Stress@work

What's your current stress level?

Detection of stress patterns from GSR sensor data

Jorn Bakker, Mykola Pechenizkiy, and Natalia Sidorova

Eindhoven University of Technology, the Netherlands

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http://www.win.tue.nl/stressatwork

Outline

- What is stress?
- Acute stress detection as drift detection
- Preliminary experimental results
- Further work

Impact of Stress at Work

WHO: by 2020 Top 5 diseases will be stress related.

USA: health care expenditures are ~50% greater for workers who report high levels of stress at work (J. Occup. Env. Med, 40:843-854).

the Netherlands: (TNO, 2006):

- The direct costs of stress are 4 billion Euro per year.
- Every year 150.000 – 300.000 employees become ill because of stress at work.
- 1 out of 7 disabled gets his condition because of stress at work.

Parties Interested

- Insurance companies
- Employers and employees
- Health and safety executives
- Medical specialists

Types of Stress and Stressors

Three kinds of stress:

- Acute: caused by an acute short-term stress factor.
- Episodic acute: occurs more frequently & periodically.
- Chronic: caused by long-term stress factors - harmful.

Factors causing stress@work:

- long work hours, work overload, time pressure, difficult, demanding or complex tasks, high responsibility, lack of breaks, lack of training
- conflicts, underpromotion, job insecurity, lack of variety, and poor physical work conditions (limited space, temperature and lighting conditions)

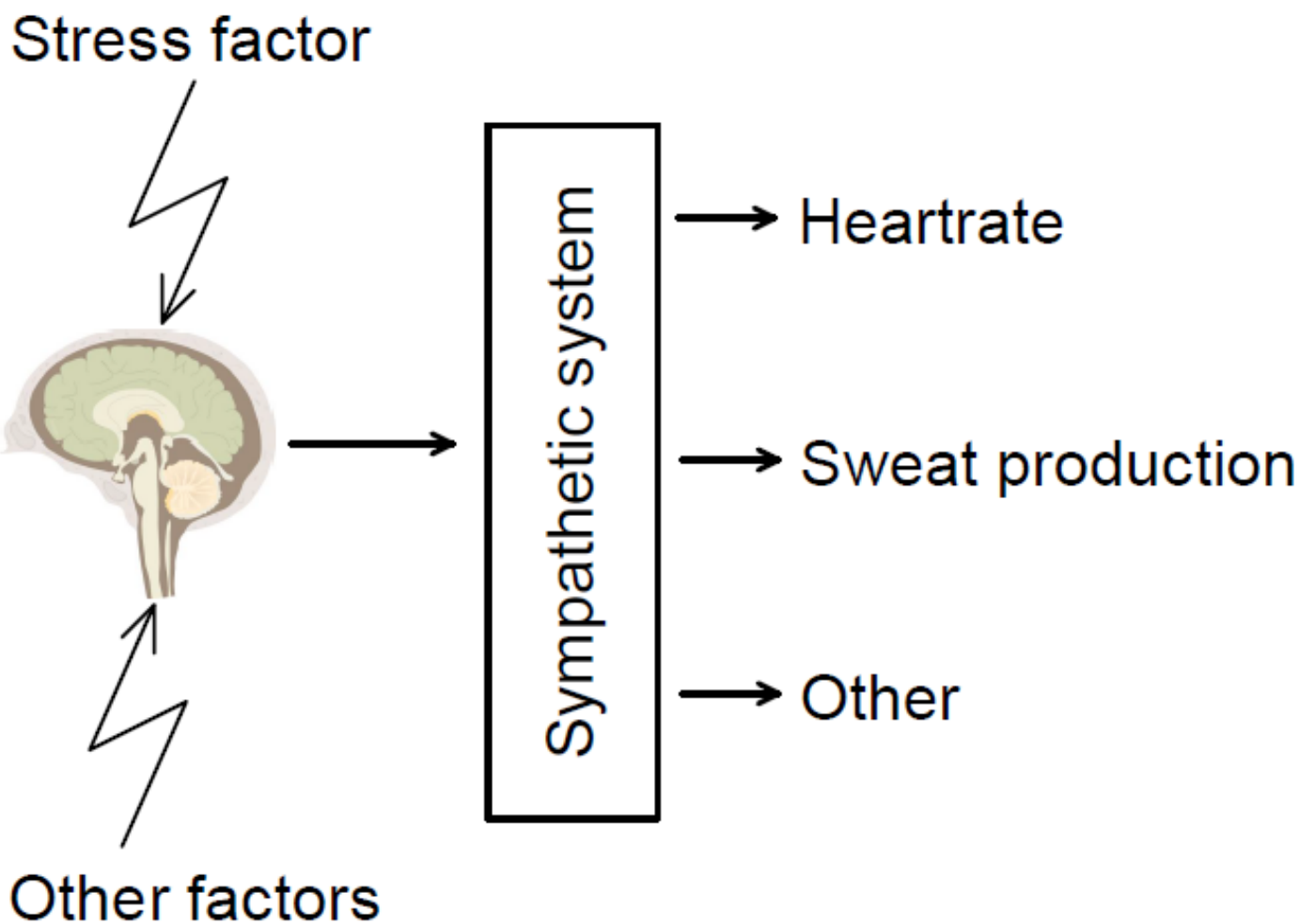
It's Better to Prevent Than to Cure

- Physical signals of acute stress can be observed:
  - Skin conductivity
  - Heart rate
  - Facial expressions
  - …

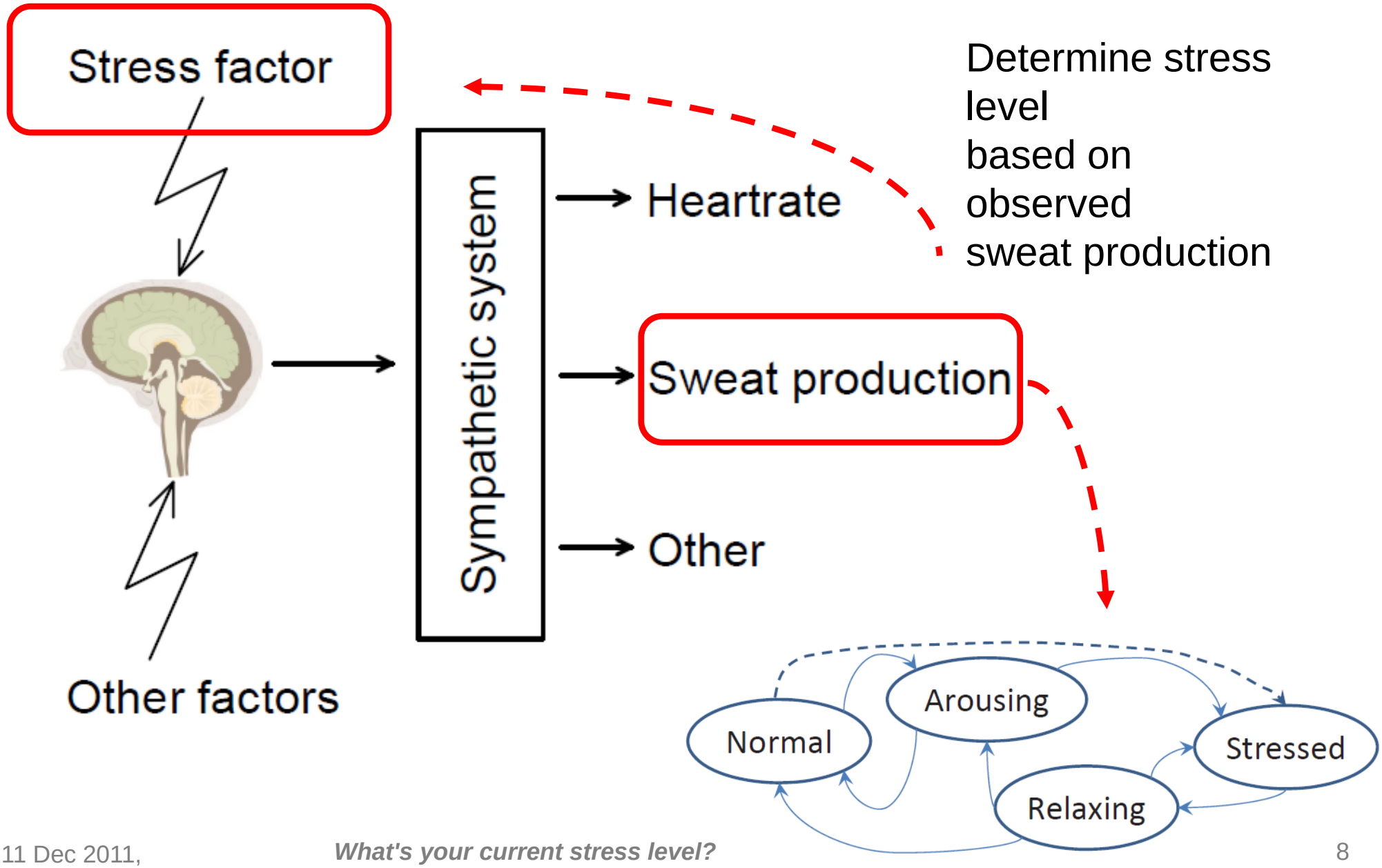
Be-eep!
You are getting stressed!

