EEG Enhanced Hypnotherapy

Lincoln Stoller, PhD, CHt,

Two obstacles to the use of electroencephalography in hypnotherapy have been overcome. The first was the impracticality of the technology, and the second was the difficulty of interpreting the result. While the barriers are down, they are not completely gone as there remains a learning curve for its application. I will bring you up-to-date with what I consider the easiest hardware and its simplest application.

EEG Hardware

Electroencephalography is simply the recording of the changing electric field at various locations on the scalp. The difficulty in using the EEG stems from the weak signals and their complex origin.

Getting a clean signal requires a clean, disturbance-free electrical circuit. Resolving the details in the signal requires its amplification. Technical improvements have lowered the cost of amplifiers to under $300, and some below $100. The effort required for a clean signal has been reduced to putting on a somewhat finicky headset. I feel the best combination of cost, ease, and performance is offered by the Muse headband, manufactured by InteraXon of Toronto and sold as a non-medical device. There are others, but I will discuss the Muse.

The Muse resembles a pair of eyeglasses in which the lens that sit across the bridge of your nose are replaced by a headband fitting snugly across your forehead. The Muse is battery powered and connects via Bluetooth to a smartphone. There are no wires, pastes, or gels required for its use. The headset must sit directly against the skin, making contact both behind the ears and across the forehead. Hair, dirt, or oil will impede the signal and degrade the headband's metal surfaces.

A signal processing computer is a necessary third piece of hardware. Since most of us have a general purpose, pocket-sized computer called a SmartPhone, the cost of this component is reduced to that of a SmartPhone app. Such an app is included with the Muse Headband.

However, the Muse SmartPhone app, created by InteraXon, is meant only as an aid to meditation. The Muse is designed to focus exclusively on mindfulness training, a form of meditation aimed to reduce stress. I have not found the InteraXon application to be useful for hypnotherapy, so I instead use a 3rd party Smartphone application called Muse Monitor, written and sold for under $15 by James Clutterbuck at MuseMonitor.com.

The headset only connects to one app at a time. Although we're using the Muse Monitor in place of the InteraXon application, you can still quit the Muse Monitor app and launch the InteraXon application, if you wish. You can continue to use the Muse with the InteraXon application for mindfulness training, as they were designed. There is good reason for doing this, both for improved health and hypnosis, but we will not discuss that here. For information on the standard use of the Muse refer to InteraXon's website at choosemuse.com.

Because of the cost and risk of marketing medical hardware we cannot expect low-cost, therapeutically-enabled products anytime soon. Instead, we must cobble together components, each of which will continue to avoid medical liability, and consequently therapeutic ease-of-use, like a hot potato.

Installation and Use

The Muse Headband can be purchased online. InteraXon's Muse application can be downloaded for Apple or Android phones from the AppStore or GooglePlay websites. The Muse Monitor can be purchased from the AppStore, GooglePlay, or Amazon. You can find purchase links at MuseMonitor.com.

Begin with all hardware sitting on the table. Turn the Smartphone's Bluetooth service on or ensure that it is on, and then launch the Muse Monitor app. Turn on the Muse headband. Pairing between the phone and the headband can take up to 20 seconds, happen more quickly, or not at all if there is a problem. The application and the headband launch in pairing mode but will exit pairing mode after varying amounts of time, controls are different on different models. There are few diagnostic indicators for pairing, so make sure all batteries are charged. Keep the Smartphone and the headband near each other for the strongest signals.

Once paired, put the headband on the client. The software tests the signal quality at each of the sensors. The signals at all sites must be sufficient or the software will display a "horseshoe" icon with circles that appear empty for the sites making a poor connection. The ear and forehead contacts have different sensitivities. The software compensates for these differences and integrates all the input into a single, analyzed signal.

When all the components are working, which is normally the case, this all happens automatically. You only need to turn the units on, launch the software, don the headset, and wait for the display to begin.

EEG Software

The Muse Monitor application immediately begins displaying data in one of five display modes. You can toggle between display modes by tapping a spike-shaped, on-screen icon. I'll only mention two of these modes, referred to as Absolute and Raw data displays. We'll work with the Absolute display.

