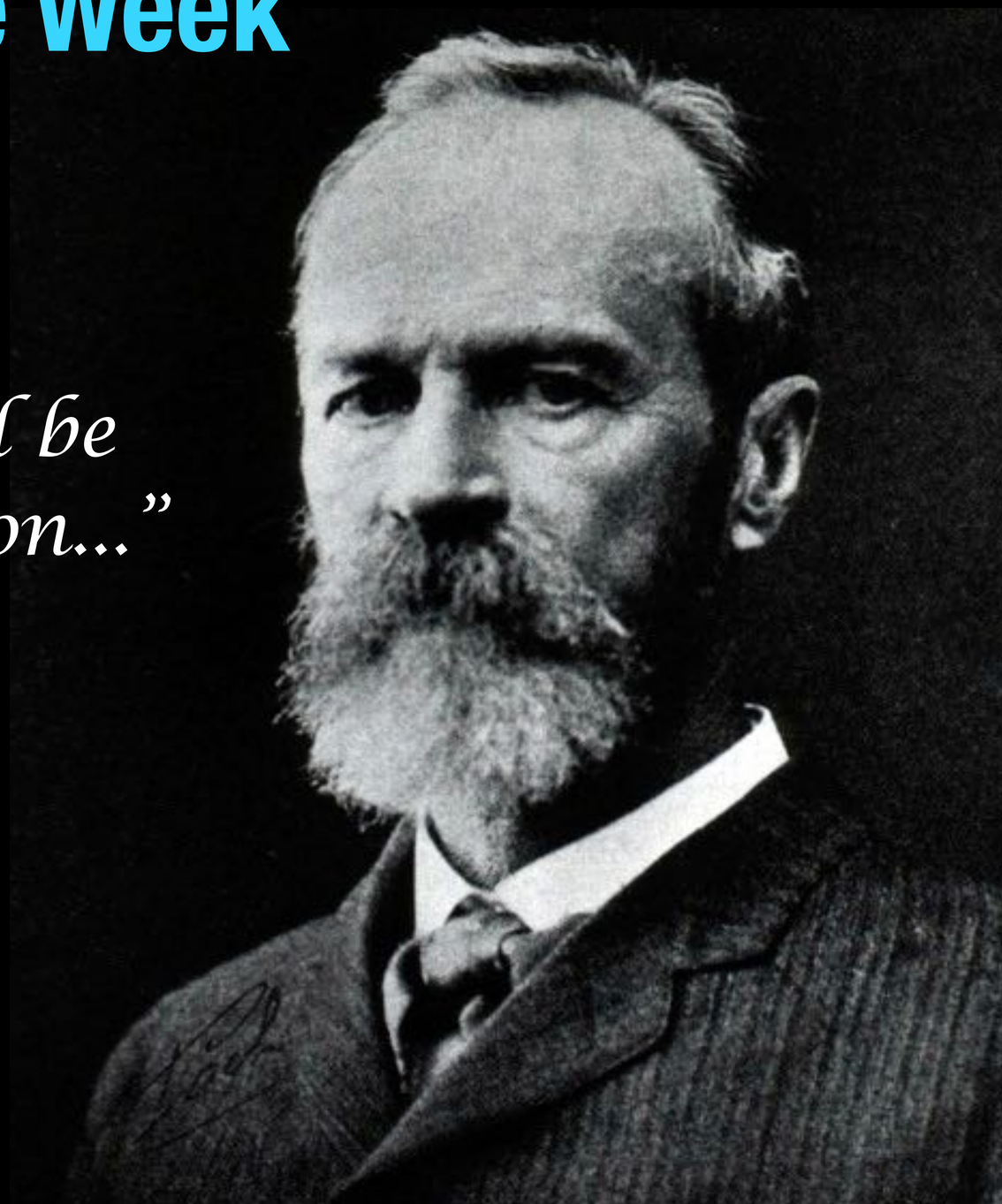
Quote of the Week

"No shade of emotion should be without a bodily reverberation..."

William James (1898)

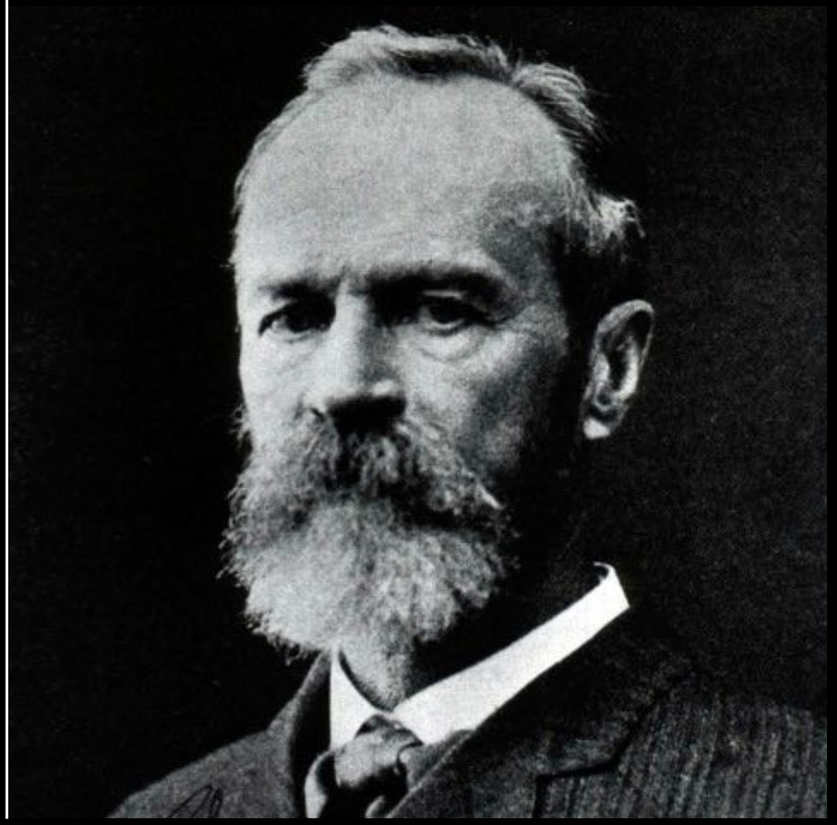


Human Emotion

Psychology 3131
Professor June Gruber

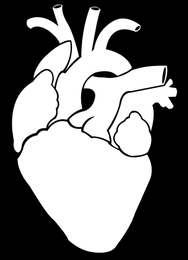
Theories of Emotion Timeline

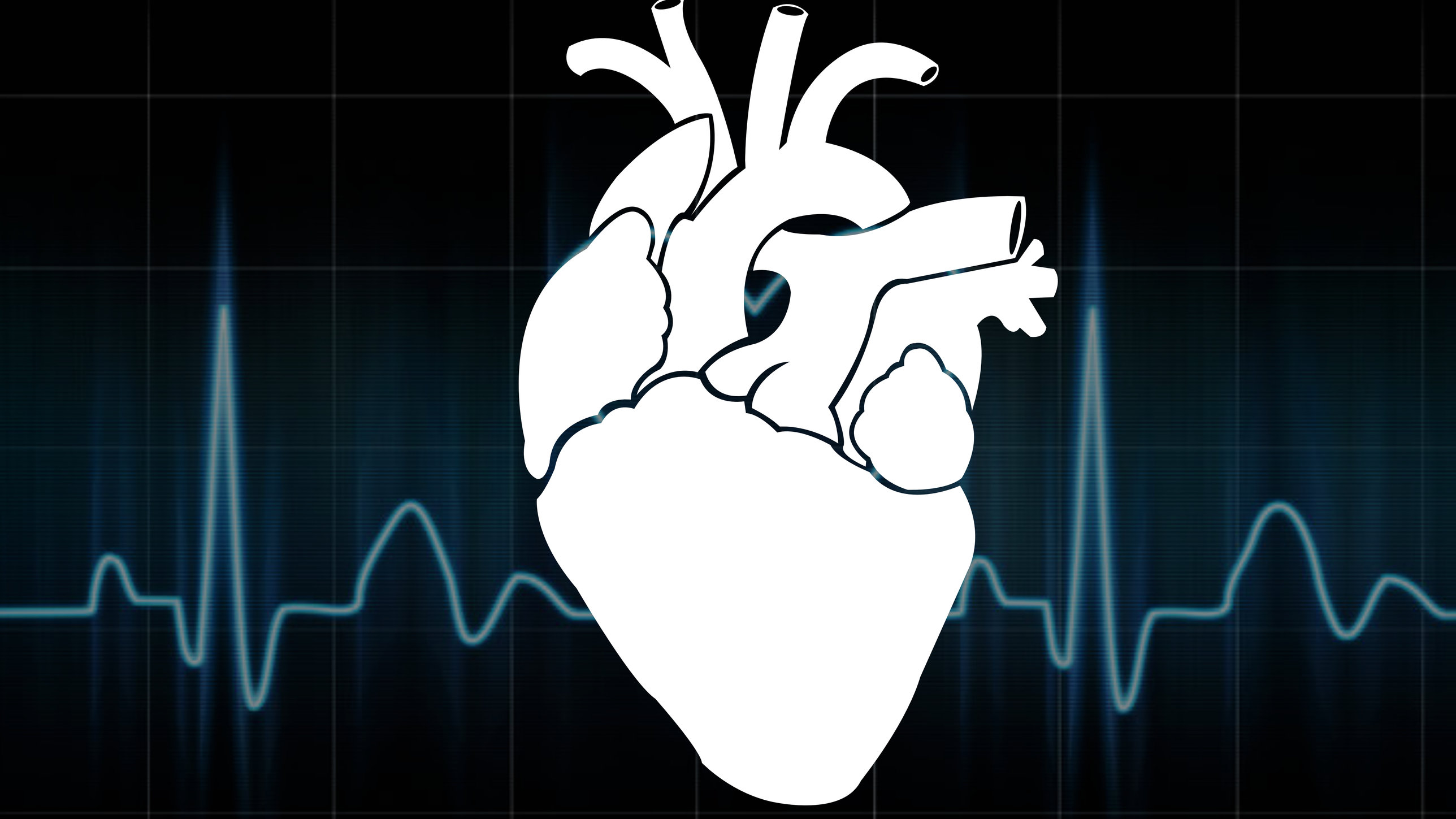
William James



Physiological Approach

Emotions secondary to physiological phenomenon





Human Emotion

Emotion and Psychophysiology

Blood, sweat, tears, and fears?

Roadmap

Course Logistics

Definitions and Measurement

Emotion Specificity

Emotion Coherence

Take-Away Qs & Expert Interview

Course Logistics

Exam 1 - Questions?

Course Logistics

Exam 2 - Not So Distant Future

Exam Review Sheet Handed Out Next Week in Class

Course Logistics

Outreach Project

General Email with Feedback Across Proposals

-APA 6th Edition Formatting Example

Individual Email Responding to Questions Raised

Course Logistics

Outreach Project

Extra Credit Opportunity

-Help fellow classmate doing FACS on “Poker Face”

-Worth equivalent of 1 Twitter Response

Course Logistics

Outreach Project

5 minute break out, pick partner you have not yet spoken to or know from class

-Share your current project topic

-Share your progress (where are you at)

-Share any questions you have at this point

-Generate “1 question” you have for class and “1 thing” you’re most excited about

Roadmap

Course Logistics

Definitions and Measurement

Emotion Specificity

Emotion Coherence

Take-Away Qs & Expert Interview

Emotions and the Body Exercise

Take a moment and close your eyes…

(1) What feelings do you notice?

(2) What thoughts are going on in your mind?

(3) What’s going on in your body?

Definitions

Psychophysiology: Definition

"The science which concerns physiological activities which underlie or relate to psychic events."

Darrow (1964)

"The scientific study of social, psychological, and behavioral phenomena as related to and revealed through physiological principles and events in functional organisms."

Cacioppo, Tassinary, & Berntson (2000)

"The use of a particular set of physiologically-based dependent or independent variables to gain insights into psychological questions."

Allen (2006)

Psychophysiology: What it is NOT

Physiological psychology

Subdivision of biological psychology that studies the neural mechanisms of behavior through the direct manipulation of neural tissue in experiments.

Behavioral neuroscience

Scientific study of the neural bases of behavior and mental states.

Psychophysiology: Pros and Cons

PROS

- Get around social desirability (pressure to respond correctly)
- Provide information outside of conscious awareness
- Identify how mental and physical health are related

CONS

- Methods are sometimes difficult and expensive
- Controversy on what to infer
  (e.g., does a higher heart rate = anger? sadness?
  or just a sign of movement?)

The Nervous System

Central Nervous System

BRAIN +
SPINAL CORD

Peripheral Nervous System

ALL OTHER
NERVES

Autonomic Nervous System

Monitors internal world; carries out automatic processes.

Somatic Nervous System

Monitors external world; carries out voluntary processes.

