“No shade of emotion should be without a bodily reverberation...”

William James (1898)
Human Emotion

Psychology 3131
Professor June Gruber
Physiological Approach
Emotions secondary to physiological phenomenon

Theories of Emotion Timeline
William James

FEAR
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

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

- Increases heart rate and blood pressure

- Slows digestion

- Dilates pupils
Parasympathetic Nervous System (PNS)

- 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 (engaged 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
Come on and twist a little closer now! (Twist a little closer)
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

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.
- 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*
**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.

<table>
<thead>
<tr>
<th>Electrodermal Activity (EDA)</th>
<th>Sympathetic</th>
<th>Parasympathetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase sweating (provides firm grip in fight-flight situation)</td>
<td>None</td>
<td></td>
</tr>
</tbody>
</table>
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
<table>
<thead>
<tr>
<th>Measure</th>
<th>Physiological System</th>
<th>Correlated Psychological Constructs</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate (HR)</td>
<td>Sympathetic and Parasympathetic, Cardiac</td>
<td>Effort, Activation, Emotional Arousal</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>Inter-beat Interval (IBI)</td>
<td>Sympathetic and Parasympathetic, Cardiac</td>
<td>Effort, Activation, Emotional Arousal</td>
<td>Milliseconds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(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).</td>
</tr>
<tr>
<td>Measure</td>
<td>Physiological System</td>
<td>Correlated Psychological Constructs</td>
<td>Units</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------------</td>
<td>----------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Respiration Rate (RESP)</td>
<td>Sympathetic</td>
<td>Effort, Active Coping, Challenge Appraisals</td>
<td>Breaths per minute (freq. of an entire respiratory inspiration &amp; expiration cycle)</td>
</tr>
</tbody>
</table>
Measured as:
Frequency: Breaths Per Minute
Volume: Tidal Volume of Air
Cardiovascular Measures

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

Respiratory Sinus Arrhythmia (RSA)
High Frequency Heart Rate Variability (HRV)
(Vagal Tone/Parasympathetic Nervous System)
<table>
<thead>
<tr>
<th>Measure</th>
<th>Physiological System</th>
<th>Correlated Psychological Constructs</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate Variability (HRV)</td>
<td>Parasympathetic</td>
<td>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.</td>
<td>msec² in high frequency bandwith</td>
</tr>
<tr>
<td></td>
<td>(Time Domain Approach: High Freq. Brandwith - 0.15-0.40Hz) Porges Approach</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory Sinus Arrhythmia (RSA)</td>
<td>Parasympathetic</td>
<td>RSA refers to the natural variation in heart rate due to respiratory factors. During inspiration, the heart period (distance between R-spikes) becomes smaller; during expiration, the heart period increases.</td>
<td>msec</td>
</tr>
<tr>
<td></td>
<td>(peak valley approach)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grossman Approach</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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)
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.**

<table>
<thead>
<tr>
<th></th>
<th>Sympathetic</th>
<th>Parasympathetic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skin (SKT)</strong></td>
<td>Increased blood transported to region, skin temperature increases</td>
<td>None</td>
</tr>
</tbody>
</table>
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)

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)
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
<table>
<thead>
<tr>
<th>What it measures</th>
<th>How?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Finger Pulse</strong></td>
<td><strong>Blood flow to periphery (often ear or finger)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Indirect; Reflected light on periphery (finger or ear) bounces back when hits blood</strong></td>
</tr>
</tbody>
</table>
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).
(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).
<table>
<thead>
<tr>
<th>FPTT</th>
<th>What it Measures</th>
<th>How?</th>
<th>Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time takes for blood to flow from heart to extremity (e.g., finger).</td>
<td>Time difference (msec) between heart beat (R-Spike in ECG signal) and Finger Pulse Spike (upstroke of pulse pressure wave at fingertip)</td>
<td>Affected by 2 factors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Heart pumping</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- SNS increase --&gt; HR increase --&gt; FPTT decrease</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Vasoconstriction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(resistance to blood flow in vessels)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- SNS increase --&gt; Vasoconstriction - &gt; FPTT decrease</td>
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</tbody>
</table>

Fredrickson & Levenson, 1998; Mauss et al., 2005; Newlin & Levenson, 1979
<table>
<thead>
<tr>
<th>FPA</th>
<th>What it Measures</th>
<th>How?</th>
<th>Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blood volume in finger tip</td>
<td>Amplitude of Finger Pulse Spike signal (calculate distance between trough and peak).</td>
<td>Affected by 2 factors</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Heart pumping</td>
</tr>
<tr>
<td></td>
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Fredrickson & Levenson, 1998; Mauss et al., 2005; Newlin & Levenson, 1979
ECG

