

***Hello all,***

Welcome to the July COHERENCE Newsletter.

In this newsletter we will complete our present exploration of cardio-pulmonary resonance, where I answer the question: *What happens when the respiratory arterial pressure wave is absent?* (as it is for most of us, most of the time).

Next month's feature article is titled *The Art of Coherent Breathing*. It will provide an essential review of the Coherent Breathing method, attempting to address both obvious and subtle aspects. (Thank you for your requests.)

This month's ***Point of Interest*** is: *Don't Rush!* Living life in a rush is the easiest way to defeat our goal of living life in the state of balance. If we're going to rush, *allow both body and mind to rush together!*

As a reminder, Dee Edmonson and I will be presenting the 3 hour workshop *Respiration, Arterial Pressure, Heart Rate Variability, and Autonomic Nervous System Governance: Theory and Practice*, at the upcoming 15<sup>th</sup> Annual Conference of The International Society for Neurofeedback and Research, September 6-9 in San Diego, CA. ([www.isnr.org](http://www.isnr.org))

I will also be presenting the poster presentation, *The Respiratory Arterial Pressure Wave – The Cardiopulmonary Mechanics Behind The Heart Rate Variability Cycle*. We hope you are able to make it.

Lastly, if you have a website and would like to exchange links, please email [linkexchange@coherence.com](mailto:linkexchange@coherence.com).

As always your interest and support is most appreciated.

Wishing you wellness,

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## What Is Cardiopulmonary Resonance – A Theory (Part III)

Recall, that in the June Newsletter we discussed the respiratory arterial pressure wave (RAPW) and its role in moving the blood. In it, I argued that the autonomic nervous system “desires” the presence of the respiratory arterial pressure wave because it assures circulation and represents homeostasis. Last month’s article ended with the question:

*“So what happens when the respiratory arterial pressure wave is absent?”*

To understand the answer to this question, let’s quickly review what’s going on. According to the theory set forth in *The New Science of Breath – 2<sup>nd</sup> Edition*, the respiratory arterial pressure wave (RAPW) is a primary determinant of the heart rate variability (HRV) cycle. The peak of the RAPW, the moment of maximal blood volume and pressure, determines the valley of the HRV cycle. Similarly, the valley of the RAPW, the moment of minimal blood volume and pressure, determines the peak of the HRV cycle.

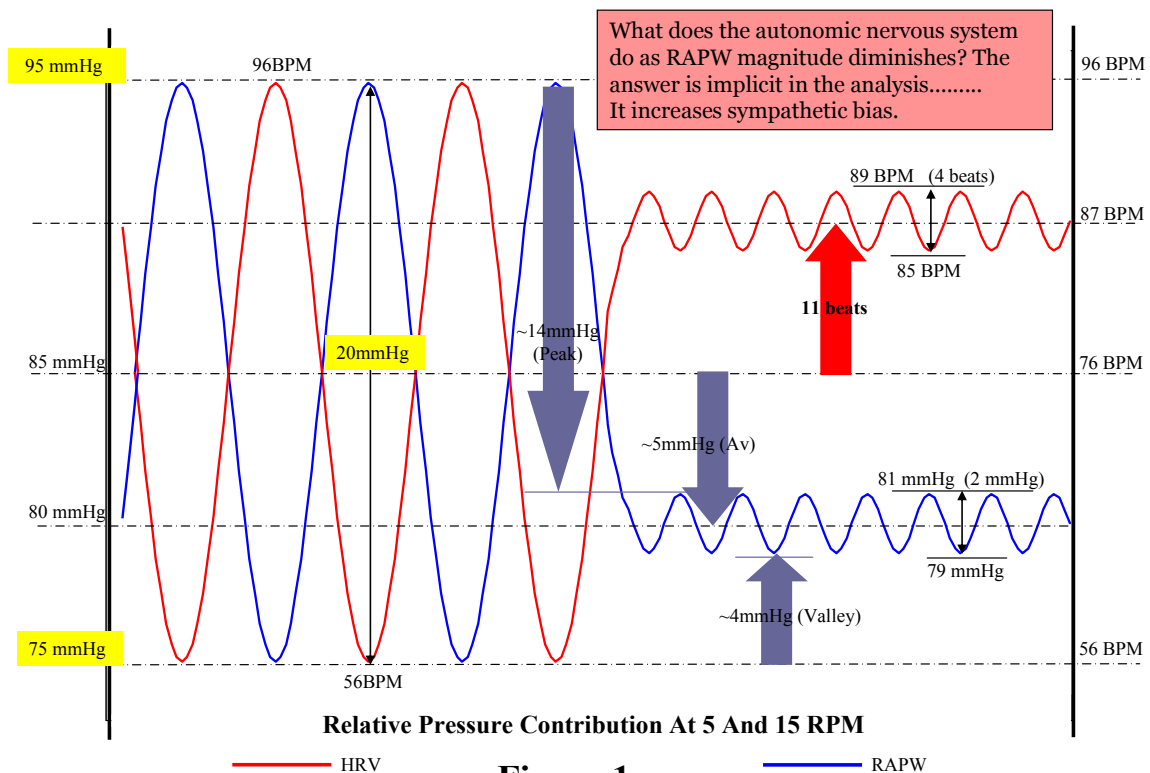


Figure 1 depicts a model of RAPWs and their respective HRV cycles at 5 and 15 respirations per minute (RPM). The respiratory arterial pressure wave at 5 RPM is measured, as are heart rate variability cycles at 5 and 15 RPM.

