Neurofeedback Standardised Protocols and Information
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1. Background

Neurofeedback follows the international 10/20 standard for electrode placement during EEG recordings and brain training events. Various brain conditions can be detected by an EEG and the international 10/20 standard is critical to ensure tests being conducted can be reproduced. Evidence gathered through the international standard ensures that scientific rigor is maintained and that the scientific community can judge test results objectively.

The international standard being followed is illustrated by figure 1.

![Figure 1: Neurofeedback Alliance. (2018) EEG & Electrophysiology. [Online]. http://neurofeedbackalliance.org/eeg-electrophysiology/](neurofeedbackalliance.org/eeg-electrophysiology/)

Various lobes in the brain responsible for specific tasks are illustrated by figure 2.

![Figure 2: University of Queensland. (2018) Queensland brain institute. [Online]. https://qbi.uq.edu.au/posters](qbi.uq.edu.au/posters)

The advancement in technology makes more detailed analysis possible, including Quantitative Electroencephalogram (QEEG), Low Resolution electromagnetic Tomography (LORETA) and Standardized Low Resolution Electromagnetic Tomography (sLORETA) which includes looking at Brodmann areas and also Evoked Potentials (EVP). It is however important to remember that even though all these new methods of assessment exist considerable success has been obtained over the years by making use of single-channel assessments. (Thompson & Thompson, 2015)
1. Frequency Overview

- **Delta 1-3 Hz** = Slow wave associated with sleep. It should not be dominant in adults. Excess delta may be associated with damage to the brain in head injuries and learning disabilities.

- **Theta 4-8 Hz** = Daydream-like state of mind. Excess causes attention problems. Excess daydream waves (theta) and deficient thinking waves (beta) is seen in one type of attention deficit disorder.

- **Alpha 8 –12 Hz** = Relaxed idling brain waiting to respond. Excess alpha may be associated with attention problems, depression, and memory disorders. Too little alpha may be seen in those with alcoholism, insomnia, and anxiety.

- **Beta 12 –20 Hz** = Small fast waves occur with mental activity and concentration. Deficient beta may be present in attention problems, learning disabilities, and brain injuries. Excess beta (brain over arousal) is associated with anxiety, alcoholism, insomnia, PTSD, and attention problems.

- **High Beta 20 -30 Hz** = Fast waves associated with worry, anxiety, over thinking.

- **Gamma 30-100Hz** = Function is still unclear, but Neuroscientists believe that gamma waves are able to link information from all parts of the brain - the gamma wave originates in the thalamus and moves from the back of the brain to the front and back again 40 times per second - not only that, but the entire brain is influenced by the gamma wave. This rapid “full sweep” action makes the gamma state one of peak mental and physical performance.
2. Existing Technology, Used in "Repairing" Brain Patterns

Other Treatment modalities:

**Heart rate variability training (HRV)**
- Is dependant on the variation (R-R intervals) between heart beats.
- It is a normal cyclic variation in heart rate and one aims to have a variation of at least 10.
- The Respiratory Sinus Arrhythmia (RSA) is the naturally occurring variation in heart rate that occurs due to the breathing cycle and is directly proportional to the HRV.
- Training is aimed at monitoring the RSA and adjustment of breathing patterns in order to increase HRV.

**Transcranial Direct Current Stimulation (tDCS)**
- Involves direct current stimulation of very small direct electrical current (DC) between an anode and cathode.
- Typically below 2 milliamps and cannot be felt by the client.
- Electrodes are typically connected to a conductive pad which distributes the current over the surface of a saline-impregnated sponge.
- Anode stimulation is theorised to result in excitation of the underlying superficial cortical neurons and cathode stimulation will result in hyperpolarization and cortical inhibition. The anode stimulation will increase beta and reduce delta while the cathode stimulation increases delta.
- It has been found to be useful to use prior to regular neurofeedback.

**Cranial Electrical stimulation (CES)**
- This technique passes small impulses of alternating current (AC) through the brain.
- Typically involves a weak pulse applied bilaterally across the cranium via placement of small electrodes on the side of the head.
- AC of mainly 0.5-100Hz is employed.
- It is hypothesized that the effects are mediated through a direct action on the brain involving the brain stem, limbic system, reticular activation system and the hypothalamus.  
  *Further research is still required.*

**Light therapy (low intensity laser) and LENS**
- Generally used to decrease inflammation and improve healing.
- LENS (low energy neurofeedback system) stimulates the brain using low intensity, high frequency stimulation that pulsates at different rates. It involves stimulation without effort from the client and is more invasive than the regular neurofeedback approach.

