A Matter of Mind®
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June, 2013

TAGx2 for Nexus BioTrace+

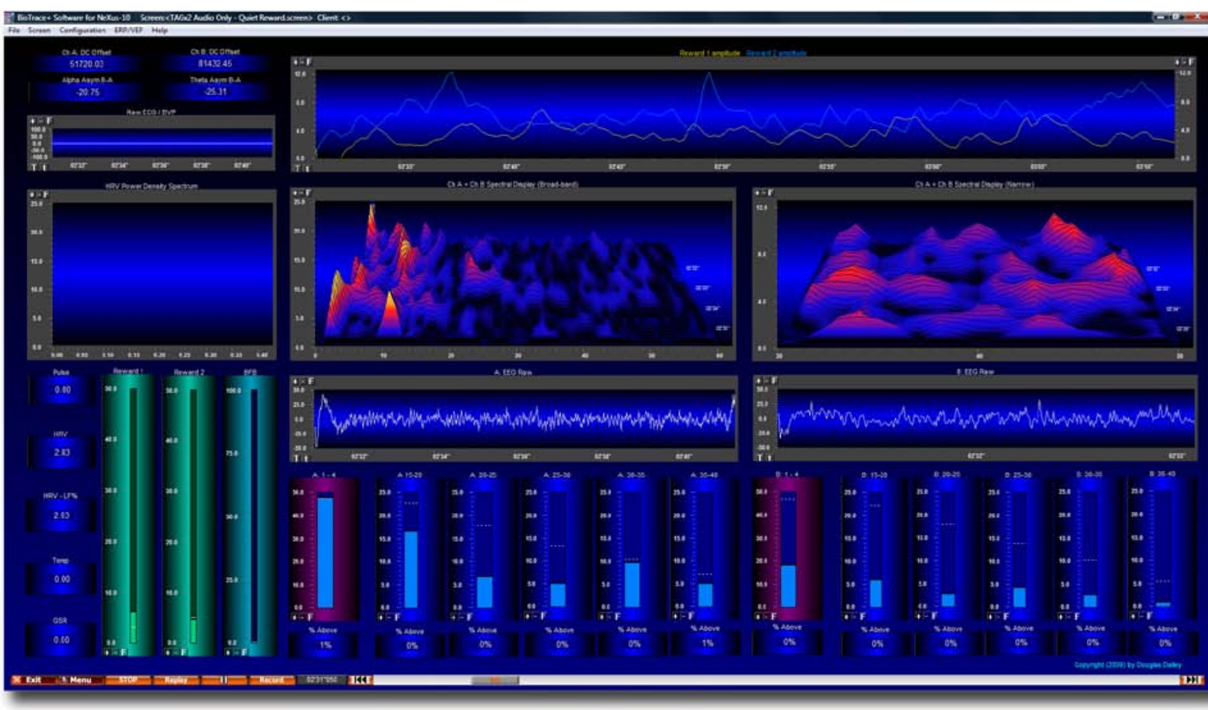
Theta Alpha Gamma Synchrony

Operations - Introduction

Here we will look at the different instruments which make up the dual-channel theta-alpha-gamma synchrony (TAG Sync) screen and show how they work together. These 2 channel designs are referred to as TAGx2.

Please take a moment to look at **figure 1** - the TAG Sync training screen. We will discuss the component instruments individually and in groups. We will be recording 2 EEG channels called "A:" and "B:".

Figure 1 - Theta-Alpha-Gamma Synchrony training screen - Nexus TAGx2



Notice in the center of the main screen shown above that there are two instruments (labeled "A: EEG Raw" and "B: EEG Raw") displaying raw EEG tracings. The leads for these two channels will be placed at different locations depending upon clinical indications. **Figure 2** shows how the two instruments ("A:" and "B:") might look with a typical setup involving Fz and Pz.

Figure 2 - Typical lead setup for TAG Synch. The two channels, "A:" and "B:" (located here at Fz and Pz) display their raw EEG in the center of the main screen (figure 1).

