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The Effect of ROSHI Protocol and Cranial Electrotherapy Stimulation on a Nine-Year-Old Anxious, Dyslexic Male with Attention Deficit Disorder: A Case Study

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ABSTRACT. This case study describes diagnosis and treatment of a nine-year-old male with poor reading achievement, attention deficit disorder, and severe generalized anxiety disorder. The goal of the treatment

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was to significantly increase this young man's reading achievement, reduce his anxiety to a normal level, and to reduce his ADD symptoms so he could concentrate at a normal level for his age and sex. Psychological testing was administered and QEEGs were recorded before and after treatment intervention. The patient was treated using the ROSHI Complex Adaptive Protocol, Cranial Electrotherapy Stimulation, and Project Read Reading Program. This multimodal treatment lasted six months with follow-up testing administered 15 months after initial diagnostic testing. Before and after objective psychological test results and QEEG changes indicate significant improvement in reading achievement, significant math and spelling achievement, significant reduction in anxiety, and significant reduction in ADD symptoms.

KEYWORDS. Roshi, neurotherapy, Alpha-Stim SCS, QEEG, cranial electrotherapy stimulation, anxiety, WISC-III, Project Read

INTRODUCTION

The participant was a nine-year-old male diagnosed with a Generalized Anxiety Disorder and Attention Deficit Disorder (ADD). He also displayed poor scholastic achievement, with his greatest weakness in reading. He had been prescribed Ritalin, which had little effect on his achievement. Previous psychological testing revealed the absence of a learning disability. He frequently reported stomachaches and headaches, which would dissipate if he was allowed to stay home from school. He rarely completed assignments at home unless his parents worked with him one on one. He was nervous, withdrawn at times, and acted in a disorganized manner.

At the time of testing the participant was in the third grade in a private school. He was in a classroom of six to seven students, where he received sporadic individual attention from his teacher. His mother and father reported helping him with his schoolwork on a regular basis. He was tutored twice a week for one-hour sessions and worked with a speech and language pathologist three times a week for 30 minutes a session. The teacher felt that a speech and language pathologist would be able to help him with word recognition and the pronunciation of letters and words. He spoke very little in class and she thought it was due to the fact that he had trouble speaking. Previous intelligence testing indicated that he may have borderline intelligence. Developmentally, the parents reported no problems until he went to kindergarten and began to do poorly academically. They tried different teachers and psychologists without success.

METHOD

Tests Administered

Two batteries of psychological tests were administered to the participant. Both batteries consisted of the Wechsler Intelligence Scale for Children-III (WISC-III; Wechsler, 1991), Wide Range Achievement Test-III (WRAT-III; Wilkerson, 1993), Bender Visual Motor Gestalt Test (Bender, 1946), and Psychophysiological Stress Profile (Schwartz & Andrasik, 2003). The first battery was administered prior to the treatment intervention. The second battery was administered fifteen months after the original evaluation and immediately after treatment. A QEEG was recorded at the same time as the first battery of tests before treatment intervention, and again after the treatment period at the same time as the second battery of psychological tests.

QEEG Assessment

A fitted electrode cap with leads placed according to the International 10/20 system was applied to achieve a standardized 16-channel Mindset (Gupta, 1993) EEG recording. A linked ears referential montage was obtained with FP1, FP2, F7, F3, F4, F8, T3, C3, C4, T4, T5, P3, P4, T6, O1, and O2. Data was acquired at a sampling rate of 512k with less than 10 Ohms at all sites. QEEG recordings included an eyes-closed recording, an eyes-open recording, and a recording during a visual-spatial task. Digitized EEG data was analyzed with an automated system to remove gross artifact. The remaining EEG record was visually inspected to remove any remaining artifact. Atypical transients in the EEG signal were noted for subsequent analysis during this procedure. The artifacted EEG data was then analyzed using the SKIL QEEG analysis software and database (Sterman & Kaiser, 1999). QEEG analysis included data tables, spectral maps, individual frequency band topometric analysis, topographic maps, and covariance analysis. Statistical analysis compared participant data with a normative database that corrects for time-of-day and state transition effects. Topographic brain maps showing covariance between all sites at relevant frequencies were compared with a normative database to evaluate the status of functional cortical interactions.

