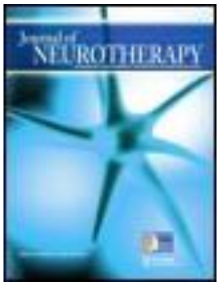

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Effective Use of LENS Unit as an Adjunct to Cognitive Neuro-Developmental Training

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Effective Use of LENS Unit as an Adjunct to Cognitive Neuro-Developmental Training

Curtis T. Cripe, PhD

SUMMARY. This article describes three case studies where the Low Energy Neurofeedback System (LENS) was used to augment neurotherapy/neuro-development training to help overcome cognitive and developmental issues. Simultaneously applying neuro-developmental exercises and LENS training has reduced treatment time in our clinic for certain conditions such as Pervasive Developmental Disorder (PDD) and Autistic Spectrum Disorder. The LENS training actually seems responsible for allowing other forms of treatment to take place.

The first case study was of 4 1/2-year-old identical twins, with developmental delay and autistic spectrum that completed their training within 18 months and graduated out of our program symptom-free, performing as normal 6-year-olds. The second case involved Attention Deficit Disorder with hyperactivity and Oppositional Defiant Disorder in a 12-year-old male with comorbid learning and memory issues compounded by undetected food allergies which had affected CNS functioning since birth. The final case was a 43-year-old female with a mild head injury and significant visual and auditory processing problems. In all cases the post-treatment quantitative EEG results demonstrated normalized Z-scores. Cognitive ability testing with the Woodcock-Johnson® III Tests of Cognitive Abilities (Woodcock, McGrew, & Mather, 2001) likewise documented that post-treatment cognitive abilities had normalized. Following the case presentations clinical impressions about LENS training and its effectiveness are presented. doi:10.1300/J184v10n02_07

KEYWORDS. Neurotherapy, neuro-development, EEG and cognitive abilities, toxicity

INTRODUCTION

Based on the objectively measured outcomes, we first noticed how effective the addition of the Low Energy Neurofeedback System (LENS) was in working with cases of extreme pervasive developmental disorder (PDD). Later we found it was equally effective in most of the cases coming to our clinic. Due to the nature of the PDD condition, progress can be very slow and in some cases we found these children simply were not able to respond to training without using the LENS treatments. Based on our clinical experience we have found that cases involving excess delta or theta brain wave activity, especially when there is a concurrent underlying medical condition, seem to be particularly responsive to LENS treatment. Assuming that we

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address the medical condition and apply a comprehensive neuro-development program which includes LENS training, we make comparable rapid progress with the PDD clients. In our clinical experience we have found LENS treatment is limited or has no effect in cases where there is an excess of beta brain wave activity. We have found that the majority of these cases that involve excess beta activity seem to involve medical conditions, falling under the category of malabsorption and/or neurotoxicity.

Recently in the field of neuroscience, many studies are beginning to demonstrate that cognition, even though it is influenced by genetic factors, is also a developmental age appropriate process based upon the maturation of the client. Specific cognitive abilities are associated with unique EEG patterns in both the non-engaged (resting) and engaged states of different cognitive activities (Goel & Dolan, 2004; Gray, Chabris & Braver, 2003; Prabhakaran, Smith, Desmond, Glover & Gabrieli, 1997; Rivera, Reiss, Eckert & Menon, 2005; Zhang & Poo, 2001). Using quantitative EEG (QEEG) measures along with evoked potentials (EP and ERP) measures, cognitive processes can be quantified and a more specific determination made as to which brain functions appear to be inhibiting an individual's performance (Zani & Proverbio, 2003; Atherton, Zhuang, Bart, Hu, & He, 2003; Aleksandrov, Polyakova, & Stankevich, 2003; Ferstl & von Cramon, 2001; Newman, Carpenter, Varma, & Just, 2003; Geake & Hansen, 2005). When reviewing the biomedical literature it has also been found that some of the underlying cognitive performance problems may be related to underlying health issues which disturb cognitive processes. This results in what can be more accurately described as a loss of functional performance (Beauchaine, 2001; Burgess, Zhang, & Peck, 2000; Porges, 2001; Burns, Baghurst, Sawyer, McMichael, & Tong, 1999; Kidd, 2005; Uhlig, Merkenschlager, Brandmaier, & Egger, 1997; Tang et al., 1999; Eydie et al., 2005). These health/medical issues may include such things as neurotransmitter problems due to mal-absorption issues, allergy irritations, medication effects, etc.