**Infrared hemoencephalography (pIR HEG)**
- Includes the use of one or two infrared detection sensors that reflect temperature changes in the cortex.
- Usually placed on the forehead by a Biofeedback practitioner.
- Based on the principle that an increase in temperature reflects changes in the metabolic activity of the frontal lobes.
- This should indicate beta activation in these areas with improvement of executive functions.

**Slow Cortical Potential (SCP) Neurofeedback**
- Slow cortical potentials are slow, event-related, direct current (DC) shifts of the EEG and originates from the upper cortical layer.
- SCP training is not traditional amplitude training. There is rather a monitoring of the shifting of brain potentials relative to a standard reference and makes it possible to either shift this potential up or down. The polarity of the training is important as this is what dictates whether the potentials will be trained in either an activating or deactivating manner.

**Transcranial magnetic stimulation (TMS)**
- Typically used in a hospital or private practice setting. It is a repetitive process and is mostly used for atypical depression. Positive results have also been seen in Parkinson’s and a decrease in beta spindling has been noted where low frequency 10 Hz rTMS has been used over areas where spindling occurs.
3. Single Channel Assessment

The most widely used single channel assessment is known as the Clinical Q and was developed by Paul Swingle. It provides diagnostic data that permits accurate descriptions of the complaints a client has without any description of symptoms. It only requires 6 and a half minutes of recording time when using a single electroencephalogram (EEG) channel and one looks at identifiable EEG patterns associated with physical and psychological disorders.

The 10/20 sites included in the measurement are Cz, O1, F3, F4 and Fz. The frequencies measured at each site are Delta at 2Hz, Theta at 3-7Hz, Alpha at (8-12 Hz), Sensory Motor Rhythm (SMR) at 13-15Hz, Beta at 16-25 Hz and Hibeta-Gamma at 24-40 Hz. Lo-alpha at 8-9Hz and Hi-Alpha at 11-12 Hz is also included. (Swingle, 2015)

1 Channel assessment From Paul G. Swingle Summary Tables from *Adding Neurotherapy to Your Practice*

<table>
<thead>
<tr>
<th>Symptoms associated with Cz</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Symptoms associated with O1</th>
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<td></td>
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</tbody>
</table>
Symptoms associated with F3 and F4

<table>
<thead>
<tr>
<th>Table 2.3</th>
<th>Basic clinical probes for location F1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formula</strong></td>
<td><strong>Amplitude in microvolts (μV)</strong></td>
</tr>
<tr>
<td>Alpha recovery: Alpha(EO2)/Alpha(EO1) after</td>
<td>0.25 %</td>
</tr>
<tr>
<td>Theta(EO1)/Beta(EO1)</td>
<td>1.8—2.2</td>
</tr>
<tr>
<td>Total amplitude (EC)</td>
<td>&gt;0.5</td>
</tr>
<tr>
<td>Peak alpha frequency (EC)</td>
<td>&gt;0.5</td>
</tr>
</tbody>
</table>

Symptoms associated with disparities between F3 and F4

<table>
<thead>
<tr>
<th>Table 2.4</th>
<th>Basic clinical probes for locations F3 and F4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formula</strong></td>
<td><strong>Amplitude in microvolts (μV)</strong></td>
</tr>
<tr>
<td>Theta(EO1)/Beta(EO1)</td>
<td>&lt;2.2</td>
</tr>
<tr>
<td>Total amplitude (EC)</td>
<td>&gt;0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2.5</th>
<th>Basic clinical probes for imbalances between locations F3 and F4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formula</strong></td>
<td><strong>Amplitude in microvolts (μV)</strong></td>
</tr>
<tr>
<td>(F4)/F3</td>
<td>&gt;0.20 %</td>
</tr>
<tr>
<td>F3</td>
<td>&gt;15 %</td>
</tr>
<tr>
<td>F4</td>
<td>&gt;15 %</td>
</tr>
<tr>
<td>F3</td>
<td>&gt;15 %</td>
</tr>
<tr>
<td>F3</td>
<td>&gt;15 %</td>
</tr>
<tr>
<td>F3</td>
<td>&gt;15 %</td>
</tr>
</tbody>
</table>
4. QEEG Based Assessment

The QEEG is based on the determination of EEG abnormalities by comparing the individuals to a “normative” or “reference” database. Statistical deviations from the mean values in the database are used in combination with other clinical information to determine abnormalities or deviances in brain function. Several databases are available for (Johnstone, Gunkelman, & Lunt, 2005) evaluation. They mostly differ in sample size; screening criteria and EEG features normed.