Intervention

At the meeting with his parents to discuss diagnoses and results of initial psychological evaluation of their son, the parents decided that their son's goals should be to reduce his anxiety and ADD symptoms and make significant improvement in his reading achievement. It was decided by the parents to begin a treatment program that consisted of hiring a private reading teacher to work in the private school with their son two to three hours per day, five days a week using the Project Read Reading Program (Wright & Groner, 1993). This was my suggestion since the Project Read Program is a research-based mainstream language arts program for students who need a systematic learning experience with direct teaching of concepts and skills through multi-sensory techniques. I had seen the program used very successfully for a number of years in my consultation to a number of school districts when I found a student that could not learn reading skills in the normal phonetic approach, but had no history of brain injury. The program involves phonology, linguistics, reading comprehension and written expression.

In addition, it was felt that the Ritalin was not working so we would try Adderall. Their son had severe side effects to Adderall so his medication was quickly changed to Concerta. My suggestions to use neurotherapy to supplement the work of the teacher and the Alpha-Stim SCS (Kirsch, 2000) to help him relax and also help with the ADD symptoms were rejected as too expensive at that meeting. I continued to monitor him, encourage him and counsel him once a week using good cognitive techniques (Tinius & Tinius, 2001).

However, after three months their son showed no improvement in achievement scores, reading achievement, or anxiety level. He also stated that he felt that he was "not any better." His parents noticed that he was nervous, kept changing the subject when he talked with them, and was quite disorganized in his school work and in his thinking. After three months of no significant change in any of the areas where they had set goals, the parents decided to try a plan that I suggested initially. ADD medication was discontinued and we initiated a *revised* treatment plan that consisted of continuing to use the reading teacher in the same manner using an Alpha-Stim SCS morning and evening for anxiety and reduction of ADD symptoms, and using the ROSHI/BrainLink® neurotherapy device (Davis, 1996) twice a week for one hour during the time the teacher was working with their son in order to help him to concentrate on the task. I continued to counsel him weekly. This treatment plan was implemented for the next six months, which corresponded to the end of the school year.

The Alpha-Stim® SCS is a prescription medical device categorized as a cranial electrotherapy stimulator (CES). It is authorized by the FDA to be marketed for anxiety, depression and insomnia. It uses up to 500 microamperes at variable frequencies applied via ear clip electrodes for 20 minutes to one hour. Several EEG studies have demonstrated a normalization of brain electrical activity (Mercola & Kirsch, 1995; Kennerly, 2003; Smith, 1999) and neurochemical research in humans and animals has shown CES to increase serotonin and beta-endorphins (Kirsch, 2002).

The patient began to use the Alpha-Stim SCS cranial electrotherapy stimulator for one hour in the morning before school and one hour in the early evening. The patient's parents monitored his use and reported back to me at least once a week. They stated that he looked forward to using the device after school to "settle down." It was harder to get him to use it in the morning, but they found him "easier to work with after he used it."

The ROSHI/BrainLink® neurotherapy device was administered by the author for one hour intervals twice per week during the time that the teacher was working with him. The ROSHI/BrainLink® is a real-time two or four-channel EEG spectrum analyzer with light, sound and electromagnetic EEG neurofeedback. The screen is modeled after the Mind Mirror® (Davis, 1996) but with a response time of 8 to 12 milliseconds. The software uses the BrainLink® Patton (Davis, 1996) protocol a well as 15 other preprogrammed protocols and can be used in a discrete mode and/or a complex adaptive visual stimulation mode. The theory is that since this pulsed system is designed to "fake" the optical system of the brain into "thinking" that these are neuronal data and since the brain is inside this closed loop system, the neurology has the task of correcting for this "intrinsic" error. Since this machine is marketed only as a meditation and peak-performance trainer and not as a medical device, its task is to "normalize" and stabilize a subject's brain electrical activity for an improved, clear and stable thinking performance (Ibric, 2001).

