Brainmaster Case Study

Clinician Identifier, Credentials, and Date of Submission
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Case Identifier
DQ

History/Symptom History
DQ is a 9-year-old Caucasian male, attending the 4th grade in a rural public school. He was referred for neurofeedback for "behavioral problems at school and home." At the time of his initial assessment, this student received a Functional Behavior Assessment (FBA) by another clinician to develop strategies to assist in the school environment. The FBA report indicated that DQ has had an Individual Education Plan and behavioral plan since Kindergarten. His most recent goals involved refraining from hitting, kicking, biting, spitting, throwing items, or destroying property when frustrated at school. Numerous discipline reports from school indicated incidents of verbal and physical aggression toward other students, staff, and family members and refusing to accept instruction or assistance from teachers or aides in the classroom. Because of his inability to control his temper, this student was placed on half-day school attendance. The school had implemented a sensory diet in the first grade involving activities for vestibular and proprioceptive discrimination, tactile defensiveness, somatodyspraxia and impaired bilateral motor coordination. Other interventions were in place to assist with DQ's tendency to become aggressive during changes in routine or schedule. This student participated in occupational therapy twice weekly and language therapy once weekly at school. DQ exhibited a great deal of difficulty with expressive language. His speech was often pressured with word finding difficulties and frequent stuttering. Past diagnoses included ADHD, Combined Type, Oppositional Defiant Disorder, Separation Anxiety Disorder and rule out diagnoses for Sensory Integration Disorder, Generalized Anxiety Disorder and Posttraumatic Stress Disorder. He was diagnosed with ADHD, Combined Type and Disruptive Behavior Disorder, Not Otherwise Specified by this clinician. He was taking Concerta, 27 mg, once daily for ADHD as diagnosed by a psychiatrist at the onset of neurofeedback.

Procedure
An initial qEEG assessment was conducted by a licensed psychologist who is also BCIA certified in EEG biofeedback. EEG data were digitally recorded at 19 electrode sites and referenced to linked ears using a Lexicor digital EEG acquisition system (Neurosearch-24). Data was analyzed using the Neuroguide database (Thatcher, 1998). When considering eyes open z scored FFT Absolute Power scores, DQ showed a significant lack of alpha activity in most locations. The 6 sites with "significant" (greater than 1.96) z-score deviations included F3 (-1.97), C3 (-2.10), P3 (-2.21), C4 (-2.19), P4 (-2.19), Pz (-2.25). In addition, there was a significant excess of delta activity at FP1 (2.05). There were 9 other locations with deviations between 1.5 and 1.96 z-scores, most of these in the alpha band. There were also areas of hypercoherence and hypocoherence present. Most notable of these were 6 hypercoherent location dyads in the beta range.

The neurofeedback treatment was 39 sessions in length. EEG biofeedback equipment from Brainmaster was utilized. Specifically, the Atlantis 4 x 4 was used along with the ANI (Applied Neuroscience, Inc) Z DLL software. This software enables the BrainMaster 2.5 and 3.0 software to compute and use z scores in real time for assessment and training. A 4-channel live z-score program with independent upper and lower limits was used for all treatment sessions (percent ZOKUL). The percent of targets required was set to 94. This setting resulted in the occasional occurrence of "capturing" 100% of the measured variables. The upper and lower thresholds were adjusted independently to result in a success rate between 70 and 80%. In general, these thresholds were between 2.1 and 1.9 for the upper threshold and –2.0 and –1.9 for the lower threshold. Dual monitors were used and feedback was provided through visual and auditory control of DVD movies. Different placements were used on each of the first three sessions to determine optimal placement. Placement decisions were made by considering both qEEG data as well as functional localization of training. Electrode placement at session one was F3, F4, P3, and P4. The electrode placement for session two was FZ, PZ, C3, and C4. The placement for session three was F3, F4, CZ, and PZ. This placement was maintained for sessions 4 through 12 (10 sessions). The placement was changed to T3, T4, FZ, and CZ for sessions 13 through 27 (15 sessions). While T3 and T4 were not the most deviant locations according to the qEEG, it was hoped that training at these locations would provide a stabilizing effect on behavior and mood. For sessions 28 through 39, the electrode placement was moved to F3, F4, P3, P4 (12 sessions). Alpha enhance was added to all four channels to the protocol for sessions 31 through 39. The thresholds were set differentially with greater emphasis on the parietal placements. The thresholds were adjusted such that the percentage of time above threshold at F3 and F4 was between 85-90%. The thresholds at P3 and P4 were adjusted so that the percentage of time above threshold was between 75-85%.

Results

At around session 15, it was noted that DQ's clarity of speech had improved significantly. There was much less stuttering at around session 17. At session 22, the mother reported that he was much less argumentative and stopped having temper tantrums. At session 26, DQ's grandparent indicated that he had not had any medications for two weeks and was continuing to show behavioral improvements at home and school. At session 27, it was noted that the client seemed happier and friendlier. At session 30, it was noted that DQ seemed more energized. Improved energy and affect were noted in several of the next sessions. DQ was observed to demonstrate more cognitive flexibility and ability to handle transitions in session and in the office during the remaining sessions as well as continued improvements with speech. At the end of treatment, DQ no longer exhibited a stutter and his speech was clear and easy to understand. He has had no behavioral incidents at school since session 20 and discontinued all medications at approximately session 22. The school added 1.5 hours to DQ's school day and were preparing to return him to full day attendance.

