Dear COHERENCE Customer,

I'm Stephen Elliott, founder of **COHERENCE®** and author, with dear friend and colleague Dee Edmonson, of ***The New Science of Breath – Coherent Breathing for Autonomic Nervous System Balance, Health, and Well-being***.

I've struggled long and hard with the question of whether or not to publish a newsletter. Personally, I find that most newsletters start out being "newsworthy" and within a short time become "advertisements". However, because I am making exciting new discoveries relative to this *new science of breathing* on a regular basis – I am compelled to share this information with you.

So, I'm pleased to present to you, the first **COHERENCE** "newsletter".
I hope you find it important and useful. I will make this commitment…..If I don't have anything worth communicating, I won't send a newsletter. (This being said, if you prefer not to receive it in the future, there is an opt-out link at the bottom of this email.) If you did not receive the newsletter directly and would like to subscribe, click here (its free).

The topic I've chosen for this newsletter is:

"What Is Cardiopulmonary Resonance – A Theory"

The newsletter is available in .html and unprotected Adobe .pdf format:

http://www.coherence.com/coherence_newsletter_may_07_production.pdf

Please feel free to share it with friends and colleagues.

Before I get started, I'd like to thank you for your interest and support. At present, there are several thousand copies of RESPIRE 1 in use around the globe. ***The New Science of Breath*** is nearing 2000 copies in circulation in more than 6 nations.

Thank you for your interest and consideration,

Stephen Elliott
COHERENCE
The New Science of Breath

What Is Cardiopulmonary Resonance – A Theory (Part I)

The topic I've chosen for this newsletter is: **"What Is Cardiopulmonary Resonance – A Theory"**. Why? Because, in my view this continues to be the most basic and important question, i.e. "what" is this thing we call "cardiopulmonary resonance" anyway, and why should we care.

(Please note that while my confidence in this theory is high, it is a work in progress.)

I'll begin by offering this answer: Cardiopulmonary resonance is fundamentally about blood flow. Allow me to explain……..

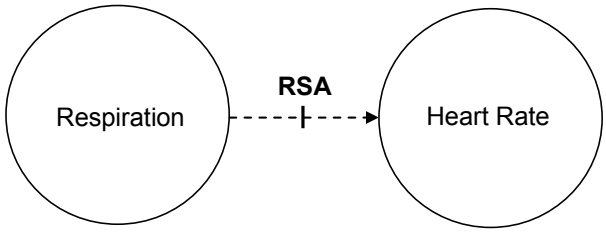

Figure 1: Respiration affects heart rate

It is known that heart rate and respiration are highly related. This relationship is referred to as "respiratory sinus arrhythmia". The relationship is such that heart rate increases coincident with inhalation and decreases coincident with exhalation in a "sinusoidal" fashion, hence the name respiratory "sinus" arrhythmia. This phenomenon has been known about for hundreds of years in the West, and thousands of years in the East.

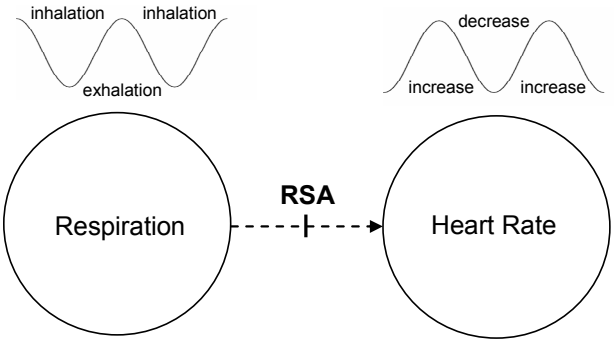

Figure 2: Heart rate variability

Variable respiratory rhythm results in variable heart rhythm. This phenomenon goes by the name "heart rate variability", recognizing that breathing rhythm is not the only factor affecting heart rhythm.

It is generally accepted that the mechanism behind respiratory sinus arrhythmia and its result, heart rate variability, is autonomic nervous system regulation of arterial pressure via the *baroreceptor reflex*.

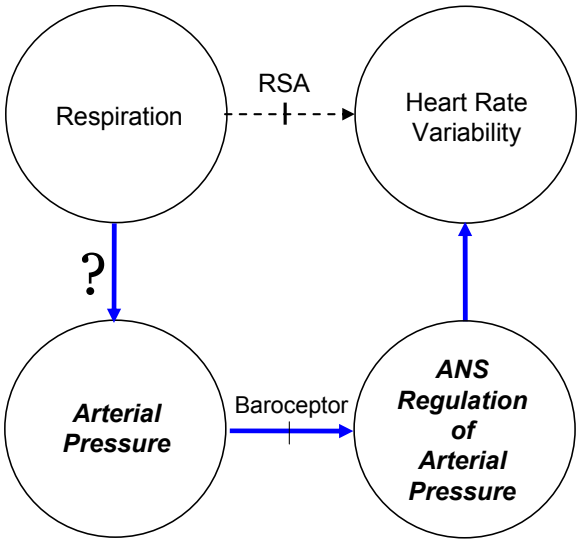

Figure 3: ANS regulation of arterial pressure via baroreceptor reflex

Baroreceptors are specialized neurons located throughout major arteries. Their function it is to monitor arterial pressure. Via the autonomic nervous system, baroreceptors work in *opposition* to changes in blood pressure, i.e. if blood pressure decreases, the ANS facilitates an increase, and visa versa.