The predictive accuracy and error rate are dependent on the data that makes up any given database and the sensitivity and specificity is directly proportional to the adherence to established statistical principals. (Thatcher, Walker, Biver, & North, 2003) The Four Daubert Factors (Thatcher, Walker, Biver, & North, 2003) for scientific standards of admissibility in Federal Courts that have already been met for several databases are:

1. Inclusion and exclusion criteria
2. Error estimates of reliability and validity
3. Peer reviewed publications
4. General acceptance.

It is important to know that these databases contain EEGs of medication free subjects. One must be able to recognize the influence of psychoactive medications when interpreting QEEGs. (Johnstone, Gunkelman, & Lunt, 2005) (Gunkelman, 2012)

Various articles have been published where certain QEEG biomarkers have been identified and tied to specific disorders. EEG and QEEG Phenotypes can also be defined as a QEEG profile or a neurophysiological “phenotype” that is variably representative in one or more disorders defined behaviourally. (Johnstone, Gunkelman, & Lunt, 2005) It
is however important to realize that even though an individual QEEG profile may contain elements of several phenotypes it may be more complex and can contain elements of several patterns.

It can also be a manifestation of both the genome and behaviour and these phenotypes are highly heritable and not isomorphic with DSM categories. This can have implications on the therapeutic level. (Pop-Jordanova, Zorcec, Demerdzieva, & Gucev, 2010) Different phenotypes are discussed in section 2 with the most widely used treatment protocols for these phenotypes or conditions.

As published by the Association for Applied Psychophysiology and Biofeedback (AAPB) (Tan, Shaffer, Lyle, & Teo, 2014):

Biofeedback is a technique that enables an individual to learn how to change physiological activity for the purposes of improving health and performance (Gilbert & Moss, 2003; Schwartz & Andrasik, 2003; Shaffer & Moss, 2006). Biofeedback instruments are used to feedback information about physiological processes, assisting the individual to increase awareness of these processes and to gain voluntary control over body and mind. Biofeedback instruments measure muscle activity, skin temperature, electrodermal activity (sweat gland activity), respiration, heart rate, heart rate variability, blood pressure, brain electrical activity, and blood flow.

Research shows that biofeedback, alone and in combination with other behavioural therapies, is effective for treating a variety of medical and psychological disorders, ranging from headache to hypertension to temporomandibular to attentional disorders. The present publication surveys these applications and reviews relevant outcome research.

Biofeedback is used by physicians, nurses, psychologists, counsellors, physical therapists, occupational therapists, and others. Biofeedback therapies teach the individual to take a more active role in maintaining personal health and higher level mind-body health.

Neurofeedback is a specialty field within biofeedback, which is devoted to training people to gain control over electro-physiological processes in the human brain (Demos, 2005; Evans & Abarbanel, 1999; LaVaque, 2003; Thompson & Thompson, 2003). Neurofeedback uses information from the electroencephalogram (EEG) to show the trainee current patterns in a patients’ cortex. Many neurological and medical disorders are accompanied by abnormal patterns of cortical activity (Hammond, 2006).

Neurofeedback assessment uses a baseline EEG, and sometimes a multi-site QEEG, to identify abnormal patterns (LaVaque, 2003). Clinical training with EEG feedback then enables the individual to modify those patterns, normalizing or optimizing brain activity. Neurofeedback practice is growing rapidly with the widest acceptance for applications for attention deficit hyperactivity disorder (ADHD), learning disabilities, seizures, depression, acquired brain injuries, substance abuse, and anxiety (Clinical EEG, 2000).”

“Treatment” versus “Training”

“Treatment” implies a passive patient receiving something therapeutic from an active practitioner.

The patient’s automatic healing processes may be expected to operate, but beyond that, the patient is not asked to do much more than show up for procedures or swallow pills on schedule. “Treatment” is what insurance is traditionally designed to reimburse.

