

A background image of a pond with green lily pads and purple flowers. The text is overlaid on a dark grey rectangular area.

Heart Rate Variability: Biofeedback in Clinical Practice

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Introduction: Biofeedback

- Biofeedback...
 - What is this?
 - What are some examples?
 - What is it used for?



Introduction: Biofeedback

- Biofeedback:
 - A type of therapy that teaches a person to change and control physiological processes through practice
 - The practice involves providing trainee with instantaneous electronic display of a physiologic function, and providing techniques to help them try to change & improve the output

Lehrer et al



Introduction: Biofeedback

- Types of Biofeedback:
 - EMG Muscle Tension
 - Headaches, incontinence, TMJ dysfunction, fibromyalgia and musculoskeletal pain disorders
 - Finger Temperature Thermal Biofeedback
 - Stress and anxiety, Raynaud's syndrome
 - EEG Neurofeedback
 - ADHD, anxiety disorders, PTSD, insomnia
 - Heart Rate Variability
 - Depression and anxiety, asthma, cardiovascular disease, hypertension, fibromyalgia and musculoskeletal pain disorders

Glick and Greco

Goals Biofeedback

1. Education about connections between patient's symptoms and physiology
2. Skills training in changing biofeedback signals corresponding to physiologic processes (example: HRV)
3. Development of awareness of internal states linked to arousal and relaxation
4. Application of skills training to carry-over in recognizing and modifying internal states without aid of instrumentation
5. Development of sense of self-efficacy and empowerment

Glick and Greco

Clinical Sessions Components

- Initial Session

- Interview and assessment
- Build therapeutic relationship
- Educate on plausible relationship regarding psychophysiology and biofeedback, and how it relates to patient's symptoms
- Engage patient in treatment
- The patient accepts responsibility for practicing at home (ideally daily)

Glick and Greco

- Subsequent Sessions

- Discuss how practice is going at home
- Discuss any change in symptoms or other changes perceived by patient
- Engage patient in biofeedback treatment (usually they sync and respond more quickly)
- Eventually, patient is aware of internal states, and equipment is not needed

Clinical Applications

- Depression, Anxiety, and other mood disorders (PTSD, OCD, panic)
- Situational Stress
 - Test and performance anxiety
 - Insomnia
 - Agoraphobia or other situational anxiety disorders
- Chronic pain conditions
- Anger / Conflict resolution
- Addiction / Impulse control
- Abdominal pain, IBS, and functional GI disorders
- Several others...

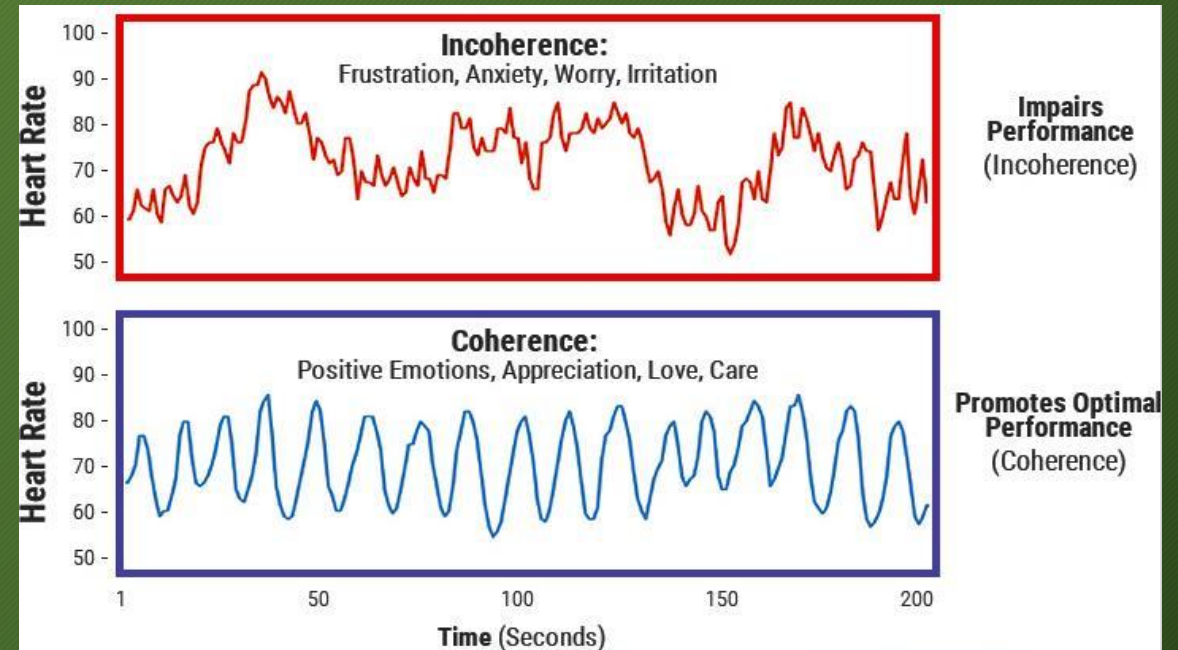
Introduction: Biofeedback

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Glick and Greco

Heart Rate Variability

- Heart Rate Variability (HRV) through Heart Math:
 - Measures the physiologic phenomenon of respiratory sinus arrhythmia (RSA)
 - Inspiration -> Slight rise in heart rate
 - Expiration -> Slight decline in heart rate



