Monitoring technology for well-being

Egon L. van den Broek
This initiative

EU-OSHA (2016): "Software exists that allows the emotions of a computer user to be monitored remotely - this could even be promoted by the developers as a way of detecting early signs of stress in employees, ..."

What do we need?

"the scientific understanding and computation of the mechanisms underlying affect and their embodiment in machines" (Van den Broek, 2011)
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The 21st century black plague

Cary L. Cooper (2007): "We're talking now I think about the 21st century black plague. I see stress as the main source of disease or the trigger for disease in the 21st century developed world."

Although stressed, we do not perceive ourselves as ill (Barlot, 2016). However, stress can
- weaken our immune system
- cause overeating
- lead to hypertension
- deteriorate our cardiovascular system
- ...
Not so very new – Body and “Mind”:
Flanders Dunbar (1935/1954)

“Scientific study of emotion and of the bodily changes that accompany diverse emotional experiences marks a new era in medicine ... In this knowledge, we have the key to many problems in the prevention and treatment of illness, yet we are scarcely begun to use what we know. We lack perspective, concerning our knowledge in this field, and are confused in our concepts of the interrelationship of psychic, including emotional, and somatic processes in health and disease.” (Dunbar, 1954, p. vii).
Experience of stress = similar physiological responses emerge as during stressful events.

Repetition can cause:
- Pervasive and structural chemical imbalances in physiological systems (e.g., nervous, endocrine, and immune systems)
- Treatment by altering cognitive representations or memory systems.
- Evaluation requires high level of expertise.

Top priority in health care; #1 priority in mental health care
Well-being (1)

› “the state of being happy, healthy, or prosperous” ([http://www.m-w.com/](http://www.m-w.com/))

› “good health or fortune” Synonyms: comfort, contentment, eudaemonia, happiness, health, profit, prosperity, protection, safety, security, success, welfare. ([http://thesaurus.com/browse/well-being](http://thesaurus.com/browse/well-being))

› “the state of being comfortable, healthy, or happy” ([http://oxforddictionaries.com/](http://oxforddictionaries.com/))

› “Mental health is defined as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.” ([http://www.who.int/](http://www.who.int/))
Well-being (2)

“Well-being is most commonly used in philosophy to describe what is non-instrumentally or ultimately good for a person.” (http://plato.stanford.edu/)

“… This subjective definition of quality of life is democratic in that it grants to each individual the right to decide whether his or her life is worthwhile. It is this approach to defining the good life that has come to be called "subjective well-being" (SWB) and in colloquial terms is sometimes labeled "happiness." SWB refers to people's evaluations of their lives - evaluations that are both affective and cognitive. …” (Diener, 2000)
Monitoring
Not so very new ... (1)

Not so very new ... (2)

N.A. Harvey (1911). *Physiological Psychology*. Ypsilanti, MI, USA: State Normal College
“That men are machines (whatever else they may be) has long been suspected; but not till our generation have men fairly felt in concrete just what wonderful psycho-neuro-physical mechanisms they are.”

William James (1842 - 1910)

“NOW JUST WALK NORMALY...”
Unobtrusive biosignal recordings
Monitoring for well-being at work
Early Electronic Performance Monitoring (EPM) at work: Advantages

› Helps identify training needs
› Facilitates goal setting
› Can lead to productivity gains
› Facilitates telecommuting and “flex hours”
› Assists in resource planning
› Enhances value of investment in computer systems
› Can provide immediate, objective feedback
› Reduces bias in performance evaluations
Early Electronic Performance Monitoring (EPM) at work: Disadvantages

- Invasion of privacy
- Increases stress and possible negative long-term health outcomes
- Can lower satisfaction and morale
- May reduce contact between employees and supervisor
- May reduce contact between employees and coworkers
- Can lead to focus on work quantity while sacrificing quality
- Can transform work climate into “electronic sweatshop”
- May overwhelm supervisor with data and feedback expectations
Monitoring technology’s signals

- audio-based (e.g., automatic speech recognition);
- biosignals (e.g., electrocardiogram);
- vision-based (e.g., facial expressions);
- text (e.g., Twitter messages);
- blood samples (e.g., hormone levels);
- interaction-based (e.g., mouse and keyboard interaction, pressure sensors, GPS);
- questionnaires (e.g., using 5-point Likert scales); and
- interviews (e.g., using a chat bot)
Closed-loop monitoring technology
Signal processing + pattern recognition

Signal processing (in detail)
- Physical system
- Measurement space / the signals
- Preparation (details below)
- Pattern space
- Feature + parameter selection
- Reduced pattern space

Preparation (in detail)
- Preprocessing (e.g., filtering, and artifact removal)
- Synchronization & segmentation
- Feature extraction
- Parameter extraction
Bij draagbare elektronica loopt de hardware ver voor op de software

De waarde van wearables zit in de interpretatie van de verzamelde data en de dienstverlening erachter, zegt Egon van den Broek van de Universiteit Utrecht. De grootste uitdaging wordt volgens hem om bruikbare informatie te halen uit de enorme hoeveelheid data. ‘De hardware loopt ver voor op de software. En dat verschil wordt almaar groter.’

Het zou beroerd zijn als Nederland daar niet van profiteert, zegt Van den Broek. ‘We zijn goed in de integratie van die sensoren in producten. Ik heb ook veel
Towards some common ground

Monitoring technology for well-being has been subject to criticism. Reasons for this included:

1. Lack of proven efficacy
2. Absence of standards
3. Fuzzy relation between signals monitored and well-being
Challenges (1)

› Its need for a holistic approach (Follmer, 2016; Blaxton & Bergeman, 2017).
› The fragile theoretical frameworks from medicine (e.g., incl. physiology and neuroscience) and psychology it has to rely on (Kalish et al., 2015; Jarvis, 2016).
› The incredible, continuous variance that characterizes our world (Follmer, 2016; Schmitz & Wolkenhauer, 2016).
Epilogue

› stress disorders (e.g., burn out)
› musculoskeletal problems, including RSI
› vision problems
› headache
› obesity
ICT: Health's worst enemy? (2):
A suggested complement

› metabolic issues, such as vitamin deficiencies and diabetics
› addiction (e.g., to games, social media, and Internet)
› sleeping problems
› social isolation
› an unrealistic world view (e.g., resulting in depression)
ICT: Health's best friend?

› Gadgets
› many-to-many relationships
› sense making remains problematic
› torture the data until it confesses, yielding Type I errors (Van den Broek, 2012), as "we cannot browse over the field of nature like cows at pasture" (Medawar, 1969)
› One size fits all; lack of true personalization: taking people's personality into account.

A wealth of information creates a poverty of attention.

Herbert A. Simon, 1971
Monitoring well-being’s challenges at work

- Sense making
- Big brother as stressor (privacy)
- Security
- Embedded and wearable monitoring technology
  - Butcheries augmented with sensors
  - Knowledge workers with stress-sensing ICT
- Monitoring elderly
- Advanced pacemakers
- Recording law enforces at work
- Persuasive (monitoring) technology
Conclusion

› Monitoring well-being is a trending, highly complex field of science and practice.
› Indisputably, monitoring technology will be part of our future; in particular, biosensors will quickly become more common and more important.
› Monitoring technology started with occupational Electronic Performance Monitoring (EPM).
› Advantages and disadvantages of ICT at the workplace.
› For specific occupations, in specific contexts, monitoring technology can already increase workers well-being.
› **Monitoring technology for well-being is already and will be become more and more a game changer in future workplaces.**
Thank you!

Questions?