

Hello all,

Welcome to the September 2007 COHERENCE Newsletter. In this newsletter we continue our in-depth exploration of *The Art of Coherent Breathing*. Again, we will do this by way of exploring the *essential principles*.

In the August newsletter we established that *depth* is the single most important principle because depth determines RAPWave magnitude. And, when there is no RAPWave it means that the mechanical action of breathing has ceased to contribute to the generation of blood flow and arterial pressure. According to the proposed theory, the autonomic nervous system compensates for this absence by elevating heart rate and heart output, and by reducing arterial capacity, thereby raising average blood pressure. It effects this change in blood pressure by increasing relative sympathetic bias. I believe that it is *this* bias that if allowed to persist, results in many modern day maladies including anxiety, depression, insomnia, chronic muscle tension, hypertension, etc. Find the August issue of the newsletter here: http://www.coherence.com/coherence_newsletter_august_2007_production.pdf

This month I introduce the 2nd most important principle – ***relaxation***.

This month's ***Point of Interest*** is: What's Up your Nose?

In the way of news, Dee Edmonson and I presented the workshop: *Respiration, Arterial Pressure, Heart Rate Variability, and Autonomic Nervous System Governance: Theory and Practice*, at the 15th Annual Conference of The International Society for Neurofeedback and Research, September 6-9 in San Diego, CA. It was received well and has generated much interest since. The presentation is available (for free) in protected Adobe .pdf at: http://www.coherence.com/publications_html_production.htm

As always your interest and support is most appreciated.

Regards,

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The Art of Coherent Breathing – Principle # 2: Relaxation

You may recall the statement from *The New Science of Breath* that “heart rate variability amplitude correlates highly with mortality risk from all causes”. I argue that HRV amplitude is an outcome of autonomic nervous system governance of instantaneous blood flow and arterial pressure, i.e. the respiratory arterial pressure wave (RAPWave), which varies with breathing. If so, then it is breathing sufficiency that correlates highly with all causes of mortality. And to be very precise, it is the magnitude of the respiratory arterial pressure wave that varies with all causes of mortality.

Last month I asserted that *depth* is the single most important principle of Coherent Breathing® because it is the key determinant of RAPWave magnitude. Please note that depth and frequency are two sides of the same coin. Their relationship is kind of complicated. In engineering speak, we can say that “depth” is a *time domain* phenomenon and that “frequency” is a *frequency domain* phenomenon. In a nutshell depth limits but does not determine frequency. Similarly, frequency limits but does not determine depth. To put it in simpler terms, we are interested in the range of diaphragmatic movement. So, for practical purposes we’ll use the definition we established some time ago.....*depth is the extent of diaphragmatic movement.*

Diaphragmatic action affects RAPWave magnitude by “pumping” *both* air and blood. We can see that this “design” makes imminent sense in light of gas exchange. As we inhale lung alveoli fill with air from the external environment. Simultaneously, pulmonary capillaries fill with venous blood returning to the lungs via the right side of the heart. Air and blood meet under opposing pressure across the extremely thin alveolar surface, thereby facilitating the exchange of oxygen and carbon dioxide. See Figure 1.

When we exhale, the opposite occurs. Both air and blood exit the lungs. Blood exits the lungs via the pulmonary veins, flowing through the left side of the heart into the systemic arterial tree. The heart checks the flow and elevates the pressure by about 80mmHg.

Now, if you’ve practiced Coherent Breathing with HRV biofeedback assistance, you may notice that even if you breathe at the frequency of resonance, your HRV cycle may not be very “robust”.

