

Tech Talk by Dave Siever

Heart Rate Variability (HRV) & Audio-Visual Entrainment (AVE)

Introduction

The heart beats to several of its own rhythms - within its every beat, between consecutive beats, during breathing and with every thought. For instance, with every breath we take, our heart speeds up with our in-breath (inspiration) and slows down with our out-breath (expiration). The heart also has long, slow swings the span several breaths. These slow (low frequency) swings in heart rate reflect a degree of "flight-or-fight" response, anxiety, or sympathetic activation within our bodies in relation to fears, anger and aggression (which are also forms of fear). Rapid, small (high frequency) variations and "spiking" that show up within the natural variations in heart frequency during breathing, reflect para-sympathetic activity as the heart tries to compensate for the reduced output caused by sympathetic activation.

Therefore, we can assess heart rate variability, process its spectral properties and see how much heart activity is normal, sympathetic and parasympathetic. We can see what thoughts, foods and events can trigger unhealthy heart rhythms and we can use HRV feedback to teach ourselves how to relax.

There are several HRV systems available. Two systems that I know of are the "Cardio-Pro", by Thought Technology and the "Freeze-framer" by Heartmath. The Cardio-Pro consists of an EKG sensor and software as an add-on to the Procomp from Thought Technology. It has advanced analysis software and is meant for the professional.

The Freeze-framer consists of software and an optical sensor that plugs into the COM port of a computer. The Freeze-framer costs under \$300.00 US and has reasonably good analysis. It may be used by both professionals and the general public.

The breathing rate that is considered to be optimal is based on a 10 second breathing cycle - breathe in for five seconds and breathe out for 5 seconds, making six breathing cycles per minute.

How HRV Works

Figures 1-4 below are from two women with their data taken from the Freeze-framer. The Spectral Analysis window is normally viewed from a separate selection but for the sake of space, we have dropped it into the HRV-heartbeat rate display. Figure 1 has two large sections (pre AVE & post AVE) within it. Each of these sections contains four smaller sections.

The upper left side of each profile (in green) shows the actual heart rate in beats per minute. It would normally span across the entire top area, but we stuck the spectral results (blue "mountains") over top of some of it so we could see everything on one page. The spectral results show a peak at the breathing frequency of 0.1 Hz (ten-second breathing cycles). "Mountains" that are on the left represent sympathetic activity while the smaller "hills" to the right represent para-sympathetic activity. These ten second breathing cycles are paced from a synthesized "babump" heartbeat sound from a Paradise XL through a set of headphones. The user hears these sounds and inhales for two beats and exhales for two beats, and - you got it - they listen to 24 beats per minute, which when divided by 4 beats per breath cycle = 6 breaths per minute (brpm).