In this ROSHI/BrainLink® treatment the complex-adaptive protocol was used. I asked Chuck Davis, the creator of the ROSHI/BrainLink® and the complex-adaptive protocol to explain what happens to the individual mind when that protocol is used with the ROSHI/BrainLink. Chuck Davis stated (personal communication, February 19, 2005) that in the complex adaptive protocol " . . . the raw brainwaves (EEG) are fed through an algorithm that treats the complex EEG as chaos and modulates the LEDs accordingly. Thus the intensities (of the LEDs) are constantly 'adapting' to neuronal conditions in real time. The brain is an unpredictable, complex, and 'chaotic' system. The ROSHI processes the brainwaves from this system using fractal-type math, then responds, in milliseconds to changes in them. What the user's brain sees in the LED goggles is a complex, constantly changing flicker based on changes in his or her brainwaves. It's as though the brain is 'seeing' itself. To the brain, these signals measured at the scalp, are treated as 'error.' The brain being an intrinsically error correcting system proceeds to do its internal error correcting work. Unlike earlier systems, the ROSHI disentrains as well as entrains brainwaves towards flexibility. Thus it can down train, or reduce certain frequencies such as the slow waves associated with ADD, ADHD or brain injury, as well as up train, or bring into balance, the desired frequencies." I felt that this would be the best modality to use with this young man since it would produce more flexibility in his thinking and thus he could learn what the teacher was introducing quicker and easier. Depression was successfully treated using the ROSHI/BrainLink® utilizing the discrete protocol (Hammond, 2000b), but I felt that the complex-adaptive would work better on a non-depressive problem like this one.

The active sensors were placed at FP1 and FP2 and the remaining ground and reference sensors placed at the mastoid behind his ears (Ibric, 2001). The ROSHI/BrainLink® complex adaptive protocol was administered during the participant's tutoring sessions with the Project Read teacher. Clear lenses goggles with lights at the edges were used for the SMR complex adaptive visual entrainment. SMR magnetic stimulation was provided via ROSHI/BrainLink® on top of the head at approximately C3-C4. Fifty-five (55) ROSHI/BrainLink® sessions were provided to the patient over a six-month period. This entire *revised* treatment period was six months starting in December and ending in May at the end of the school year.

RESULTS

Pre-Treatment

Before treatment when compared to individuals his own age, the participant scored in the very low range in Digit Span of the WISC-III (short-term memory, span of attention, and immediate auditory sequential memory). His Information subtest of the WISC-III (long-term memory, cultural knowledge, and knowledge of background information) was in the below average range. The participant scored in the below average range in the Similarities subtest of the WISC-III (his ability to discriminate relationships between things and ideas) and Arithmetic subtest of the WISC-III (the performance of simple mental computations). He also scored below average in the Vocabulary subtest of the WISC-III (general language background, verbal definition of words, word use, and verbal fluency). His Comprehension subtest on the WISC-III (self-direction, practical judgment, and practical social knowledge) was in the average range.

When compared to individuals his age, the participant scored in the average range in the Picture Arrangement subtest of the WISC-III (social planning and alertness, anticipation of social situations, and action sequencing). He scored in the average range in the Picture Completion subtest of the WISC-III (visual alertness, attention to detail, visual powers of concentration, visual closure, and constructive visual imagination). He also scored in the average range in Coding (psychomotor speed, learning of new non-verbal material, immediate visual recall, and visual rote learning). His ability to scan and see relationships was also average. He scored in the above average range in Block Design (visual problem solving and concept formation and in the use of visual-spatial relationships).

