Developmental Trauma, LENS and Neural Regulation: Brain and Body

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Abstract

Individuals with a history of Developmental Trauma often have complex histories and symptom patterns that do not respond easily to therapeutic interventions. The addition of LENS Neurofeedback and its integration with other psychotherapeutic interventions for Developmental Trauma are discussed. LENS is unique in the field of neurofeedback in that it applies the concept of neural regulation not only to the brain but also to the body, reflecting both Top-down and Bottom-up interventions. Such an integrated body mind approach dovetails uniquely with other information processing interventions. Case studies of individuals that had previously had not responded to other interventions are presented who benefitted from the integration of LENS neurofeedback and associated neural regulation approaches into standard trauma treatment interventions. It is suggested that individuals with a history of Developmental Trauma benefit from the addition to LENS neurofeedback by directly intervening at the level of the electrical or frequency domain.

Keywords: neurofeedback; LENS neurofeedback; neuro therapy; alpha-theta; alpha feedback; posttraumatic stress disorder; developmental trauma; dissociative disorder, complex regional pain syndrome; EMDR; opioid antagonist; naltrexone; LDN;

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1. Introduction

The use of LENS Neurofeedback and its integration with psychotherapeutic interventions is discussed. Specifically, case studies are described of individuals with a history of developmental trauma that had not responded adequately to treatment as usual. Prior treatment commonly included multiple pharmacological interventions, as well as trauma-focused interventions including Cognitive Behavioural Therapy (e.g., Ehlers, 2013), EMDR (e.g. Shapiro, 2018), Sensorimotor Psychotherapy (e.g., Ogden & Fisher, 2015), as well as Ego-State Therapy (e.g., Watkins, 1997) including targeting dissociative symptoms (Boyd et al., 2018).

LENS lends itself to integration with other psychotherapeutic modalities due to the short duration of feedback, thus allowing time for additional interventions. Further, LENS is unique in the field of neurofeedback in that it applies the concept of neural regulation not only to the brain but also to the body, reflecting both Top-down and Bottom-up interventions. Such an integrated body mind approach dovetails uniquely with other information processing interventions, like mindfulness-based interventions, body-oriented psychotherapy, as well as EMDR.

2. Background and Literature:

2.1. Developmental Trauma

Developmental Trauma is a term used to describe childhood trauma that includes chronic abuse, neglect or other types of adversity while growing up. When a child is exposed to overwhelming stress and their caregiver does not help reduce this stress, or is the cause of the stress, the child experiences Developmental Trauma. While some of these children will go on to develop PTSD, many do not. Nevertheless, they are at risk for a host of complex emotional, cognitive and physical disorders that commonly affect them throughout their lives. Thus, individuals with a history of developmental trauma often present with a wide variety of mental and physiological symptoms, including significant dissociative symptoms (van der Kolk, 2005). They tend to be difficult to treat and frequently do not, or only minimally respond to standard trauma treatment approaches (Schmid et al., 2013).

2.2. Trauma, EEG, Abnormalities and Neurofeedback

EEG abnormalities are a common response to traumatic stress and include alterations in multiple frequency bands: gamma (Cohen et al. 2012; Huang et al. 2014), beta (e.g., Cohen et al. 2012; Huang et al. 2014), alpha (Jokić-Begić & Begić, 2003; Huang et al., 2014), theta (Todder et al., 2012; Huang et al., 2014) and alpha/theta ratio (Veltmeyer et al., 2006). Fisher (2014) has previously made a case for the use of neurofeedback in individuals with histories of developmental trauma. Operant-based neurofeedback has shown some promise (e.g., Fisher et al., 2016), but tends to be fairly time-intensive and thus difficult to integrate with standard trauma-focused treatment interventions that are typically delivered in 50-minute sessions.

2.3. Alpha Alpha-Theta and Trauma Treatment

One of the early neurofeedback studies with anxiety found both enhancement and suppression of alpha activity to have a beneficial effect (Plotkin & Rice, 1981). Neurofeedback research with regard to treatment of PTSD has frequently utilized alpha-theta feedback (e.g., Peniston & Kulkosky, 1991; Peniston et al., 1993). Kluetsch et al. (2014) in a group of individuals with PTSD related to childhood abuse used alpha desynchronizing feedback at Pz that resulted in initially decreased alpha amplitude during training that was followed by a significant increase or rebound in resting alpha synchronization. This rebound was associated not only with increased calmness but also in alterations in functional connectivity.