“Training,” on the other hand, implies more active participation; people are trained to ride a horse, perform a job, ice-skate, etc. Learning is interactive, guided by
instruction and information in order to develop a skill. Most biofeedback is done with this orientation, even though the action may be internal and visible only with the biofeedback instruments. Insurance policies often exclude procedures labelled “educational.” The educational component in biofeedback, however, is more akin to speech therapy or rehabilitation than to a more abstract pursuit of knowledge.” (Tan, Shaffer, Lyle, & Teo, 2014)

“Both biofeedback and neurofeedback are holistic therapies, based on the recognition that changes in the mind and emotions affect the body and changes in the body also influence the mind and emotions. Biofeedback and neurofeedback emphasize training individuals to self-regulate, gain awareness, increase control over their bodies, brains, and nervous systems, and improve flexibility in physiologic responding.” (Tan, Shaffer, Lyle, & Teo, 2014)

5. Assessment and Intervention of Various Disorders

It is important to note that various protocols exist for training and that it is never a one size fits all approach. That is why having a QEEG or other assessment data available will allow for the most effective protocols to be developed. Neurofeedback is objective and data driven. When deviances are noted from what normative ranges, one trains to correct this. The client understands that the purpose of treatment/training is to correct these anomalies in order to modify symptoms associated with it. As a rule most clinicians are trained to start with training from the back of the head and move forward. Excess activity in frontal areas typically improves with improvement at Cz. For the conditions below recommendations are made based on literature but individualized adjustments can be necessary.