Achievement testing revealed that he was not able to write his name and could not state his birthday. He did not visually recognize all the letters of the alphabet and was not able to recognize words visually. He was essentially dyslexic, reading at the Kindergarten eighth month level. He could not associate phonetic sounds with letters or groups of letters. His computation math skills were at the second grade level. The patient's grade achievement in spelling was approximately two and a half years below his current grade level. He could calculate addition and subtraction, but had considerable difficulty with multiplication and division.

Psychoneurologically, the patient was functioning below normal. Bender Gestalt Testing indicated a mild amount of distortions, asymmetry, rotations, blunting, compression and overlapping, with the most significant deficits found in asymmetry and overlapping. There were sufficient soft signs detected to indicate mild organic involvement and neural irritability. His spatial recall score of three on the Bender Gestalt suggests that his immediate spatial memory was comparable to that of a six-year-old. Psychophysiological measures (EDR of 18.8 micromhos) indicated that the participant was experiencing significant anxiety (Kirsch, 1999).

The baseline QEEG indicated significant slow wave activity at FP2 and F8 (Kennerly, 2003) in all three recording conditions. During the visual-spatial task, significant asymmetries were noted in SMR and beta frequencies.

Post-Treatment

Post-treatment testing (completed 15 months after the initial evaluation) indicated significant improvements in a number of areas (see Table 1). The client's overall IQ increased one standard deviation (97 to 112). Freedom from distractibility, particularly auditory concentration, significantly increased from baseline (75 to 96). The client showed significant increases in the Information subtest of the WISC-III (knowledge of background of information) and significant improvement in Similarities (abstract thinking ability), which was further supported by reports from his reading tutor and classroom teacher. Both of these gains seemed to be influenced by an increase in auditory processing.

His WRAT Word Recognition Score (ability to pronounce written words) significantly increased from a kindergarten to third grade level and his Math score (a visual paper and pencil test) significantly increased from a second to fourth grade level. His Spelling (verbal) also significantly increased from a first to fourth grade level. His Bender Gestalt Results displayed significantly fewer discrepancies in the ability to reproduce figure drawings and an increase in the number of figures that he was able to remember.

He also became less tense. His psychophysiological stress profile showed less micromhos of resistance in his body (18 down to 8 micromhos). The blood flow in his fingers became more normal (81.4 to 91.9 F). The tension in his frontalis muscles also showed normalization (below 2.5 microvolts). These increases in relaxation are further supported by reports from the client and his parents. He was not getting stomachaches, headaches, etc., and was no longer trying to stay home from school.