2.4. Low Energy Neurofeedback System (LENS)

The Low Energy Neurofeedback System (LENS) is an EEG biofeedback system that is unique in the field of neurofeedback in that rather than being based on operant conditioning, it uses tiny electromagnetic signals as a carrier wave for the feedback to assist in reorganizing brainwave activity (Ochs, 2006). The feedback frequency is linked to the momentary peak frequency detected by the system. “Subjects are not consciously learning to change brainwave activity; instead, the brainwave changes are the result of the brain continuously interacting with the resonant changes in the feedback pulses.” (Nelson et al., 2010; p. 913). In comparison to typical operant-based neurofeedback, LENS sessions are typically much shorter and do not require attentional demands on the part of the client.

Empirical evidence for LENS is limited at this time. There are several case studies with the precursor of LENS, the Flexyx system being effective with traumatic brain injury, PTSD and traumatic stress symptoms (Nelson & Esty, 2012; 2015a; 2015b; 2018; Schoenberger et al., 2001). More recently, Larsen et al. (2006) provide supporting evidence for LENS using a sample of convenience. Further, a randomized, double-blind, placebo-controlled trial suggested a trend towards improvement with regard to fibromyalgia symptoms, potentially supporting its utility as an adjunctive intervention for fibromyalgia (Nelson et al., 2010). Finally, a single case study found LENS to be effective for anosmia associated with TBI (Hammond, 2007).

2.5. LENS and EEG Maps

LENS uses the 10/20 system with the addition of Fpz and Oz for a total of 21 sites. Different from a qEEG map, data are acquired sequentially, one site at a time. LENS uses both ‘Standard Maps’ and ‘Suppression Maps’ that provide information about EEG amplitude and variability. ‘Standard Maps’ order the electrode sites to be accessed by amplitude plus standard deviation or frequency and standard deviation at each site. ‘Suppression Maps’ are based on a coefficient of variation. The latter is determined by taking the standard deviation at a specific site and dividing it by the average amplitude and/or the standard deviation of the dominant frequency and dividing it by the average dominant frequency.

LENS typically defines a site as being suppressed if such coefficient of variation falls below a value of .35 – a number that has been found to be a useful heuristic for the notion of EEG suppression. With LENS treatment there is an initial release from suppression which results in both increased amplitudes, as well as increased variability, as measured by the standard deviation. While this typically correlates with improved behavioural functioning, as Ochs suggests, “the EEG at the end of a successful LENS treatment can look more typical of what accompanies impairment of functioning than it did at the beginning from the traditional qEEG point of view” (Lanius et al. 2015), raising questions about the reliability of qEEG maps in trauma survivors and basing treatment plans on those qEEG’s.

2.6. Survivors Syndrome, Dissociative Symptoms and EEG Suppression

The concept of EEG suppression and ‘Survivors Syndrome’ is unique in the neurofeedback literature. Individuals with Trauma- and Stressor-related Disorders commonly exhibit what Ochs refers to as a ‘Survivors Syndrome.’ The latter is typically associated with an extreme lack of variability of the EEG that is hypothesized to be related to inhibitory neurotransmitter activity (Ochs, 2006). On the ‘Standard Map’, ‘Survivors Syndrome’ commonly presents as multiple electrode sites with low amplitudes with small standard deviations. On the ‘Suppression Map’ EEG variability is also limited: Commonly, the majority of electrode sites exhibit a low coefficient of variation.

Ochs’ notion of suppression is related but not identical to the concept of burst suppression (e.g., Niedermeyer, 2009), an EEG pattern correlated with cerebral anoxia and anesthesia with mixed slow and fast electrical activity with decreasing amplitude as anesthesia deepens. This kind of EEG suppression in trauma survivors with complex histories may be neurochemically related to the dissociative symptoms commonly experienced by this group (van der Kolk, 2005). Indeed, it has been suggested that dissociation is at least in part mediated by stress-related release of endorphins and endogenous opioids (e.g., Schore, 2001; Lanius, 2014).

2.7. LENS Feedback To Body and Brain

EEG biofeedback typically involves the use of sensors placed on the scalp only. While biofeedback approaches have used EMG, temperature, GSR, ECG and others, they typically do not use EEG on the body. LENS neurofeedback is different in that it uses a measurement of the dominant frequency and applies feedback not only to the scalp, but also to other locations of the body. The latter application is often preferred when using LENS to alleviate CNS dysfunction associated with pain activity or musculoskeletal issues.

