# Heart Rate Variability 101

## An Introduction to HRV and Interpreting SweetBeat HRV Graphs and Numbers

SweetWater Health™

BeatHealthy™

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# SweetBeat Display Description

Flip Screen to HRV Details Screen

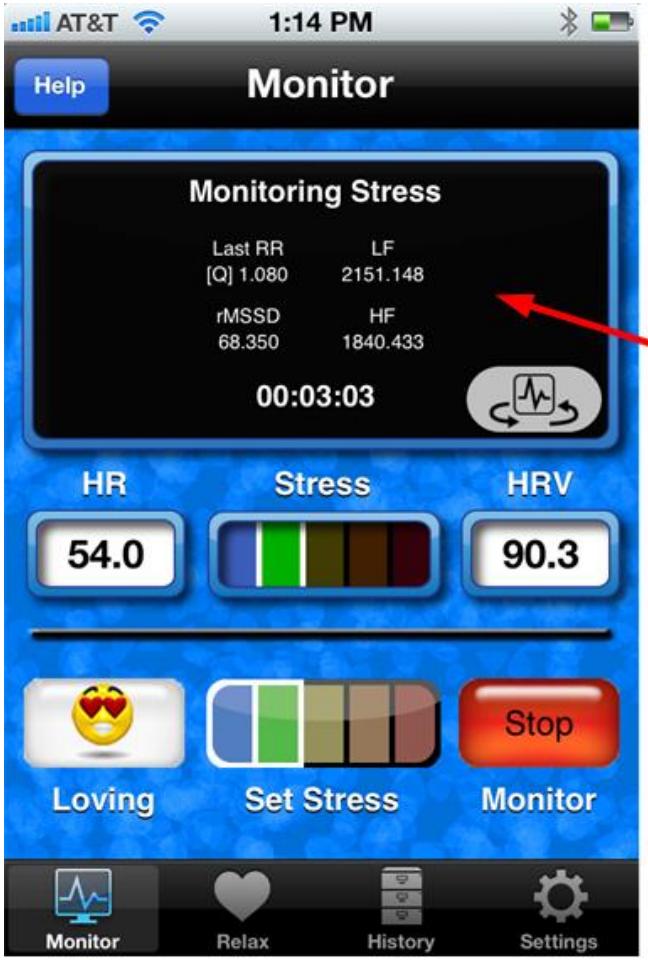
The set mood and stress functions do not change the readings, rather they provide the user with contrast from how they are feeling (if they are chronically stressed they may think stress is normal) and what objective measurement is saying

HRV is a scaled version of rMSSD and represents the state of the parasympathetic nervous system and ability to respond/react and recover from stressors. These stressors include orthostatic (standing and sitting), environmental and psychological.

For consumer friendly purposes, rMSSD has been scaled to a number between 0-100 and the higher the better. Most people are between 50 – 80.

The stress gauge is a representation of the balance of your nervous system. The two branches are sympathetic which represents fight or flight and parasympathetic which represents relaxation, repair and recover. Blue indicates that the parasympathetic is dominant and red that sympathetic is dominant. The colors in between represent varying dominance of the 2 branches