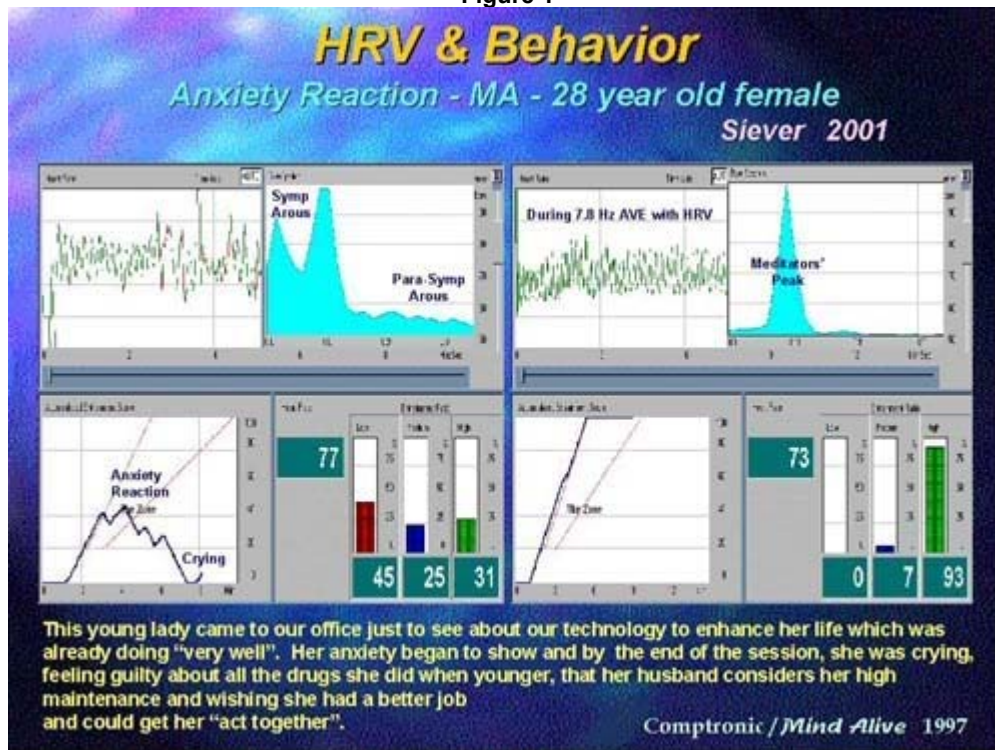
Breathing entrainment (BE) is the measure of how smooth & flowing her heart rate variability is with her breathing (a new form of the word "entrainment"). BE is shown on three bar graphs, where green is the best BE, blue-intermediate and red – poor.

Client Results

We've seen many anxious people on the Freezeframer and the results are always the same. When their breathing is paced at 6 brpm, their anxiety shows itself after about three minutes. Their heart rate becomes erratic ("jaggely" green lines with red sections in it) and their performance score begins to erode (small window below). The lady in Figures 1 and 2 was crying in the end. Her average heart rate was 77 and her score (green, blue and red bars) was quite poor.

We gave her a five-minute break to "collect herself" and put her back on the Paradise XL, but we added AVE at 7.8 Hz in addition to the heart beats that she had been already breathing to. In the right-hand section, you can see that as she began dissociating from her anxious thoughts, her breathing and heart rate became smooth and rhythmic as can be seen in the green heart rate chart area. Spectral analysis shows one beautiful "meditators peak" at 0.1 Hz, her breathing frequency. All sympathetic and parasympathetic activity was gone. Her performance score went straight up and her heart slowed by 5 bpm to 73 bpm. Her breathing entrainment was almost perfect at "93".

Figure 1



Moving onto Figure 2 is a comparison of her three sessions. Her first was free breathing (charts not provided in this example). The second was the paced, 10-second breathing cycle from the Paradise XL (shown above), and the third was paced and 7.8 Hz AVE from the Paradise XL. You can see that her free breathing was so erratic that her breathing entrainment score was "0", all in red. Paced breathing was better with some green in the bar graph, but the challenge of paced breathing forced up her heart rate. AVE assisted breathing produced close to perfect results with a slowing in heart rate as well.