Our clinical assessment procedure evaluates age-appropriate cognitive abilities and performance. This requires us to both understand if the client is functioning at optimal age-appropriate cognitive levels, as well as to understand the underlying reasons why normal performance is not being achieved.

This paper presents three different case studies where LENS was used and where we documented that afterwards functional brain processing issues were normalized. Brain function was measured with both QEEG and psychometric measures of cognitive functioning. The three cases involved (a) developmental issues associated with autistic tendencies, (b) attention deficit disorder (ADD) problems that appeared to be associated with health related issues, and (c) auditory-visual hypersensitivity and learning disability problems associated with a head injury.

METHOD

Analysis Perspective

At the Crossroads Clinic and Centers the focus is on evaluating and improving cognitive abilities. Examining the client from a cognitive neuro-functioning perspective requires one to assess an individual's cognitive abilities as well as to seek to determine the possible root causes of poor cognitive performance. In the educational literature there appear to be four primary schools of thought concerning intellectual cognitive function: (a) the Cattell-Horn-Carroll (CHC) theory (Cattell, 1971; Sternberg, 2000; Sternberg, & Kaufman, 1998; Gilhooly, 1994) which outlines 10 primary cognitive processing domains that interact; (b) the Luria school of thought (Cattell, 1971; Sternberg & Kaufman, 1998; Sternberg, 1998, 2000), which focuses on the interaction between cognitive processing engagement and executive functions; (c) the Gardner school of thought (Gardner, 1983; Sternberg, 2000; Sternberg & Kaufman, 1998) which focuses on cognitive processing styles; and finally (d) the Sternberg method (Sternberg, 2000; Sternberg & Kaufman, 1998) which focuses on the concept of developing life mastery skills. As in personality theory, each school of thought has its place in evaluating a client's overall cognitive profile.

Greenspan and his colleagues (Murray, Clermont, & Brinkley, 2005) defined a term which they called "personal competence," which helps to define many areas of natural cognitive ability. Personal competence is viewed as comprising a set of skills that we use in attaining our goals and solving problems. Cognition refers to the sub-component of these skills involved in thinking and understanding. The Greenspan model consists of three elements: physical competence, personal competence and performance competence.

The evaluation model we use in our clinic model extends the Greenspan model's definition by including a fourth factor adapted from Sternberg's (2000) learned mastery concept. We seek to quantify and track changes in overall levels of performance abilities as a person progresses through our clinic program. This is done through defining in a practical manner what we term PQ™ or Performance Quotient. This initial qualitative mathematical function is defined as: $PQ = w_1{*}P_1 + w_2{*}P_2 + w_3{*}P_3 + w_4{*}P_4$ and consists of four main weighted (w_i) domains (P_i) with several components: P_1 = physical competence, P_2 = personal competence, P_3 = performance competence, and P_4 = P-factor (the life mastery or maturity level of the child). The broad domains defined above are further divided into twelve sub-domains.

- Physical competence consists of the health of our brain and nervous system, as well as organ (e.g., vision, heart functioning) and motor competence (e.g., strength, coordination).
- Personal competence consists of temperament (e.g., emotionality, distractibility), natural personality (e.g., gregariousness, social orientation), and our level of maturity.
- Performance competence includes practical competence (i.e., the skill to think about and understand problems in everyday settings), conceptual competence (i.e., the skill to think about and understand problems of an academic or abstract nature), language (i.e., the skill to understand and participate in communications), and social competence (i.e., the skill to think about and understand social problems).
- P_i Factor represents both our innate and learned ability to incorporate the concept of "mastery." It requires that we learn how to interact with life, learn from it, and ultimately contribute to its direction by helping shape the events that come into our world. Generally, this is measured by how we are performing in life.