While the use of EEG neurofeedback on the body seems unusual, it should be noted that the skeletal muscles operate at a frequency of about 10hz, similar to the dominant frequency of the human brain. As suggested by Horsley & Schäfer (1888): “Every prolonged contraction of the skeletal muscles which is provoked by excitation (…) is a titanic contraction (…) passing along the motor nerves at an average rate of about 10 per second. ” This frequency is similar at multiple sites of the body. There is suggestion that it is not innervated by the brain’s alpha rhythm, in that it continues if the brain is isolated from the body (Marshall & Walsh, 1956).

3. Methodology

Four non-randomly selected cases are described that were selected on the basis that they had not previously responded or incompletely responded to previous psychological, psychiatric, as well as in two cases previous neuro therapy intervention. All cases described were conceptualized in terms of a Developmental Trauma Disorder. Each client exhibited significant dissociative symptoms and met, among others, diagnostic criteria for a Dissociative Disorder, e.g. Dissociative Identity Disorder, Depersonalization/ Derealisation Disorder and/or Other Dissociative Disorder not specified.

All LENS neurofeedback to the head was conducted with Lensware 2 installed on a Toshiba laptop running Windows 7 64-bit software. Single channel LENS neurofeedback to the body also utilized Lensware 2. Two-channel LENS neurofeedback was conducted with Lensware 3 installed on the same laptop computer. The amplifier used on all occasions was an Alpha 200.

All scalp sites were prepared with Nuprep (Weaver) and standard EEG electrodes were attached with Ten20 conductive paste (Weaver), using A1 and A2 as reference and ground respectively. For body sites, ECG leads and electrodes (Kendall H124SG) were used. In case of LENS neurofeedback to the body, electrodes were affixed to their respective sites/locations in the shape of an equilateral triangle. In the case of bilateral 2-channel applications, the grounds for both sites were linked at the amplifier. For LENS neurofeedback to the brain, electrode sites were accessed in order based on topographic EEG maps that provide information about EEG amplitude and variability. In all cases, ‘Suppression Maps’ were utilized as long as suppression was evident.

The author had previously found that optimal dosing of the LENS neurofeedback in a population of clients with Developmental Trauma was difficult at times, in that the window for optimal amounts of feedback tended to be narrow, with clients having a tendency to exhibit symptoms of excessive stimulation that included ‘wiredness’, ‘tiredness’ and headache activity.

Encouraged by the findings of Kluetsch et al. (2014) the author developed a set of hybrid protocols that include the use of an alpha filter (8-12hz) when applying LENS neurofeedback – typically LENS feedback is based on 1-42hz activity. Apart from limiting feedback to 8-12hz and using 100% duty cycle, stronger or more aggressive feedback settings were used – increased duration, increased number of sites, decreased offset (smaller offsets tend to have more powerful effects), more frequent use of a narrow band rather than broad band carrier wave (narrow band has more powerful effects than broad band), etc. Rather than providing feedback at

Pz or another posterior site alone, LENS was administered to all 21 electrode sites (10/20 system), the approach commonly used when administering LENS.

3.1. Case 1-Depersonalization Disorder

The client was referred by a psychiatrist for neurofeedback to assist with an intractable Depersonalization Disorder. The client had a history of neglect with absent parents during early childhood including multiple and inadequate caregivers. There was suggestion of probable childhood sexual abuse by a substitute caregiver. Onset of depersonalization symptoms occurred after a recreational MDMA (Ecstasy) experience. A pre-existing history of Social Anxiety was noted. There had been a full medical and neurological work-up with CT-scan, MRI and EEG previously. Some CT scan anomalies were noted in the right temporal lobe but these were judged to be artifact on a later MRI. In addition, some right temporal lobe anomalies were noted on EEG but these were judged as not epileptiform in nature. Prior to referral, the client has undergone pharmacotherapy with antidepressants, Sensorimotor Psychotherapy and EMDR, all to little or no avail.

Subsequent to the referral, a course of neurofeedback with Neuroptimal was introduced that resulted in a mild decrease in anxiety but had no effect on depersonalization symptoms. In conjunction with the referral source, a course of low dose naltrexone (LDN) was started, an intervention that has been found helpful in Dissociative Disorders (Lanius & Corrigan, 2014; Pape & Wöller, 2015). A slight but functionally insignificant effect on depersonalization was noted. Subsequently, higher doses of naltrexone were introduced, as these had been demonstrated to be beneficial in Depersonalization Disorder specifically (Simeon & Knutelska, 2005). Starting dosage was 50mg per day that was titrated up in 50mg steps. The most notable therapeutic effect on depersonalization occurred at 150mg per day, with 200mg per day triggering significant anxiety. Nevertheless, depersonalization and social anxiety continued to interfere profoundly with both employment and social functioning.