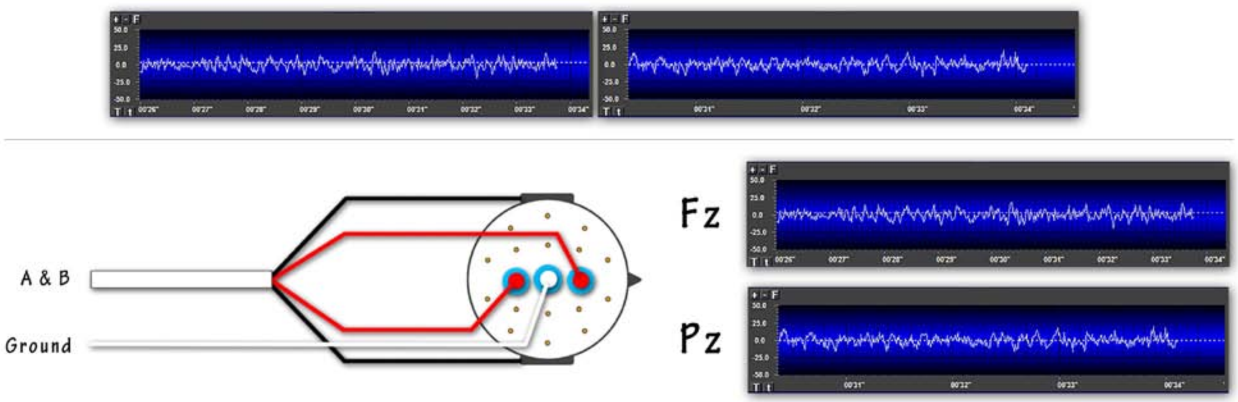


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Figure 3 - Six "inhibit bins" for the "A:" channel

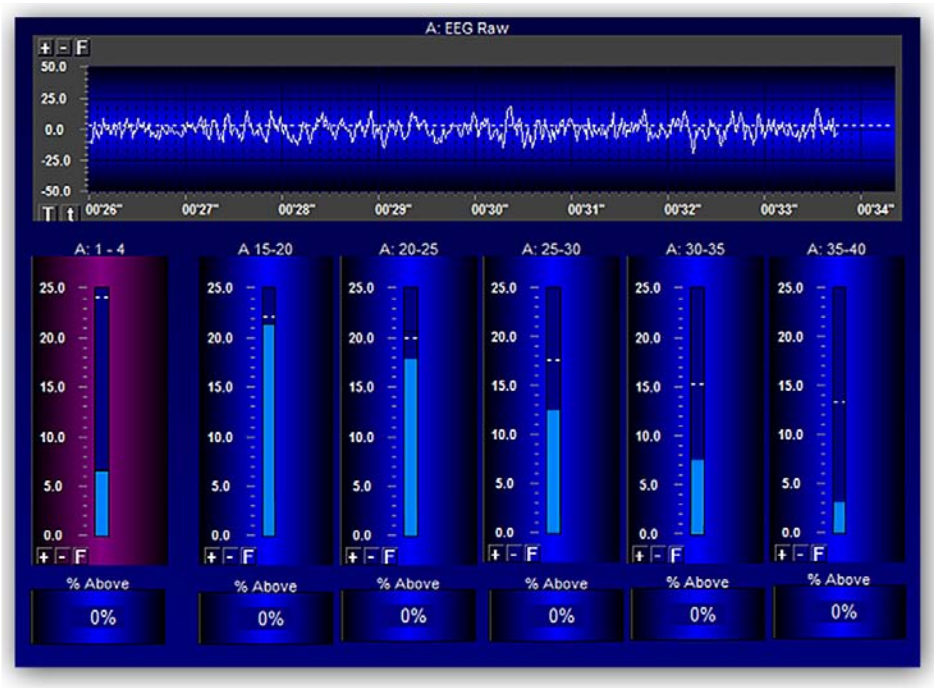

Figure 3 (above) shows the six "inhibit bins" for the "A:" channel. They are located immediately below the associated A: EEG Raw instrument in figure 1 above. In a common scheme the inhibit bins are set to sound an alert when there is a rogue excursion above threshold in any one of the bins. A characteristic of so-called "1 over f " (1/f) systems is that phase shifts in lower frequency bands can lead to amplitude shifts in higher bands, not all of which might be expected or beneficial. These higher frequency amplitude shifts may excite a fairly narrow peak of recurrent beta spindling. In figure 3 note above each of the vertical bar instruments is the frequency bin for that instrument, e.g., 1-4 Hz, 25-30 Hz, etc. Below the vertical bar you can see the percent of time that the signal spends above that bin's threshold marker.

