FEATURE ARTICLE

The Effect of LENS Treatment on Cognitive Functioning and Brainwave Patterns

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Twenty-six subjects with a variety of medical disorders were studied pre- and post-LENS neurotherapy treatment utilizing the Central Nervous System Questionnaire and a quantitative EEG (QEEG). Significant differences were found on seven of eight CNS scales with the emotions scale showing the greatest change. Significant changes were also found in the QEEG scores with Delta and Theta frequencies improving the most. Three sites (T4, C4, and CZ) showed the greatest changes of the 19 sites studied. Examination of the relationship between the measures showed a significant relationship. Discussion of possible mechanisms of change and neuroplasticity conclude the paper.

Introduction

Pure North S'Energy (PN) is a charitable foundation whose goal is the improvement and enhancement of the quality and length of life through the use of their self-developed nutritional supplements, heavy metal reduction therapy, and lifestyle management. In addition, PN collects data on the interventions delivered through the foundation. At the time of writing, the program was voluntary at no cost to patient(s) with data on approximately 25,000 people collected.

As part of a health enhancement program EEG neurotherapy (biofeedback) Low Energy Neurofeedback System (LENS) was made available to staff, relatives of the staff, and participants registered in the PN program. This article summarizes the results of a study on 26 participants who completed a LENS neurotherapy intervention.

LENS

LENS is a form of EEG neurotherapy in which the electrical activity of the brain is monitored utilizing a computer-based software program that is connected to an EEG device, which measures brainwaves. LENS "treats functional chronic neurological problems" and "opens the communication channels in the central nervous system, thus enabling the nervous system to set its own course and action" (Ochs, 2006, p. xiv). Treatment consists of the administration of invisible radio frequency waves that are several hundred times weaker than what your brain is exposed to each time you hold a cellular phone to your head. Not only is the LENS signal incredibly weak, but the length of exposure to it is extremely short. The duration of actual LENS stimulation during a typical LENS session is from 1 second to 1 minute per site on the head (OchsLabs, n.d.).

The LENS technique has a goal of disentraining the brain, so that "individuals become more functional and discerning, more flexible in their approaches to life" (Ochs, 2006, p. xv). The LENS systems samples the current dominant frequencies in neural activity, and feeds back very low amplitude electromagnetic stimulation at a frequency almost but not quite the same as the dominant activity. The slight difference from the original dominant frequency is called an offset. By feeding back stimulation at almost the same frequency that various areas of the brain are emitting and adding the slightest amount of change, this causes the brain to self-adjust, self-regulate, harmonize, and minimize its dysfunction. "When the nervous system is free from gross distortions, or 'static,' people are able to confront their own 'psychodynamic' problems and issues much more clearly and successfully" (Larsen, 2006a, p. 15).

The LENS process is not a treatment for any specific condition or directed toward a specific diagnosis. It is a general process that optimizes brain function. "The ultimate goal is for the brain to be calmed through the feedback of its own energy" (Larsen, 2006b, p. 23). However, as self-regulation occurs, many symptoms that have their basis in central nervous system dysfunction begin to improve. It can manifest as mood improvement in people with anxiety, depression, and explosiveness. It can manifest in improved sleep in people with sleeping disorders, restless leg syndrome, or night teeth grinding. This unique neurofeedback technique may also benefit people who are already healthy and are interested in peak functioning and inner resilience to stress.

A controlled study of 100 subjects with diagnoses of ADD, traumatic brain injury, and bipolar disorder showed that 90% of them did better after LENS (Larsen, Harrington, & Hicks, 2006). Previous research by the

authors on a similar population ($n = 36$), using a similar protocol showed that LENS treatment (a) improved sleep by 54%, (b) improved cognitive functioning by 56%, and (c) improved general sense of well being by 54% as reported on a Likert-type rating scale (Donaldson, Donaldson, & Moran, 2013; Donaldson & Hammond, 2012). Changes were also noted in the QEEG including: (a) decreased absolute power in High Beta at specific sites, and (b) changes in coherence and phase lag.

What makes this study unique is the application of EEG biofeedback techniques to an organization and its population as a whole without preselecting participants or focusing on a particular dysfunction. This study is a second step in evaluating changes produced by LENS utilizing rating scales specifically designed to investigate central nervous functioning and matching these results with quantitative electroencephalograph (QEEG) results.

