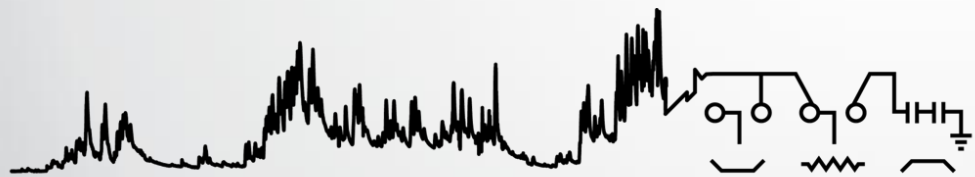


Call Center Stress Recognition with Person-Specific Models



affectivecomputing



MIT MEDIA LAB



**Massachusetts
Institute of
Technology**

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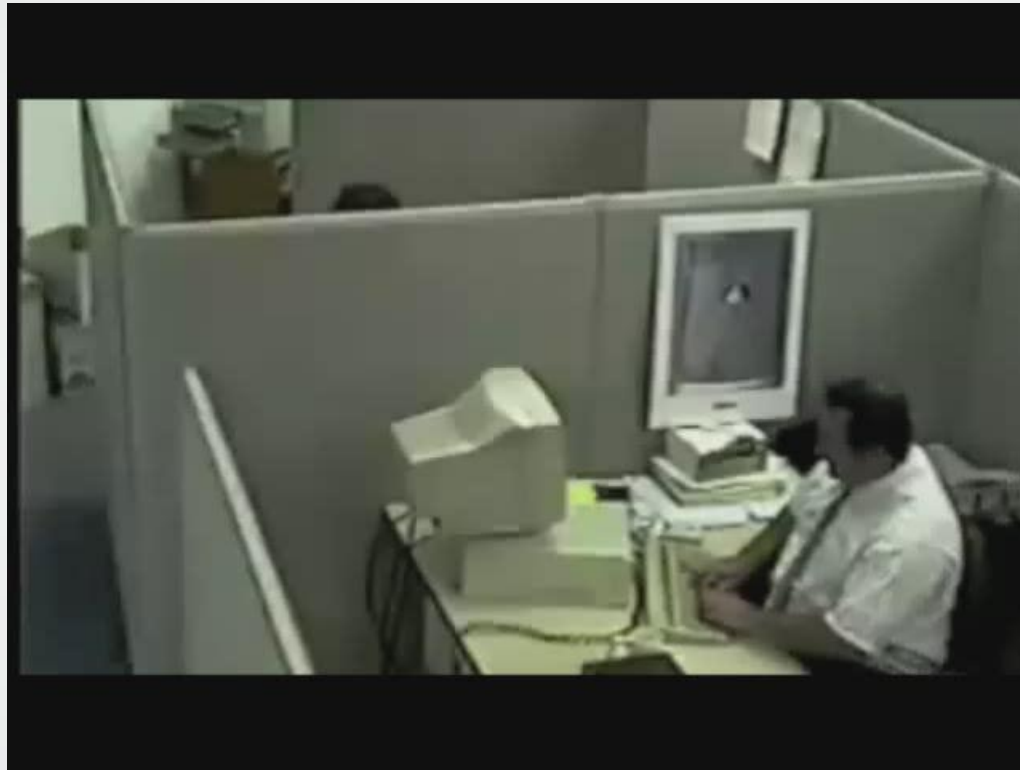
ACII 2011 – October 11