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Figure 4 - Inhibit bins spanning 15-40 Hz with "1/f" curve superimposed in green. Notice the 25-30 Hz bin.

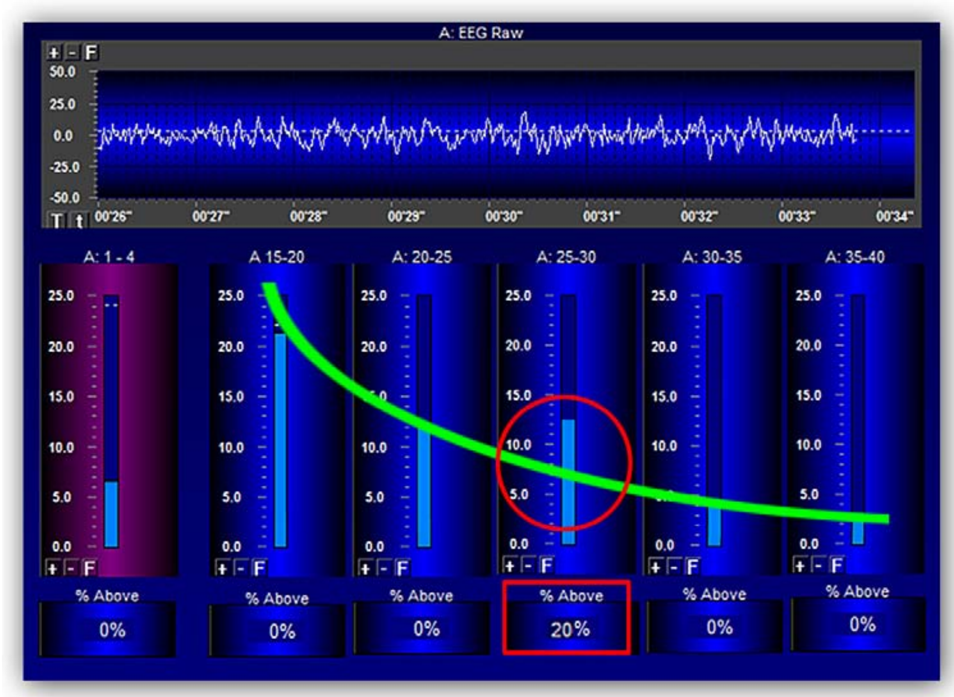

Figure 4 (above) shows the inhibit bins with a "1 over f" curve (1/f) superimposed in green. The amplitudes in the bins should approximately follow this line. You can see in this figure that the 25-30 Hz bin is elevated above threshold. When an excursion such as this occurs repeatedly in one particular bin, or when a particular beta excursion is associated with a behavioral change such as restless legs, self-stimulation, or irritability, then you may be dealing with irritable cortex or beta spindling.

It is convenient to program the inhibit bins so that that during audio feedback they emit an alerting sound when any exceeds a set threshold. For video feedback they can be set to pause the display when exceeded.

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Figure 5 - Raw waveforms for channels A and B are added together and sent to the spectral display