Heart Rate Variability

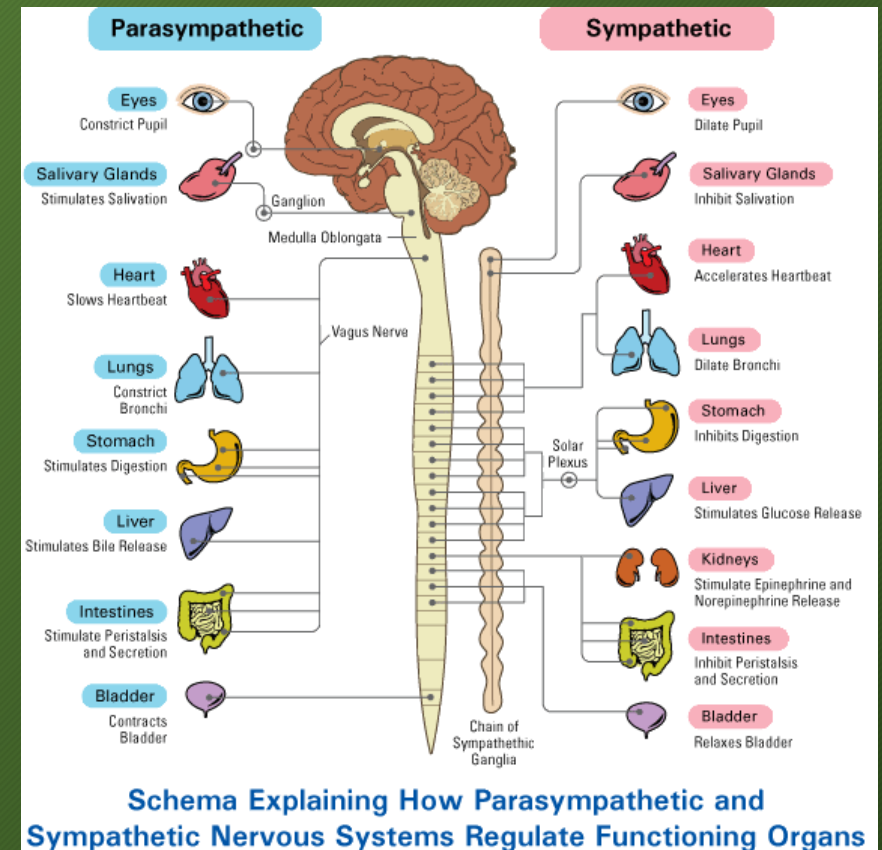
- Variations in heart rate...
 - What “systems” are at play that affect Heart Rate Variability (HRV)?



Heart Rate Variability

- An attempt for the body to maintain internal “homeostasis” through balance of sympathetic and parasympathetic nervous systems
- A neuroendocrine system that responds to external stimuli to support and execute appropriate physiological functions
 - Stimuli: time of day, temperature, external threat, food, etc.

Buijs, Handbook of Clinical Neurology, Chapter 1



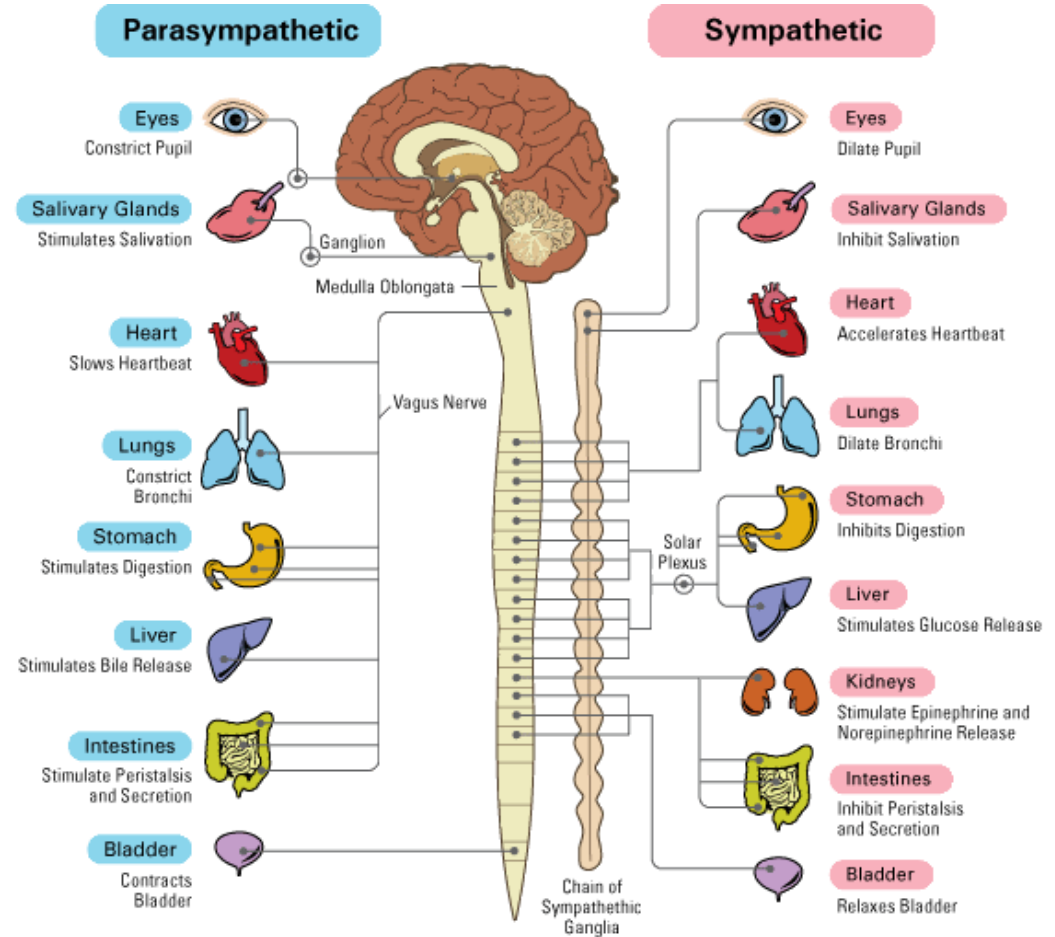
Autonomic Nervous System

- Sympathetic Nervous System

- “fight or flight”
- Organized along long chain of motor neurons in spinal cord
- Epinephrine, norepinephrine