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Motivation



Motivation

Headaches



Fatigue



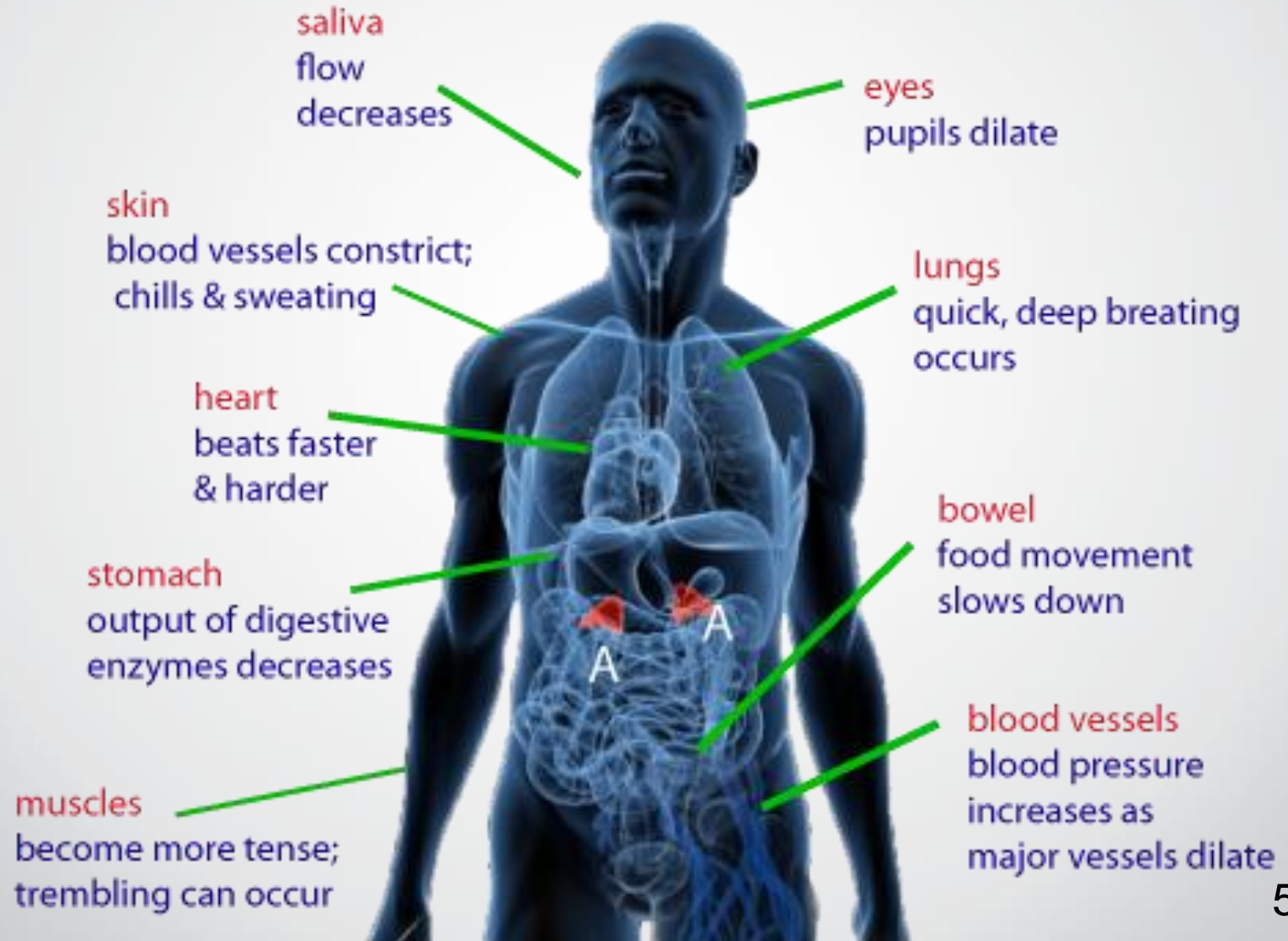
Anxiety

Depression

Insomnia

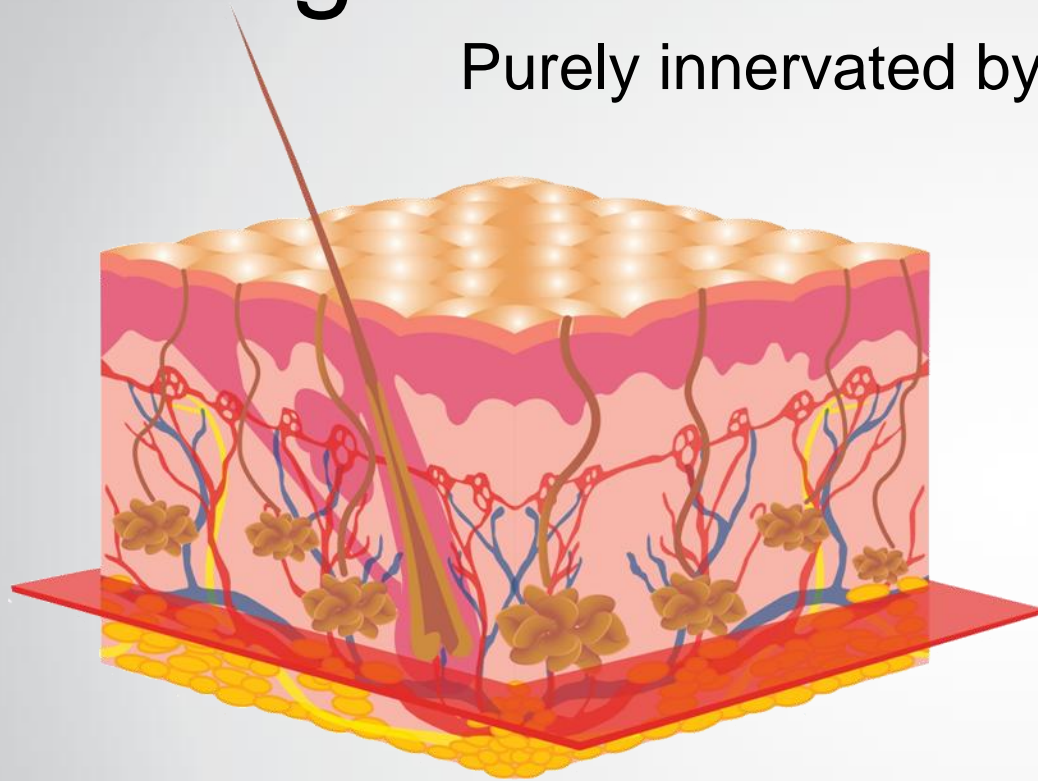


Background: Stress



Background: Eccrine Sweat Glands

Purely innervated by Sympathetic Nervous System



Measurement

- Electrodermal Activity (EDA)
- Skin Conductance
- Simple Sensors

Very Sensitive

- Humidity
- Physical Activity
- Pressure

Poh, Swenson & Picard, 2010



Background: Stress Recognition

Controlled Settings

Barreto et al. 2007

Shi, et al. 2010

Setz et al. 2010

Artificial Stressors

Electric shocks, cognitive tasks, psychosocial threats...

Uncontrolled Settings

Healey & Picard 2005

Plarre et al. 2011

Obtrusive Sensors

Blood volume pulse, pupil dilation, heart rate variability, respiration, muscle tension...