A set of initial LENS maps, both a ‘Regular Map’ and a ‘Suppression Map’, was acquired. The ‘Regular Map’ was notable for low amplitudes on the majority of sites with the exception of elevated amplitudes with little or no standard deviation on P4, F4, C4, and O2. On those very sites an elevated dominant frequency was also noted with a lack of normal variability. On the ‘Suppression Map’, each and every one of the 21 sites accessed was suppressed, e.g., had a coefficient of covariation that fell below the .35 value.

LENS treatment - using standard LENS 100% duty cycle applications (100% duty cycle applications are generally recommended in seizure spectrum disorders) - proceeded slowly, as the client could only tolerate a limited number of sites (2-3) being accessed at a time without responding either with increased anxiety on one hand or increased depersonalization on the other. Amplitude suppression failed to lift significantly. In order to lift suppression more effectively, a LENS application that uses changeable offsets, commonly referred to as a Variable Pulse application, was utilized. While this resulted in a successful removal of suppression on the sites accessed, the client reported a panic attack in the week following treatment while travelling in a car with her family.

Subsequently, the author, based on theoretical notions discussed above and experience with other clients, used a LENS application (Appendix A) with an alpha bandwidth filter (8-12hz), 100% duty cycle, a relatively small offset of 10hz and narrow band. The client responded well to this new LENS application, with much less adverse effects. Indeed, the number of sites could be rapidly increased, with the client ultimately able to tolerate accessing all 21 sites in a single session. This application seemed to lift amplitude suppression quite effectively, while at the same time introducing decreased variability with regard to frequency. That is, it tended to lift the dominant frequency into the alpha range with decreased variability, thus introducing frequency suppression while lifting average amplitude suppression. This was correlated with significant improvement in depersonalization and social anxiety.

In addition to the 21 site sessions, multiple sessions where 7 sites were accessed at a time followed up by EMDR, were conducted. 7 sites was judged to be the maximum number of sites that would allow sufficient time for conducting an EMDR session within a 50 minute-hour therapy session. Whereas the client had been unresponsive to EMDR treatment previously due to excessive levels of levels of depersonalization, the combination of naltrexone and LENS seemed to result in the client increasingly benefitting from EMDR treatment. Finally, a further application was written to assist with lifting frequency suppression (Appendix B). A variable pulse application with small offsets, narrow band, 100% duty cycle that was followed by a period of a 100% duty cycle with an alpha filter. This application lifted frequency suppression completely while re-introducing a limited amount of mean amplitude suppression. At the time the client had undergone 48 LENS sessions. At this point, depersonalization and social anxiety had massively decreased to a point where they no longer interfered with employment and social functioning and the patient terminated treatment.

3.2. Case 2-Other Dissociative Order not Specified

The client had a history of severe attachment issues that included parental abandonment and neglect and childhood sexual abuse. He was being treated pharmacologically with antidepressant and stimulant medication. He had a graduate degree in psychology. He was unable to work when he self-referred. He had previously been diagnosed with Major Depressive Disorder and Attention Deficit Disorder. He had a pornography addiction. He also presented with significant dissociative symptoms. He specifically requested a course of Sensorimotor Psychotherapy, as well as expressing an interest in EMDR.

Initial interventions included Sensorimotor Psychotherapy, EMDR, as well as Neuroptimal neurofeedback. There was only limited response to treatment, which was attributed to significant depersonalization and derealisation. The treating psychiatrist agreed to prescribe LDN. The addition of LDN resulted in a significant improvement in functioning - e.g. increased attentional functioning, decreased dissociative symptoms and improved mood - but response to psychotherapy remained limited.

The client reluctantly agreed to LENS neurofeedback due to beliefs about the nature of LENS, as compared to standard neurofeedback that he was familiar with. His initial LENS map again showed a ‘Survivor Syndrome’ on both the ‘Regular Map’ and the ‘Suppression Map’. The client was able to tolerate the use of 100% duty cycle application with an alpha filter (Appendix A) on all 21 sites, with a concurrent lifting of mean amplitude suppression on several sites that was correlated with further improvement in functioning.

