

Hello all,

Welcome to Volume 1, Issue 13 of *Alternativz*. Over the next few months we'll delve into an unexplored area of neuroscience, this being breathing, blood flow, and the brain. This issue is titled, ***Breathing & The Brain - Part I***.

The 2nd Edition of *The New Science Of Breath* (2006) built on the limited body of medical literature on the subject of breathing, heart rate, and arterial pressure, adding to that body a comprehensive theory of "heart rate variability" (HRV) and of resonant cardio-pulmonary-circulatory operation.



Figure 1: Hemo-Encephalography Allows Blood In The Brain To Be Observed Through The Skull

Since that time, much of our work has been focused on developing a more complete understanding of that theory. In 2009, with colleagues at J&J Engineering, COHERENCE launched the first instrument that allows us to observe the relationship between blood flow and heart rate, this being *Valsalva Wave Pro*. It allows us simultaneous observation of the blood wave that breathing produces and the heart rate that is induced by that blood wave via baroreceptor action.

Using *Valsalva Wave Pro*, we can observe the blood wave virtually anywhere that the sensor can be fitted to capillary circulation, i.e. the earlobe, finger tip, skin, etc. The wave is also visible at any artery or vein that is accessible on the surface of the body. I have documented these views many times in recent years. But an outstanding question has remained, this being: *Does the Valsalva Wave exist in the brain? If it does, what are the implications?* The wave is visible everywhere on the surface of the head but does the brain actually experience the wave?

There are indications that it does. For example alpha wave amplitude increases sharply with even a single cycle of Coherent Breathing. (Thank you Dr. Elsa Baehr for making this subtle observation.) The period of 1 cycle of Coherent Breathing is nominally 12 seconds. Why would a single 6 second inhalation followed by a single 6 second exhalation cause an immediate increase in alpha wave amplitude?

Prior to *Valsalva Wave Pro*, HRV instruments could not see the breathing induced blood wave. They were concerned with detecting heart beats which have a period of 10ths of seconds, i.e. typical HRV instruments are 10 times "too fast" to see the signal. The same is true of the spectrum of interest of contemporary EEG machines which observe frequencies in the 1-40 Hertz range. The frequency of Coherent Breathing and the blood wave it induces is ~.085 Hertz, about 12 times slower than the lowest frequency of interest of the contemporary EEG machine.

The principle innovation behind *Valsalva Wave Pro* was widening the frequency range to be able to see very low frequency phenomena. When we did, the wave was there at its amplitude was surprisingly large, often equal to that of the cardiac systole when breathing coherently. As the cardiac systole exerts 40mmHg of pressure, then the breathing induced wave also approximates 40mmHg when breathing coherently. And they are additive, together exerting something on the order of 80mmHg when they are synchronous. We will come back to this point in a later issue.

In 1999 two biofeedback professionals, the late [Hershel Toomim](#) and [Robert Marsh](#) (both of [Biofeedback Institute Of Los Angeles](#)) were awarded US Patent #599587, [Biofeedback Of Human Central Nervous System Activity Using Radiation Detection](#). Their invention employs red and infrared light to peer through the skull and assess the oxygenation of cerebral blood. You can think of it as a brain blood oximeter. Today, this form of biofeedback is referred to as “hemo-encephalography” or simply HEG.

In 2009, Dr. Bob Grove (J&J Engineering) and I were discussing the potential for the wave to exist in the brain. If it did, what would it mean to neuroscience? Bob suggested I call Hershel (a friend and colleague of Bob’s) and inquire about his HEG instrument - could it detect the Valsalva Wave? I did...

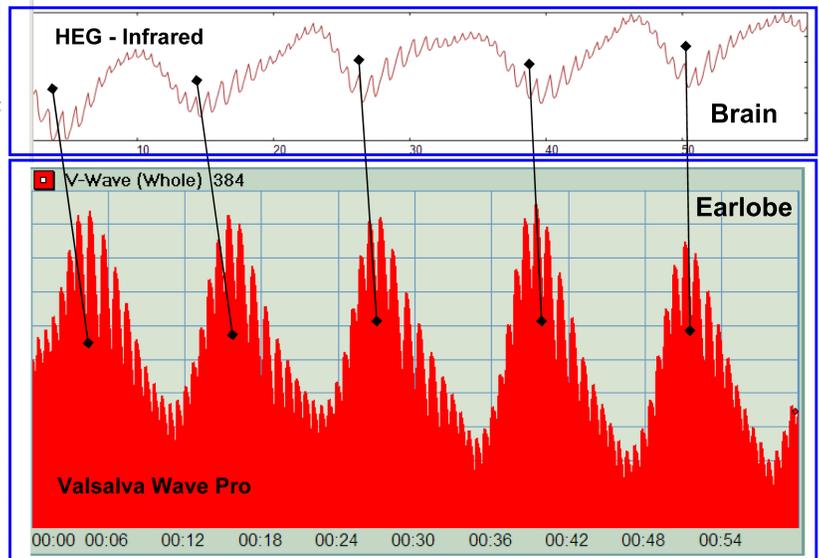


Figure 2: Simultaneous view of Valsalva Wave in the brain via HEG and at the earlobe via Valsalva Wave Pro

Hershel said that he was familiar with my work and had looked for a breathing induced blood wave in the brain but alas, had not seen it. We discussed this for some time musing about the possibilities. I related that I could see the wave all over the surface of the head, virtually anywhere I could fit a sensor and that I was certain that the wave existed at the arterial inputs to the brain and that it was observable at the jugular vein. Hershel suggested that the reason he had not seen it was because of the strict control the brain has over cerebral blood. In other words, the brain turns varying blood flow into constant blood flow, which was and is the prevailing neuroscientific view.

I related that the innovation that allowed us to see these low frequency changes in blood flow elsewhere in the body was elimination of the low frequency filtering and wondered if that could be limiting HEG visibility of the wave. We parted, both agreeing to think more about it. Hershel, one of America’s biofeedback pioneers passed away in 2011 at age 95. We didn’t get to speak a 2nd time.

This year, I learned that Hershel’s grandson [Jonathan](#) had taken up his research. I contacted Jonathan, introduced myself, and we picked up where Hershel and I had left off 5 years earlier. In the interim period Jonathan had created a research instrument wherein the low frequency filtering had been removed. One evening he demonstrated it for me via Skype. When he breathed slowly, deeply, and rhythmically, the wave was clearly visible, also when he yawned (a key test). Within a month or so, Jonathan had created an instance of the research instrument for my use.

Figure 2 presents the results. It shows simultaneous views of the Valsalva Wave while breathing coherently. The bottom panel is Valsalva Wave Pro at the earlobe. The top panel is from Jonathan’s HEG instrument, the signal being a function of infrared light that is projected through the skull into the brain and reflected back by the blood. We can clearly see that it is a mirror image of the Valsalva Wave at the earlobe, heartbeat and all, confirming that in fact the brain does experience the Valsalva Wave. Does this explain the brain’s immediate increase in alpha wave activity with 1 cycle of Coherent Breathing, a single wave? This is a difficult question to answer and will take us some time to know...

In the next issue we will discuss cardio-pulmonary-circulatory physiology and biological impetus for the wave. Until then...

Thank you for your interest, Stephen Elliott, President, COHERENCE LLC

[Subscribe to *Alternativz* - An Occasional Journal Of Complementary Solutions For Health, Well-being, Performance & Longevity](#)

COHERENCE - THE NEW SCIENCE OF BREATH®