Figure 2



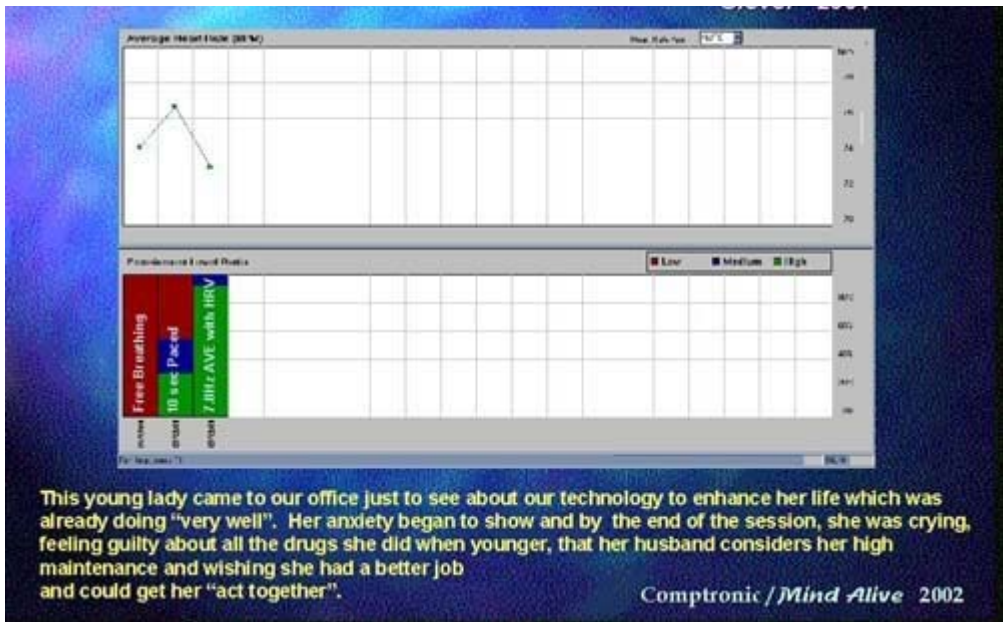
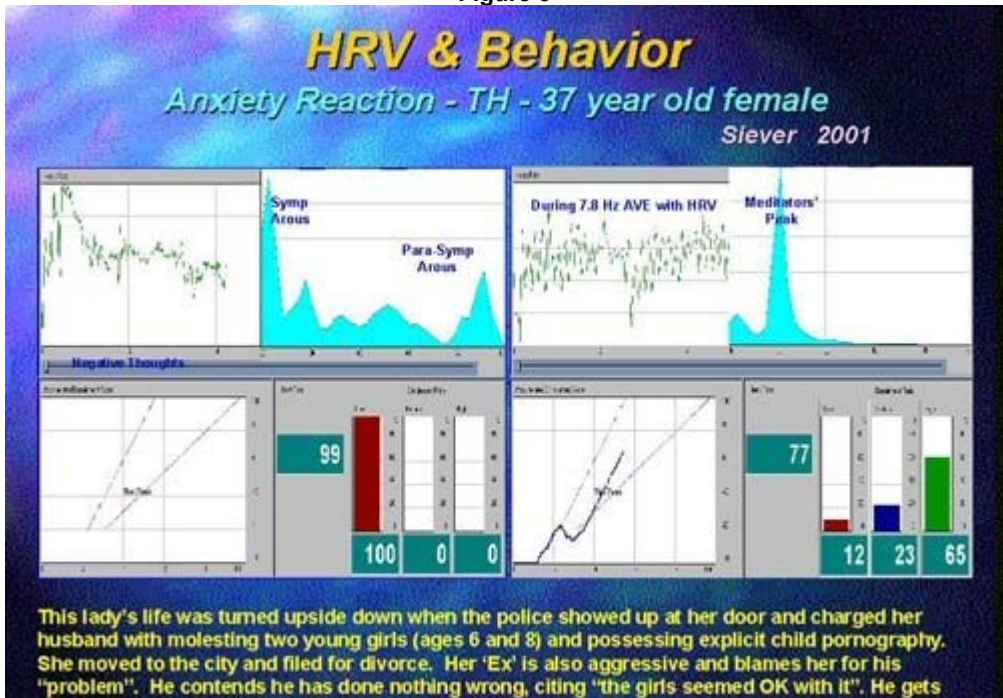