# SweetBeat "Stats for Nerds"

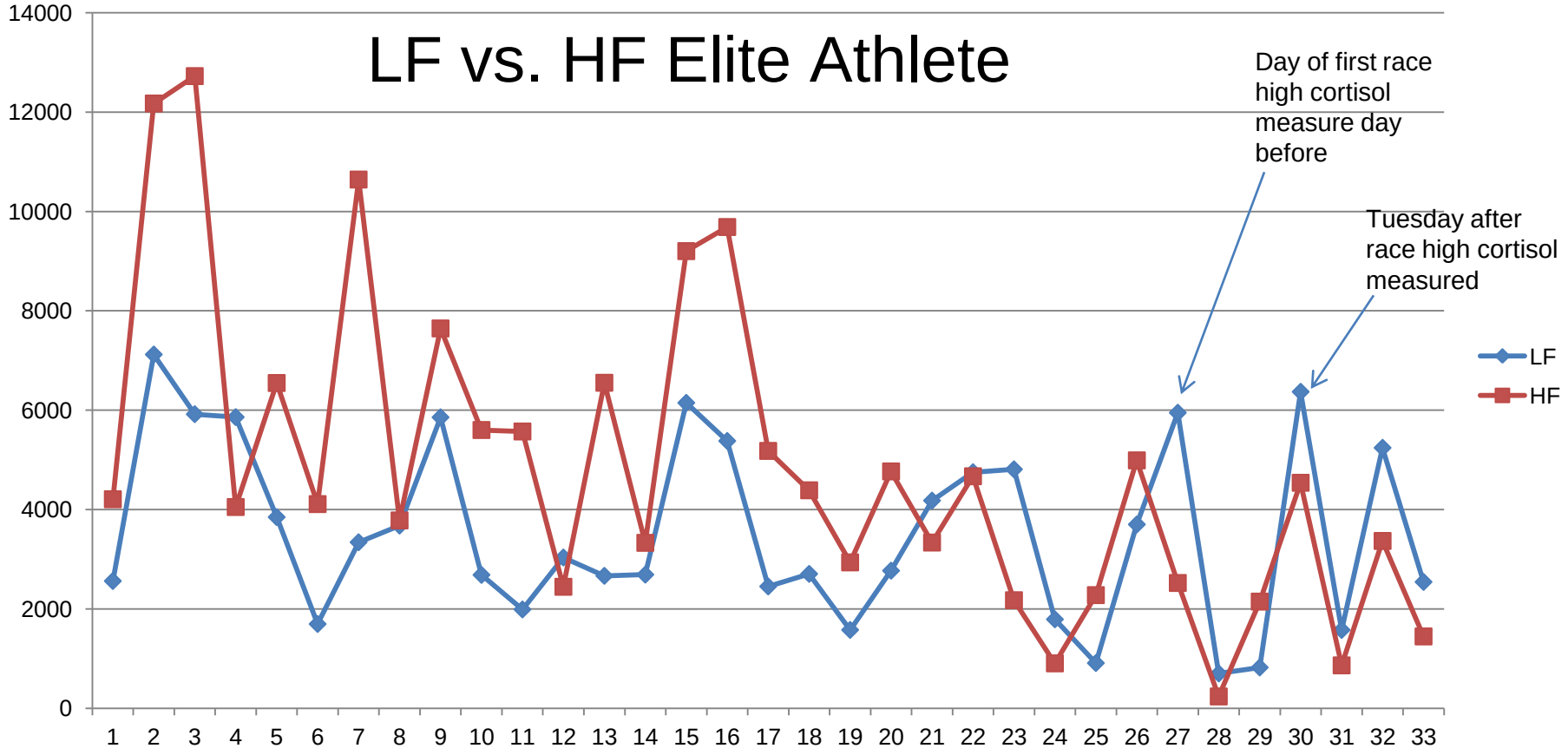



The flip side of the ECG shows the real-time rMSSD and the power of the LF (sympathetic, fight or flight) and the HF (parasympathetic, repair and recover) aspects in raw form. It also shows real-time RR intervals.