- Parasympathetic Nervous System

- “rest and digest”
- Vagus nerve and its branches
- Acetylcholine



Schema Explaining How Parasympathetic and Sympathetic Nervous Systems Regulate Functioning Organs

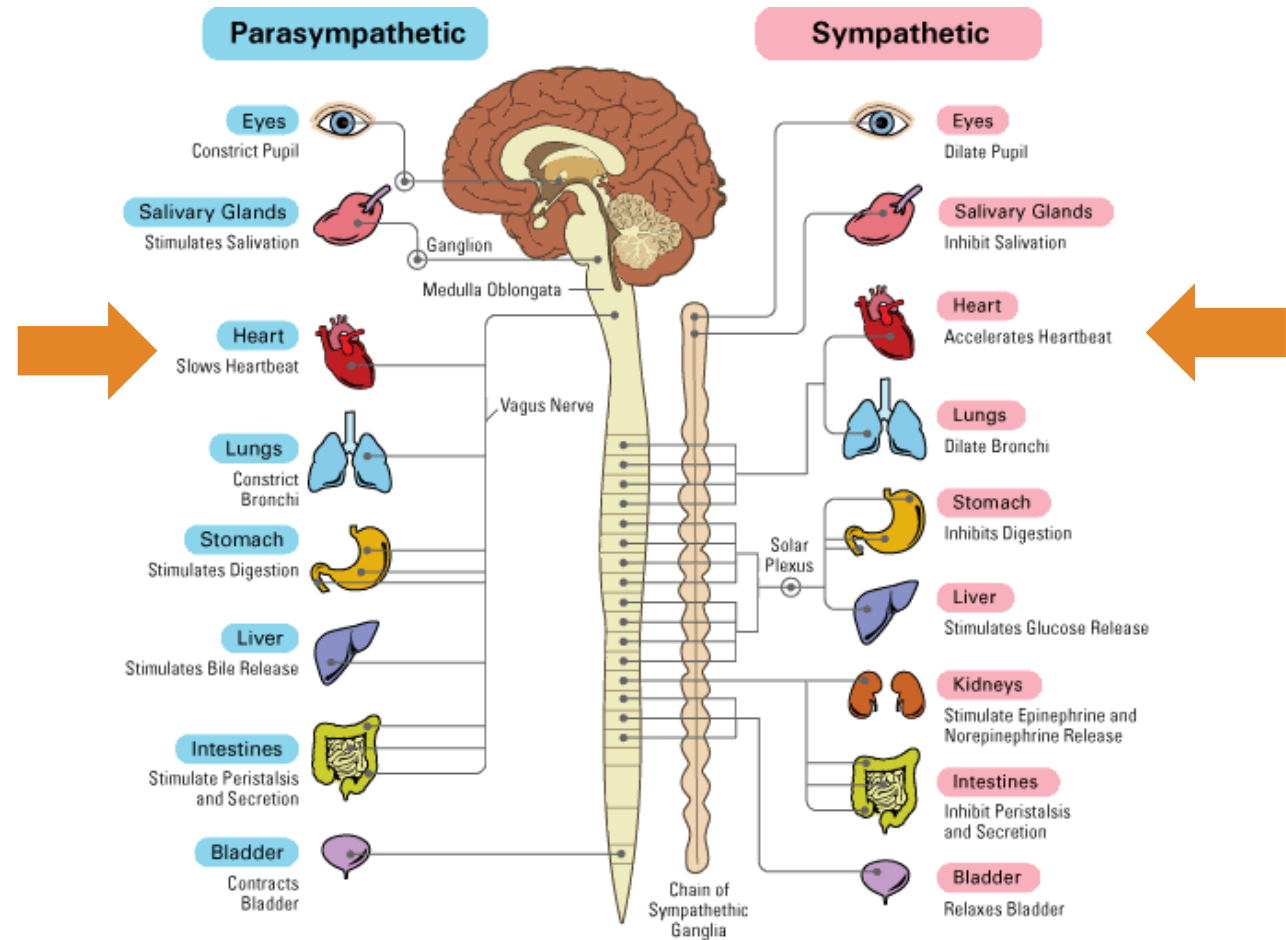
Autonomic Nervous System

- Stimulus -> Brain response -> up/down-regulation of parts of autonomic nervous system -> physiologic changes
- Exerts control over blood supply through causing vasodilation or vasoconstriction of blood vessels to various organs
- Allows for differential activation:
 - Example) In the evening, strong sympathetic signal to pineal gland, norepinephrine release results in melatonin release. At same time, weaker sympathetic signal to heart results in slower heart rate
 - Allows for fine-tuning of different parts of the system

