A wee bit more Cardiovascular Psychophysiology …and then…

The Skeletomotor System

Announcements 3/1/21

- Lab: We meet on Wednesday (EKG/EMG)
- No Class Meeting March 8
- Research Paper/Project: Details next week

Questions and Feedback

My resting heart rate is quite high, and I am a small

Has the Valsalva maneuver been studied as a stress

Not a class related question but do you know if there is

I was very intrigued by QT syndrome causing sudden

I have submitted class questions/comments on the day

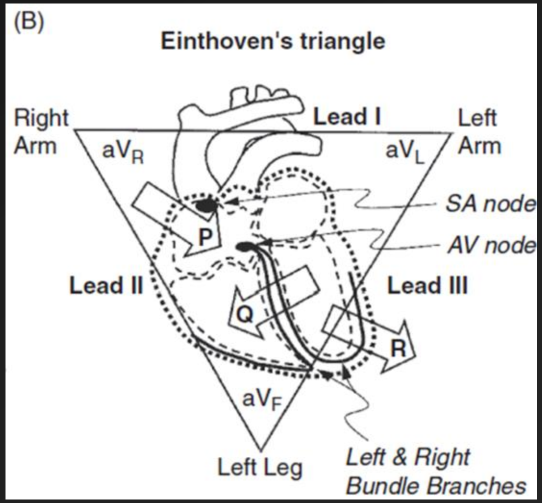
It seems like stress/threat is one of the easiest things to

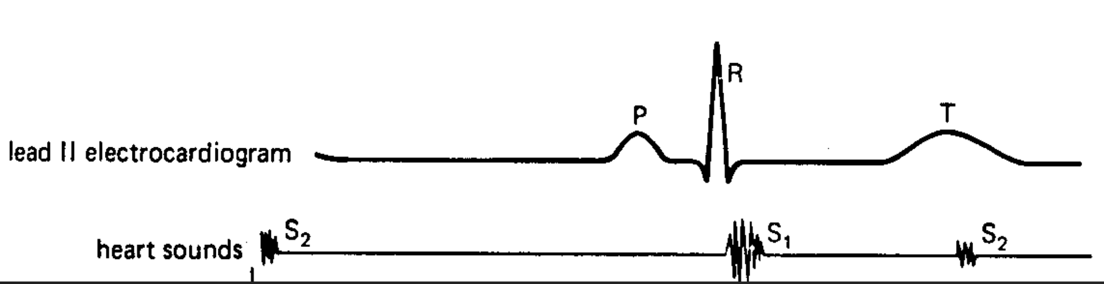
What are the mechanisms behind how people like Wim

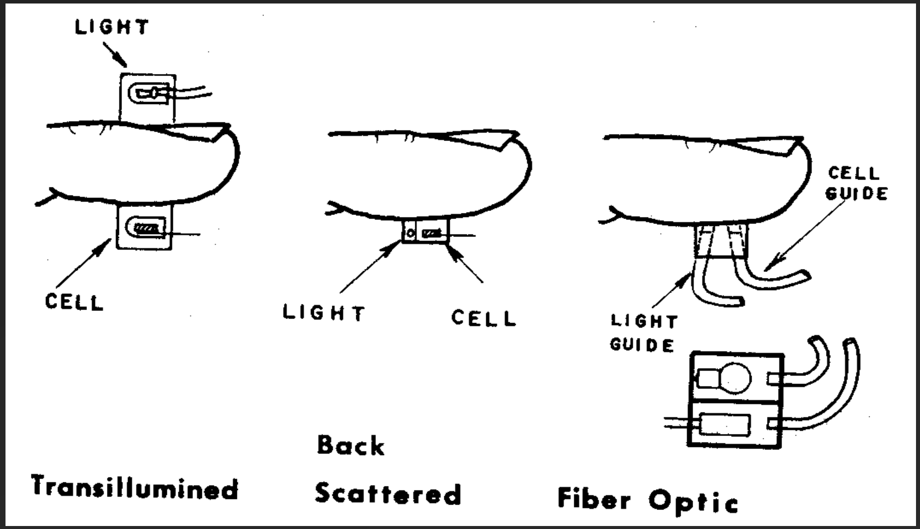
Returning to last time

Cardiovascular Measures

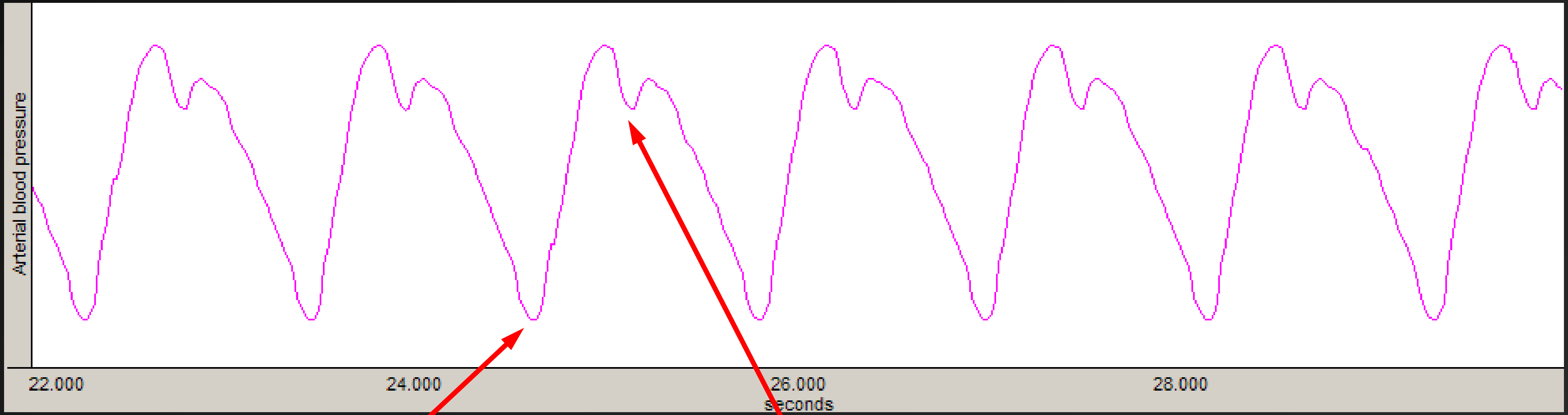
- Electrocardiogram (EKG)
- Phonocardiogram (PCG)
- Photoplethysmography
- Impedance cardiography
- Ballistocardiography
- Blood Pressure







The Photoplethysmographic Output

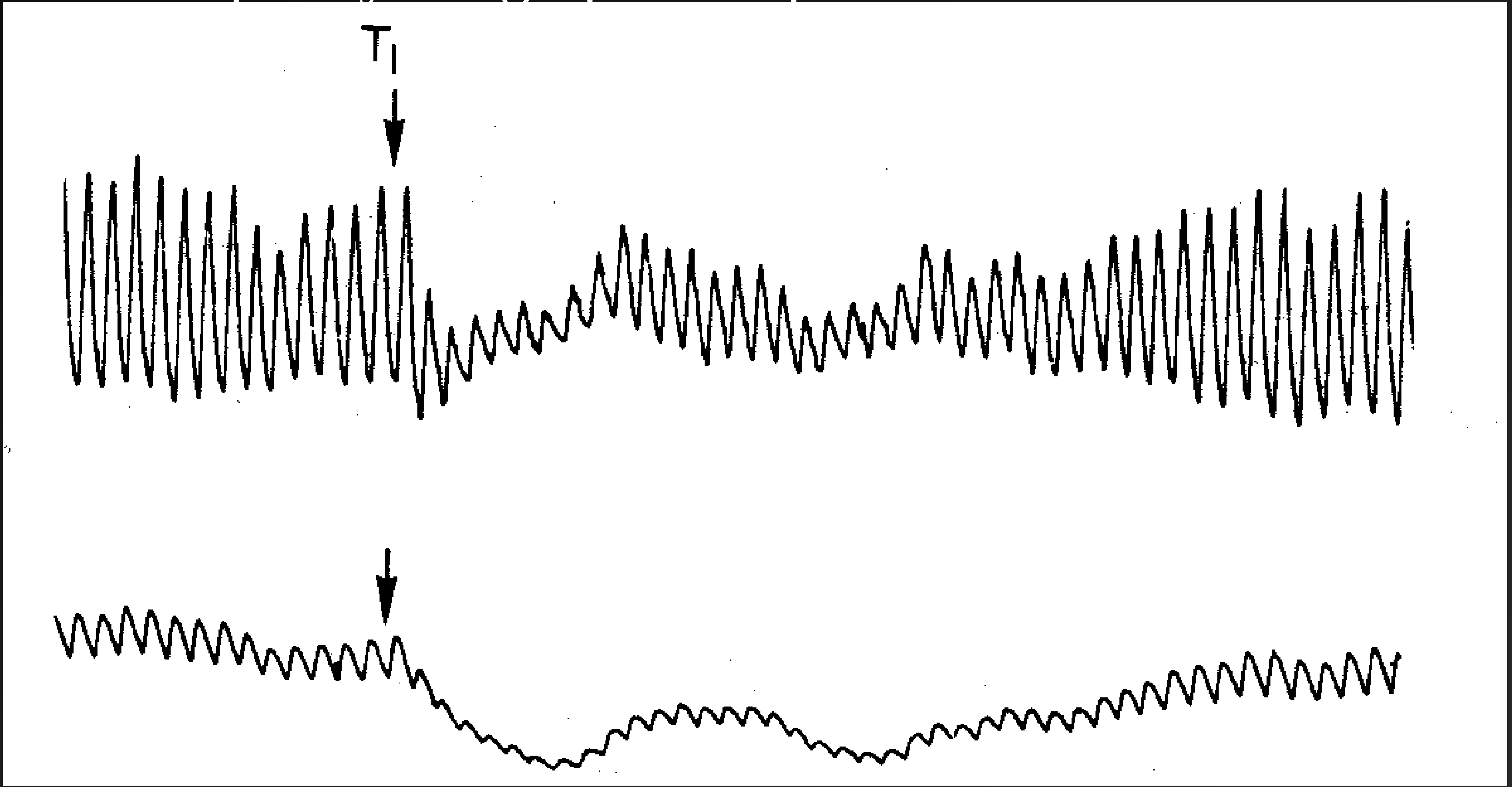


~LVET

Increase in Pressure due to opening of Aortic Valve

Dichrotic Notch; closing of valve, end of ejection

Photoplethysmograph: Peripheral Vasoconstriction

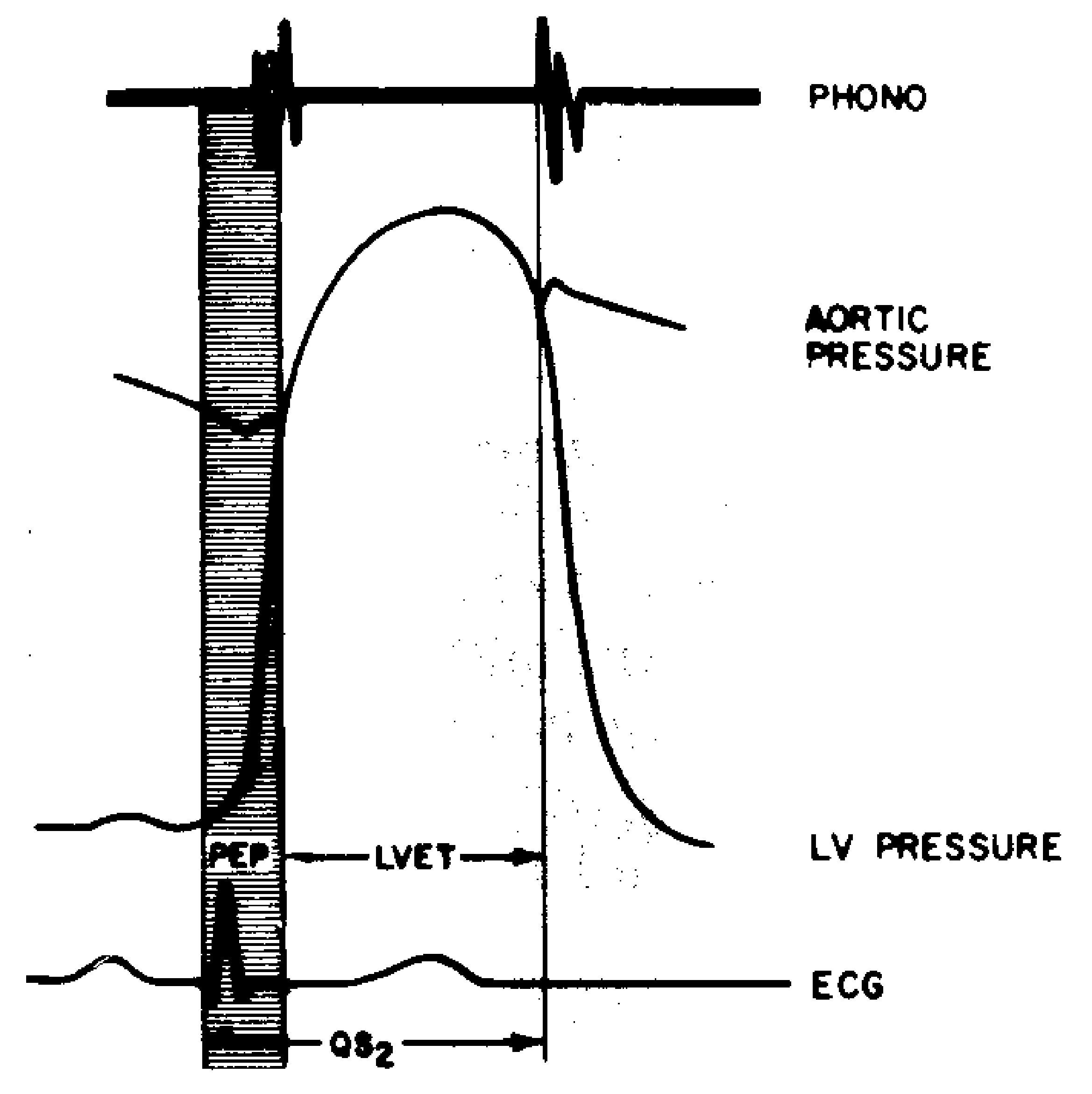


T1 is onset of constriction
Top Panel: Pulse Volume (recorded with 1 sec time constant)
Lower Panel: Blood Volume (no filter)

Measuring contractility with EKG, PCG, and Photoplethysmography

PEP = Pre-ejection period
LVET = Left Ventricular Ejection Time
= Upswing of pressure wave to S2
Electromechanical Systole = Q to S2
PEP = EMS – LVET

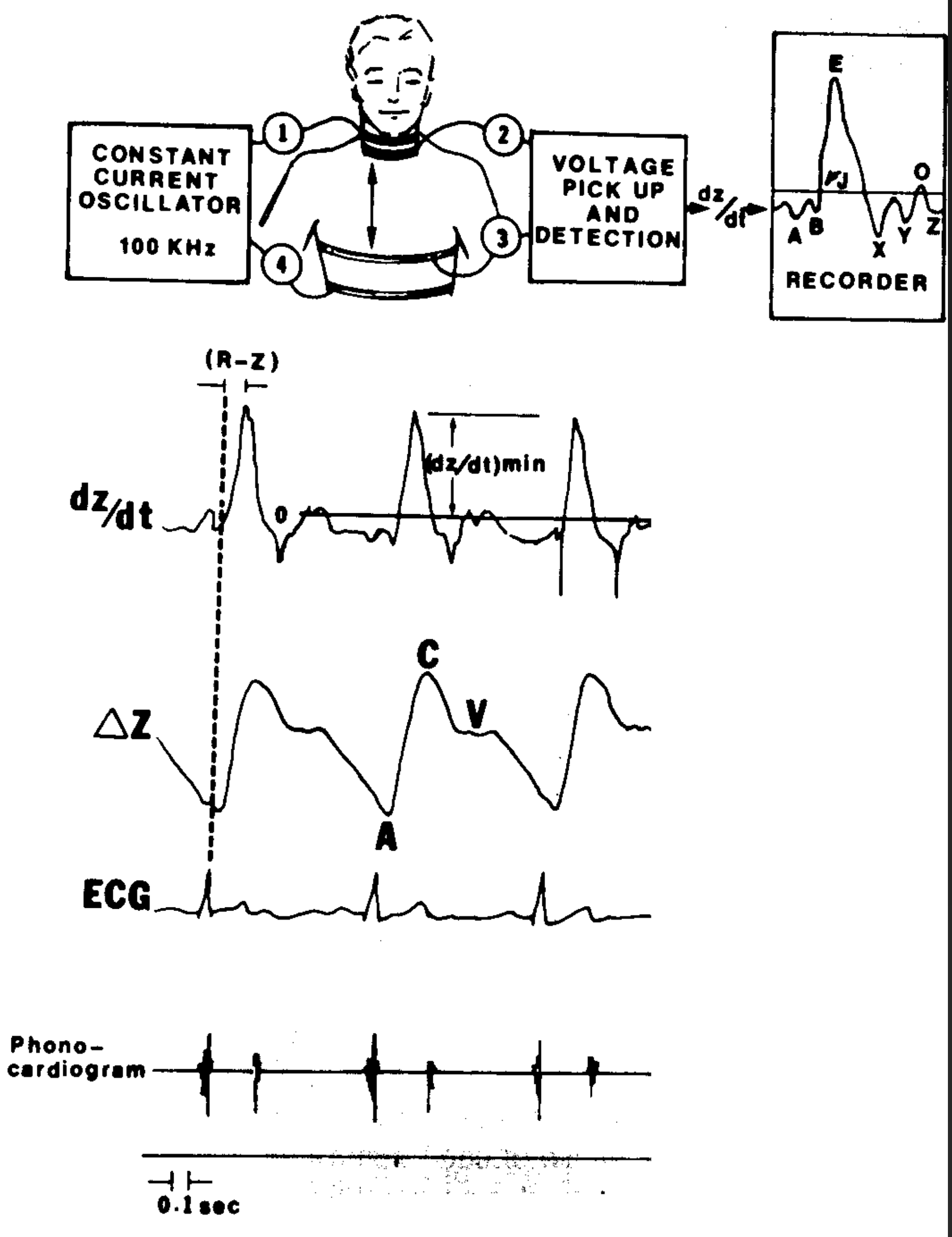
PEP reflects sympathetic influence on cardiac contractility



After Newlin & Levenson (1979) *Psychophysiology, 16*, 546-553

Impedance Cardiography

- Low energy high-frequency AC passed through thoracic region (1-4 mA, 100 KHz)
- Changes in impedance to signal created by mechanical events of cardiac cycle, especially changes in thoracic blood volume
- ΔZ is change in impedance
- Dz/dt is 1st derivative of impedance signal Z
- R-Z is time from r-wave to peak ventricular contraction indicated in Z signal
- The “Heather” index – divide dz/dt by R-Z interval; putative measure of heart’s ability to respond to stress



Ballistocardiography

- Imagine
  - On a chair on a platform on an air hockey table
  - Cardiac events cause movement of platform
- Applications:
  - Finding individuals hiding in vehicles
  - Finding individuals stuck in rubble
  - N er patients
    (L

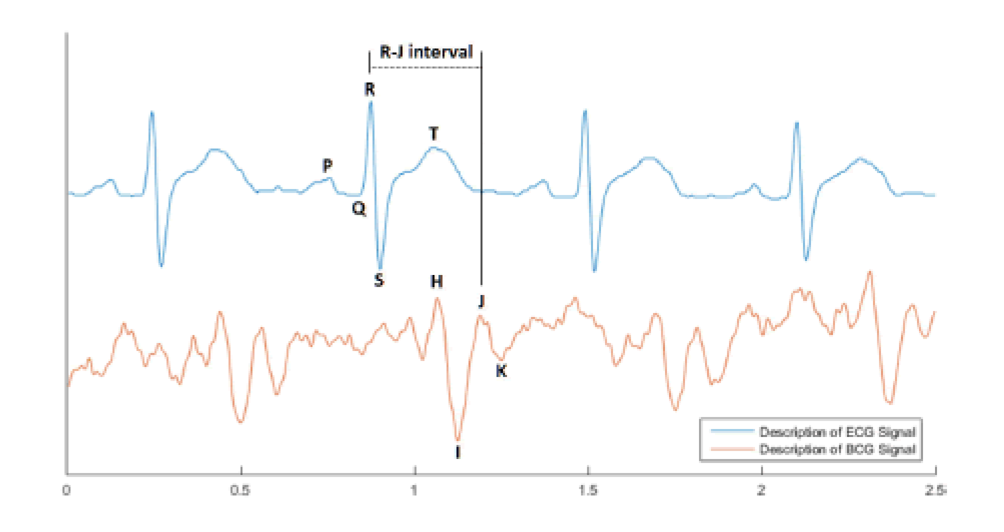
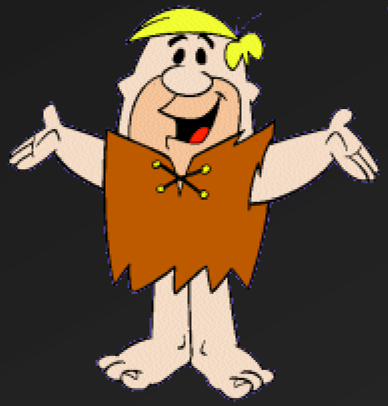
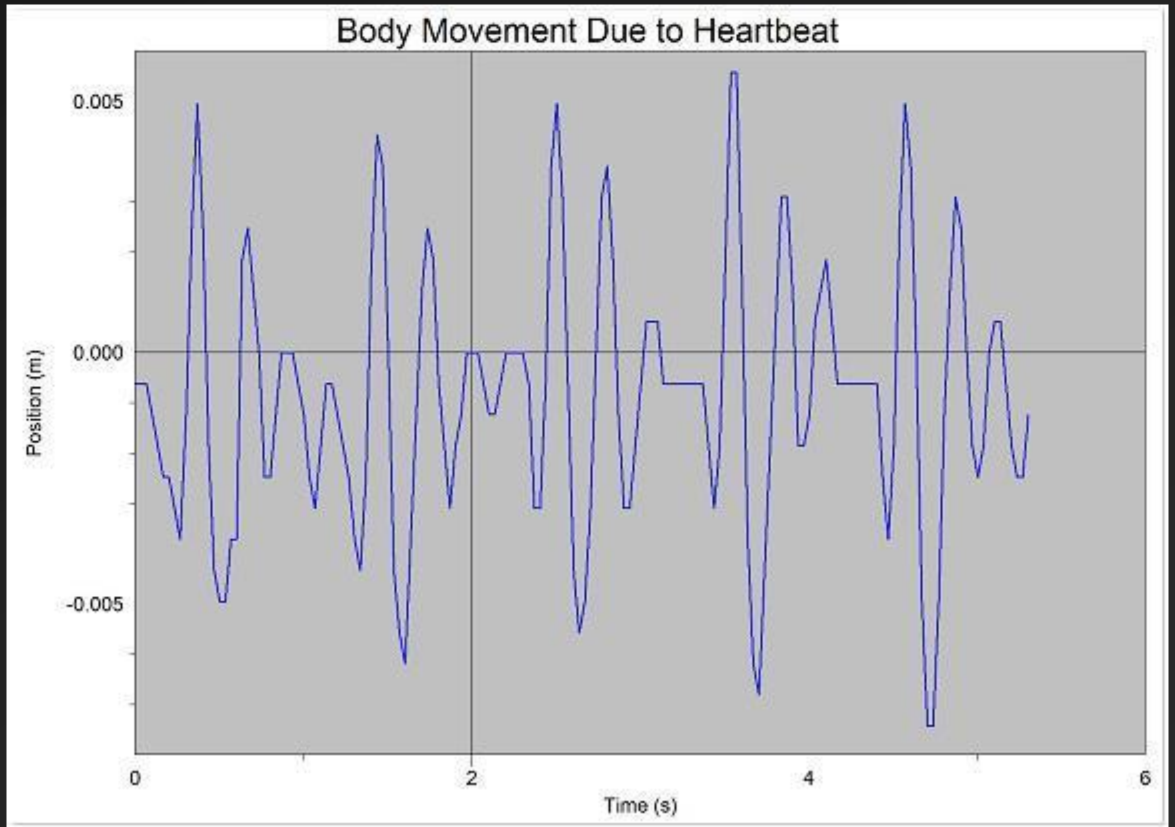


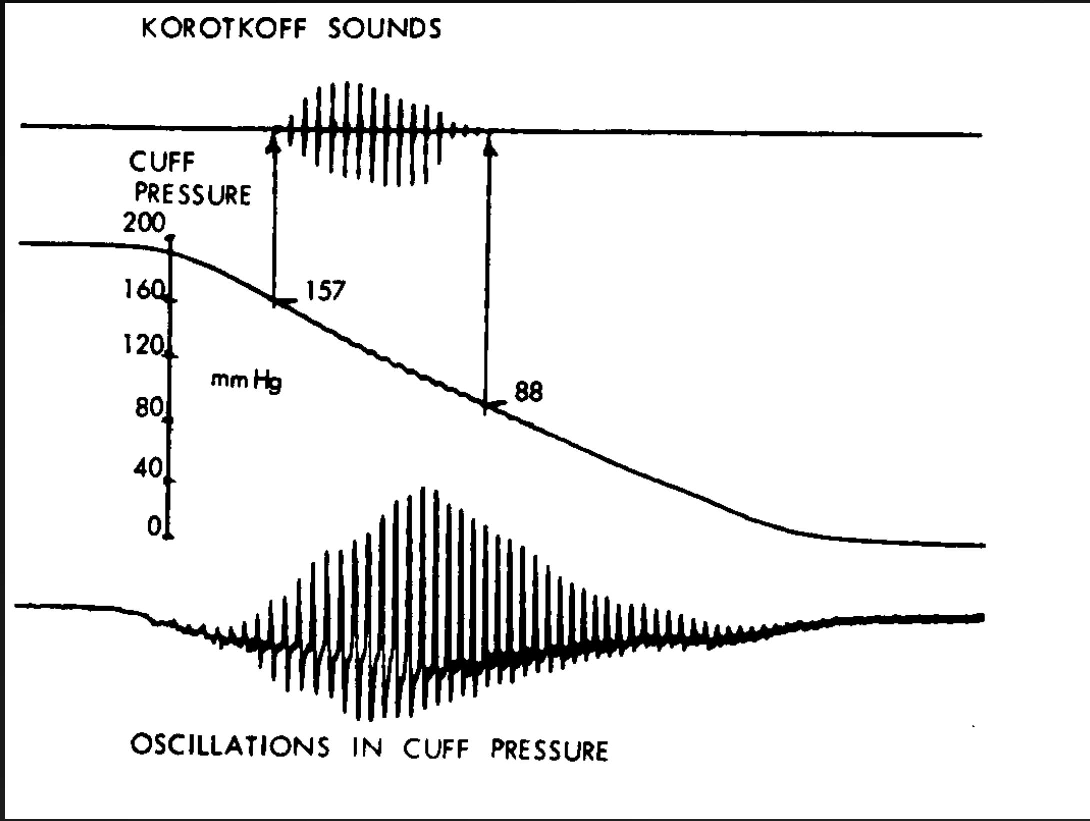
Figure 1. Location of P, Q, R, S, and T peaks in ECG and H, I, J, and K peak in BCG signal. The x-axis represents time [sec], and the y-axis is expressed in arbitrary units.

Ballistocardiography





Measuring Blood Pressure



Inflate cuff and then slowly deflate

As cuff pressure decreases below SBP, K-sounds will appear and slowly increase in volume

They will then decrease and finally disappear when cuff pressure reaches DBP

Auscultatory Technique
- Not good for instantaneous readings
- Not good for repeated readings

See also: https://www.youtube.com/watch?v=VJrLHePNDQ4

BP and Stress?

Psychophysiology, *45* (2008), 327–332. Blackwell Publishing Inc. Printed in the USA.

DOI: 10.1111/j.1469-8986.2007.00622.x

Cardiovascular effects in adolescents while they are playing video games: A potential health risk factor?

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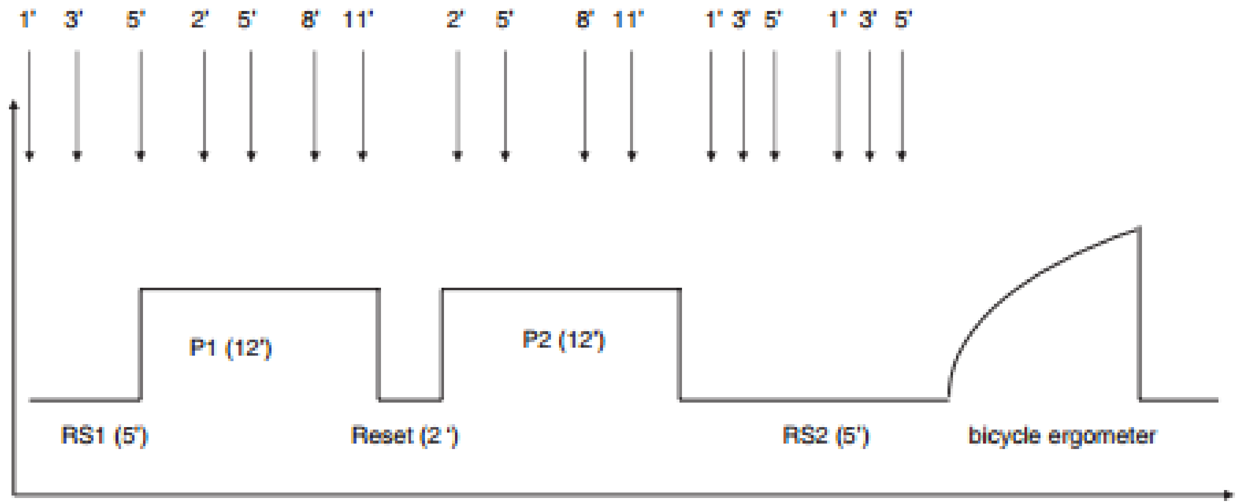


Fig 1. Study design (RS1, RS2 = resting phase 1 and 2; P1, P2 = video game phase 1 and 2; arrows indicating blood pressure measuring)

BP and Stress?