FPLE

FPTT
<table>
<thead>
<tr>
<th>Summary</th>
<th>What measures?</th>
<th>How?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrocardiogram (ECG/EKG)</td>
<td>Heart rate</td>
<td>Direct; Electrodes placed on skin</td>
</tr>
<tr>
<td>Skin conductance (GSC/GSR)</td>
<td>Sweat</td>
<td>Indirect; Applied voltage or current and more sweat increases conductance</td>
</tr>
<tr>
<td>Electromyogram (EMG)</td>
<td>Muscular Movement/Contraction</td>
<td>Direct; Electrodes placed on skin</td>
</tr>
<tr>
<td>Respiration</td>
<td>Breathing frequency, tidal volume</td>
<td>Indirect; Transducer (measured by amount respiration belt moves)</td>
</tr>
<tr>
<td>Skin Temperature (SKT)</td>
<td>Skin Temperature</td>
<td>Indirect; Thermistor (resistance varies as function of SKT)</td>
</tr>
<tr>
<td>Finger/Ear Blood Pulse</td>
<td>Blood flow to periphery (ear, finger)</td>
<td>Indirect; Reflected Light on finger or ear lobe that bounces back when hits blood</td>
</tr>
</tbody>
</table>
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
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
<table>
<thead>
<tr>
<th>Emotion</th>
<th>ANS Basis</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anger</td>
<td>Vasodilation Pupils</td>
<td>Reddening in skin, Blood vessels bulge, Constriction</td>
</tr>
<tr>
<td>Fear</td>
<td>Vasoconstriction Sweat Glands</td>
<td>Pale/blanching, Sweaty, Clammy palms, Higher skin conductance</td>
</tr>
<tr>
<td>Sad</td>
<td>Lacrimal Glands</td>
<td>Tearing, Crying</td>
</tr>
<tr>
<td>Disgust</td>
<td>Salivary Glands</td>
<td>Salivate, Drool</td>
</tr>
</tbody>
</table>
Are there different patterns of autonomic nervous system activity for different emotions?

Positive Emotions
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<th>ANS Basis</th>
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<td>Fear</td>
<td>Vasoconstriction Sweat Glands</td>
<td>Pale/blanching sweating, Clammy palms Higher skin conductance</td>
</tr>
<tr>
<td>Sad</td>
<td>Lacrimal Glands</td>
<td>Tearing, Crying</td>
</tr>
<tr>
<td>Disgust</td>
<td>Salivary Glands</td>
<td>Salivate, Drool</td>
</tr>
<tr>
<td>Happiness</td>
<td>Vagus Nerve</td>
<td>Tightness in chest, Goosebumps</td>
</tr>
</tbody>
</table>
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 (RSArest) indexes important aspects of individual differences in emotionality. In the present investigation, the authors address whether RSArest is associated with tonic positive or negative emotionality, and whether RSArest relates to phasic emotional responding to discrete positive emotion-eliciting stimuli. Across an 8-month, multiassessments study of first-year university students (n = 80), individual differences in RSArest 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. RSArest 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?
<table>
<thead>
<tr>
<th></th>
<th>ENTHUSIASM</th>
<th>LOVE (attachment)</th>
<th>LOVE (nurturant)</th>
<th>AMUSEMENT</th>
<th>AWE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heart Rate (IBI)</strong></td>
<td></td>
<td>↑</td>
<td>↑</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PEP</strong></td>
<td></td>
<td></td>
<td></td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td><strong>SCR (GSR/GSC)</strong></td>
<td>↑</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>RESP</strong></td>
<td></td>
<td></td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td><strong>RSA</strong></td>
<td>↓</td>
<td>↓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MAP</strong></td>
<td></td>
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</tbody>
</table>

Shiota et al. (2011)
Roadmap

Course Logistics

Definitions and Measurement

Emotion Specificity

Emotion Coherence

Take-Away Qs & Expert Interview
What is an emotion: Six Features

Brief
Unbidden
Cross-Species
Coherent Really?
Fast
Automatic Appraisal/Evaluation

Paul Ekman UCSF
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?
<table>
<thead>
<tr>
<th></th>
<th>Amusement Facial Behavior</th>
<th>Cardio</th>
<th>SCL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amusement Experience</strong></td>
<td>.73*** [.89***]</td>
<td>.22*** [.25***]</td>
<td>.51*** [.57***]</td>
</tr>
<tr>
<td><strong>Amusement Behavior</strong></td>
<td></td>
<td>.34*** [.37***]</td>
<td>.47*** [.51***]</td>
</tr>
<tr>
<td><strong>Average Absolute r for Amusement</strong></td>
<td></td>
<td></td>
<td>.39 [.52]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Sadness Facial Behavior</th>
<th>Cardio</th>
<th>SCL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sadness Experience</strong></td>
<td>.74*** [.97***]</td>
<td>.00 [.00]</td>
<td>-.39*** [-.53***]</td>
</tr>
<tr>
<td><strong>Sadness Behavior</strong></td>
<td></td>
<td>-.05 [-.06]</td>
<td>-.52*** [-.58***]</td>
</tr>
<tr>
<td><strong>Average Absolute r for Sadness</strong></td>
<td></td>
<td></td>
<td>.36 [= .53]</td>
</tr>
</tbody>
</table>

**Upshot**

Moderate coherence on average

Highest between experience & behavior

Almost NO coherence between physiology and either experience or behavior

Mauss et al (2005)
<table>
<thead>
<tr>
<th>Controls</th>
<th>Dancers</th>
<th>Meditators</th>
</tr>
</thead>
<tbody>
<tr>
<td>COHERENCE between heart rate &amp; self-reported emotion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest</td>
<td>Middle</td>
<td>Highest</td>
</tr>
</tbody>
</table>
Roadmap

Course Logistics
Definitions and Measurement
Emotion Specificity
Emotion Coherence

Take-Away Qs & Expert Interview
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