Buijs, Handbook of Clinical Neurology, Chapter 1

Autonomic Nervous System, Balancing Act

- If any organ or part of the system is out of balance, the whole system may suffer:
- Shift work: Biologic clock says it is time to fast and rest, so internal organs prepare for this. But person eats and is active, results in ANS imbalance and increased risk for hypertension, obesity, and diabetes
- Anxiety and Panic: Sympathetic overdrive results in cardiovascular, gut, and other organ problems



Schema Explaining How Parasympathetic and Sympathetic Nervous Systems Regulate Functioning Organs

Control Of Cardiac Function

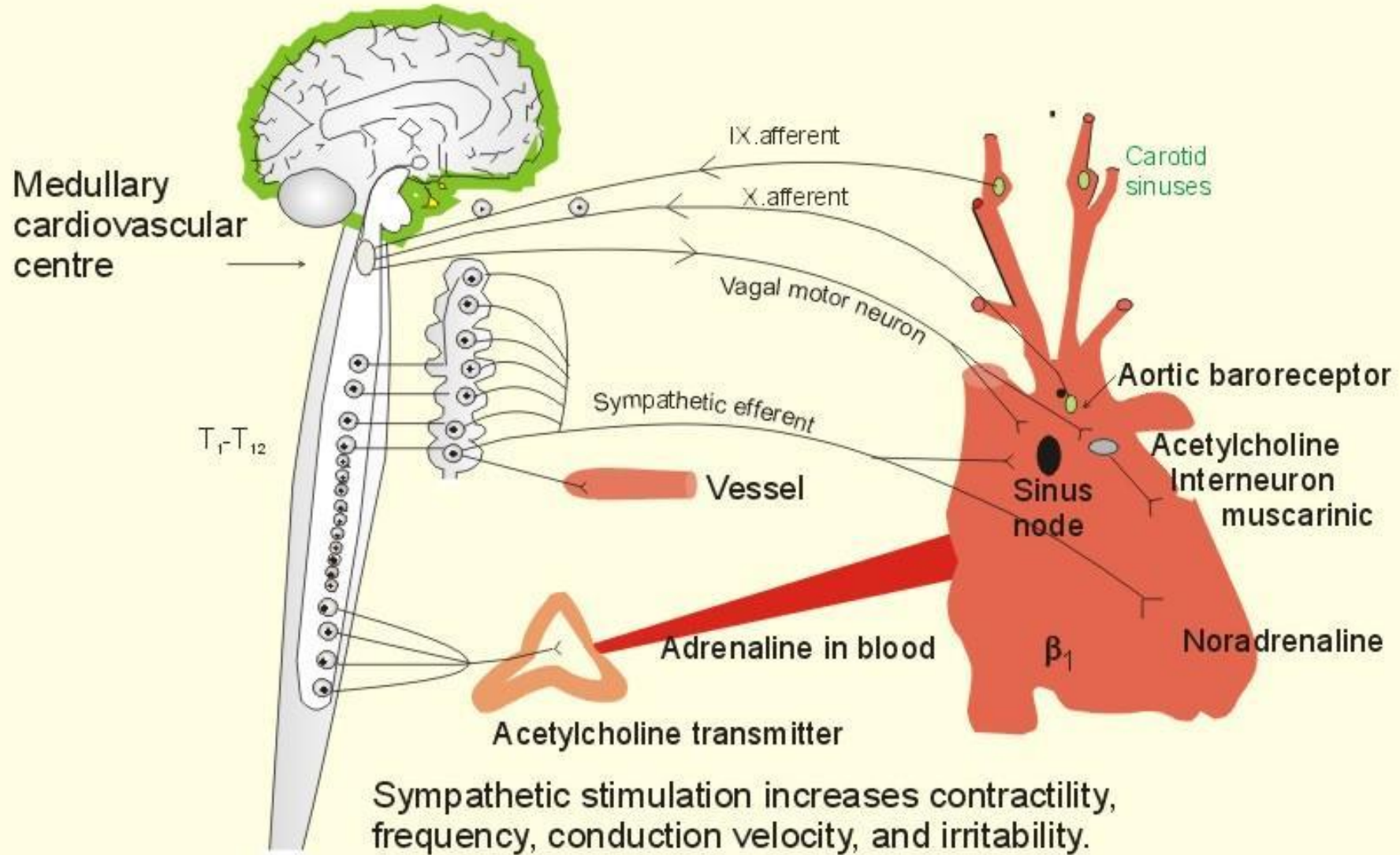


Fig. 11-1

Heart Rate Variability

- Reflects beat-to-beat changes, which are related to ongoing interplay between sympathetic and parasympathetic arms of the ANS
- Respiratory sinus arrhythmia generally mediated by parasympathetic (vagal) arm
- Affected by mental or physical stress & certain disease states
- Shift towards increased sympathetic and decreased vagal tone associated with higher risk of cardiac disease and other comorbidities