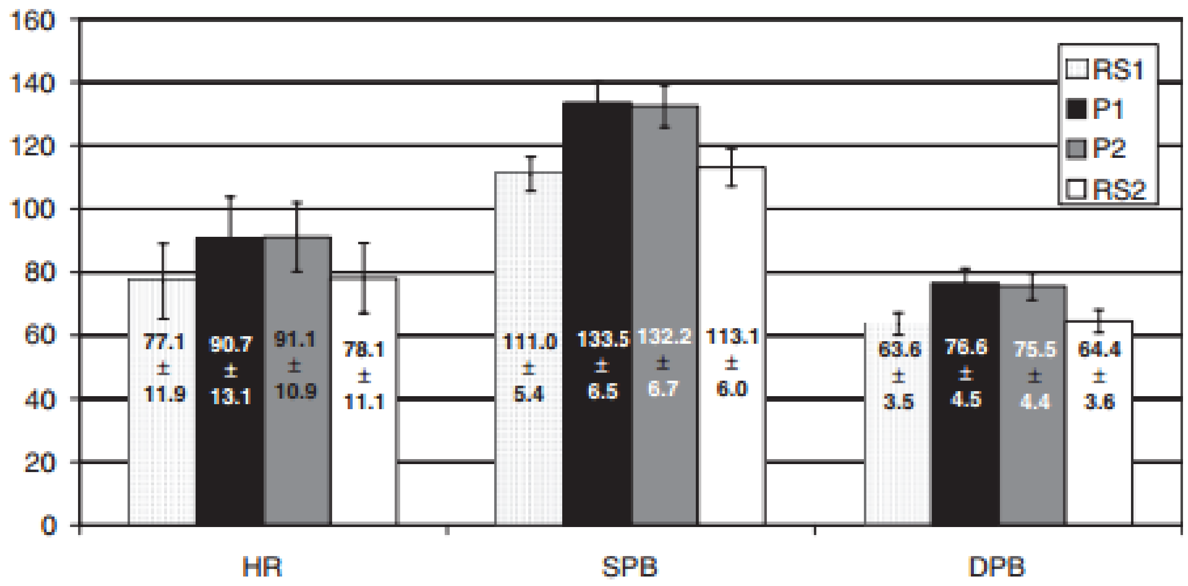


Fig 2. Mean values and SD of cardiovascular parameters during resting state and video game

Differences were significant for heart rate (HR), systolic (SBP) and diastolic blood pressure (DBP) comparing resting phases and game phases. No significant differences could be found comparing RS1 vs. RS2 and P1 vs. P2 (RS1, RS2 = resting phase 1 and 2; P1, P2 = video game phase 1 and 2).

- Significantly elevate BP during Video Game (VG)
- Energy consumption during Video Game unaltered compared to Rest, and significantly lower compared to Exercise!
- "Comparing all measured parameters it can be said that the relation of blood pressure and energy consumption during VG might not be favorable."

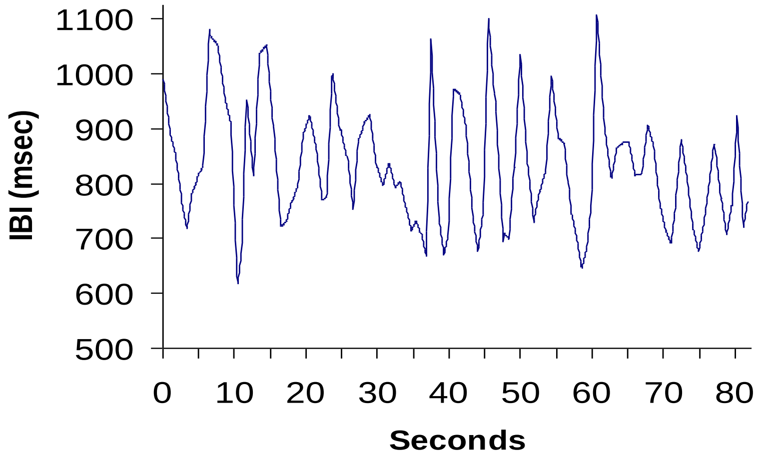
Stress, Exertion, or both?

https://www.youtube.com/watch?v=rMqVmilOwU4

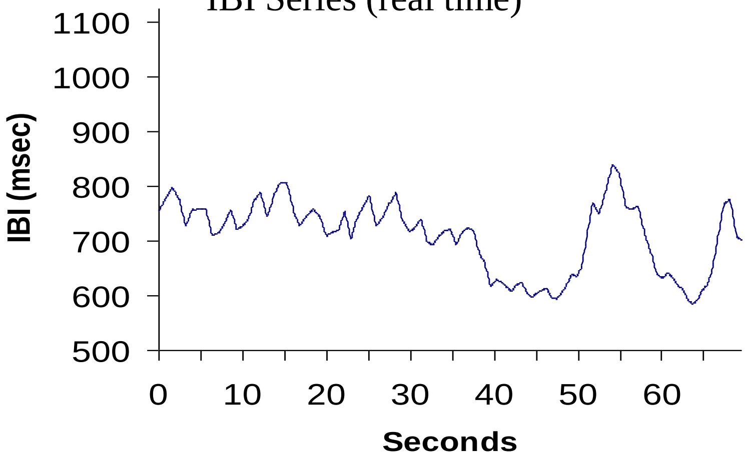
Measuring Vagal Influence

- Descending Vagal Influence slows HR
- Respiration interrupts this vagal influence
- The size of periodic oscillations due to respiration can therefore index the strength of the Vagal influence
  - Note, however, that under some circumstances, there can be dissociation between RSA and presumed central cardiac vagal efferent activity (cf., Grossman & Taylor, 2007)
  - Concerns over changes in rate, and to lesser extent depth
  - See special issue of *Biological Psychology*, 2007 for more in depth treatment of these issues and more!
- Demo with QRSTool

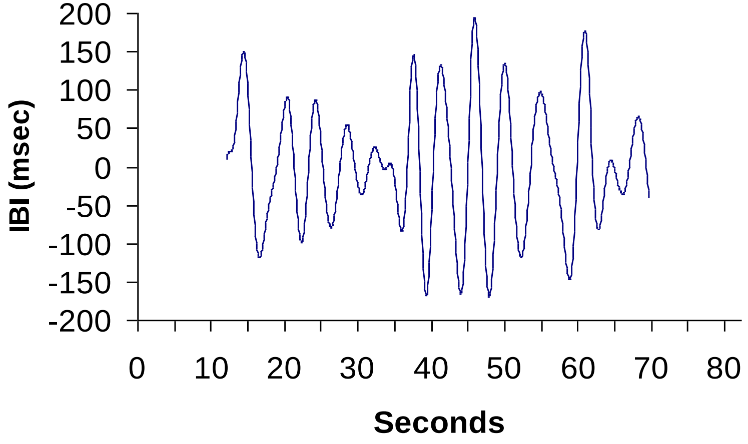
IBI Series (real time)



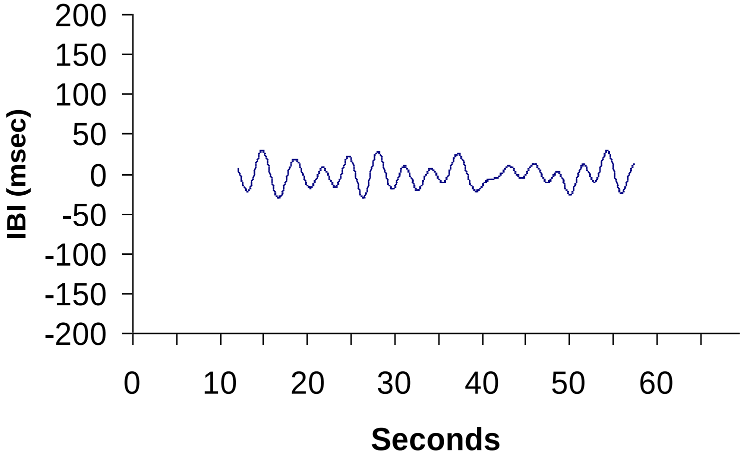
IBI Series (real time)

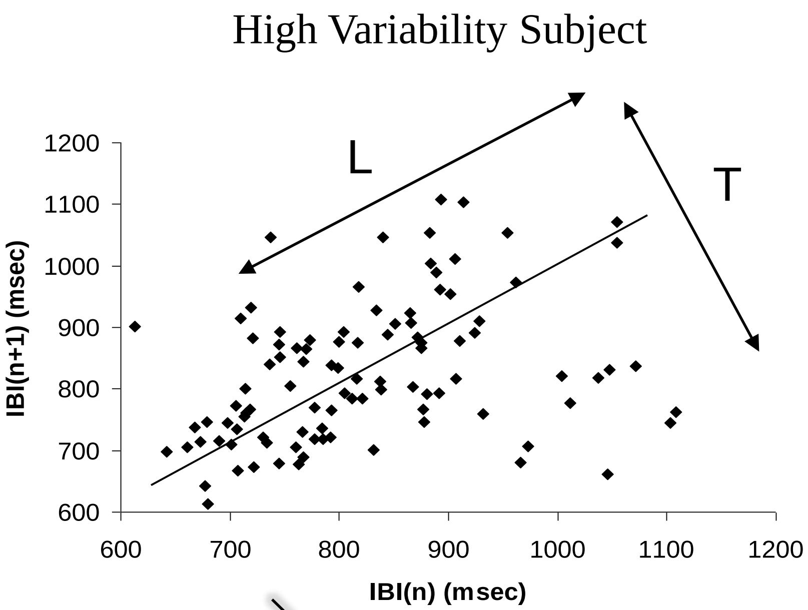


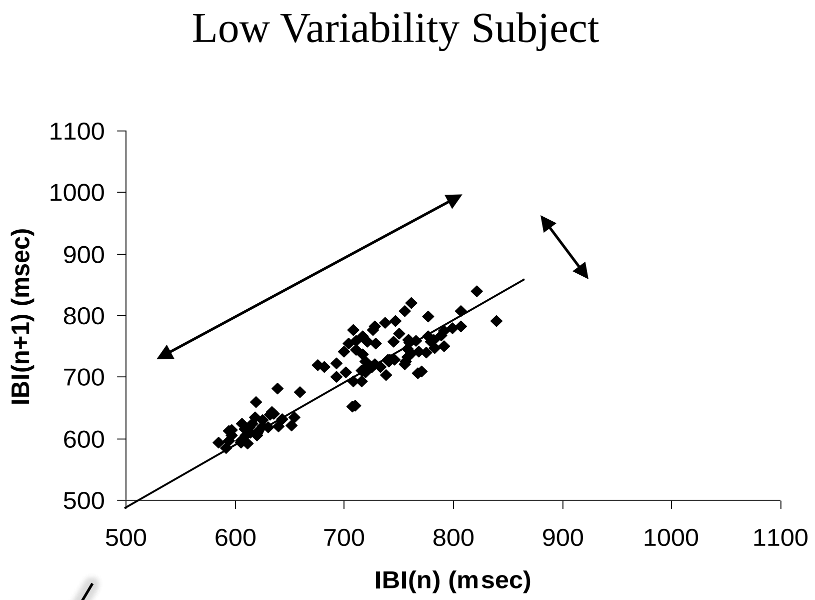
.12-.40 Hz filtered IBI Time Series



.12-.40 Hz filtered IBI Time Series







	Rate	
73.3	HR	85.7
832.3	IBI	707.7
	Total Variability	
9.2	HRV	8.3
112.4	SDNN	66.3
132.8	RMSSD	27.7
	"Sympathetic"	
1.4	CSI	4.7
	"Parasympathetic"	
57.1	PNN50	10.8
97.6	MSD	22.0
5.3	CVI	4.5
8.8	RSA	5.3

Metrics output by CMetX, with notes concerning computation

Metrics of rate, which are influenced by both parasympathetic (PNS) and sympathetic (SNS) influences

- Mean interbeat interval (IBI), calculated as simple average of IBIs
- Mean heart rate (HR), calculated as the average of the rate-transformed IBIs, not as the rate-transformation of the average IBI

Metrics summarizing total heart rate variability, which are influenced by both SNS and PNS

- Heart rate variability (HRV), operationalized as the natural log of the variance of the IBI time series
- Standard deviation of IBI series (SDNN); NN in the acronym SDNN is the abbreviation for "normal-to-normal intervals," which is the artifact-free IBI series
- Root mean square of successive differences between IBIs (RMSSD)

Putative sympathetic metric

- A cardiac sympathetic index (CSI; Toichi et al. (1997), see Fig. 1)[a]

Putative parasympathetic metrics

- Mean absolute successive IBI difference (MSD)
- Proportion of consecutive IBI differences >50 ms (pnn50)
- Respiratory sinus arrhythmia (RSA), defined as natural log of band-limited (.12–.40 Hz) variance of IBI time series
- A cardiac vagal index (CVI; Toichi et al. (1997), see Fig. 1)[a]

Spectral approaches

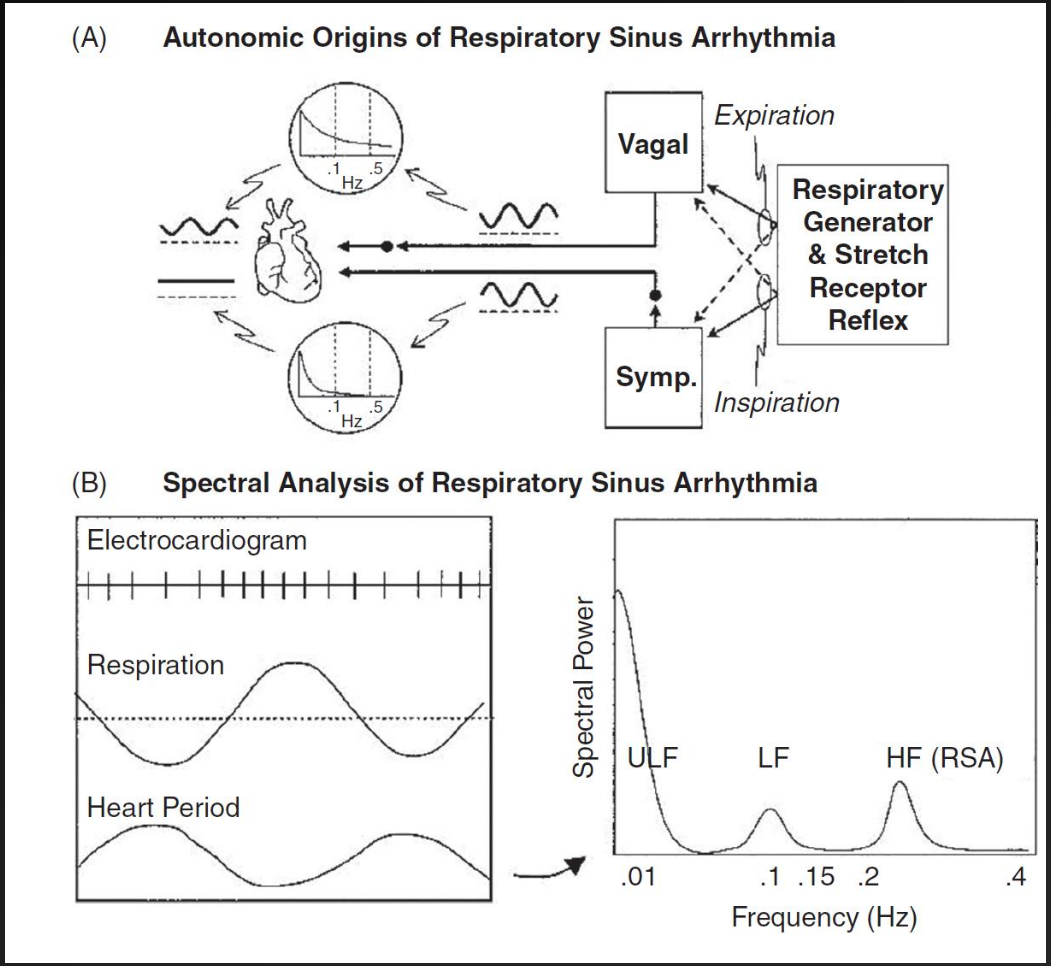
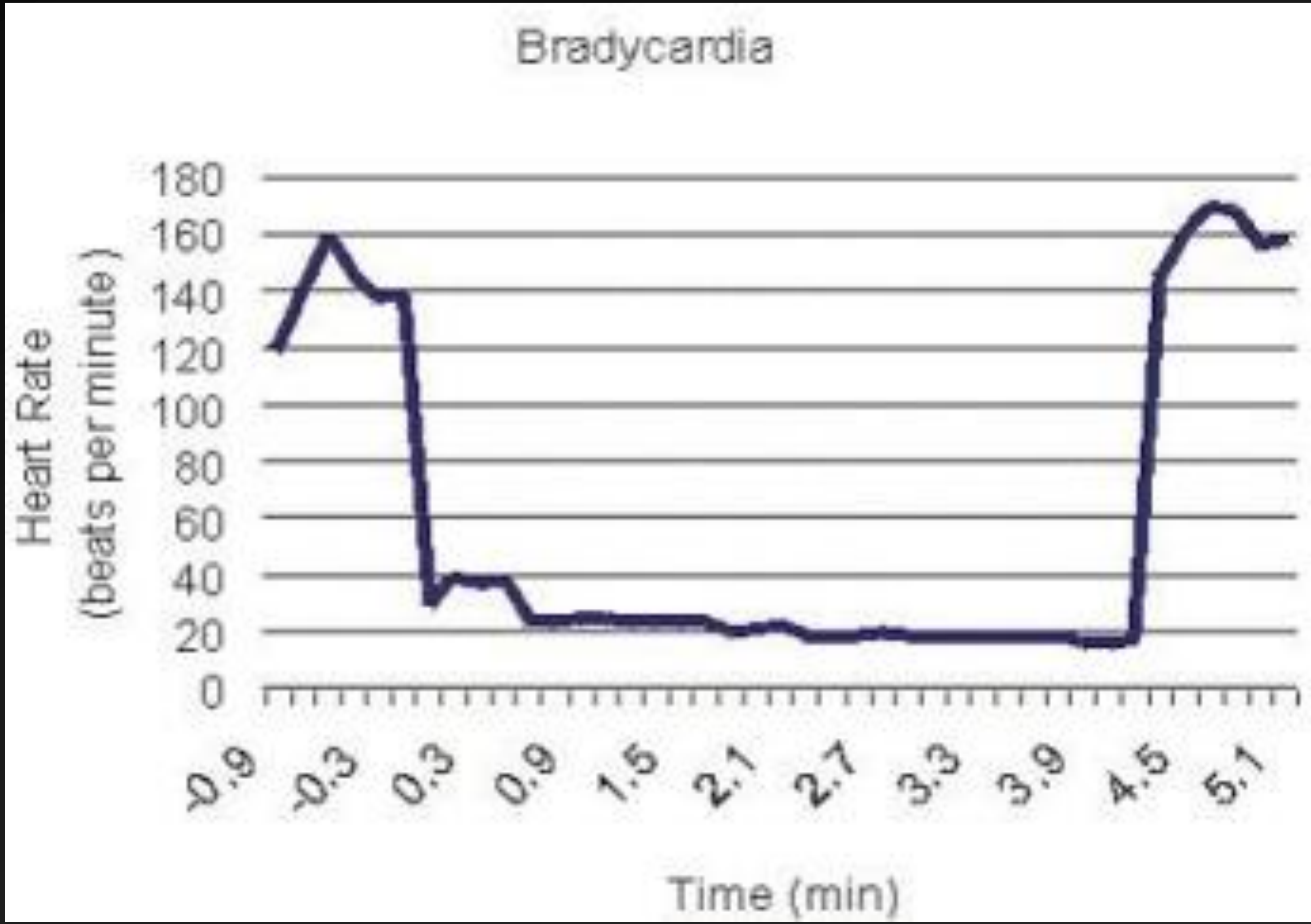


Figure 9.10 Respiratory sinus arrhythmia (RSA). (A) Neurophysiological generators of RSA. Respiratory rhythms are apparent in both sympathetic and parasympathetic nerves, but the different transfer functions (inserts) allow the parasympathetic but not the sympathetic innervations to impart a respiratory rhythm to the beat of the heart. (B) Illustrations of the relation between respiration and heart period, and its quantification by spectral analysis. ULF = ultra-low frequency; LF = low frequency, HF = high frequency.

Cardiac Vagal Control and Modulation

- Two Vagal Efferent Branches which terminate on SA Node (Porges 1995, 2003, 2007)
  - Reptilian “Dumb”: Dorsal Motor Nucleus
    - Massive reduction in HR & conservation of oxygen.
    - Dive reflex -- cold water on the face during breath hold
  - Phylogentically newer “smart” Vagus
    - Orginates from Nucleus Ambiguous
    - Modualtes influence to:
      - Promote attentional engagement, emotional expression, and communication.
    - Mobilizes organism to respond to environmental demands
      - Phasicly withdraws inhibitory influence, increasing HR
      - Upon removal of the environmental stressor, resumes its efferent signal
        - Slowing heart rate
        - Allows the organism to self-sooth
- This polyvagal theory is not without its critics (e.g., Grossman & Taylor, 2007).



Bradycardia observed in a diving seal. **Data adapted from R.S. Elsner (1998), courtesy of http://www.deeperblue.net/article.php/225**

	ANS Component	Behavioral Function	Lower motor neurons
III	Myelinated vagus *(ventral vagal complex)*	Social communication, self-soothing and calming, inhibit "arousal"	Nucleus ambiguus
II	Sympathetic-adrenal system	Mobilization (active avoidance)	Spinal cord
I	Unmeyelinated vagus *(dorsal vagal complex)*	Immobilization (death feigning, passive avoidance)	Dorsal motor nucleus of the vagus

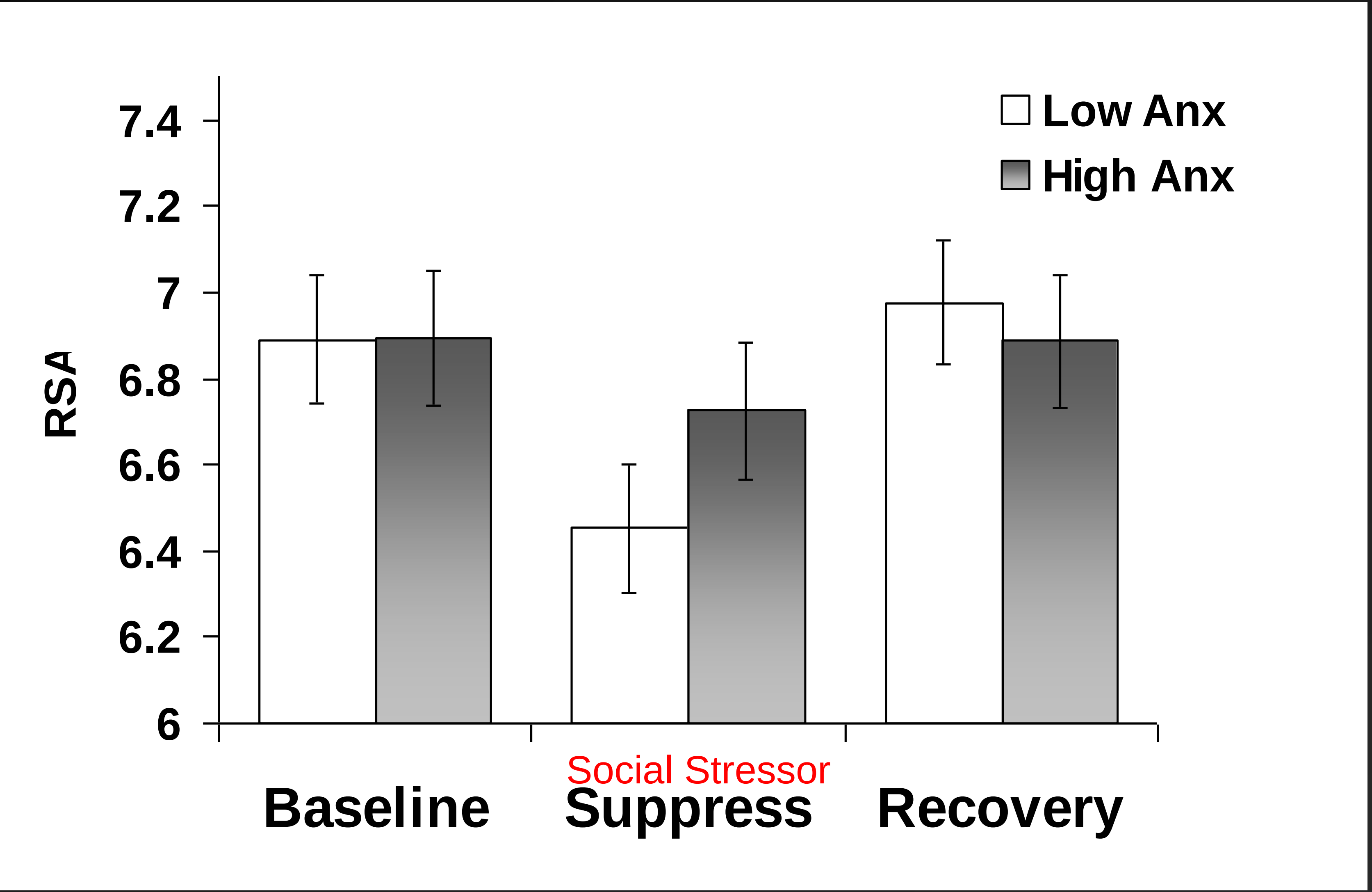
Fig. 1. Phylogenetic stages of the polyvagal theory.