- Philips develops a device measuring and recording vital signs like skin conductivity (GSR) and heart rate, with a high frequency

How to measure stress

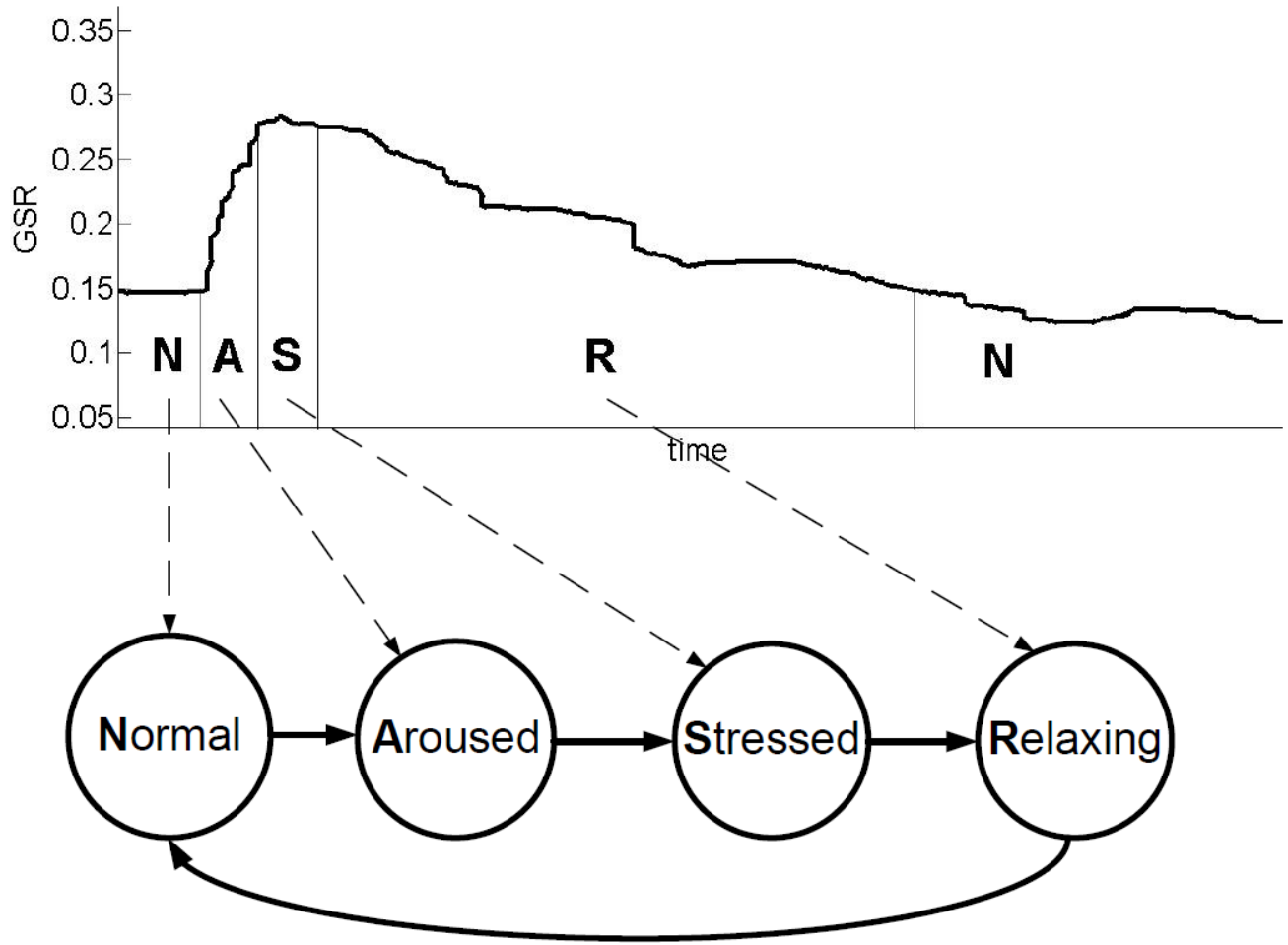


How to measure stress



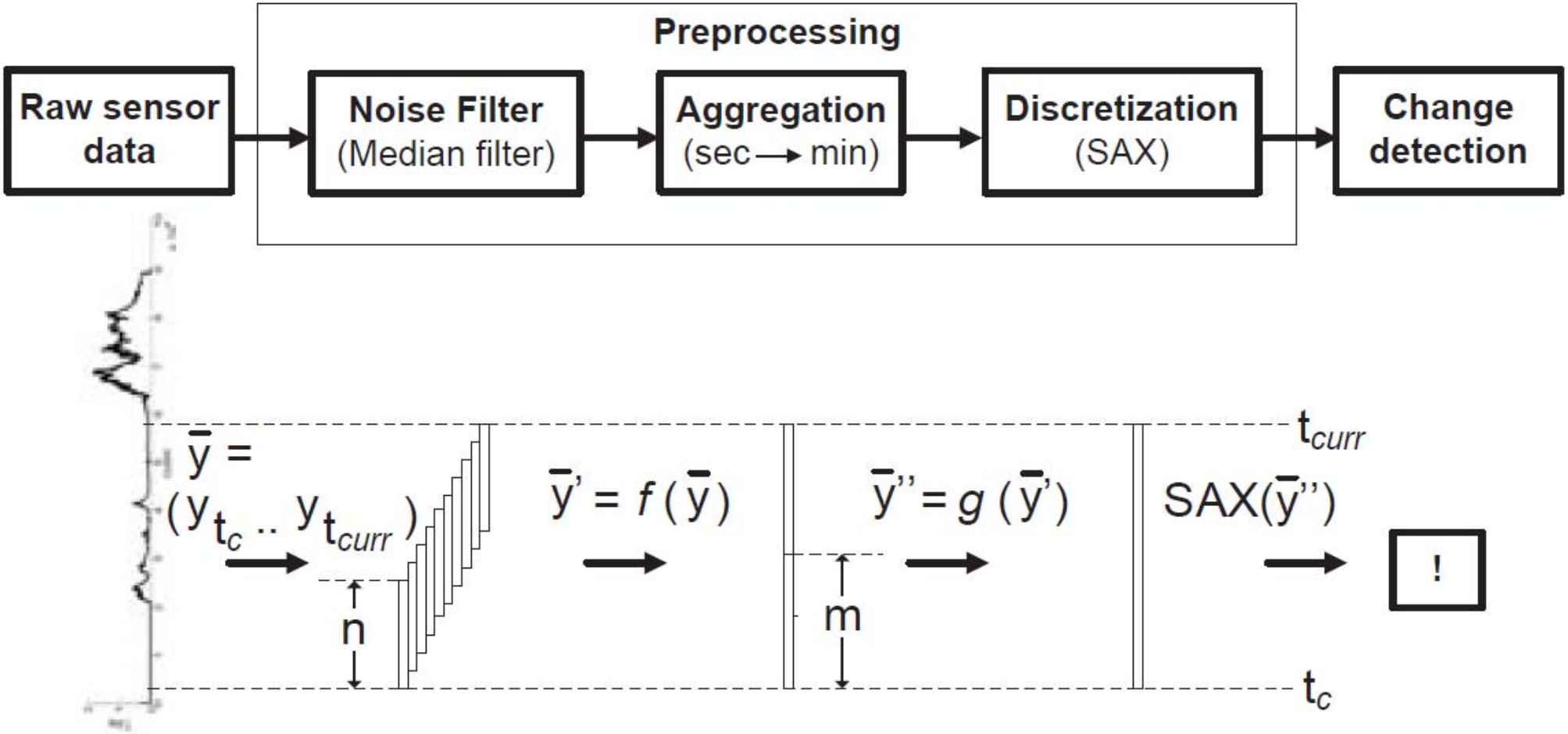
Detection and Categorization of Stress

Based on GSR data alone - not as easy as the following figure may suggest:

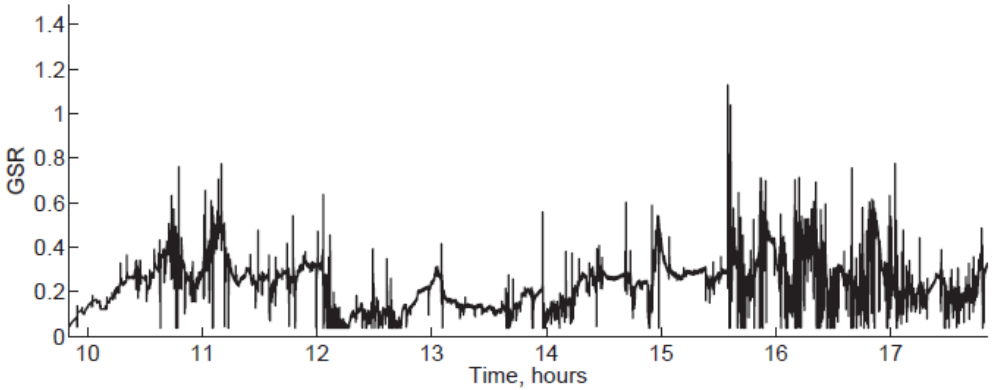


Our current detection approach

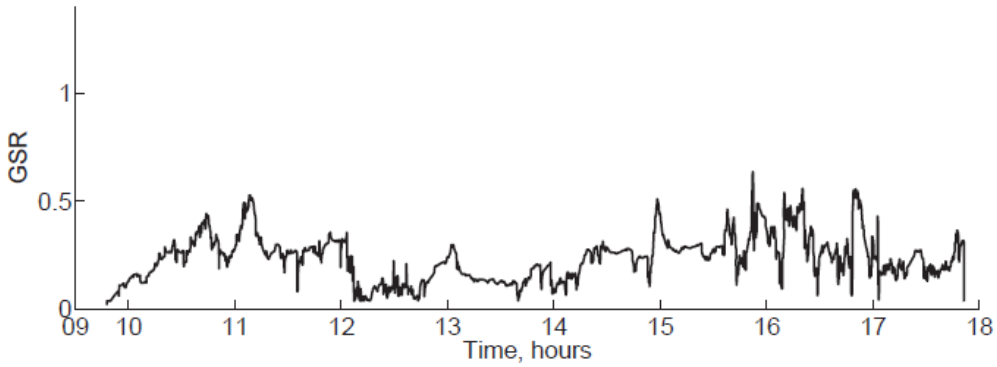
Online settings



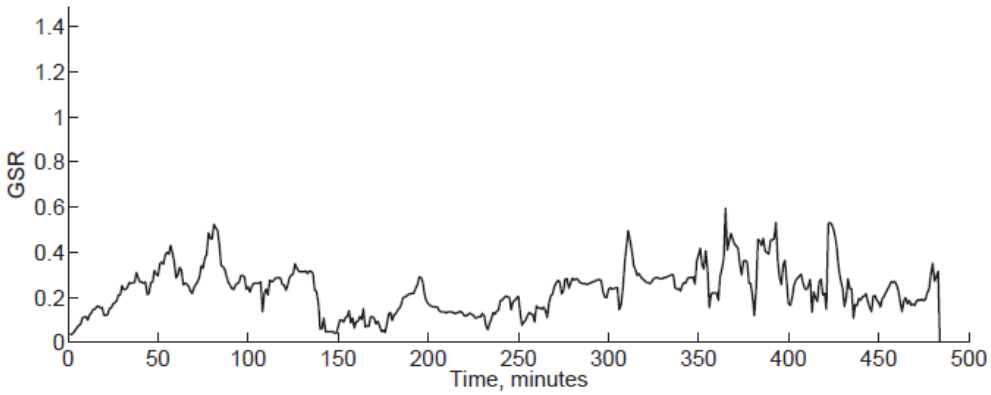
Preprocessing steps



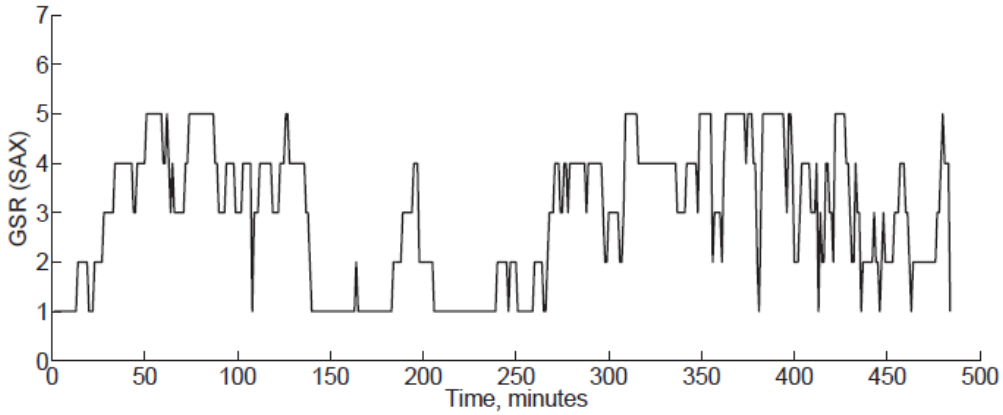
(a) Raw GSR signal



(b) Filtered GSR signal



(c) Aggregated GSR signal



(d) Discrete GSR data

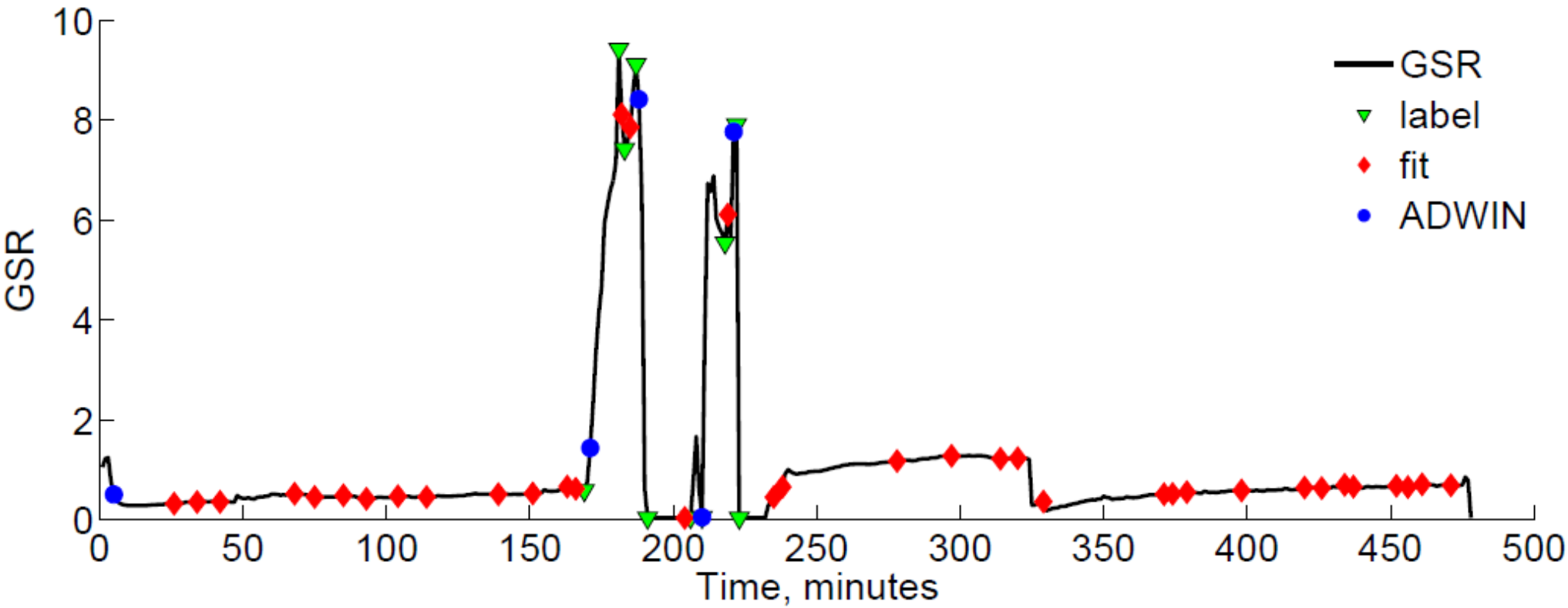
Experiment Setup

DATA SET SUMMARY.