2. Instructions for Complete Protocol while using Bellabee within NFB Session

Take note that these are general recommendations and that individual protocol adjustments might be needed for different clients to get an optimal response. A 1-Channel assessment or QEEG is recommended to help with these adjustments but it is also always important to monitor client response and make adjustments accordingly.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Typical Deviance</th>
<th>Neurofeedback Recommendation</th>
<th>Bellabee Recommendation</th>
</tr>
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<tbody>
<tr>
<td>ADD/ADHD (Various subtypes)</td>
<td>Excessive slowing noted compared to fast wave activity. Look at the Theta (3-7Hz) to Beta(13-21 Hz) ratio. If the ratio of Theta to Beta is more than 3:1 suspect ADD/ADHD. Typically measured at Cz.</td>
<td>1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta Inhibit 22-30Hz Hi-beta at C4 or Cz 2. Zscore training at C3-C4, P3-P4, F3-F4 3. ISF at T3-T4 4. sLoreta in the DMN or ROI Inhibit theta in relevant areas</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min</td>
</tr>
<tr>
<td>Excess frontal Beta</td>
<td>Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta, Inhibit 22-30Hz Hi-beta at C4 or Cz, 2. Zscore training at C3-C4, P3-P4, F3-F4, 3. ISF at T3-T4, 4. Alpha training at O1/O2 or Pz (Enh 11-12Hz)</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min OR 8 Hz 10 Min, (1 Hz 10 min, 10 Hz 20 Min, 9 Hz 10 Min, 8 Hz 10 Min OR where lower alpha peak is seen 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min</td>
<td>8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min</td>
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<tr>
<td>Low Alpha Peak frequency for the clients age is usually associated with slower processing speed. Can be measured at Pz.</td>
<td>1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly 2. ISF T3/T4 (Although no current research is currently available clinical experience has shown an increase in alpha peak freq for most individuals) 3. sLoreta training ROI precuneus/occipital enh alpha</td>
<td>8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min</td>
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<tr>
<td>Frontal Slow is seen where there is excessive Theta or Alpha activity in the frontal lobes. Can be measured at F3/F4.</td>
<td>1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta, Inhibit 22-30Hz Hi-beta at C4 or Cz, 2. Zscore training at C3-C4, P3-P4, F3-F4, 3. ISF at T3-T4</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min</td>
<td></td>
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<tr>
<td></td>
<td>1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta, Inhibit 22-30Hz Hi-beta at C4 or Cz, 2. Zscore training at C3-C4, P3-P4, F3-F4, 3. ISF at T3-T4</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min</td>
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<tr>
<td>Fast Alpha, not low amplitude. There is usually a complaint of attention difficulties in conjunction with anxiety as the hypervigilance can act as a source of distraction. It has also been noted 1-2 years post injury in areas where there has been acute trauma. (Johnstone, Gunkelman, &amp; Lunt, 2005)</td>
<td>1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta Inhibit 22-30Hz Hi-beta at C4 or Cz 2. Zscore training at C3-C4, P3-P4, F3-F4 3. ISF at T3-T4</td>
<td>8 Hz 10 Min, (Hz 10 min, 10 Hz 20 Min, 9 Hz 10 Min, 8 Hz 10 Min OR 12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min</td>
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<tr>
<td>Persistent EO Alpha. In the eyes open state Alpha generally drops by 50% or more in amplitude or magnitude. (Johnstone, Gunkelman, &amp; Lunt, 2005) This is due to the specific projection system of the hypothalamus. If this system is failing it is suggestive of reticulo-thalamic activation problems and can lead to under-arousal. In anxious individuals’ Alpha can attenuate in the eyes closed condition.</td>
<td>1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta Inhibit 22-30Hz Hi-beta at C4 or Cz 2. Zscore training at C3-C4, P3-P4, F3-F4 3. ISF at T3-T4</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min</td>
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</tbody>
</table>
| Depression | Frontal Alpha asymmetry. Depression is correlated with an increase in alpha power in the left frontal lobe and a decrease in the right frontal lobe. | 1.10-12 Hz down and 7-9Hz up on F7 and F4/F8 respectively.  
2. Zscore training at F7 Fz F4 Cz  
3. ISF training starting at T3-T4  
4. sLoreta training Z score frontal lobes or area 4 and 6. | If fast alpha  
8Hz 10 min,  
6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
If slow alpha  
8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min  
OR  
12 Hz 10 Min,  
13 Hz 10 Min,  
14 Hz 10 Min,  
15 Hz 20 Min,  
13 Hz 10 Min |
| Deficits in slow activity (Delta/Theta/Alpha)  
The neurofeedback element of the Peniston protocol focuses on increasing occipital alpha and theta power. | 1. Peniston Protocol increase occipital alpha and theta  
2. ISF T3-T4  
3. Z Zscore training at C3-C4,P3-P4, F3-F4 | 8Hz 10 min,  
6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
OR  
12 Hz 10 Min,  
13 Hz 10 Min,  
14 Hz 10 Min,  
15 Hz 20 Min,  
13 Hz 10 Min |
| High frontal Beta activity. High Beta activity sometimes noted in the right frontal area in individuals with depressive symptoms and anger control problems. | 12 Hz 10 Min,  
13 Hz 10 Min,  
14 Hz 10 Min,  
15 Hz 20 Min,  
13 Hz 10 Min  
OR  
8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min |
| Insomnia | **Deficits in slow activity.** Decreased amounts of delta and Theta noted which reduces the ability to reach deep sleep. | 1. 12-15 Hz up on Cz or C4. Inhibit 4-7 Hz and 20-28 Hz  
2. Train 26-32 Hz down on Fz  
3. Zscore training at Fz Pz T3 T4. Add a beta inhibit at Fz for excessive Hi-beta activity.  
4. ISF training at T3-T4 | 8Hz 10 min,  
6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
OR  
In session training focused on calming the brain 8 Hz 10 Min, 9 Hz 10 min, 10 Hz 20 Min, 9 Hz 10 Min, 8 Hz 10 Min |
| --- | --- | --- | --- |
| **Increased Hi-beta activity.** High amounts of fast activity lead to insomnia due to overactivity in the brain and the patient struggles to quiet the mind. | 1. Train 7-9 Hz up at O2 or 11-13Hz up at T6.  
If fast alpha 8Hz 10 min, 6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
If slow alpha 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min | |
| Anxiety | **High Beta** | **High Alpha** | 8Hz 10 min,  
6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min |
| 1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta  
2. Zscore training at P3 P4 Cz Fz  
3. ISF at T3-T4 or T4-P4 | 1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly | 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min |
| 1. Inhibit 3-7Hz Theta, Reward 12-15Hz Lobeta  
2. Zscore training at P3 P4 Cz Fz  
3. ISF at T3-T4 or T4-P4 | 1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly | 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min |
| **Low Alpha** | 1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly | 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min |
| Cingulate dysfunction | 1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly | If fast alpha 8Hz 10 min, 6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
If slow alpha 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min  
OR  
12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min |
<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>OCD</td>
<td>Excess Theta and Alpha</td>
<td>1. 12-15 Hz up on Cz or C4. Inhibit 4-7 Hz and 20-28 Hz</td>
</tr>
</tbody>
</table>
| OCD | Excess Beta at Fz | 1. Inhibit Hi-beta according to analysis for example 20-30 Hz at Fz or Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly  
2. ISF T3-T4 or T4-P4  
3. sLoreta ROI / Zscore/ISF Anterior Cingulate |  
If fast alpha 8Hz 10 min, 6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min  
If slow alpha 8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min  
OR  
12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min |
| Post-Concusive Syndrome                                                                 | Diffuse slow activity, with or without low frequency Alpha: Commonly seen when there is a decrease in CNS activation and usually involves the reticular activation system (RAS) and the thalamic projection system. (40) This can lead to a decrease of Alpha and an increase in slow activity. | 1. 12-15 Hz up on Cz or C4. Inhibit 4-7 Hz and 20-28 Hz  
2. Zscore training at C3-C4,P3-P4, F3-F4 |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Mixture of diffuse lower voltage Delta and Theta and low frequency Alpha can be seen separately or coexistent.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Autism-Spectrum Disorders                                                              | Dysfunctional mirror neuron system in the EEG as a decrease of alpha power over the sensori–motor strip (so-called Mu suppression) as a result of observing human motor actions (as opposed to one’s own motor actions) | 1. Theta, Reward 12-15Hz Lobeta Inhibit 22-30Hz Hi-beta at C4 or Cz  
2. Zscore training at C3-C4,P3-P4  
3. ISF at T4-P4                                                                                                                                  | 12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min  
OR  
8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min  
| Increased Theta and decreased Alpha can be noted. Down training theta activity and simultaneously uptraining beta activity has positive effects on both executive functions and social behaviour in autistic children |                                                                                                                                                                                                     |  