At this time, response to EMDR therapy much improved. At the same time, on the regular map significant high delta amplitudes in the frontal region emerged (F8, F7, FZ, FP1, FP, FP2) with slightly higher amplitudes in the left hemisphere. An attempt to decrease delta activity in the frontal lobes, a LENS application using a delta filter was utilized. This was effective in reducing delta band activity but resulted in symptom re-instatement. A return to the application using the alpha filter resulted in the improvement of functioning to previous levels. After a total of about 40 LENS sessions, some of which were LENS only (all 21 sites accessed) and others were LENS (7 sites accessed) in combination with EMDR, the client found employment in another community and chose to move and subsequently terminated treatment.

3.3. Case 3-Complex Regional Pain Syndrome

A client who presented with Complex Regional Pain Syndrome (CPRPS) was experiencing intractable pelvic pain. She had undergone multiple interventions that had essentially been unsuccessful. The client had a history of severe attachment trauma, early sexual abuse, as well as multiple severe medical trauma. CRPS was triggered by a medical procedure during adulthood. The client was on antidepressant medication, gabapentin, lorazepam, cesamet prn, Sativex, as well as topical ketamine and gabapentin. She also had been prescribed LDN for her CRPS pain (Chopra & Cooper, 2013) by a specialist but was unable to tolerate the LDN prescription of 4.5mg per day, as it created massive activation and anxiety for her. As a result the client discontinued the medication and returned to relying on prn opiates for pain control. After a consultation, the client weaned herself of all opiates and it was decided to massively lower the LDN dose to less than a quarter of what had been prescribed previously to 1mg per day. The client then underwent a combination of LENS neurofeedback to the scalp (all sites), as well as to the body.

The body location chosen was acupuncture spot Kidney 1 (K1) based on Oschman et al. (2015) who reported electrical grounding (earthing) of K1 to be effective in reducing inflammation in pelvic pain. A long body application (Appendix C) was utilized bilaterally on K1 on the soles of both feet three times for a total of 10 sessions. The client experienced being much more grounded (sic). There was noticeable decrease in perceived pain intensity after the first session that persisted and improved over time.

In addition, LED low level light therapy (LLLT) was used for brief durations on multiple occasions. LLLT has been shown to assist in decreasing pain activity (Cotler et al., 2015). The client could only tolerate short applications of LLLT, as again she had a tendency to become overstimulated. The combination of interventions resulted in a massive reduction in pain activity with much improved functioning. At the same time a diagnosis of a Dissociative Identity Disorder emerged. Psychological Treatment is ongoing. Naltrexone dosing has been slowly increased to 2mg per day in .1mg increments. While there remains ongoing pain activity in the pelvic area, the achieved pain reduction has been stable over two years and the client continues to make improvements in functioning.

3.4. Case 4-Early Childhood Medical Trauma

The client has early childhood medical trauma including severe birth complications including breech position, prolonged labour and uterine complications resulting in compression of the baby's neck. After 8 hours of labour an emergency C-section was conducted. APGAR score at birth was 1. At about 8 months of age, surgical hernia repair was conducted. The client was then put into daycare at 11 months of age. There is a history of significant attachment trauma due to multiple substitute caregivers prior to age one, as well as subsequently throughout childhood. Mother had a history of depression and alcohol abuse. Father was largely absent due to work. There were several incidents of sexual childhood sexual abuse by substitute caregivers. Previous diagnoses include Attention Deficit Disorder, learning disability, PTSD, as well as a Dissociative Disorder. He has also had a previous history of substance abuse. He has been maintained on antidepressants and LDN and has benefitted from both. On three occasions he has had flashbacks so severe that this resulted in a dissociative psychosis. He had undergone weekly LENS session over a period of three years, refusing other forms of psychotherapeutic interventions. The client made significant gains that have resulted in much improved educational functioning – he has been attending university, taking a part-time course load. However, he continued to suffer significant PTSD symptoms that include body tics like muscle tightening and grimacing around the face and neck, as well as pain and muscle spasms around the area of the hernia repair radiating into the groin.

At some point in time the client agreed to participate in other forms of psychotherapy, including EMDR. Sessions targeted multiple traumatic events - targeting the birth trauma using a narrative provided by the mother and focusing on the facial and neck sensations and tics – over 40 sessions in total. Sessions typically provided temporary relief at the time, usually lasting several days but did not hold over time with body tics returning with a similar level of severity and the SUD's level returning to previously elevated levels. In conjunction with the client, it was decided to give Body LENS a trial: Electrodes were placed in an equilateral triangle (approximately 2") arrangement on the area of the neck that was exhibiting the most severe muscle spasms. The previously utilized narrative was used to trigger muscle spasms and a LENS body application with a duration that was slightly longer than 30 minutes that was set to run the whole duration of the session (Appendix C; Periods 4, 6, 10 were set to 10 minutes respectively).