Weighting factors are determined based upon the initial intake assessment and is biased, based upon the areas where the client needs to focus (i.e., health issues, skill development, development of cognitive abilities). The weighting factor is derived from both objective physiological measures as well as client or parent reports. All P_i factor scores are a combination of physiologic measures, test scores and subjective ratings. Low scores indicate the need for focus on the physiological needs; medium scores suggest the need to focus on personality or skill set development, and higher scores indicate a need for peak performance training or learned mastery skill development. For younger children the importance of using the P_i factor is more apparent than for adults, due to lack of developmentally age appropriate cognitive processing skills which generally are learned at younger ages.

Training Methods

In all cases, training methods included neuro-sensory stimulation during the use of either the LENS unit and/or in combination with conventional neurotherapy. Neuro-sensory stimulation includes tactile, visual, and auditory training, generally targeted towards engagement of frontal/temporal/parietal interactions. More specifically, these consist of a series of exercises uniquely assigned and tailored to the individual's needs. Training exercises and neurotherapy protocols were selected based upon the QEEG, cognitive ERP data, and standardized cognitive performance test data obtained through cognitive ability tests, as well as client goals. As the sessions progressed, exercises and protocols were adjusted during treatment based upon follow-up QEEGs, ERPs, and cognitive performance testing.

Case 1: Autistic Spectrum Disorder

Identical twins entered the program at age 4 1/2. Both girls were cognitively present, but overall age maturation was estimated at only about 24 to 30 months of age based upon the Nepsy (Kirk, Korkman, & Kemp, 1999) and Doman Delacato (Doman, Spitz, Zucman, Delacato, & Doman, 1960) scores. They both fell within the Autistic Spectrum Disorder (ASD) based upon the Gilliam Autism Rating Scale (Gilliam, 2002) and had previously been diagnosed with the classification of ASD. Language expression was "twin speak," in that you could only understand some of their expressions, but they knew what was being said between them. When looking at their QEEGs both girls had nearly identical values within all frequency bands. The most remarkable features included excess absolute delta and beta values, which exceeded three Z-scores as well as hypercoherence in all frequency bands in excess of three Z-scores. Medical measures showed that there was a significant gut dysbiosis (intestinal inflammation often affecting nutritional absorption, due to many possible underlying issues including yeast overgrowth, food allergies, antibiotic reactions, etc.) for both girls, as well as heavy metal in their system. It appeared from other medically based measures that their neuro-immuoendocrine systems were in a hypersensitive state which resulted in other autonomic reactivities.

Looking at the Performance Quotient (PQ) factor it was apparent that treatment bias needed to be toward remediating the physiological system and promoting enhanced cognitive performance, which meant helping them mature to a more age appropriate natural ability. For both girls the more problematic cognitive systems were the auditory memory system, as well as auditory processing, which impacted their overall maturation and ability to engage socially.