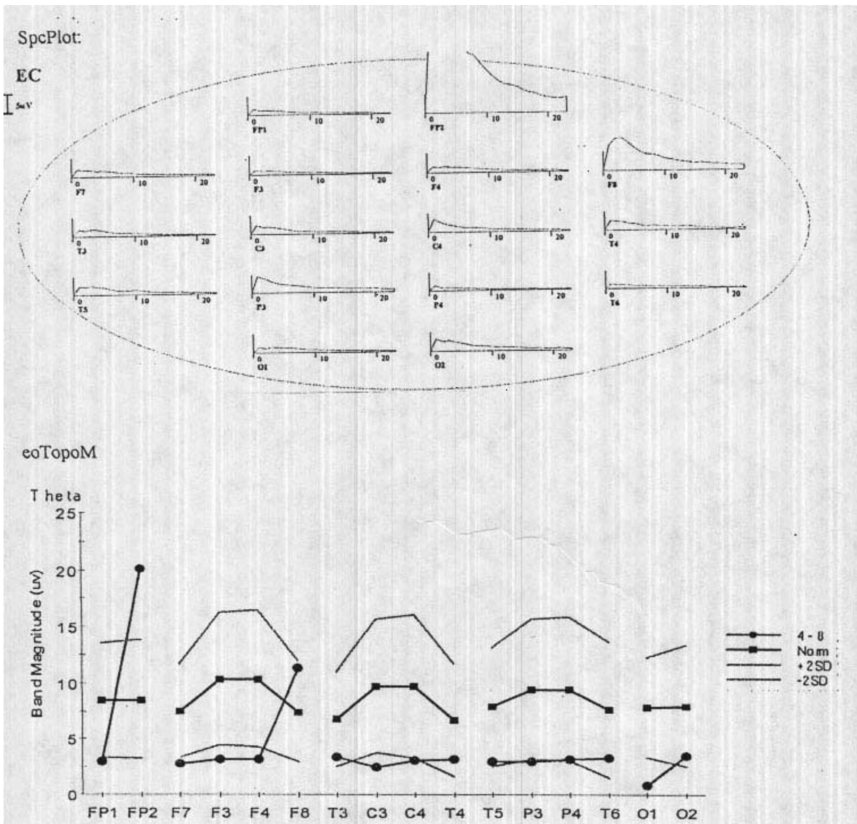
Pre- and Post-Treatment QEEG Comparison

Comparison of pre-treatment and post-treatment QEEG data shows a normalization of slow wave activity seen at FP2 and F8 (Niedermeyer, 1999a). In comparing Figure 1 to Figure 2, one can see how the specific plot in the eyes-closed segment improved greatly from pre-treatment to post-treatment. This is also true with the eyes-open topographical seg-

TABLE 1. Test Scores

	BEFORE TREATMENT	AFTER TREATMENT
WECHSLER INTELLIGENCE SCALE FOR CHILDREN-III		
FULL SCALE I.Q.	97	112
VERBAL COMPREHENSION	91	96
FREEDOM FROM DISTRACTIBILITY	75	96
PERCEPTUAL ORGANIZATION	104	104
PROCESSING SPEED	104	101
VERBAL I.Q.	90	106
INFORMATION	6	8
SIMILARITIES	8	10
ARITHMETIC	8	9
VOCABULARY	8	8
COMPREHENSION	11	11
DIGIT SPAN	3	9
PERFORMANCE I.Q.	105	116
PICTURE COMPLETION	10	10
CODING	11	11
PICTURE ARRANGEMENT	8	9
BLOCK DESIGN	9	14
OBJECT ASSEMBLY	10	9
SYMBOL SEARCH	9	9
WIDE RANGE ACHIEVEMENT TEST-III		
WORD RECOGNITION (GRADE):	K.8	3.8
ARITHMETIC (GRADE):	2.4	4.1
SPELLING (GRADE):	1.0	4.0
CURRENT GRADE LEVEL (GRADE):	2.6	3.9
BENDER VISUAL-MOTOR GESTALT TEST		
DEVELOPMENTAL AGE (YEARS):	8	10
PASCAL-SUTTEL Z SCORE:	45	27
KOPPITZ BRAIN INJURY SCORE:	2	1
SPATIAL RECALL SCORE:	3	6
PSYCHOPHYSIOLOGICAL STRESS PROFILE (PATIENT'S AVERAGES)		
Cardiovascular Response (CV)	81.4°F	91.9°F
Glandular Response (EDR)	18.8 mocromhos	8.8 mocromhos
Electromyograph (EMG)	4.5 mvolts	3.5 mvolts