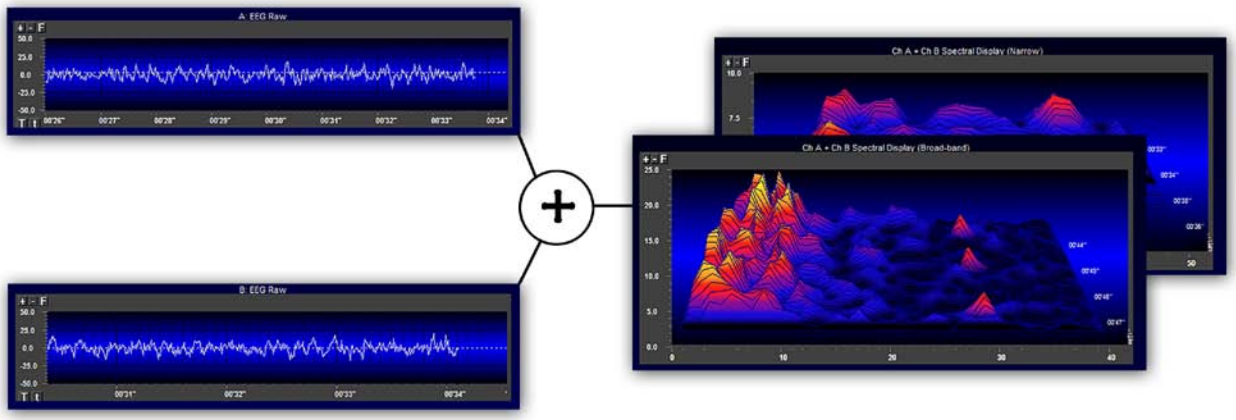

Figure 5 shows how the raw signals from channels A and B are added together then sent to the spectral display instruments on the right. At times somewhere in the middle of the spectral display you may see evidence suggestive of beta spindling. It may appear as a brightly colored peak that occurs episodically, usually in the same narrow frequency band as simulated in the spectral display of figure 5 at about 28-30 Hz.

Because the spectral display adds together channels A and B, you will not be able to tell from the spectral display whether the recurrent beta spindling is coming from channel A (for example Fz) or channel B (for example Pz). The spindling might show in one of the raw waveforms, either channel A or B. The spindling is most likely to show in the spectral display *and* in the inhibit bins (figure 4) where one frequency bin might show more time above threshold than the others.

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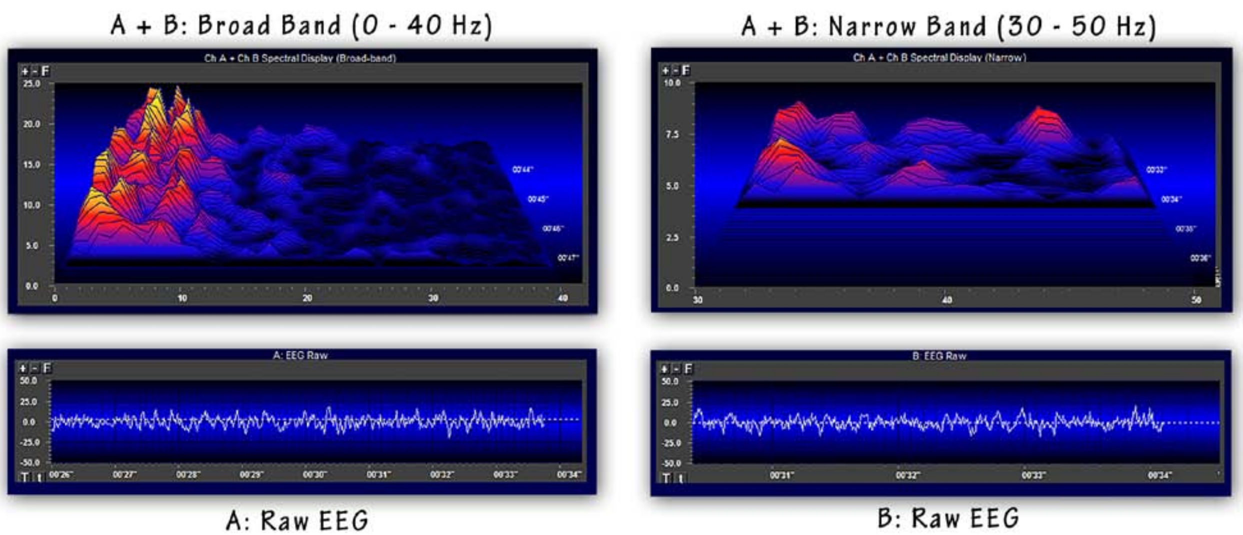
Figure 6 - Note that the spectral displays are not individually associated with the raw EEGs shown immediately below them. Channels A & B (shown individually on the bottom) are added together then mapped to the Broad spectral display *and* the Narrow spectral display.



The broad band spectral display (upper left) can show 0.5 - 100 Hz and can help identify muscle artifact as well as identify theta and alpha frequencies used for local phase resets. The sensitivity (vertical scale) is set to 25 µV meaning that the largest slow waves have to be about 25 µV to reach the top of the display. To see the much lower voltage gamma activity, the second spectral display shows only 30-50 Hz and the sensitivity, 10 µV, allows one to observe the preferred gamma activity.