If this is so, i.e. if HRV is an outcome of ANS regulation of arterial pressure, then respiration must affect arterial pressure. And there is much evidence that it does. However, not much is known about how.

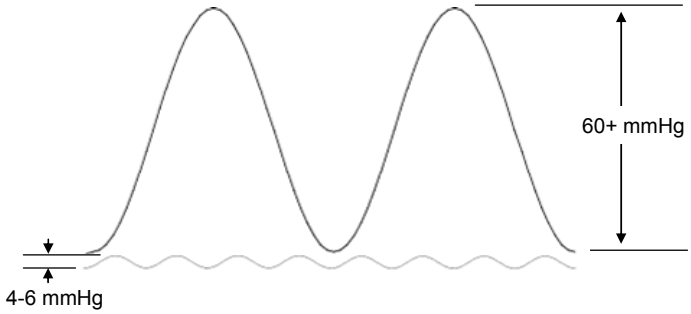

Figure 4: The respiratory arterial pressure wave

Respiration results in the ***respiratory arterial pressure wave*** (RAPW) which typically rises and falls by 4-6 mmHg (as measured at the extremities) during *normal* respiration. "Normal" respiration is generally considered to be 15 breaths per minute for the typical adult (however there is evidence that it is more like 17-19 breaths per minute). However, the RAPW may vary to a much greater degree during deep respiration, i.e. 60+ mmHg[1].

During cardiopulmonary resonance (optimal frequency and depth of respiration), arterial pressure rises and falls with blood volume, as you would expect. In other words, when blood volume in the systemic arterial tree increases, pressure goes up. And the converse, as blood volume decreases, pressure goes down.

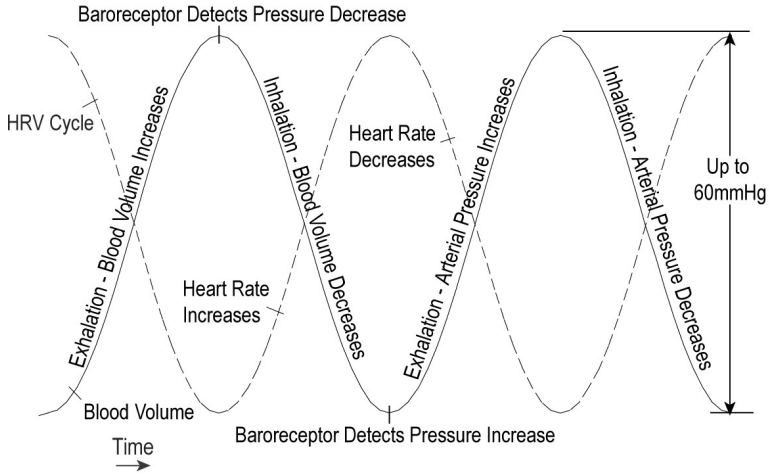

Figure 5: Heart rate and blood volume are 180 out of phase during resonance

Also, during resonance, blood volume and arterial pressure[2] are 180 degrees out of phase with heart rate. During resonance, blood volume and arterial pressure rise as heart rate falls, and fall as heart rate rises. (From this, we can infer that *heart rate* is not the primary determinant of this blood volume/arterial pressure wave.)

In accordance with our understanding of respiratory sinus arrhythmia, relative to the breathing cycle, blood volume and arterial pressure rise coincident with exhalation and fall coincident with inhalation, but how? If *heart rate* is not the primary determinant of blood volume and consequent pressure, what is?

We'll explore this question in Part II of the **COHERENCE Newsletter**.

Additional Point of Interest

Average thoracic pressure matches the average barometric pressure of the external environment. If the internal and external pressure differential were significantly mismatched, breathing would be very difficult. If the internal pressure were much higher than the external environment, it would be very difficult to inhale, and if much lower, it would be very difficult to exhale. Of course, this is why it is difficult to exercise heavily at high altitude if you are not used to inhaling deeply.

Notes:

1. Elliott, S., Edmonson, D., *The New Science of Breath – 2nd Edition*, p. 26, COHERENCE PRESS, 2006

2. Vaschillo, E., Lehrer, P., Rishe, N., Konstantinov, M., Heart Rate Variability Biofeedback As A Method For Assessing Baroreflex Function: A Preliminary Study of Resonance In The Cardiovascular System, *Applied Psychophysiology and Biofeedback*, Vol. 27, No. 1, 1-27 (2002).