Data Collection

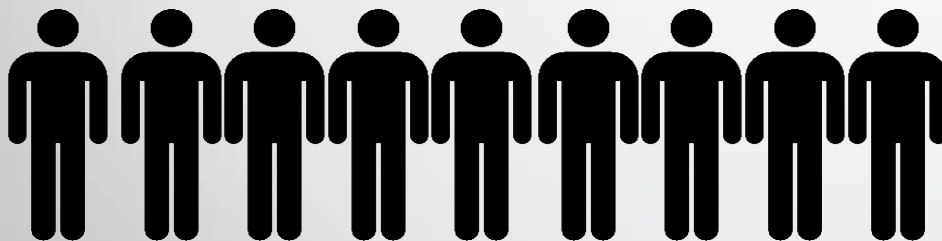


9 call center employees

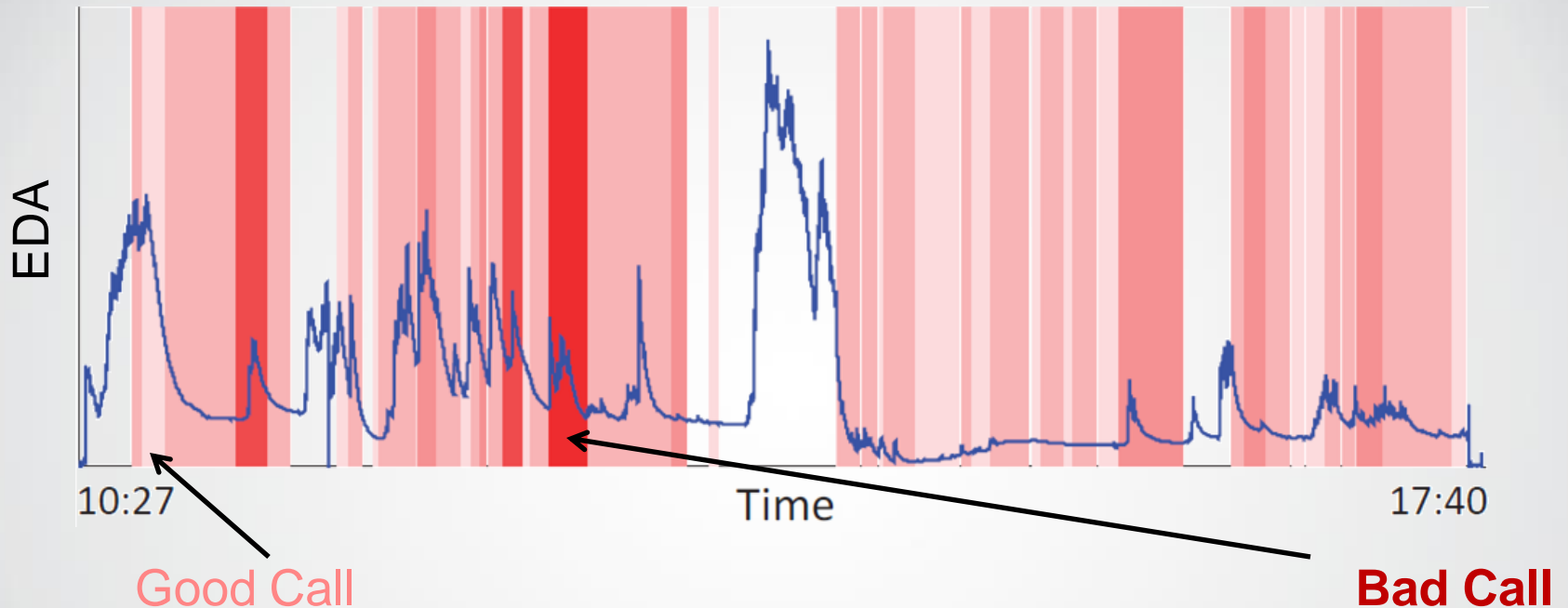
One week

1500 calls

113 hours of EDA



Data Collection



Ratings	1	2	3	4	5	6	7
# Calls	657	379	163	139	45	83	38

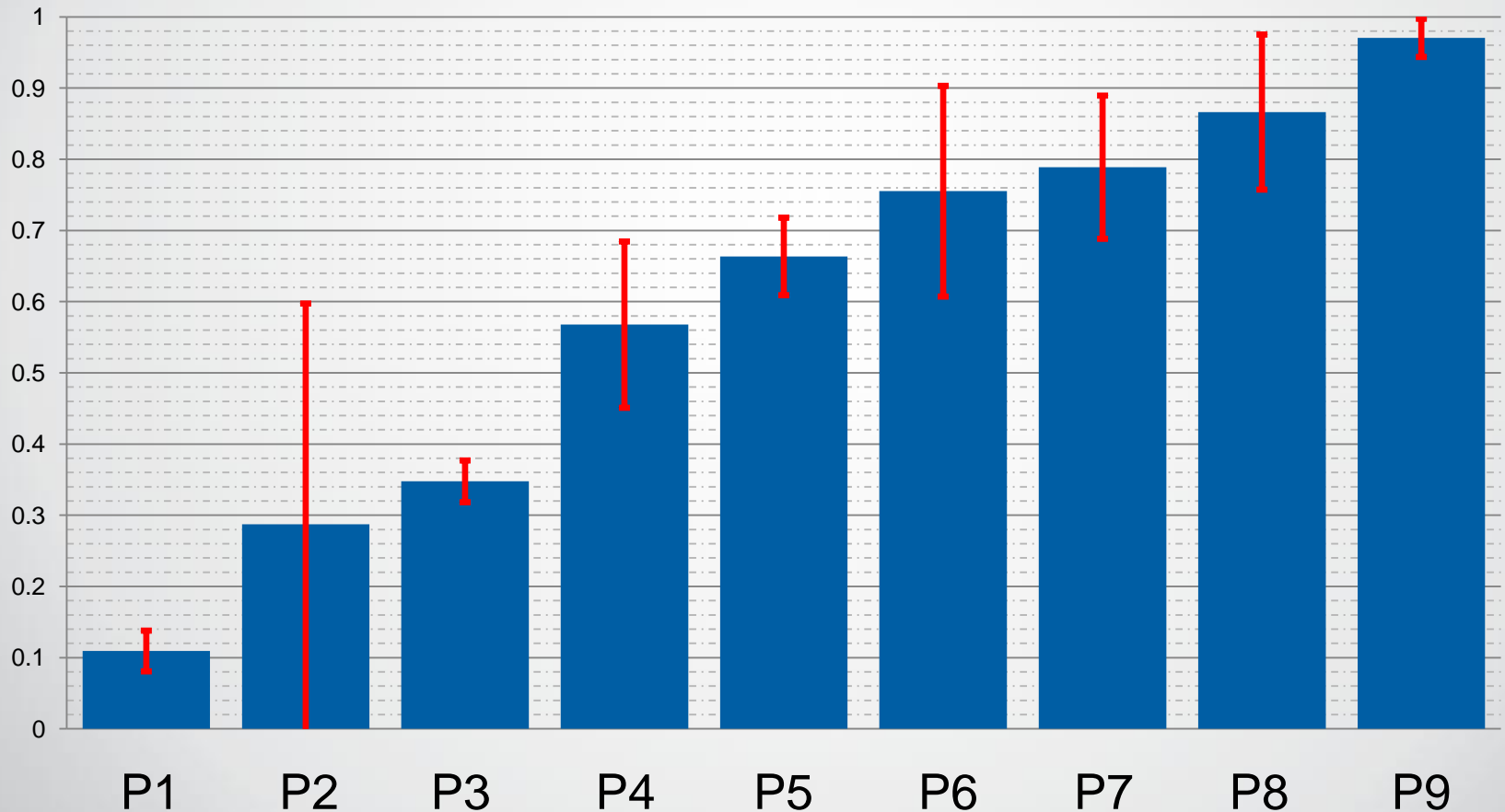
“Non-Stressful”

VS

“Stressful”

Person Variability

