PROFESSIONAL ISSUES

A Cost/Benefit Analysis of Different Intervention Models for the LD/Special Education Student

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Abstract: *Since the decade of the brain was declared in 1990, there have been impressive advances in the area of neurodiagnostic instrumentation measuring the physical functioning of the brain and providing a deeper understanding of the functioning of the brain. However, scientific advances allowing us to alter the mind's functioning have not followed the speed and sophistication of these developments in assessment and understanding. This article presents a cost/benefit analysis across several remediation approaches for Learning Disabilities, and shows the superiority of one method. The method is the development of an activation QEEG database (0-64 Hz) to guide intervention protocols applying QEEG biofeedback to the treatment of learning disabilities. Outcome studies of this method have provided evidence of its ability to improve memory ability in the learning disabled student an average of 3 standard deviations.*

Introduction

The analysis of the educational/political situation of the special education student and of the effectiveness of current programs leads one to an array of prevalence figures, spiraling costs and research data, which demonstrate minimal effectiveness against a background of lack of accountability. Historically, school systems have produced minimal research reports on effectiveness of their programs, have relied upon tradition to determine procedures and have been unresponsive to the introduction of new research based approaches. For example, over 7,000 schools in New Jersey and New York, every state special education department, every private school/organization in the US (information available on web) specializing in the LD student were contacted (via mail, fax, or phone) regarding the scientific effectiveness of QEEG biofeedback and only one school has actively responded. It took six years before the New York City (NYC) board of education was willing to hear a presentation on the QEEG biofeedback approach. After hearing the presentation, the special education department decided to remain with the Orton-Gillingham method, the most expensive program with the least number of subjects reported in the research and one of the least effective programs.

Education Chancellor Klein (NYC) recently reiterated this concern in his desire to "move from a system that largely fails to provide effective education, that engages in multiple layers of evaluation, and that encourages excuses and non-accountability" (Moskowitz, 2003). Despite this message and concern over a 3.2 billion dollar budget for NYC special education, the NYC school system is hiring 1,000 teachers to implement the Orton-Gillingham method (Moskowitz, 2003) and Mel Levine's Schools Attuned program. The results obtained with individual instruction in the Orton-Gillingham method are matched by use of the Orton-Gillingham video tape (Oakland, et al., 1998). Dr. Levine's approach instructs teachers in their approach, with no direct intervention with the students. Research reports either exclude the special education student (Ingemi, 2003), provide data in terms of decreased child study team referrals or classifications (Flores-Brother, 2003), or are difficult to interpret in terms of individual changes or traditional scientific criteria (control groups, maturation effects, confounding effects, etc.) (Carey, 2003).

The estimated prevalence rate for dyslexia is 5-17% of the student population (Temple, 2002). There were 6,272,007 million children who received services for special education needs in 2002 (National Clearinghouse for Profession in Special Education, 2001). Approximately 63% of these children who have specific learning disabilities or problems do not have a secondary disability (Chambers, 2004a).

The federal government has spent between $460 to $500 billion on Special Education since 1975 (Wood, 1998) During the 1999-2000 period 50 billion dollars was spent on special education with an average incremental cost of $8,080 over the cost of educating a normal child (Chambers, 2004b). The additional spending for a child with a specific learning disability averaged $3,500 (Chambers, 2004a). Some 62% (or 31 billion) of the special education expenditures go to direct instruction (Parrish, 2001). The percentage rise in special education costs from 1982 to 1989 was 117% compared to an increment of 67% for general education (Parrish, 2000).

An astonishing 95 percent of theIDEA enrollees (Individuals with Disabilities Education Act) stay in Special Education remedial programs until they leave school (Wood, 1998). "In short, an incredible remedial education army of 1.2 million Title I and Special Education teachers, aides, and professional supporters — approaching the size of the U. S. Armed Forces — is trying to teach remedial reading, math, and language arts to 16 million supposedly disadvantaged and disabled students, who comprise 36 percent of the nation's 45 million public students. And though the 1998 price for their remediation services will probably exceed $65 billion, they are not succeeding and they have never succeeded" (Wood, 1998).