The client again experienced a significant calming effect, as soon as feedback was initiated. The client was asked to focus on the body sensation only using an EMDR bottom-up processing protocol (Lanius, 2009) and tactile bilateral stimulation (hand taps) was administered. The feedback seemed to allow the client to stay more easily in touch with the somatic sensations and seemed to result in the facilitation of somatic trauma discharging (e.g., Payne et al., 2015). For the first time, the therapeutic gains during the session were maintained over time and the decreased SUD level remained over time. The client reported much decreased activation in the neck and face, likely reflecting decreased somatosensory flashbacks. After five sessions, the activation in the facial and neck area had largely disappeared and the patient requested to target the area of the hernia repair that produced similar results.

4. Results and Discussions

4.1. LENS Neurofeedback to the Brain Effects

All cases described here have in common that there was no further progress with regard to response to treatment until the addition of LENS neurofeedback that changed the trajectory of treatment response in only a few sessions. The treatment response seemed to be correlated to the removal of suppression that was related to a marked improvement in overall functioning including a reduction in dissociative symptoms.

Typically, individuals with 'Survivors Syndrome' only tolerate relatively slow removal of suppression. Further it has been the author's experience that clients with Dissociative Disorders typically tolerate removal of amplitude suppression more easily than the removal of frequency suppression. Based on clinical observations, the use of specifically developed LENS applications that included the use of an alpha bandwidth filter has a profound impact not only on how LENS was conducted, but also on the EEG and behavioural response.

Three of the clients had undergone LENS treatment with standard LENS applications and they typically were able to tolerate accessing 2-4 sites per session. Using an alpha bandwidth filter they were able to tolerate the accessing of all 21 sites during a session, without undue adverse effects. When using an application that utilized an alpha bandwidth filter for the entire duration of the feedback, typically amplitude suppression was effectively removed - it appeared, more easily so than with typical LENS applications. At the same time, this seemed to reliably introduce frequency suppression on each and every site accessed (99% of the time). Moreover, if one subsequently used a complex LENS application and added a period with the use of an alpha filter at the end, both amplitude suppression and frequency suppression were effectively removed without undue adverse effects.

In addition, when using an alpha filter, the raw EEG clearly showed brief reduction in alpha amplitude with a subsequent alpha rebound. Moreover, more often than not, there was also an increase of theta amplitude, with theta intermittently rising above alpha. This phenomenon occurred both with eyes open and closed, though more reliably so with eyes closed. It appeared, that applying LENS neurofeedback to the brain with an alpha filter resulted in triggering a similar response to what is typically achieved with operant-based alpha-theta neurofeedback.

Finally, the emergence of delta activity in the frontal lobe as specifically described in section 3.2 is a relatively common phenomenon in clients with Developmental Trauma. The author, with a number of other clients, used a delta filter to reduce delta activity. Consistently, in each and every case, this resulted in symptom reinstatement until another LENS application was run without the delta filter. This raises the question whether such an emergence of slow wave activity is an essential part of information processing therapies. A similar emergence of slow wave delta activity has been observed during EMDR bilateral stimulation and has been hypothesized to be involved in memory consolidation (Pagani et al., 2017).

4.2. LENS Neurofeedback to Body

Body LENS seems to have a significant role in reducing somatic reactivity, somatic flashbacks and pain activity. In both cases, a LENS application was utilized that included the use of an alpha filter at the end of the application. This was based on theoretical grounds that included the findings that the body resonates at a frequency in the alpha range and previous successful use when applying LENS neurofeedback to the brain, though I have no data or observations that support the use of that strategy with regard to Body LENS.

In both cases described, LENS neurofeedback was again administered for longer durations with more aggressive settings than is typically the case. It should be noted that the author has used the LENS approach discussed in section 3.3 with two further CRPS clients. In one case, where the client was not on opiates, this was also successful. In another, where the client continued to be on opioid medication, the first session seemed initially successful but did not hold with the client continuing to use opiates for pain control. In that case, further sessions did not seem beneficial, only leading to increased perceived pain, potentially suggesting the involvement of the opioid system in the effectiveness of LENS.