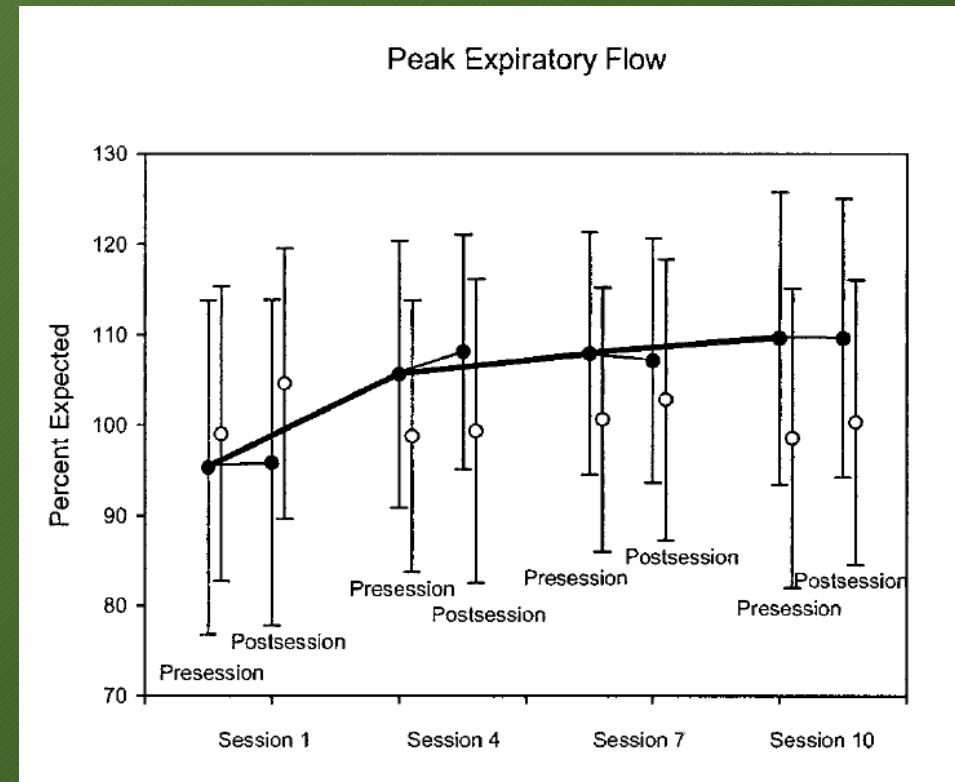
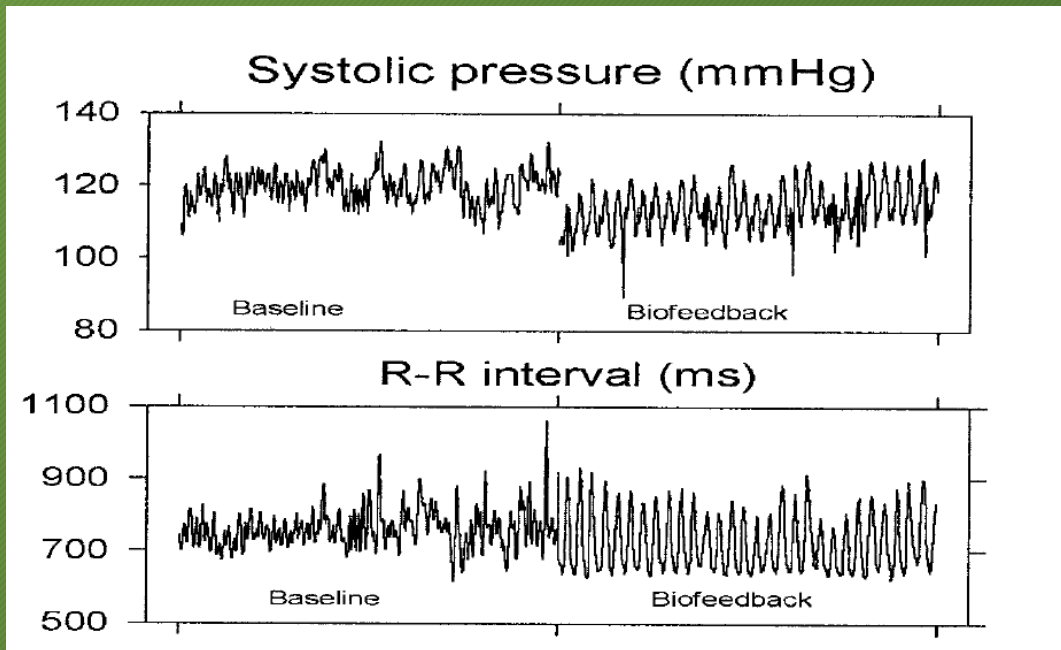
Cygankiewicz, Handbook of Clinical Neurology, Chapter 31 Bernstein

Heart Rate Variability – Research Trends

- HRV for cardiovascular and other health states
 - 1) Predicting mortality after acute myocardial infarction
 - Relative risk for mortality 5.3 x higher for group with HRV less than 50 ms compared to HRV greater than 100 ms (1)
 - 2) HRV and risk of hypertension
 - HRV is reduced in men and women with hypertension, and lower HRV is associated with greater risk for developing hypertension in men (2)
 - 3) HRV is known to decrease with age, severe CAD, CHF, and diabetes (1)
 - 4) HRV and asthma / COPD
 - Improvements in peak expiratory flow and tidal volume with HRV biofeedback for patients with asthma (3)