Sympathetic Nervous System

Facilitates energy expenditure (fight or flight)

Parasympathetic Nervous System

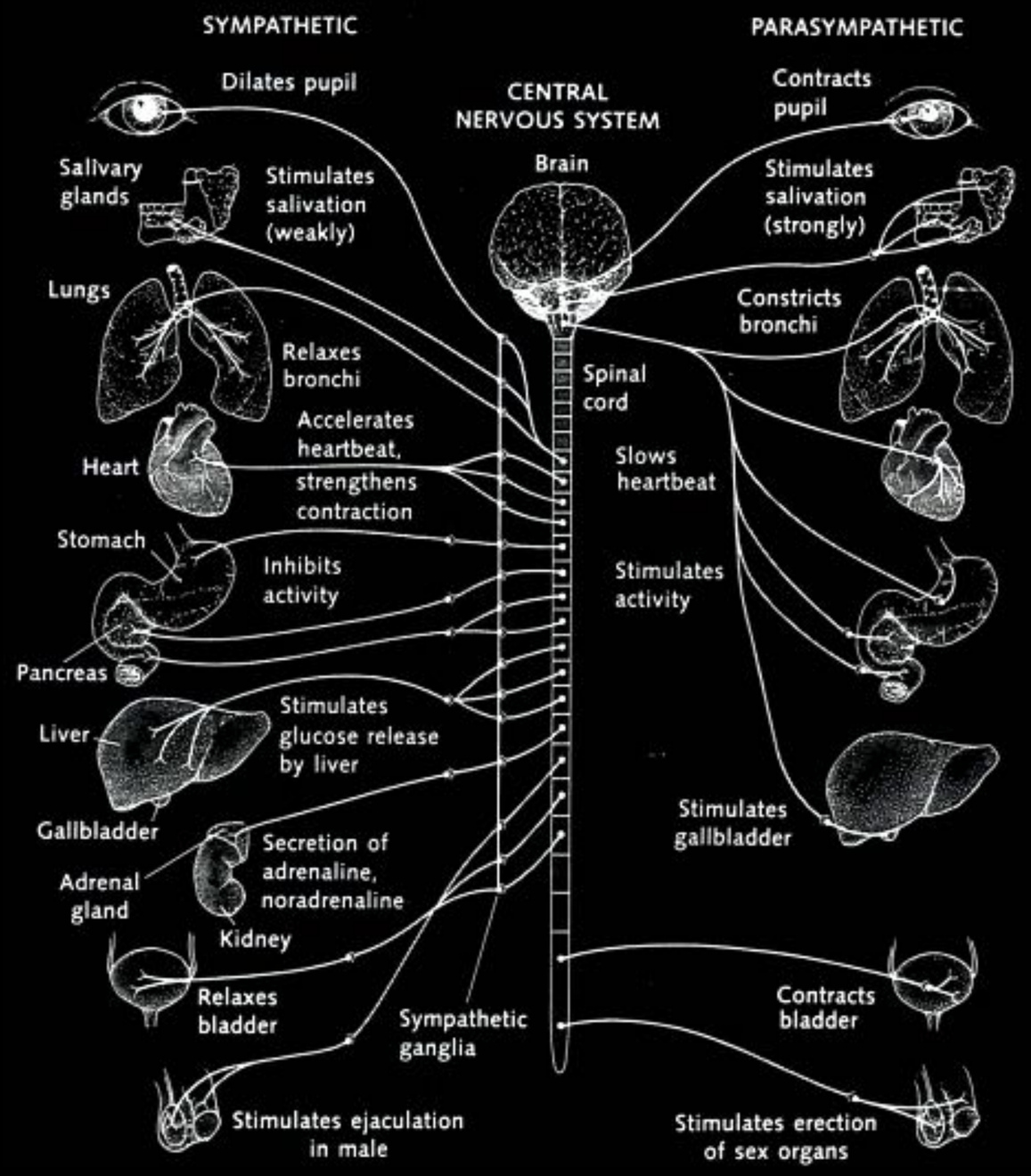
Facilitates energy storage (rest and digest)

Sympathetic Nervous System (SNS)

Fight or Flight, Excitatory

Parasympathetic Nervous System (PNS)

Rest and Digest



Sympathetic Nervous System (SNS)

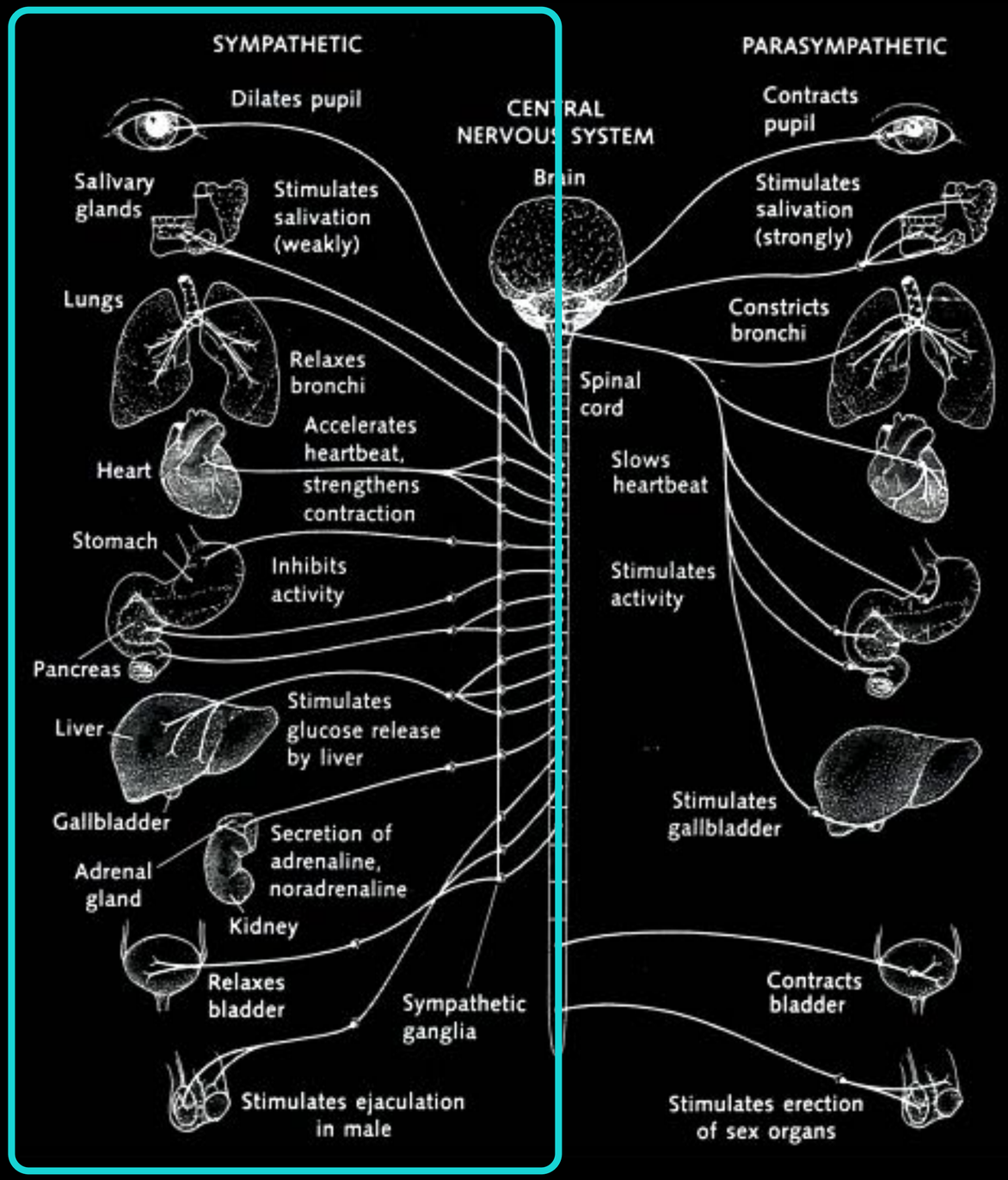
Fight or Flight, Exictatory

- Causes release of catecholamines (epinephrine and norepinephrine) from adrenal medulla

-Increases heart rate and blood pressure

-Slows digestion

-Dilates pupils



Parasympathetic Nervous System (PNS)

Rest and Digest

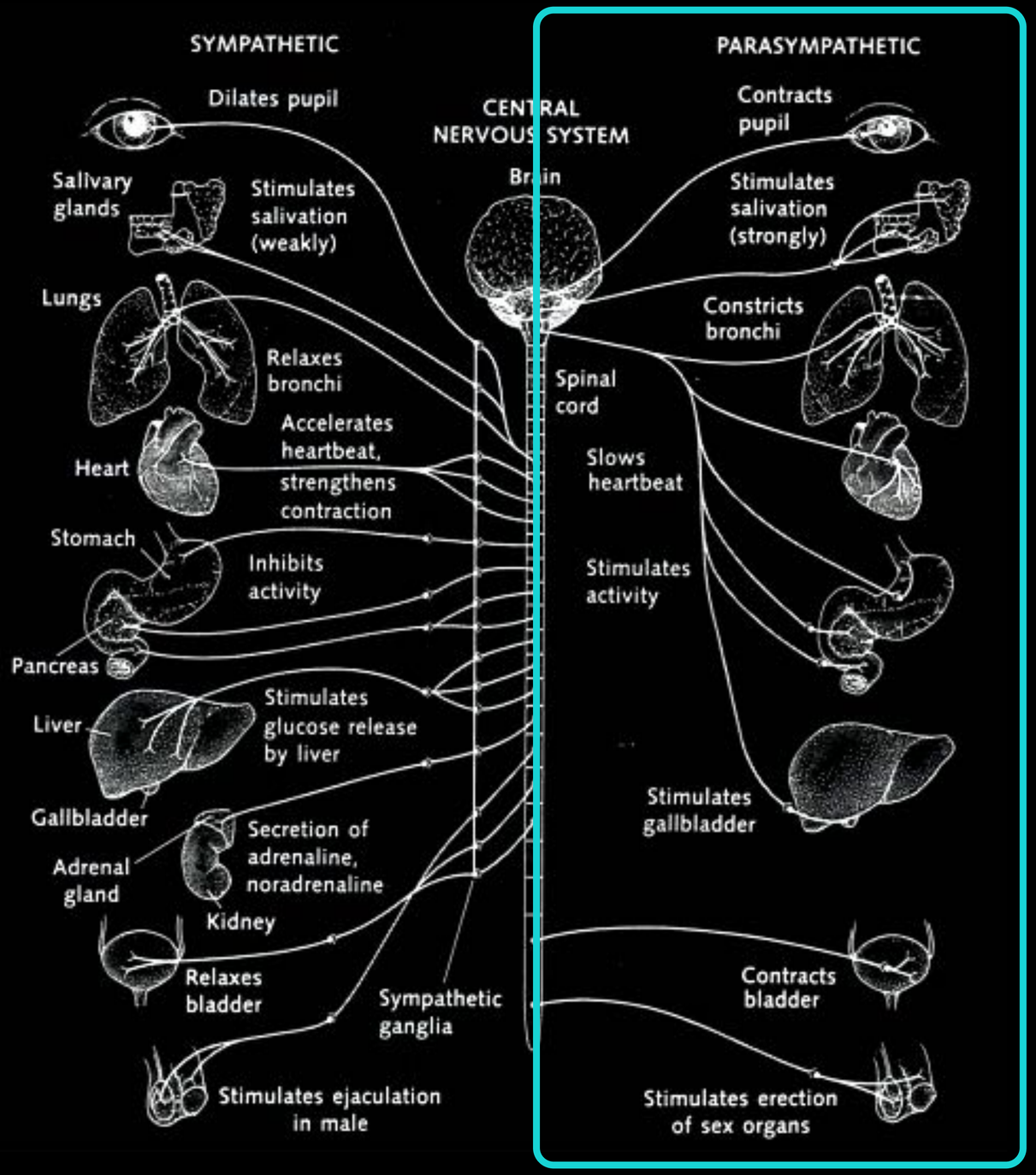
-Facilitates energy storage

-Decreases heart rate and blood pressure

-Activates digestion

-Contracts pupils

-Vagus nerve (“wandering”)



ANS INTERACTION PROFILES

SNS Activation
[high]

High SNS, Low PNS

Reciprocal Sympathetic Activation
(stress response)

High SNS, High PNS

Coactivation
(enaged in stress, and engage regulatory systems)

Low SNS, Low PNS

Coinhibition

Low SNS, High PNS

Reciprocal Parasympathetic Activation

PNS Activation
[high]