<table>
<thead>
<tr>
<th>Alzheimer's/ Dementia/ Memory Disorders</th>
<th>Increased Delta and Theta Power</th>
<th>Decreased Alpha and Beta Power</th>
<th>Low voltage slow EEG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. 12-15 Hz up on Cz or C4. Inhibit 4-7 Hz and 20-28 Hz</td>
<td>2. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly</td>
<td>3. ISF T3/T4</td>
</tr>
<tr>
<td></td>
<td>40 Hz 10 Min, 10 Hz 10 Min, 45 Hz 10 Min, 12 Hz 20 Min, 42 Hz 10 Min OR</td>
<td>12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min OR</td>
<td>8Hz 5 min, 9 Hz 5 min, 10 Hz 10 Min, 11 Hz 10 min, 12 Hz 10 Min, 11 Hz 10 Min, 10 Hz 10 Min</td>
</tr>
<tr>
<td></td>
<td>If client has sleeping problems at home training can include Sleep protocol</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Parkinson’s                            | The theta power in temporal left region and the alpha1/theta ratio in the central left region can be affected | QEEG measures reflecting EEG slowing, particularly decreased dominant frequency and increased θ power, correlate with cognitive impairment and predict future cognitive deterioration |
|                                        | 1. Enhance Gamma 40-46Hz | 1. Enhance Gamma 40-46Hz |
|                                        | 2. ISF T3-T4 | 2. ISF T3-T4 |
|                                        | 3. Zscore training at C3C4P3P4 and later Temporal sites | 3. Zscore training at C3C4P3P4 and later Temporal sites |
|                                        | 4. sLoreta ROI/ Zscore Left temporal lobe | 4. sLoreta ROI/ Zscore Left temporal lobe |
|                                        | 130 and 135Hz - time can be determined by individual client response. Start with 20 minutes and increase. | 130 and 135Hz - time can be determined by individual client response. Start with 20 minutes and increase. |</p>
<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Sclerosis</td>
<td>Increased slow activity typically noted across motor area and F3 F4.</td>
<td>1. 12-15 Hz up on Cz or C4. Inhibit 4-7 Hz and 20-28 Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. ISF T3/T4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Zscore training at C3 C4 P3 P4 and later F3F4</td>
</tr>
<tr>
<td></td>
<td>Sometimes Decreased Beta noted</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40 Hz 10 Min, 10 Hz 10 Min, 45 Hz 10 Min, 12 Hz 20 Min, 42 Hz 10 Min</td>
</tr>
<tr>
<td>Peak Performance</td>
<td><strong>Peak performance or executive performance</strong></td>
<td>1. Inhibit theta (4-7.5 Hz) and Hi-beta (35-45 Hz) and enh Beta (13-19 Hz).</td>
</tr>
<tr>
<td>Fibromyalgia</td>
<td>Decreased power especially in Alpha</td>
<td>1. Reward Alpha typically 11-12 Hz at Pz. Be aware of client age and response and make frequency adjustment accordingly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 Hz 10 Min, (Hz 10 min, 10 Hz 20 Min, 9 Hz 10 Min)</td>
</tr>
</tbody>
</table>
For increased Alertness
Bellabee setting: 15Hz 10min, 16Hz 10min, 17Hz 10 Min, 18 Hz 10 Min, 16 Hz 20 Min

