Stress@work: From Stress Measurement to Understanding the Stressors

Mykola Pechenizkiy

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Portsmouth University, England

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

• Philips develops a device measuring and recording vital signs like skin conductivity (GSR) and heart rate, with a high frequency Be-eep! You are getting stressed!
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Concept

Stress factor

Sympathetic system

- Heartrate
- Sweat production
- Other

Other factors
Detection and Categorization of Stress

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

[Graph showing GSR changes over time with stages labeled Normal, Aroused, Stressed, Relaxing.]
Challenges in Stress Detection

• All kinds of noise, e.g. losing 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 NNNNNNNNNNNNNNNNNNNN ......
Possible Examples

Preparing a meeting with the boss

10 minutes presentation before 60 listeners on a telco

Meeting with external contacts for a joint project, not the “right partners”

A project review meeting - presenting the results of the project to the stakeholders

Real data with fake Interpretations
Beyond Stress Detection

Stress predictions

Low stress  High stress

Stress causes

Location  Timing

Content  Self-evaluated

People  Unknown

Coaching advices

Relaxation  Preparation  Rescheduling

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Coaching: Advice in Outlook

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Scenario

- Project brief
- Data gathering
- Coaching model
- Software application
  - Requirements
  - Design cycle
  - Scenario
  - Live demo
- Evaluation
- Conclusions

Calm and full of energy at meetings

Checks schedule…

Follows advice to Reschedule

Goes prepared

Has a refreshing sleep…

Is ready for a new day…

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Identifying Stressors is Challenging

- Personal agenda gives info about what, when, where, with whom (4w)
- We can use data and process mining techniques in order to discover the correlations between the stress level changes and the 4w
Predict Acute Stress wrt Agenda

- Assuming some regularity in the agenda we can
  - Predict the stress level for the coming period of time
  - Give recommendations about adjusting the agenda
    - Including relaxation moments
    - Rescheduling/canceling certain events
    - Reserving some space for regular activities (answering emails, etc.)
    - ...

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Possible to Link Other Information

• Sensor data:
  – Temperature, air-conditioning
  – Quality of sleep, other vital signs
  – Lighting conditions

• Events that can trigger stress
Stress detection and prediction

What, When, Where, with Whom

Vital signs

(non-) work-related content

Stress detection & prediction models

Coaching

“Reschedule”
“Prepare”
“Take a break”

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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 discover
  – Much richer data
• Visual analytics
  – Interactive exploration of stress-related data
  – Collecting subjective data/labels from a person
Data availability

We have data from the pilot experiment (April – June 2011)
• 5 persons wearing the device during their working hours;
  – GSR and 3D accelerometer data
  – Anonymized MS Outlook agenda

We will have more data from the forthcoming field studies
• At TU/e – lectures, researchers, students
  – What data we collect depends on how well we are prepared
• Together with Human Capital Care – an occupational health and safety company
  – groups with an increased risk profile: school teachers, medical staff, working parents, ...
How much positive and negative content do we read or write?
OLAP Style Exploration of Data Summaries

- Negative
- Objective
- Positive

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Exploration of Individual Cases, e.g. e-Mails
Multilingual Sentiment Classification

- Short text
- Natural language
- Unstructured

Language Identification → POS Tagging → Subjectivity Detection → Polarity Detection

Language L

Language L POS-Tags

Language L POS-Tags

Language L POS-Tags

Language L POS-Tags

Objective

Subjective

Subjective Polarity P

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Multi-Source Emotion Classification

- Short text
- Natural language
- Unstructured

Emotion classification

Facial expression analysis

GSR & other sensors

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News in media or business are considered to be sentiment neutral,
– but they often contain positive or negative information, e.g.

“You will be fired in 3 months because of the serious budget cuts.”
– no sentiment, but negative information

Similarly, in work-related correspondence there could be stressing information:
– How can we identify it?
HCI aspects

• Visual analytics
• Labels collection in explicit/implicit way
Work out privacy issues
Alignment of Information Sources

• What person reads and writes
• What person does with the computer
  – http://wakoopa.com/
• What person does in general according to
• Environment context (lighting, noise, temp etc.)
• Annotate data from video, sound, text processing, and vital signs
• ...

Different aspect with pre-processing, storing, managing
References


• http://www.win.tue.nl/stressatwork/
Stress@work Team

Jorn Bakker, Researcher (TU/e)
Rafal Kocielnik, Researcher (TU/e)
Mykola Pechenizkiy, co-PI (TU/e)
Natalia Sidorova, PI (TU/e)
Erik Tromp, TU/e (now with Accenture)

Collaboration within EIT ICT Labs
  Jaakko Hollmén, Aalto University, Finland
  Leszek Holenderski, Philips Research
  Joyce Westerink, Philips Research

Collaboration is welcome!