Porges, 2007

Tonic Vs Phasic

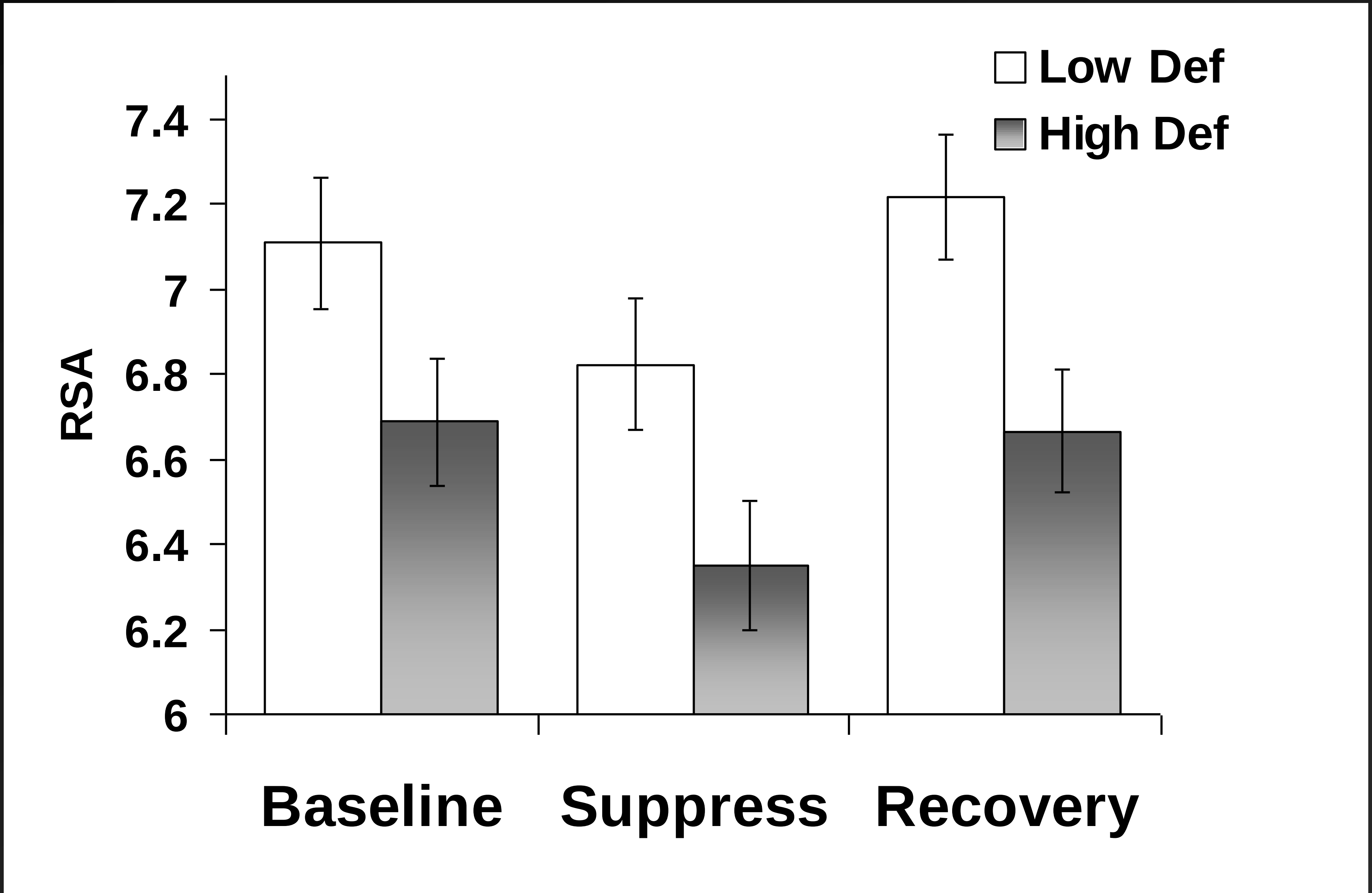
- Tonic Level indexes capacity
- Phasic change indexes actualization of that capacity
- Attention
  - higher vagal “tone” was associated with faster reaction time to a task requiring sustained attention
  - Hyperactive kids treated with Ritalin (Porges, Walter, Korb, & Sprague, 1975).
    - attentional skills improved
    - appropriate task-related suppression of heart rate variability was observed while performing the task requiring sustained attention
- Emotion
  - Beauchaine (2001):
    - low baseline vagal “tone” is related to negative emotional traits
    - high vagal withdrawal is related to negative emotional states

Task-related and Emotion-related modulation



Movius & Allen, 2005

Vagal Control and Defensive Coping



Movius & Allen, 2005

Individual Differences in Cardiac Vagal Control (aka "Trait Vagal Tone")

- Infants
  - Various sick infants have lower vagal tone (Respiratory Distress Syndrome, Hydrocephalic)
  - Infants with higher vagal tone (Porges, various years)
    - More emotionally reactive (both + & -)
    - More responsive to environmental stimuli (behaviorally and physiologically)
- Anxiety Disorders
  - Lower Vagal Tone in GAD (Thayer et al., 1996)
  - Lower Vagal Tone in Panic Disorder (Friedman & Thayer, 1998)
- Depression
  - Depression characterized by lower Vagal tone?
  - State dependent? (Chambers & Allen, 2002)

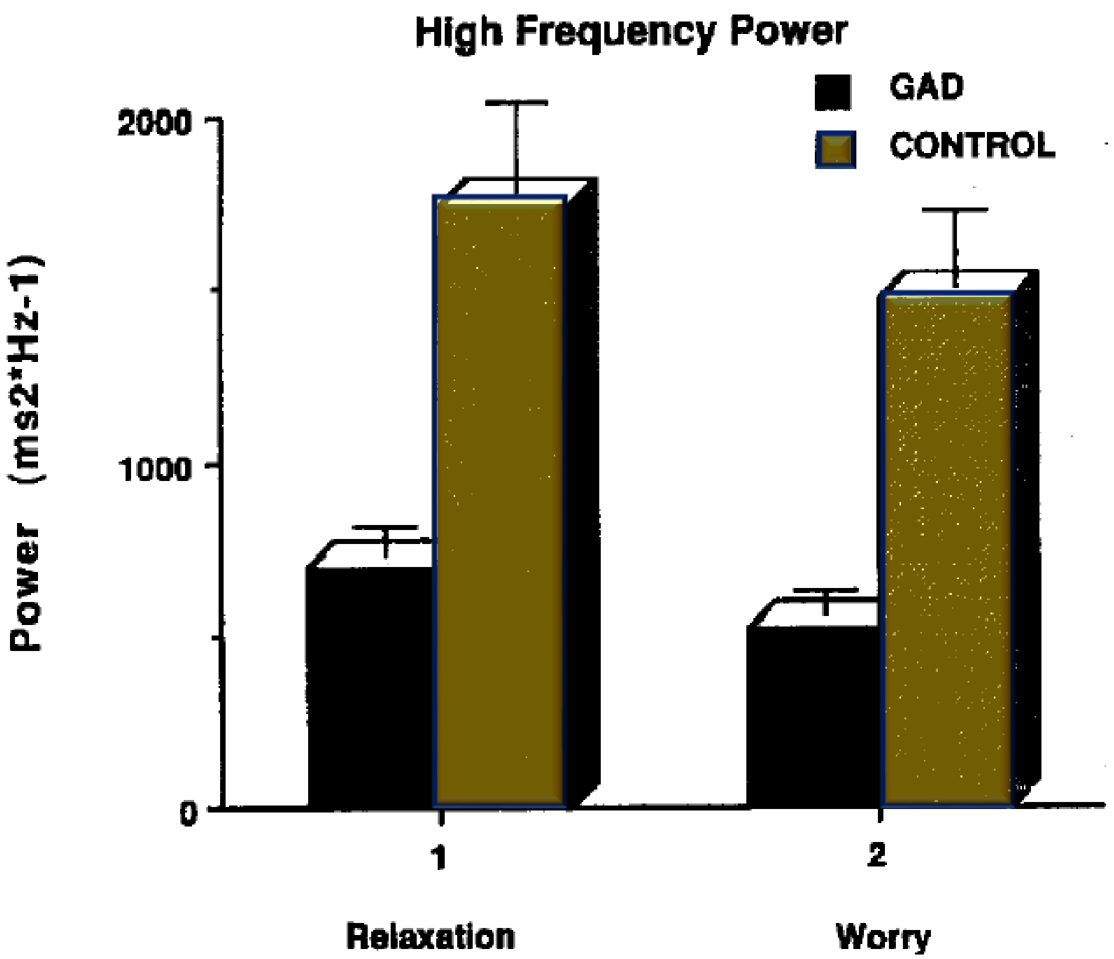
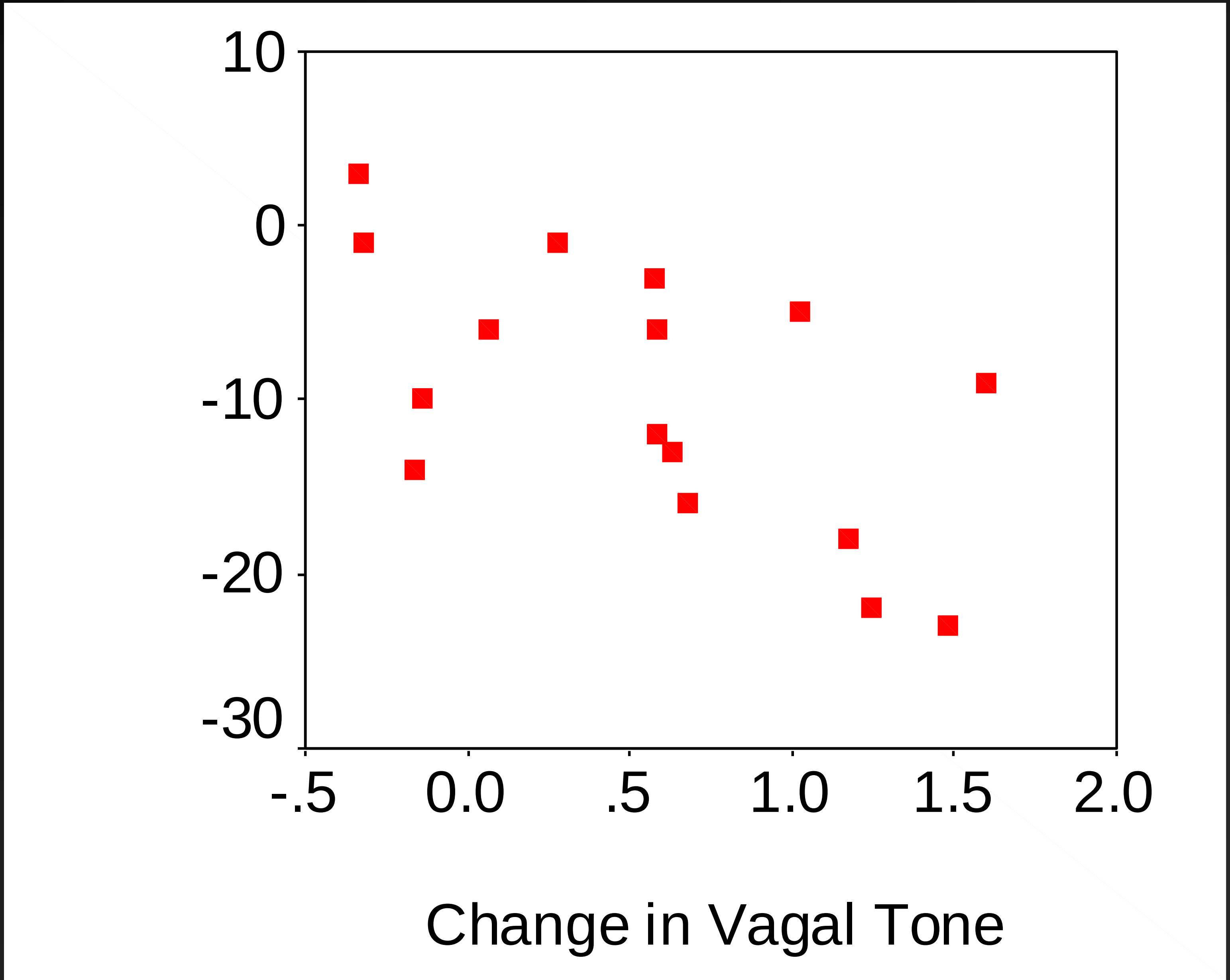


Figure 1. Power in the high frequency (respiratory) component of heart period variability in GAD patients and controls during relaxation and worry.

Table 1
Significant contrasts among panickers, blood phobics, and controls

Variable	Panic (mean, S.D.)	Blood phobic (mean, S.D.)	Control (mean, S.D.)	*T* ratio, df, *p* value
IBI (ms)	761.8 (141.0)	837.1 (92.4)	905.2 (132.5)	P < B 4.59 (215) $p<0.001$ P < C 7.65 (214) $p<0.001$ B < C 4.30 (207) $p<0.001$
VAR (ms^2)	3942 (4009)	4334 (2663)	6112 (4563)	P < C 3.70 (214) $p<0.001$ B < C 3.44 (207) $p<0.001$ P = B N.S.
MSD (ms)	44.4 (31.2)	55.6 (22.7)	71.4 (32.1)	P < B 3.05 (215) $p<0.001$ P < C 6.34 (214) $p<0.001$ B < C 4.11 (207) $p<0.001$
HF power (ms^2 Hz^{-1})	991 (1225)	1385 (1073)	2239 (1911)	P < B 2.49 (212) $p<0.01$ P < C 5.67 (212) $p<0.001$ B < C 3.90 (203) $p<0.001$
LF/HF	2.1(2.5)	1.3 (1.8)	1.0 (1.5)	P < B 2.41 (209) $p<0.005$ P < C 3.64 (203) $p<0.001$ B = C N.S.

P, panic; B, blood phobic; C, control.



Chambers and Allen (2002) *Psychophysiology*

Can Vagal Control predict development of anxiety following stressors?

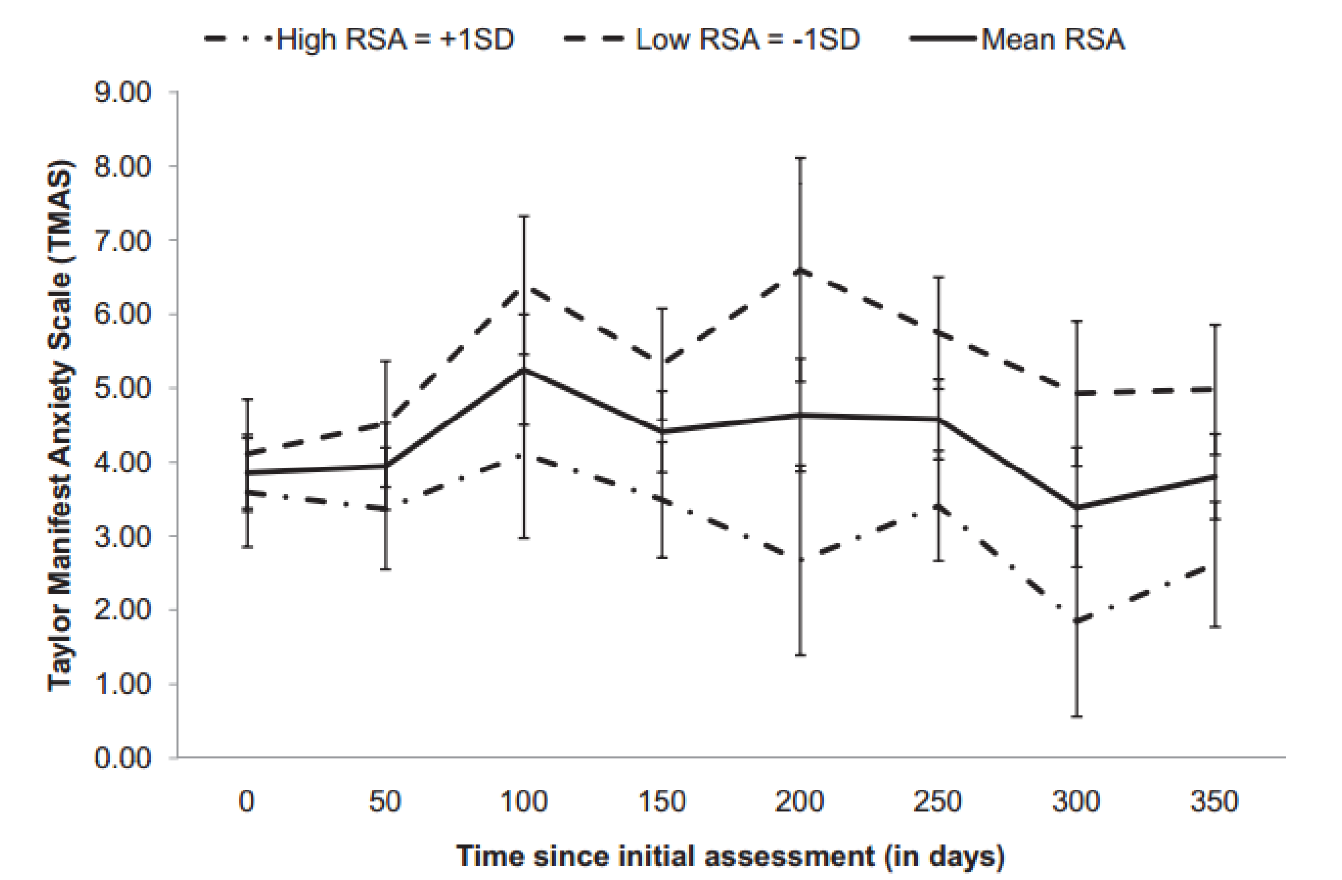


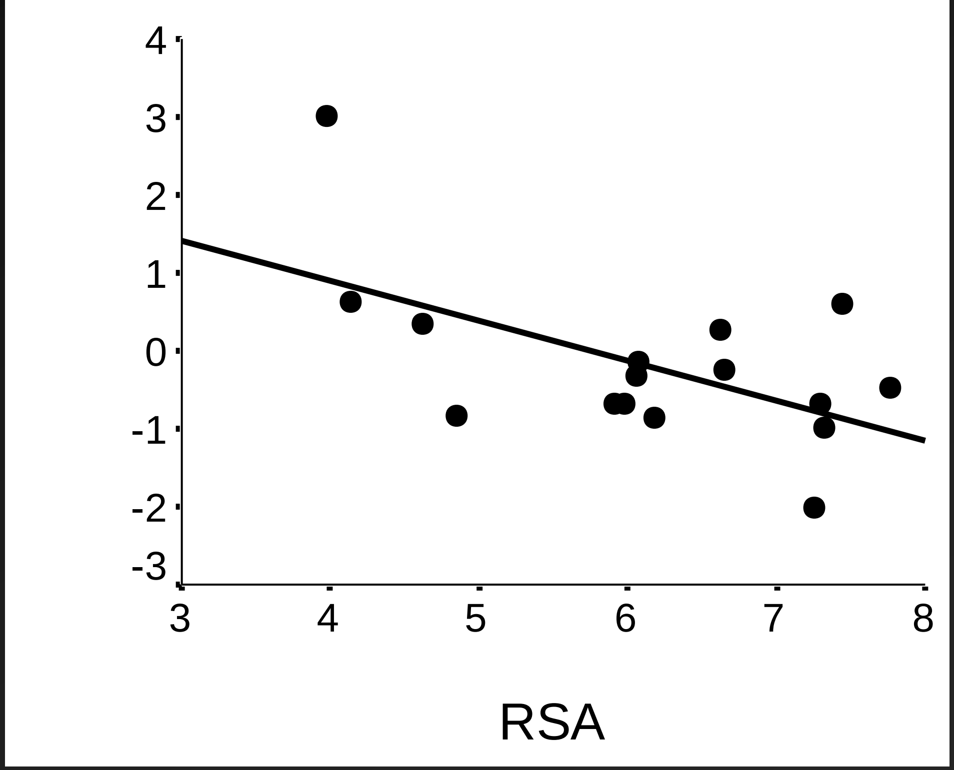
Fig. 1. Effect of the interaction between RSA adjusted for age and Time since initial assessment on TMAS over a 1-year period. Although RSA is a continuous variable, for illustrative purposes, its effect on TMAS is plotted at ±1 SD from the mean. Error bars represent standard errors. RSA: respiratory sinus arrhythmia; SD: standard deviation; TMAS: Taylor Manifest Anxiety Scale.

Kogan, Allen, Weihs (2012)
Biological Psychology

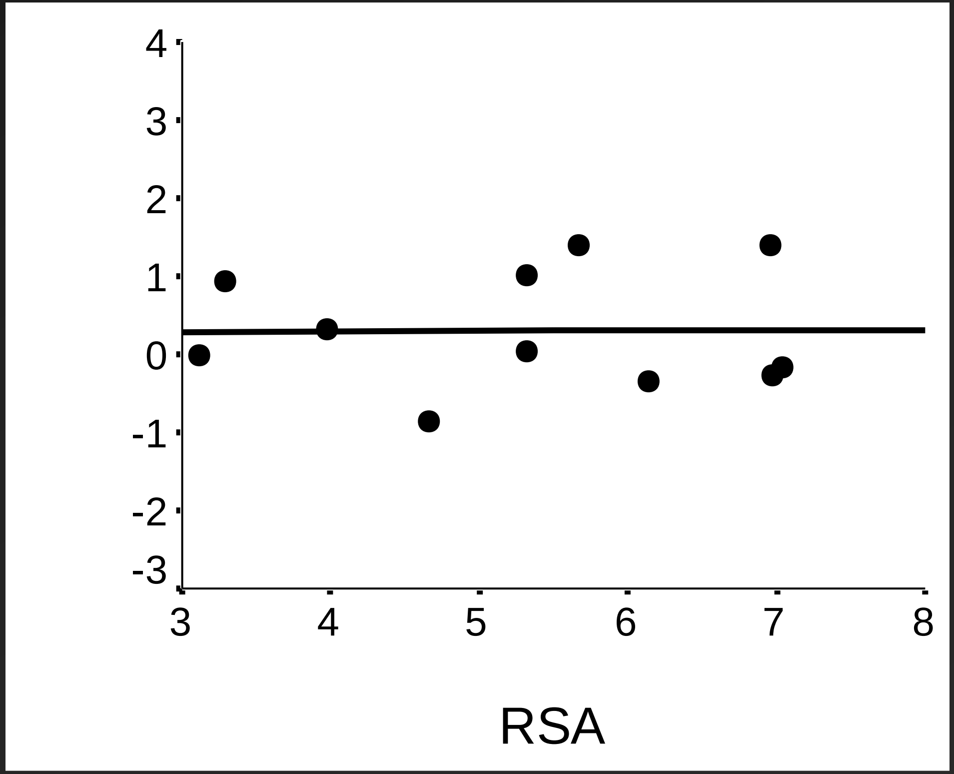
Trait Vagal Tone as Moderator of Response following Bereavement

- Bereavement as a period of cardiovascular risk
- Disclosure as an intervention for Bereavement (O'Connor, Allen, Kaszniak, 2005)
- Overall, all folks get better, but no differential impact of intervention
- BUT… Vagal Tone as moderator

Intervention Group



Control Group



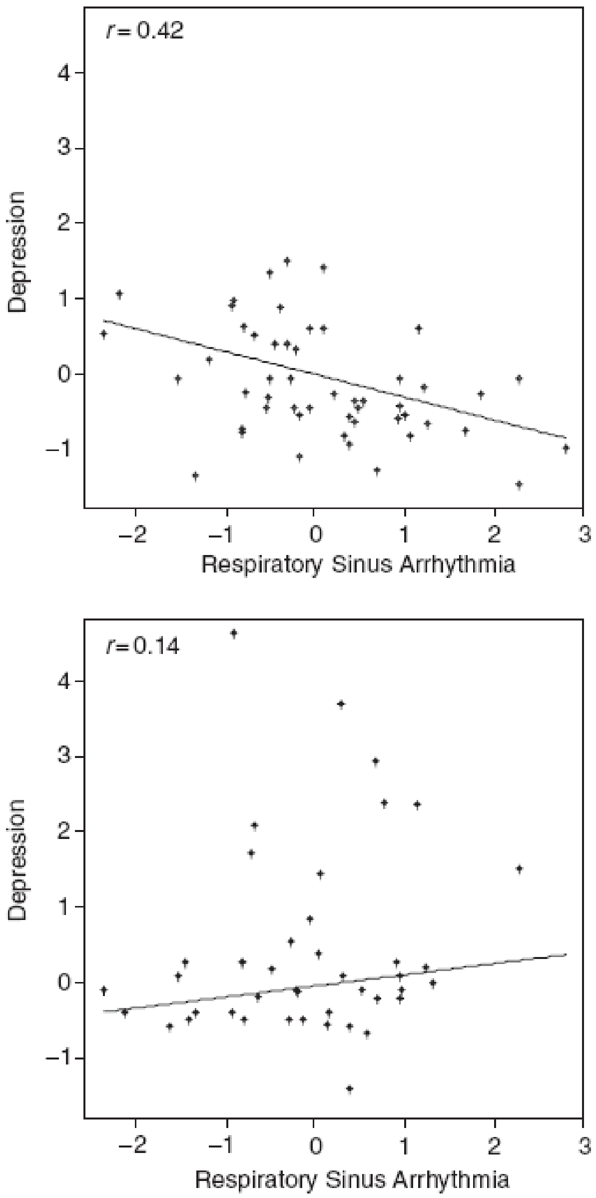


Figure 1. Scatterplot, prediction line, and prediction equation for the relationship between respiratory sinus arrhythmia (log of the variance of the band-limited [.12–.40 Hz] IBI series) and depression score (residualized on baseline depression score), for the disclosure group (top panel) and the control group (bottom panel). Negative depression score represents improvement from baseline to follow-up.

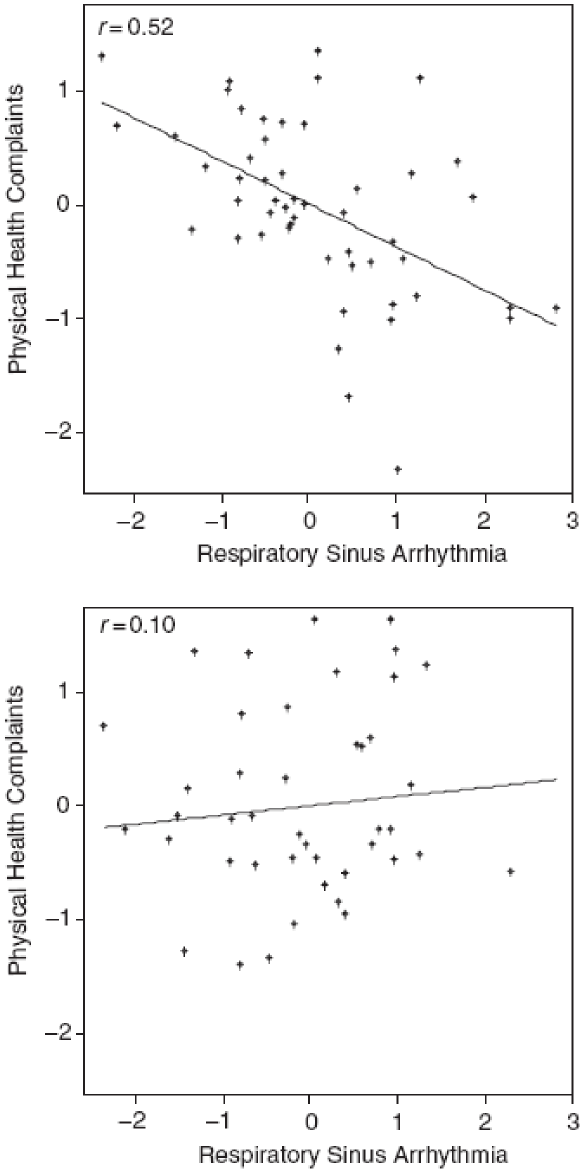
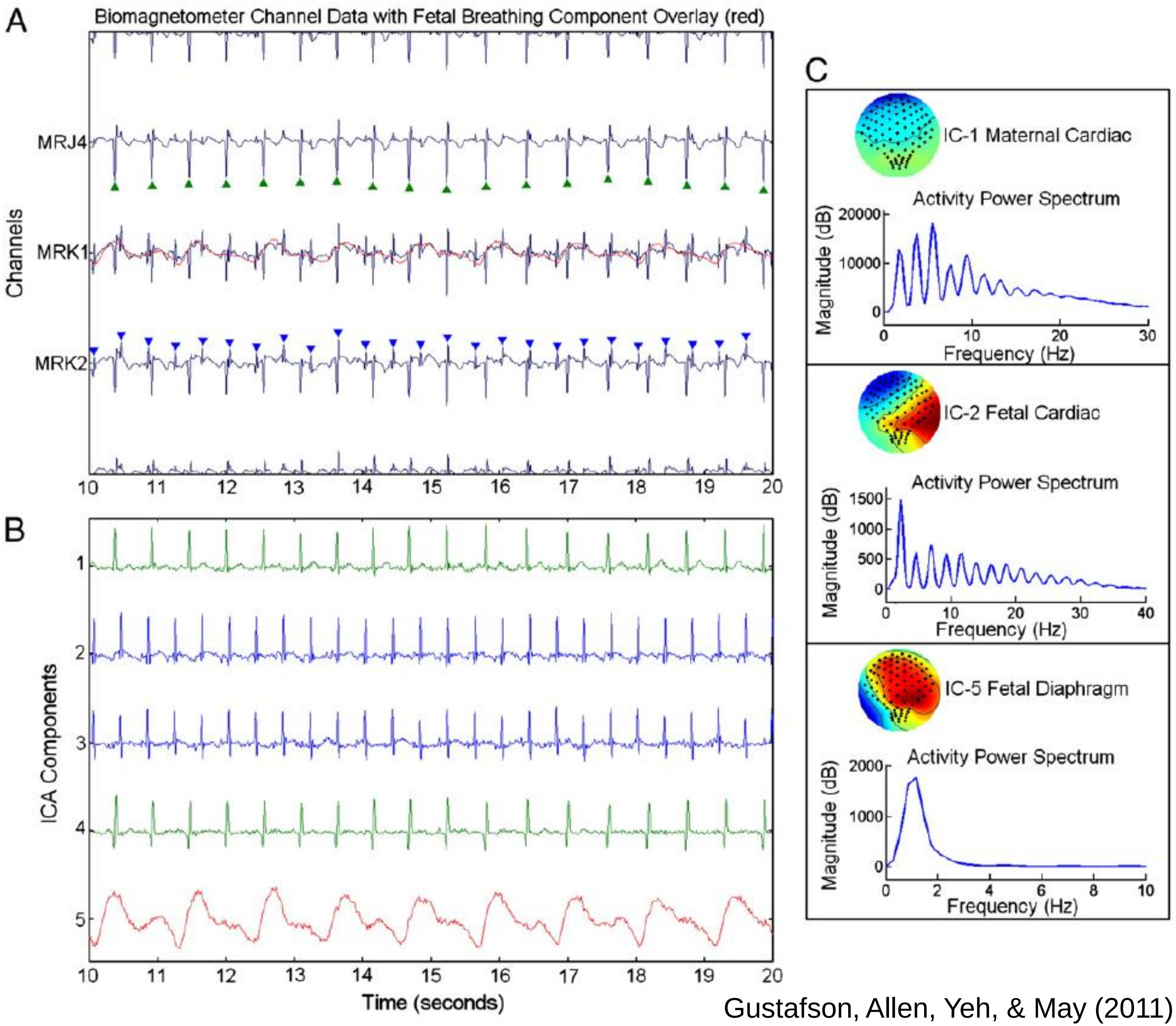


Figure 2. Scatterplot, prediction line, and prediction equation for the relationship between respiratory sinus arrhythmia (log of the variance of the band-limited [.12–.40 Hz] IBI series) and physical health complaint score (residualized on baseline physical health complaints score) for the disclosure group (top panel) and the control group (bottom panel). Negative physical health complaint score represents improvement from baseline to follow-up.