The Raw display

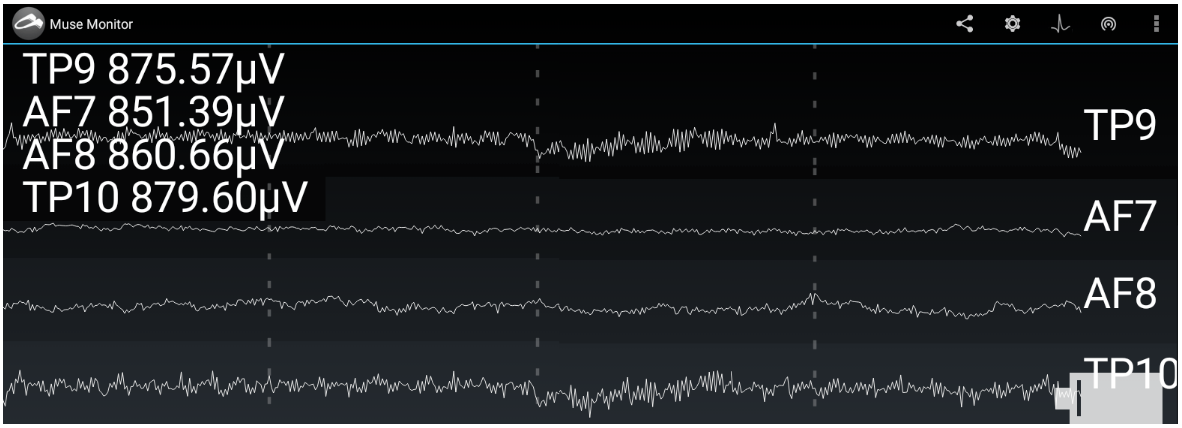

Figure 1 - The raw voltages recorded at each of the Muse headband's four sensor sites. Time proceeds to the right. Dashed vertical lines mark 1-second intervals.

The Raw display shows the signals from the four sensors: TP9 and TP10 behind the left and right ear, AF7 and AF8 at the left and right forehead, with the headband's battery level indicated in the lower right. This display is useful when checking the quality of the sensor connections. The signals are different and there is nothing obviously wavelike about them.

Brainwaves are a collective, mathematical contrivance that don't have an independent existence. We extract them as harmonics from noisy signals, and we get somewhat different brainwave signals depending on our analysis.

At some times, for some people and under some conditions, these waves are persistent and characteristic of mental processes. What those processes are will change according to the analysis and the person, and can vary over periods as short as a few seconds. Most of what is meant when we refer to "brainwaves" is the rather approximate, more or less stable picture characteristic of some brain processes. That's what we're looking for in the Absolute display.

The Absolute Display

The following figures graph five categories of brain waves—delta, theta, alpha, beta, and gamma—recorded over a short period of 10-seconds duration. It is not the brainwaves that are shown in the Absolute display, but a graph over time of the relative power of each of five computed brainwave categories. The vertical scale is in decibels, which are proportional to power.

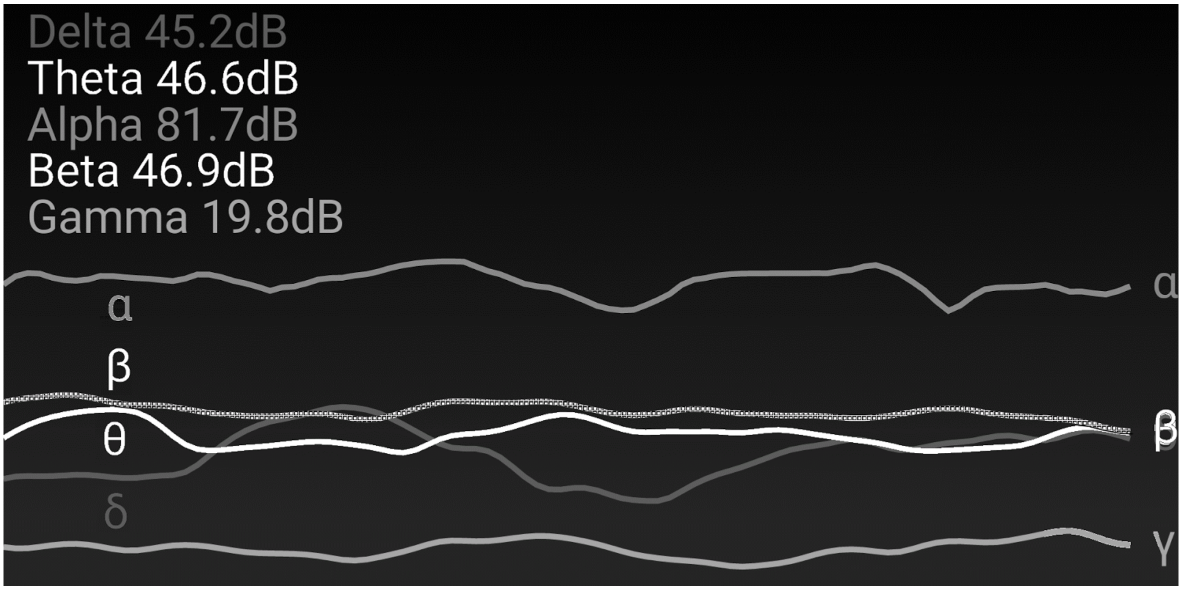

Figure 2 - A calm EEG typical of a relaxed person in a trance state with eyes closed. The vertical axis is power, and time increases to the right.