5. Conclusion

In clients that did not respond or had a limited response to other interventions, LENS seems to have utility in stabilizing clients, as well as facilitating psychotherapeutic response in clients with Developmental Trauma that did not respond to other treatment interventions. While LENS does not seem unique among different types of neurofeedback in facilitating increased response to psychotherapeutic interventions, (e.g., Gerge, 2018; Yordy, 2018), at least one other type of neurofeedback had been ineffective in two of the cases discussed here. While the reported results are encouraging, placebo effects cannot be ruled out. A trial of LENS with Developmental Trauma under double – blind conditions is desirable.

When compared to operant based neurofeedback, LENS, due to its short treatment duration, allows for easier integration with other psychotherapeutic interventions. In addition, the possibility to use LENS on the body that includes areas activated due to intractable somatosensory flashbacks, as well as the targeting of specific acupuncture sites, may provide additional venues for clients suffering from complex Developmental Trauma that are not responsive or only minimally responsive to the usual treatment interventions. This use of LENS is consistent with an information processing approach, allowing opportunity to integrate both bottom-up and top-down processing.

Ochs hypothesizes that LENS may affect the levels of inhibitory neurotransmitters. The notion that the level of inhibitory neurotransmitters – endogenous opioids, beta-endorphin in particular - being affected by neurofeedback was first noted by Peniston & Kulkosky (1989), who found increased beta-endorphin levels in individuals that underwent treatment as usual, and reduced levels in those that underwent neurofeedback. Inhibitory neurotransmitters are also involved in dissociative symptoms (e.g., Simeon & Knutelska, 2005) and may play a role in EEG suppression. Pharmacological interventions that target the opioid system may have additional and synergistic effects with regard to the effectiveness of neurofeedback. For instance, Lensing et al. (1995) suggested that excessive opioid activity interferes with cortico-thalamocortical processing of visual stimuli, finding that the opioid antagonist naltrexone reinstated selective alpha blocking, thereby increasing visual pursuit behaviour. Further research with regard to neurofeedback and the role of inhibitory neurotransmitters is indicated.

It has been suggested that alpha desynchronizing neurofeedback, while associated with decreased alpha amplitude during training, is followed by a significant increase (‘rebound’) in alpha amplitude (Kluetsch et al., 2016). That phenomenon bears much resemblance to what the release of suppression looks like during LENS neurofeedback. Moreover, this alpha rebound phenomenon may throw a different light on Plotkin and Rice (1981) notion of attributing neurofeedback effects to placebo, based on their findings that reducing alpha amplitude had similar effects to increasing alpha amplitude on anxiety reduction. Indeed, it seems that suppressing alpha activity, either with operant conditioning based neurofeedback, or targeting alpha with LENS, ultimately seem to have an effect that appears similar to that of rewarding alpha amplitude.

Klimesch (2012) has argued that alpha plays a significant role in information processing. Specifically, he suggests that alpha-band oscillations are involved in inhibition and timing that relates to fundamental functions of attention, enabling one’s ability to be consciously oriented in time, space, and context. As such, alpha-band oscillations reflect one of the most basic cognitive processes. Thus, targeting alpha activity may affect basic homeostatic processes essential to information processing.

While there is clear theoretical rationale for learning and operant based neurofeedback that is supported by an emerging field of research, (an) underlying functional mechanism(s) for LENS are at this time, for the most part, hypothetical and speculative. Nevertheless, LENS conceptualizations and effects raise some questions relevant for traditional operant based neurofeedback. At the same time, LENS may benefit from integrating alpha focused interventions, as suggested by relevant research with regard to traditional neurofeedback.