People vary hugely in how many calls they label as “stressful”



Person Variability

There are many person-dependent variables in EDA

Age

Ethnicity

Hormonal Cycle

Personality

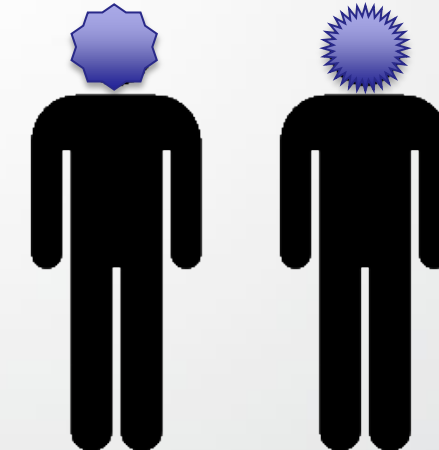
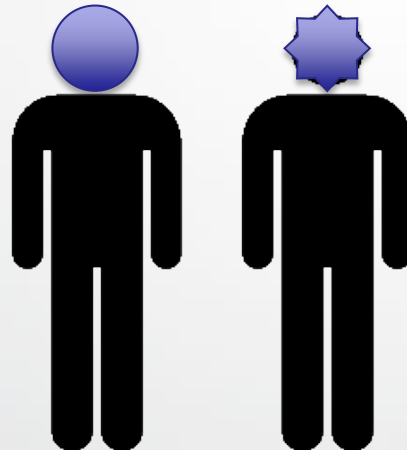
Gender

Stabiles

Labiles

Electrodermal
Responsivity

Low



High

Active
Expressive
Assertive
...