1) Kleiger, 2) Singh, 3) Lehrer

Heart Rate Variability and Asthma



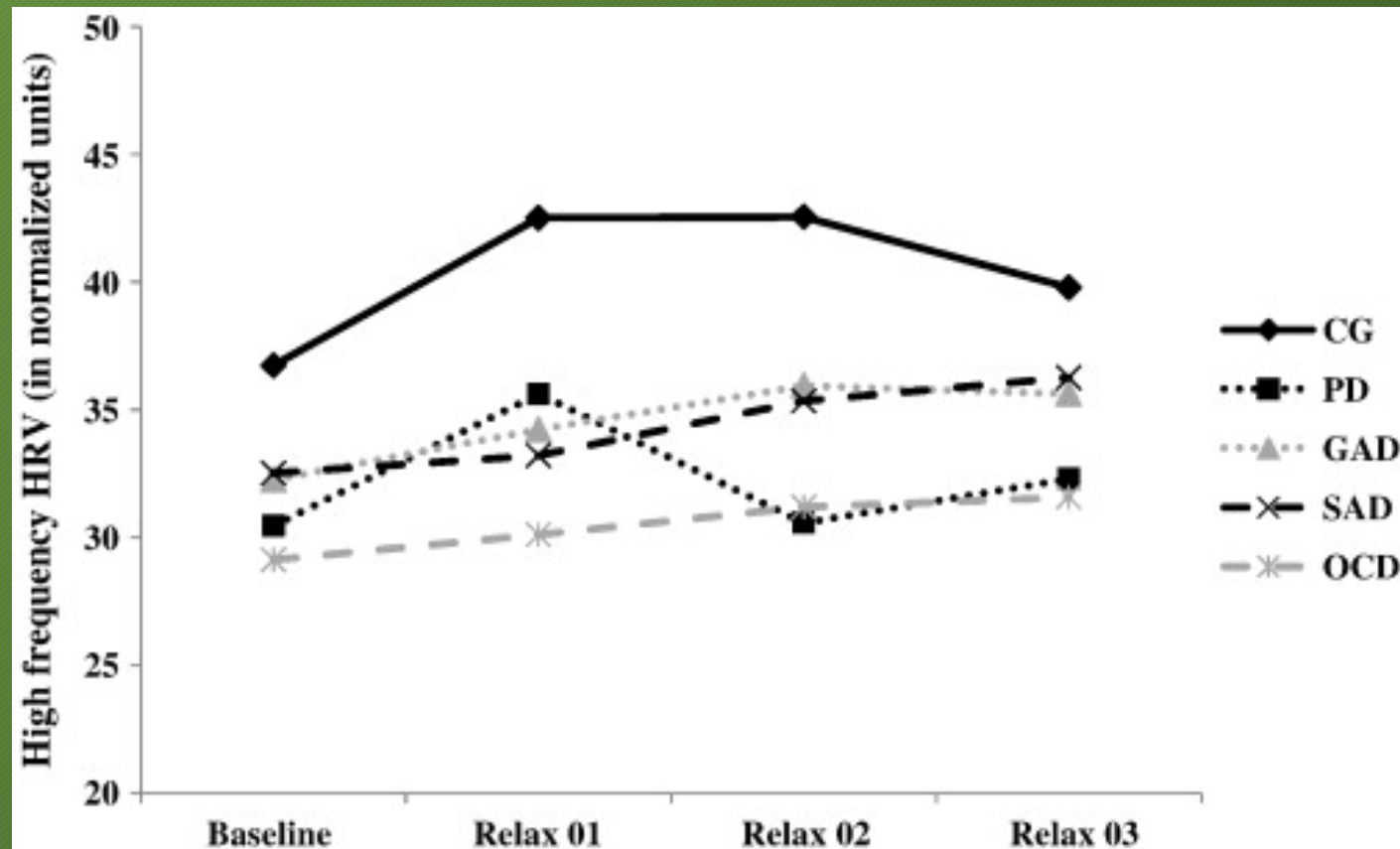
● Biofeedback ○ Waitlist Control

Heart Rate Variability - Psychophysiology

- HRV and psychophysiology
 - Generalized anxiety subjects had lower HRV compared to controls, and states of worry was associated with even lower HRV (1)
 - Subjects with panic disorder, generalized anxiety, social anxiety, and OCD all with lower HRV compared to controls (2)
 - 10-week HRV course for patients with major depression (MDD) resulted in significant reductions in depression scores (Hamilton & Beck scales) (3)
 - Decreased pain, improved functioning, and decreased depression scores in pilot study of HRV for patients with fibromyalgia (4)

