Heart Rate Variability 101

An Introduction to HRV

Ronda Collier
SweetWater Health™

BeatHealthy™

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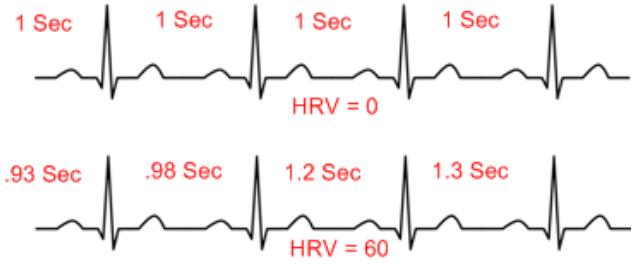
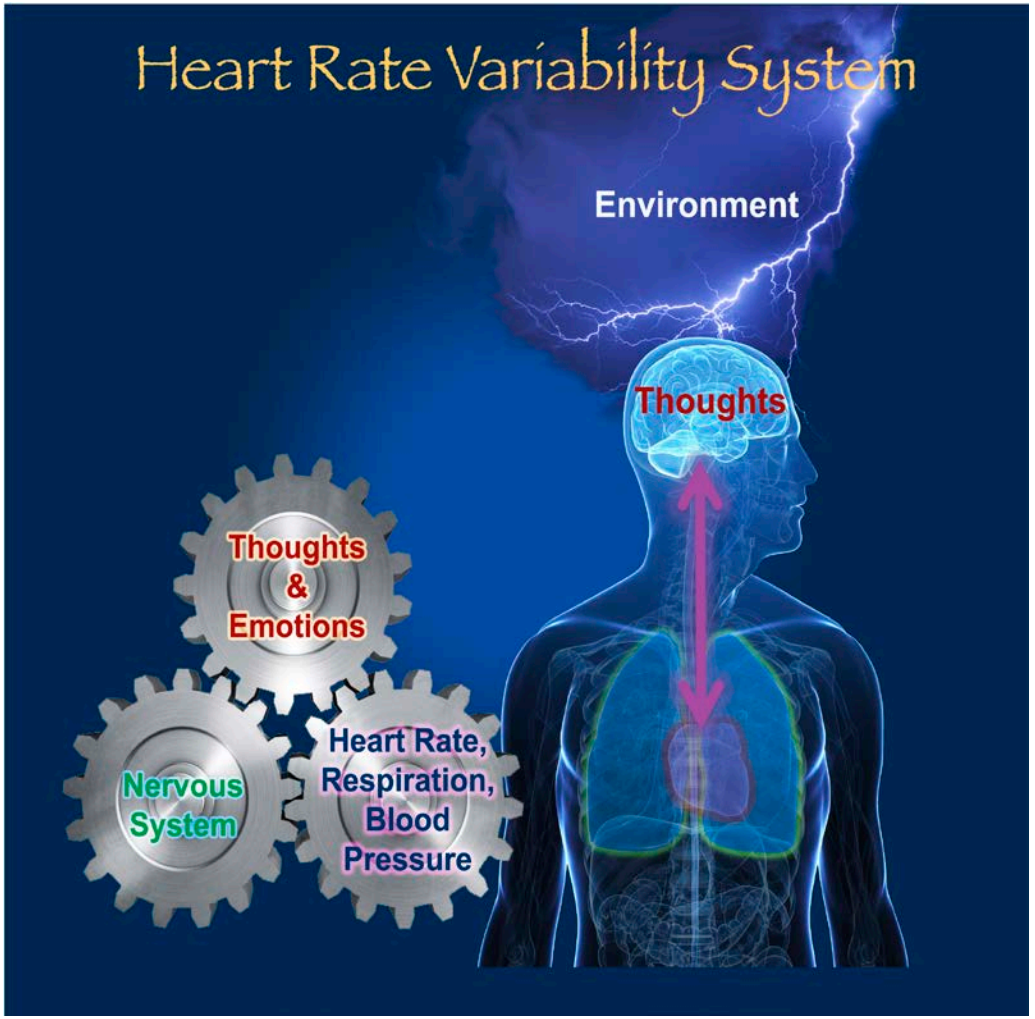
The Science of HRV