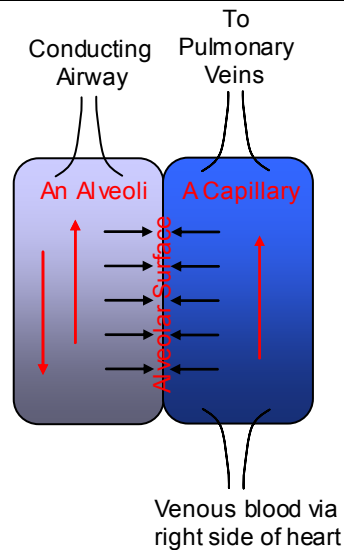


Figure 1 – Opposing air pressure and blood pressure against the alveolar surface

Maybe it is around 10 beats from peak to valley vs. 20-30 beats. In fact, it is not unusual to practice for several weeks or months and not see the amplitude build significantly, but why not?

This brings us to the focus of this month's newsletter – *relaxation*. I believe that tension in the body results in vascular constriction. Both arteries and veins are very highly distensible, meaning that they both expand and contract to a great extent, under both autonomic control and instantaneous blood pressure. Blood vessel dimensions are controlled by low threshold muscle motor units of which they are constructed. When these low threshold motor units contract vessels narrow, when they relax vessels expand. The ability to expand and contract both veins and arteries is a primary way that the autonomic nervous governs blood flow and pressure throughout the body. The extent of control is surprising – in the event of loss of a limb, the autonomic nervous system has the ability to shut off blood flow to the affected limb completely! It does this by *closing* vessels to the affected area.

Again, blood vessels are constructed of low threshold muscle motor units. Low threshold motor units are *very* sensitive to nervous electrical potential. Stress generates low level electrical impulses that cause low threshold muscle motor units to contract and stay contracted. We feel this contraction as stiffness in the muscles, this limiting our comfortable range of movement, especially movement involving the spine. The science of electromyography (EMG) works on the basis of measuring muscular electrical activity and feeding that information back to the user for purposes of gaining conscious

control over muscular excitation and related nervous control. I had a very positive experience with EMG biofeedback for temporomandibular joint dysfunction in ~1980.

The same persistent contraction, i.e. stiffness that we feel in our muscles also affects the capacity of our blood vessels (my assertion). If the systemic arterial tree is not relaxed it cannot accommodate the wave of blood exiting the lungs coincident with exhalation, nor can the veins accommodate high flow during inhalation. In other words, “the magnitude of the wave is limited by the size of the pipes”. And for this reason, we don’t see a large respiratory arterial pressure wave, or an HRV cycle of high amplitude.