1) Thayer, 2) Pittig, 3) Katsamanis, 4) Hassett

Heart Rate Variability – Anxiety Disorders



Heart Rate Variability - Coherence

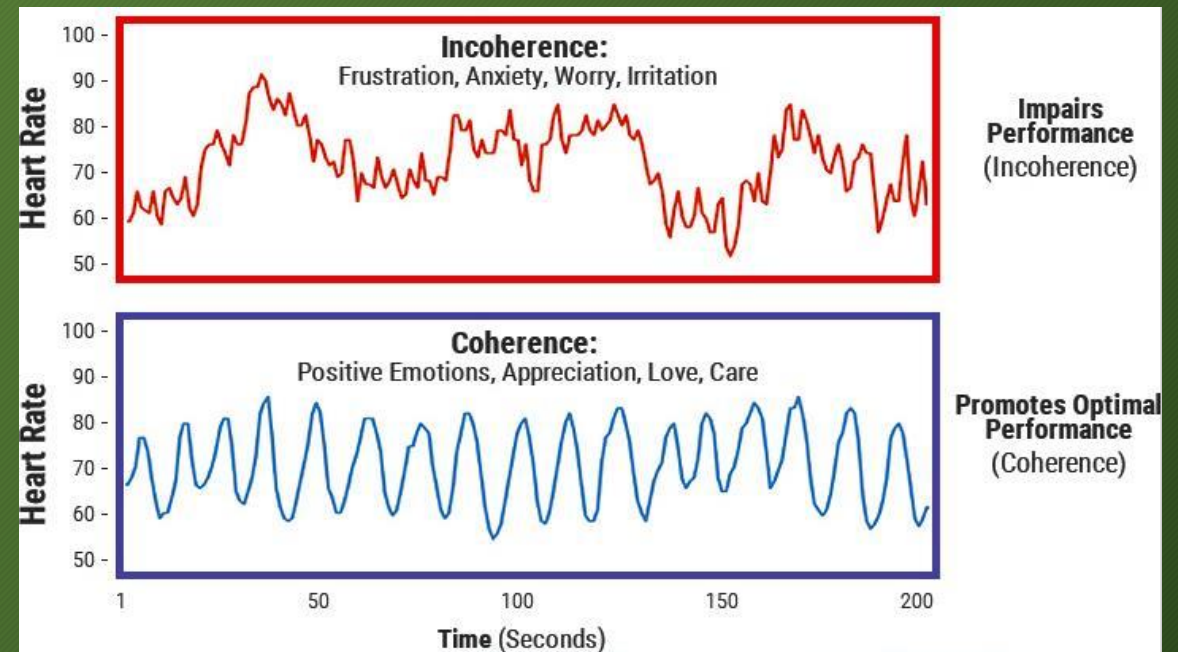
- Physiologic coherence measured through HRV manifests as a sine wave-like pattern at a frequency around 0.1 Hz
- Coherence:
 - Increased harmony between two branches of ANS
 - Shift of autonomic balance towards greater vagal (parasympathetic) activity • Improvements in self-regulatory capacity and psychosocial well-being
- Incoherence:
 - Less vagal control and more activity of sympathetic nervous system

Heartmath.org; Citations from Bradley, Lloyd, Ginsberg, McCraty

Heart Rate Variability - Coherence

- Coherence associated with:
 - Increased ability to self-regulate
 - Improvements in memory
 - Increased ability to focus & process information
 - Faster reaction times (sports)
 - Improved ability to learn

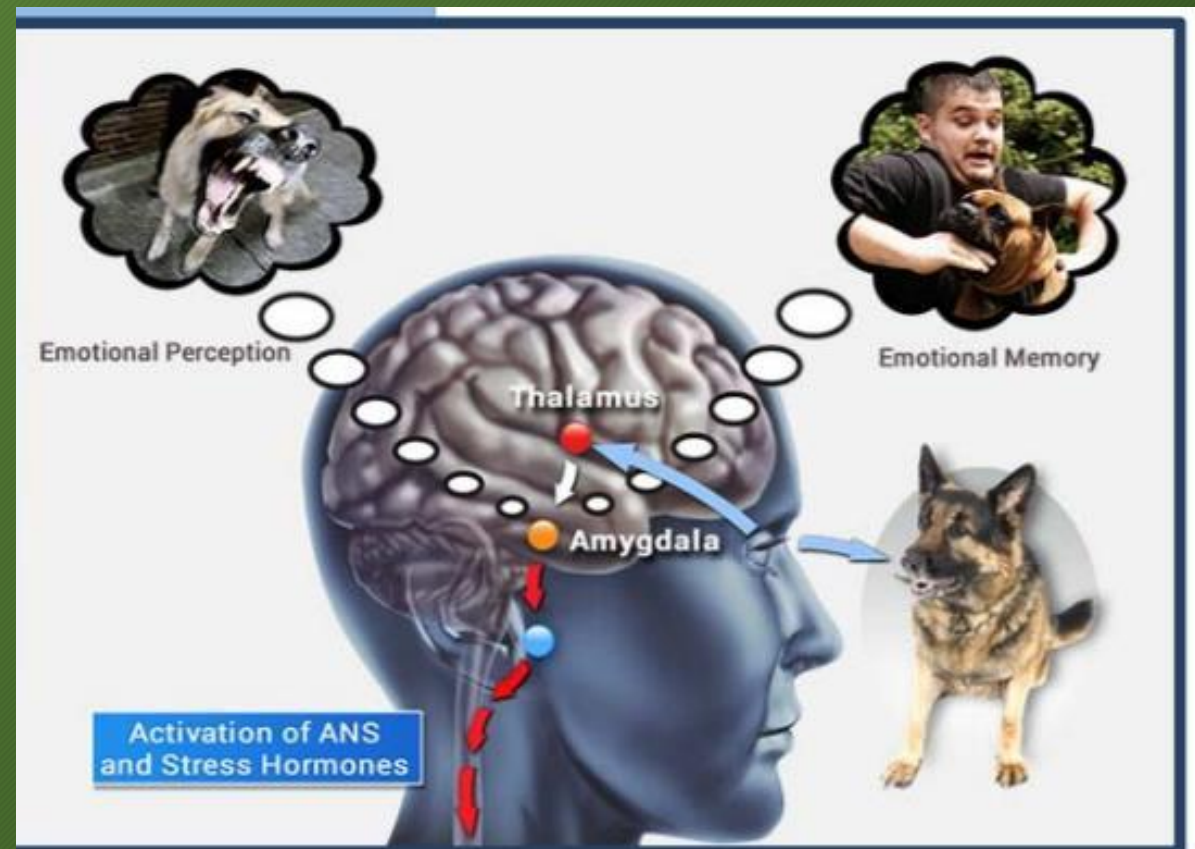
Heartmath.org; Citations from Bradley, Lloyd, Ginsberg, McCraty