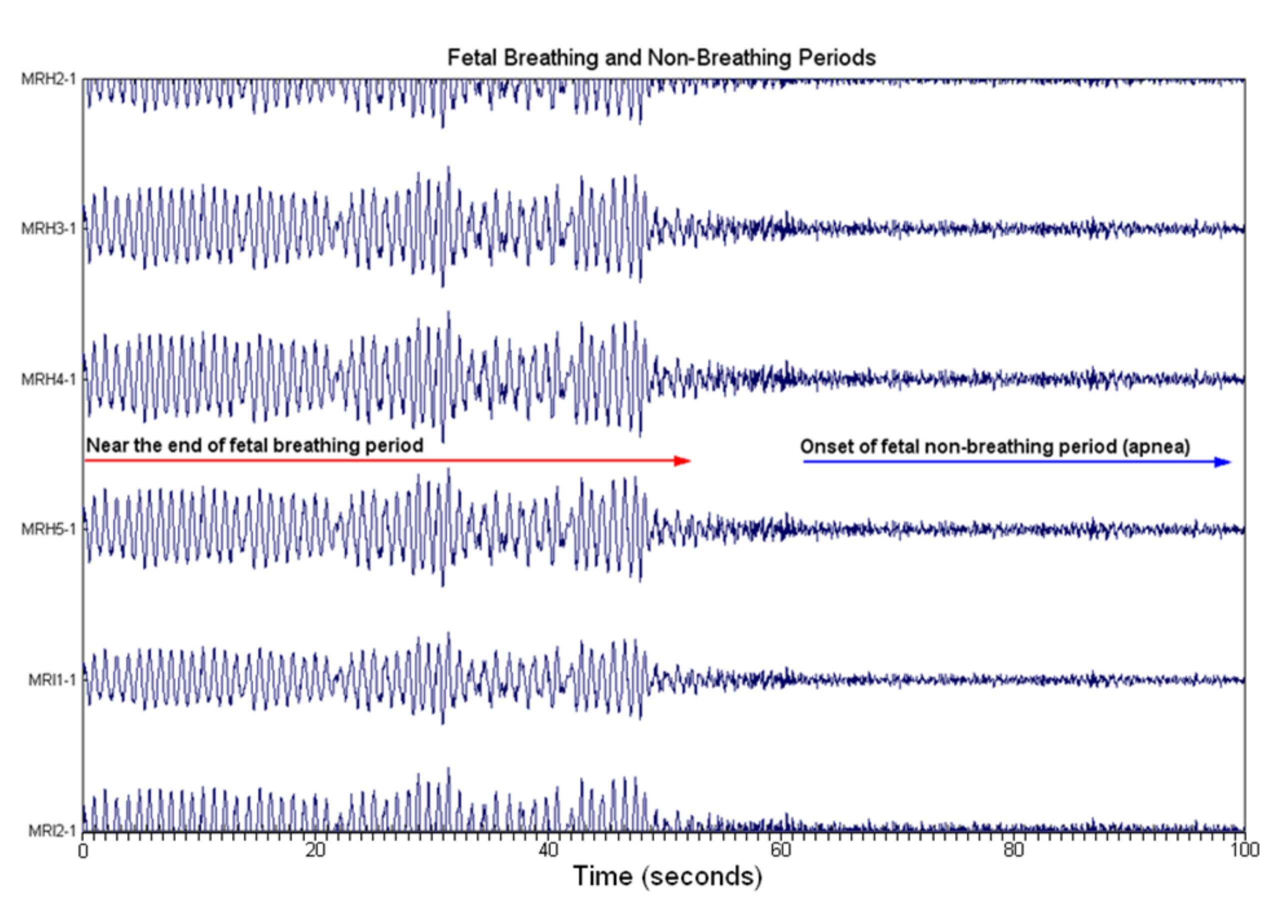
Fetal Vagal Control?

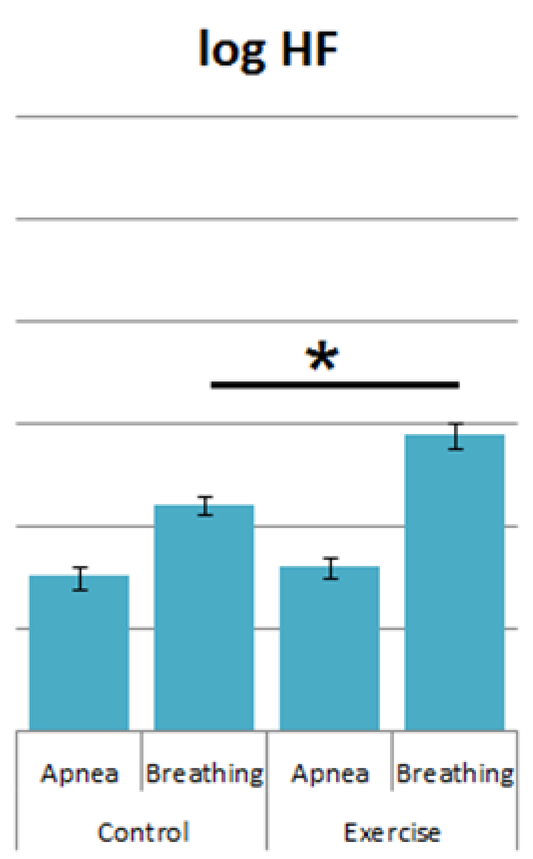


Gustafson, Allen, Yeh, & May (2011)

Do Maternal Behaviors Affect Fetal Cardiac Vagal Control?

Fig. 1.

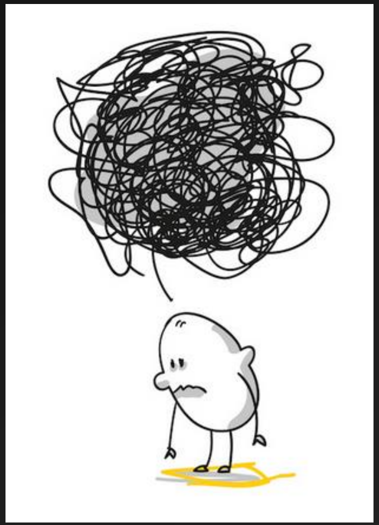




Gustafson, May, Yeh, Million, & Allen (2012)

Perseverative Thinking

- Transdiagnostic feature for distress disorders
- Worry: Anticipation of future negative consequences (that may or may not happen)
- Rumination: Dwelling on negative thoughts about past events
- Induces stress unrelated to the current environmental context



Perseverevereverative

Physiological Concomitants of Perseverative Cognition: A Systematic Review and Meta-Analysis

Cristina Ottaviani
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The Ohio State University

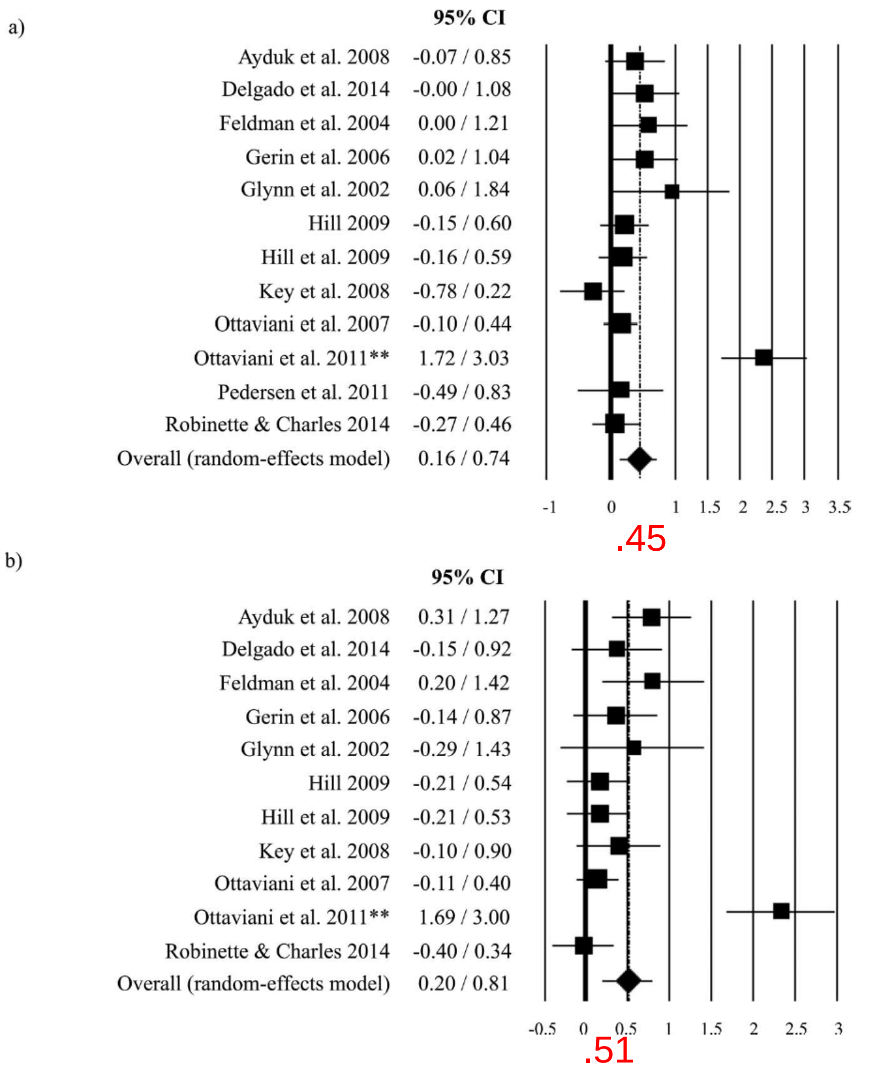
Bart Verkuil
Leiden University

Antonia Lonigro
IRCSS Santa Lucia Foundation, Rome, Italy

Barbara Medea and Alessandro Couyoumdjian
Sapienza University of Rome

Jos F. Brosschot
Leiden University

Blood Pressure   Heart Rate   HRV



igure 2. Forest plots for meta-analysis on (a) systolic blood pressure and (b) diastolic blood pressu oncomitants of perseverative cognition when experimental studies were examined.

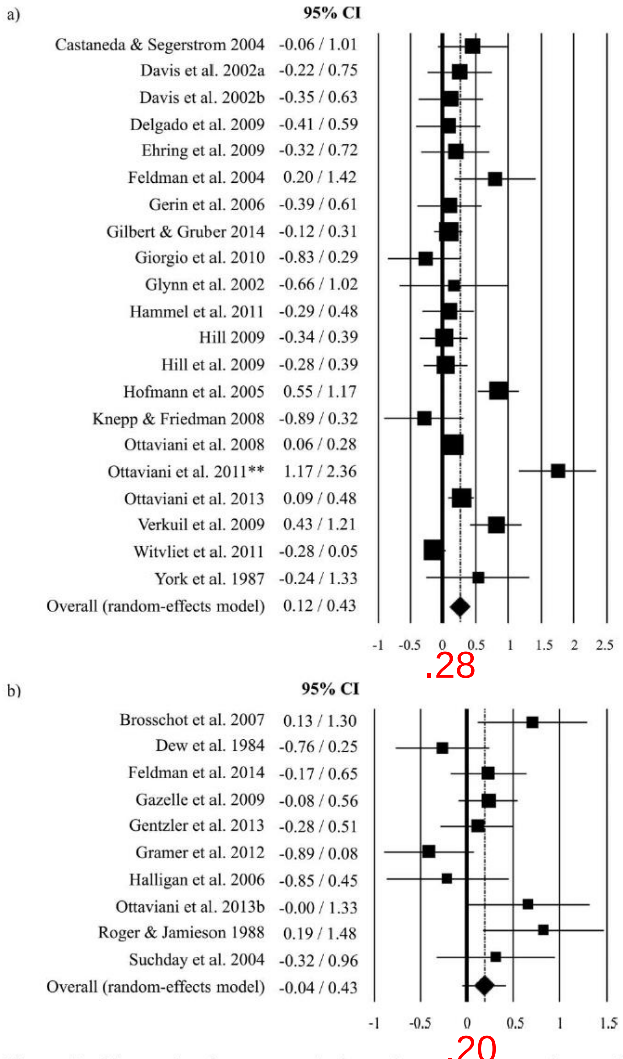


Figure 3. Forest plot for meta-analysis on heart rate concomitants of perseverative cognition when experimental (a) and correlational (b) studies were examined.

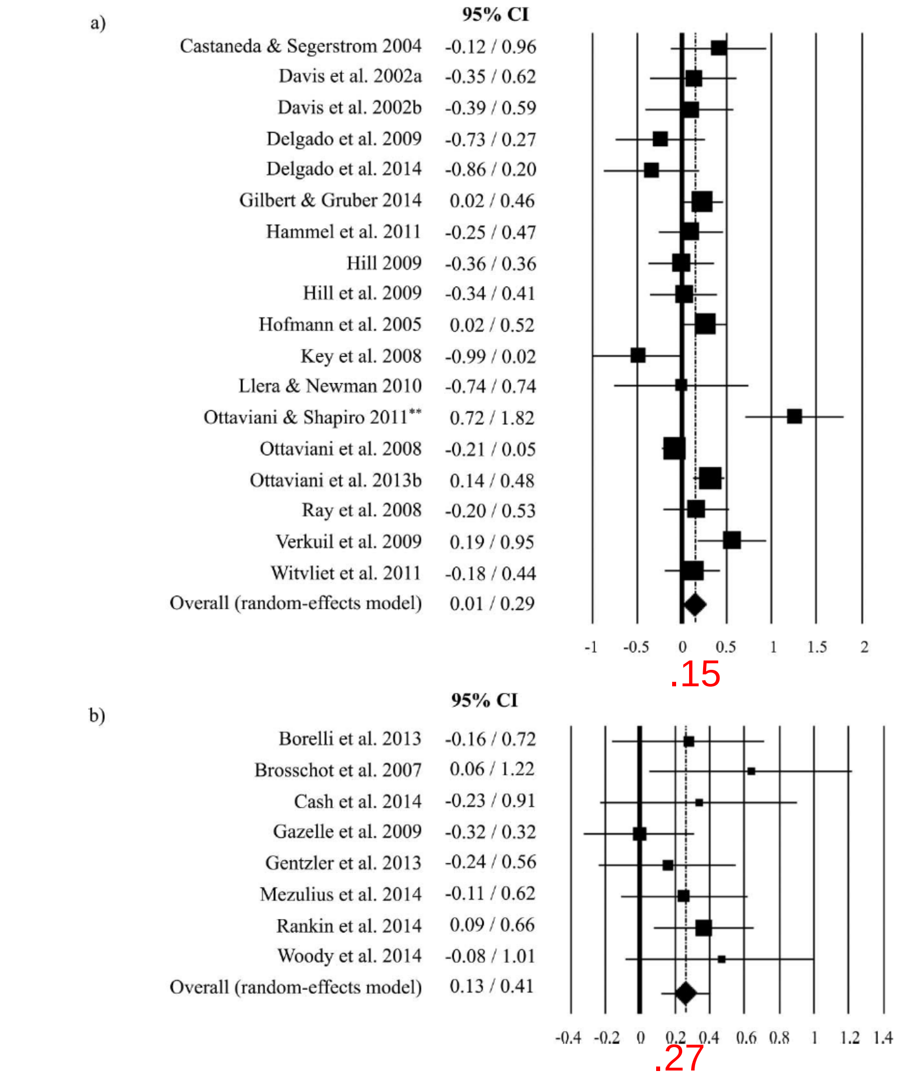
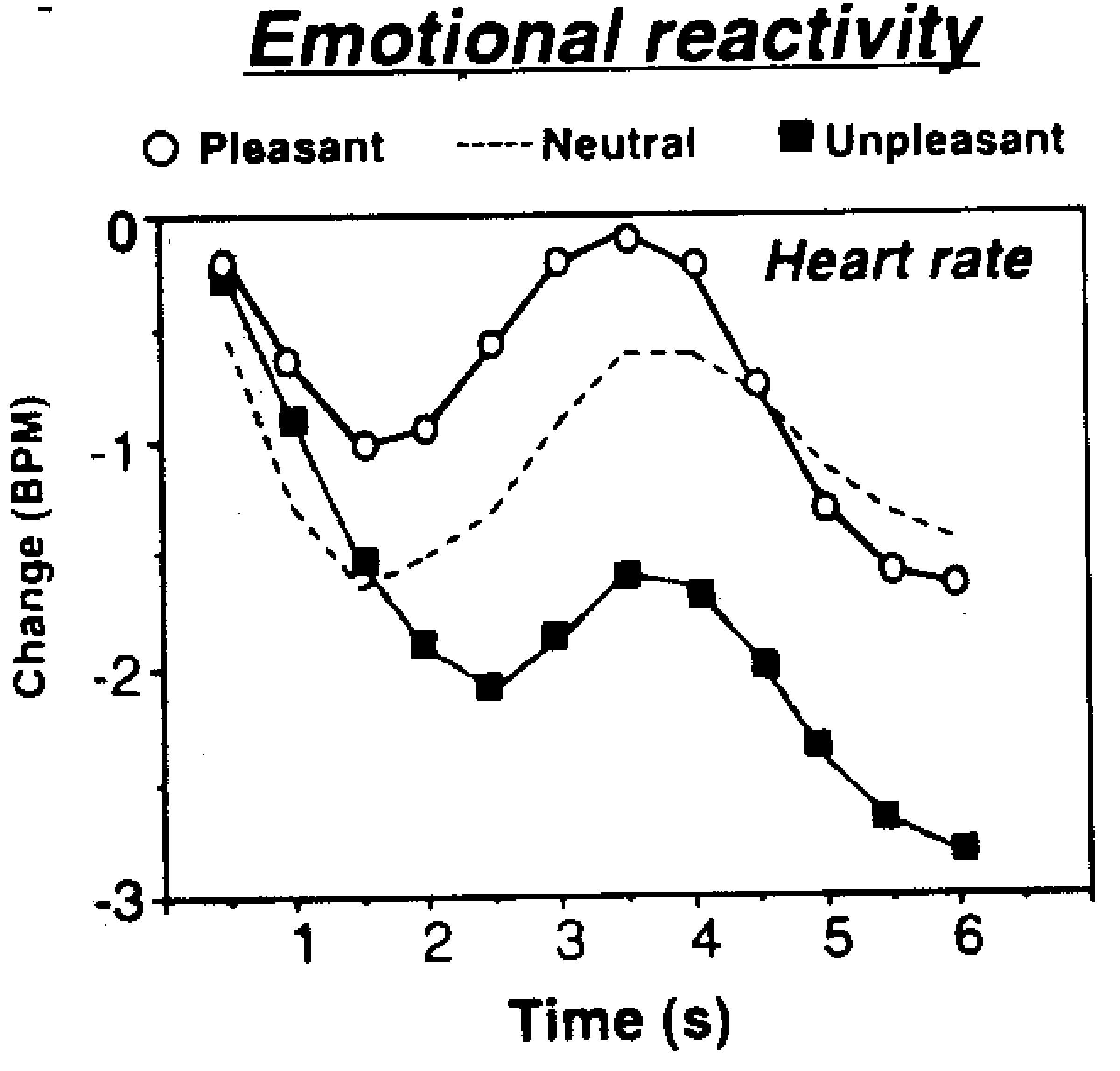


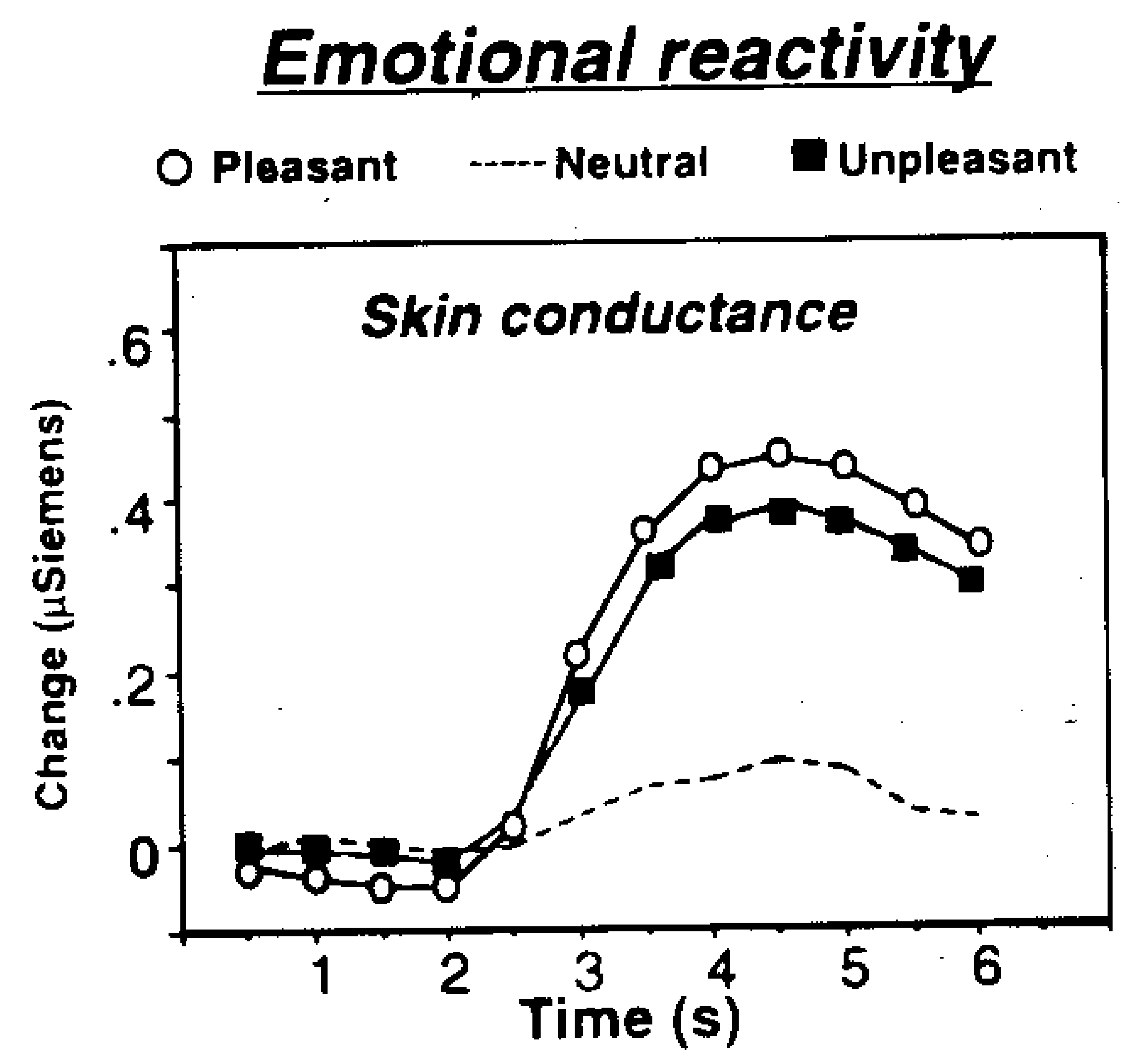
Figure 4. Forest plot for meta-analysis on heart rate variability concomitants of perseverative cognition wher experimental (a) and correlational (b) studies were examined.

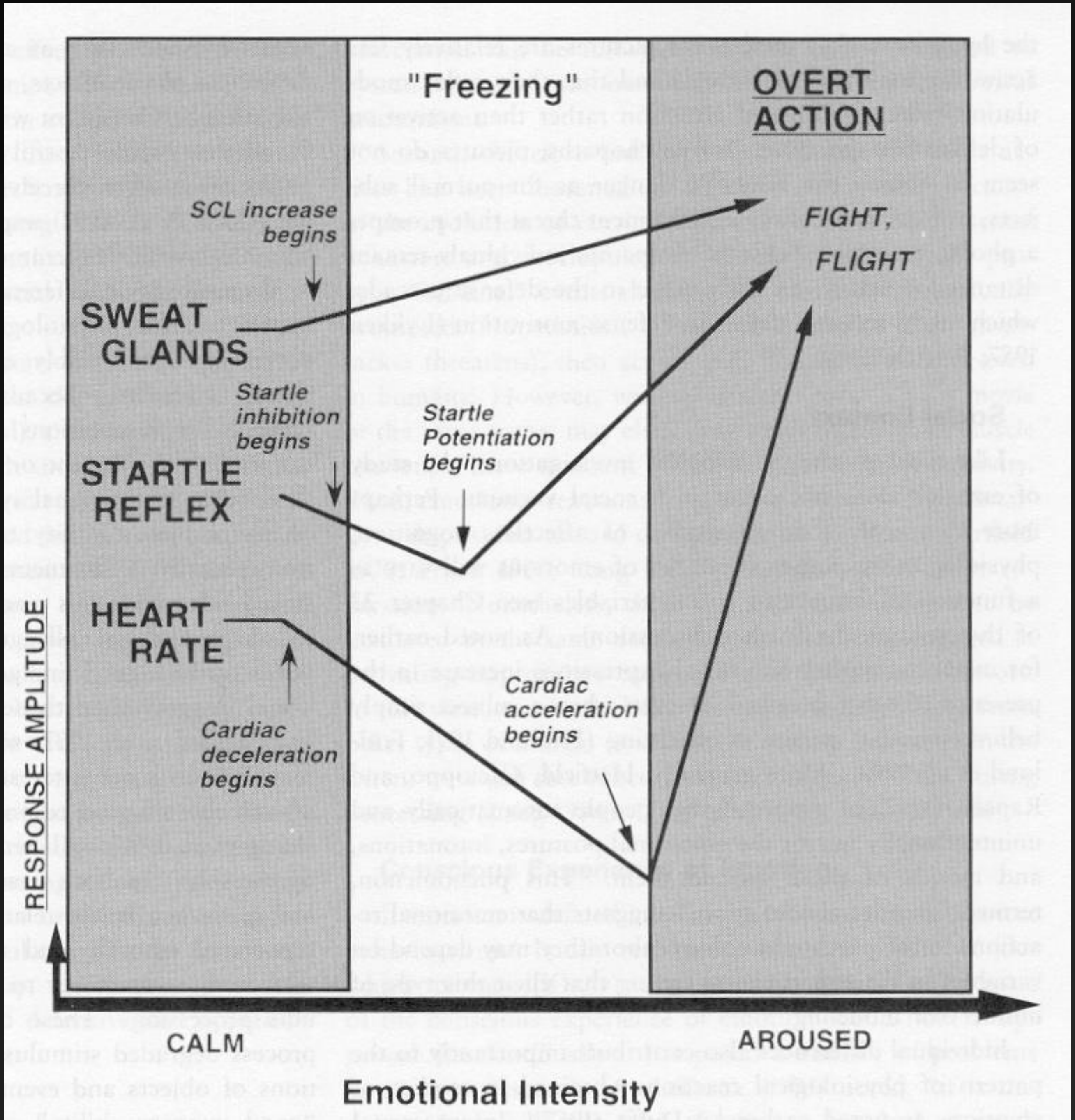
INTEGRATING MEASURES TO ASSESS ORIENTING VS DEFENSIVE RESPONSES

Orienting, Attention, and Defense



SCR (by contrast)




"Freezing"
OVERT ACTION
SCL increase begins
FIGHT, FLIGHT
SWEAT GLANDS
Startle inhibition begins
Startle Potentiation begins
STARTLE REFLEX
HEART RATE
Cardiac acceleration begins
Cardiac deceleration begins
RESPONSE AMPLITUDE
CALM
AROUSED
Emotional Intensity

OR Vs DR

Electromygraphy

Why Record EMG?

- Facial Musculature rich; emotional expressions; a “leaky channel of expression”
- Startle blink as a probe for affective valence
- Muscle tension in disorders and stress
- Record “pre-behavioral” motor output
  - Facial Expressions
  - Human Performance (e.g incorrect channel EMG in forced-choice RT task)

The Expressive Face

- Clip 1
- Clip 2

Striated Muscle

- Large number of muscle fibers arranged in parallel
- “Striated” reflects that these fibers actually comprise smaller fibrils
  - Fibrils have repeating cross striations (Z-lines)
  - Fibrils plus tissue between = Sarcomeres

Striated Muscle

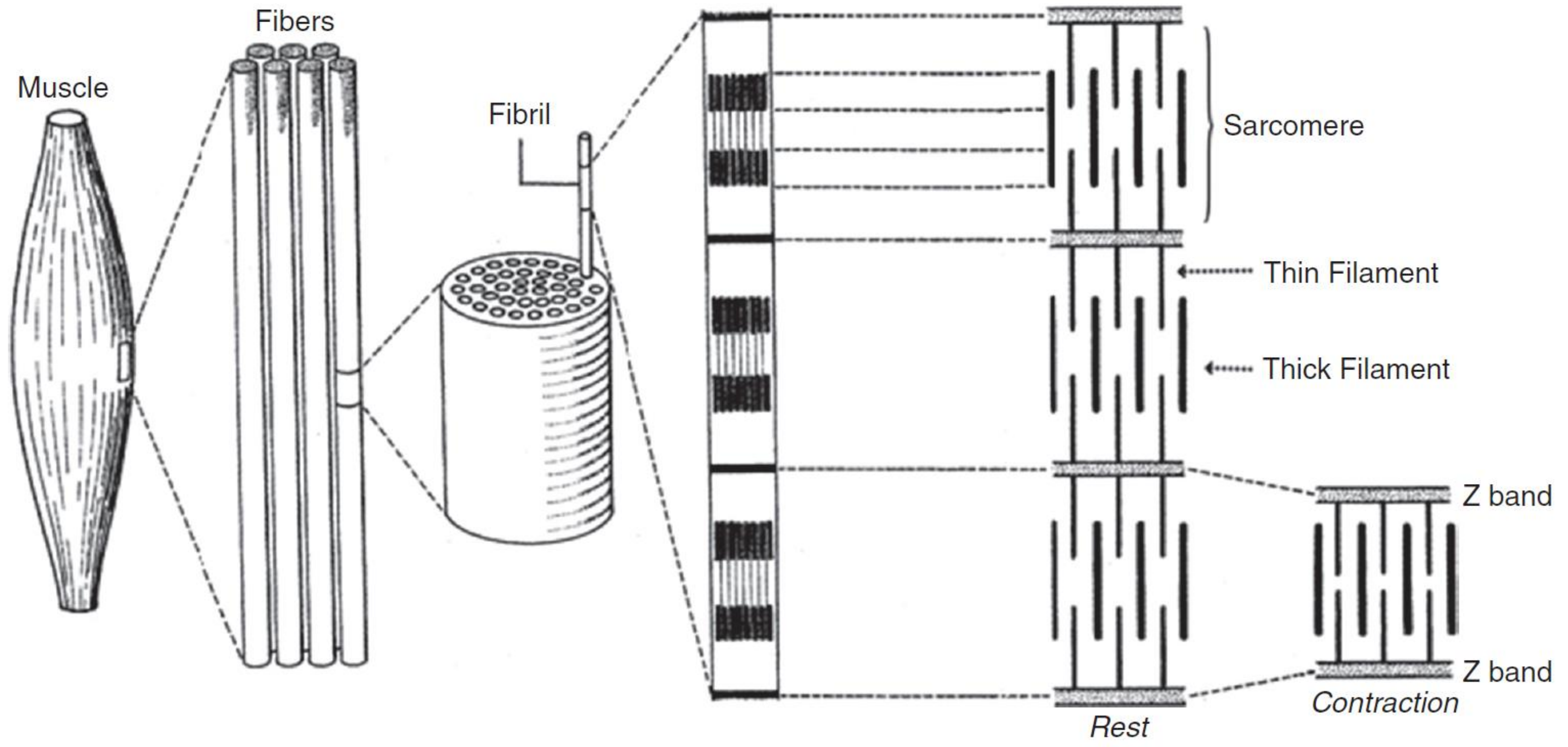


Figure 8.2 Diagram of the structure of the muscle with increasing magnification going from left to right. The bottom corner of the figure illustrates the microgeometric changes that occur with contraction (modified from Figure 10.7 of Schmidt-Nielsen, 1997).