Changes in alpha theta synchrony over time, as well as phase large phase resets, can be seen using the instruments in Figure 7. Unlike "alpha-theta crossover", a marker in standard alpha-theta training, theta-alpha-gamma synchrony training aims to produce more and larger theta-alpha phase resets.

Figure 7

Occasionally clients become disturbed during a session. Monitoring peripheral measures (Temp, GSR, HRV, EMG, Respiration, etc.) may provide suggestions for further investigations or biofeedback training. Some of these signals operate at ultra-low frequencies and, as is the case for HRV, influence the EEG power spectrum.

Figure 8 - Peripheral measurements and statistics are available to help monitor sessions or observe relationships between low frequency peripheral measures and central EEG.

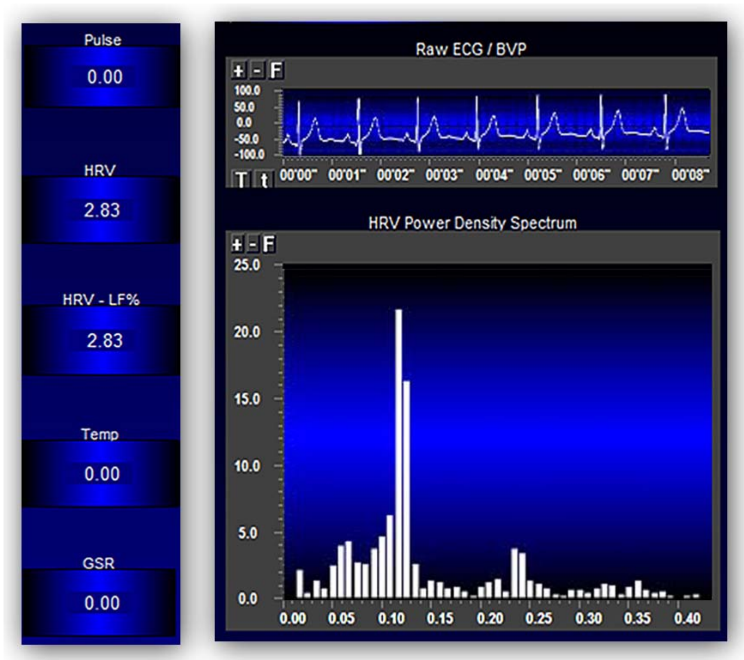


Figure 9 - TAG Sync screen using second monitor for video feedback

Figure 9 above shows the TAG Synch screen with its second monitor playing a video. This is an ideal setup for training some individuals, especially children. Your TAGx2 suite contains screens suitable for single monitor work (with audio and/or video feedback on the trainer's screen) and dual monitor work.

For adults and astute youngsters I like to train what I call the "salience of silence". For an adult I prefer to set reward 1 to repeat a low pitch sound (midi flute may work) when the client's reward 1 (e.g., theta) is below threshold. I set reward 2 to play a loop of *pink* noise (included) whenever reward 2 (e.g., alpha or gamma) is below threshold. At the beginning of the session I set reward 1 and reward 2 thresholds high enough that the client hears both sounds (theta rumble and alpha pink noise), but not so high that the client does not spontaneously exceed one or the other of the thresholds every few seconds. I ask the client to make both the noises go away. As the client increases both reward 1 & 2 amplitudes, the room remains quiet longer, so I raise the thresholds, which encourages the client to further regulate the synchrony. Ultimately, when synchrony has increased and there are no inhibit bins sounding alerts, the client is, hopefully, sitting unperturbed and experiencing non-judgmental awareness. TAG Sync theory is, in part, based on observations of EEGs of skilled mindfulness practitioners. The neurofeedback process itself activates the salience mechanisms involving anterior cingulate, anterior insula and operculum, and thalamus. The salience of silence is a good exercise to prepare a person to take decisions with reference to somatic markers in the insula.

For further information visit these websites:

www.tagsynchrony.com
www.mindsupplies.com
www.growing.com/mind
www.cortexercise.com
www.qeegsource.com

Best wishes,

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