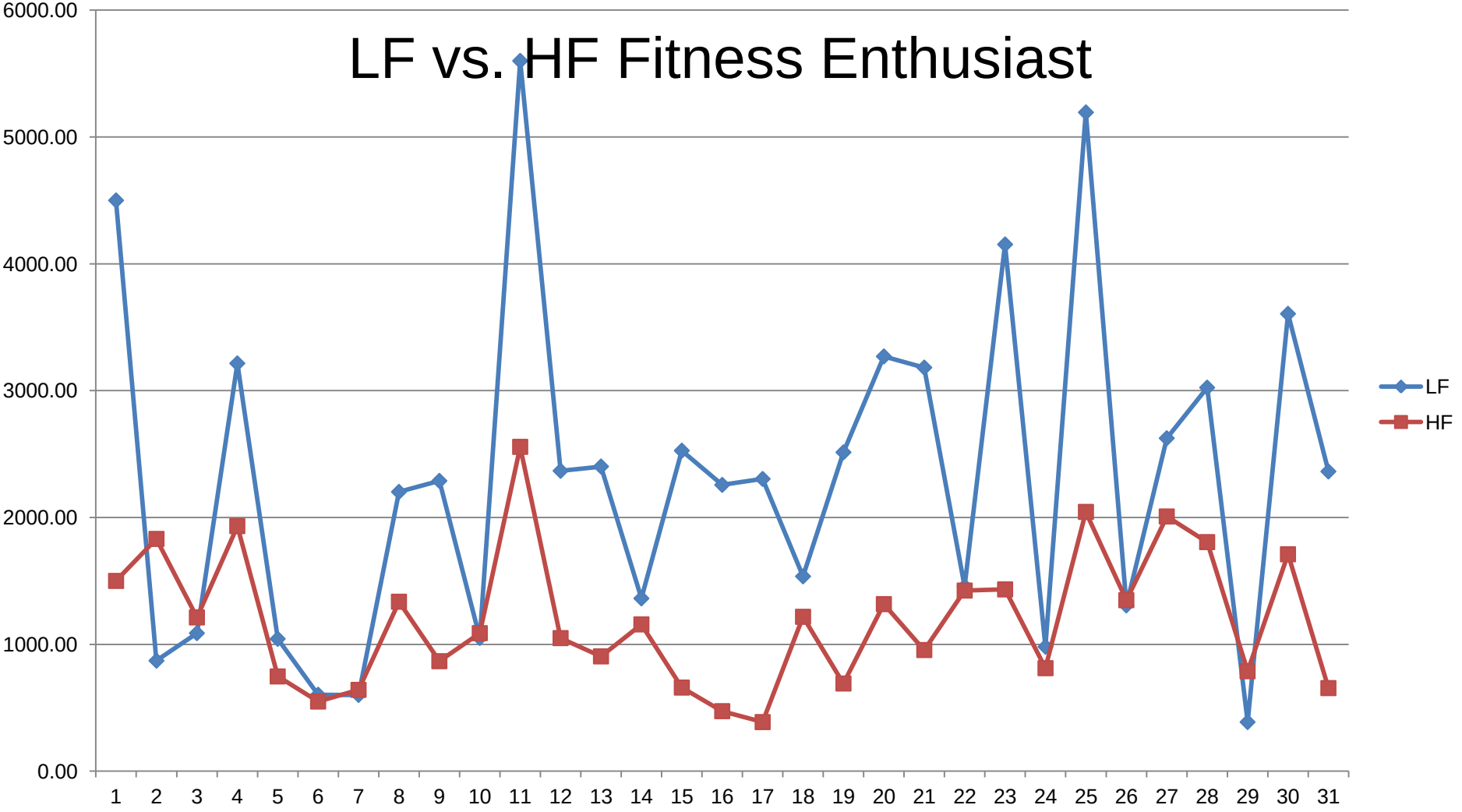
# HRV Interpretation

- HRV can vary greatly from person to person depending on health and fitness
- HRV can vary greatly for an individual from day to day and even hour to hour
- While there are “average HRV values” determined through clinical research, HRV is dynamic and individuals will tend to have their own range
  - Scroll down to see charts of “average HRV values” from some research papers
- Some athletes have HRV values that are magnitudes higher than average persons
- **SweetBeat is about understanding and managing the nervous system and not intended to diagnose anything. If you feel your HRV is “low” see your doctor**
- Athletes use HRV to guide training
  - As seen on the next 2 charts, HRV power levels vary quite a bit
  - The elite athlete has LF and HF power that are orders of magnitude higher than average
  - Don’t be alarmed if your HRV values are closer to average