Method

All subjects in the study were volunteers who were recruited by signs located in the foundation's kitchen, by recommendation from the foundation's medical staff, and by word of mouth. Each volunteer received an information package about the program and about LENS treatment. Volunteers were then given a choice as to volunteer or not. If they chose to proceed, the second author obtained a brief description of their concerns, a statement of what they hoped to gain out of the program, a review of their history as it related to their concerns, demographics, and information as to medications.

Upon acceptance into the program a QEEG was administered following standard procedures as outlined by Thatcher (2012). At the same time the Central Nervous System Questionnaire (CNS Questionnaire) was administered. The participants then received a LENS offset mapping, 28 sessions of LENS therapy lasting for 30 minutes each. Following therapy, they then received another QEEG and completed a second CNS Questionnaire.

Instruments

The CNS Questionnaire is an instrument designed by Len Ochs to report upon various aspects of central nervous function (Larsen, Ochs, Schultheis, & Esty, 2006). It is divided into eight sections including: (a) sensory, (b) emotions, (c) clarity, (d) energy, (e) anxiety, (f) memory, (g) movement, and (i) pain. Each section has a number of items related to that area of interest. These are as follows: (a) sensory—5 items, (b) emotions—6 items, (c) clarity—12 items, (d) energy—5 items, (e) anxiety—7 items, (f) memory—4 items, (g) movement—2 items, and (i) pain—8 items, for a total of 49 test items. Participants are asked to select a number from 0–10 rating how

much the issue is currently bothering them. Zero (0) means not at all, 10 means all the time. The responses are summed for each of the eight sections and then totaled for the entire test.

The second time the questionnaire was completed, the individuals did not see the answers from their first questionnaire.

A copy of the questionnaire is attached as Appendix A.

QEEG Protocol

The QEEG was administered in a standard fashion to all subjects. Prior to the day of the assessment all subjects were instructed to wash their hair twice with a nonconditioning shampoo, and not to apply any conditioner, mousse, or hair spray products after washing. All QEEG assessments were conducted between the hours of 8:00 a.m. and 2:00 p.m., with all subjects seated and fully supported in a recliner chair. All subjects were fully informed of the nature of the assessment. Data was collected from 19 sites using an ECI electro-cap, with electrodes located in the Standard International 10/20 locations. Impedance was checked at each site, with levels of resistance below 5K ohms established before data collection. Standardized instructions were given to all subjects for each condition. They were instructed to advise the examiner if they became fatigued and a break was given. Data was collected over two conditions: eyes open and eyes closed using the BrainMaster Discovery 24 (BrainMaster Technologies, Inc., Bedford, OH) with a sampling at a rate of 128 samples per second with a gain of 32 K. The data was analyzed using the NeuroGuide database (Applied Neuroscience, Inc., Seminole, FL) as developed by Thatcher (2012) with the Absolute Power raw data converted to Z scores. The data was artifacted by a trained artifacter (lead author) and then reviewed by the second author for epileptiform phenomena. No person was disqualified for this issue.

Demographics

The subjects were 11 males and 15 females, average age of 43.1, with 24 right handed. Three of the subjects had a history of concussion(s), two were diagnosed as epileptic, six had a history of drug abuse, four were diagnosed (by others) as suffering from fibromyalgia, and three were reported as suffering from ADD. The remainder (eight) were interested in improving their cognitive performance and enhancing the quality of their lives. Length of time with a dysfunction was extremely variable, ranging from their entire life to six months.

Results

All statistics performed were completed on the IBM SPSS Statistics Program Version 20.

Table 1. Paired Samples *t* Test Comparing Pre and Post CNS Questionnaire Total Scores

| | Paired Differences | | | | | | | |
| | | | | 95% Confidence Interval of the Difference | | | | |
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	*t*	*df*	Sig. (2-tailed)
Pair 1 AllCNSpre–AllCNSpos	74.98077	43.81015	8.59188	57.28546	92.67607	8.727	25	.000

CNS Questionnaire

First the total score from the 49 questions for the pretest was compared with the total score from the posttest, with the null hypothesis being no significant change. The results from a paired samples *t* test (2 tailed) showed a significant difference at $p < .006$. These results are shown in Table 1.

Given the positive findings, the eight sections of the test were compared pre to post utilizing a paired samples *t* test (4 tailed). The results are highlighted in Table 2 and demonstrate that seven of eight sections showed significant changes. Only movement was not significant.