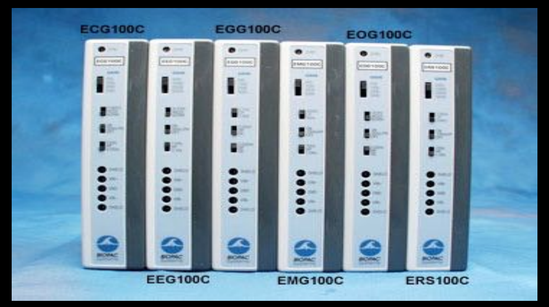
Graph inspired by Iris Mauss

Measurement

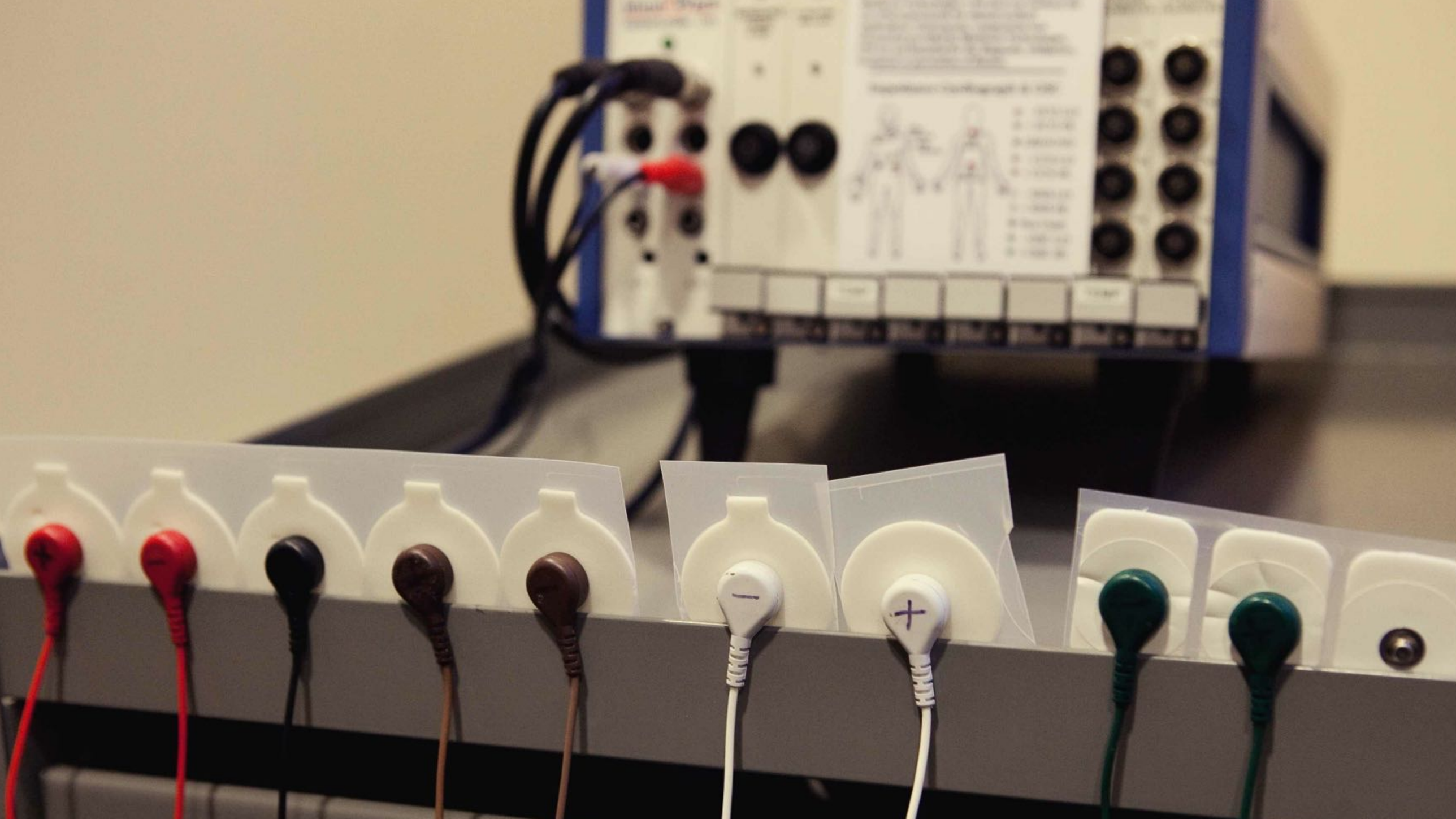
Inside the Lab

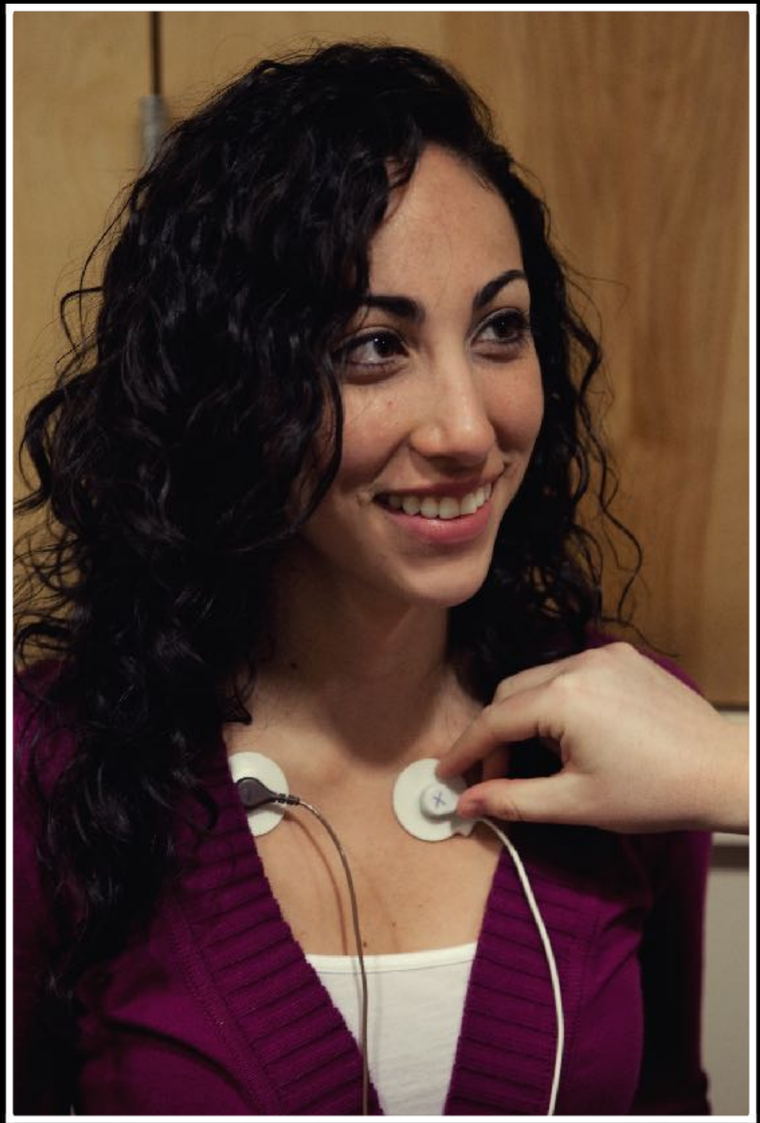
Grass Model 7

Biopac

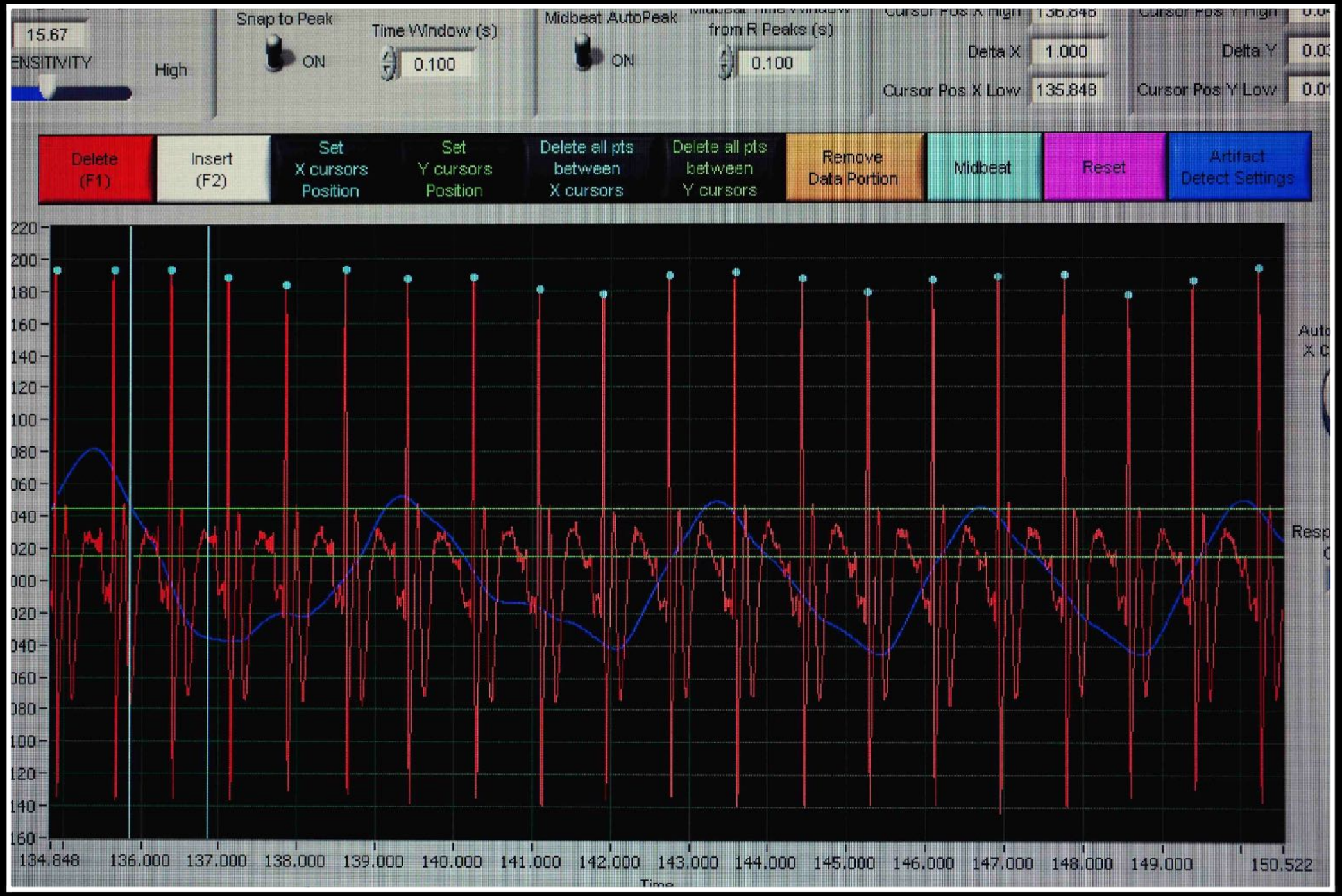


MindWare






Leave on except for singing task
SHUT DOWN AT END OF STUDY
Come on and twist a little closer now! (Twist a little closer)
SAMSUNG
SHUT DOWN AT END OF STUDY
ROOM 1 ACQUISITION
SAMSUNG



Outside the Lab

Ambulatory Physiology
Biopac Bioharness (Zephyr)

Heart Rate (HR)
Skin Temperature (SKT)
Respiratory Sinus Arrhythmia (RSA)
Gross somatic movement

Electrodermal

Cardiovascular

Blood Flow & Temperature

Electrodermal

Cardiovascular

Blood Flow & Temperature

Electric Meter Tests Skin to Gauge Emotion

Emotions shown on faces in background are recorded by instrument sensitive to electric resistance of skin. Scientist is testing young woman

Call it an emotion meter, lie detector or what you will, an electric device contrived by Dr. D. Urich Greenwald at the University of Iowa draws a curve of your emotions as they run the gamut of joy, horror, fear, surprise, love. As you react to some stimulus that "gets under your skin," the electric needle reacts to emotional changes in resistance in your skin. Used by Dr. Christian A. Ruckmick in studies of emotion, this instrument is called a dermohmograph; derm for skin, ohm for electrical resistance, graph for its record on photographic paper. The scientists theorize that human emotion causes a piling up of positive and negative ions on the walls of skin cells, affecting resistance of the skin to passage of electricity. Essentially the emotion meter consists of dry cells, electrodes, fixed and variable resistances and a galvanometer. By reading the galvanometer while the subject watches a motion picture or reads a letter, his emotional reaction can be seen. For recording purposes, the deflection of the galvanometer guides a beam of light striking a moving roll of sensitized paper.