- **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**



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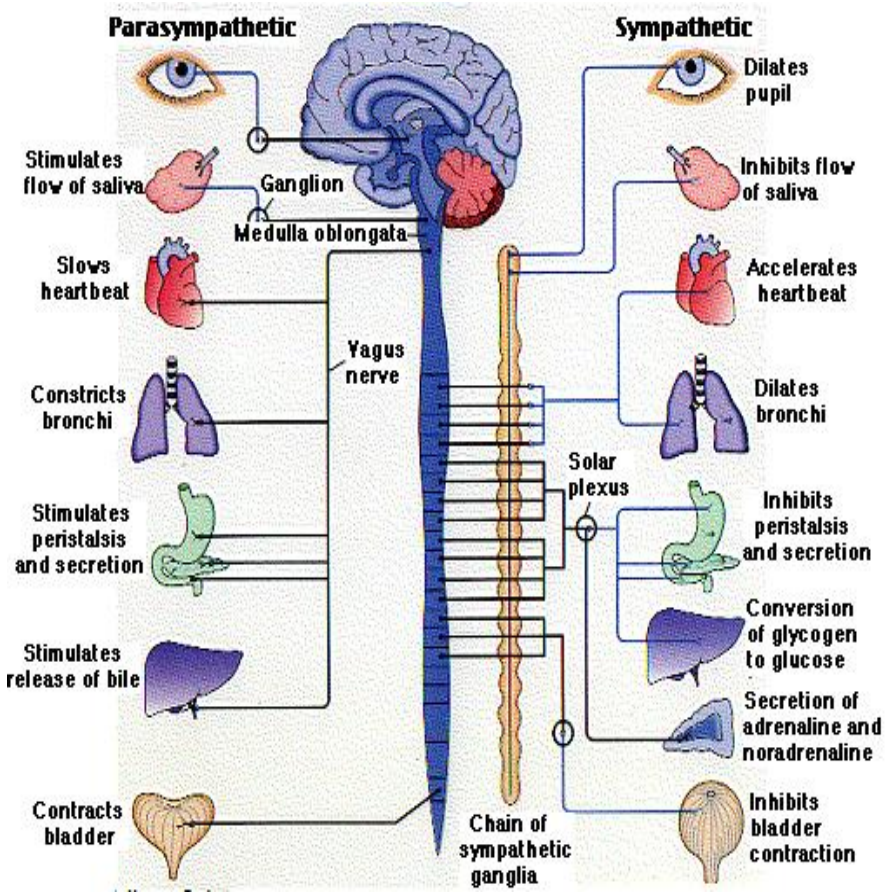
HRV and Vagal Tone

- 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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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
  - 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

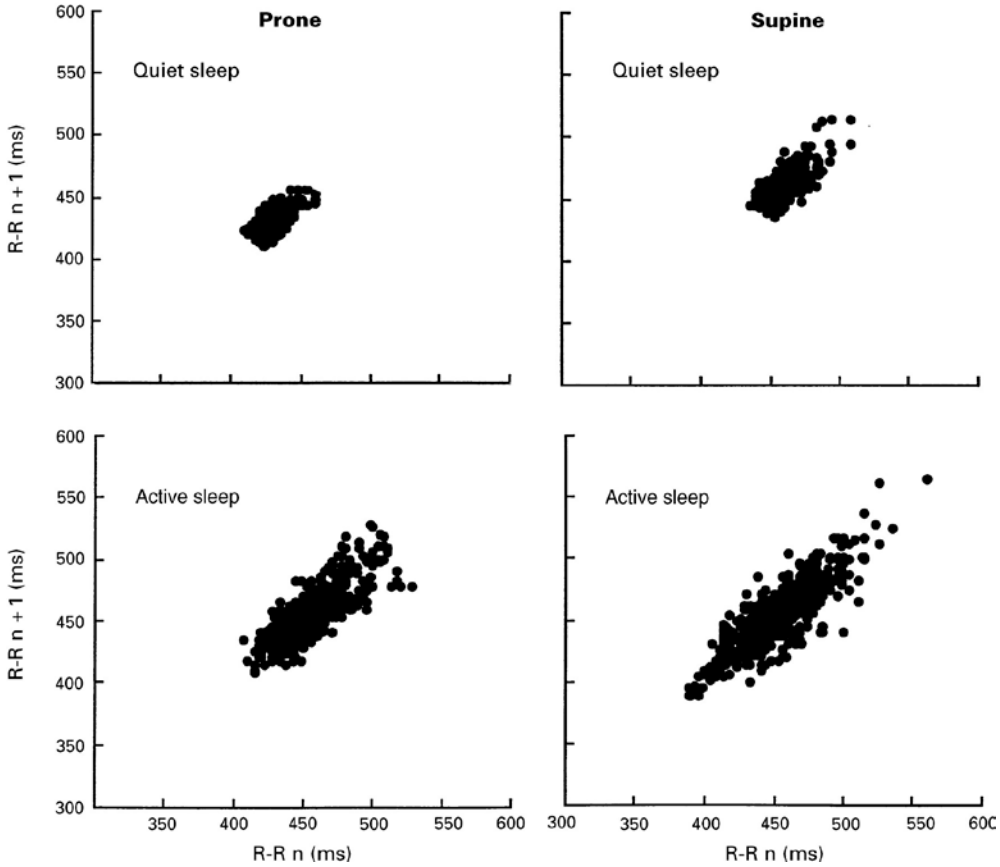
- Heart Rate Variability is measured by several parameters:
- Time domain – These are standard statistical analysis of the heart beat time series
  - Standard Deviation (SDNN)
  - Root Mean Square of Successive Differences, (rMSSD)
  - Heart Rate (HR)
  - pNN50, TINN, Triangular index
- Frequency Domain: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