The figures accompanying this article present a cost/benefit analysis using published research for current intervention approaches to these students. This analysis employs only research reports providing data that could be analyzed with respect to standard deviations of change. The tutoring intervention did not provide information in SD units and was not included in Figures 3 and 4. Table 1 present the numerical values underlying figures 2, 3 and 4. Figures 3 and 4 are double Y axis graphs. These two figures present simultaneous information on two variables across the different intervention models. Initial and post evaluation costs were not calculated for the figures, as these figures are generally not provided. The figures employ a $35 an hour intervention cost across all models, as a rough estimate of what it would cost to implement a program in a school environment (salary plus benefits). The cost figures for New Jersey and Chicago public schools were drawn from public information sources. The question mark indicates that there is no information available on the effectiveness of these programs.

The “activation QEEG guided” label reflects a specific neurotherapy approach (Thornton, 2000, 2002; Thornton & Carmody, in press) that employs an activation QEEG database to determine the intervention protocols. The deviation of the subject’s electro-cortical activity from normative database values are determined at various cortical sites (in particular for those variables that correlate positively with task performance), and are the focus of the intervention protocols.

The research reports employed differing measures of outcome. Figure 1 presents the methods, the type of variable assessed (in parenthesis), and the effect in standard deviation units. The standard neurotherapy intervention label refers to protocols which reward beta magnivolts (in the 13 to 32 Hertz range) and inhibit theta magnivolts (in the 4 to 8 Hertz range) along the sensorimotor strip (C3-Cz-C4). The effect in standard deviation units was averaged across attention and IQ measures.

To address the question of relative effectiveness the following ratio was applied: # of intervention hours / SD effect. This formula reflects how many hours are required to produce a one standard deviation (SD) amount of change, assuming that effect would continue at the same rate of progress. The lower the number the more effective the treatment. The formula generates the following indices: Orton-Gillingham method - 1029; Lindamood-Bell - 961; FastForWord - 250; Standard QEEG - 53; Activation QEEG - 13. Thus the activation QEEG approach is 77 times more effective than the Orton-Gillingham method, 72 times more effective than the Lindamood-Bell, 19 times more effective than the FastForWord program, and 4 times more effective than the standard QEEG approach.

Table 1. Cost structure of programs and effectiveness in standard deviation units, employing a $35/session staff fee and number of sessions reported in theresearch literature for LD and Special Education students.

Method	# Sessions	Cost	SD Effects
Orton-Gillingham[2]	350	$12,250	0.34
Phonics[10]	180	$6,300	0.00
Lindamood-Bell[3]	125	$4,375	0.13
FastForWord[4]	100	$3,500	0.40
Tutoring[9]	75	$2,625	grade level reading
Avg. Incremental Cost of Special Ed. Student[11]	?	$8,080	?
Addt. Spending for Specific LD[12]	?	$3,500	?
Standard QEEG Biofeedback[5,6]	40	$1,400	0.75
Activation QEEG Guided Neurotherapy[7,8]	40	$1,400	3.00

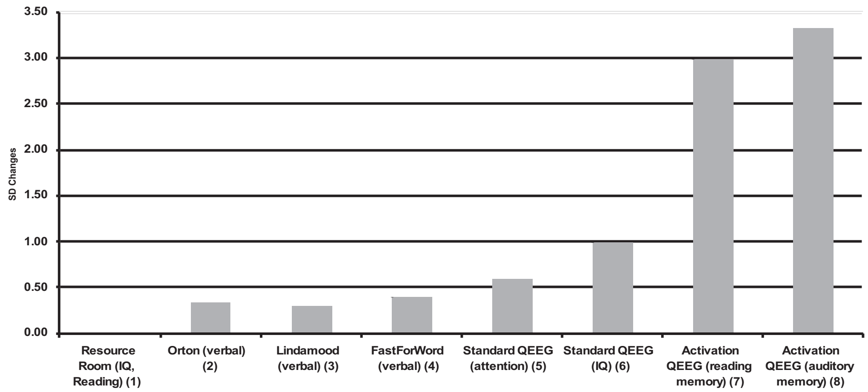


Figure 1. A comparison of different approaches (instandard deviation units-SD) with respect to differentabilities assessed post treatment.