For sleep
Bellabee setting: 8Hz 10 min, 6Hz 10 min, 5 Hz 10 Min, 4 Hz 10 Min, 3 Hz 10 Min

For a clear mind/to reduce mental fog
Bellabee setting: 40 Hz 10 Min, 10 Hz 10 Min, 45 Hz 10 Min, 12 Hz 20 Min, 42 Hz 10 Min

For peak/Executive performance training
Bellabee setting: 15 Hz 10 Min, 40 Hz 10 Min, 17 Hz 10 Min, 45 Hz 10 Min, 19 Hz 10 Min, 42 Hz 10 Min

**To increase Focus**
Bellabee setting: 12 Hz 10 Min, 13 Hz 10 Min, 14 Hz 10 Min, 15 Hz 20 Min, 13 Hz 10 Min

**Anxiety/Relaxation training**
Bellabee setting: 8 Hz 10 Min, 9Hz 10 min, 10 Hz 20 Min, 9 Hz 10 Min, 8 Hz 10 Min

If the client experiences irritation or agitation when using the focus, alert or peak performance protocol decrease the frequency by 1Hz until the client is more comfortable.

### 3. The Technology Behind Bellabee

All people of all ages can benefit from brain stimulation treatment. What Bella Bee does is to enable the brains’ internal rhythmic clock to function better. This works by the use of Pulse Electro Magnetic Field (PEMF) technology. PEMF is a method which is in use many years in Europe and works on the principle that a magnetic field is created to stimulate the brain without harm. The audio frequencies from the Bella Bee app are converted into an electromagnetic pulse. The pulse enables the brain to follow a specific rhythm and then operates at a better more optimum level. The frequency levels concur with neuroscience standards in order to support the brains’ functionality fully. There is no harm being done to the brain, no energy spikes created or electrification of the brain is being performed by the device.

### 4. Bellabee Safety

Bellabee using PEMF technology uses magnetic field strengths of 200 Micro-Teslas. Electro magnetic therapies such as those used for depression in clinics make use of field strengths of 1 to 2 Tesla. Bellabee is very low electromagnetic fields stimulation when compared to a 1 or 2 Tesla machine, which operate at a field rate of 10 000 times stronger. Bellabee is safe, even head phones when listening to music has a much stronger field strength.

### 5. Introducing Existing Preliminary Tests

**ADHD:**

<table>
<thead>
<tr>
<th>BASELINE - Before any Bellabee use</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Brain Activity Graphs" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8Hz - After 4 at 8 Hz Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2.png" alt="Brain Activity Graphs" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10Hz - After 4 Minutes at 10 Hz</th>
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</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Brain Activity Graphs" /></td>
</tr>
</tbody>
</table>
Legend - Red indicates very high activity, Blue indicates very low activity and Green / Grey areas are within more normal boundaries.

A decrease in Delta shows that the brain is waking up. Also, the decrease in slow Theta activity will improve concentration and focus.

Depression and Anxiety:

**BASELINE - Before any Bellabee use**

**8Hz - After 4 at 8 Hz Minutes**
A decrease in Delta and frontal Theta and Alpha makes the individual feel more awake and energised. There is also a significant decrease in Hi-Beta activity, which will make the individual feel much calmer and relaxed.

After only 12 minutes of Bellabee use the individual reported feeling focused, full of energy and calm the whole day.

It is also important to note that not only do clients/individuals using Bellabee experience better cognitive performance but also feel physiological differences. By measuring this while the client was using Bellabee the following was noted:
This indicates that the individual was moving from a sympathetic (stressed) state into a parasympathetic (relaxed) state. Current research indicates an increase in body temperature, relaxation of the trapezius (shoulder) muscle, a decrease in the rate of respiration, a decrease in heart rate and a decrease in blood pressure.

References


Thompson, M., & Thompson, L. (2015). The Neurofeedback Book (2nd ed.). Toronto: AAPB.