Fun Sweat Gland Facts

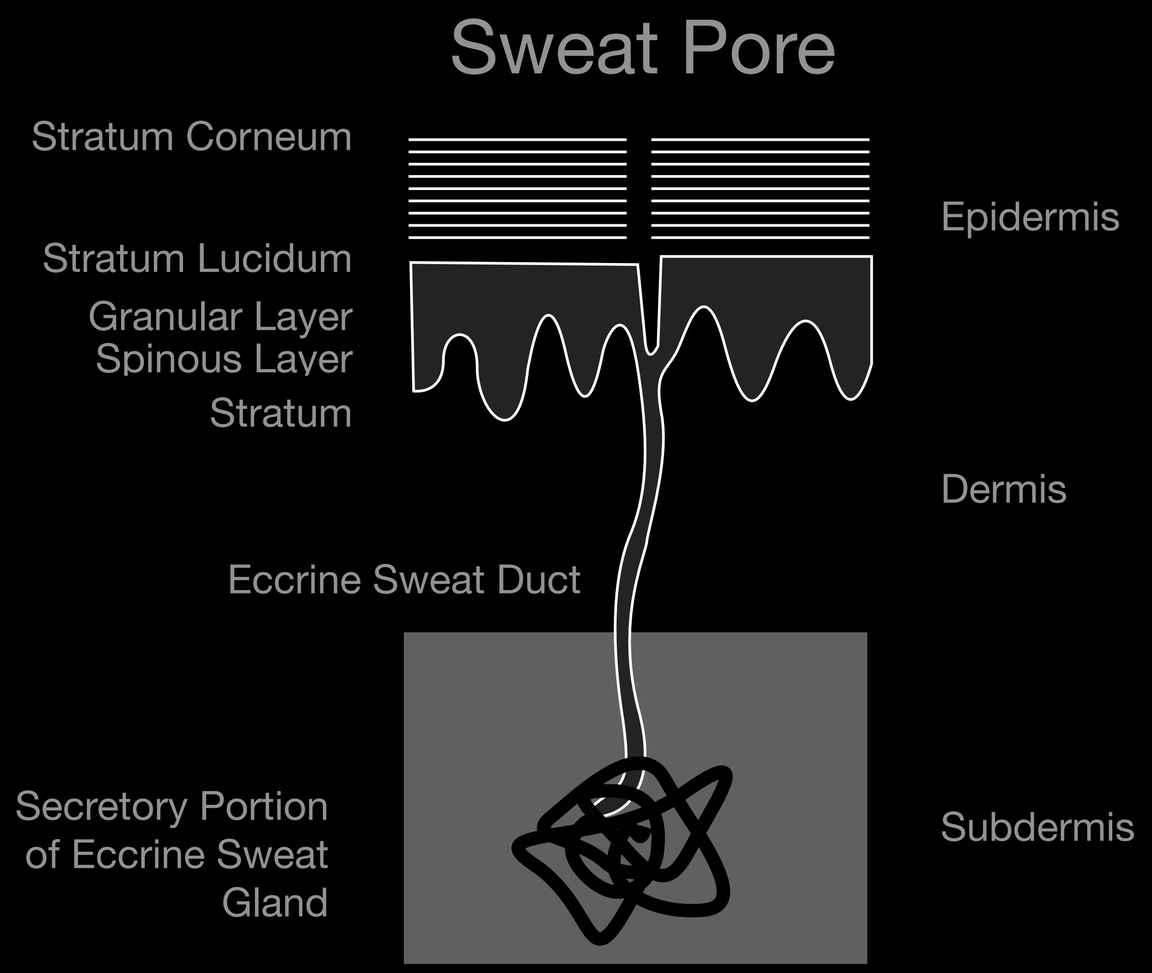
- 2-3 million on body. Most dense in palms of hands and soles of feet.

- Two kinds

  1. Apocrine Glands: armpits, genitals, give off odor

  2. Eccrine Glands: all over body, involved in thermoregulation, respond to stress, **EMOTION**, attention**.**

***EMOTION RESEARCHERS MEASURE ECCRINE GLANDS ON PALMS OF HANDS**



	Sympathetic	Parasympathetic
Electrodermal Activity (EDA)	**Increase sweating** *(provides firm grip in fight-flight situation)*	**None**

EDA: Also referred to as Galvanic Skin Response (GSR) or Galvanic Skin Conductance (GSC). Relatively undiluted measurement of SNS activity. Assesses secretion of sweat from the eccrine glands which are directly innervated by the SNS. Amount of sweat increases as SNS activity escalates.

How it works:

- **2 sensors** placed on hand palms (or finger phalanges) with a saline (NaCL) conductive paste.

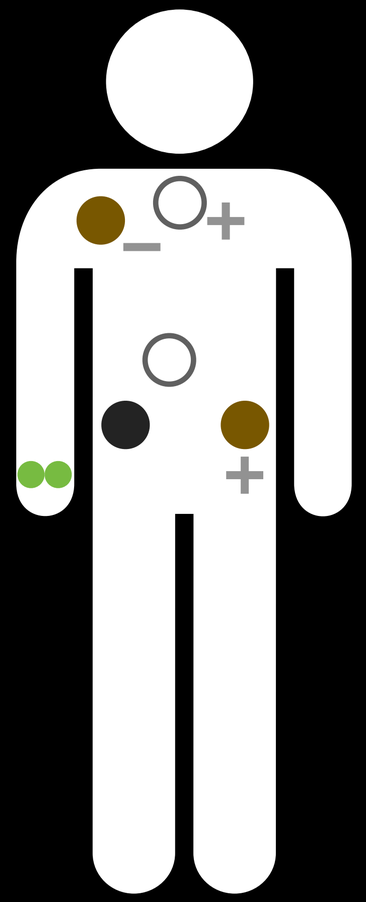
- Pass a 0.5v **current** between two sensors.

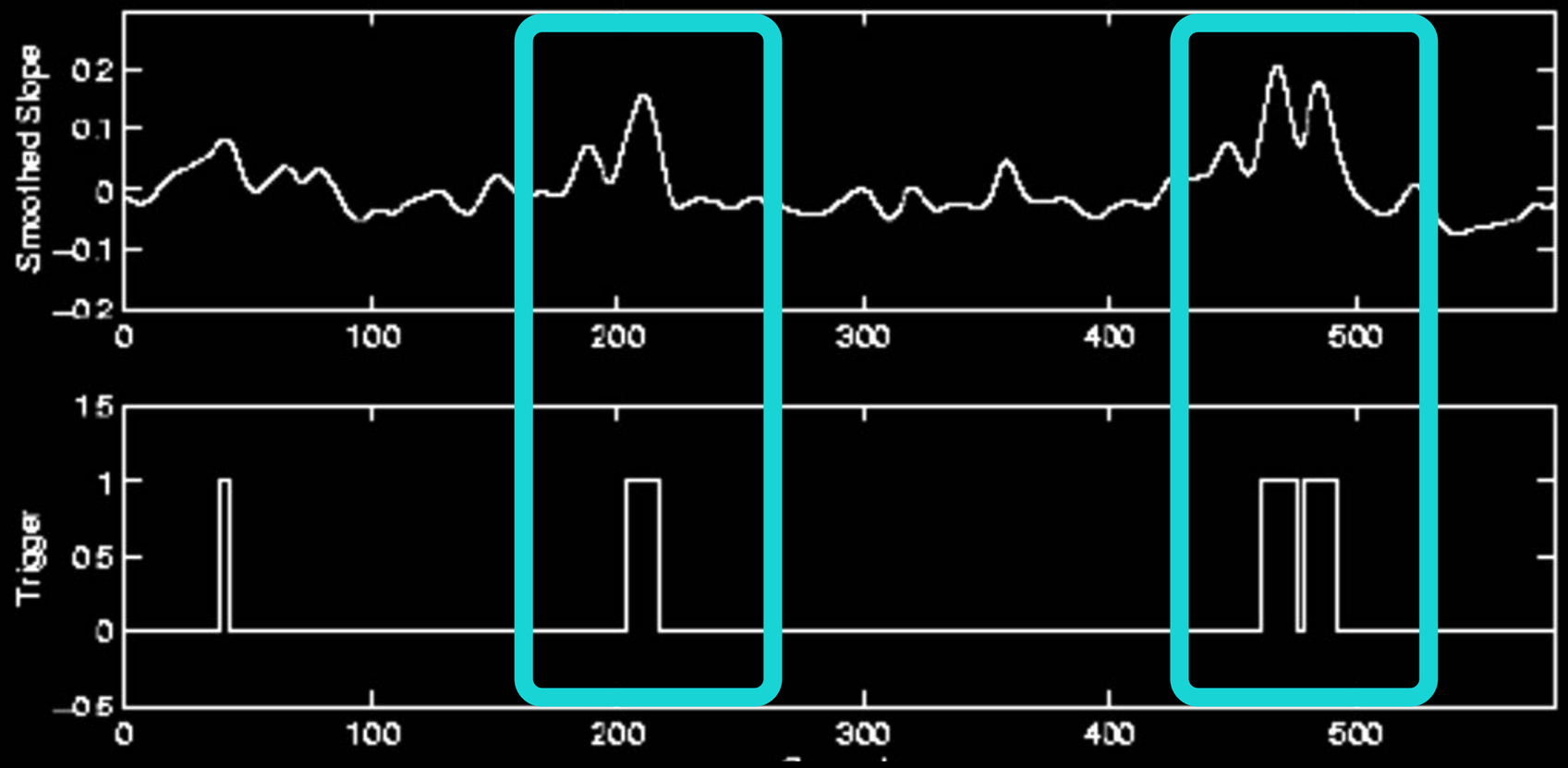
- As sweat increases, provides a more **conductive path**, and thus greater current (proportional to amount of sweat released).

- This signal is transmitted through a transducer and appears in digital display on computer monitor.

- Measured in units called “**micro siemens**”

EDA (GSR) Signal



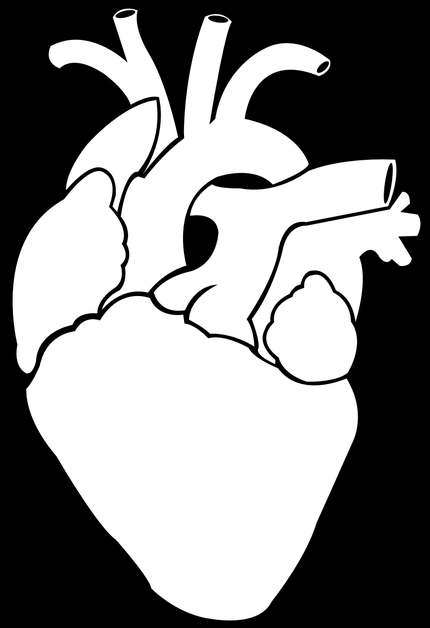


Electrodermal

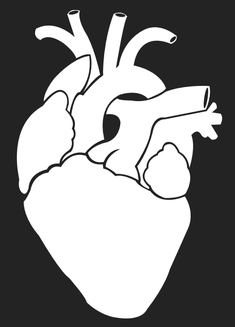
Cardiovascular

Blood Flow & Temperature

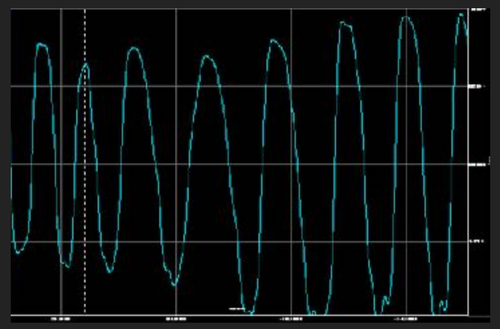
Heart Rate Variability



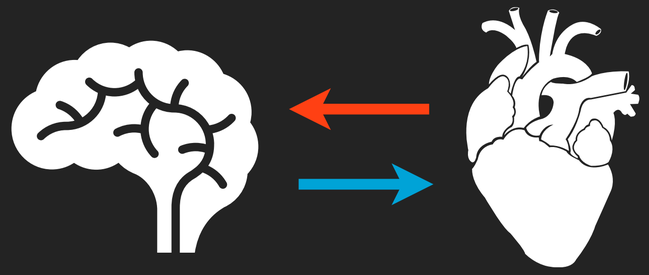
Cardiovascular Measures



Heart Rate (HR)
Inter-beat Interval (IBI)

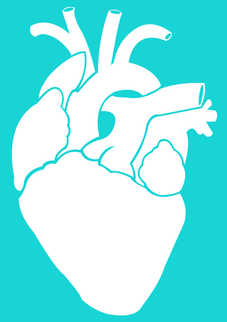


Respiratory Frequency

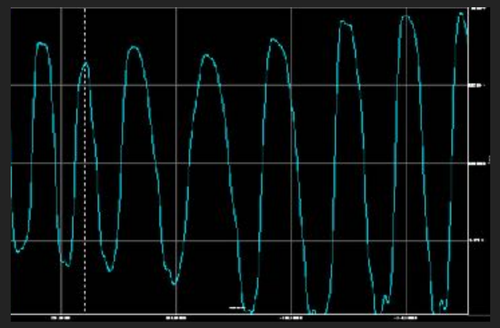


Respiratory Sinus Arrhythmia (RSA)
High Frequency Heart Rate Variability (HRV)

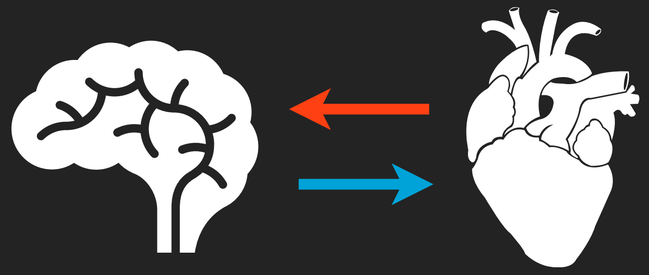
Cardiovascular Measures



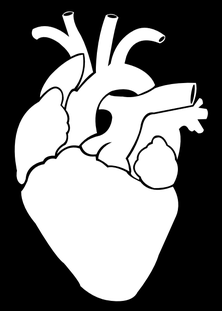
Heart Rate (HR)
Inter-beat Interval (IBI)

