNING DISABILITIES (LD)**

*Abstract of study published in Journal of Biofeedback & Self-Regulation, March 1996*  
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**PROBLEM**

Attention Deficit Disorder (ADD) is the most common psychiatric disorder of childhood. This disorder is estimated to impact approximately 5-10 percent of all children. Learning Disabilities (LD) have been described in the literature since the onset of formal education began. Recently, a biological basis for ADD and LD was postulated. These disorders are currently believed to be inherited. Together with the associated disorders of hyperactivity (ADHD) and Oppositional Defiant Disorder, it is estimated that 20 percent of all children are affected. The ramifications of these disorders are widespread, encompassing academic performance, parenting and peer relations.

EEG Biofeedback treatment for Attention-Deficit Disorders with or without hyperactivity, and Learning Disabilities has emerged as an important component in enhancing attention, cognitive functioning and behavior. Reports by several researchers of significant increases in I.Q. scores, grades and educational test scores suggest promise for this new procedure. However, all of the previous studies of EEG Biofeedback treatment with children lack appropriate control conditions and have extremely small sample sizes.

The current study utilized a two group experimental design, an EEG Biofeedback treatment and a waiting list control group, in order to evaluate the effects of EEG Biofeedback training. Eighteen children diagnosed with ADD, ADHD or LD, according to DSM-III-R criteria, between the ages of 5 and 15 were randomly assigned to one of the two groups. None of the subjects in either condition received psychotherapy or pharmacological treatment during their participation in the study. All subjects were measured at pre-treatment and post-treatment on a battery of tests including measures of intellectual functioning (Kaufman-Brief Intelligence Test/K-BIT) and parental reports of inattention, hyperactivity, aggressive and defiant behaviors. The treatment group (N=9) received 40 sessions, two times a week of EEG Biofeedback. The EEG Biofeedback was provided by computerized Autogenic A620 and Biocomp instrumentation using a bipolar placement at Cz and Pz. The EEG Biofeedback protocol reinforced the enhancement of Beta brain waves (16-20 Hz) and the suppression of Theta brain waves (4-81 Hz). Muscle tension artifact (EMG) was also suppressed as part of this training protocol. The control waiting list group (N=9) received no EEG Biofeedback. The EEG brain waves were shaped based on the individual subject's performance.

## RESULTS

At post-treatment the experimental group demonstrated a significant mean increase in composite I.Q. of nine points greater than the control group ( $p < .05$ ; see Table 1). The treatment group also significantly reduced inattentive behaviors as rated by parents ( $p < .05$ ; see Table 2). No significant differences were found for hyperactive or aggressive and defiant behaviors. Hyperactive behaviors declined in the experimental group to within normal limits after treatment. Furthermore, the subjects in the experimental group diagnosed with only LD had an average I.Q. increase of 20 points, although the number of pure LD subjects was not large enough to reach statistical significance. Since there were several dependent measures in this study, the risk of Type I error is greater and the results should be interpreted with caution.

**TABLE 1**

**Means and Standard Deviations for K-BIT I.Q.  
Changes Pre and Post EEG Biofeedback Treatment**

	Experimental Group		Control Group	
	M	SD	M	SD
Pre	101.1	26.2	99.1	13.2
Post	110.4*	21.2	100.0	10.1

\* $p < .05$

**TABLE 2**

**Means for Pre and Post Parent Ratings of  
Inattentive, Hyperactive & Aggressive-Defiant Behaviors**

	Exp Pre	Exp Post	Control	Pre Control Post
Inattention	11.33	*8.11	-12.00	12.44
Hyperactivity	8.56	-4.77	9.83	9.00
Aggressive	5.66	3.00	8.45	7.45
Defiant				

\* $p < .05$

## DISCUSSION

The results of this study lend support to the previous research of Lubar and Tansey. This study included a larger sample size than most of the previous studies; large enough to have adequate power to evaluate significant differences in I.Q. and inattentive behavior. The current study also utilized numerous controls, including: 1) a control group which received no treatment of any kind; 2) one type of EEG Biofeedback (Beta); 3) the same length of treatment (number of sessions); 4) reliable dependent measures to assess improvement and 5) randomized subject assignment.

The significant improvements in intellectual functioning as measured by increases in I.Q. scores may be the result of the treatment having an impact on the subjects' ability to attend and concentrate, and thus perform better on test tasks which comprise the K-BIT. The findings in this initial controlled study of EEG Biofeedback effects on ADD and LD children are quite promising, even though the cognitive (I.Q.) increases are somewhat smaller than the previous reported findings in non-controlled studies.

The application of EEG Biofeedback may prove to be an important new treatment component for Attention Deficit Disorder and Learning Disabled children. Further research utilizing double-blind placebo designs and larger sample size are needed to support and replicate these findings. In addition, larger sample sizes are needed to determine if this treatment protocol is more effective with children having only ADD, LD or a combination of both.

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