Each of these five categories are themselves averages of undulations of varying length. Delta is the sum of slow undulations ranging in period from 1 to ¼ second. Theta is the sum of undulations ranging from ¼ to ⅛ seconds. This continues for alpha, beta, and up to gamma, which includes undulations ranging from 1/30th to 1/44th of a second.

The term "brain waves" has us thinking of waves, but this picture only applies when the signal presents a regular character that persists for an extended period of time. For the Muse, this epoch is one second and this is the window over which the waveforms are calculated.

When the signal's character changes within this time period, which happens frequently, the presence of these "brainwaves" does not refer to a wave, but a change in the character of the raw signal within the timespan of that type of wave. This is analogous to the disordered "chop" sometimes evident on the ocean's surface, in contrast to regular ocean waves.

For example, we'll often see a rapid rise and fall in the amplitude of the slow delta waves. This does not mean that the signal's character is dominated by slow oscillations. It means that the character of the overall signal is experiencing a change that's taking place over 1 to ¼ of a second. Changes in mental focus and emotional state do occur at this rate, and these bursts of delta waves signal state changes of this sort. They may be the only signal of this sort because muscular changes, visible in posture or facial features, occur more slowly for a physically relaxed person.

In order to interpret the EEG most easily the subject needs to be relaxed and stationary. If they're anxious or restless, then the electrical signals generated by muscle movement, or the cerebral signals that attend muscle movement, invade the EEG signal. These artifacts disturb the deeper-state signature the EEG is attempting to represent.

The largest EEG effect of which you should be aware is the effect of a person's eyes being open or closed. When we close our eyes our brains generate a clear, oscillating electrical pattern at 8 to 12 cycles per second. This starts and stops immediately upon closing and opening one's eyes. It occurs most prominently at the back of the head, is evident at recordings from the temporal areas where the Muse records, and is measured to a lesser degree in the frontal locations.

For this reason you can expect the brainwaves will appear disorganized when a person is opening and closing their eyes. While this is happening, you'll see the power in the alpha band rise above and then fall within the range of the other brainwave frequencies. The client's eyes need to be continuously open or closed for the period over which you are using the EEG to monitor their state.

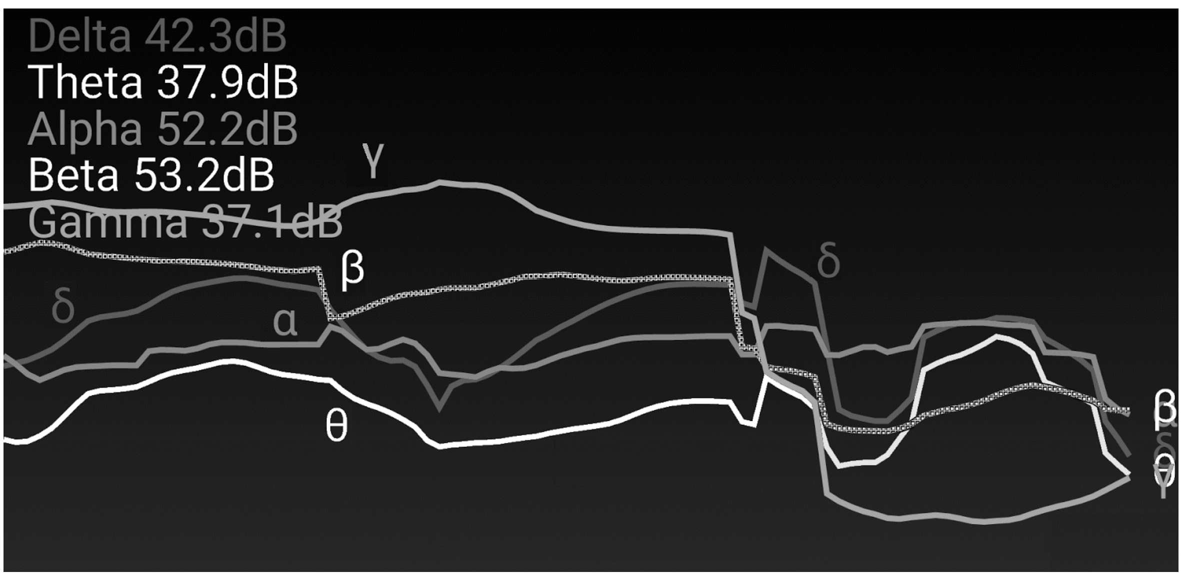

Figure 3 - An anxious, high-gamma state on the left transitions toward calm on the right.