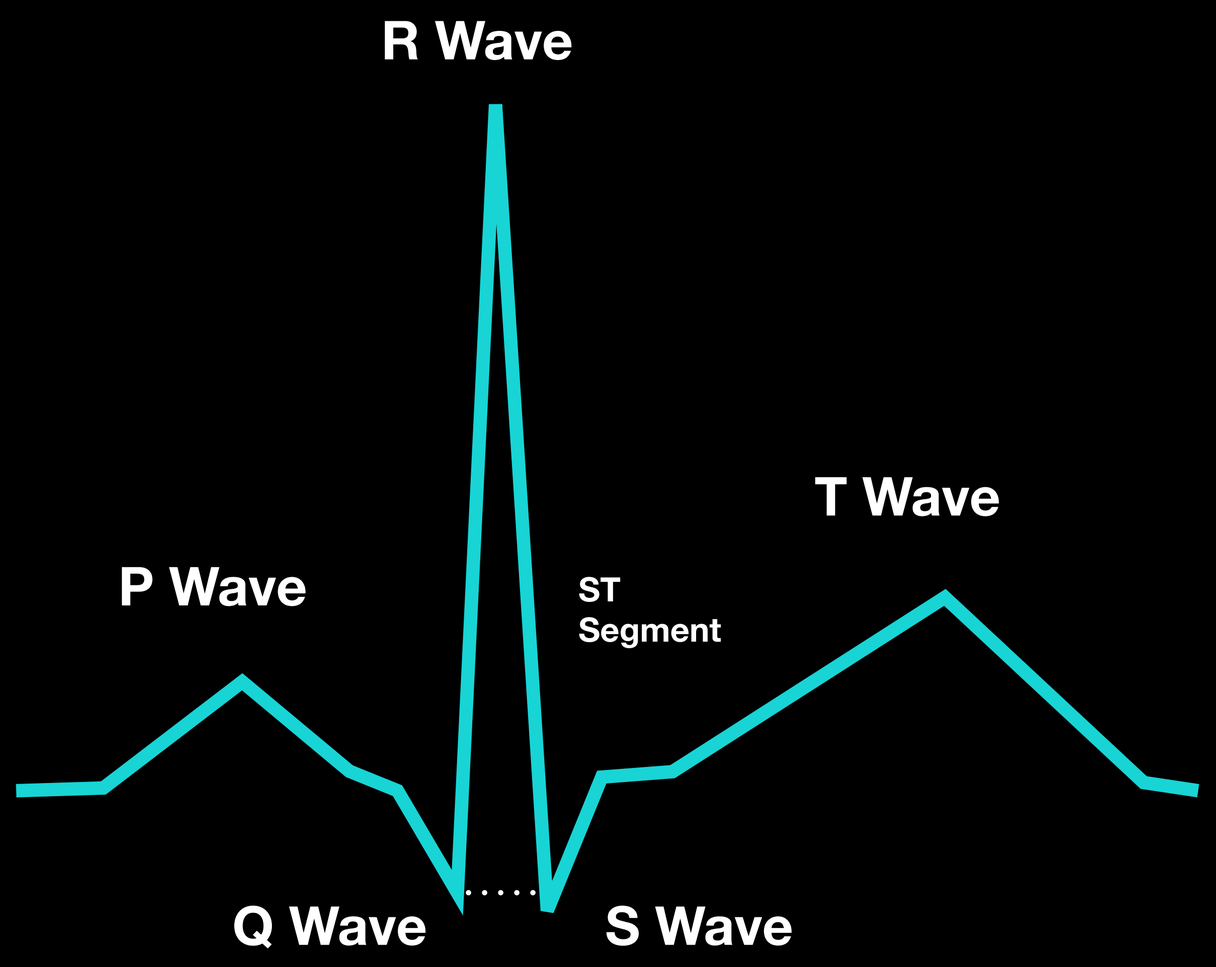


Respiratory Frequency



Respiratory Sinus Arrhythmia (RSA)
High Frequency Heart Rate Variability (HRV)

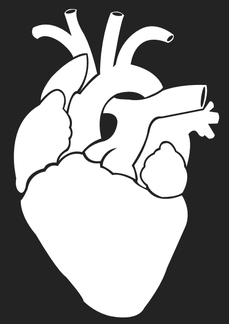




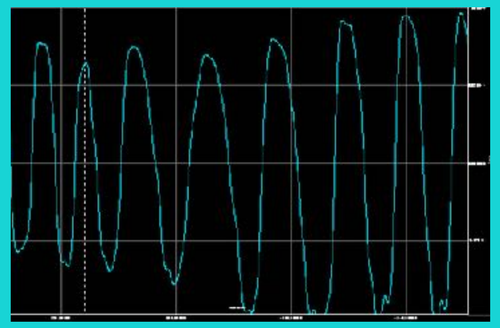
P = Atrial depolarization
QRS = Ventricular depolarization
T = Ventricular repolarization

Measure	Physiological System	Correlated Psychological Constructs	Units
Heart Rate (HR)	Sympathetic and Parasympathetic, Cardiac	Effort, Activation, Emotional Arousal	Beats per minute
Inter-beat Interval (IBI)	Sympathetic and Parasympathetic, Cardiac	Effort, Activation, Emotional Arousal	Milliseconds (time between R-spikes in ECG signal, or time between successive heartbeats). It bears a direct relationship with HR, such that a HR of 60 will be equal to an IBI of 1000 msec (1 second in between beats).

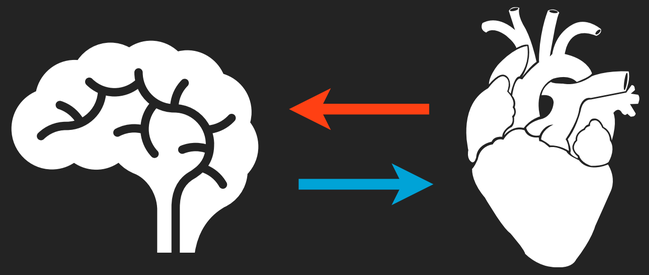
Cardiovascular Measures



Heart Rate (HR)
Inter-beat Interval (IBI)



Respiratory Frequency



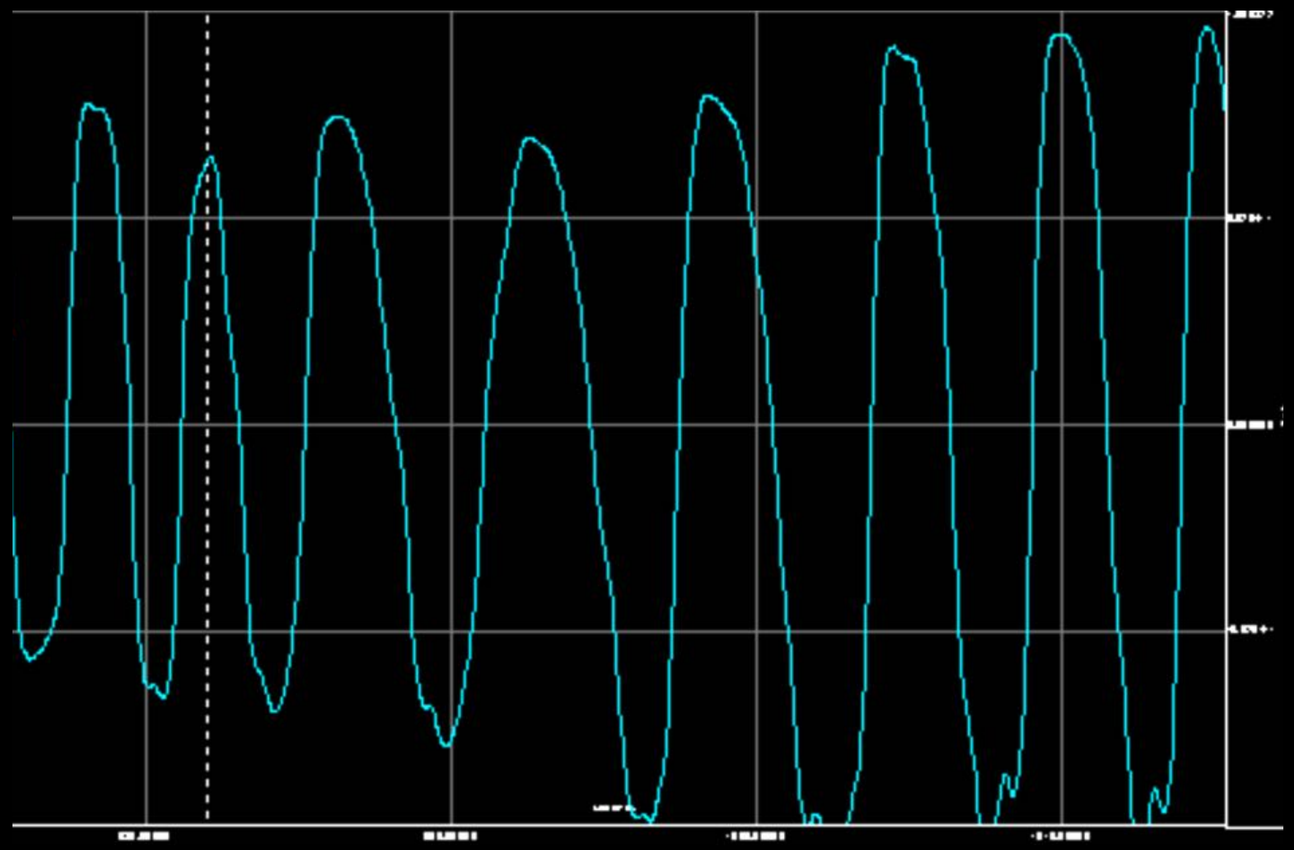
Respiratory Sinus Arrhythmia (RSA)
High Frequency Heart Rate Variability (HRV)

(Vagal Tone/Parasympathetic Nervous System)

Measure	Physiological System	Correlated Psychological Constructs	Units
Respiration Rate (RESP)	Sympathetic	Effort, Active Coping, Challenge Appraisals	Breaths per minute (freq. of an entire respiratory inspiration & expiration cycle)

INHALATION

EXHALATION



Measured as:

Frequency: Breaths Per Minute

Volume: Tidal Volume of Air

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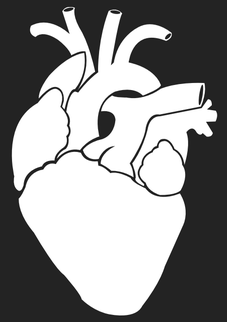
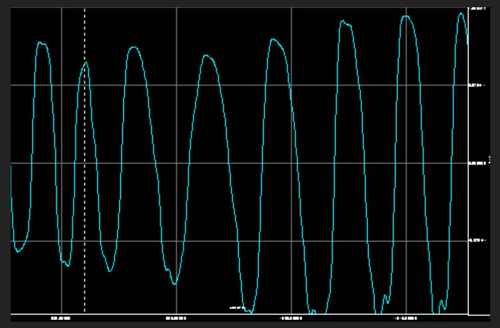
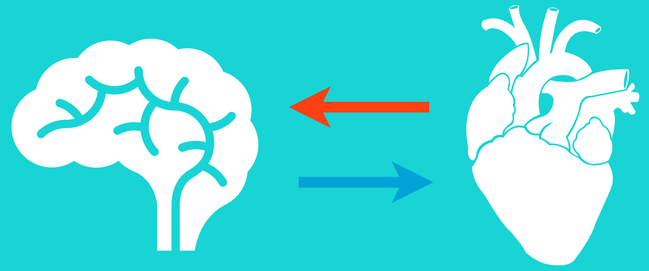
Cardiovascular Measures



Heart Rate (HR)
Inter-beat Interval (IBI)



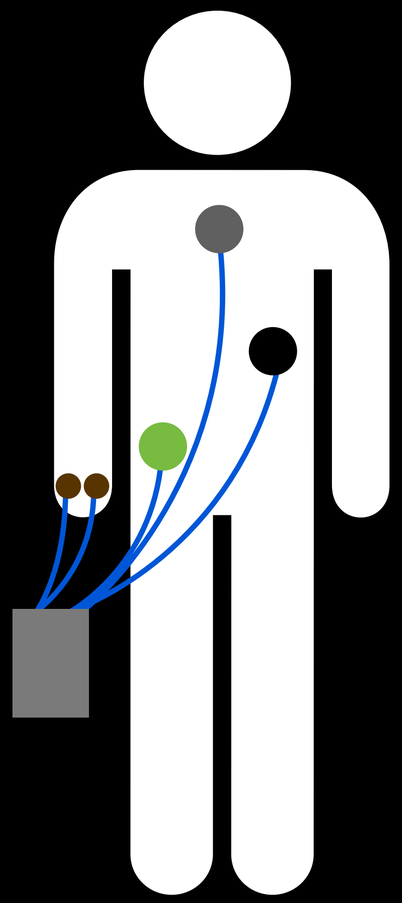
Heart Rate (HR)
Inter-beat Interval (IBI)