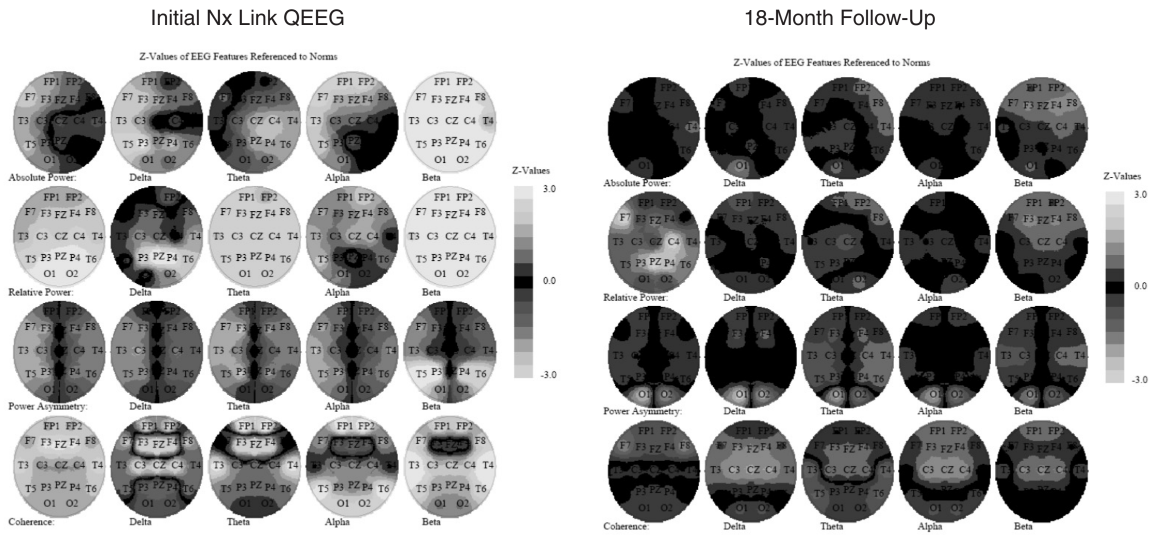
Treatment for both girls consisted of a two pronged approach that included a set of sensory integration/differentiation exercises along with a set of cognitive development exercises. This was combined with a medically based set of treatments targeted at improving the function of the gut, organ systems, and replenishing nutritional support which biological test results determined was missing. During each of their treatment sessions neuro-developmental exercises were applied along with targeted auditory training in conjunction with LENS neurofeedback. In working with this population we discovered empirically that during auditory training sessions, if we would apply the LENS training in each session for a certain number of seconds in sequence at electrode sites F4, F3, Fz, Cz, and Pz (which we have labeled the "T-Walk™"), these cognitively compromised children subsequently tend to respond more rapidly to their cognitive developmental exercises. Additionally, we find that the sensory systems tend to begin to "calm down" or normalize at a more rapid rate following the introduction of LENS training.

As the twins matured their PQ scores improved so that by the eighth month we needed to shift the treatment focus to teaching social skill sets. Both girls responded well to the program and at age six they have both improved to the point that they now hit their age appropriate developmental milestones. One became right handed and the other left handed. Additionally, their speech improved to a clear non-compromised speech pattern and all cognitive abilities normalized to that of a typical six-year-old. Due to overdependence on each other, catching up on socialization required the children to be placed in different kindergarten class rooms. Table 1 displays the treatment progress of the twins on various ratings, and Figure 1 presents the QEEG of one of the twins that was done at the beginning and at the completion of treatment. The extreme excesses in absolute and relative power beta, as well as absolute and relative power alpha, are almost entirely normalized. The most extreme beta absolute power excesses were at Fz, Pz, Cz, and T5 in the map

TABLE 1. Progress of Case One in Treatment

Treatment time	PQ Score	GARS	Doman-Delacato Indications
Intake	22	130 Severe	23 to 30 month cognitive development
4 months	33	119 above average	33 to 36 month cognitive development
8 months	42	98 average	46 to 60 month cognitive development
12 months	66	69 very low	60 to age appropriate development
18 months	86	12 none	Age appropriate development

FIGURE 1. Case 1 Pre-/Post-Treatment QEEG



found in Figure 1, and represented deviations of 3.4, 3.1, 3.02, and 2.98 Z-scores, respectively.

Case 2: ADD with Comorbid ODD/Learning and Memory Issues

The second case was a 12-year-old male who was diagnosed by his psychiatrist with Attention Deficit Disorder (ADD) and Oppositional Defiant Disorder (ODD), with comorbid learning and memory problems. Food allergies were discovered to be present which affected central nervous system functioning. The parents believed that this had been a problem since birth. This young man presented clinically as well intended, but extremely absent-minded or inattentive, as well as argumentative. His grades were mostly Ds because of his failure to turn in homework, combined with his C and high D grades on tests. He was in resource (special classes for academic remediation) for math and reading. He was very cranky and resisted any direction unless it was self-initiated. His scores on the Woodcock Johnson showed low normal General Intellectual Ability (GIA) and attention issues, combined with a problem with auditory working memory.