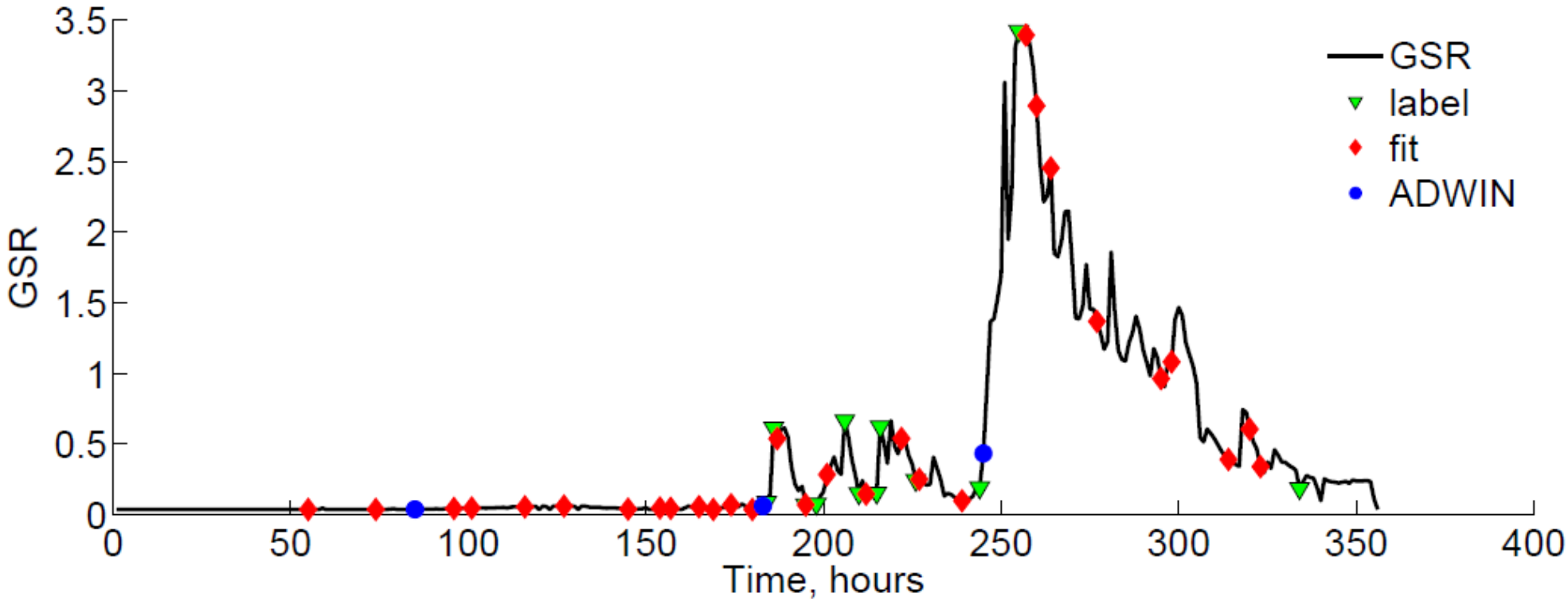
Number of users	5
Number of time series	72
Time series per user (mean)	14
Mean length (samples)	98721
Number of change points overall	368
Mean change points per series	6.5

- Change detection in online settings

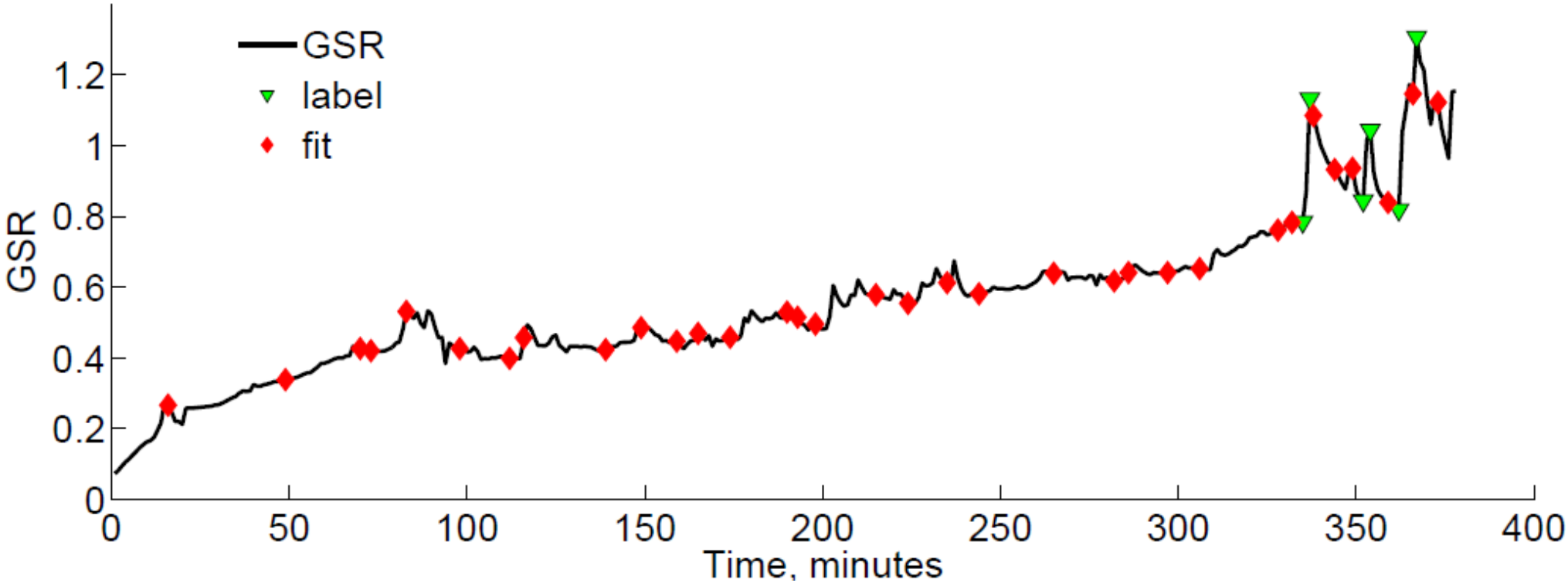
Results


GSR
label
fit
ADWIN
GSR
Time, minutes
0
2
4
6
8
10
0
50
100
150
200
250
300
350
400
450
500

Results

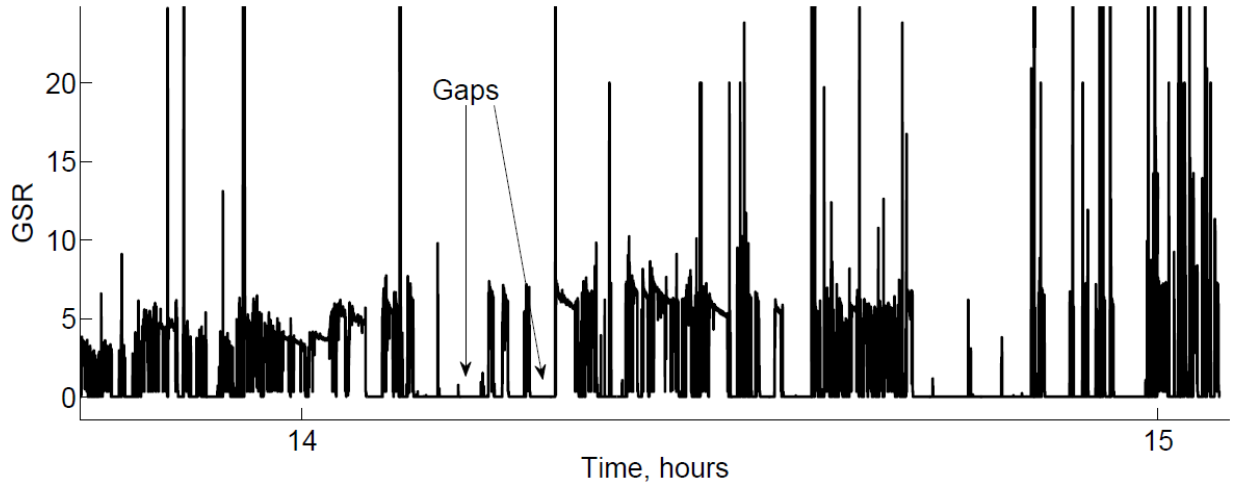

GSR
label
fit
ADWIN
GSR
Time, hours
0
0.5
1
1.5
2
2.5
3
3.5
0
50
100
150
200
250
300
350
400