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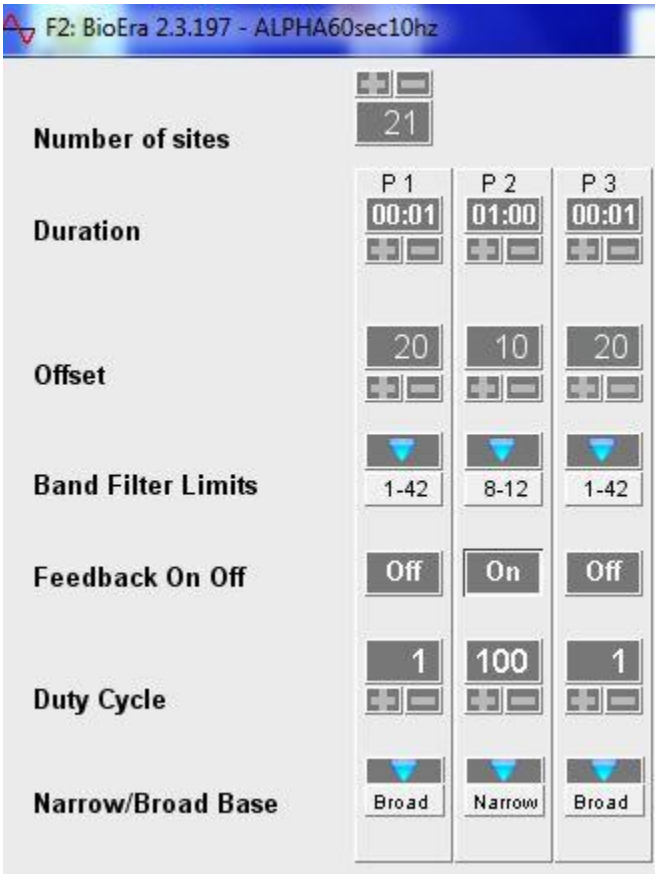
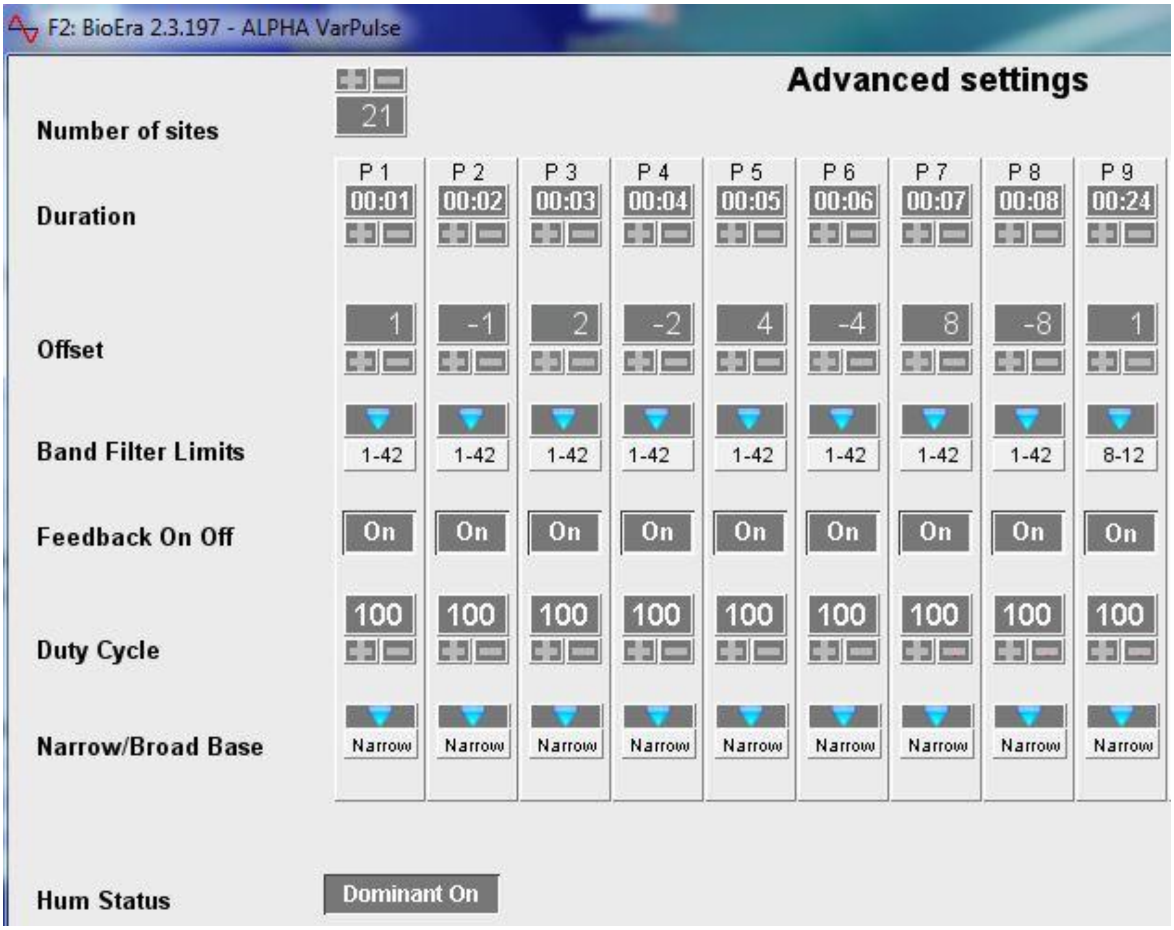
Appendix A: Initial LENS alpha filter application



Appendix B: Variable Pulse alpha filter application



Appendix C: Body application