Medication treatment had been recommended, but he reacted negatively to Ritalin, Concerta and Strattera. The Doman-Delacato developmental profile also validated problems with working memory and suggested a lack of brain system maturation in the ear and eye dominance factor, and in basic mobility factors. This resulted in anxiety and emotional ups and downs.

His PQ factor score indicated that treatment should focus on health, brain developmental factors and basic academics. A three prong treatment approach was initiated. Specific allergy testing was undertaken with the discovery that an allergy to wheat and dust mites both significantly affected his ability to perform on the classic aural digit span for working memory. In digit span testing his capacity ranged from 2 digits to 4 digits. For his age he should have been attaining digits span scores of 6 or more, which he was able to attain after three months of treatment.

LENS neurofeedback was used to help reduce the excessive delta and theta brainwave activity as well as to augment his developmental memory training during lab sessions. During his in-office lab training sessions he performed neuro-developmental exercises along with conventional theta inhibit/SMR enhance neurotherapy protocols based upon his QEEG. The results after 24 sessions showed his performance at school had improved in most classes from Ds to Cs and Cs to B +. At the end of 12 weeks he had graduated out of resource classes, but he was still struggling with his basic reading comprehension.

Initially, the family did not want to address his academic issues, hoping they would just clear up, but his PQ factor indicated a need to shift to enhancing his personal skill sets. The Wide Range Achievement Test III (Wilkinson, 1993) was administered and it was discovered that it would be necessary for the young man to relearn some academic basics in the area of vocabulary building and reading strategies. A tutoring program was recommended and implemented, which allowed his academic test grades in the classroom to catch up. On a personality level, this initially cranky 12-year-old became quite pleasant and helpful to staff. Similar reports by his parents were made on his a six month follow up. Table 2 summarizes treatment progress, and Figure 2 displays his pre- and post-treatment QEEG findings. As seen in Figure 2, the extreme excesses of absolute power across frequency bands were normalized by the end of six months.

Case 3: Mild Head Injury

The final case is a 43-year-old female who was suffering from a mild head injury with significant visual and auditory processing hypersensitivity. The sensory hypersensitivity created harsh headaches and emotional pain. The accident occurred from a hit-and-run car accident two years prior to her coming to our office. She also presented with problems with memory, focus and attention. Memory aural and visual digit span scores indicated that something was interfering with her memory system interactions. Her General Intellectual Abilities (GIA) score on the Woodcock-Johnson III Test of Cognitive Abilities (Woodcock et al., 2001)

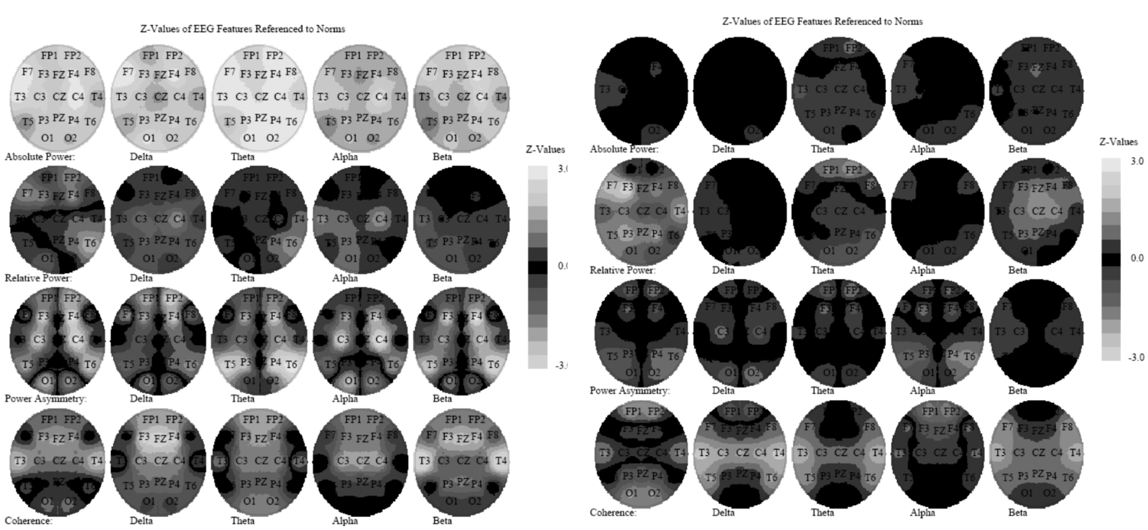
TABLE 2. Progress of Case Two in Treatment