Results

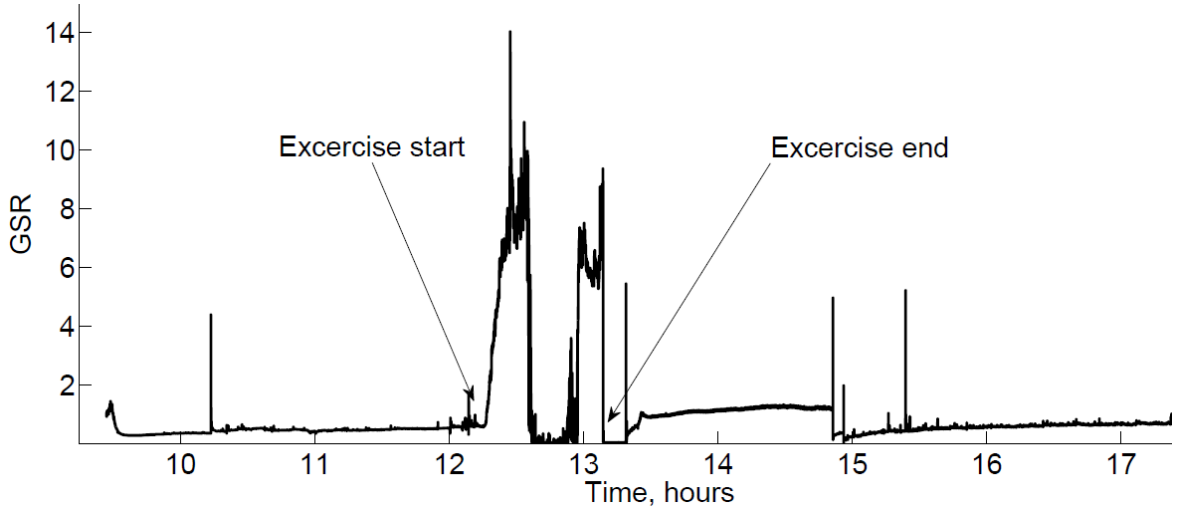

GSR
label
fit
GSR
1.2
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
300
350
400
Time, minutes

Challenges in Stress Detection

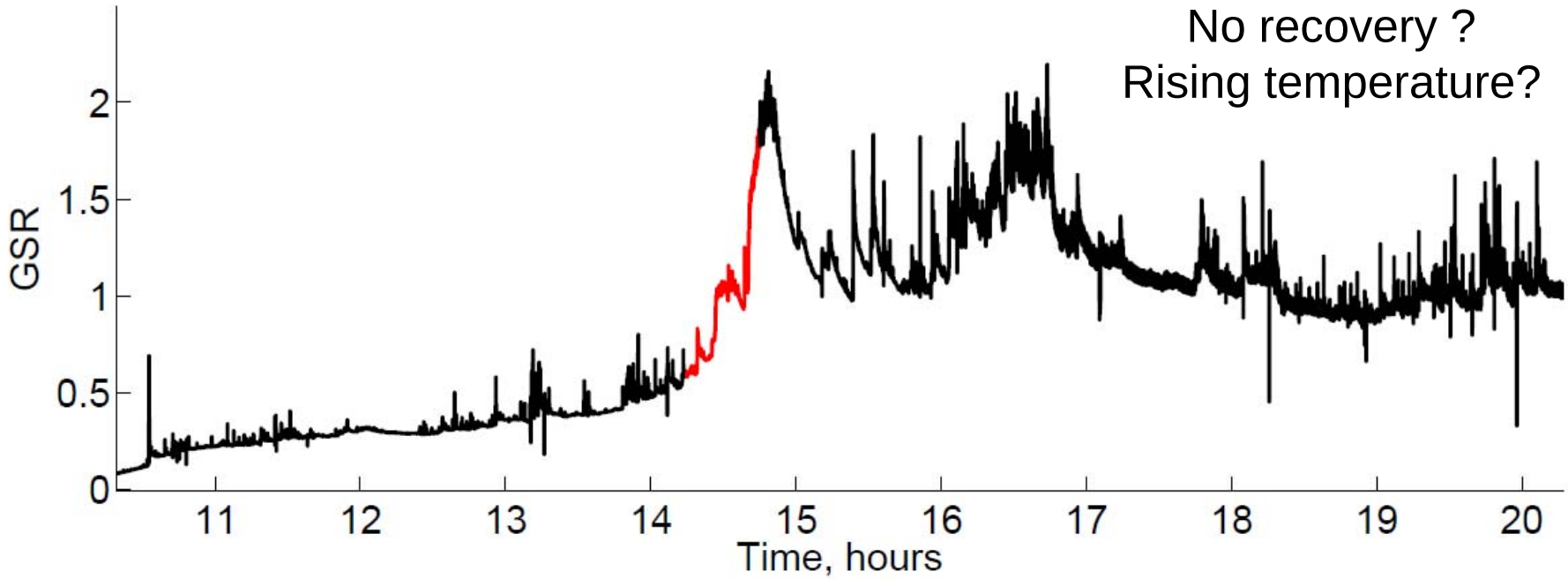
- All kinds of noise, e.g. loosing contact with the skin

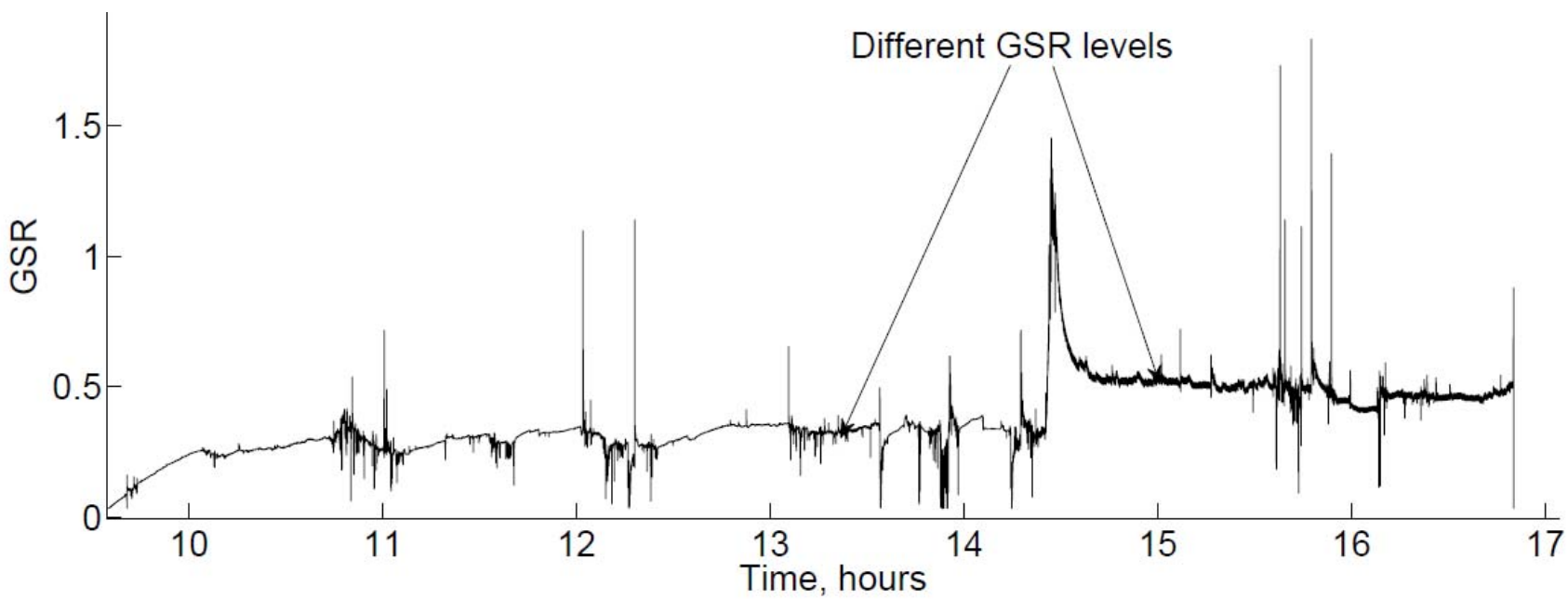


- Activity (exercising) , environment (cold/hot) context and personal differences may impact GSR we observe