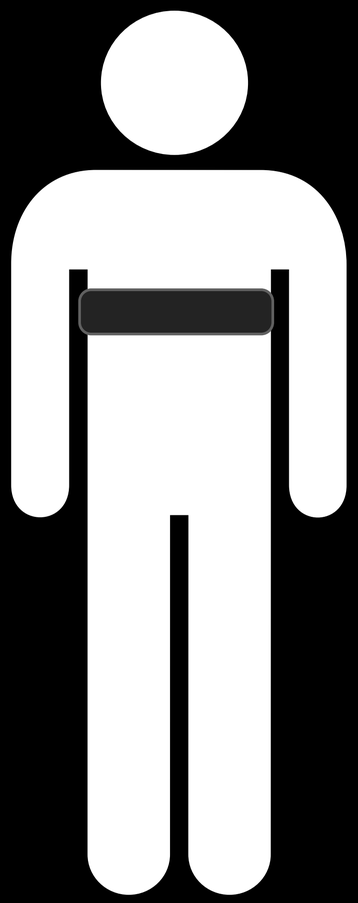


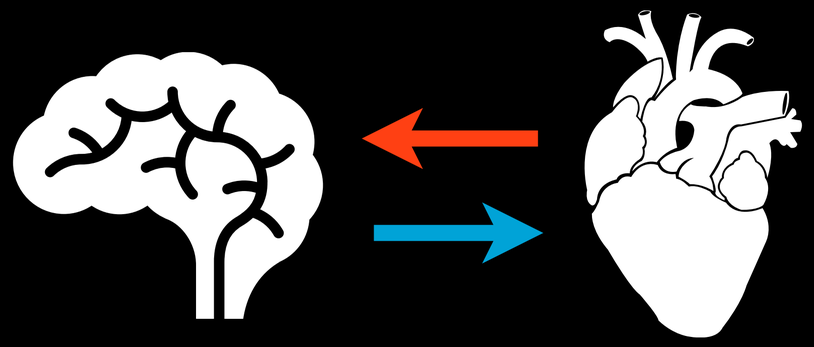
Respiratory Sinus Arrhythmia (RSA)
High Frequency Heart Rate Variability (HRV)

(Vagal Tone/Parasympathetic Nervous System)

Measure	Physiological System	Correlated Psychological Constructs	Units
Heart Rate Variability (HRV)	Parasympathetic (Time Domain Approach: High Freq. Brandwith - 0.15-0.40Hz) Porges Approach	Examination of physiological rhythms that exist in the beat-to-beat interval of the ECG signal that covary with respiration. HRV involved performing frequency domain analysis of human ECG data to extract standard HRV measures.	$msec^2$ in high frequency bandwith
Respiratory Sinus Arrhythmia (RSA)	Parasympathetic (peak valley approach) Grossman Approach	RSA refers to the natural variation in heart rate due to respiratory factors. During inspiration, the hear period (distance between R-spikes) becomes smaller; during expiration, the heart period increases.	msec





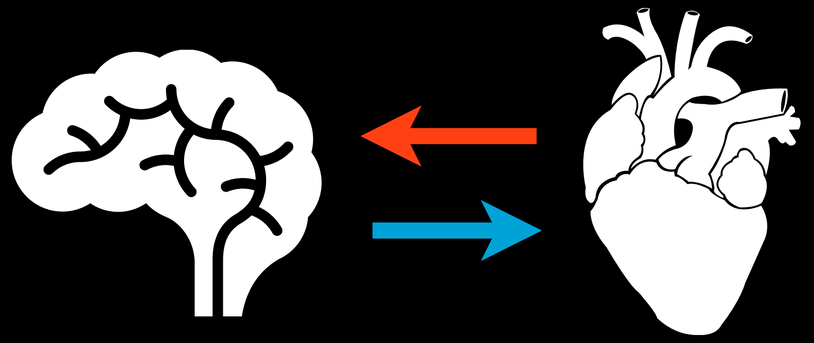


RSA & HRV: Measure of PNS Activity (Porges, 1998; 2001)

Vagal tone = PNS activity. Quantified as either RSA or HRV (High Freq.)

RSA/HRV = Measure of heart rate variability linked to breathing

↑ **Vagal tone = PNS; positive mood and relaxation** *(apply vagus nerve brake)*



↑ Vagal Tone

Positive emotion
(Oveis, et al., 2009; Porges, 1992)

Emotion regulation
(Butler et al., 2006)

Resiliency to stressors
(Fabes & Eisenberg, 1997)

Decreased depression
(George, 2000).

Electrodermal

Cardiovascular

Blood Flow & Temperature

Blood Flow Parameters:

1. Skin Temperature (SKT)

2. Finger Pulse Transit Time (FPTT)

3. Finger Pulse Amplitude (FPA)

Blood Flow Parameters:

1. Skin Temperature (SKT)

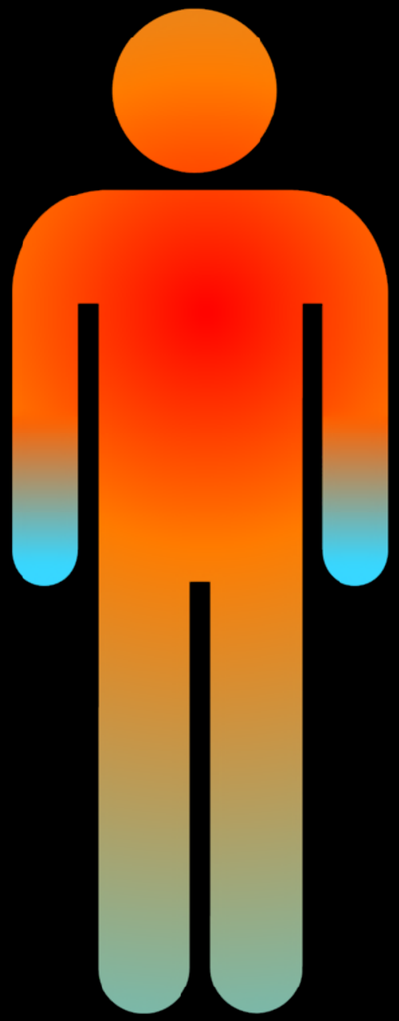
2. Finger Pulse Transit Time (FPTT)

3. Finger Pulse Amplitude (FPA)

	Sympathetic	Parasympathetic
Skin (SKT)	Increased blood transported to region, skin temperature increases	None

SKT: Blood is transported to an area of the skin which then becomes heated (i.e., more blood = higher SKT). When SNS activated, blood directed *away* from peripheral systems (e.g., finger, ear) and towards large locomotive muscle groups. Increased SNS = lower SKT in peripheral systems.

SNS activation -> Vasoconstriction --> Less blood flow --> Lower SKT.



Finger Skin Temperature

- Fingertip skin has arterioles

- Arterioles: smallest branches of arterial tree (.3-.4mm)

- Arterioles on the fingertips only have sympathetic constrictor nerves -> **Useful measure of SNS activity**

Pros

-Clean measure of SNS activity
(arterioles on fingertip only have sympathetic nerves)

Cons

-Difficult to determine cause
-Slow in onset (SNS --> finger SKT change ~15 sec)
-Small changes in magnitude (~1 deg.)
-External factors influence (room temp)

SKT Decrease

-Negative emotions
(sad, disgust, fear, embarrassment)
-Crying

SKT Increase

-Positive emotions (excitement)
-Anger (approach oriented)

(Boudewyns, 1976; Bugental & Cortez, 1988; Graham, 1962; Gross, Frederickson, and Levenson, 1994; Kistler, Hirota & Hirai, 1990; Mariauzouls & Berlepsch, 1998; Mittleman & Wolff, 1939; Schachter, 1957; Thyer et al., 1984)

How it works

- Sensor placed on peripheral body extension (e.g., distal phalange of finger).
- Sensor called a THERMISTOR
- Voltage that is generated by thermistor varies systematically with skin temperature changes.
- On a computer, can convert these voltage signals to degrees (Fahrenheit)

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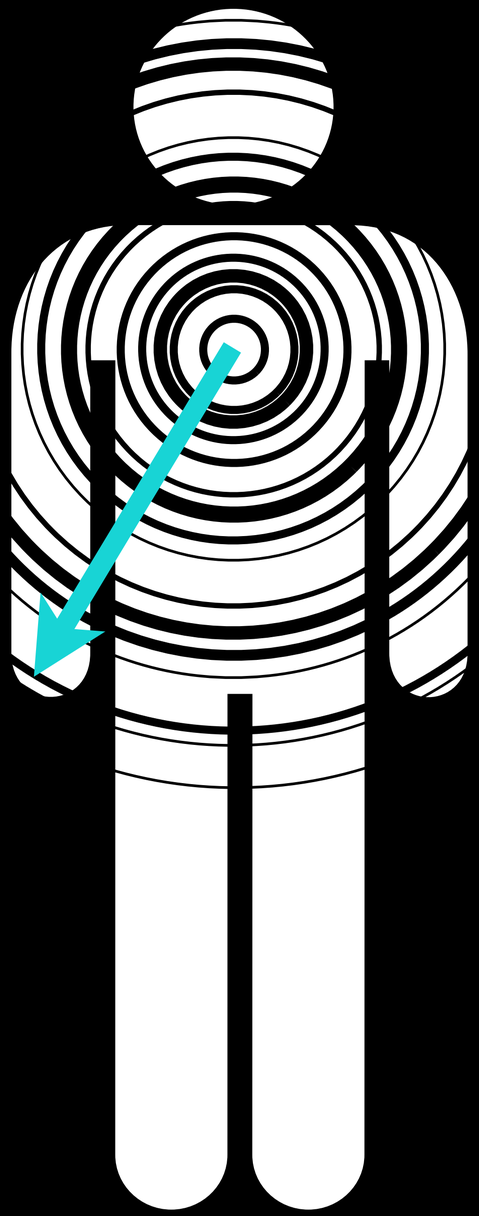
Blood Flow Parameters:

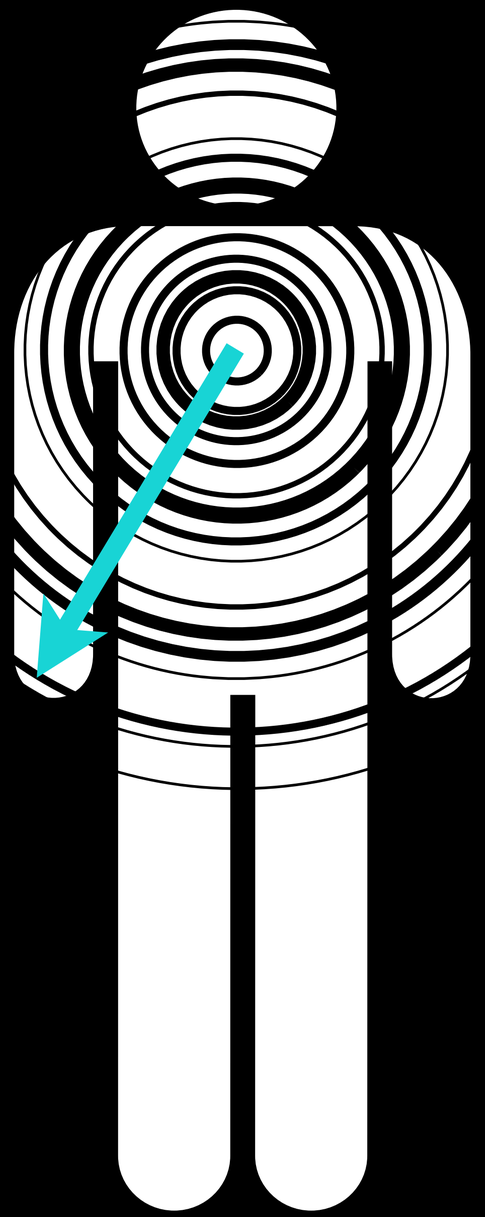
1. Skin Temperature (SKT)

2. Finger Pulse Transit Time (FPTT)

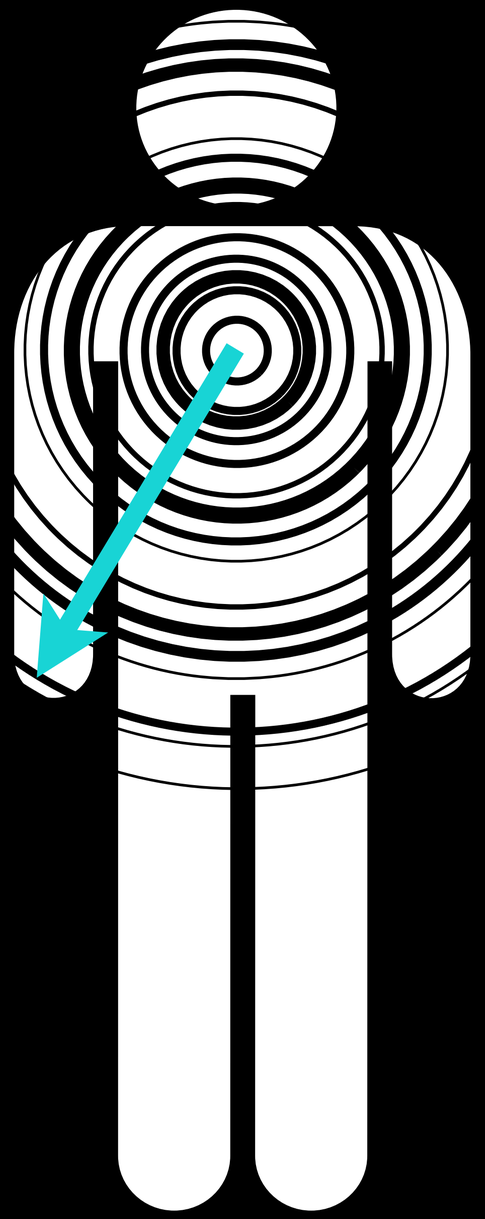
3. Finger Pulse Amplitude (FPA)