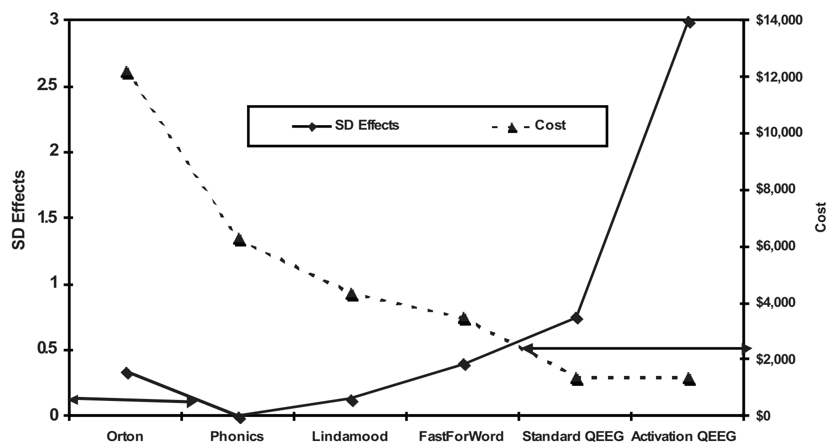
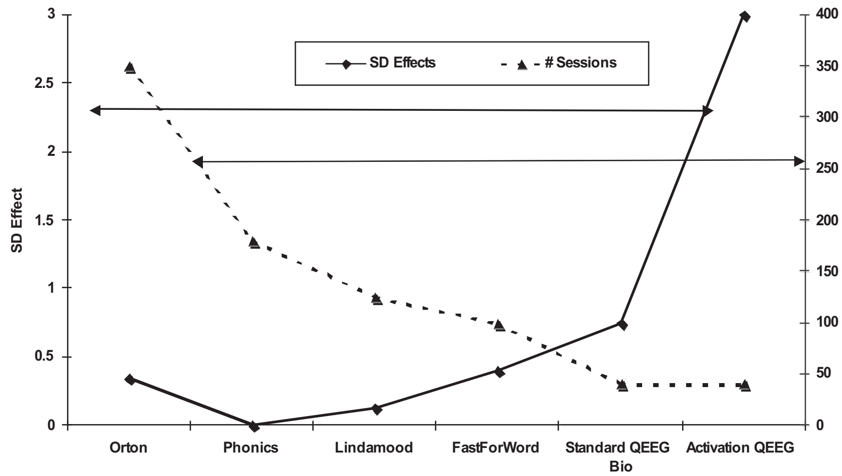


Figure 2. Cost structure/program and changes in standard deviation (SD) units, showing effectiveness of programs for LD/special education children.



Conclusion: Activation QEEG guided neurotherapy is the most effective program with least # of interventions

Figure 3. Number of sessions and standard deviation (SD) effects by program type.

Conceptual Differences in Approaches

The interventions presented in this analysis can be conceptualized under two general categories – psychoeducational and psychophysiological. The psychoeducational approaches (Orton-Gillingham, Lindamood-Bell, FastForWord, tutoring, phonics) generally employ an approach based upon research concepts and results emanating from the educational and psychological field. For example, in the reading disability literature deficits are reported in phonic ability, rapid naming, etc. It is then logically assumed that if the interventions are directed towards the reported deficits (phonics), then the ability (reading) will improve. The multisensory Orton-Gillingham method states that dyslexia is caused by neurophysiologically-based disabilities that may be helped by multisensory teaching techniques that provide linkages between the visual, auditory and kinesthetic senses. The approach concentrates on fusing smaller units (letters, sounds, and syllables) into more complex wholes (words). The Lindamood-Bell intervention model follows the five components of reading – phonemic awareness, phonics, fluency, vocabulary and comprehension as specified in the No Child Left Behind Act (lindamood-bell.com). The program is conceptualized as a sensory-cognitive approach, which involves imagery as well as other exercises in the interventions.

