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Infra-Low Frequency: A Proposed Mechanism

Infra-Low Frequency (ILF) work is a new development in neurofeedback training. Executed in a bipolar montage, it addresses the lowest energy the brain produces: less than .1 hertz. Often confused with Slow Cortical Potential(SCP), this slow moving signal is addressed in the alternating current (AC) domain.

Recent developments in commercial amplifiers available to neurofeedback practitioners have produced an instrument that is Direct Current (DC) coupled. This seamless integration of the lower (DC) and higher(AC) energies has produced a superior instrument for infra-low training. These DC coupled amplifiers produce enough "bounce" in the low alternating current domain, riding as they do on the DC off-set, to filter and train energies below .1 hertz with little or no noise in the signal.

The infra-low signal may have similar properties with SCP, influencing the excitability cycle of higher frequencies produced in the cerebral cortex. However, the training of these two energies (SCP/ILF) produce very different clinical effects.

The effects of ILF training are often immediate within session in contrast to SCP training. Producing subtle and not so subtle state shifts on the arousal continuum, the therapist's goal is to optimize the training so the client is most relaxed and at the same time most alert. This is accomplished through optimizing the reward contingency for each client. The positive effect of training is often immediately apparent. Pain reduction, euthymia, calming, and improved attention are just a few of the common reactions to training. Improved autonomic functioning is typical of this intervention. The speed of symptom reduction should not be confused with symptom elimination. As with all

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neurofeedback, many repetitions are necessary for the improved symptomology to become operantly learned behavior. Due to the fast response within session, ILF can be a potent client retention tool as well.

Infra-Low frequency training is powerfully self-regulating. When using this intervention to address a clients chief complaint, very often the resolution of dysfunction in other regulatory networks, such as the sleep cycle, digestion and elimination, affective functioning, focus and concentration become greatly improved. These outcomes resonate with recent research that has established the low frequencies as integral to many brain functions. An explanation for this generalized impact on function may be found in the fact that the Infra-low frequencies are embedded in and determinant of the excitability cycle of higher frequencies. Vanhatalo (2004) established a role for the Infra-low frequencies in the control of gross cortical excitability. This research detected a close association between the ILF and cyclic modulation of fast EEG activity. Moreover, these slow frequencies are tightly associated with K complexes and inter-ictal activity. According to Monto(2008) human behavioral performance is correlated with the infra-low fluctuations in on-going brain activity. He detected a strong correlation between a subjects ability to detect a sensory stimuli and the phase of the low frequency signal. Supporting this correlation, Broyd (2011) found attention induced deactivations of the ILF signal do not occur in Default Mode areas of cortex in subjects with ADHD suggesting that they get "stuck" in self-referential processing unable to turn off areas of cortex when appropriate.

It was almost fifty years ago that Aladjalova (1964) proposed a role for the Infra-low frequencies in hypothalamic functioning. His animal research discovered that stimulation of the ventromedial nucleus of the hypothalamus resulted in high-amplitude slow waves with a long latent period appearing in the EEG of both hemispheres. The ILF increased in amplitude simultaneously with the appearance of high-amplitude slow waves, 40-50 min after the onset of stimulation. At the same time the infraslow oscillations decreased, slowing its frequency from 8 to 5 osc/min and the amplitude increased from 0.3 to 1 mV.

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Additionally, the ILF becomes intensified by agents that elicit a defense reaction similar to the response to "stress". Their research suggests the efficacy of ILF training may lie in its impact on the Hypothalamus.

Situated as it is within the limbic system, the hypothalamus plays an integral role in affective response, as well as, playing a vital role in maintaining homeostasis. It is the control center for many autonomic functions of the peripheral nervous system.

Hypothalamic hormones control pituitary hormone secretion which in turn manages adrenal secretion of Epinephrine and Neuroepinephrine, the hormones that organize sympathetic nervous system response. Known as the Hypothalamic/Pituitary/Adrenal Axis (HPA), this organ system has feedback loops that promote reparative, parasympathetic nervous system, response as well. Colloquially, this system is referred to as the flight or fight mechanism.

Traditionally, ILF training has used one or the other of the temporal lobes as one of two bipolar placements on the scalp. The other placement may be any of the other nineteen 10/20 sites. It is proposed that this configuration explains the routine reactions of calming, arousal reduction, and attention promotion observed among trainees. This bipolar electrode configuration promotes difference in the training. So theoretically it separates brain areas linked in chronic autonomic stress by differentiating them electrically from the hypothalamic or limbic areas. Separating the non-temporal area from the HPA distress signal.

Recent ILF work with children on the autism spectrum has produced profound positive changes in behavior. During ILF training we focus on areas that link limbic functioning with areas that support facial recognition, sensory integration, prosody, and emotional equilibrium. Results have been very positive. So much so that a special needs school has contracted with us to start a neurofeedback program. After approximately twenty five sessions of Infra-Low Frequency training preliminary results were very encouraging. The first group of children diagnosed with Autism Spectrum Disorder and trained with ILF

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showed one and two standard deviations of improvement on the Child Behavior Checklist in many areas of behavior including social functioning, attention, and conduct problems.

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