Striated Muscle

- During contraction:

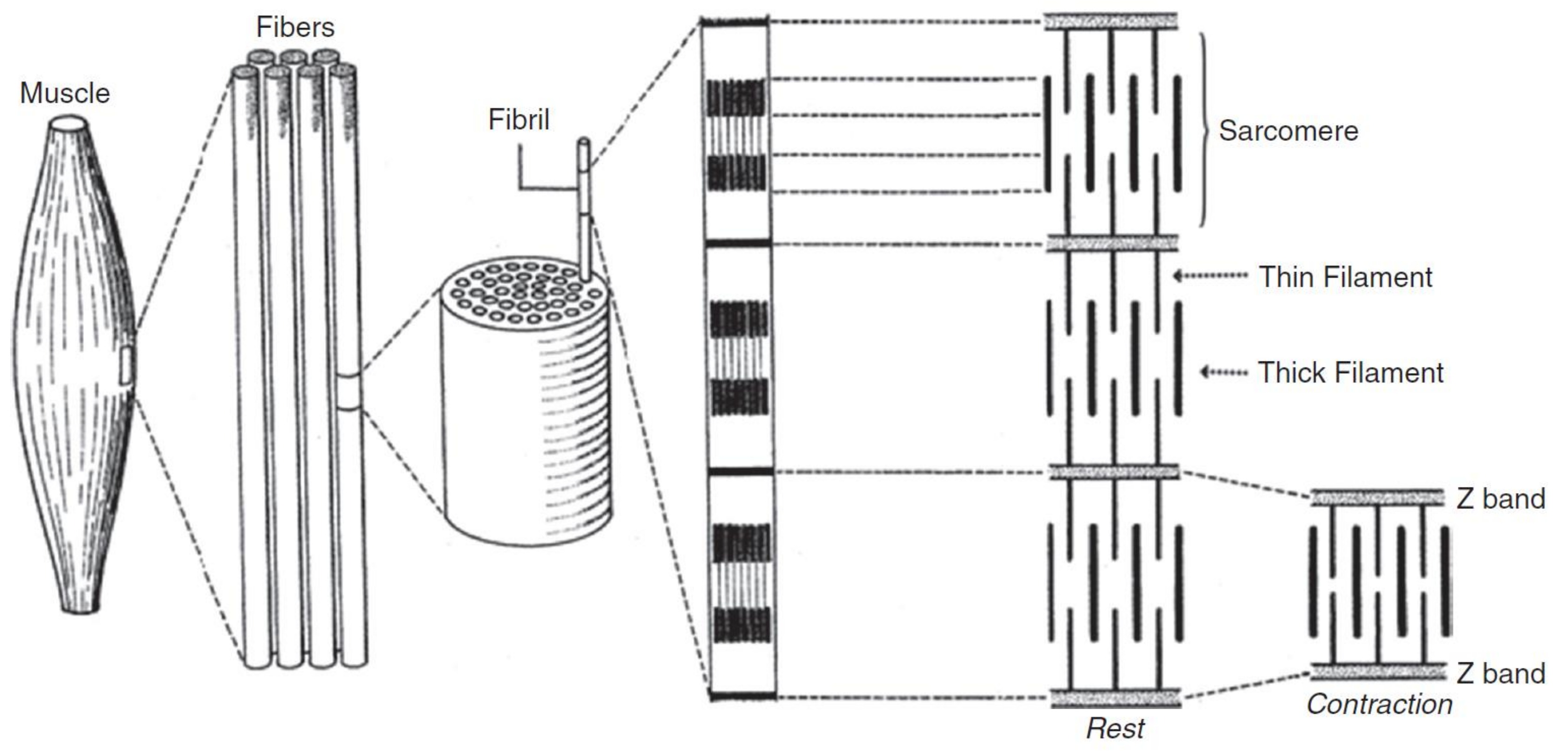


Figure 8.2 Diagram of the structure of the muscle with increasing magnification going from left to right. The bottom corner of the figure illustrates the microgeometric changes that occur with contraction (modified from Figure 10.7 of Schmidt-Nielsen, 1997).

Innervation

- Muscle needs stimulation to contract
- The motor nerve
  - Contains many motoneurons
  - Each motoneuron branches into several axon fibrils
- At end of each axon fibril is a junction with the muscle fiber
  - Known as the motor endplate

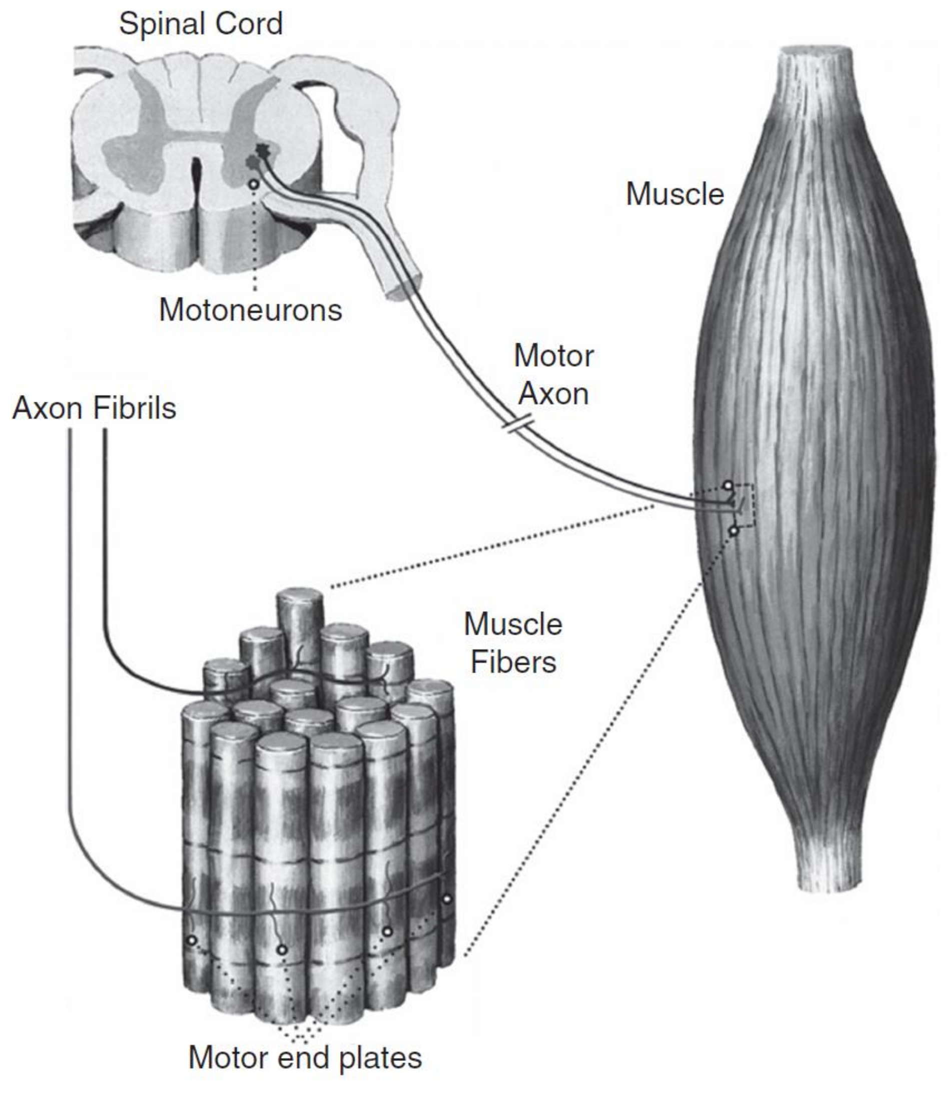


Figure 8.3 Diagram of two motor units (modified from slide 3705 of Netter, 1991).

Innervation

- Each motoneuron innervates several to many muscles (innervation ratios 10:1 to 2000:1), but each muscle innervated by only one motoneuron
  - Therefore, muscle fibers fire simultaneously or in concert with one another
  - Stronger contractions due to either more motoneurons firing, or increases in rate of already firing motoneurons

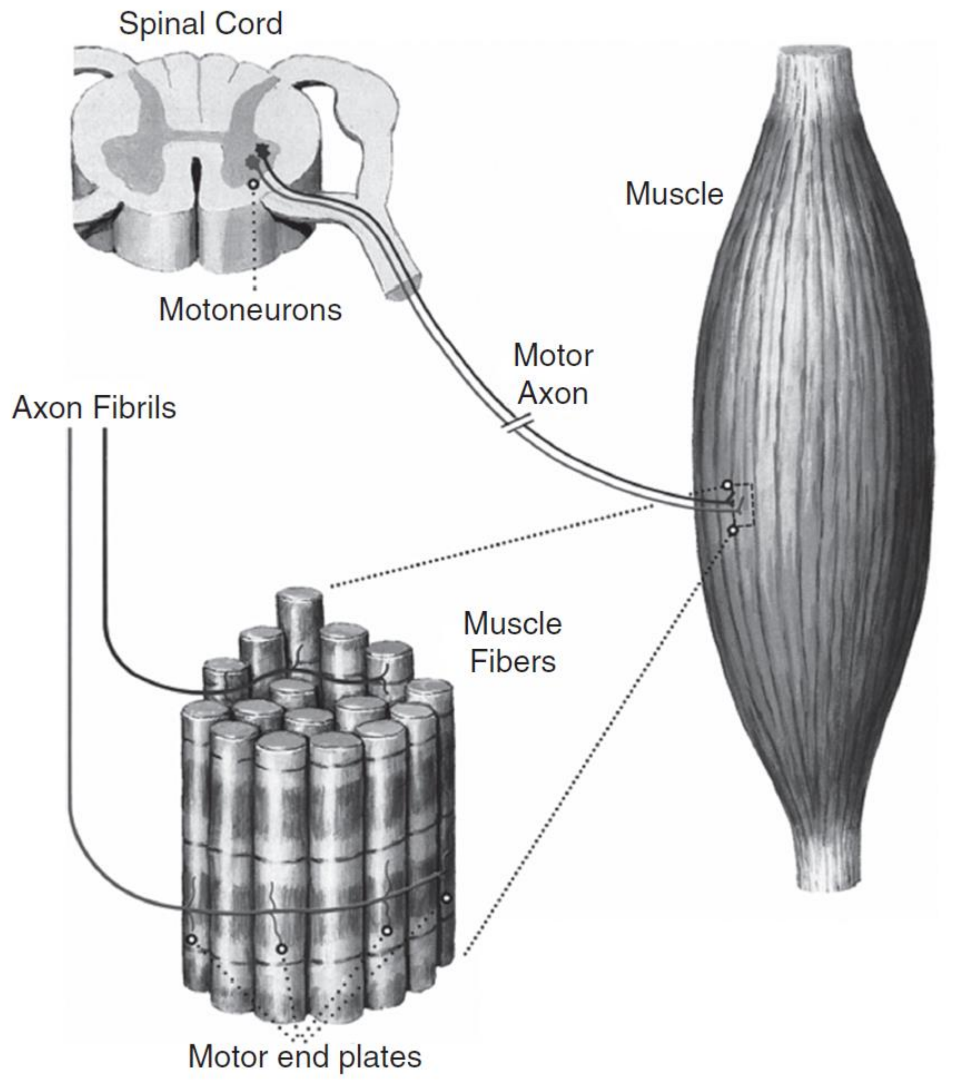
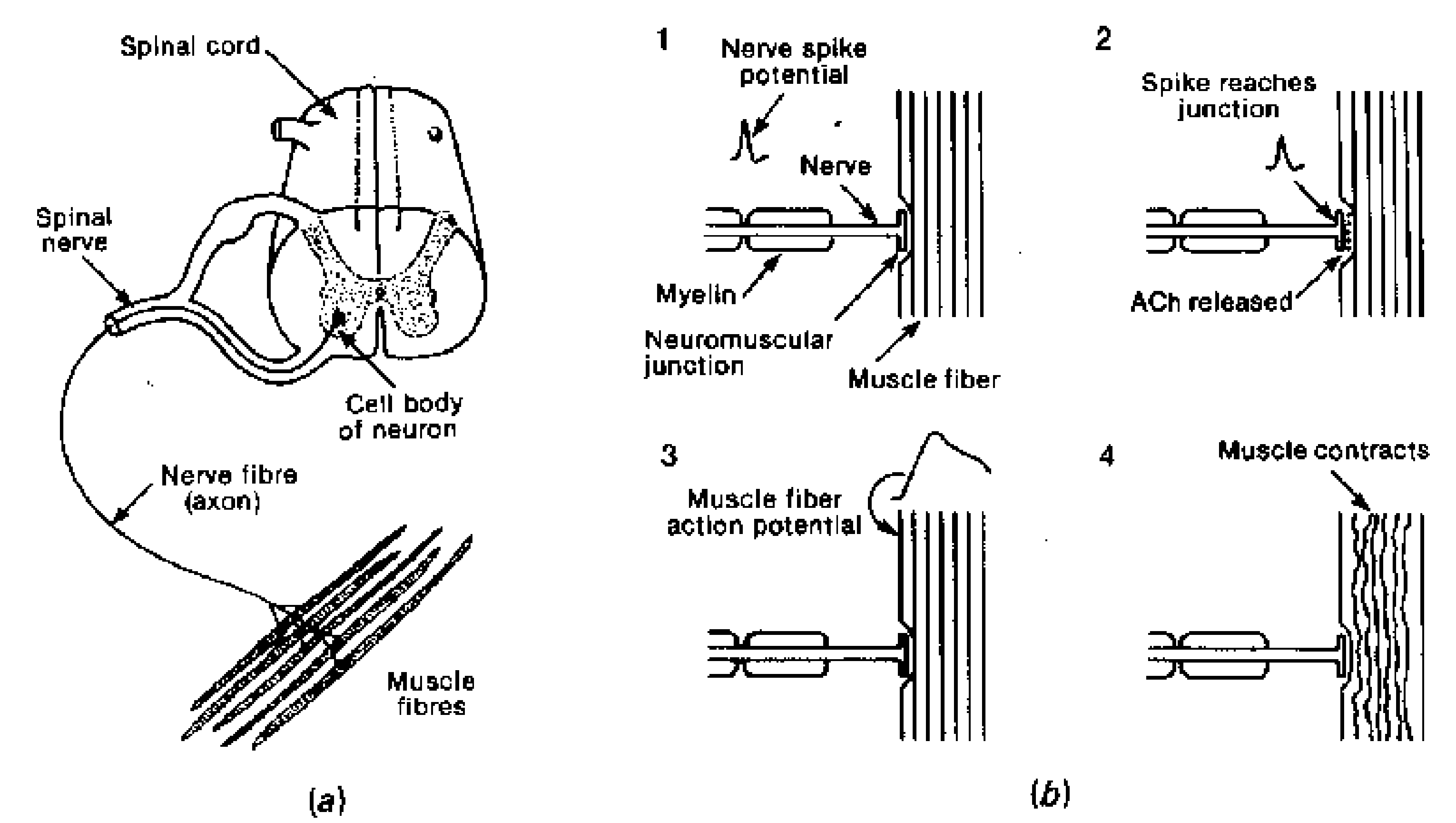


Figure 8.3 Diagram of two motor units (modified from slide 3705 of Netter, 1991).

Cartoon of how it works



Before

After

BOTOX® Cosmetic

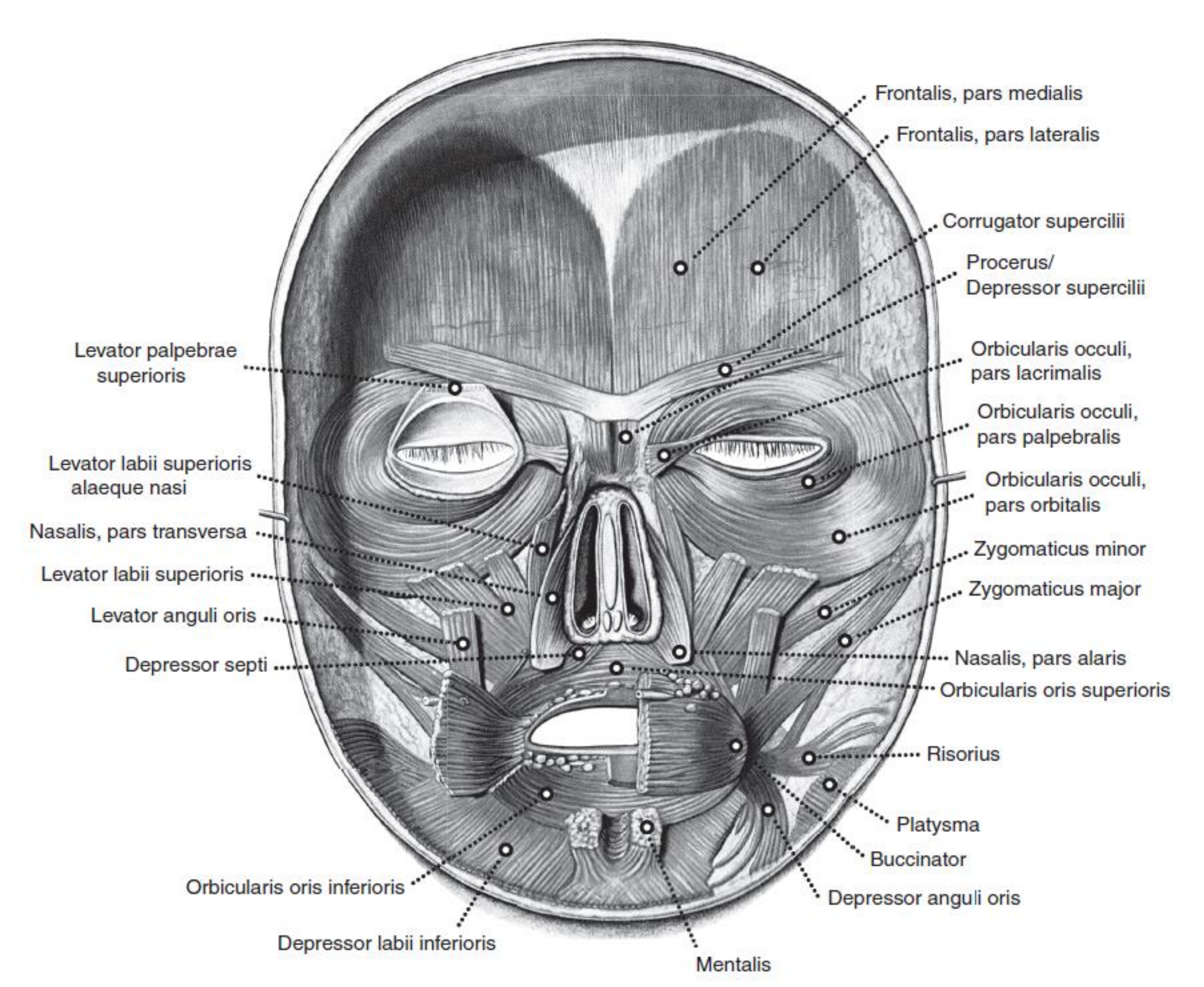
Before

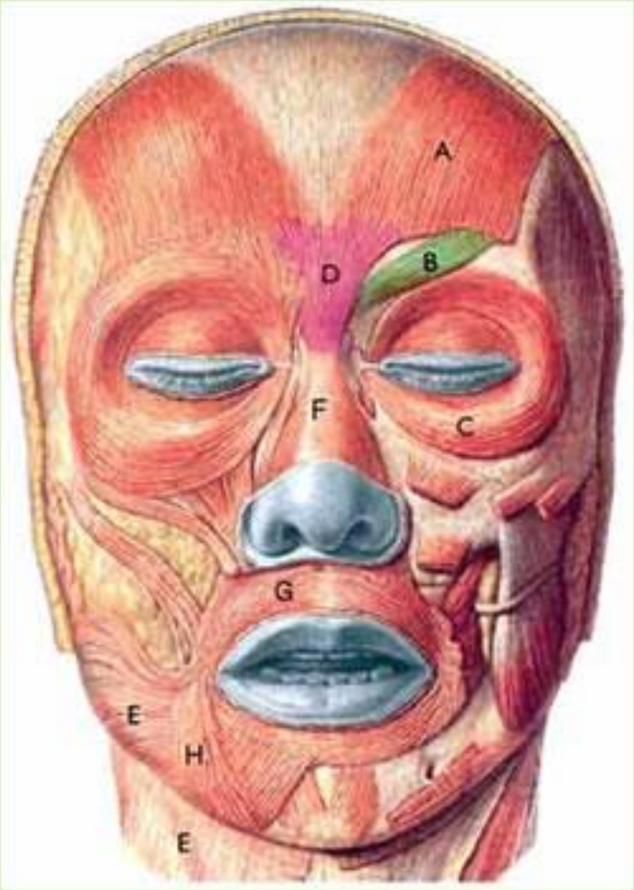
After

What is EMG signal?

- Reflects electrical field generated by Muscle Action Potentials (MAPs)
- Small portion conveyed to surface via extracellular fluids to skin
- Can also record invasively with subcutaneous needle electrodes

The Facial Muscles

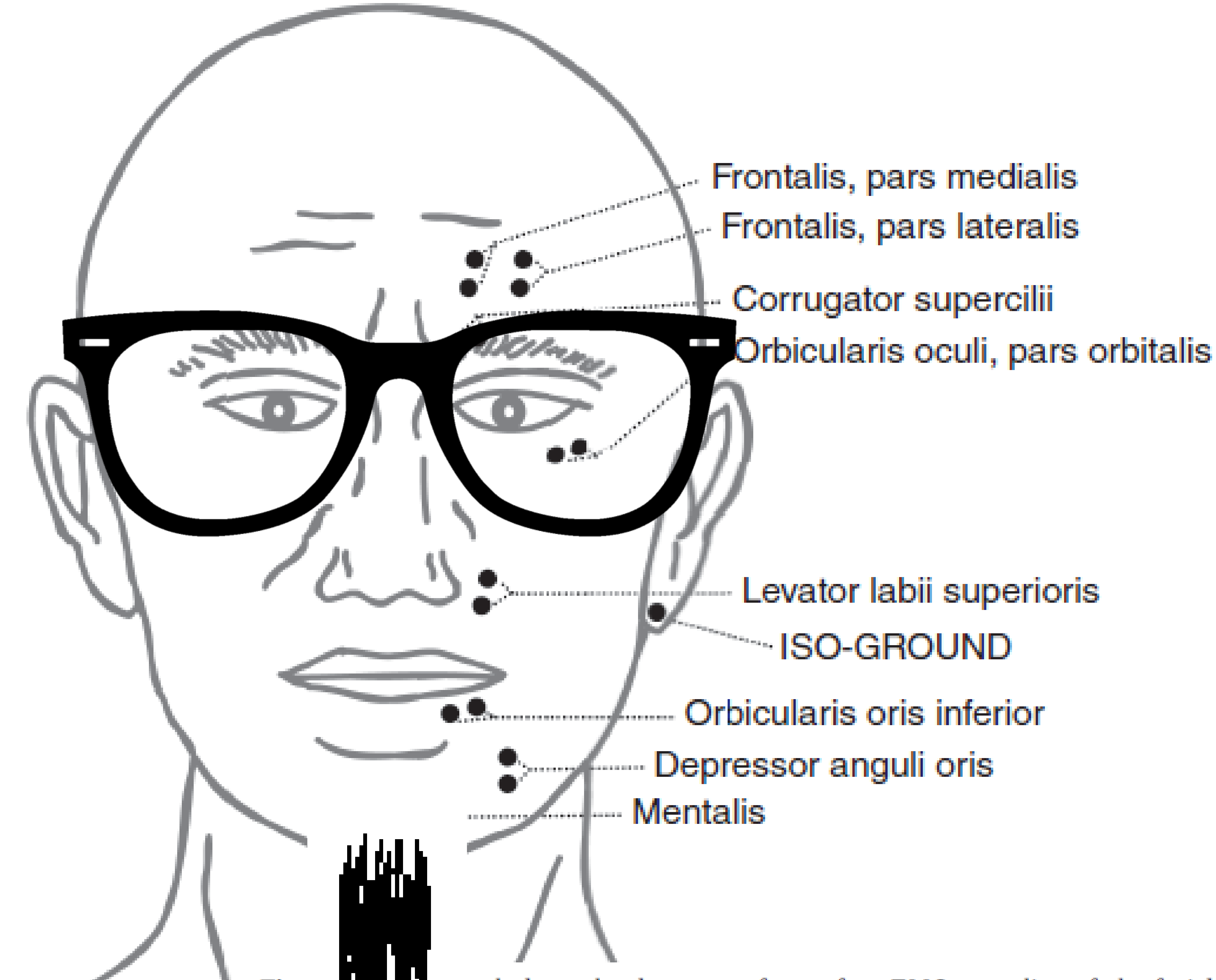




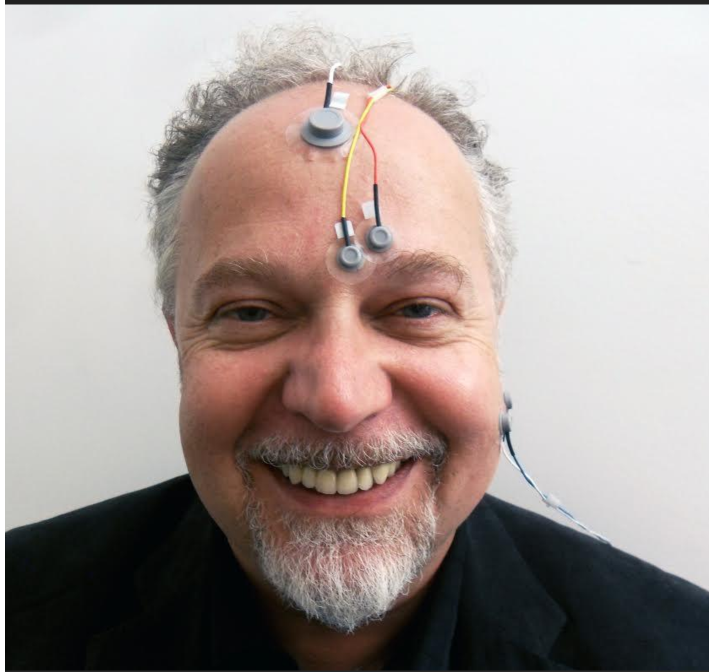
The primary muscles of facial expression treated with BOTOX:

(A) Frontalis
(B) Corrugator and Depressor supercilli complex
(C) Orbicularis oculi
(D) Procerus
(E) Platysma
(F) Nasalis
(G) Orbicularis oris
(H) Depressor anguli oris

From the educational website of
S. Sean Younai, MD,
Board Certified Plastic, Cosmetic, and Reconstructive Surgeon



Figu [redacted] ted electrode placements for surface EMG recording of the facial muscles, based on Fridlund and Cacioppo (1986). From Tassinary, Cacioppo, and Vanman (2007, Figure 12.4).