Fast ForWord Language is a computer based reading intervention program consisting of seven adaptive exercises to improve auditory and language processing by using nonlinguistic and acoustically modified linguistic speed (rapid frequency transitions in speech are slowed and amplified). Oakland, Black, Stanford, Nussbaum, Balise, et al. (1998, p. 336) stated that a review of the treatment literature on dyslexia "reveals a limited number of scientifically sound and clinically relevant reports of significant treatment effects."

The current scientific trend in this area is to examine the physical response of the brain in learning impaired subjects and changes as a result of treatment. A number of fMRI neuroimaging studies have compared cortical activation patterns under reading related tasks in readers with dyslexia (DYS) and control groups of nonimpaired readers (NI) (Shaywitz, Shaywitz, Pugh, Fulbright, Constable, Mencl, et al., 1998; Shaywitz, Shaywitz, Pugh, Mencl, Fulbright, Skudlarski, et al., 2002; and Shaywitz, Shaywitz, Fulbright, Skudlarski, Mencl, Constable, et al., 2003). This series of studies showed that NI adults increased their activation in posterior superior temporal gyrus, angular gyrus and supramarginal gyrus as the task demands increased from orthographic comparisons to phonological comparisons (Shaywitz, et al., 1998). In contrast, DYS adults showed over-activation in response to increasing task demands in anterior regions including the inferior frontal gyrus. While NI readers showed activation of a widely distributed system for reading, the DYS readers had disrupted activity in the posterior cortex that involves traditional attentional, visual and language areas. Temple, Deutsch, Poldrak, Miller, Tallal, Merzenich, and Gabrieli (2003) demonstrated a correlation ($r = .41$, $p < .05$) between increased MR signal in left temporo-parietal region and change in total language score as a result of the FastForWord program interventions.

QEEG Biofeedback

The QEEG biofeedback/neurotherapy approach continues this trend but assumes that the underlying brain development problem is also reflected in the electrophysiological signals and can be most effectively addressed by a simple operant conditioning paradigm (reference numbers on Figure 1 refer to numbered footnotes). The learning disabled subject is trained via QEEG biofeedback to modify electrical activation patterns in the cortex. The standard QEEG biofeedback research model has indicated that increased (above normal values) magnivolt levels of delta (0-4 Hertz) and theta (4-8 Hertz) activity are negatively related to general cognitive functioning (IQ measures, attentional abilities) and beta magnivolts (13-32 Hertz) levels are positively correlated with these measures. The locations addressed have traditionally involved the sensorimotor strip (an area historically associated with the reception of sensory signals and efferent motor activity).

The "activation QEEG" approach is a further refinement of the standard QEEG biofeedback approach. It addresses the cognition/electrophysiological relationship problem from a broader perspective. The model asserts that the electrophysiology of the brain differentially responds to different tasks in terms of locations, connection patterns and frequencies. In one cognitive task a particular variable may be detrimental to performance while in another task the same variable may aid performance. Therefore, improvement of a specific cognitive ability resides with the improvement of the task relevant variables. The approach also includes an analysis of the higher frequency range (32-64 Hertz), a range often excluded in the more traditional eyes closed databases. As can be discerned from the figures provided, this approach appears to provide excellent results for the abilities measured (auditory and reading memory) — improvements of 3 standard deviation units or more (Thornton & Carmody, in press).