Treatment time	PQ Score	WJC III	Doman-Delacato Indications
Intake	33	GIA 83-89 weak thinking ability, normal cognitive efficiency	Need for memory work, cross pattern
2-months	63	GIA 98-104 normal thinking ability, normal cognitive efficiency	Need for memory work, cross pattern
6-month follow up	88	GIA 105-115 normal thinking ability, normal cognitive efficiency	Within normal ranges

FIGURE 2. Pre-/Post-Treatment QEEGs for Case 2

Initial Nx Link QEEG

QEEG at 6-Month Follow-Up



was between 83 and 95, far below her level of educational achievement. (She had a bachelor's degree in English.) Testing on the Doman-Delacato profile indicated that her developmental profile was age appropriate and her lack of cognitive performance was most likely due to a loss of memory function. She was assigned cognitive development exercises which consisted mostly of sensory system desensitization combined with auditory and other cognitive developmental training as indicated by her QEEG and other testing. Within twelve sessions of using the LENS combined with frequency specific auditory training, her hypersensitivity to both sound and light began to normalize as indicated from retesting and her self report. Cognitive function returned to normal within 20 sessions.

Table 3 summarizes her treatment progress and Figure 3 presents her pre-/post-treatment QEEG results. The pre-treatment QEEG showed excess absolute power alpha and in absolute power averaged across frequency bands. This was no longer present after treatment. The patient's traumatic brain injury discriminant function scores and patterns normalized following treatment.

DISCUSSION AND CONCLUSION

Neurotherapy with the LENS is one of many tools that we use. It has been our experience that LENS can be very effective when used appropriately and in conjunction with neurodevelopment, bio-chemical, physiological and body health interventions. The LENS unit acts as a very precise and specific tool. It is my impression, as was the case with the twins cited above, that patients who are more significantly developmentally and learning disabled, or individuals with brain injuries are able to progress in neurocognitive exercises because of the facilitating effects that come from LENS training. Commonly LENS training seems to help jump start cognitive systems, as it did with the twins, and not only allow them to perceive what is being asked of them, but also allow them to be able to engage in the neuro-rehabilitation exercises. In the case of the 12-year-old ADD/ODD male cited in this paper, LENS training seemed to not only accelerate the progress of this young man, but it also enabled us to help normalize the auditory processing to allow more normal auditory perceptual integration. For the 43-year-old woman who had experienced a traumatic head injury, the LENS unit affected a change in her hypersensitivity to both the auditory and visual input. The LENS training seemed to be the factor that allowed subsequent desensitization exercises to become more effective, reducing treatment time, and allowing her to regain normal functioning of her auditory and visual brain systems.