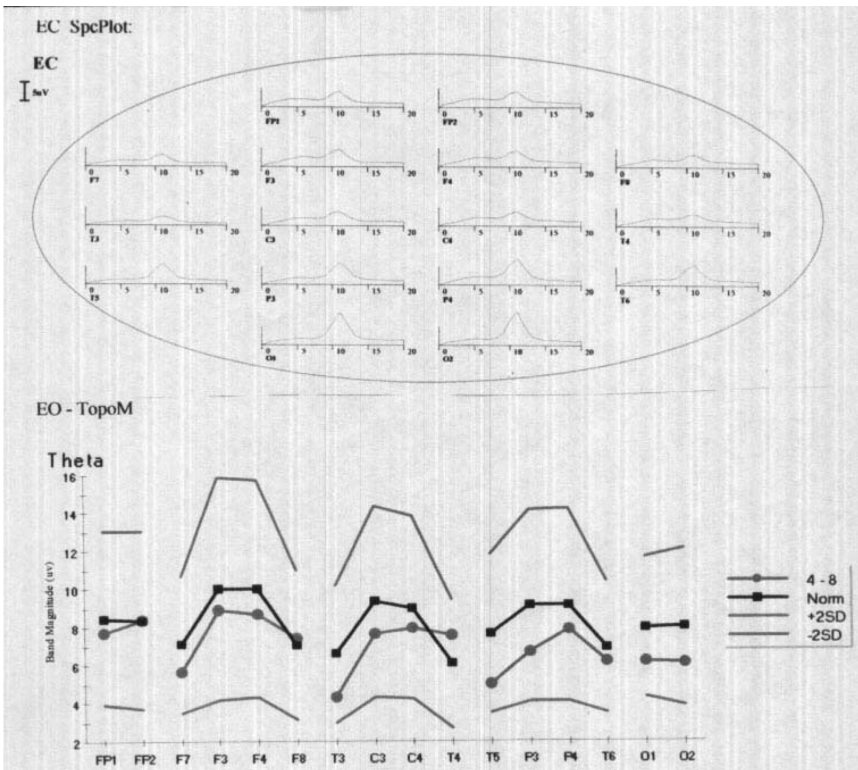
FIGURE 1. Pre-treatment QEEG.



ment of Figure 1 and the topographical segment in Figure 2 when comparing it to the norms as well as the information we have concerning normal EEGs (Brazier & Finesinger, 1944).

Table 2 and Table 3 show the Z-score data before and after the treatment. SMR F8 was the only Z-score that was not within the normal range in the post-treatment QEEG, but there were 15 Z-scores (in bold print) that were not within the normal range in the pre-treatment QEEG. This normalization was also seen in both the spectral analysis and in the topographical map as a significant decrease in delta, with some decrease in theta. Post-treatment brain maps show low delta and more normal activity in the alpha and theta bands. SMR and beta amplitudes increased during treatment in the eyes-closed condition. However, after treatment

FIGURE 2. Post-treatment QEEG.



there was no significant increase in SMR or beta amplitudes. At baseline, SMR and beta asymmetries were noted during a visual spatial task. At the post treatment, there were no beta or SMR asymmetries during task.

DISCUSSION

In my experience, I have rarely seen an individual improve his IQ or learning potential a full standard deviation in the positive direction. Table 1 shows the results of the before and after WISC-III results, the WRAT-III results, Bender Gestalt results, and the Psychophysiological Stress Profile results. This appears to be a dramatic and unexpected treatment effect. Increases in freedom from distractibility and improvements in auditory concentration are dramatic as well. Both his reading and classroom teacher reported an increase in abstract thinking and dealing with concepts. They both stated that he was picking up ideas in class much faster and was asking questions on a conceptual basis much more often. They also felt that his memory appeared better. This could account for the increase in his background of information. He and the teachers also reported that he was more relaxed and his parents reported positive behavioral changes, which seemed to be indicative of his decreased anxiety.