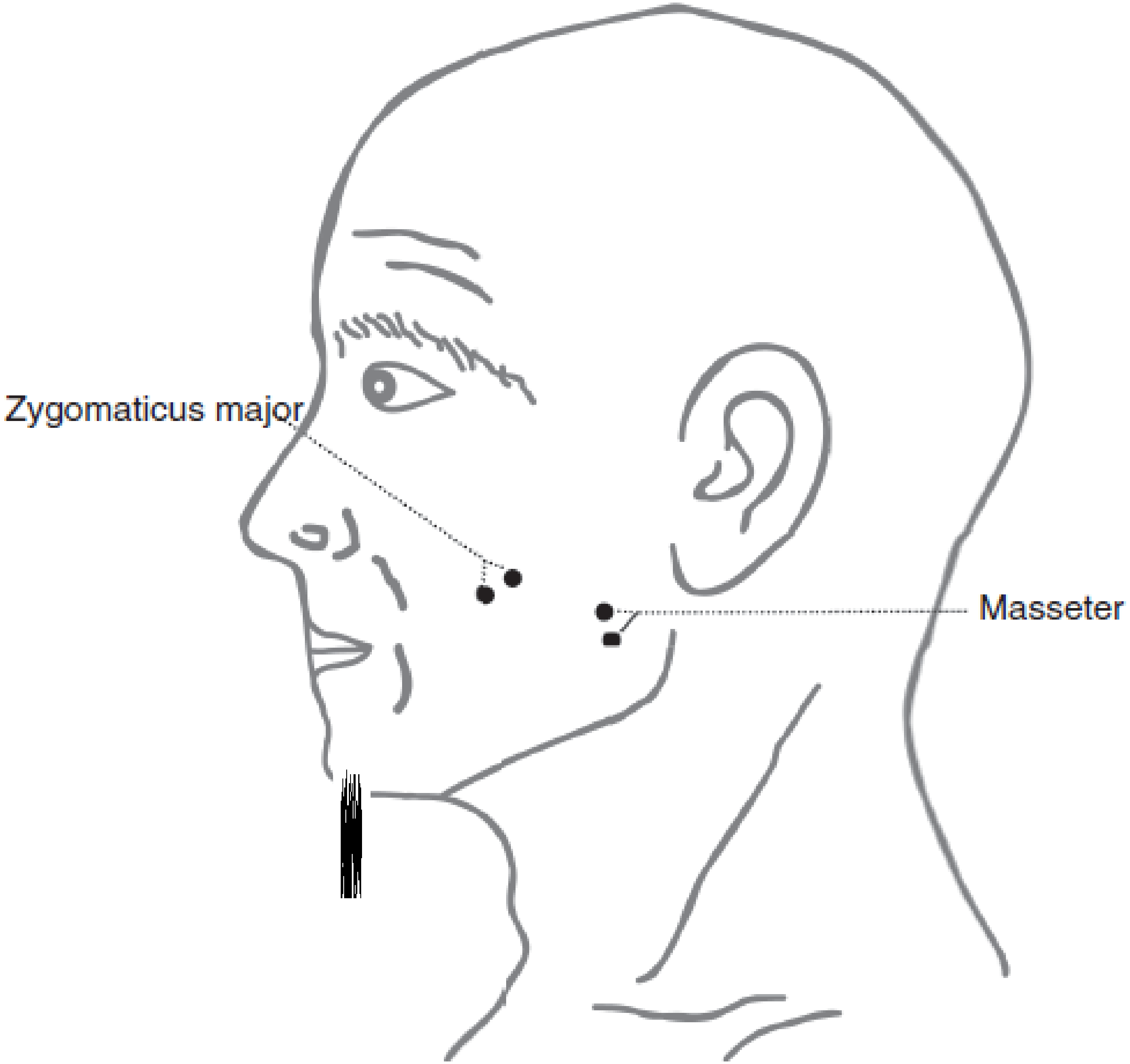
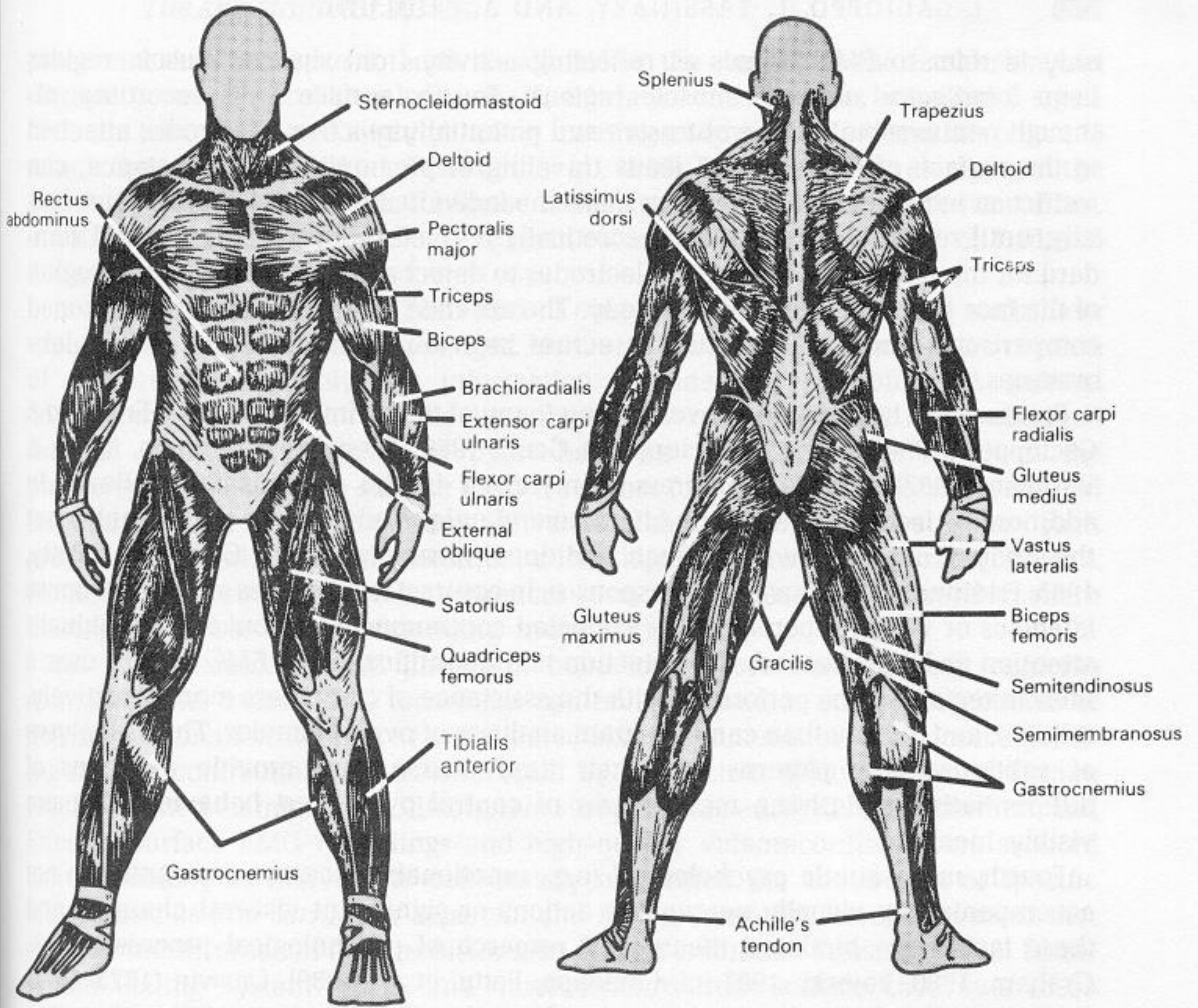
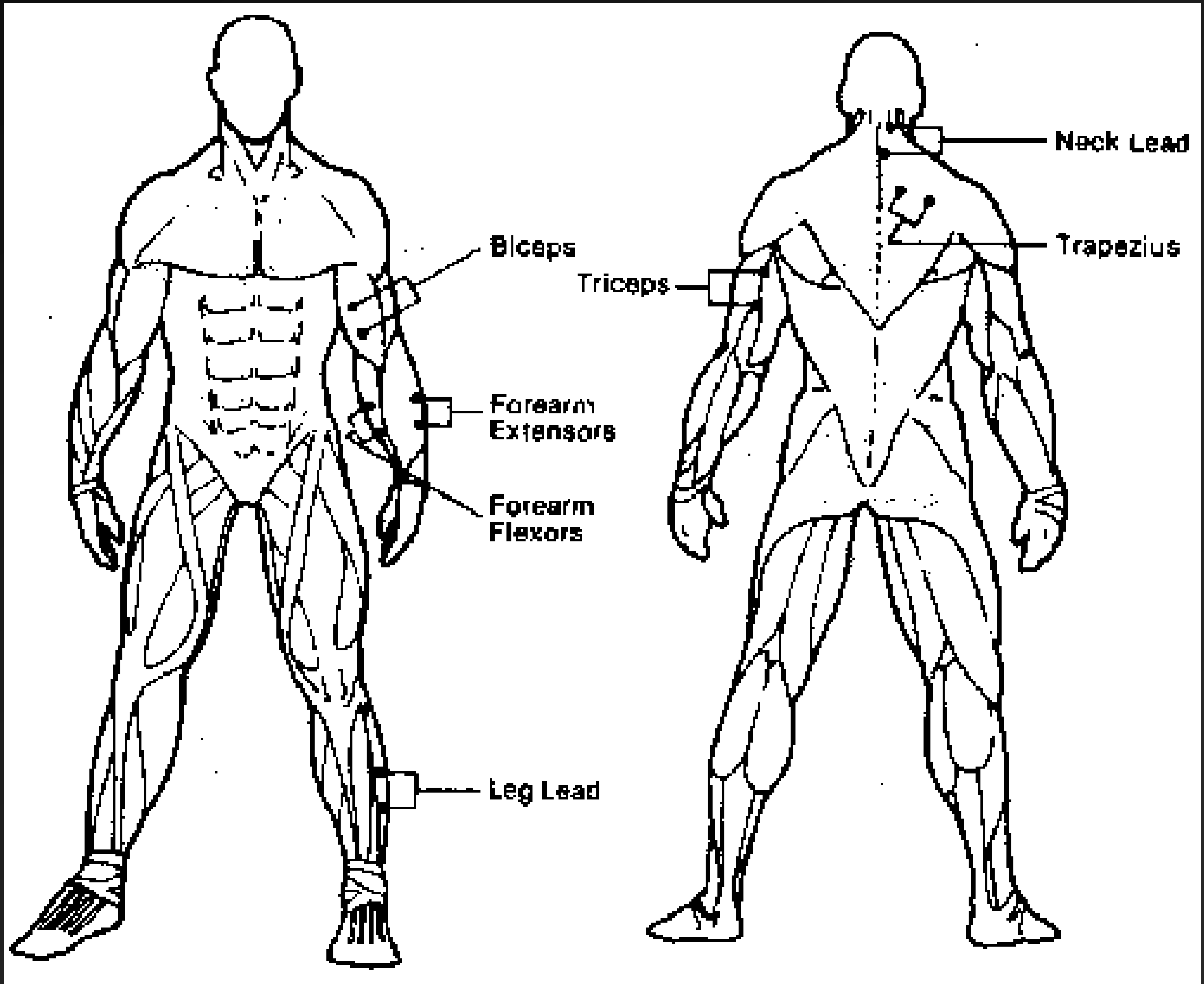


Figure 8.4 Suggested electrode placements for surface EMG recording of the facial muscles, based on Fridlund and Cacioppo (1986). From Tassinary, Cacioppo, and Vanman (2007, Figure 12.4).

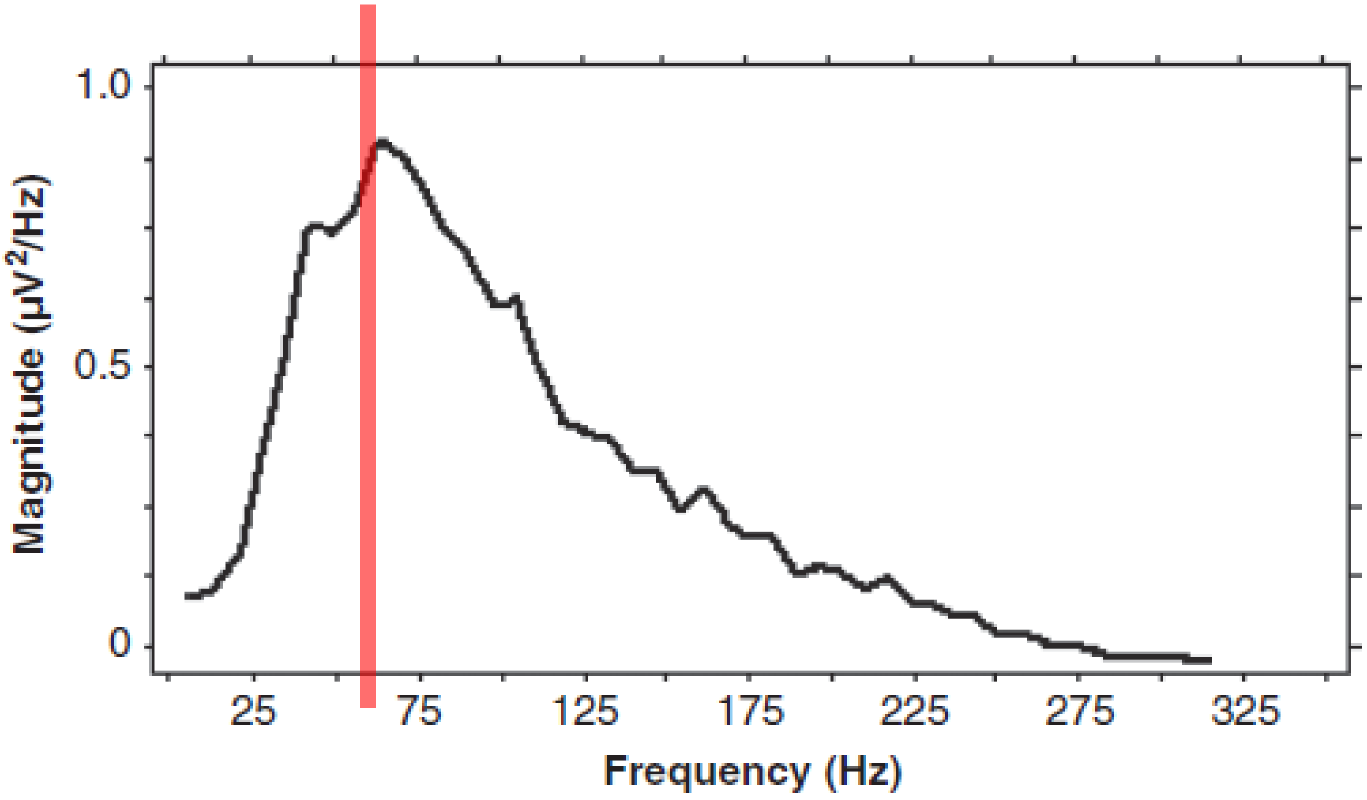

Sternocleidomastoid
Deltoid
Rectus abdominus
Pectoralis major
Triceps
Biceps
Brachioradialis
Extensor carpi ulnaris
Flexor carpi ulnaris
External oblique
Satorius
Quadriceps femorus
Tibialis anterior
Gastrocnemius
Splenius
Trapezius
Deltoid
Latissimus dorsi
Triceps
Flexor carpi radialis
Gluteus medius
Vastus lateralis
Gluteus maximus
Biceps femoris
Gracilis
Semitendinosus
Semimembranosus
Gastrocnemius
Achille's tendon


Biceps
Forearm Extensors
Forearm Flexors
Leg Lead
Neck Lead
Trapezius
Triceps

Signal Recording

- MAPs summate in quasi-random fashion to produce resultant signal
  - Range of ~10-500 Hz
  - Amplitude of sub-microvolt to over 1000 microvolts
- Note overlap with 60 Hz range
  - Prepare ground site carefully; Differential amplifier will assist in removing 60 Hz
  - Prepare recording sites carefully to lower impedance
  - Shielded rooms and leads can help
  - Can also filter out this range, but may toss “baby with bathwater”

EMG Power

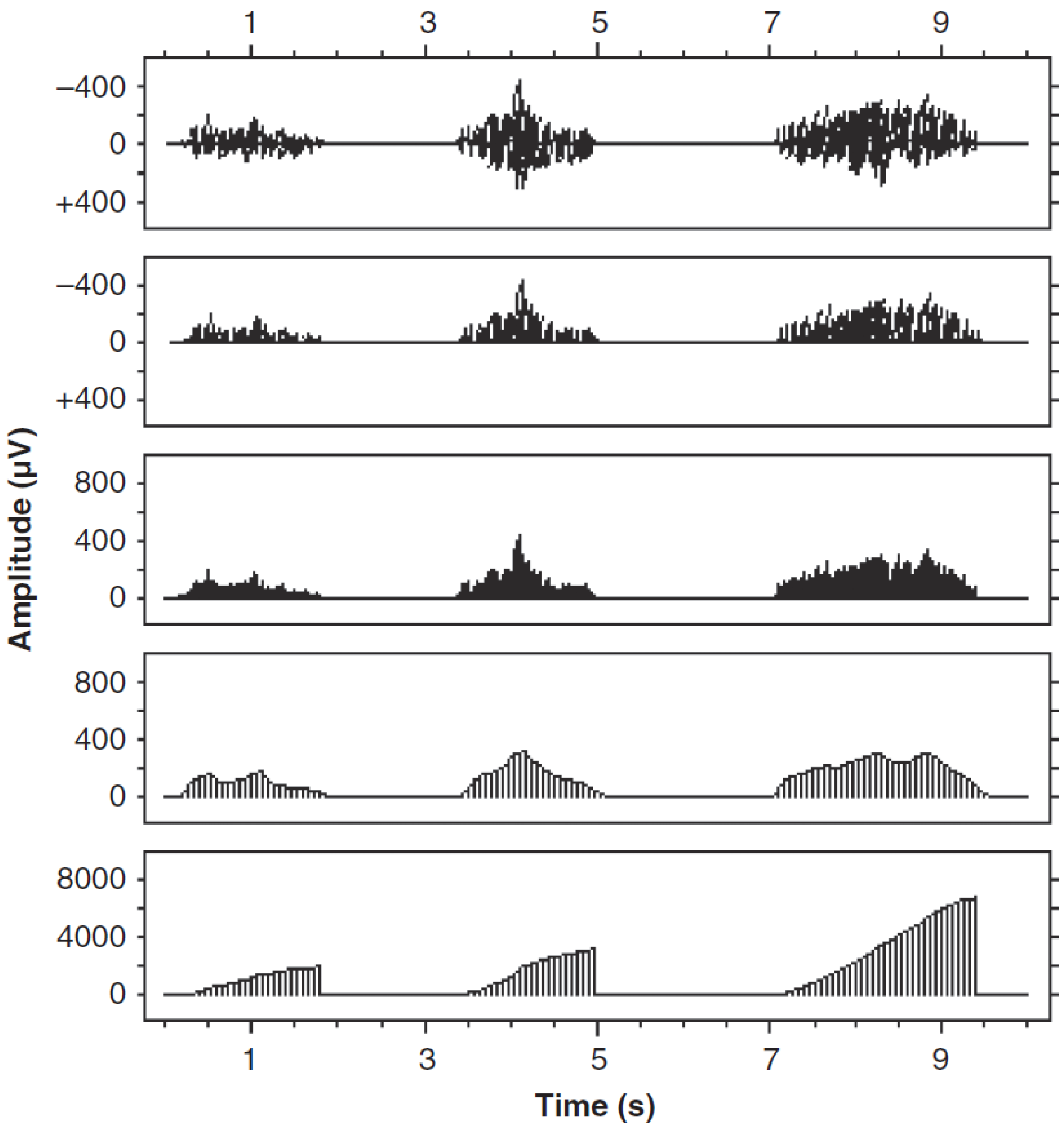


Signal Recording (cont')

- Can use wide variety of electrodes
  - Ag-AgCl still preferred
  - Small size increases specificity of recording
- Skin Prep
  - Abrade to reduce impedance to < 5K Ω
- Use Bipolar arrangements, in line with long direction of muscle of interest
- Use common ground for all sites
- Keep wires and such out of subject's visual field
- Describe placements precisely
  - Standard for location is Fridlund & Cacioppo (1986) for facial EMG placements

Signal Recording (cont')

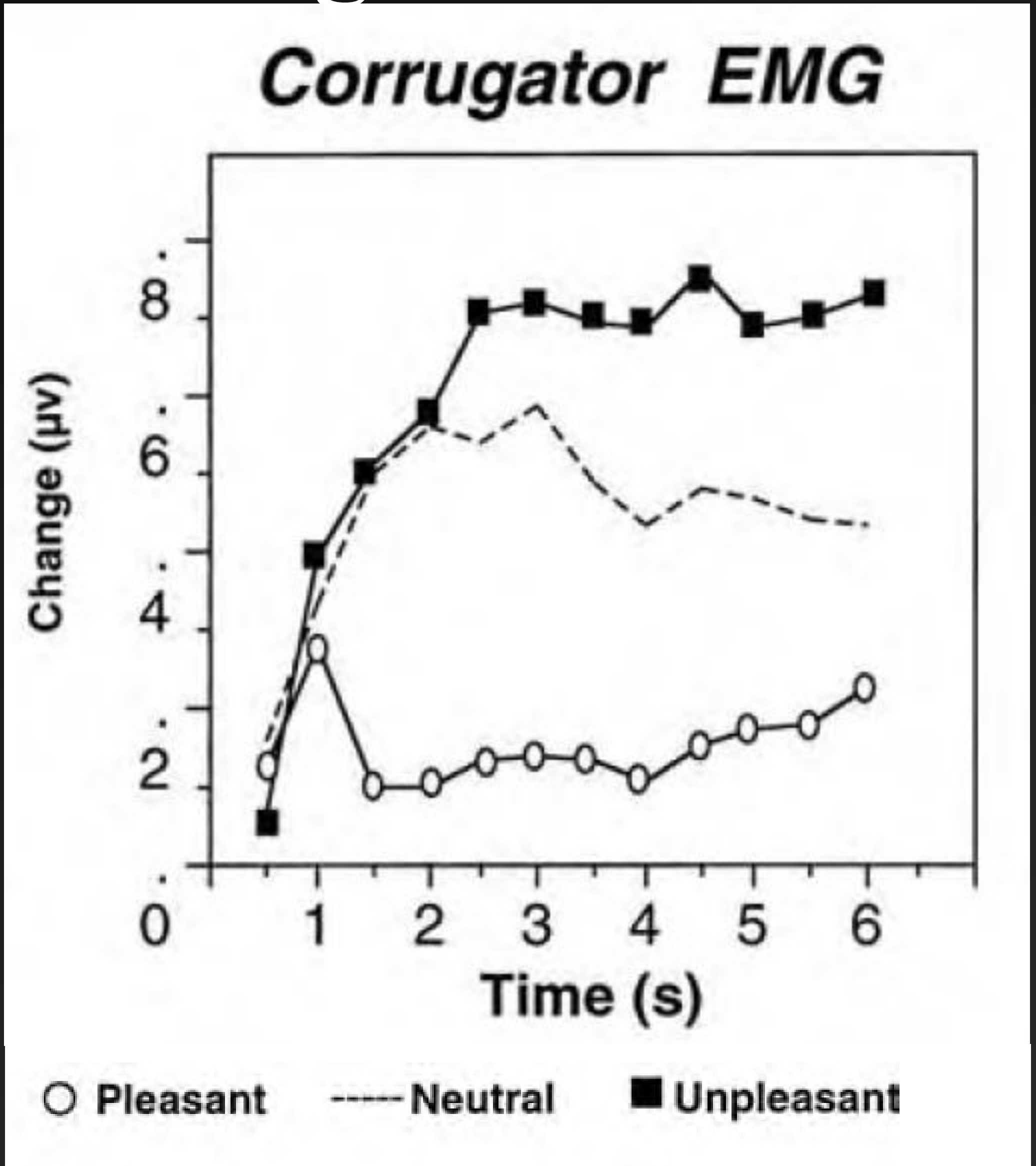
- Amplification
  - Differential amplifiers with common mode rejection
  - Actually double differential (ground)
- Amplify voltages 1000-20000 times
- May use on-line filter
  - Should pass 10-500 Hz
- Digitization (more in next lecture)
  - Fast, very fast
  - Or, slower, following on-line signal processing



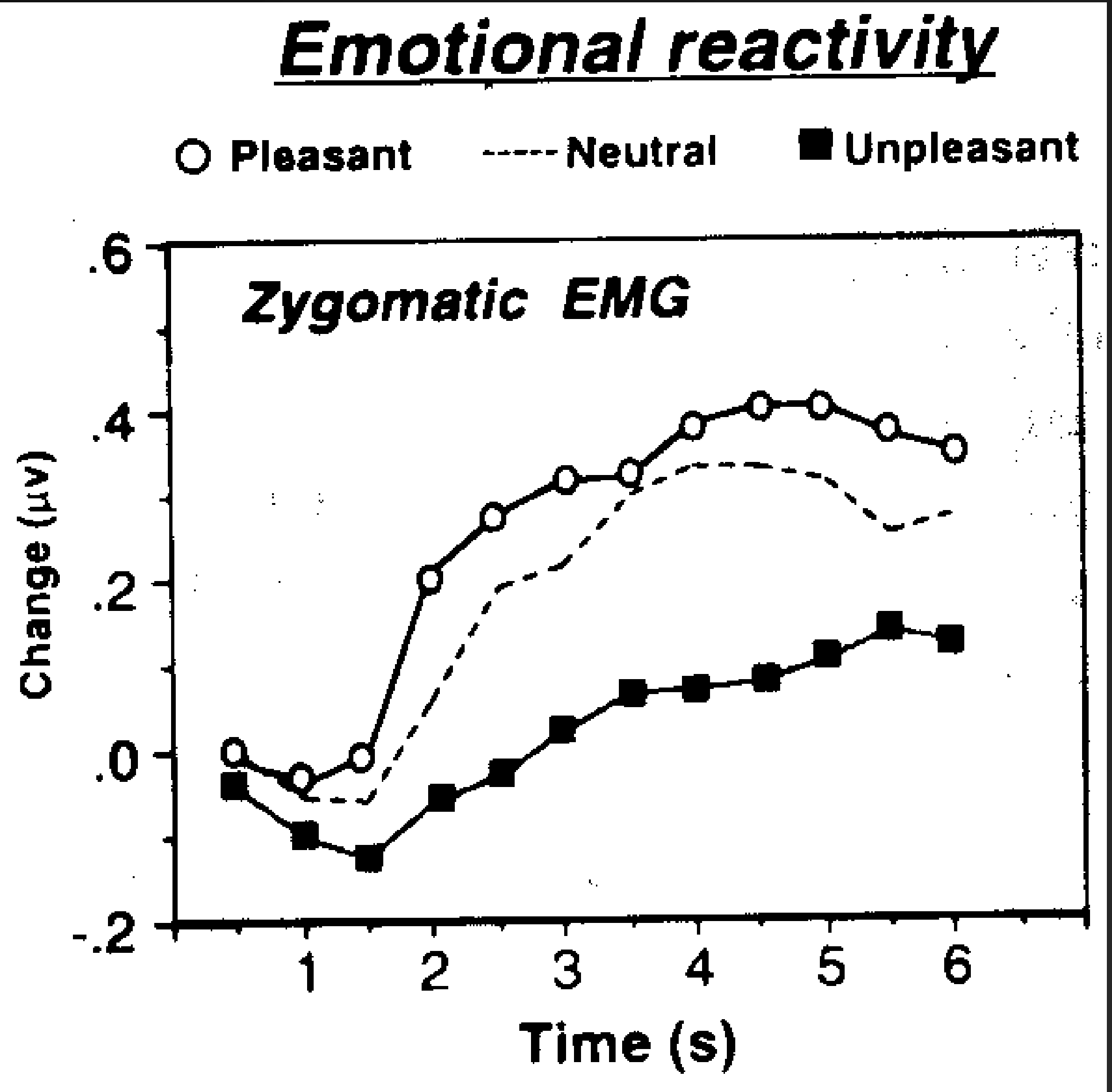
Signal Transformations

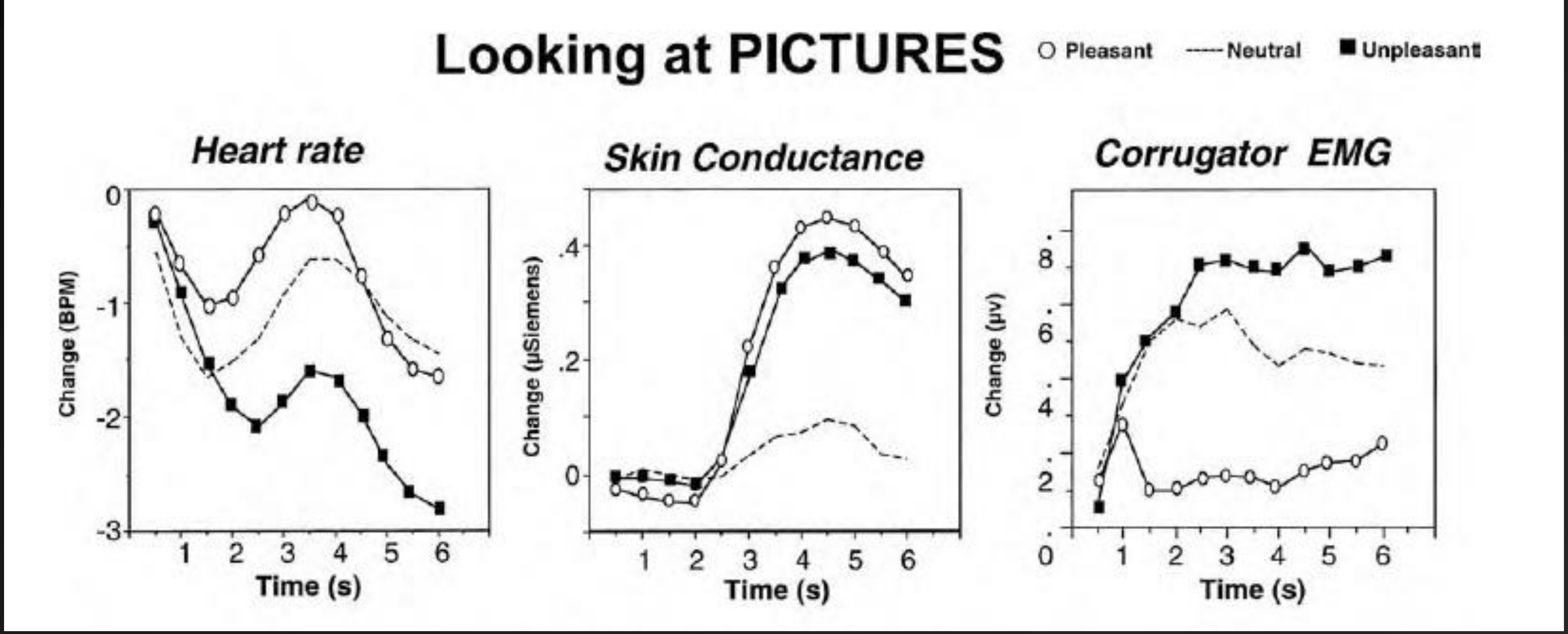
Figure 8.5 Common alternative representations of the surface EMG signal. The top five smaller panels depict three distinct non-fatigued responses. Going from top to bottom: the first represents "raw" (amplified and bandpass filtered only) waveforms; the second, half-wave rectified waveforms; the third, full-wave rectified waveforms; the fourth, "smoothed" waveforms; and the fifth, true integrated waveforms.The larger bottom panel depicts how one of these responses might appear if represented in the frequency domain. From Tassinary et al. (2007, Figure 12.5).