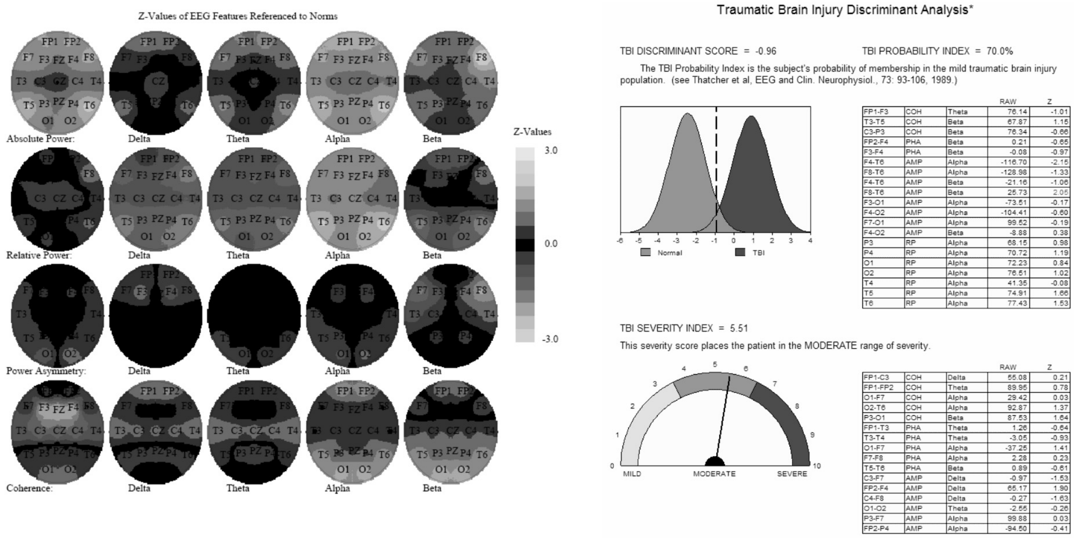
Although our clinical results are uncontrolled and confounded by the inclusion of other forms of treatment, it was our experience that prior to implementing LENS training our treatment program with both children and adults required 8 to 12 months for us to achieve the same results that we are now achieving within 3 to 6 months, once we added the component of LENS training. It appears that LENS neurofeedback may be able to help accelerate the reduction of the slow brainwave activity during our treatment of allergies, as well as help augment the performance of the memory exercises during neurocognitive training sessions.

TABLE 3. Summary of Treatment Progress in Case 3

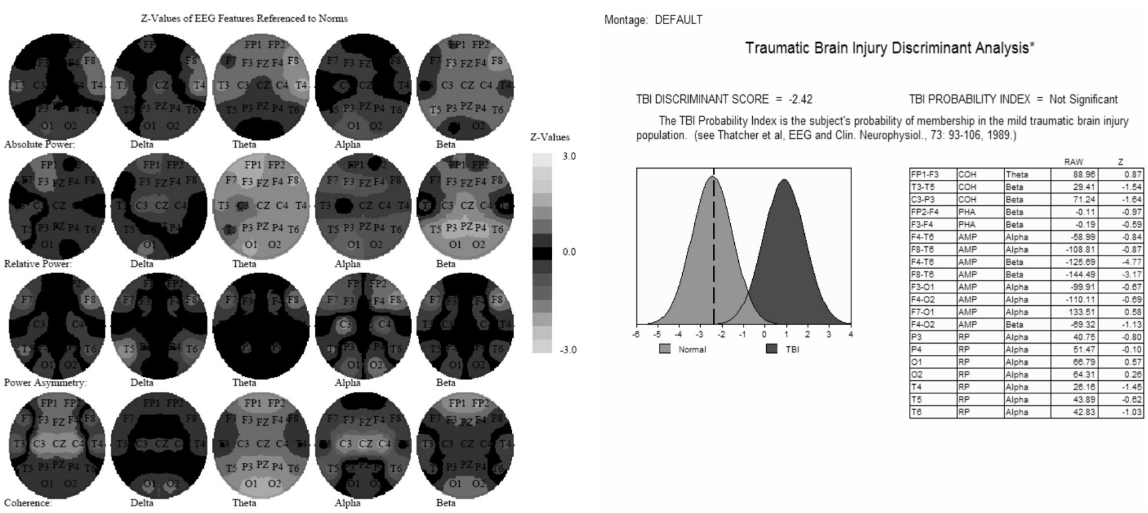
Treatment time	PQ Score	WJC III	Doman-Delacato Indications
Intake	55	GIA 83-95 (weak thinking ability, weak cognitive efficiency)	Normal development, hypersensitive sensory processing
2-months	83	GIA 110-115 (normal range thinking ability, normal cognitive efficiency)	Normal development, sensitive sensory processing
6-month Follow up	93	GIA 110-115 (normal thinking ability, normal cognitive efficiency)	Normal development, normal sensory processing

FIGURE 3. Pre-/Post-Treatment QEEGs and Brain Injury Discriminant Scores

Initial NxLink and Neuroguide Mild Traumatic Brain Injury Discriminate Match



6-Month Follow-Up



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