Both in broader family of Finger Pulse measures

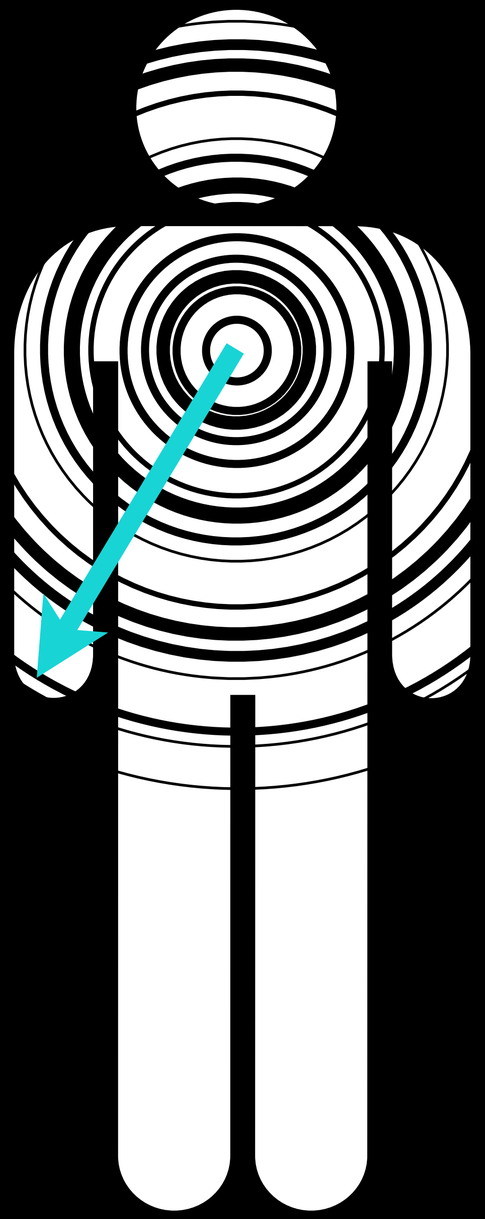




	Sympathetic	Parasympathetic
Finger Pulse	Blood flow to periphery (often ear or finger)	None



	What it measures	How?
Finger Pulse	Blood flow to periphery (often ear or finger)	Indirect; Reflected light on periphery (finger or ear) bounces back when hits blood

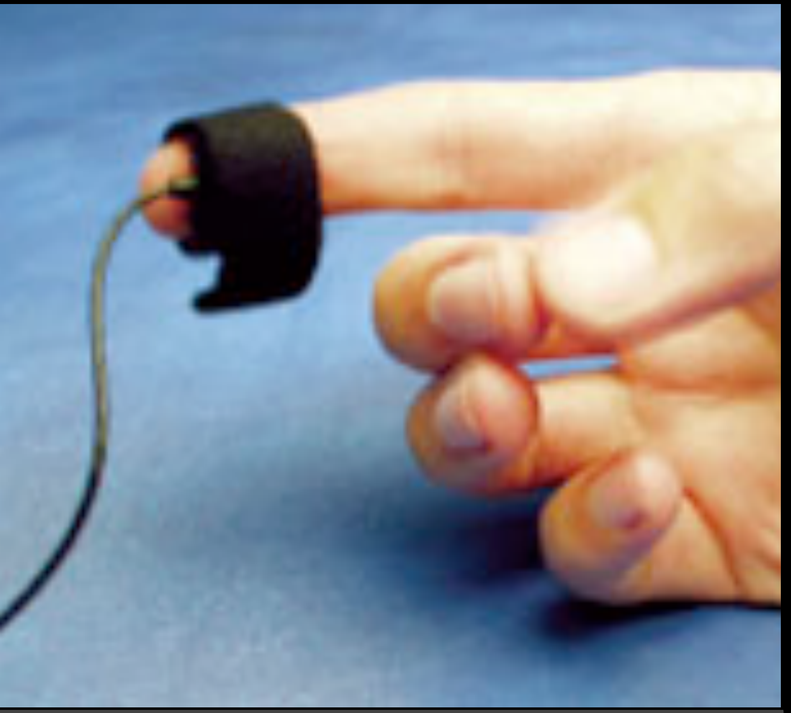


How it works

4 SENSORS

1) **3** ECG Sensors: Measure heart rate

2) **1** Finger (or Ear) Plethysmograph Sensor: sensor that uses infrared sensor to detect volume and amplitude of blood in finger tip (i.e., measuring mini-pulse in finger).



FINGER PULSE

CAN DERIVE 2 THINGS:

(1) Pulse Transit Time: Time takes for blood to flow from heart to extremity (finger or ear).

(2) Pulse Amplitude: Blood volume in extremity (finger or ear).

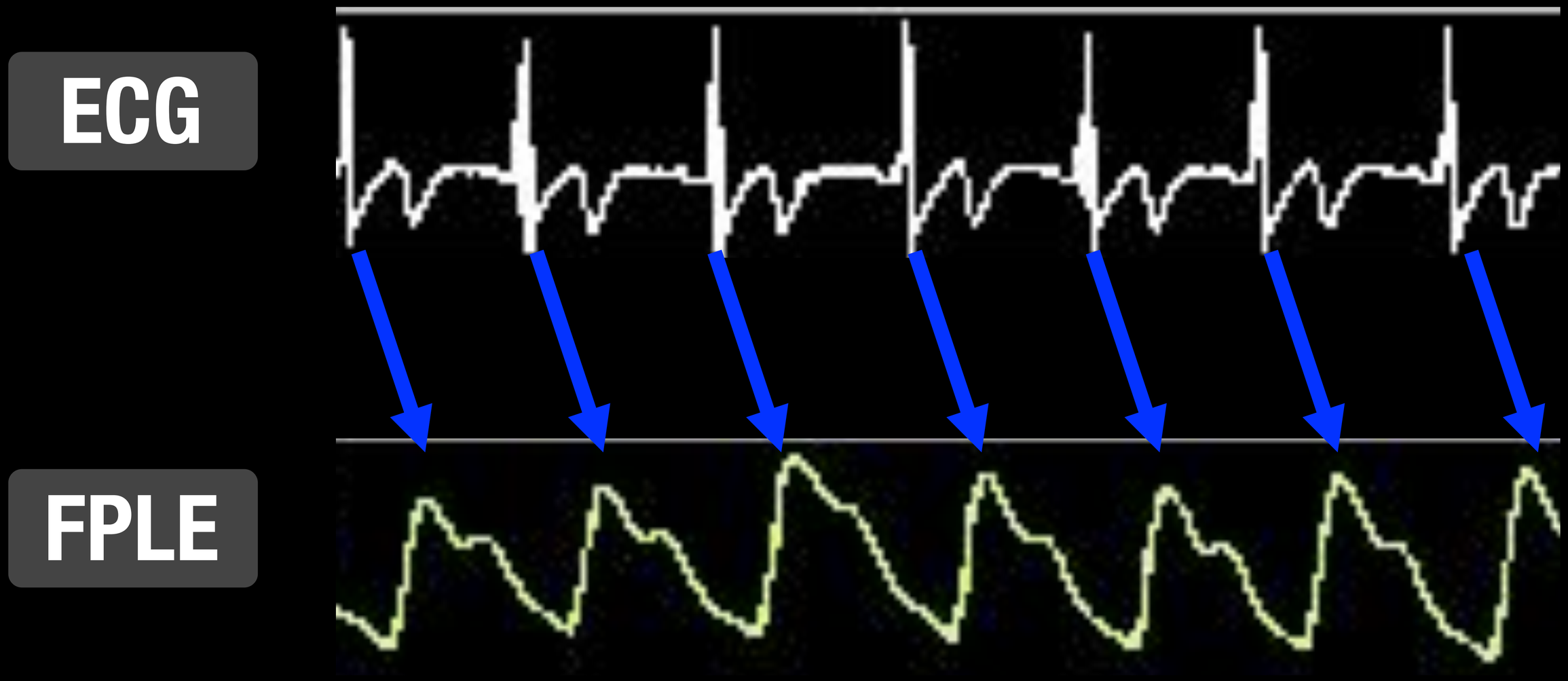
	What it Measures	How?	Facts
FPTT	Time takes for blood to flow from heart to extremity (e.g., finger).	Time difference (msec) between heart beat (R-Spike in ECG signal) and Finger Pulse Spike (upstroke of pulse pressure wave at fingertip)	**Affected by 2 factors** **1. Heart pumping** -SNS increase --> HR increase --> FPTT decrease **2. Vasoconstriction** (resistance to blood flow in vessels) -SNS increase -> Vasoconstriction -> FPTT decrease

Fredrickson & Levenson, 1998;
Mauss et al., 2005; Newlin & Levenson, 1979

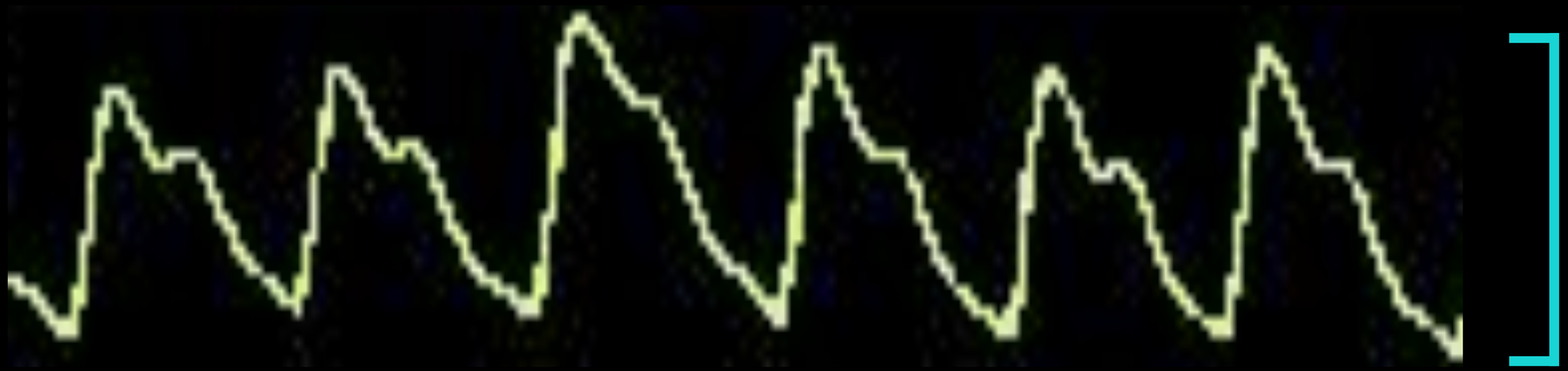
	What it Measures	How?	Facts
FPA	Blood volume in finger tip	Amplitude of Finger Pulse Spike signal (calculate distance between trough and peak).	**Affected by 2 factors** **1. Heart pumping** -SNS increase --> HR increase --> FPA decrease **2. Vasoconstriction** (resistance to blood flow in vessels) -SNS increase -> Vasoconstriction -> FPA decrease

Fredrickson & Levenson, 1998;
Mauss et al., 2005; Newlin & Levenson, 1979

FPTT



FPA



Summary

	What measures?	How?
Electrocardiogram (ECG/EKG)	Heart rate	Direct; Electrodes placed on skin
Skin conductance (GSC/GSR)	Sweat	Indirect; Applied voltage or current and more sweat increases conductance
Electromyogram (EMG)	Muscular Movement/Contraction	Direct; Electrodes placed on skin
Respiration	Breathing frequency, tidal volume	Indirect; Transducer (measured by amount respiration belt moves)
Skin Temperature (SKT)	Skin Temperature	Indirect; Thermistor (resistance varies as function of SKT)
Finger/Ear Blood Pulse	Blood flow to periphery (ear, finger)	Indirect; Reflected Light on finger or ear lobe that bounces back when hits blood

Other Measures: Hemodynamic

1. Pre-Ejection Period (PEP)

2. Left Ventricular Ejection Time (LVET)

3. Stroke Volume (SV)

4. Cardiac Output (CO)

Time Interval:
How quickly is blood flowing?

Volume Interval
How much blood is pumping?

Roadmap

Course Logistics

Definitions and Measurement

Emotion Specificity

Emotion Coherence

Take-Away Qs & Expert Interview

Robert Levenson

Lani Shiota

Are there different patterns of autonomic nervous system activity for different emotions?

Are there different patterns of autonomic nervous system activity for different emotions?

Negative Emotions

Emotion	ANS Basis	Change
Anger	Vasodilation Pupils	Reddening in skin, Blood vessels bulge, Constriction
Fear	Vasoconstriction Sweat Glands	Pale/blanching Sweaty, Clammy palms Higher skin conductance
Sad	Lacrimal Glands	Tearing, Crying
Disgust	Salivary Glands	Salivate, Drool

Are there different patterns of autonomic nervous system activity for different emotions?