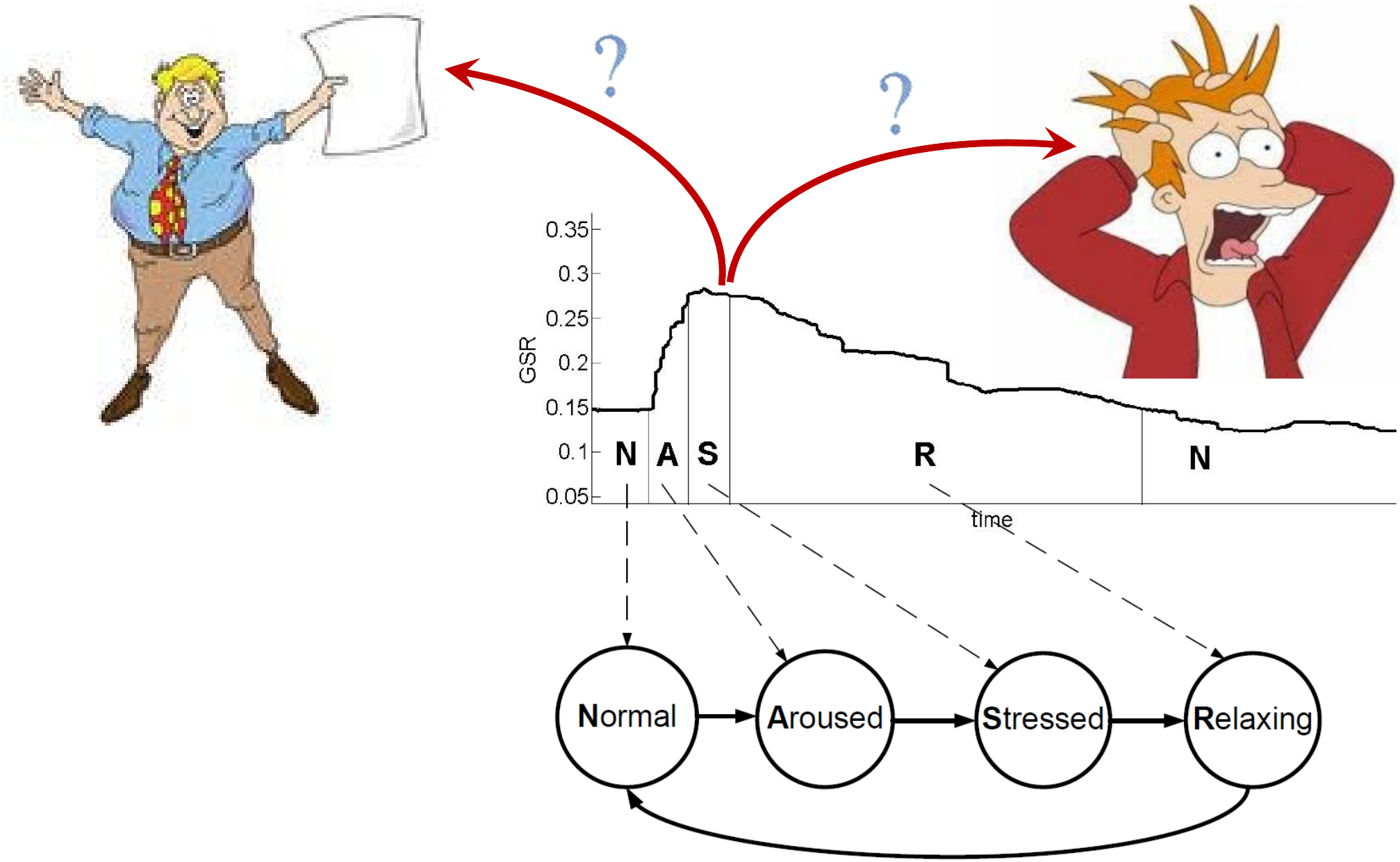


Interpretation Isn't Straightforward

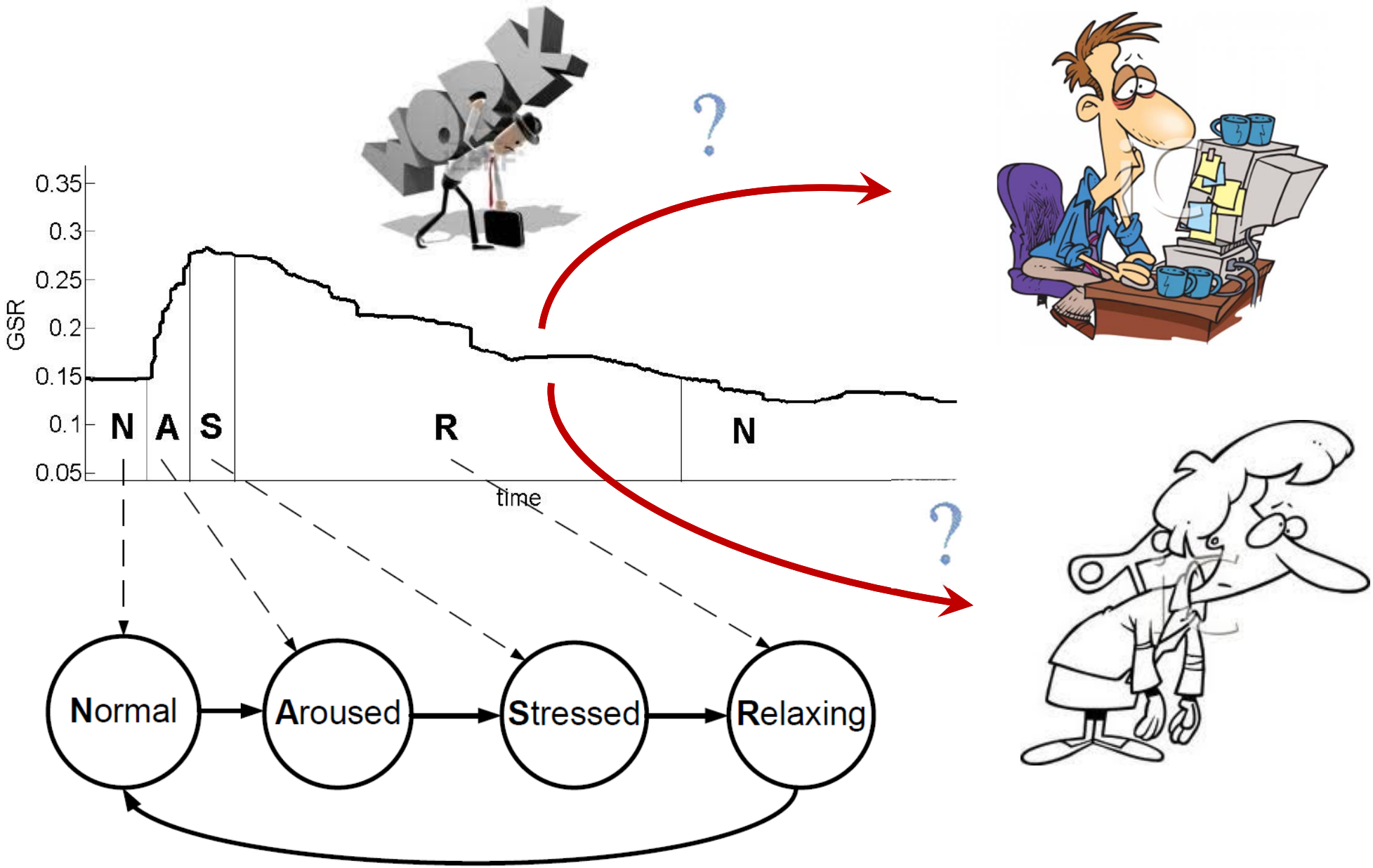




Is Acute Stress Good or Bad?

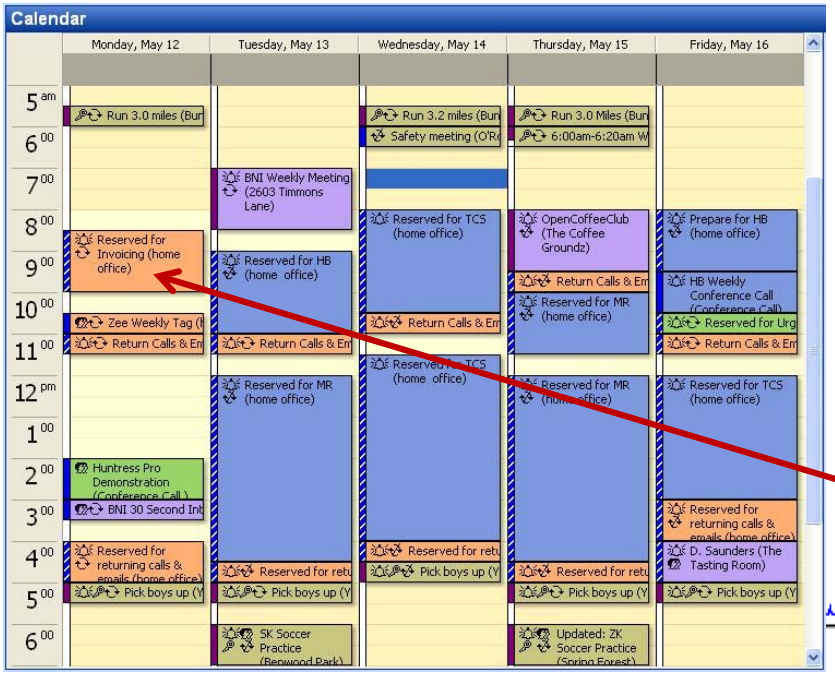


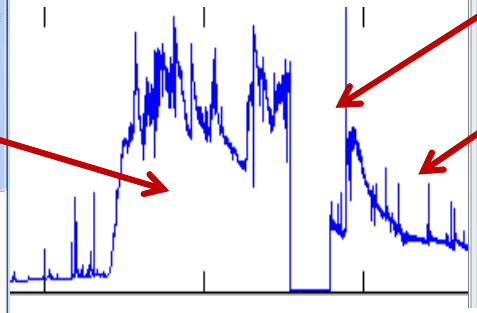
What is the Relaxation Then?