The RAPW at 15 RPM is derived (assuming a simple linear relationship between RAPW magnitude and HRV amplitude – which appears to be appropriate).

The RAPW is represented by the blue line and the consequent HRV cycle by the red line. The left vertical axis is pressure in millimeters of mercury (mmHg). The right vertical axis is heart beat rate in beats per minute.

If I measure the arterial pressure wave peak-to-peak, I consistently measure 60+ mmHg. However, the heartbeat normally contributes 40 mmHg which is why we see a 40mmHg difference between normal systolic and diastolic blood pressures. Subtracting 40 from 60, we see that the respiratory component of the RAPW is 20mmHg peak-peak. This is consistent with Medical Physiology (Guyton & Hall).

So, we see that breathing at 5 respirations per minute yields an RAPW of 20mmHg (this is the respiratory component only) and an HRV amplitude of 40 beats. Breathing at 15 respirations per minute yields an HRV cycle of 4 beats and a derived RAPW (using the mirror image of the HRV cycle) of 2mmHg. For purposes of this model we can see that 1mmHg yields 2 beats of HRV amplitude ( $40 \text{ beats HRV amplitude} / 20 \text{ mmHg} = 2 \text{ beats/mmHg}$ ).

Now, note that the RAPW of 15 respirations per minute (2mmHg) is 10 times smaller than the RAPW at 5 respirations per minute (20mmHg). Not only is it smaller, it is shifted downwards. Its peak is 14mmHg below that of 5 respirations per minute. Its average pressure “contribution” is shifted downward by 5mmHg. Its valley is 4mmHg above that of 5 breaths per minute. In other words, relative to 5 respirations per minute, RAPW peak and average pressure are diminished; valley pressure increases.

What is the consequence of this? The answer to this question is implicit in the analysis.....in the absence of the pressure wave generated by breathing, the autonomic nervous system compensates by increasing sympathetic bias. It accomplishes this by moderating three mechanisms: heart rate, heart output, and arterial capacity.

However, unlike the cyclic pressure generated at resonance, which vacillates between 95 and 75 mmHg (respiratory component only) with every inhalation and exhalation, this pressure increase is “steady state” in nature. It is what in engineering terms we call a “DC shift”, i.e. pressure is elevated and remains elevated, varying by only 2mmHg as opposed to the 20mmHg variation we see at 5 respirations per minute. Thus it represents a significant increase in cardiovascular “work”.

Summarizing, while there is certainly much to be known about the RAPW phenomenon, I believe its demise via suboptimal breathing to be the *root cause* of the “sympathetic shift” we are trying to avoid. The theory also explains how slower deeper breathing serves to mitigate hypertension – by restoring a healthful respiratory arterial pressure wave with consequent blood flow and resulting autonomic nervous system balance.

### Additional Point of Interest: *Don't Rush!*

Having just finished our discussion of the respiratory arterial pressure wave, there are 2 primary factors that govern its magnitude: 1) breathing frequency and depth, and 2) relaxation. When we allow ourselves to “rush”, we sacrifice both. And in doing so, we invite sympathetic bias into our lives.

Now, sympathetic bias is not all bad – it is “the spark of life”. Without some degree of sympathetic bias we would lose consciousness altogether. Sympathetic bias is absolutely necessary during periods of activity, for example physical work, exercise, etc. And of course, it is our most important ally during moments of “fight or flight”. Sympathetic bias is only bad when we are in a state of rest or semi-activity, i.e. when we *should be* in a state of balance or even parasympathetic bias, in which case sympathetic bias thwarts rest, recovery, and autonomic balance, in effect keeping us in a constant state of “hyperactivity”.

*The real issue is when there is a “mismatch” between what our mind and body are doing – when the mind is in a hurry and the body is stationary.*

This might include the state of rest.

Let's consider a couple of simple scenarios:

**Scenario A:** We're sitting in a traffic jam and we're late for a very important meeting. Time is ticking by..... and the traffic is..... at a stand still. Think about the mental and physical discomfort..... Arrggghh!

**Scenario B:** Circumstances permitting (or necessitating), you decide to ride a bicycle to the meeting. We're still in a hurry and we might have to ride really hard to make it on time. In this case, the body is very active. Any sympathetic “action” that might arise due to our worry over being late, we

can put into pedaling even harder. Think about how you might feel riding really hard to get there on time. Your legs may be burning as you ride uphill.....And, then you arrive. How do you feel now?

You may recognize that Scenario B is not new to humankind. We have been getting ourselves where we need to go via “work” for all of history until now.....until the advent of modern transportation, which allows us to be stationary while the vehicle is doing the rushing. When this is the case, our mental rushing causes energy to be generated that needs an outlet, yet it does not have one. It makes you want to bite your nails!

An emerging understanding of post traumatic stress disorder is that it results from the same thing only to a much greater degree, that is, the stressor is much more grave and intense, as is the mind/body reaction.

It is my professional opinion that this is what makes exciting fast moving video games so harmful to children (and adults). They experience all the ups and downs of being on a roller coaster or jet fighter while sitting on the floor wiggling their thumbs.

What do you think happens to their breathing pattern when exciting video games are played day after day, month after month? The same thing that happens to adults under stressful situations, they stop breathing.

The End.