Positive Emotions

Emotion	ANS Basis	Change
Anger	Vasodilation	Reddening in skin, Blood vessels bulge, Constriction
Fear	Vasoconstriction Sweat Glands	Pale/blanching Sweaty, Clammy palms Higher skin conductance
Sad	Lacrimal Glands	Tearing, Crying
Disgust	Salivary Glands	Salivate, Drool
Happiness	**Vagus Nerve**	**Tightness in chest, Goosebumps**

Emotion
2009, Vol. 9, No. 2, 265–270

1528-3542/09/$12.00 DOI: 10.1037/a0015383

Resting Respiratory Sinus Arrhythmia Is Associated With Tonic Positive Emotionality

Christopher Oveis
University of California, Berkeley

Adam B. Cohen
Arizona State University

June Gruber
University of California, Berkeley

Michelle N. Shiota
Arizona State University

Jonathan Haidt
University of Virginia

Dacher Keltner
University of California, Berkeley

Resting respiratory sinus arrhythmia (RSA_{REST}) indexes important aspects of individual differences in emotionality. In the present investigation, the authors address whether RSA_{REST} is associated with tonic positive or negative emotionality, and whether RSA_{REST} relates to phasic emotional responding to discrete positive emotion-eliciting stimuli. Across an 8-month, multiassessment study of first-year university students ($n = 80$), individual differences in RSA_{REST} were associated with positive but not negative tonic emotionality, assessed at the level of personality traits, long-term moods, the disposition toward optimism, and baseline reports of current emotional states. RSA_{REST} was not related to increased positive emotion, or stimulus-specific emotion, in response to compassion-, awe-, or pride-inducing stimuli. These findings suggest that resting RSA indexes aspects of a person's tonic positive emotionality.

Keywords: vagal tone, positive temperament, heart rate variability, biological marker

What about differences among positive emotions?

What about differences among positive emotions?

Enthusiasm

Attachment Love

Nuturant Love

Amusement

Awe

	ENTHUSIASM	LOVE (attachment)	LOVE (nurturant)	AMUSEMENT	AWE
Heart Rate (IBI)		↑	↑		
PEP					↑
SCR (GSR/GSC)	↑				
RESP			↑	↑	↑
RSA	↓	↓			↓
MAP					

Shiota et al. (2011)

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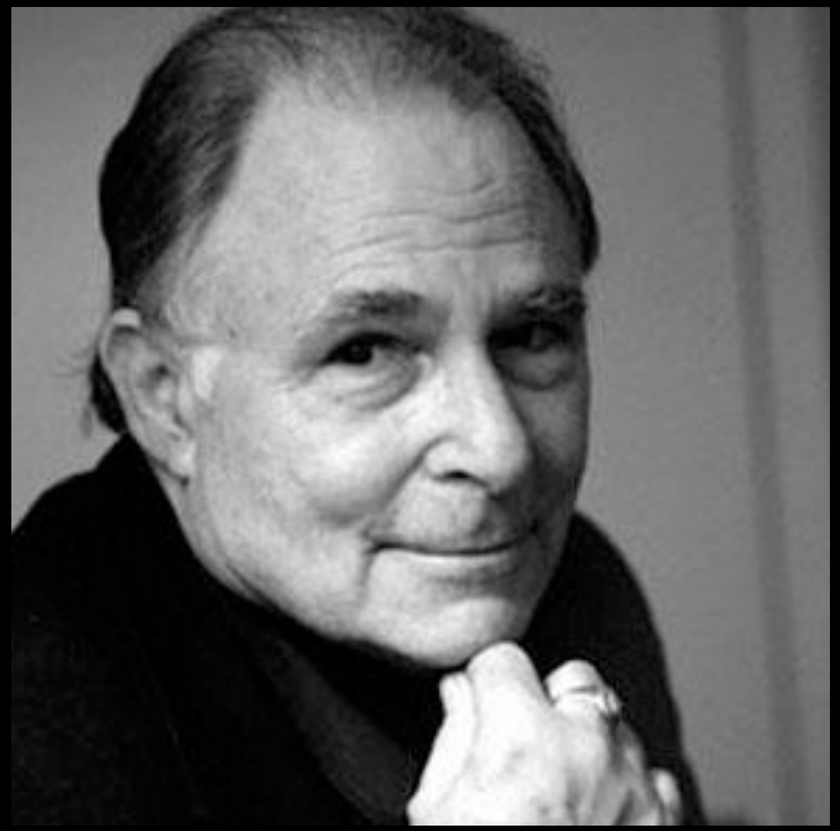
Iris Mauss

What is an emotion: Six Features



Paul Ekman UCSF

Brief

Unbidden

Cross-Species

Coherent Really?

Fast

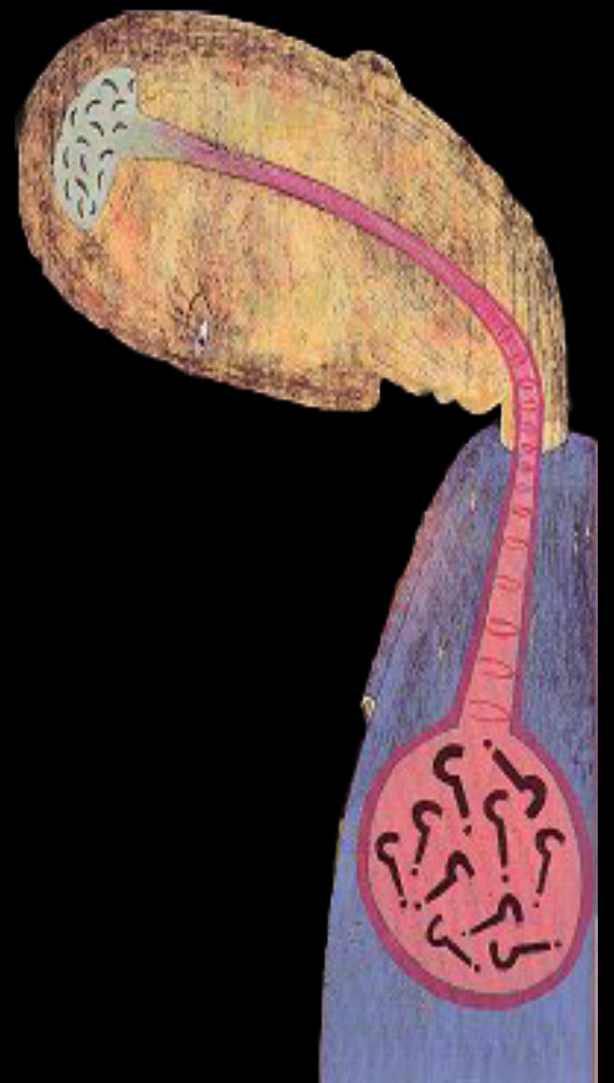
Automatic Appraisal/Evaluation

What is an emotion: Six Features

Subjective
Qualia
What it’s like to feel an emotion

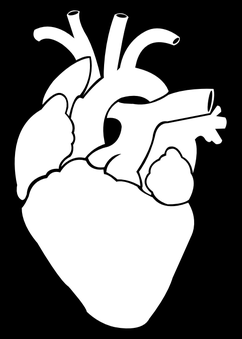
How well do they actually cohere,
or increase/decrease together?

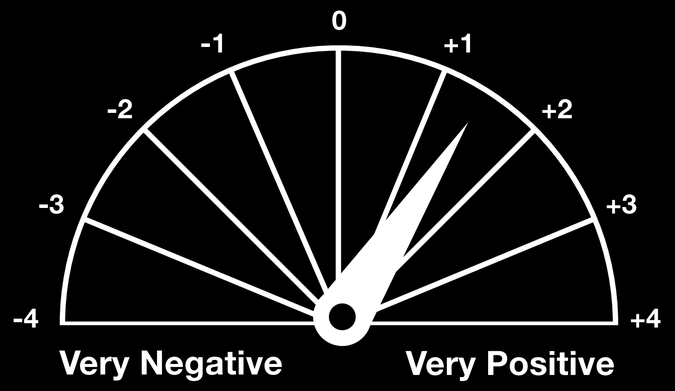
Physiology
Internal Physical Sensations



Are emotions coherent?

Where's the Evidence?





Mauss et al (2005)

	Amusement Facial Behavior	Cardio	SCL
Amusement Experience	.73*** [.89***]	.22*** [.25***]	.51*** [.57***]
Amusement Behavior		.34*** [.37***]	.47*** [.51***]
Average Absolute r for Amusement			.39 [.52]

	Sadness Facial Behavior	Cardio	SCL
Sadness Experience	.74*** [.97***]	.00 [.00]	-.39*** [-.53***]
Sadness Behavior		-.05 [-.06]	-.52*** [-.58***]
Average Absolute *r* for Sadness			.36 [=.53]

Upshot

Moderate coherence on average

Highest between **experience & behavior**

Almost NO coherence between physiology and either experience or behavior

Mauss et al (2005)

			
	Controls	**Dancers**	**Meditators**
COHERENCE between heart rate & self-reported emotion	**Lowest**	**Middle**	**Highest**

Sze, Gyurak, Yuan, & Levenson (2010)

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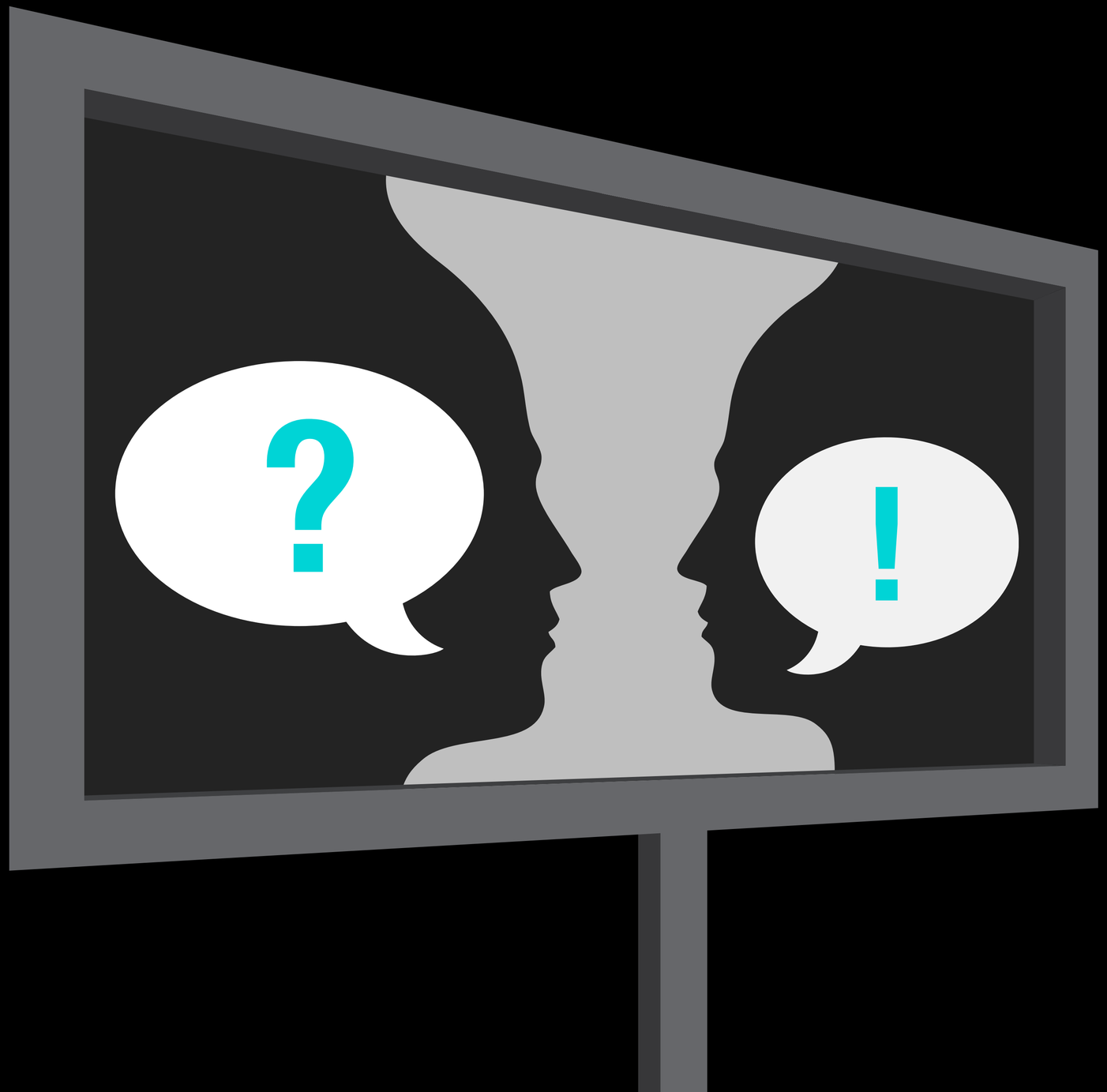

Experts In Emotion

EXTRA CREDIT OPPORTUNITY

Experts In Emotion Interview

Dr. Robert Levenson

Professor of Psychology
University of California, Berkeley

Blood, tears, sweat and fears? Autonomic nervous system and emotion

Experts In Emotion Interview

Dr. Wendy Berry Mendes

Sarlo/Ekman Endowed Chair in the Study of Emotion
Associate Professor
Department of Psychiatry
University of California, San Francisco

Psychophysiology Measurement and Health

Experts In Emotion Interview

Dr. John T. Cacioppo

Tiffany & Margaret Blake Distinguished Service Professor
Director, Center for Cognitive and Social Neuroscience
University of Chicago

Psychophysiology: Scope and promise for emotion research

Thank You!

Psychology 3131
Professor June Gruber