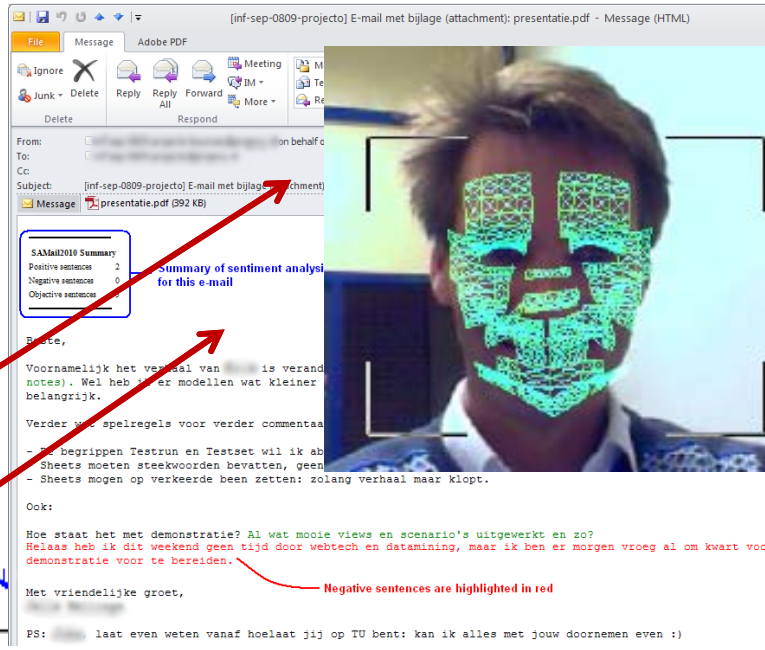


Is “Normal” Condition Good or Bad?

What if someone’s patterns looks like
NNNNNNNNNNNNNNNN ……







What, **W**hen, **W**here, with **W**hom

vital signs

(non-) work-related content

Stress detection and prediction

Stress-detection & prediction models

Coaching

"Reschedule"

"Prepare"

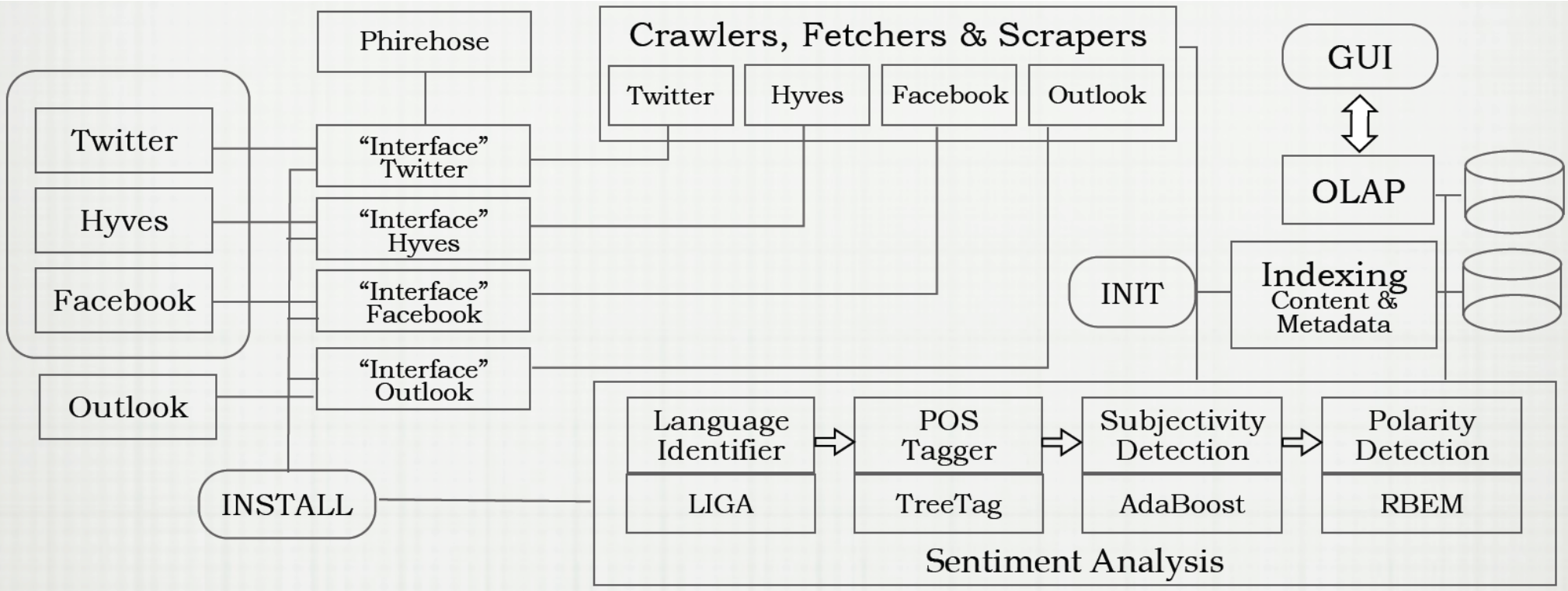
"Take a break"

Stress Analytics

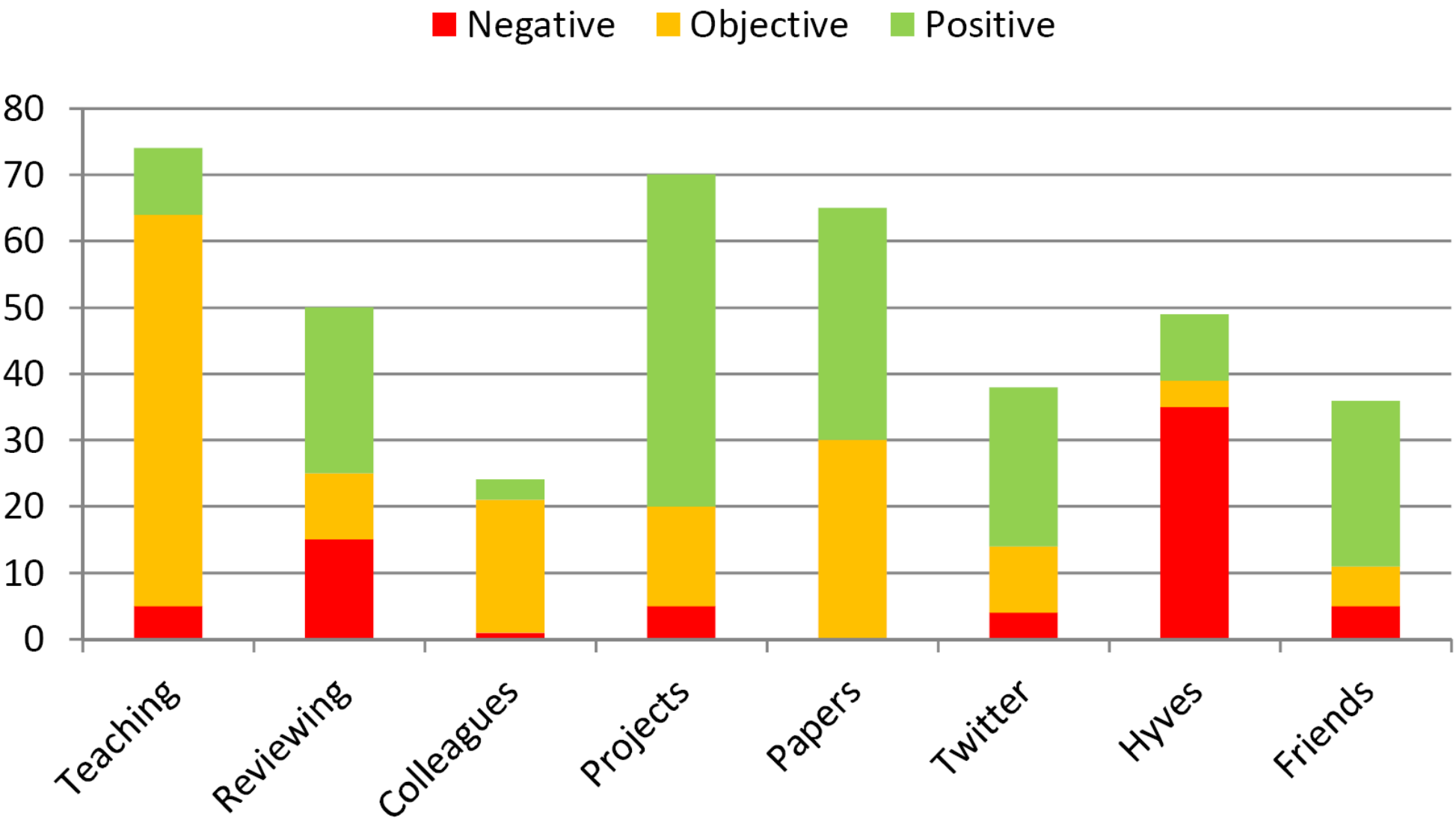
- Make a person aware of what is happening
  - how they spend their time and when and from where the stress comes in
- Provide valuable input for pattern mining/knowledge discovery
  - Much richer data
- Visual analytics
  - Interactive exploration of stress-related data
  - Collecting subjective data/labels from a person