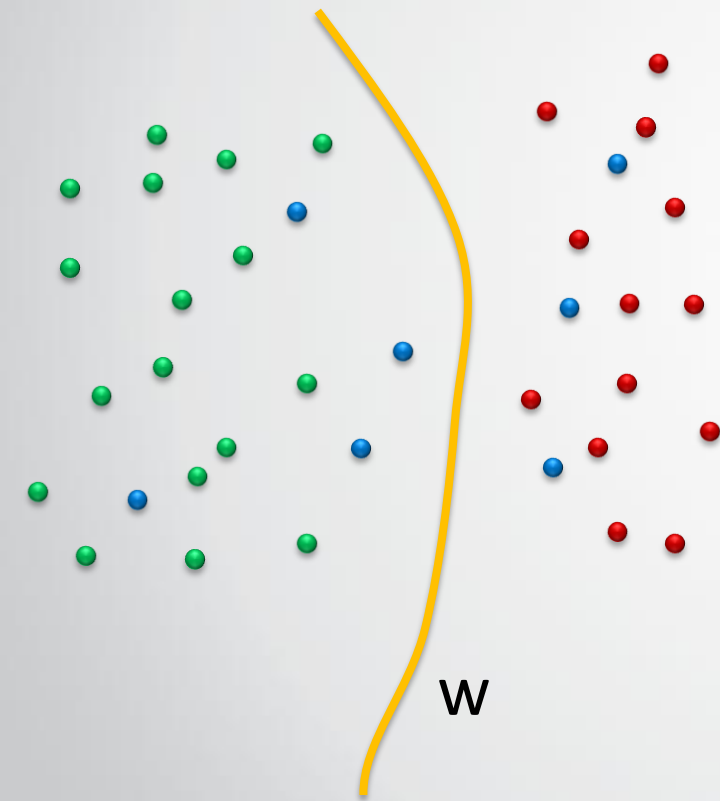
Calm
Agreeable
Deliberative
...

Kelsey, 1991

Crider, 2008

Proposed Method

Optimal Data Distribution



Support Vector Machines

$$\min_w \underbrace{\frac{1}{2} \|w\|^2}_{\text{Regularization}} + C \underbrace{\left(\sum_{i \in \bullet} \epsilon_i + \sum_{k \in \bullet} \epsilon_k \right)}_{\text{Loss function}}$$

$$\text{s.t. } w^T x_i \geq 1 - \epsilon_i$$

$$w^T x_k \leq 1 - \epsilon_k$$

$$\epsilon_i \geq 0, \epsilon_k \geq 0 \quad \forall i \in \bullet \text{ and } \forall k \in \bullet$$