# HRV for Training Example Elite Athlete



# HRV for Training Example
# Fitness Enthusiast



# Average HRV Ranges

| Gender | Age | Average SweetBeat HRV |
|---|---|---|
| Male | 10-29 | 72.29827 |
| Female | | 67.68875 |
| Male | 30-49 | 62.51162 |
| Female | | 60.47521 |
| Male | 50-69 | 52.91486 |
| Female | | 55.733 |
| Male | 70-99 | 52.91486 |
| Female | | 52.91486 |

- Source: http://www.sciencedirect.com/science/article/pii/S0735109797005548
- Values based on 24 hour measurements
- HRV represents rMSSD scaled to a value between 0 – 100 and is SweetBeat specific

| | | 20's | 30's | 40+ |
|---|---|---|---|---|
| Average LF | Male | 1480 | 678 | 212 |
| | Female | 804 | 336 | 330 |
| Average HF | Male | 925 | 314 | 131 |
| | Female | 528 | 311 | 156 |

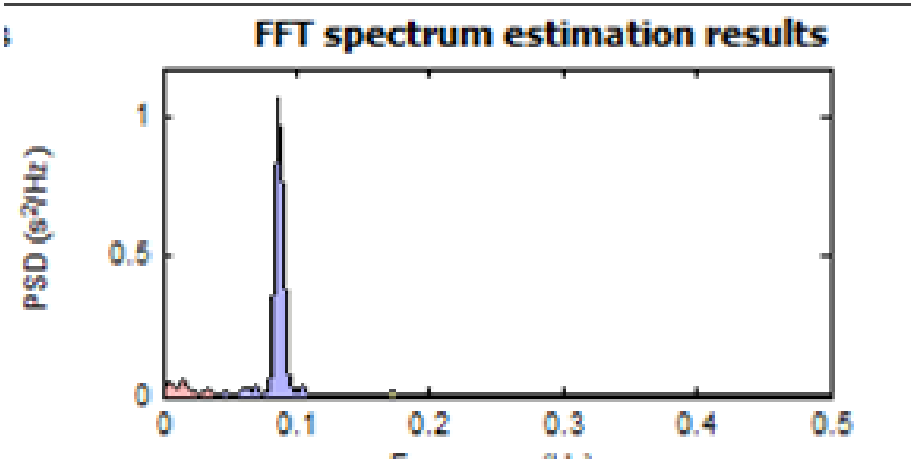
- Source:
- http://www.anti-aging.gr.jp/english/pdf/2010/7_94.pdf
- Values based on 5 minute measurements

# Coherence

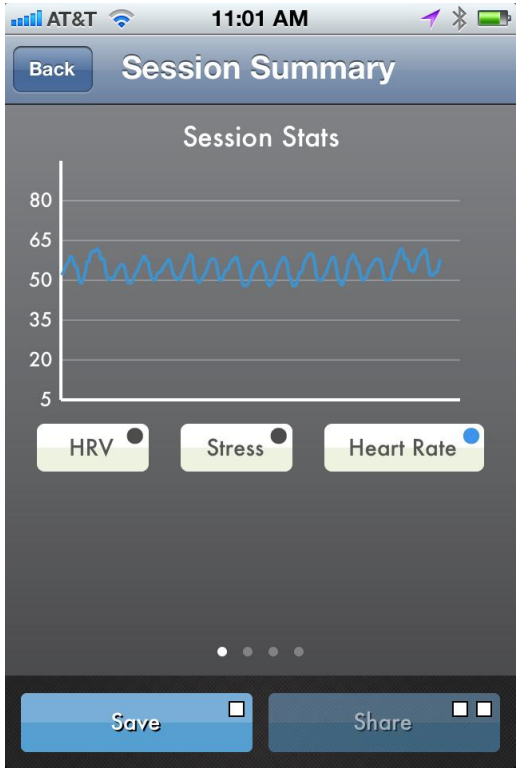
- Many SweetBeat customers use HeartMath coherence training techniques – excellent!
- Coherence is associated with a “spike” at 0.1hz frequency
- There are industry standards for LF and HF frequency ranges
  - LF = 0.04hz - 0.15Hz
  - HF = 0.15hz – 0.4hz
- Stress is associated with a high LF with respect to HF (high LF/HF ratio). Because coherence is associated with a high power spike at 0.1hz, which falls into the HRV definition of LF, **coherence shows as high stress in SweetBeat**.