SentiCorr – come to our demo on Monday

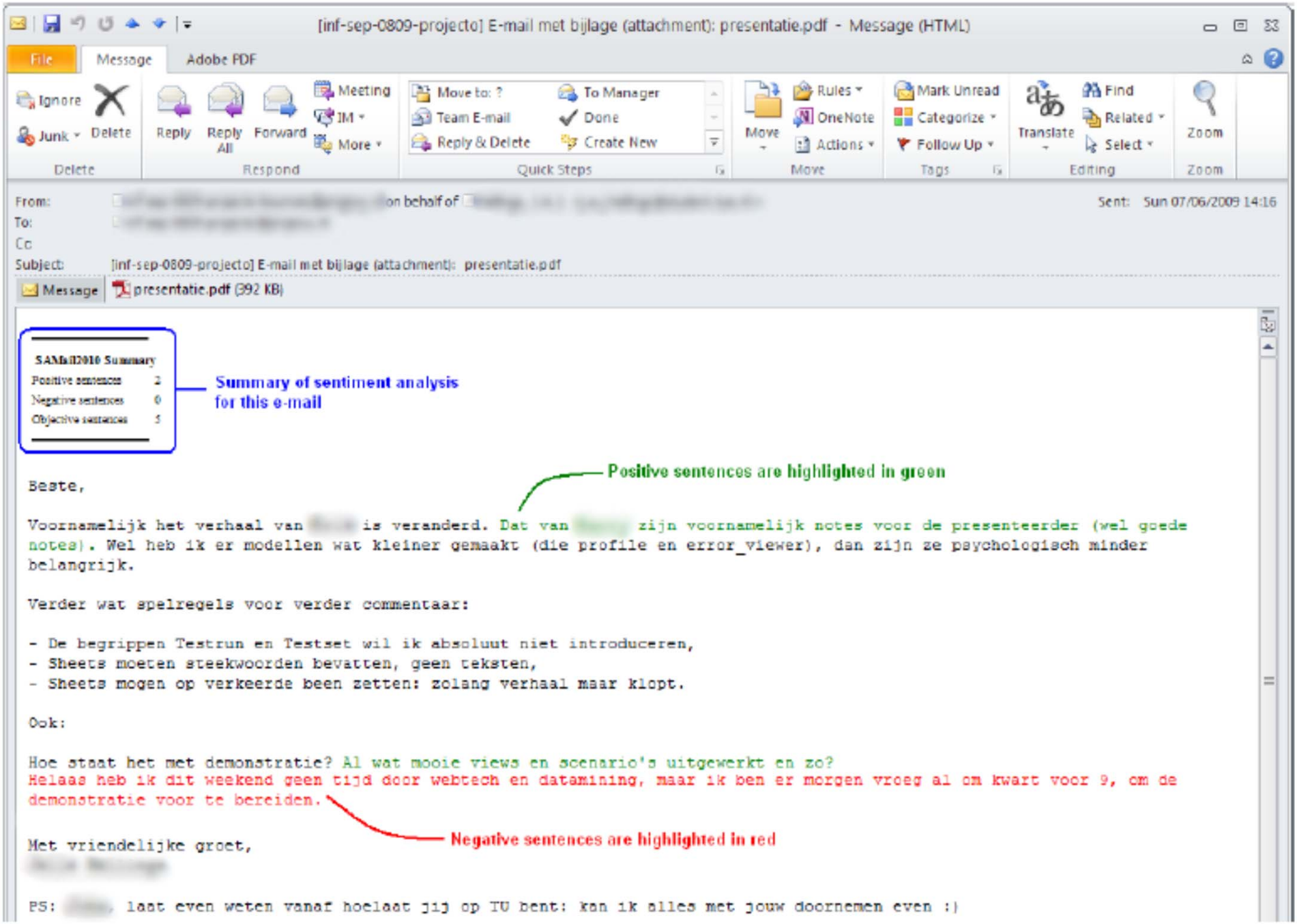
How much positive and negative content do we read or write?



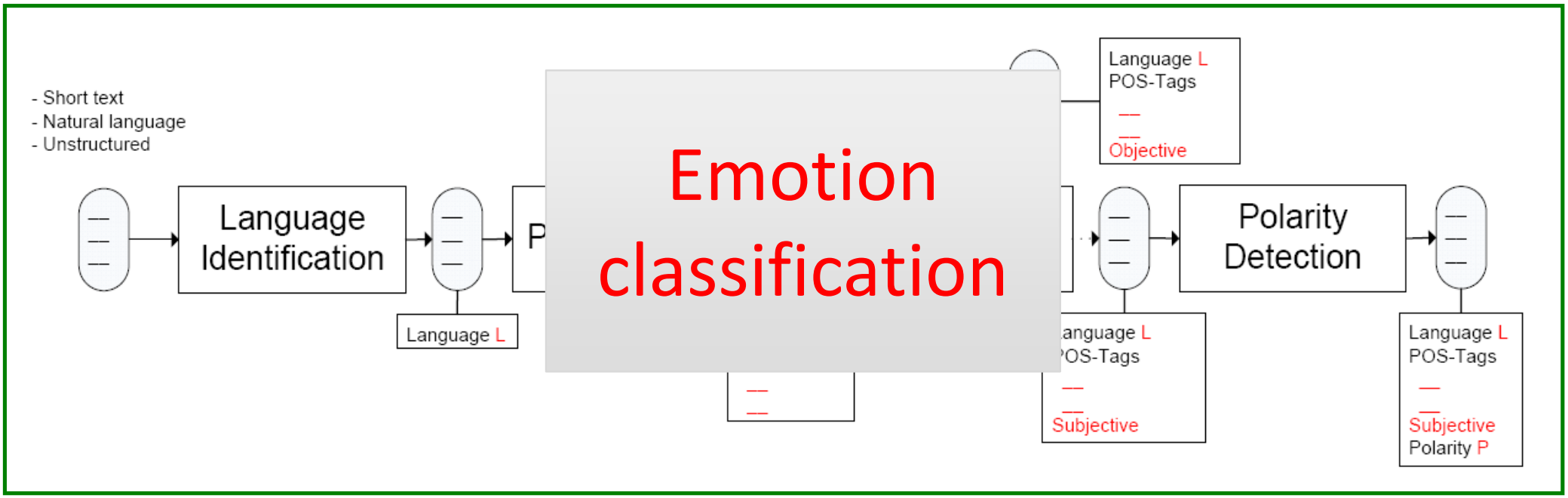
OLAP Style Exploration of Data Summaries



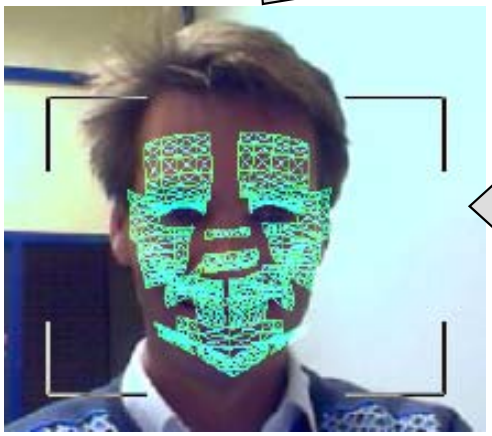
Exploration of Individual Cases, e.g. e-Mails



Multi-Source Emotion Classification



Facial expression analysis



GSR & other sensors

Conclusions and Future Work

- The detection of stress/arousal is a challenging task on itself:
  - varieties of noise and patterns in the data
- GSR data alone is highly ambiguous due to hidden contexts.
  - not clear whether certain peaks correspond to a significant physiological process, and
  - how to categorize these peaks further if they do
- Context-aware change detection and categorization; explanation of drifts