Boser et al. 1992

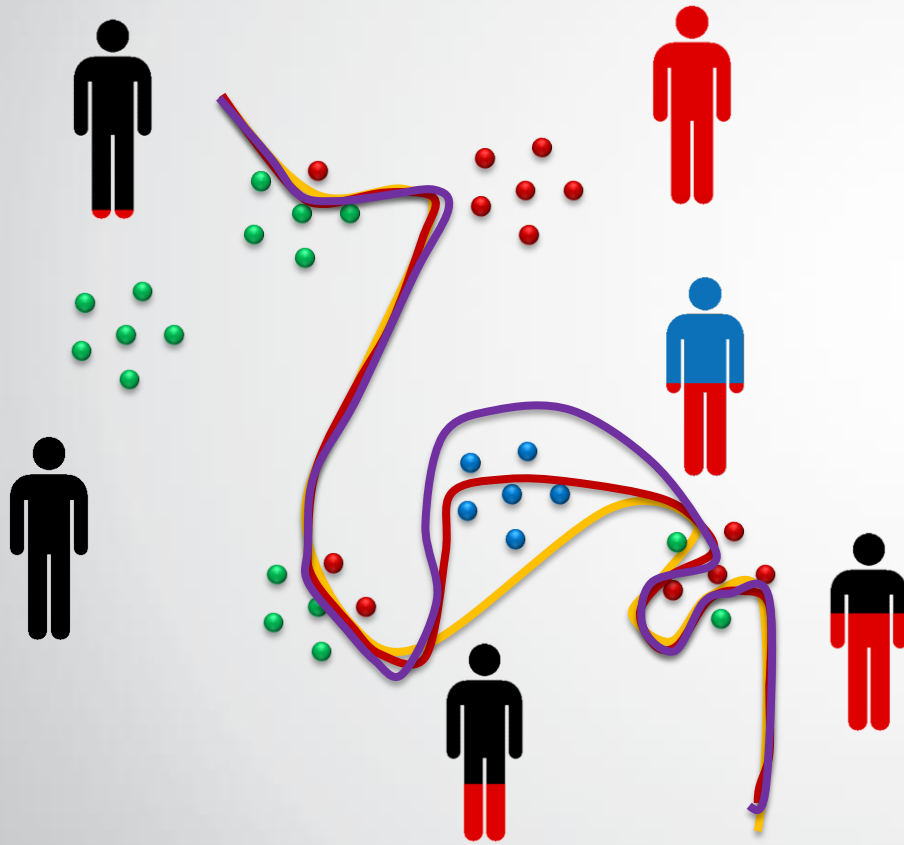
■
● “Stressful” Call

● “Non-Stressful” Call

● Testing Call

Proposed Method

“Realistic” Data Distribution



Best Hyperplane?

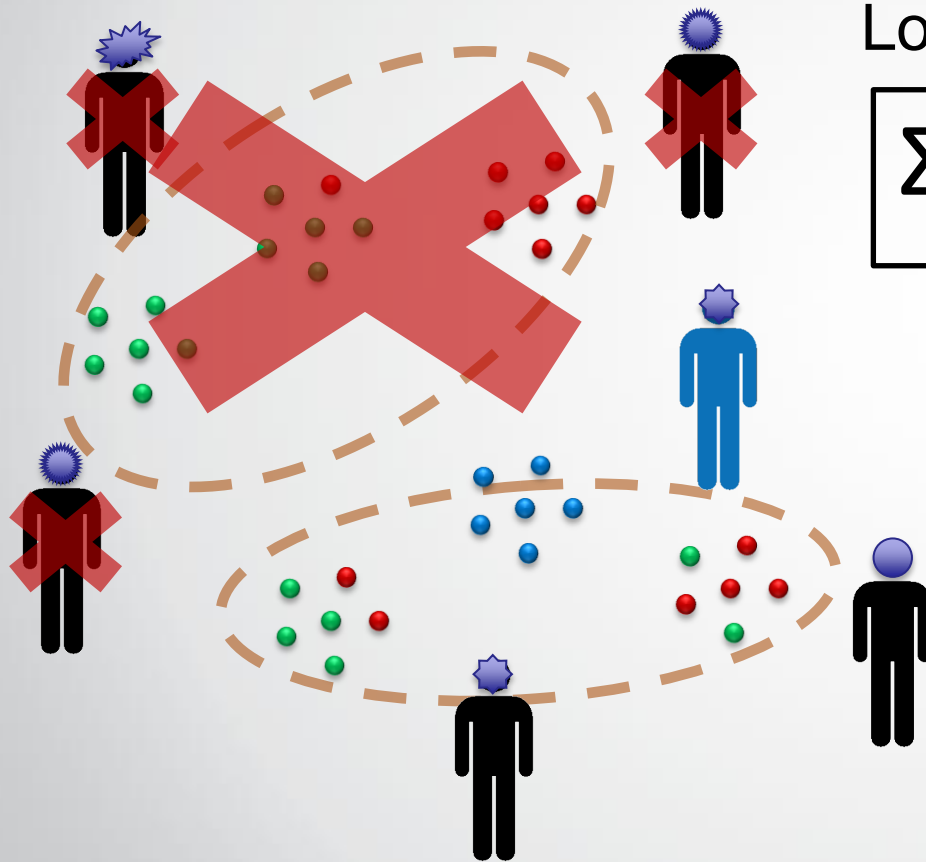
Loss function to **change priors**:

$$\sum_{i \in \bullet} S \epsilon_i + \sum_{k \in \bullet} S \epsilon_k$$
$$S = \frac{\% \bullet \text{ in testing}}{\% \bullet \text{ in training}} \quad \mathcal{S} = \frac{\% \bullet \text{ in testing}}{\% \bullet \text{ in training}}$$