Overall, this young man's learning potential improved from very average to essentially above average. The ROSHI/BrainLink® may have helped this young man pay attention better since research indicates that neurotherapy is useful in working with ADD (Hammond, 2000a). These results appear to indicate that the Alpha-Stim SCS treatment may have positive effects on concentration and/or reduction in anxiety (Overcash, 1999). The ROSHI/BrainLink® may have relaxed the patient and/or increased his ability to concentrate thereby generating a "peak performance" while treating him as the Project Read teacher instructed him. Further, these brain wave frequencies and flexibility changes appear to have continued after the ROSHI/BrainLink® was discontinued because his achievement has been maintained over the past two years. Environ-

TABLE 2. Pre-Treatment Eyes Open Z-Scores

	Delta	Theta	Alpha	SMR	Beta 1	Beta 2
FP1	**4.2**	**2.7**	−1.0	−0.6	0.5	1.2
FP2	**5.0**	**2.2**	−0.7	−0.1	0.9	**2.3**
F7	1.6	0.6	−0.4	1.2	**2.6**	**2.0**
F3	1.5	−0.5	−1.3	−0.5	0.9	0.1
F4	1.2	0.4	−1.4	−0.5	1.2	0.7
F8	**2.8**	0.5	−0.3	1.0	**2.3**	**2.5**
T3	1.2	−1.1	−0.8	−1.0	0.6	0.3
C3	**3.5**	1.8	−1.4	−0.9	0.5	0.3
C4	1.2	−0.3	−1.0	−0.3	1.8	**2.3**
T4	1.8	0.6	−0.8	−0.2	0.3	−0.2
T5	1.2	0.6	−0.6	0.2	**2.0**	**2.2**
P3	0.7	0.8	−1.3	−0.7	1.0	1.2
P4	1.2	−0.9	−.03	0.5	1.5	1.1
T6	1.4	1.2	−0.8	0.3	1.2	**3.9**
O1	1.5	−0.1	−1.0	0.4	0.9	1.2
O2	1.1	0.0	−1.0	−0.6	0.8	1.0

TABLE 3. Post-Treatment Eyes Open Z-Scores

	Delta	Theta	Alpha	SMR	Beta 1	Beta 2
FP1	−0.3	−0.3	−0.1	0.7	0.2	0.1
FP2	−0.2	0.1	0.3	1.2	0.5	0.1
F7	0.5	−0.8	−0.4	0.2	−0.5	−0.4
F3	−0.6	−0.4	0.0	0.6	−0.2	−0.3
F4	−0.5	−0.4	0.1	1.0	0.5	0.3
F8	−0.2	0.2	0.8	**2.1**	1.4	1.3
T3	−0.7	−1.2	−0.6	−0.3	−0.5	0.3
C3	−0.8	−0.7	−0.3	0.0	−0.4	−0.1
C4	−0.4	−0.5	−0.2	0.4	0.4	0.4
T4	0.2	0.9	0.8	1.2	0.4	0.1
T5	−0.9	−1.3	−0.7	−0.2	−0.4	0.2
P3	−0.8	−1.0	−0.3	0.1	−0.5	−0.2
P4	−0.4	−0.5	−0.2	0.4	−0.5	−0.1
T6	−0.3	−0.4	−0.2	0.7	−0.1	1.0
O1	−0.5	−1.0	−0.3	0.5	0.0	0.7
O2	−0.4	−0.9	−0.4	0.5	0.1	0.5

mental changes may also have played a part in these changes. It may be that it took three months for the teaching method to have an impact. I personally tested this patient both in the before and after testing. This could indicate a source of bias. Finally when one uses pre- and post-psychological testing, it is necessary to look at the reliability of the tests used.

However, it appears that the inclusion of ROSHI/BrainLink® and Alpha-Stim SCS along with the elimination of the Concerta may be the significant differences in the treatment plan since the rest of the treatment plan was implemented for three months with no significant change in his anxiety, ADD level, reading level or school achievement. It is also possible that the combination of the Project Read and/or the ROSHI/BrainLink® neurotherapy treatments were responsible for the significant increase in reading achievement.

Improvements were made in most of the testing areas. They appear to be internally consistent with each other. The combination of these modalities appear to be useful and helpful in "normalizing the brain" or helping the brain perform more effectively when one compares the pre- and post-QEEG results using the SKIL software and database (Sterman, 1999).

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