# Coherence Visualized

- Coherence spike at 0.1hz
- Note very high power in the LF range (0.04hz – 0.15hz) and little to no power in the HF range (0.15hz – 0.4hz)




- SweetBeat Heart Rate Graph during Coherence

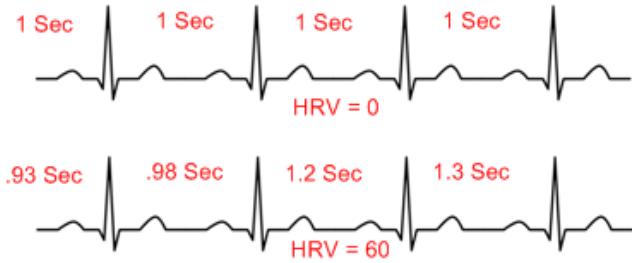


# SweetWater Health Tidbits

- SWH was founded in Feb. 2011 by Ronda Collier and Jo Beth Dow
- Idea came from the realization that in order to improve the world, individuals must improve themselves
- Much of what needs improvement is subconscious thoughts and behaviors
- SWH created an app to alert an individual in real time when their nervous system enters fight or flight, bringing subconscious reactions to the conscious mind
- An unexpected realization about how to identify good stress from bad stress
  - Power levels of nervous system are high during good stress even if sympathetic dominates – HRV increases when one is “in the zone” and highly creative
  - Fight or flight response accompanied by low HRV and low power levels
- SweetBeat is about understanding and managing the nervous system
  - Nervous system activity is the result of the coupling of biological oscillators
  - This coupling (when healthy) results in a signal that is complex (fractals, chaos, self-organizing)
- Athletes use HRV to guide training
  - HRV is the reflection of vagal tone which is affected by overtraining