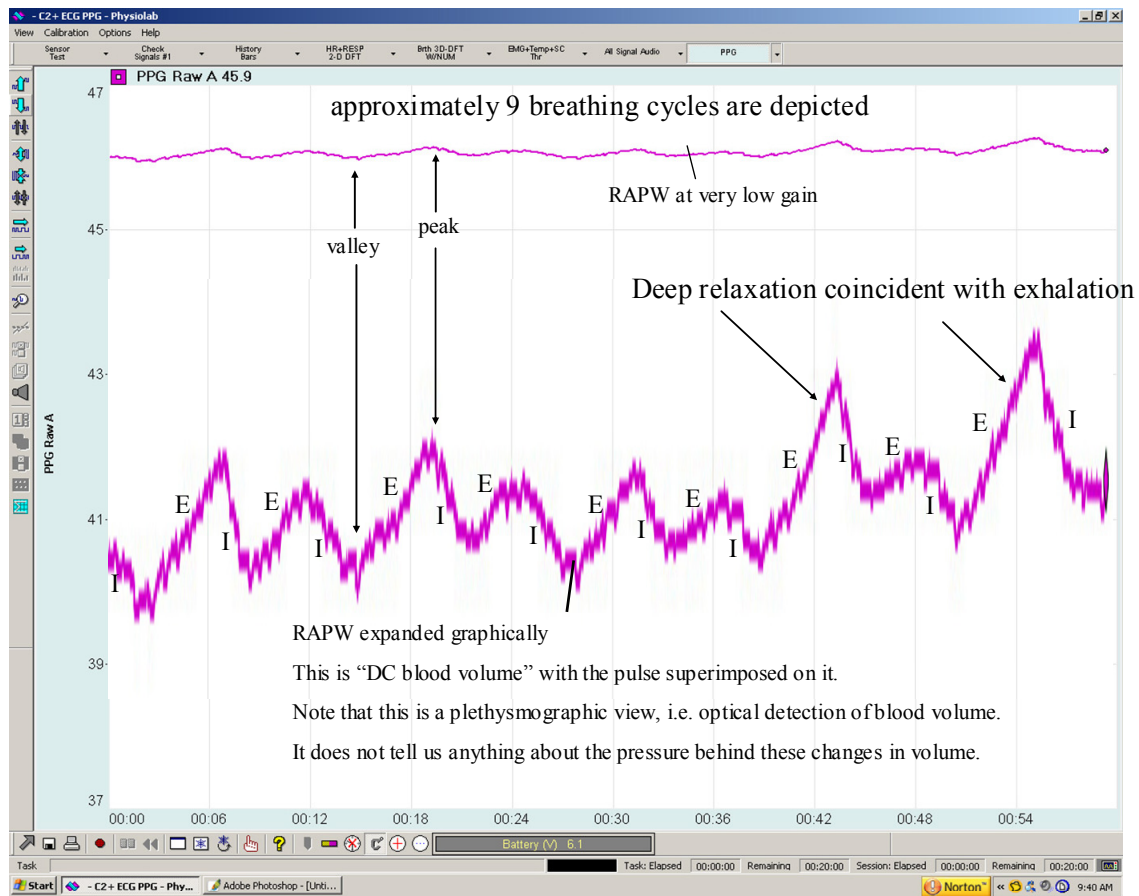


Figure 2 – Plethysmographic view of RAPWave

Figure 2 presents a view of the RAPWave measured in the finger with an experimental DC plethysmograph. Here we see 9 cycles of breathing. The exhalation phase is denoted by an “E” and the inhalation phase by an “I”.

The last two waves demonstrate deep relaxation during exhalation. Note how RAPWave magnitude increases.

But how do you know if tension is really what is holding your HRV amplitude back? Here is a simple test: Are your muscles tense or tight? Is your comfortable range of movement large? Do you suffer any chronic muscle pain that has no etiology other than tension? If you answer “yes” to these questions, then I can assure you that tension is limiting your HRV amplitude.

The way to combat tension is to cultivate the ability to relax deeply and carry this state of relaxation with you. Coherent Breathing helps. In fact, *if you do not breathe slowly and deeply, you can't relax*. Your autonomic nervous system will not allow it. So, breathing slowly and deeply is a critical prerequisite. Of course, this is why slow, deep, conscious breathing is necessary for the successful practice of yoga.

At the risk of writing a newsletter that is too long to enjoy, we will leave it here for now. Next month, we'll focus on methods for cultivating and sustaining deep relaxation, even during daily life.

Point of Interest: *What's Up Your Nose?*

The answer is your *nasal turbinates*! OK, what's there to write about nasal turbinates? Well, did you know that the surface area of the turbinates is approximately 160 square centimeters! Wow! It's hard to imagine having 160 square centimeters up the nose, even if we try. It's one of those statistics that we just have a hard time getting our mind around. Like the fact that our blood vessels would stretch around the earth a few times!

Have you noticed that the amount of air flowing through your nose varies throughout the day and night? I believe that this is a consequence of autonomic regulation of air flow so as to match blood flow, the result being maximization of RAPWave magnitude (and HRV amplitude) regardless of breathing depth or frequency (to the extent that the autonomic nervous system can manage it).

When air flow and blood flow *are* matched RAPWave magnitude and HRV amplitude are maximal, given the breathing circumstance. When they are not

matched, air flow and blood flow are “out of sync” and we see this as reduced HRV amplitude and reduced coherence.

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