The questions for each of the seven sections were then subjected to a One Way Analysis of Variance (One Way ANOVA) to see which questions changed the most. To be considered as showing significant change a criteria of $p < .01$ was utilized. The items which showed significant results are bold in Appendix A.

QEEG

The Absolute Power Z scores were totaled for all subjects for each site and each frequency for pre- and posttreatments. This data was examined with the total score from the pretest compared to that from the posttest, with the null hypothesis being no significant change. The results from a paired samples *t* test (2 tailed) showed a significant difference at $p < .006$. These results are shown in Table 3.

Given the positive findings the eight frequency sections of the QEEG were compared pre to post utilizing a paired

Table 2. Paired Samples *t* Test Comparing Pre and Post CNS Questionnaire Scores For Eight Sections

| | Paired Differences | | | | | | | |
| | | | | 95% Confidence Interval of the Difference | | | | |
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	*t*	*df*	Sig. (2-tailed)
Pair 1 SENSpre–SENSpos	4.40385	5.42221	1.06338	2.21377	6.59393	4.141	25	.000
Pair 2 EMOTpre–EMOTpos	7.38462	9.08219	1.78116	3.71624	11.05299	4.146	25	.000
Pair 3 CLARpre–CLARpos	24.73077	16.59050	3.25366	18.02972	31.43182	7.601	25	.000
Pair 4 ENERpre–NERpos	9.94231	7.98790	1.56656	6.71593	13.16869	6.347	25	.000
Pair 5 ANXpre–ANXpos	10.88462	11.12233	2.18127	6.39221	15.37702	4.990	25	.000
Pair 6 MEMpre–MEMpos	7.82692	5.93455	1.16386	5.42991	10.22394	6.725	25	.000
Pair 7 MOVpre–MOVpos	1.30769	4.01765	.78793	−.31507	2.93046	1.660	25	.109
Pair 8 PAINpre–PAINpos	8.46154	7.67453	1.50510	5.36173	11.56135	5.622	25	.000

Table 3. Paired Samples *t* Test Comparing Pre and Post qEEG Total Z Scores

| | Paired Differences | | | | | | | |
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | *t* | *df* | Sig. (2-tailed) |
				Lower	Upper			
Pair 1 Allfreqpre–Allfreqpos	−19.67888	26.51146	5.19932	−30.38709	−8.97067	−3.785	25	.001

samples *t* test (2 tailed). The results are highlighted in Table 4 and demonstrate that two of eight frequency sections showed significant changes.

Given the positive scores for Delta and Theta these scores were analyzed pre and post by site. Of the 19 sites, 13 were found to be significantly different pre to post for Delta. The significant Delta sites are reported in Table 5.

Of the 19 sites, 11 were found to be significantly different pre to post for Theta. The significant Theta sites are reported in Table 6.

Comparison of CNS Questionnaire Results to QEEG Results

The final total scores on the CNS Questionnaire were compared to the QEEG posttreatment, examining for a

Table 4. Paired Samples *t* Test Comparing Pre and Post qEEG Z Scores by Frequency

| | Paired Differences | | | | | | | |
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | *t* | *df* | Sig. (2-tailed) |
				Lower	Upper			
Pair 1 Dbothtotpre–Dbothtotpos	−12.11077	9.20581	1.80541	−15.82908	−8.39246	−6.708	25	.000
Pair 2 Tbothtotpre–Tbothtotpos	−2.82038	6.32319	1.24008	−5.37438	−.26639	−2.274	25	.032
Pair 3 Abothsubtotpre–Abothsubtotpos	1.20842	5.14499	1.00902	−.86968	3.28653	1.198	25	.242
Pair 4 Bbothsubtotpre–Bbothsubtotpos	1.54231	6.70164	1.31430	−1.16454	4.24916	1.173	25	.252
Pair 5 Hbothsubtotpre–Hbothsubtotpos	1.79192	6.17799	1.21160	−.70342	4.28727	1.479	25	.152
Pair 6 B1bothsubtotpre–B1bothsubtotpos	.64962	5.39848	1.05873	−1.53088	2.83011	.614	25	.545
Pair 7 B2bothtsubtotpre–B2bothtsubtotpos	1.98227	7.67575	1.50534	−1.11803	5.08257	1.317	25	.200
Pair 8 B3bothsubtotpre–B3bothsubtotpos	2.12154	7.05597	1.38379	−.72843	4.97151	1.533	25	.138