Huang & Du, 2005

■ “Stressful” Call ● “Non-Stressful” Call ● Testing Call

Proposed Method



Loss function to **encode similarity**:

$$\sum_{p \in \{\text{employees}\}} V_p \sum_{i \in \{\text{calls of } p\}} \epsilon_i$$

K Means ($K = 2$)

$V_p = 1$ if p is in the closer cluster
 $V_p = 0$ if p is in the further cluster

■
● “Stressful” Call ● “Non-Stressful” Call ● Testing Call

Experimental Results

Features Call duration, mean, standard deviation, peak height distribution*, slope, zero crossings, max. and min. values and their relative positions

* Setz et al. 2010

Protocols

A → Leave-one-day out

Train/test same person

B → Leave-one-person out

Train/test different people

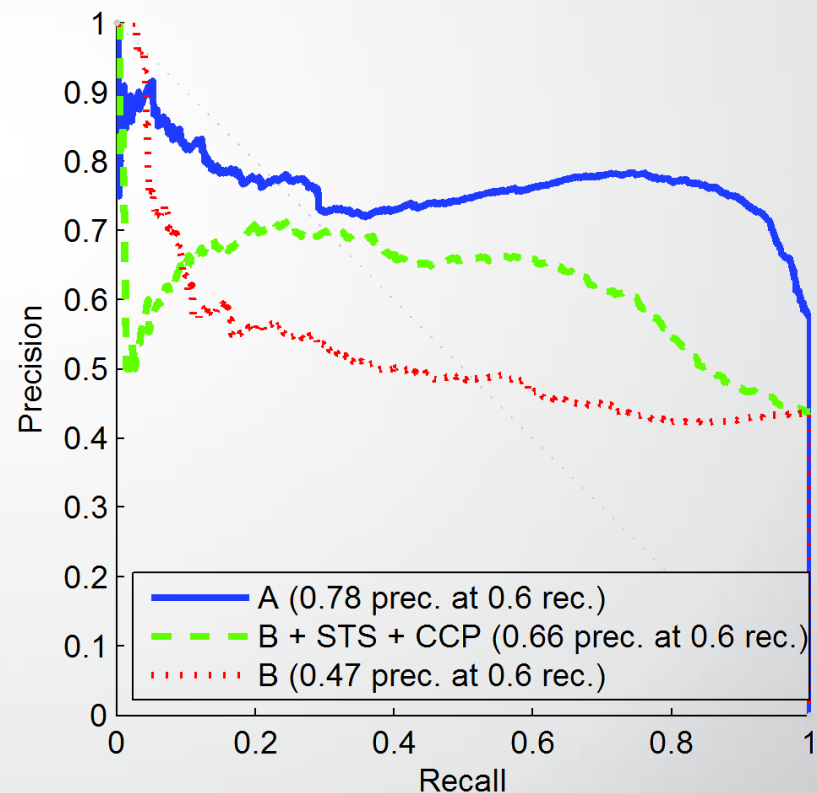
Average Accuracy

78.03% - A

58.45% - B

73.41% - B with Improvements

Precision-Recall Curves



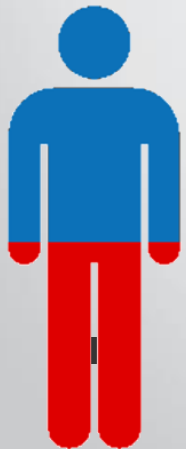
Conclusions

Uncontrolled (real-life) setting

Person-variability

- Sources (unbalanced reports, EDA lability)
- Problem (data distribution)

Using testing data



Changing Class Priors
(using one day of priors)

Selecting Training Samples
(using unlabeled testing data)



More Information

Hernandez, J., Morris, R.R., Picard, R.W. "**Call Center Stress Recognition with Person-Specific Models**," In Proceedings of the Affective Computing and Intelligent Interaction 2011

or

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