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EEG biofeedback for reading disability

(Edited/adapted from a longer article that also discussed traumatic brain injury, by David Dubin, MD,)

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Reading disabilities

Prevalence and costs

Reading disabilities present major challenges to the educational system. The estimated prevalence rate for learning disabilities is 15% of the student population [1], with 6.5 million children requiring special education in 2002 [2]. Approximately 63% of these special education children have specific learning disabilities or speech and language problems without a concomitant physical disability. Between 28% and 43% of inmates in adult correctional facilities require special education (versus 5% in normal population), and 82% of prison inmates in the United States are school dropouts [3]. Large financial and social costs are associated with programs to address learning disabilities. The federal government spent $350 billion over a 20-year period on special education programs [4], and New York City spends $55,300 per year for each incarcerated youth [3].

Efficacy research on intervention programs for students with learning disabilities

Despite the enormity of the social and educational problem, the **interventions currently used largely have been unsuccessful** in obtaining significant and meaningful results. In 1988, Lyon and Moats [19] concluded that ‘‘It is difficult, if not impossible, to find any evidence beyond testimonials and anecdotal reports that support the assumptions, treatment methods, and stated outcomes associated with medical and psycho educational models . . . [T]here is overwhelming empirical and clinical data indicating that medical and psycho educational models, as they are presently conceived and used, are inadequate for determining what and how to teach learning disabled students.’’

More recently, Birsh [20] concluded that ‘‘despite the widespread inclusion of multisensory techniques in remedial programs for dyslexic students and a strong belief among practitioners using these techniques that they work, there was little empirical evidence to support the techniques' theoretical premises.''

A comparison of the research results with current popular approaches indicates an average improvement of +0.34 standard deviations (SD) (standardized testing, 350 intervention hours, n = 48, control group) for the Orton-Gillingham program [21], an average improvement of 13% (standardized testing, 125 intervention hours, n = 171, no control group) for the Lindamood-Bell program [22], and an average +0.40 SD improvement (standardized testing, 100 intervention sessions, n = 130, control group) for the Fast ForWord program [23].

The Orton- Gillingham videotape obtained the same results as individual tutoring with this method. Increases in reading abilities can be accompanied by magnetic electroencephalographic images, however, showing that after an intervention of 80 hours of one-on-one instruction in phonologic structure, children with dyslexia increased their activations in left posterior superior temporal gyrus, left supramarginal gyrus, and angular gyrus [24].

Treatment effects of neurofeedback with reading disability

No outcome research published to date has addressed the efficacy of neurofeedback specifically for reading disability. Several studies of the effect of neurofeedback on attention deficit hyperactivity disorder (ADHD), however, have provided suggestive preliminary evidence that EEG biofeedback can result in improved cognitive function in general.

A case study of a 13-year-old child with ADHD demonstrates the effectiveness of 45 EEG biofeedback sessions [50]). There was marked improvement (tested at pre-intervention and at the twentieth and fortieth sessions) in processing speed and processing speed variability, a 19-point IQ increase (Kaufman Brief Intelligence Test), a 7.5 grade level increase in reading scores (Kaufman test of Educational Achievement–Brief Form), and significant behavioral improvements, as indicated by report of parents and patient. Follow-up at 17 months demonstrated that the behavioral and EEG changes were maintained.

With samples of learning disabled subjects and subjects with ADD and ADHD (total sample size n = 155), four independent researchers have demonstrated significant increases in IQ averaging 15 points (one SD) as a result of EEG biofeedback [51–54]. Only one study [51] used a control group, which did not demonstrate improvements on the IQ measures.

Clinical case examples

Learning disabled case reports

Case examples previously have been reported in peer-reviewed journals [73,74]. This report provides additional information and includes additional subjects. A control group used in the previously reported research did not demonstrate any significant gains as a result of practice effects or the passage of time between first and second testing.

Case 1 involves a 9-year-old girl whose parents reported a history of learning problems. Neither academic records nor formal educational or neuropsychological testing completed were examined to verify the presence of learning disability, however. She improved approximately 1069% in auditory memory (total memory score from 1.8–19.25) and 400% in reading memory (total score from 2.5–14) during the 40 sessions.

Case 2 represents another example of a child with significant history of reading problems. The parents had spent approximately (US) $25,000 in alternate standard treatment programs to improve his reading ability, which resulted in no significant gains.

After treatment his auditory memory functioning increased 589% from baseline by the end of the twenty-fifth session. He also improved on the standardized reading inventory (SRI) from the previous year 's testing (a standardized reading inventory measure administered by the school system) from a Lexile score of 360 before treatment to 753 after approximately 40 sessions, which is a much larger change than the typical improvement of 75 to 100 Lexiles per year.

His mother reported her impression of increased self-confidence, greater reading fluency, and ability to present information orally in school. There were no grades available for comparison from the resource room to which he was assigned.

Case 3 involved a 17-year-old subject with reading disability. After 20 sessions he increased his comprehension score (on the Burns Roe Reading Passages) from 45% to 90% (on alternate versions –eighth grade level) and from 20% to 70% (on tenth grade level). His performance on alternate versions of the Cognisys Story Recall Test had increased by 3 SD. On the Wechsler Individual Achievement Test reading comprehension subtest he attained a standard score of 99 for age and grade level.

Comparisons of effectiveness of interventions

For reading disability, the current programs show improvements that range from 0 to +0.40 SD on verbal skill measures, +0.60 to +1 SD for ‘‘standard’’ EEG biofeedback on attention and IQ measures, compared with the +3 to +3.3 SD changes for the EEG biofeedback (reading and auditory memory).

Summary

Our society has spent billions of dollars on efforts to remediate the cognitive and behavioral dysfunction in individuals with learning disabilities and TBI through various cognitive-based strategies.

The evidence accumulated to date indicates that few of these intervention efforts demonstrate efficacy. When change is measured for the more traditional approaches, the change scores typically result in improvements in the +0.00 SD to +0.50 SD range, often after lengthy intervention periods. Research completed to date and clinical reports show greater improvements with EEG biofeedback with these two groups.

The application of neurofeedback with reading disability is relatively recent. Although no published studies have assessed the efficacy of neurofeedback for subjects specifically diagnosed with reading disability, many studies have assessed the effectiveness of EEG with the ADHD population, which is known to have a high rate of co-morbidity for learning disabilities.

These findings suggest the possibility that neurofeedback specifically aimed at remediating reading disability would be effective. Clinical experience, as evidenced by the case examples, provides strong initial support for this suggestion. In particular, there is reason to believe that assessment and training under task conditions are likely to be fruitful.

Given the significance of the problems and the absence of proven alternatives for remediating reading disability, efforts to complete the needed research seem warranted. Given the absence of proven alternatives, clinical use of this intervention also seems to be warranted.

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