Corrugator "Frown"



Zygomatic “Smile”

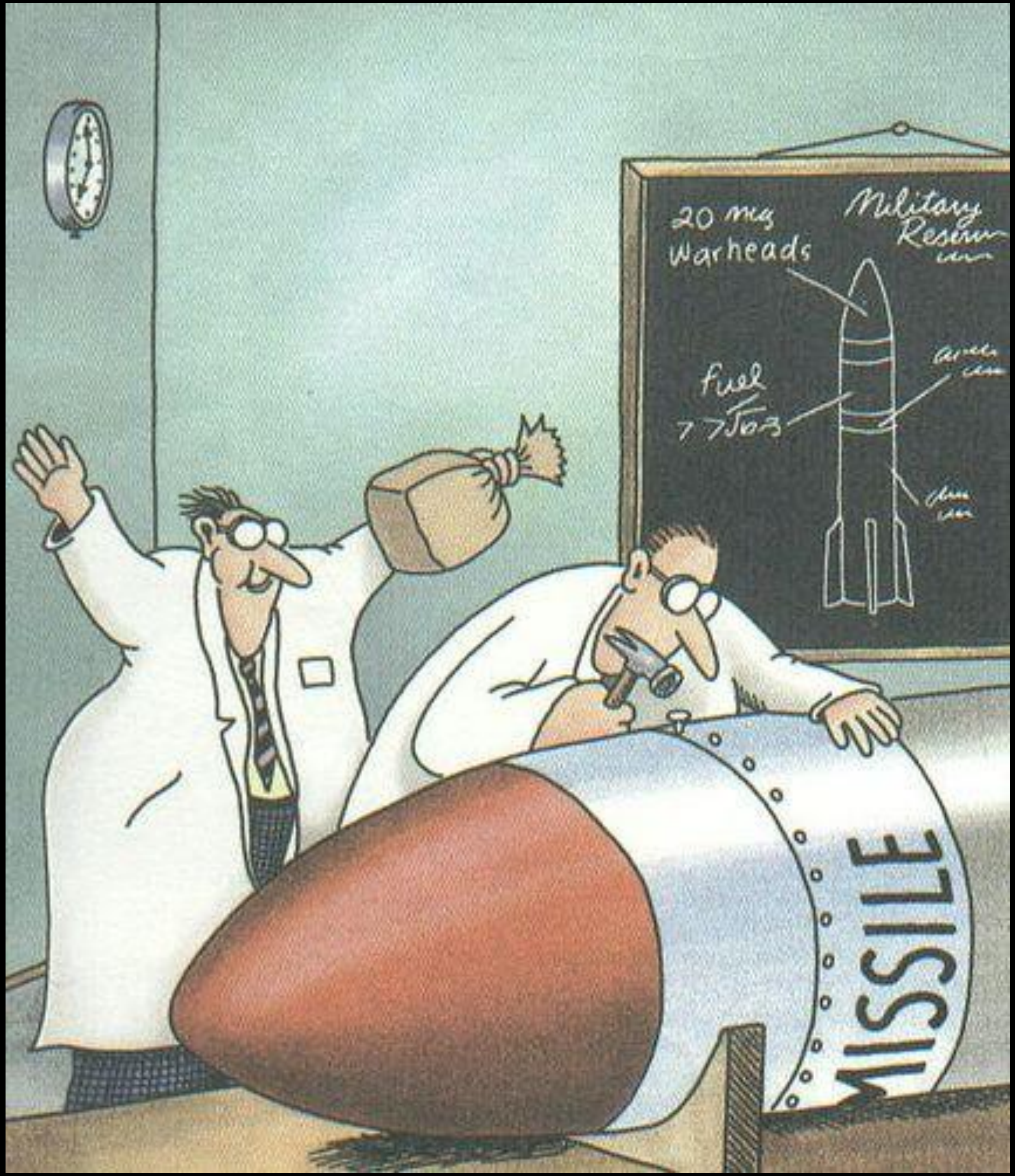




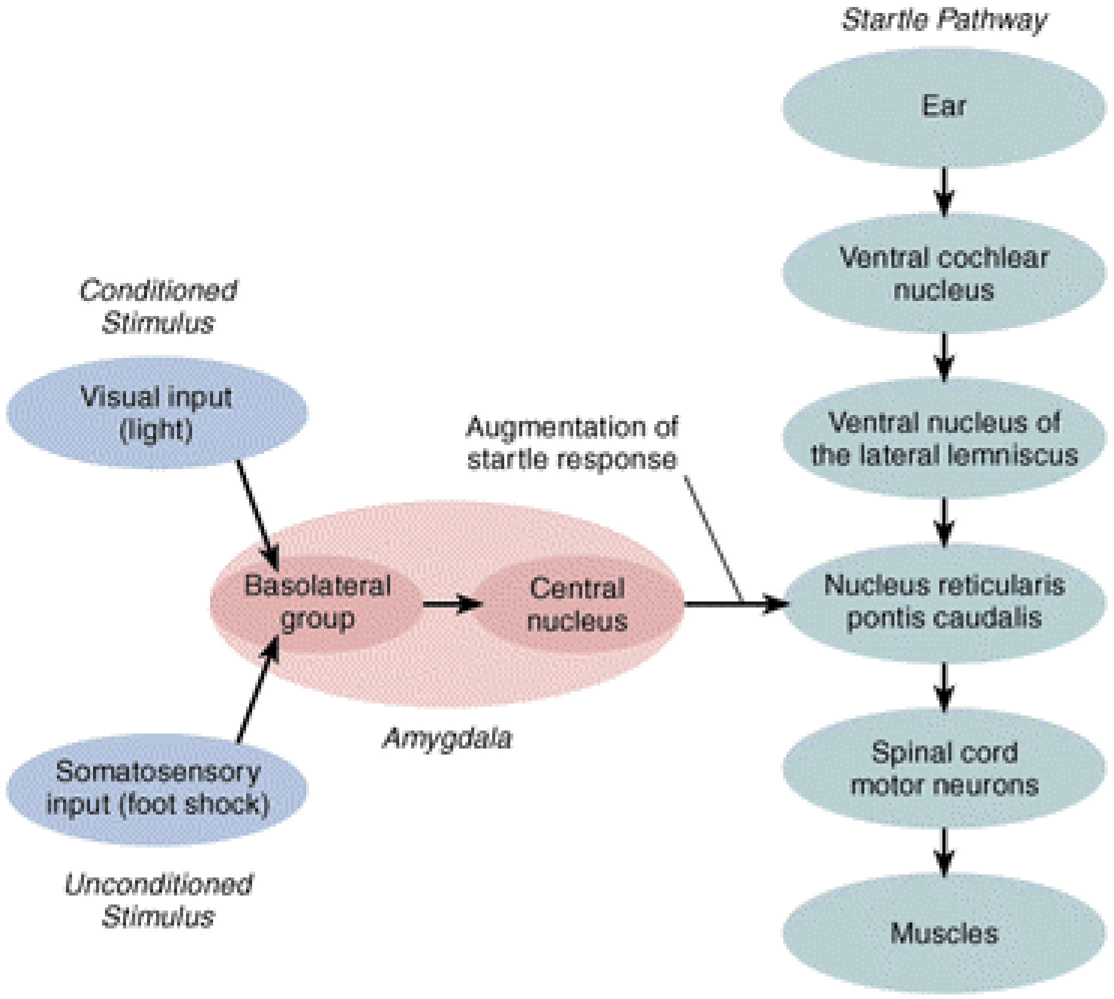
Looking at PICTURES
Pleasant
Neutral
Unpleasant
Heart rate
Change (BPM)
0
-1
-2
-3
1 2 3 4 5 6
Time (s)
Skin Conductance
Change (µSiemens)
.4
.2
0
1 2 3 4 5 6
Time (s)
Corrugator EMG
Change (µv)
8
6
4
2
0
1 2 3 4 5 6
Time (s)

A few Applications

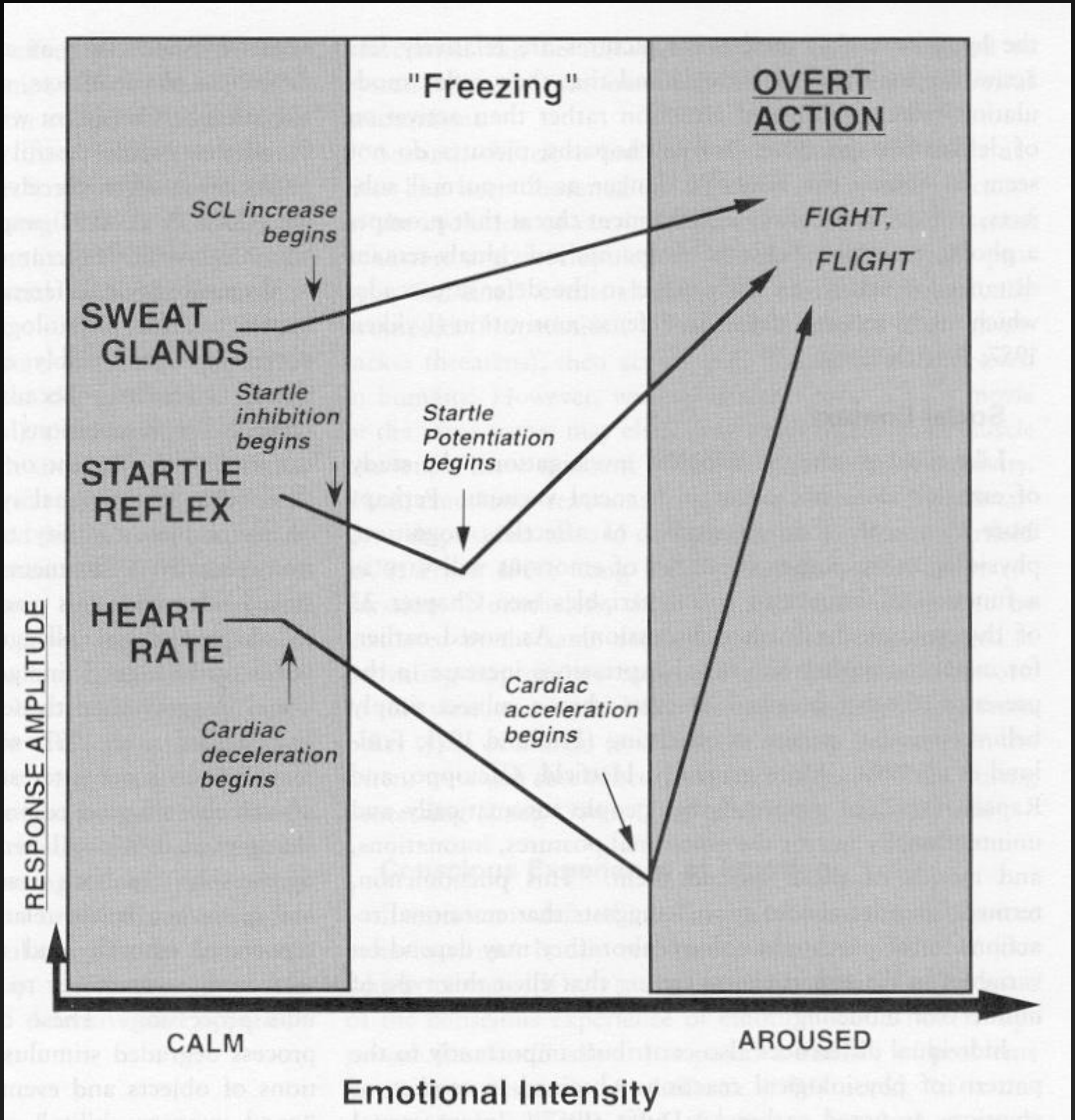
- Startle Probe
- Subtle affect
  - Mere Exposure
  - Subliminal effects
  - Mortality Salience
  - Biofeedback of EEG -- outcome measure
  - Emotion Regulation – outcome measure
  - Empathy – individual difference measure


Military
Warheads
Fuel
MISSILE

► Neural Circuits Responsible for an Auditory Startle Response and for Its Augmentation by Conditioned Aversive Stimuli

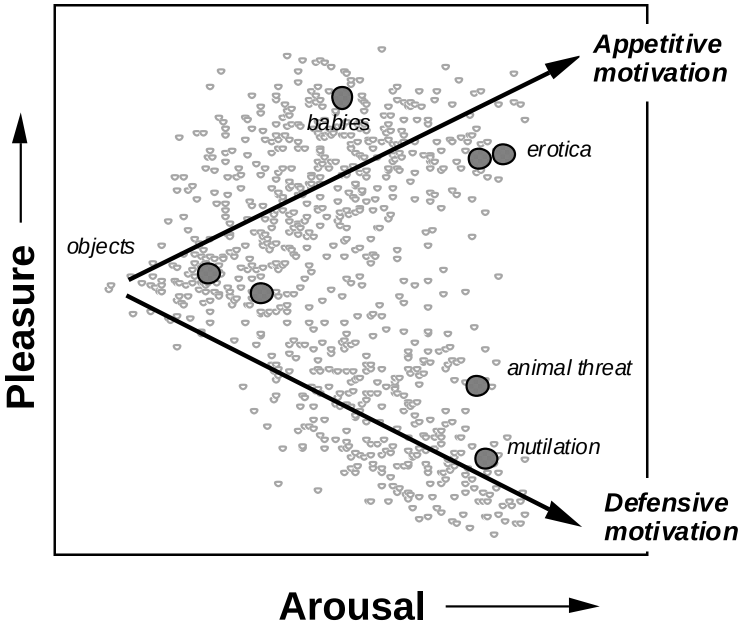


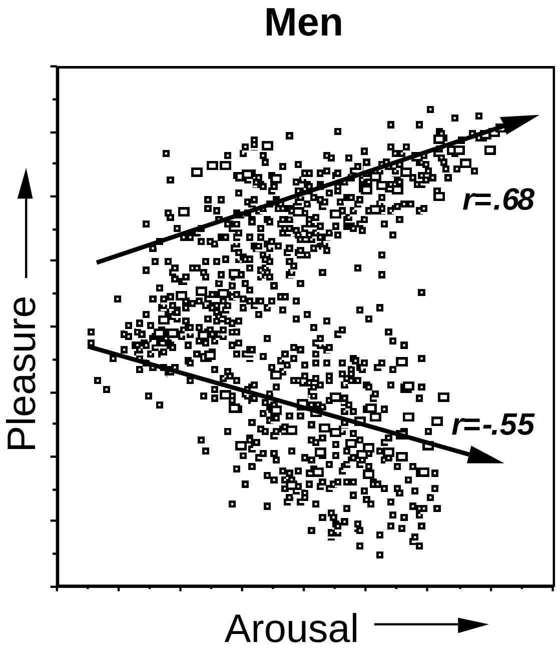
Source: Adapted from Davis, M., *Trends in Pharmacological Sciences*, 1992, *13*, 35–41.

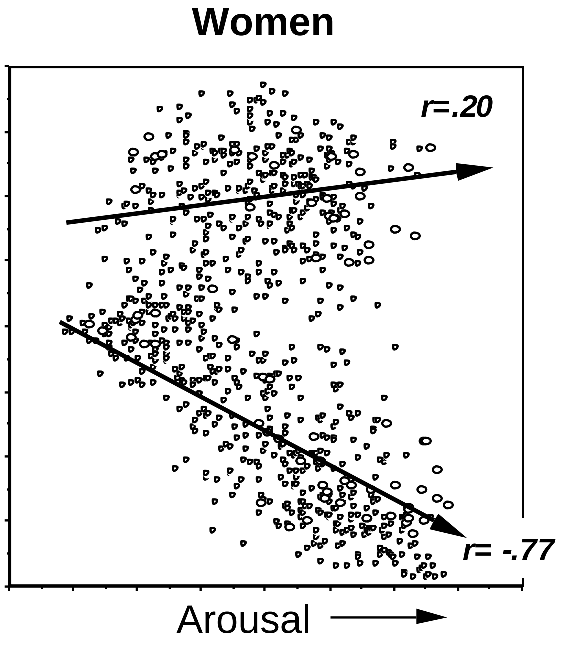

"Freezing"
OVERT ACTION
SCL increase begins
FIGHT, FLIGHT
SWEAT GLANDS
Startle inhibition begins
Startle Potentiation begins
STARTLE REFLEX
HEART RATE
Cardiac acceleration begins
Cardiac deceleration begins
RESPONSE AMPLITUDE
CALM
AROUSED
Emotional Intensity

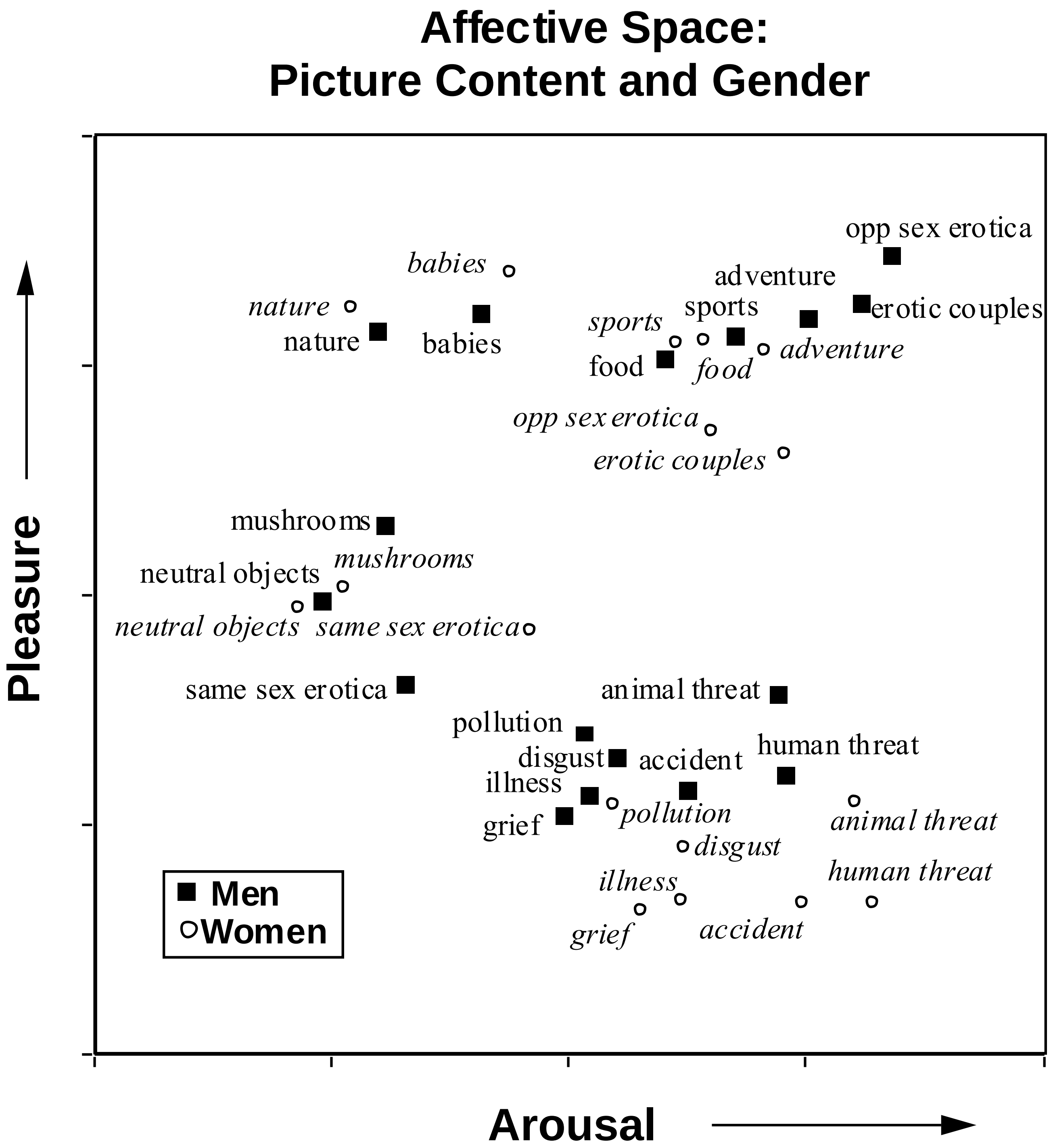
OR Vs DR

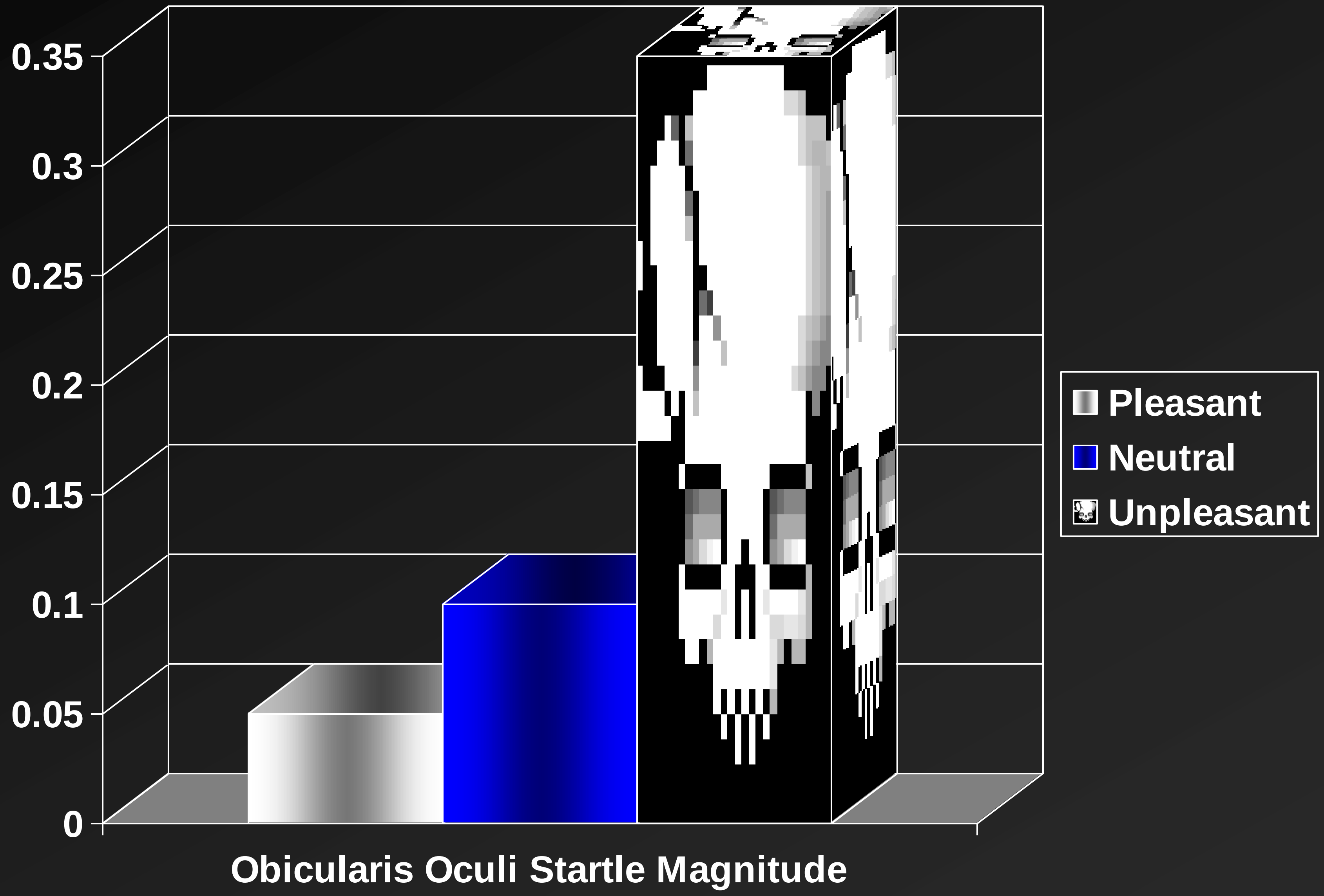
International Affective Picture System (IAPS)





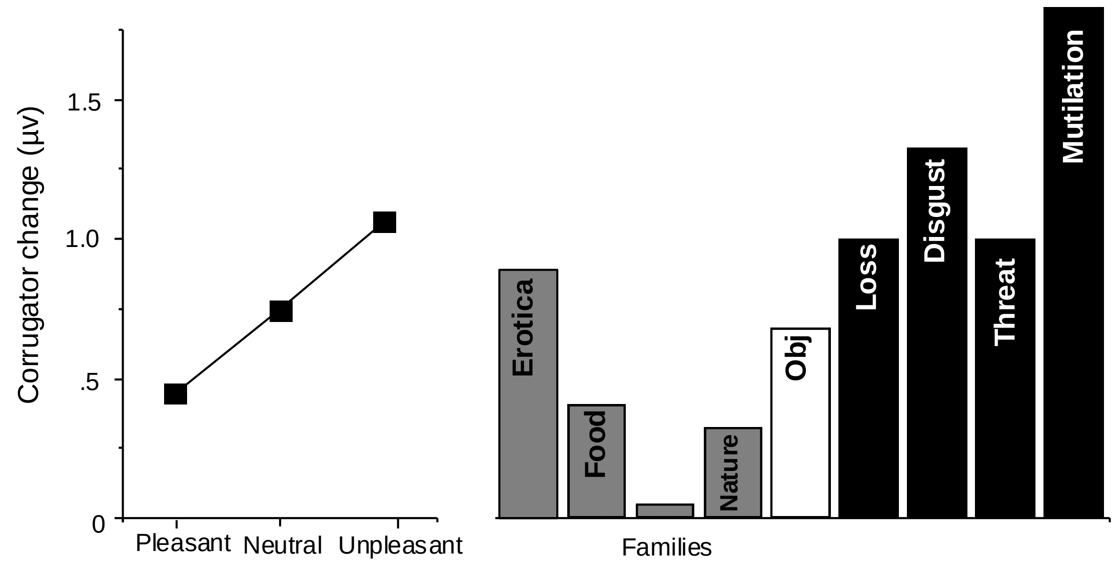



Affective Space:
Picture Content and Gender
Pleasure
Arousal
opp sex erotica
adventure
erotic couples
sports
babies
nature
babies
nature
sports
food
food
adventure
opp sex erotica
erotic couples
mushrooms
mushrooms
neutral objects
neutral objects
same sex erotica
same sex erotica
animal threat
pollution
human threat
disgust
accident
illness
pollution
grief
animal threat
disgust
illness
human threat
grief
accident
Men
Women

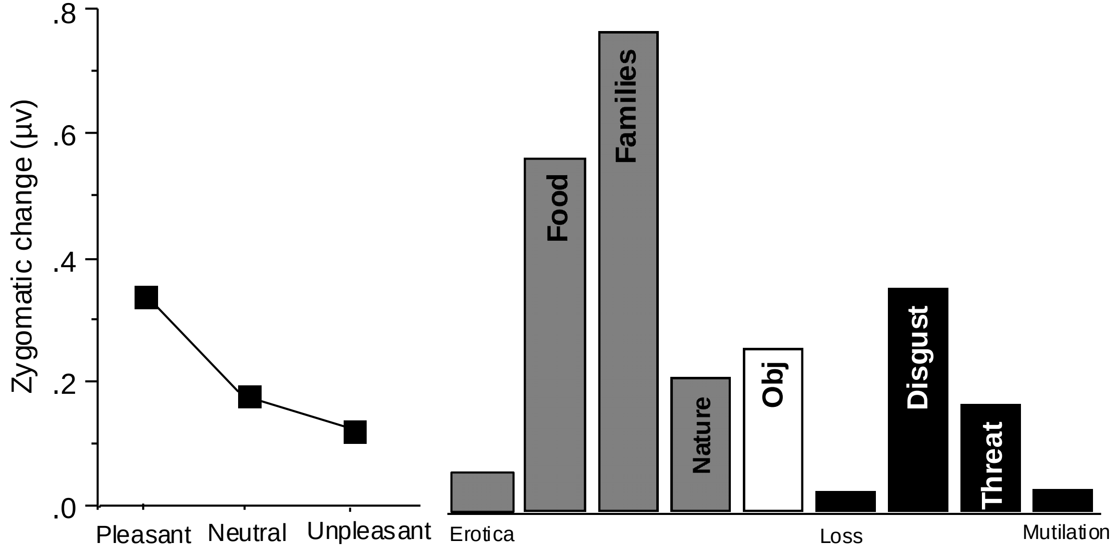


Note: same physical acoustic stimulus to elicit startle, only visual background picture differs

Corrugator EMG



Zygomatic EMG



Resting HRV as moderator of Startle Potentiation

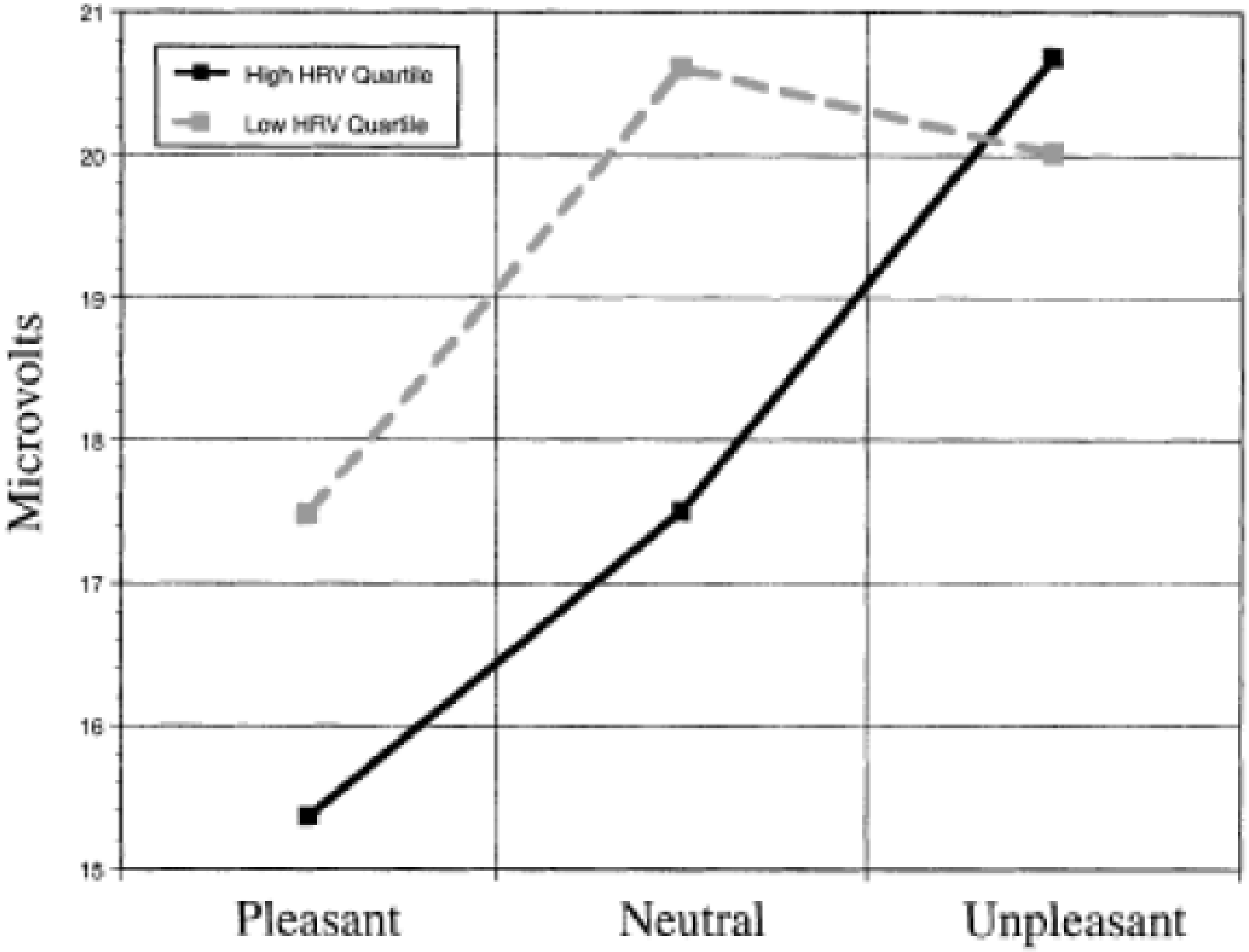


Figure 1. Mean startle amplitude as a function of baseline HRV and valence. Startle amplitudes are in microvolts.