rMSSD,SDNN,LF , HF

- SDNN reflects all cyclic components
  - Generally a 24 hour measure
- 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 5 minute window
- LF is associated with sympathetic nervous system
- HF is associated with parasympathetic nervous system
- LF/HF is ratio of sympathetic and parasympathetic
- So a high HRV means
  - High rMSSD or SDNN which means strong Vagal Tone or total variability
  - LF, HF total power in optimal range for age
- LF/HF < 2 is indication healthy stress levels

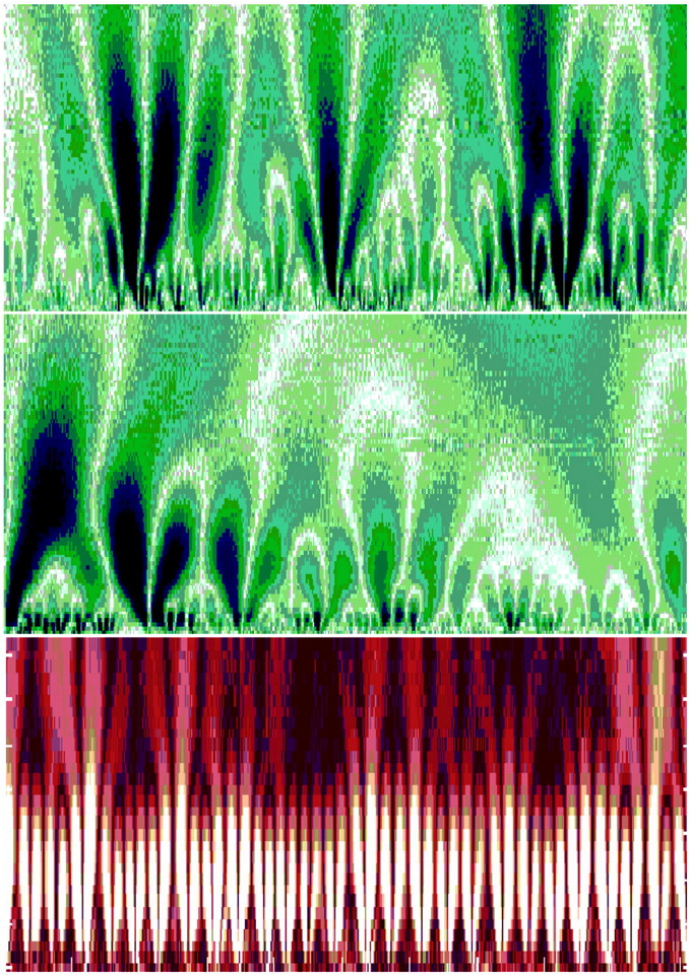
Graphical Representations of HRV Time Series

Example of the differences in Poincaré plots recorded from the same individual during prone and supine positioning in quiet and REM sleep