Cycle of Incoherence

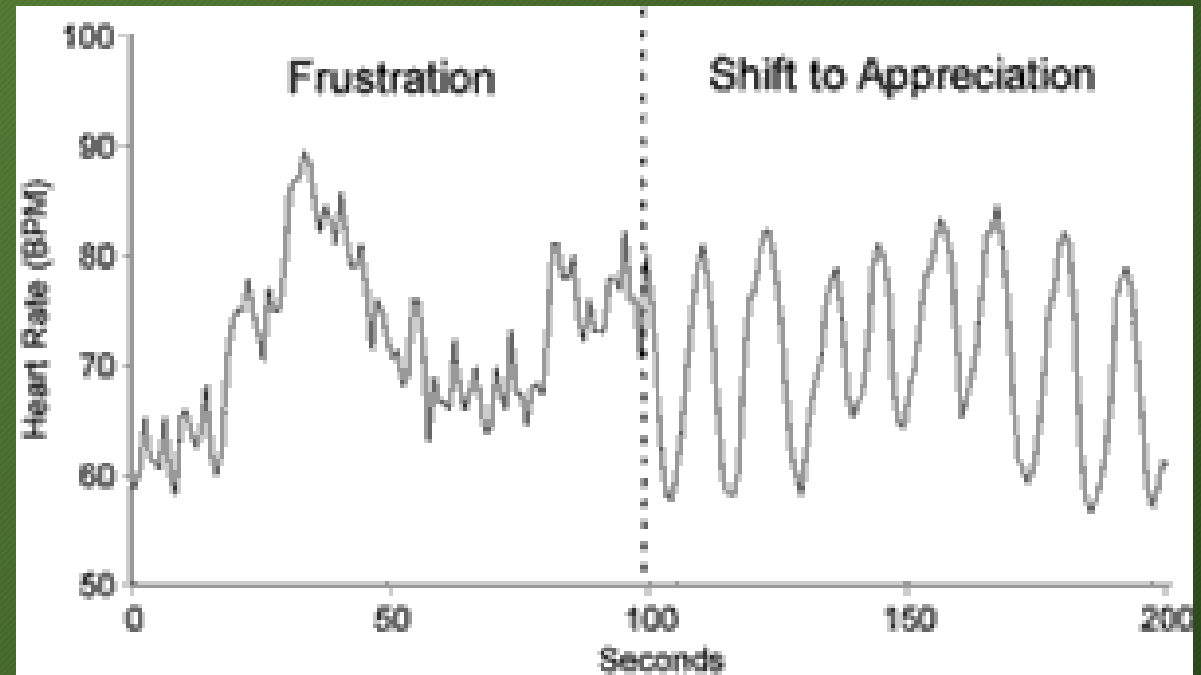
- The brain constantly evaluates information from current inputs against past experiences to evaluate the environment for risk, comfort, or safety
- Past experiences create familiar reference patterns, for which current experiences are compared against
- Sustained unhealthy emotions, stressful thoughts, and behaviors establish maladaptive reference patterns

Heartmath.org



Transitioning Towards Coherence

- Departure from familiar patterns leads to discomfort. But, with practice and encouragement, it is possible to change and improve psychophysiological baseline
- Self-induced positive emotions can shift psychophysiological systems into more globally coherent orders, associated with improved well-being and social function



Heart Rate Variability - Coherence

- Individuals take part in activities regularly that likely move them towards more coherent states
 - Yoga
 - Mindfulness meditation
 - Daily gratitude
 - Spending time in nature
 - Tai chi
 - Mindfulness in daily activities

Practice Exercise



Quick Coherence Technique

- Step 1 (Heart-Focused Breathing): Focus attention in the area of the heart. Imagine your breath is flowing in and out of your heart or chest area, breathing a little slower and deeper than usual.
- Step 2 (Activate a positive or renewing feeling): Make a sincere attempt to experience a regenerative feeling such as appreciation, love, joy, gratitude, contentment. Try to re-experience the feeling you have for someone or something you love, a special place, or accomplishment when you felt this way

Freeze Frame Technique

- Step 1 (Acknowledge): Acknowledge the problem or issue, and any attitudes or feelings you have about it
- Step 2: Heart-Focused Breathing
- Step 3: Activate a positive or renewing feeling
- Step 4 (Ask): From this more objective place, ask yourself what would be a more efficient or effective attitude, action, or solution
- Step 5 (Observe and Act): Quietly observe any subtle changes in perceptions, attitudes, or feelings. Commit to sustaining beneficial attitude shifts and acting on new insights

Heart Lock-in Technique

- Step 1: Heart-Focused Breathing
- Step 2: Activate a regenerative feeling
- Step 3: Radiate that renewing feeling to yourself and others

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Attitude Breathing Technique

- Step 1: Recognize a feeling or attitude that you want to change and identify a replacement attitude
- Step 2: Heart-Focused Breathing
- Step 3: Breathe the feeling of the new attitude slowly and casually through your heart area

Attitude Breathing Technique

- Step 1: Recognize a feeling or attitude that you want to change - **irritable, annoyed, frustrated**
- ...and identify a replacement attitude - **love, patience, understanding**
- Step 2: Heart-Focused Breathing
- Step 3: Breathe the feeling of the new attitude slowly and casually through your heart area
- Step 4: Daily practice
- ...In the future, when those **feelings** arise, try to bring attention to your breathing and remember the replacement attitude

Resources for Patients and Providers

- Bhakti Brain Health Clinic
 - [BBHC Heart Rate Variability Training](#)
- Several apps for smart phones that work
 - Breathe +
 - Breathing Zone



Heart Rate Variability

The Amazing Biomarker for Understanding
Our Body, Health and Fitness



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