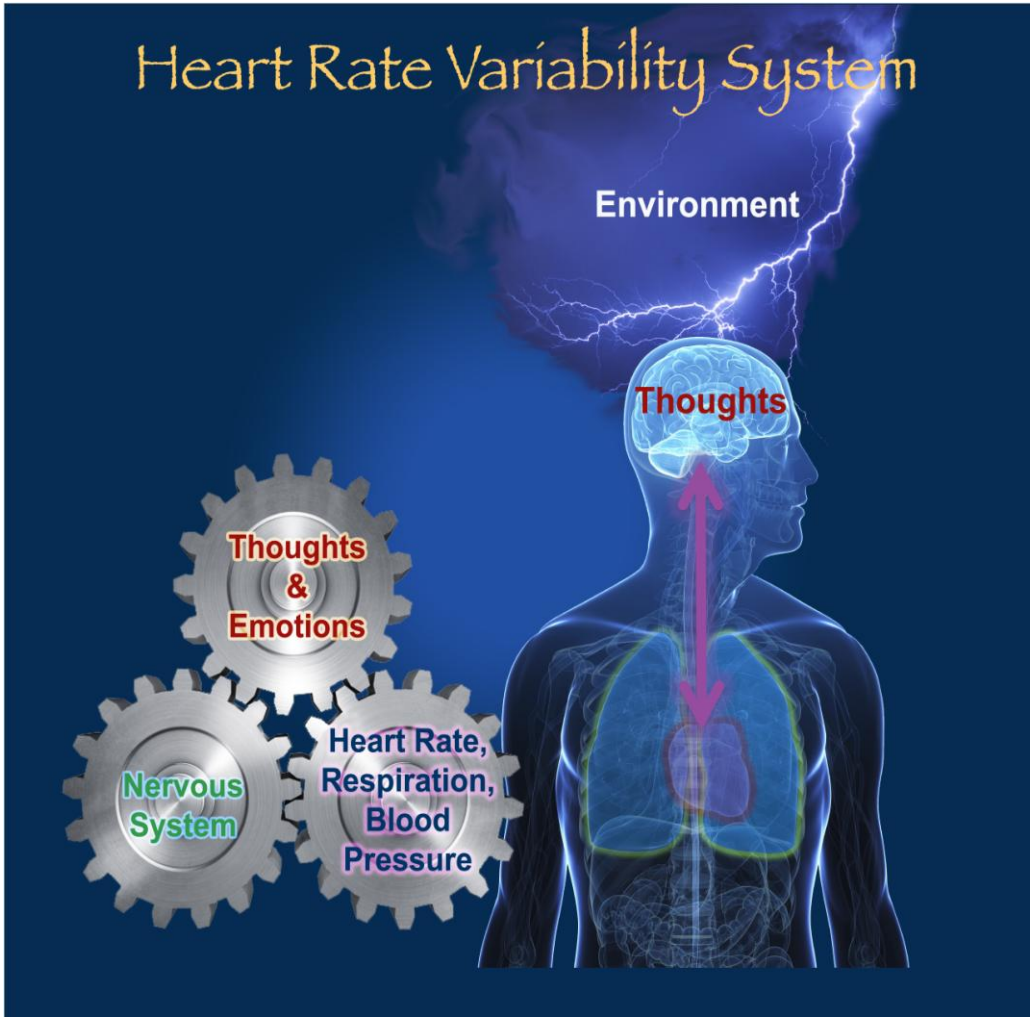
# The Science of HRV

- **What is Heart Rate Variability (HRV)?**



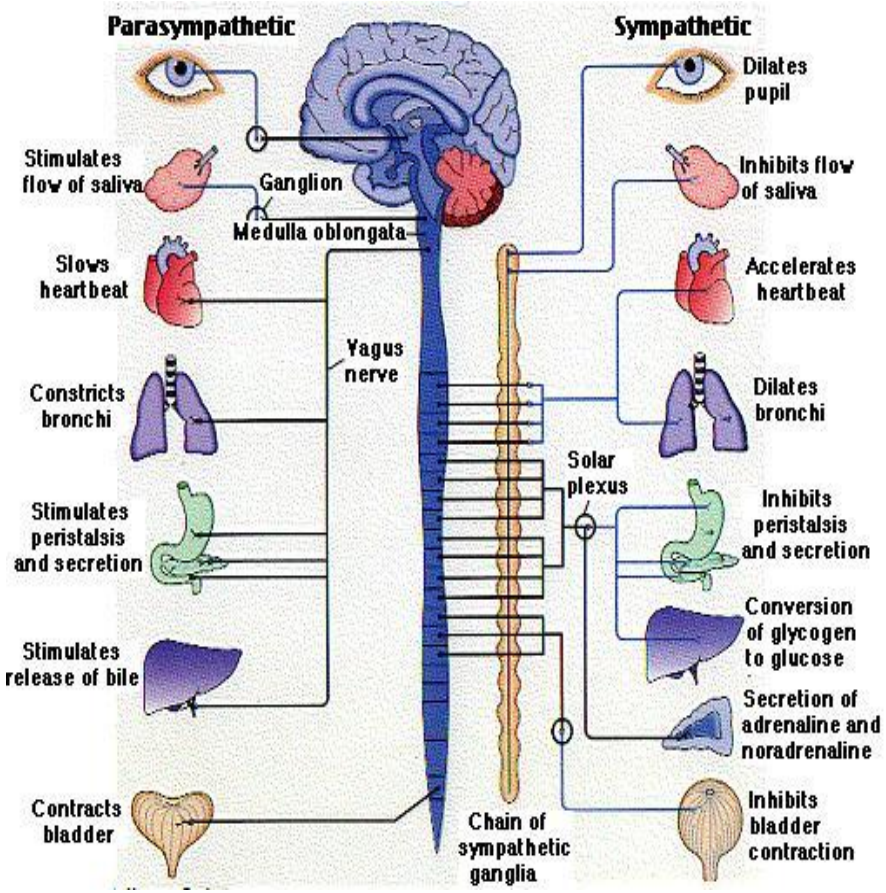

- **HRV is a result of this tightly coupled system trying to keep your body system in equilibrium**

- **HRV in the mainstream**



# SweetWater Health
# HRV and Vagal Tone

- The vagus nerve is the 10th of 12 paired cranial nerves and controls parasympathetic innervation of the heart and acts to lower the heart rate.
- Vagal innervation is the mediator of HRV and therefore HRV is an indication of Vagal Tone
- The higher the HRV, the stronger the Vagal Tone
- Higher HRV is an indication of an individuals ability to “put the brakes on stress” by mediating the sympathetic control over the nervous system and heart rate.



# Benefits of SweetBeat

## Continuous real-time generative feedback

### Balance Your Nervous System

**Sympathetic Nervous System**

The sympathetic nervous system is a bit like an accelerator; it controls the flight or fight response

**Parasympathetic Nervous System**

The parasympathetic nervous system is more like the brake pedal; it calms us down

When sympathetic and parasympathetic systems are in balance, your body is at its optimum; ready for action, yet robust and unstressed

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# SweetWater Health
# HRV and Vagal Tone

- HRV is an indication of your resilience – the ability of the nervous system to ***respond*** and ***recover*** from physical or psychological stressors
- HRV has a circadian rhythm
- IMPORTANT: HRV measured values depend on length of measurement
  - 3-5 minutes
  - 24 hour