Galland B C et al. Arch Dis Child Fetal Neonatal Ed 1998;78:F189-F194

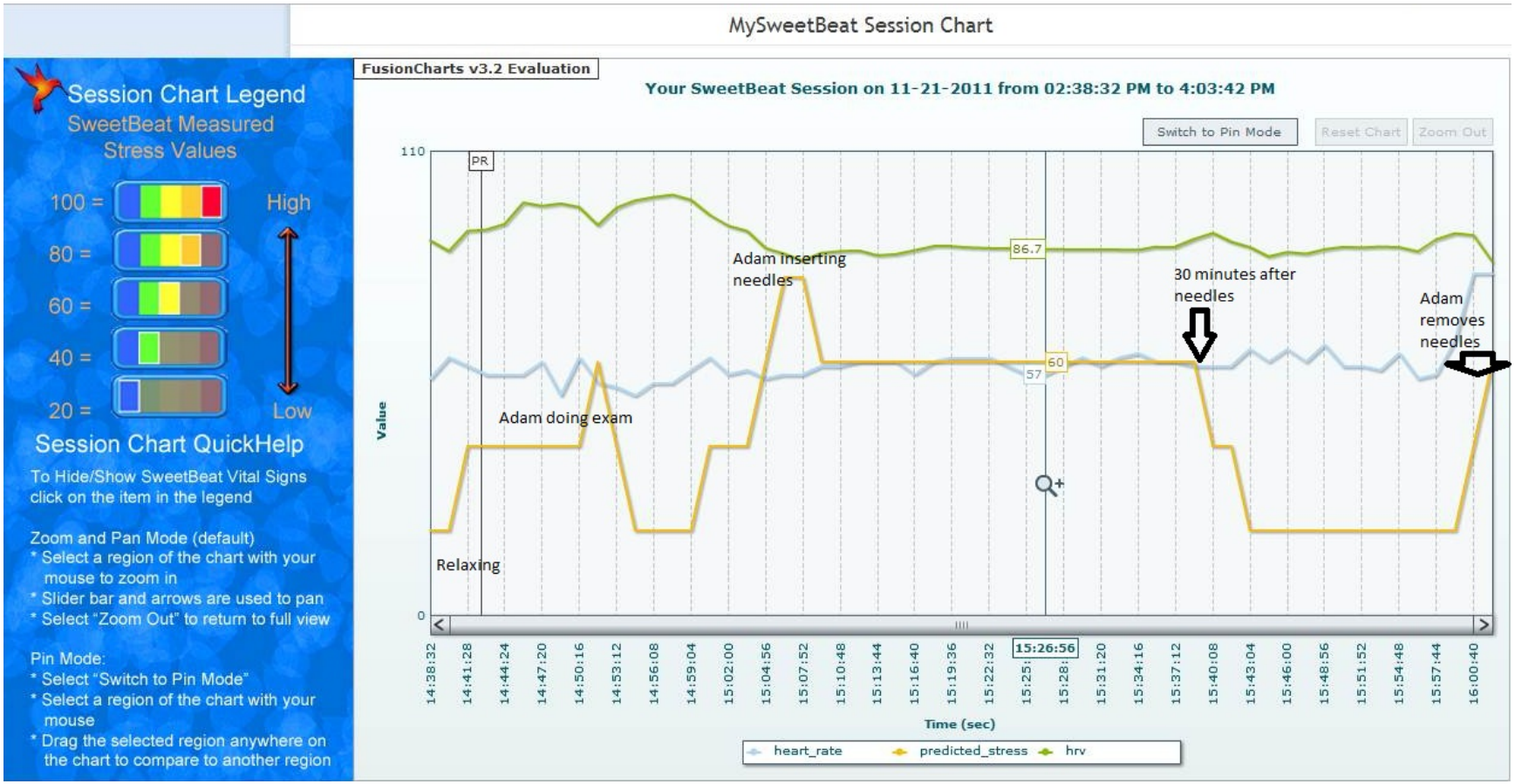
(TOP) Color-coded wavelet analysis of a heart rate time series in health.



(Bottom) Color-coded wavelet analysis of a heart rate time series of patient with OSA

Goldberger A L et al. PNAS 2002;99:2466-2472

Acupuncture 1



QiGong Class

High Stress

Low HRV