From: Ruiz-Padiala, Sollers, Vila, & Thayer (2003) *Psychophysiology*

A few Applications

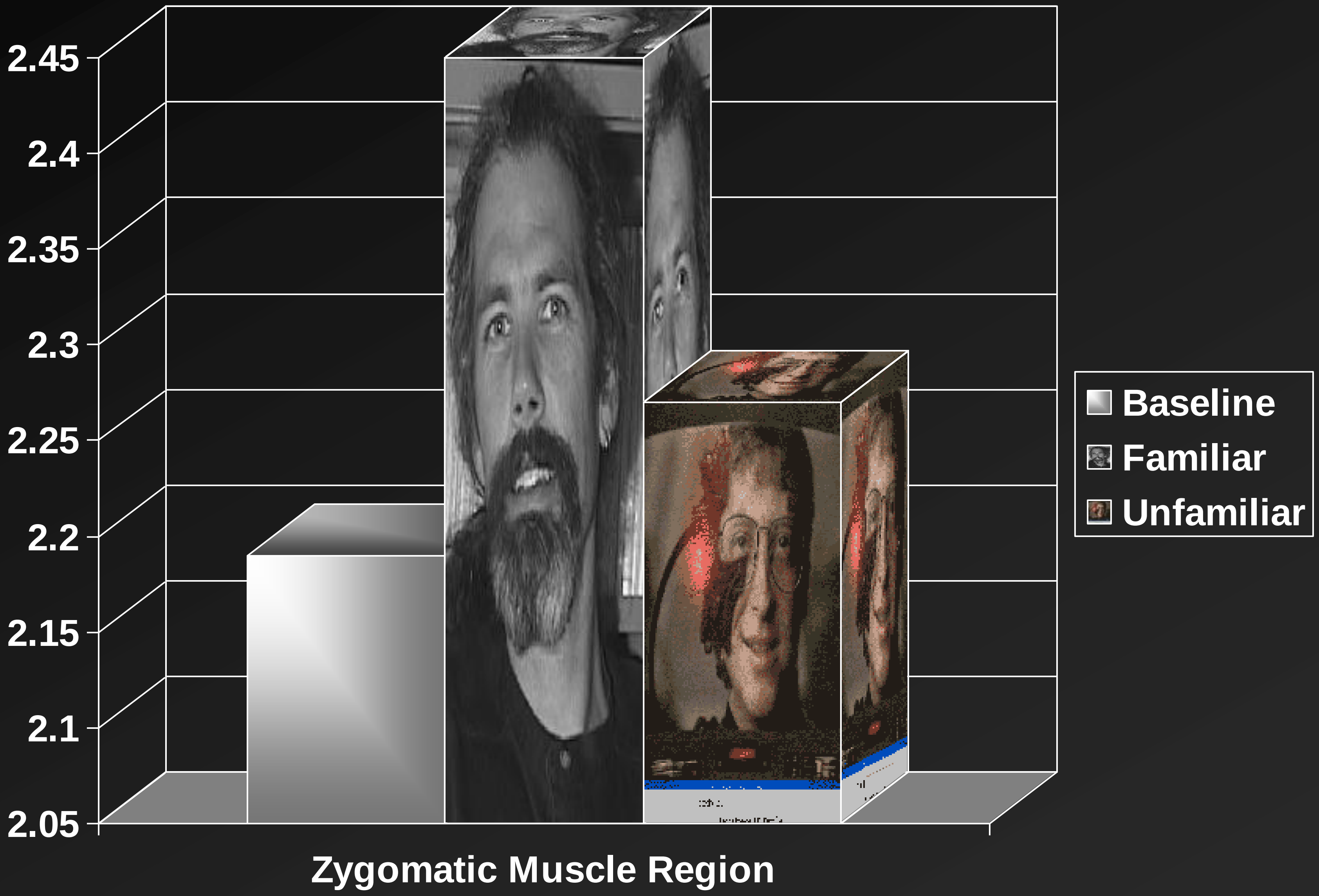
- Startle Probe
- Subtle affect
  - Mere Exposure
  - Subliminal effects
  - Mortality Salience
  - Biofeedback of EEG -- outcome measure
  - Emotion Regulation – outcome measure
  - Empathy – individual difference measure

The Phenomenon:

- People prefer stimuli to which they have been previously exposed to unfamiliar stimuli
- In absence of any reinforcement (“mere” exposure)
- Examples:
  - People we see incidentally in our routines
  - Songs
  - Scientific journal preferences
- Effect size r=.26 (Meta-analysis,Bornstein, 1989)

The logic:

- Evolutionary account Bornstein (1989)
  - it may be adaptive to prefer the familiar over the novel
  - novel objects could present a potential threat
  - organisms that had a fear of the strange and unfamiliar were more likely to survive, reproduce, and pass on genetic material
  - Preferring the familiar may thus be an adaptive trait that has evolved in humans and nonhumans
- Prediction:
  - unfamiliar as compared with familiar stimuli may be associated with more negative attitudes because of the unfamiliar stimuli’s association with potential danger
  - Thus may see greater corrugator activity to novel than to familiar
  - No prediction for positive affect (Zygomaticus activity)



Loosely translated from Harmon-Jones & Allen, 2001

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30 ms

5 ms


Dimberg et al *Psychological Science* 2000

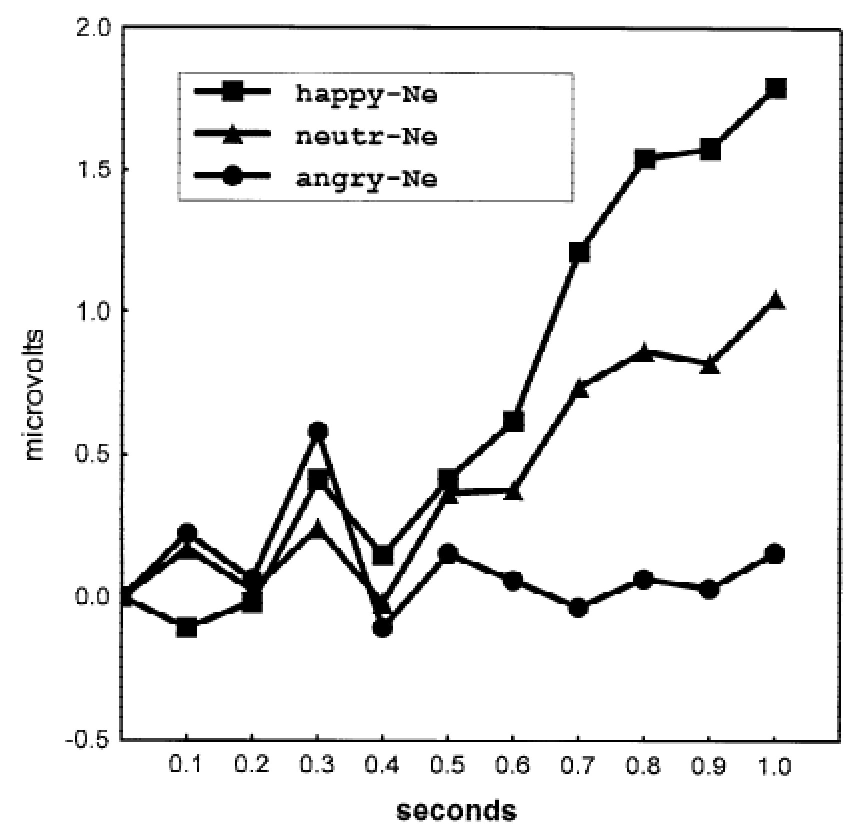

Fig. 1. Mean facial electromyographic response for the *zygomatic major* muscle, plotted in intervals of 100 ms during the first second of exposure. Three different groups of participants were exposed to identical neutral faces ("Ne"), preceded by unconscious exposure of happy, neutral ("neutr"), or angry target faces, respectively.

Dimberg et al *Psychological Science* 2000

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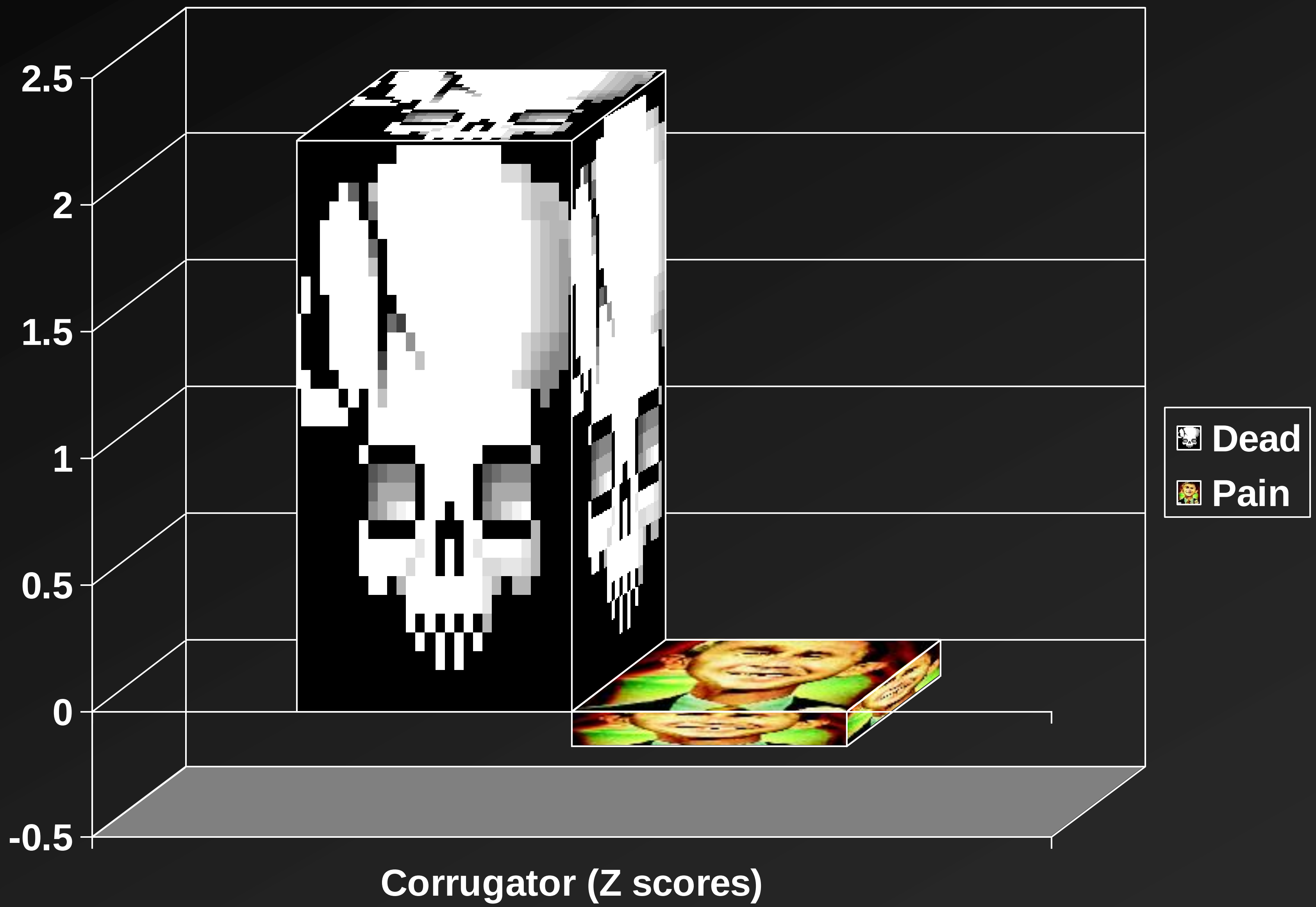

Another loose translation: Arndt, J., Allen, J.J.B., & Greenberg, J. (2001). Traces of terror: Subliminal death primes and facial electromyographic indices of affect. *Motivation and Emotion*, *25*, 253-277.

A few Applications

- Startle Probe
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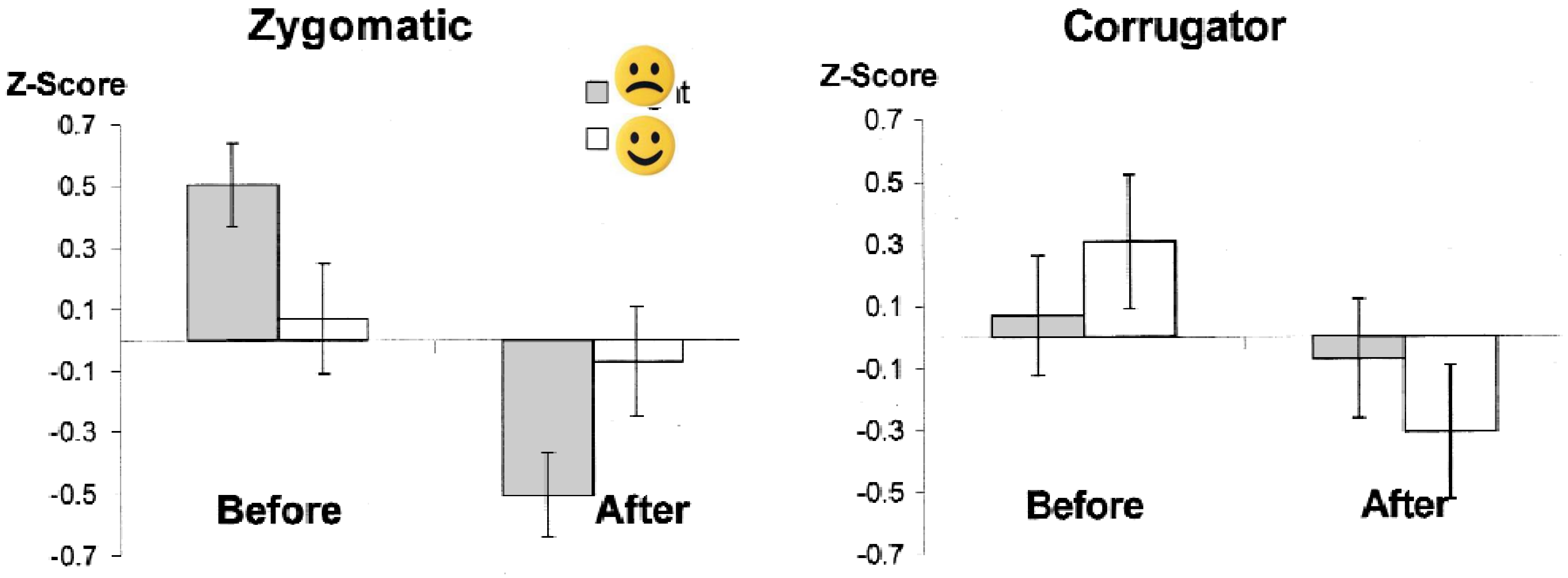

Allen, Cavender, Harmon-Jones, *Psychophysiology* 2001

A few Applications

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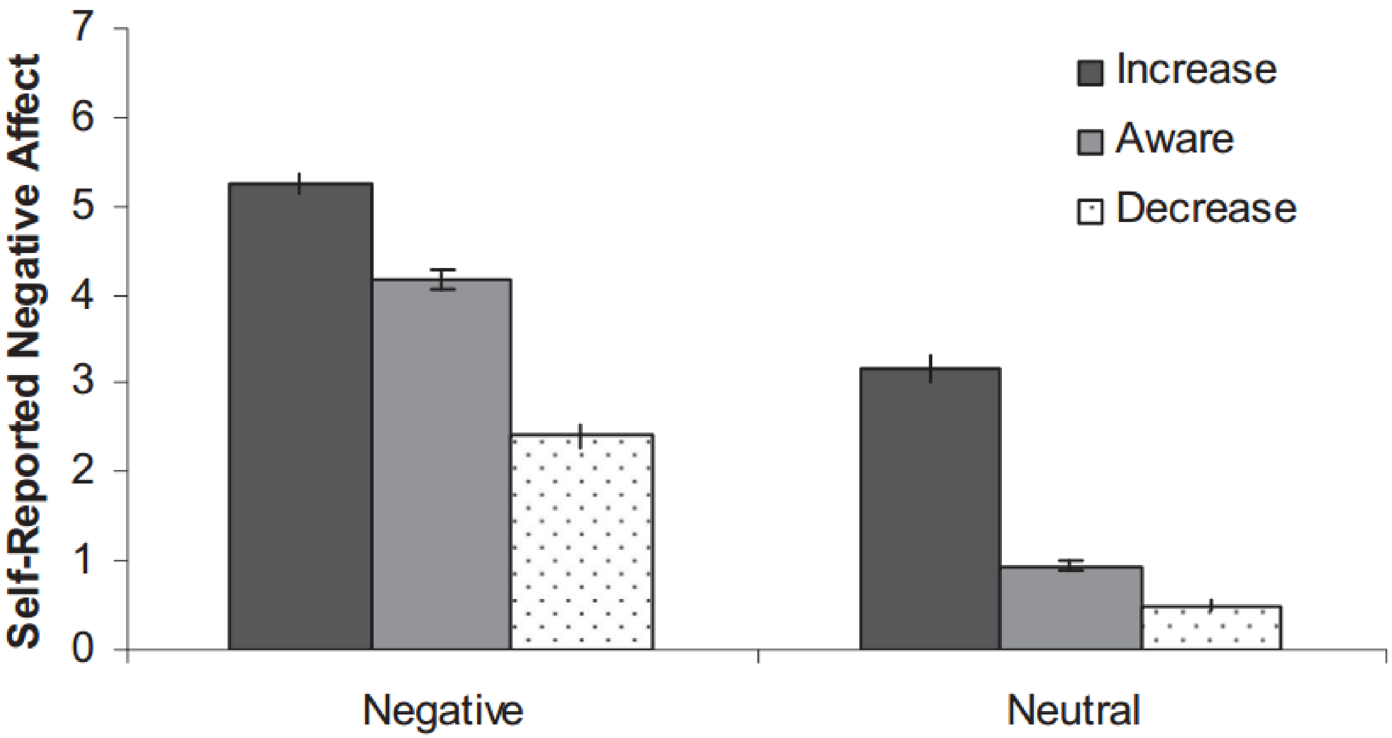

Figure 1. Self-reported negative affect on a 7-point Likert scale, where 0 = "not negative at all" and "7" = "strongly negative."

Ray, McRae, Ochsner, & Gross, *Emotion*, 2010

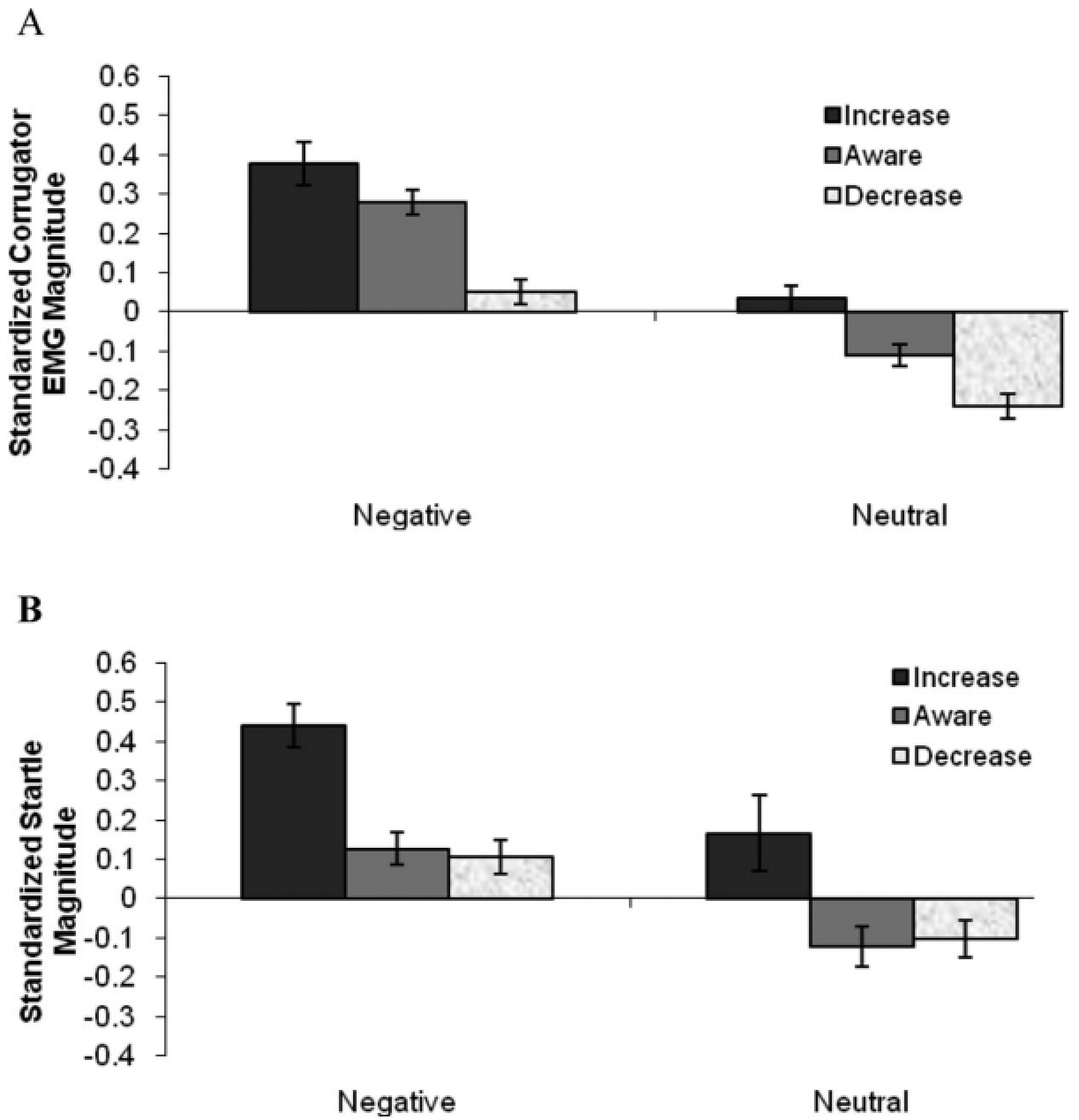

Figure 2. Standardized (A) corrugator EMG and (B) startle magnitude (averaged over Times 1 and 2).

Ray, McRae, Ochsner, & Gross, *Emotion*, 2010

A few Applications

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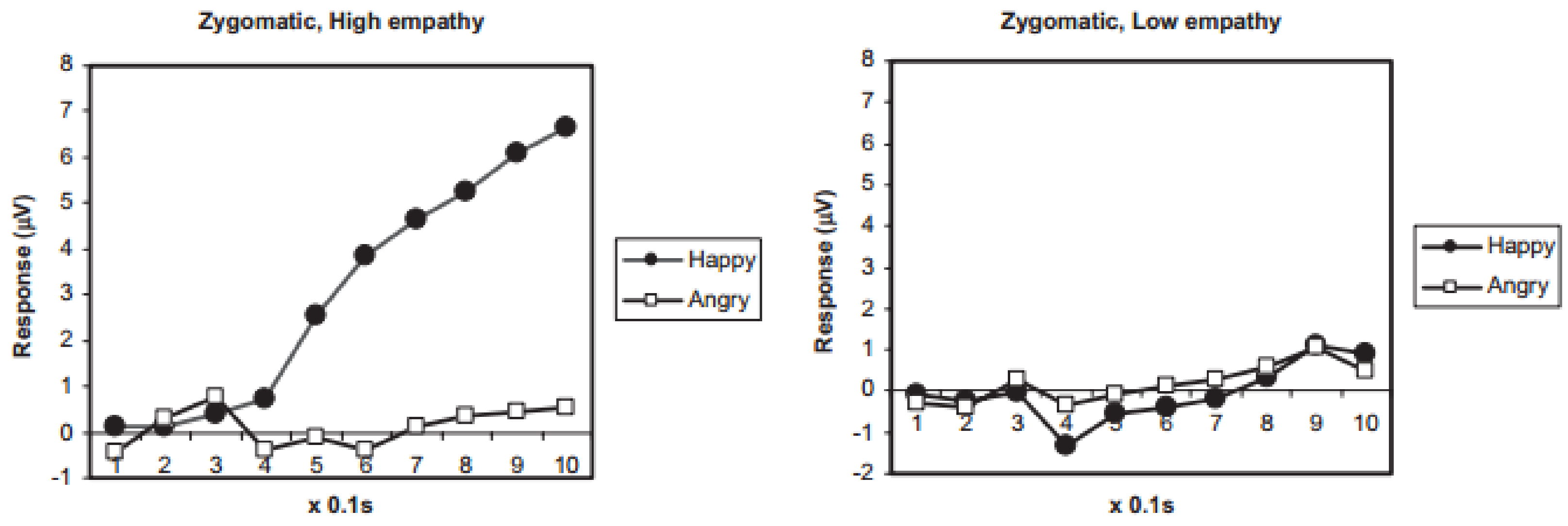

Faces

Figure 1. The *zygomaticus major* muscle response to pictures of happy and angry facial expressions for the High and Low empathy groups, plotted as a function of 100-ms intervals during the first second after stimulus onset.

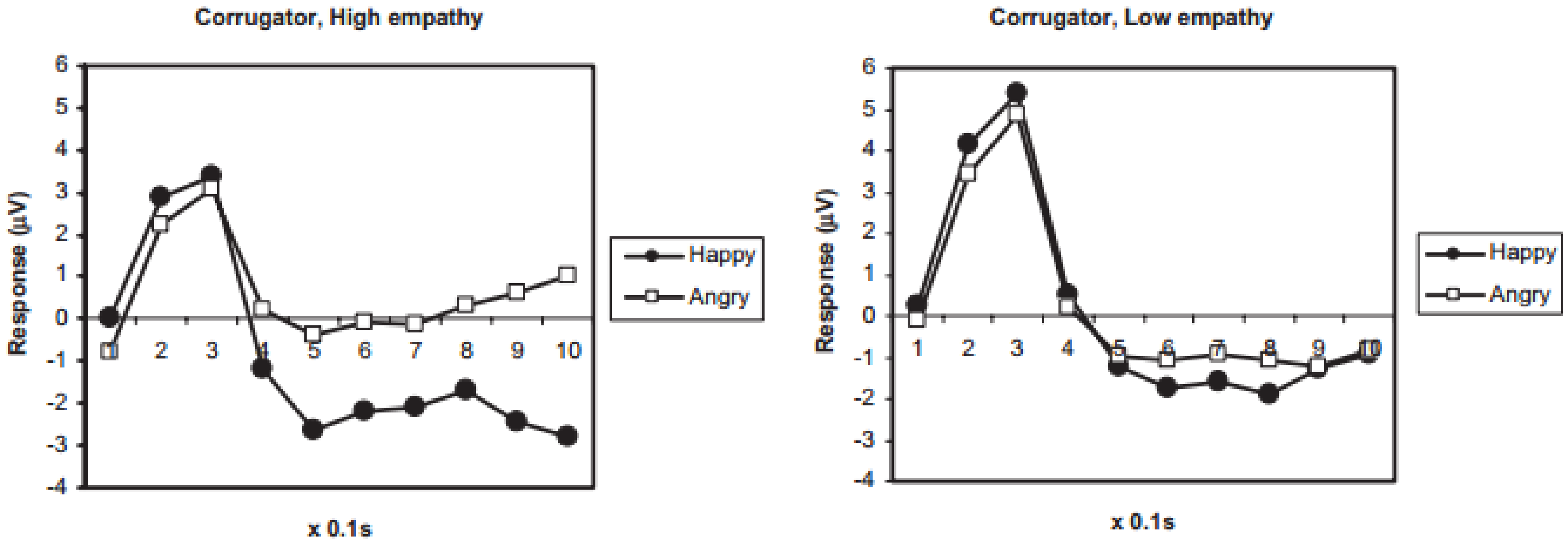

Figure 2. The *corrugator supercilii* muscle response to pictures of happy and angry facial expressions for the High and Low empathy groups, plotted as a function of 100-ms intervals during the first second after stimulus onset.

Dimberg & Thunberg (2012) *PsyCh Journal*