The conceptual approach represented by the QEEG biofeedback model is a paradigm shift in the treatment of cognitive difficulties. The model asserts that the most effective method to address these problems is through a direct operant conditioning of the internal physical parameters of brain functioning, and not through externally originating verbal strategies or interventions. This conclusion is supported by the research to date and presents a challenging opportunity for our educational system and political structure to implement.

Conclusion: Potential Cost-Savings

Many critics of QEEG biofeedback have labeled it as an expensive approach, beyond the means of the average family. The present article has shown that QEEG biofeedback is actually a more effective and less expensive approach than many of those interventions undertaken daily in our school systems. Yet these current relatively ineffective interventions are funded annually without discussion.

We will close with an estimate of the cost-savings possible, if activation QEEG guided biofeedback treatment could be made available for all of those incoming six year old special ed students for whom it is appropriate. If one assumes a successful remediation of the cognitive deficits through QEEG biofeedback, then the cost-savings would come in the elimination of the remaining years of costly special education services. Providing effective services for the incoming first grader with cognitive deficits, eliminates the need for eleven years of additional special education services.

Table 2 presents the category breakdown of the special education students who could be addressable with QEEG biofeedback. The specific learning disability presents the largest category (48%). This is the group which was addressed with the activation QEEG approach. The proper implementation of the activation QEEG guided neurotherapy approach would require the initial evaluation and 40 sessions. Additional sessions may be required for certain subjects. Assuming an initial rough cost estimate of $5,000 for QEEG biofeedback treatment the first year that a cognitively impaired student (age 6) enters the program, the annual savings would be $16,352,055,500 (T. Thornton, 2004).

In financial terms the present value of these annual savings would be $327,041,110,000 (T. Thornton, 2004). The present value statement can be understood as follows: Under the general principles of mathematical finance theory, one can equate an annual flow to a present value. The present value is today's value equivalent to the annual flow (in pertetuity) at a current rate of interest. The present value of an annual flow in perpetuity at the current rate of interest is the annual flow divided by the annual rate of interest. This is a mathematical formula. A reasonable current rate of interest is 5%. Hence, today's value of the annual savings of the technology is the annual savings divided by 5%. Please refer to mathematical finance textbooks for further clarification. This is a fact without question. These calculations are, of course, rough estimates. This financial analysis does not take into account the change in quality of life and other social and economic consequences. One such effect would be on the criminal justice system. Between 28% and 43% of inmates require special education in adult correctional facilities (vs. 5% in normal population) and 82% of prison inmates in the U.S. are school dropouts (Winter, 1997).

Table 2 -From Data tables (IDEA data tables for OSEP)

	Number	% of Total
Total Special Education (IDEA) – ages 6-12 – 2002-2003	5,946,202	
Specific Learning Disabilities – ages 6-12	2,878,334	0.48
Specific Learning Disabilities – with no secondary disability (63%)	1,813.350	0.30
Traumatic brain Injury – ages 6-12	21,488	
Speech or Language Impairments – ages 6-12	1,112,142	0.19
Mental Retardation – ages 6-12	593,612	0.10
Developmental Delay – ages 6-12	58,265	0.01
Total Addressable	4,663,841	0.78

Notes

These notes provide the sources providing data utilized in Figure 1.

1. Orlando & Rivera (in peer review)
2. Oakland, Black, Stanford, Nussbaum, & Balise (1998)
3. Lindamood-Bell (2004.)
4. FastForWord (2004).
5. Kaiser & Othmer (2000); Rossiter & LaVaque (1995); Tinius & Tinius (2000).
6. Linden, Habib, & Radojevic (1996); Othmer & Othmer (1992); Tansey (1991); Thompson & Thompson (1998).
7. Thornton & Carmody (in press).
8. Thornton (2000, 2002); Thornton & Carmody (in press).
9. Vellutino (1996)
10. Foreman (1997, 1998)
11. Chambers (2004b)
12. Chambers (2004b)

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