Pre and Post behavior checklists (BASC-2) were completed by DQ's mother, special education teacher and classroom aide. Comparative results are presented below and

clearly show a dramatic improvement in all symptoms (see table 1). In fact, while 11 of 14 scales were initially identified as "at risk" or "clinically significant" by DQ's mother, none of the scales were elevated at post-testing. Similar patterns were observed on the teacher and aide checklists. At pre-testing, all of the 13 possible scales were identified as "at risk" or "clinically significant" by the special education teacher, the classroom aide, or both. At post testing, none of the scales were clinically significant and 5 of the scales were still in the "at risk" range. It is likely that the remaining difficulties in the school environment are related to the greater level of social and academic stress present in that environment.

A pre-post comparison of the most deviant absolute power and coherence z scores shows a clear trend of movement toward "average" (see table 2). Fourteen of the scores identified as "deviant" at pre-testing showed significant movement toward normalization. Significance was defined as a shift of at least .5 standard deviations. The most notable results from this comparison are related to the improvement in beta coherence. In fact, all of the beta coherence measures identified as significantly deviant at pre-testing showed significant movement toward normalization; some of these, moving greater than 2 standard deviations.

Behavior Assessment System for Children, 2nd Ed. (BASC-2):

The BASC-2 (Reynolds, C.R. & Kamphaus, R.W. (2004), is an integrated system designed to facilitate the differential diagnosis and classification of a variety of emotional and behavioral disorders of children and to aid in the design of treatment plans. Reports are based on the parent and teacher ratings of the child. Any scores in the Clinically Significant range suggest a high level of maladjustment. Scores in the At-Risk range identify either a significant problem that may not be severe enough to require formal treatment or a potential for developing problem that needs careful monitoring. DQ's Special Education Teacher and classroom aide completed initial teacher reports. The final teacher report was completed by DQ's aide in the classroom. The parent report was completed by DQ's mother at both the initial and final assessment periods.

Scores are presented as T-scores and have a mean of 50 and a standard deviation of 10. Clinical scale scores falling between 60 and 70 are considered "at risk," while scores 70 and above are considered "clinically significant." Adaptive behavior scores between 30 and 40 are considered "at risk". Adaptive behavior scores 30 and below are considered "clinically significant." At risk scores will be identified with a single asterisk (*). Clinically significant scores will be identified with two asterisks (**).

Summary

In less than 40 sessions, 4 channel live z-score training was effective in dramatically reducing or eliminating a range of long-standing symptoms including both internalizing and externalizing symptoms, behavior disorders, school problems, and speech difficulties. While it is difficult to determine what aspects of the EEG biofeedback resulted in these changes, the most notable changes in brainwave patterns occurred in a reduction of beta hypercoherence.

Table 1

BASC-2 Pre-Post Parent and Teacher Results

	Parent		**Teacher**	
	Pre	Post	Pre	Post
Clinical Scales				
Hyperactivity	82**	54	67*/83**	64*
Aggression	74**	55	68*/81**	52
Conduct Problems	75**	51	71**/71**	49
Anxiety	59	50	64*/99**	59
Depression	70**	53	62*/67*	48
Somatization	59	42	71**/71**	69*
Atypicality	61*	44	74**/52	53
Withdrawal	62*	47	62*/67*	52
Attention Problems	65*	56	67*/69*	59
Adaptive Behavior Scales				
Adaptability	29**	46	27**/40	33*
Social Skills	43	52	44/38*	42
Leadership	32*	44	40/38*	39*
Activities of Daily Living	18**	42		
Functional Communication	28**	45	30**/29**	36*

Table 2

Eyes-Open Quantitative Electroencephalogram Pre-Post Comparison of Most Deviant Absolute Power and Coherence Z-Scores

	Pre	**Post**
Absolute Power Delta		
FP1	2.05	2.06
C3	-1.56	-0.70*
FP2	1.74	1.51
C4	-1.51	-0.95*
Absolute Power Alpha		
F3	-1.97	-1.74
C3	-2.10	-1.71
P3	-2.21	-1.69*
O1	-1.88	-1.62
T5	-1.90	-1.66
F4	-1.81	-1.72
C4	-2.19	-1.60*
P4	-2.19	-1.71*
O2	-1.94	-1.47
T6	-1.68	-1.41
FZ	-1.80	-1.84
CZ	-1.85	-1.81
PZ	-2.25	-1.78
Absolute Power High Beta		
F8	1.75	0.70**
Coherence Delta		
Fp1-T5	2.02	2.13
Coherence Theta		
F4-T6	2.04	1.30*
F8-T6	1.96	1.27*
Coherence		

Alpha		
Fp1-Fp2	-2.65	-2.31
Fp2-F4	-2.29	-2.47
Fp2-F8	-2.04	-2.22
Coherence Beta		
F3-01	2.09	1.34*
Fp2-F8	-3.82	-2.37**
F4-O2	2.37	0.01**
F4-T6	2.70	1.20**
C4-T6	2.34	1.57*
F8-T6	1.96	0.46**

Post z-scores that changed between .5 and 1.0 standard deviations are identified with one asterisk (*). Post z-scores that changed greater than 1.0 standard deviation are identified with two asterisks (**).

References

Reynolds, C.R., Kamphaus, R.W. (2004). *Behavior Assessment System for Children, 2nd Ed. Manual*. Circle Pines, MN: AGS Publishing.

Thatcher, R.W. (1998). Normative EEG databases and EEG biofeedback. *Journal of Neurotherapy*, 2 (4), 8-39.