- IMPORTANT: HRV is age and gender dependent
- HRV may change day to day with your biorhythm or due to emotional or physical stress
  - HRV associated with willpower in several studies
- Chronic low HRV is an indication of systemic health (psychological or physical) issues
- There are over 5,000 papers on HRV in the NIH database alone
- There are CPT reimbursement codes for HRV measurements

# SweetWater Health
# HRV Parameters

- Heart Rate Variability is measured by several parameters:
- Time domain – These are standard statistical analysis of the heart beat time series
  - Standard Deviation (SDNN)
  - Root Mean Square of Successive Differences, (rMSSD)
  - Heart Rate (HR)
  - pNN50, TINN, Triangular index
- Frequency Domain:
  - Very Low Frequency (VLF)
  - Low Frequency (LF, associated with sympathetic activation)
  - High Frequency (HF, associated with parasympathetic activation)
- Non-Linear:
  - SD1/SD2, ApEn, SampEN
- SweetBeat calculates rMSSD, LF and HF
  - The SweetBeat HRV value is a value from 0 – 100 and based on rMSSD

# rMSSD,LF, HF

- rMSSD is a reflection of Vagal Tone
  - rMSSD is non-stationary and varies +/- 10 ms at rest
  - Average rMSSD ranges from ~20ms to ~80ms depending on age and state of health
  - Generally calculated on 3-5 minute window
- LF is associated with sympathetic nervous system
  - Some contribution from parasympathetic
- HF is associated with parasympathetic nervous system
- LF/HF is ratio of sympathetic and parasympathetic
- So a high HRV means
  - High rMSSD which means strong Vagal Tone or total variability
  - LF, HF total power in optimal range for age and gender
- LF/HF < 2  is indication healthy stress levels