Table 5. Paired Samples *t* Test Comparing Pre and Post Delta Z Scores by Site

| | Paired Differences | | | | | | | |
| | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | *t* | *df* | Sig. (2-tailed) |
				Lower	Upper			
Pair 2 DF3pre–DF3pos	−.24692	.53429	.10478	−.46273	−.03112	−2.357	25	.027
Pair 3 DC3pre–DC3pos	−.28154	.54983	.10783	−.50362	−.05946	−2.611	25	.015
Pair 4 DP3pre–DP3pos	−.22038	.50295	.09864	−.42353	−.01724	−2.234	25	.035
Pair 7 DT3pre–DT3pos	−.16231	.36804	.07218	−.31096	−.01365	−2.249	25	.034
Pair 8 DT5pre–DT5pos	−.18538	.43682	.08567	−.36182	−.00895	−2.164	25	.040
Pair 10 DF4pre–DF4pos	−.33308	.61742	.12109	−.58246	−.08370	−2.751	25	.011
Pair 11 DC4pre–DC4pos	−.34308	.60269	.11820	−.58651	−.09965	−2.903	25	.008
Pair 13 DO2pre–DO2pos	−.25538	.57157	.11209	−.48625	−.02452	−2.278	25	.032
Pair 14 DF8pre–DF8pos	−.41808	.96716	.18968	−.80872	−.02743	−2.204	25	.037
Pair 15 DT4pre–DT4pos	−.39462	.58290	.11432	−.63005	−.15918	−3.452	25	.002
Pair 17 DFZpre–DFZpos	−.28346	.53436	.10480	−.49929	−.06763	−2.705	25	.012
Pair 18 DCZpre–DCZpos	−.35885	.60889	.11941	−.60478	−.11291	−3.005	25	.006
Pair 19 DPZpre–DPZpos	−.24731	.56804	.11140	−.47674	−.01787	−2.220	25	.036

Note: Only significant sites listed.

relationship. As the CNS Questionnaire violated several assumptions of normal distribution nonparametric measures were utilized to make this comparison. The results from the Related Samples Wilcoxon Signed Rank Test showed significance at $p < .01$. Thus, the null hypothesis was rejected and a relationship assumed.

Discussion

Neuroplasticity refers to the brain's and the complete nervous system's ability to adapt to change through modifications in their anatomy and physiology. Repeated stimulation has been shown to change and/or modify existing neural pathways, plus create new ones (Doidge, 2007). Changes are inferred by behavioral observations, self-reports, and objective measurement of neuron-pathways.

Changes may be produced by repeated behavioral interventions, by new mechanical devices (i.e., tongue sensors) or by biofeedback (i.e., EEG neurotherapy). Numerous studies have demonstrated the power and efficacy of EEG neurotherapy with changes occurring in activity in the brain with the associated predicted outcomes.

The results of this study indicate that changes occurred (a) in the subjects' perception of their dysfunctions, and (b)

Table 6. Paired Samples _t_ Test Comparing Pre and Post Theta Z Scores by Site

| | Paired Differences | | | | | | | |
| | | | | 95% Confidence Interval of the Difference | | | | |
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 3 TC3pre–TC3pos	−.18692	.42156	.08267	−.35719	−.01665	−2.261	25	.033
Pair 4 TP3pre–TP3pos	−.17885	.43479	.08527	−.35446	−.00323	−2.097	25	.046
Pair 5 TO1pre–TO1pos	−.20077	.50765	.09956	−.40581	.00428	−2.017	25	.055
Pair 7 TT3pre–TT3pos	−.15154	.36171	.07094	−.29764	−.00544	−2.136	25	.043
Pair 8 TT5pre–TT5pos	−.18769	.39972	.07839	−.34914	−.02624	−2.394	25	.024
Pair 10 TF4pre–TF4pos	−.20731	.48636	.09538	−.40375	−.01086	−2.173	25	.039
Pair 11 TC4pre–TC4pos	−.25500	.48442	.09500	−.45066	−.05934	−2.684	25	.013
Pair 14 TF8pre–TF8pos	−.35500	.64452	.12640	−.61533	−.09467	−2.809	25	.010
Pair 15 TT4pre–TT4pos	−.24885	.44216	.08671	−.42744	−.07025	−2.870	25	.008
Pair 17 TFZpre–TFZpos	−.18192	.44348	.08697	−.36105	−.00280	−2.092	25	.047
Pair 18 TCZpre–TCZpos	−.35346	.74595	.14629	−.65476	−.05216	−2.416	25	.023