Figure 3 & 4 are from a young mom with some very serious concerns in her life as indicated in the captions included with her charts. The left side of Figure 3 was recorded during negative thoughts, and she had plenty! During these thoughts her heart rate was all over the board, the spectral analysis was all over the board with ample sympathetic and parasympathetic activity. Even her paced (10 second) breathing really didn't show. Her performance score was a flat "0" and her breathing entrainment ratio was a "100" in the poor. Her average heart rate was at 99 bpm. Just five minutes later, AVE was added to the paced heartbeat heard in the headphones. Notice how smooth both her breathing and heart rate rhythms became. She had an abreaction at about two minutes (the green heart rate chart became flat, then spiky) when some negative, anxious thoughts entered her mind, but as she dissociated with the AVE her mind once again cleared and her heart rate rhythms returned. Her performance score showed the anxiety with a down turn in her score which recovered as she dissociated from her anxious thoughts. Her spectral analysis showed a nice meditators peak with a bit of sympathetic activity to the left and no parasympathetic activity at all. Her breathing entrainment score was 65% to the green while her heart slowed by 22 bpm to 77 bpm!

Figure 3

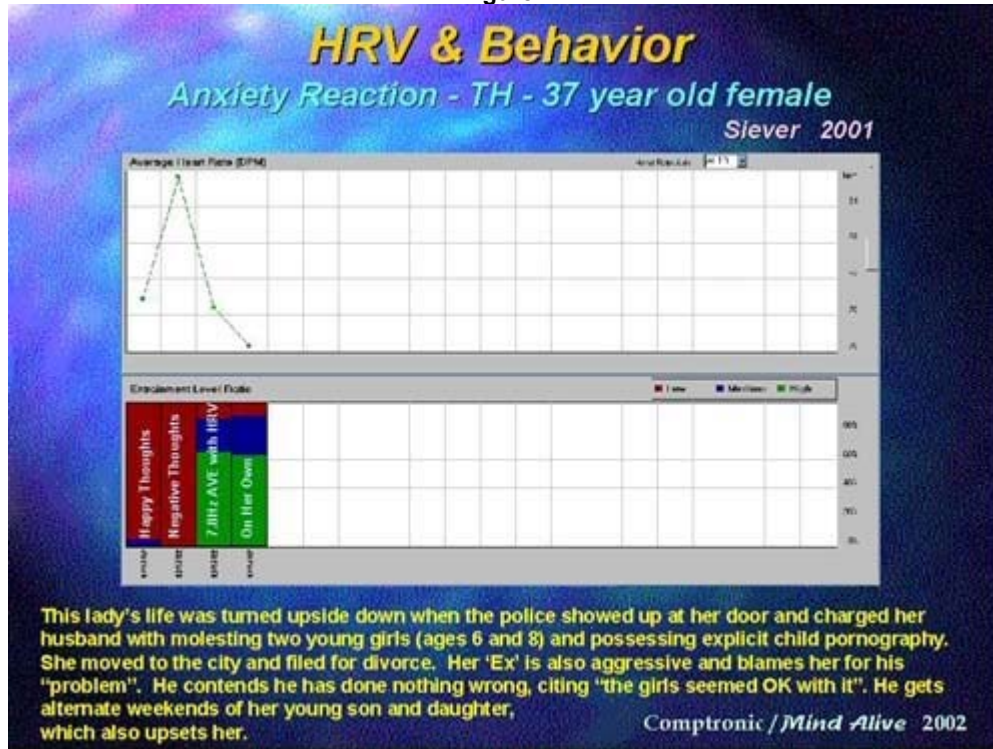


alternate weekends of her young son and daughter,
which also upsets her.

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Figure 4, like Figure 2, is a quick summary of various sessions beginning with happy thoughts, followed by negative thoughts (shown above), then the AVE session (shown above), then 15 minutes later on her own where she showed she could control her breathing very well (demonstrating that AVE helped her learn to breathe in a relaxed manner).

Figure 4



It is for these reasons that AVE is such a powerful tool in helping people in crisis. I wish we had some in New York after 9/11 and on the battle fields in Iraq! With continued research, AVE may become the main "stabilizer" for police, fire fighters, paramedics and military!

Dave Siever
- dancing in the dendrites!