Figure 3 shows an abrupt transition from anxious to calm, as evidenced by the drop in the beta and gamma levels. Beta is a wide range of frequencies whose elevated amplitude typically correlates with stress. The higher the frequency the more aggravated the character of the stress.

Low, middle, and high beta frequency regimes are usually distinguished for neurofeedback, but the Muse considers these as a single band. The Muse calculates beta over a wide range of frequencies, from 1/13th to 1/30th of a second, which includes low, medium, and high beta regions.

Figure 3 also shows a brief rise in power of theta and delta waves. As mentioned above, these don't indicate the states of calm that we associate with extended periods of dominant low frequencies. Instead, these short excursions reflect a change in the overall state occurring within the period spanning 1 to 1/8th of a second.

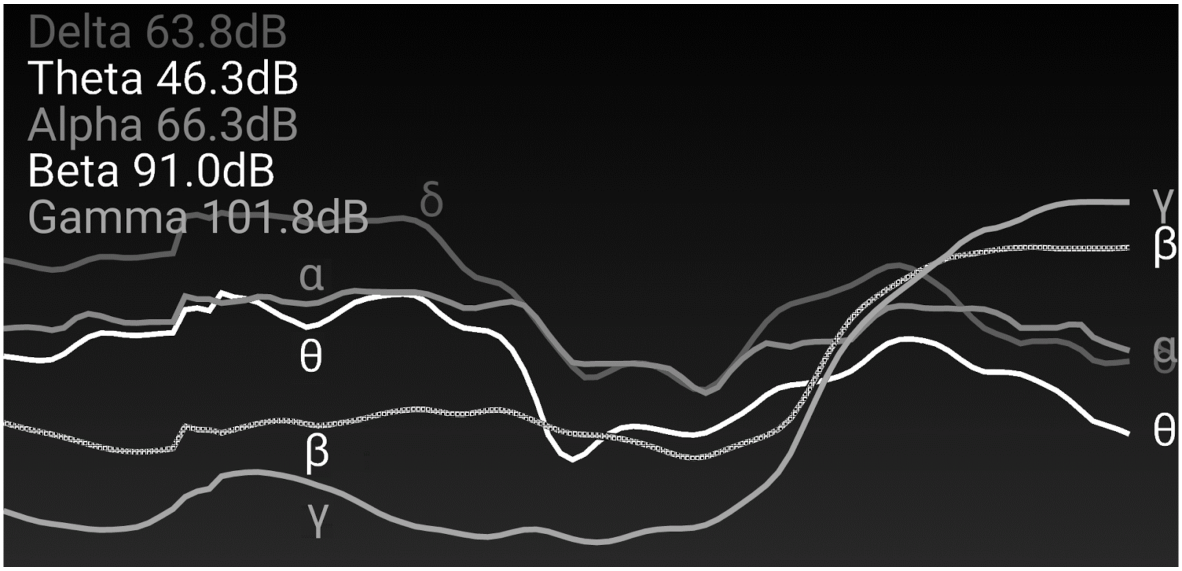

Figure 4 - A transition to a higher anxiety state.

Figure 4 illustrates a transition from lower to higher anxiety. Here the alpha levels, which are alert states, remain stable while power in the beta and gamma regions double and triple.

Use of the EEG for brainwave training, known as neurofeedback therapy, aims to establish long-duration patterns that are either under a person's voluntary control, or become habitual. For the purposes of neurofeedback training, changes of the sort shown in Figure 3 are considered transitory artifacts.

The Muse's Absolute graphs reflect various attentional, state, and cognitive changes. Changes of state are important in hypnotherapy, and the EEG offers a window to monitor them. It may be possible—though I don't believe it has yet been established—that the EEG can indicate depth of trance. One can identify stages of sleep using the EEG, but sleep waveforms are states of unconsciousness, not hypnosis.

The importance of mental states is now recognized in neurology, psychology, and physiology. Resting state networks are neurologically important. States of awareness are measured in hypnosis. Mindfulness, sleep, and attentional regulation all center on states of mind. The EEG is not generally used in clinical hypnosis but, with the advent of economical and reliable EEG feedback devices, this should change.