Note: Only significant sites listed.

in the associated QEEGs. As neural self-regulation occurs, many symptoms that have their basis in central nervous system dysfunction begin to improve. The change can manifest as mood improvement in people with anxiety, depression, and explosiveness. It can manifest in improved sleep in people with sleeping disorders, restless leg syndrome, or night teeth grinding. This unique neurofeedback technique may also benefit people who are already healthy and are interested in peak functioning and inner resilience to stress. The results from the CNS Questionnaire bear witness to this.

It is possible to point to these changes in the CNS Questionnaire as placebo and it is entirely possible this may have happened as the questionnaire is quite subjective. However, the noted changes in the QEEGs suggest that changes occurred in the brains leading to the reported changes.

This was not a carefully controlled study as the participants had numerous and various dysfunctions. The nature and type of dysfunctions were extremely variable changing on a per person basis. This suggests the power that neurotherapy may show, particularly the LENS.

The changes in the CNS Questionnaire were the strongest in the categories of emotions, memory, and pain, although seven of eight categories showed changes. This is possibly due to an overlap as the wording of the phrases could mean different things to different people. This particular instrument has not been exposed to detailed studies so the validity and the reliabilities of the different scales are not known.

The QEEG results showed significant changes in Delta and Theta with the Z scores improving. Generally decreased Delta is associated with (a) depression, (b) problems with sleep, (c) increased pain sensitivity, (d) problems with

autonomic functioning, and (e) diminished cognitive functioning. In particular Delta changes were occurring in 13 of 19 sites with the greatest changes occurring at T4, C4, and CZ. These areas specifically are associated with auditory processing, motor control, the limbic system and music processing.

Theta changes occurred in 11 of 13 sites with the greatest changes noted at T4 and C4. The Theta changes were not as significantly powerful as the Delta changes suggesting Delta had more of an influence than Theta.

In previous presentations the authors (Donaldson & Hammond, 2012) have demonstrated a relationship between QEEG data and personality measures before and after treatment with LENS. The present study supports these findings. However, little is known about what LENS is or does to the brain. The data indicate that something is happening, but further research is needed in carefully controlled studies to document the exact nature of this treatment.

Acknowledgment

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Appendix A. The CNS Functioning Assessment

Sensory:
S1: Light, in general, or lights, bother you
S2: Problems with the sense of smell
S3: Problems with vision
S4: Problems with hearing
S5: Problems with the sense of touch

Emotions:
E1: Problems of sudden, unexplained changes in mood
E2: Problems of sudden, unexplained fearfulness
E3: Problems of unexplained spells of depression
E4: Problems of unexplained spells of elation
E5: Problems with explosiveness
E6: Problems with suicidal thoughts or actions

Clarity:
C1: Feel "foggy" and have problems with clarity
C2: Problems following conversations (with good hearing)
C3: Problems with confusion
C4: Problems following what you are reading
C5: Realize you have no idea what you have been reading
C6: Problem with concentration
C7: Problems with attention
C8: Problems with sequencing

C9: Problems with prioritizing
C10: Problems not finishing what you start
C11: Problems organizing your room, office, paperwork
C12: You cover up that you don't know what was said or asked of you

Energy:
EN1: Problems with stamina
EN2: Fatigue during the day
EN3: Trouble sleeping at night
EN4: Problems awakening at night
EN5: Problems falling asleep again

Activation and Anxiety:
A1: Restlessness
A2: Problem with irritability
A3: Daydreaming
A4: Worrying
A5: Always moving

A6: Cold hands or feet
A7: Palpitations

Memory:
M1: Forget what you just heard
M2: Forget what you are doing, what you need to do
M3: Problems with procrastination and lack of initiative
M4: Problems not learning from experience

Pain
P1: Head pain that is steady
P2: Head pain that is throbbing
P3: Shoulder and neck pain
P4: Wrist pain
P5: Tender areas of muscles
P6: All over pain
P7: Joint pain
P8: Other pain