WEARABLE TECHNOLOGY FOR MENTAL HEALTHCARE: OUTCOMES AND CHALLENGES WITHIN THE CAREWEAR PROJECT

Romy Sels
Dr. Nele De Witte
“mobile computing, medical sensor, and communications technologies”

Istepanián, Jovanov, & Ehang (2004)
MHEALTH

Wearables for mental health
MHEALTH – WEARABLES

- wearables
  - the whole range of sensors, and devices that can be worn by a user
  - with the aim to collect physiological data in a manner that is reliable but also as non-invasive as possible
MHEALTH – WEARABLES

Wearables for mental health
MHEALTH – WEARABLE INDICATORS

- electrocardiogram
- heart rate variability
- electro-encephalogram
- breathing frequency
- skin conductance
- movement
- temperature
- ...

Wearables for mental health
WEARABLES – KEY ADVANTAGE

- long term monitoring far better than 1 shot
  - white coat hypertension: 10% of patients have high blood pressure when visiting their GP, but not in everyday life and receiving unnecessary medication
  - when observed in lab settings, people brush their teeth on average for 2 minutes. At home only half that time.
CLINICAL SCENARIOS

• monitoring clients with symptoms of depression
  
  – one challenge = keeping client active outside of sessions
  – real-time
    • wearable & mobile app
    • tailored feedback on movement & HRV to clients
    • insights in activity patterns

Helbig & Fehm (2004)
CLINICAL SCENARIOS

• monitoring clients with symptoms of depression
  
  − delayed
    • homework assignments & own experiences during weekly sessions
    • data as additional source of information
CLINICAL SCENARIOS

• stress at work & burn-out prevention

• wearable
  - additional source of information
  - but also: raising awareness
RELEVANT INDICATORS

- activity
- HRV
- skin conductance
- stress

Wearables for mental health
(M)H INDICATORS

• more physical activity
  – less stress
  – less symptoms of depression

• HRV
  – Top-down control
  – HRV ~ flexibility
  – indication of stress & psychological problems

• Skin conductance
  – arousal

Wearables for mental health
• heterogeneous!

  - orchestrated action tendency
  - depends on both individual and situation

  - different measurements = different strategies & tactics
  - discordance: measurements each tell a different story
(M)H INDICATORS – STRESS

• stress can be predicted using a combination of indicators
  – heart rhythm
  – skin conductance
  – movement

• BUT
  – requires user input!

Choi et al. (2012) & Wijsman et al. (2011)
INTERIM CONCLUSION

Wearables for mental health
WEARABLES FOR MENTAL HEALTH

- Large untapped potential
  - may help to tackle major workplace and MHC challenges
  - evolution towards more comfortable & multimodal devices
  - however, few clinical applications
WEARABLES FOR MENTAL HEALTH

• challenges

  - knowledge & end-user centered design

  - careful and targeted implementation
CAREWEAR

Wearables as useful tools
in companies
in clinical contexts

Wearables for mental health
COMMERCIAL WEARABLES

Wearables for mental health
SPECIFIC REQUIREMENTS

- Accelerometer
- Skin conductance
- Heart rate / HRV
- Raw data
WHICH WEARABLE?

Wearables for mental health
CHILL+

Wearables for mental health

Not commercially available
EMPATICA E4

Commercially available
FUTURE: BYTEFLIES

Commercially available
EMPATICA E4: DATA EXAMPLE

<table>
<thead>
<tr>
<th>Data Example</th>
<th>Graph Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Conductance</td>
<td><img src="image1" alt="Graph" /></td>
</tr>
<tr>
<td>Blood Volume Pressure</td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td>Accelerometer</td>
<td><img src="image3" alt="Graph" /></td>
</tr>
<tr>
<td>Heart Rate</td>
<td><img src="image4" alt="Graph" /></td>
</tr>
</tbody>
</table>

Wearables for mental health
EMPATICA E4: DATA EXAMPLE

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NEED FOR ALGORITHMS
CALCULATED PARAMETERS

• Step detection
  – First check with Fitbit ok

• Activity detection
  – First check with Fitbit ok

• Heart rate variability
  – Sample frequency Empatica ↓ for accurate results

• Resting heart rate
CALCULATED PARAMETERS

• Stress detection:
  - Sweat $\uparrow$
    $\rightarrow$ Skin conductance $\uparrow$
  - Heart rate $\uparrow$
  - Stress $\neq$ Activity
    $\rightarrow$ Only stress detection if movement $\downarrow$

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CALCULATED PAREMETERS: STRESS DETECTION

Wearables for mental health
CALCULATED PARAMETERS: STRESS DETECTION

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Quality of data:
- Dependent on type of wearable
ALGORITHMS: OBSTACLES

- Movement artefacts

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ALGORITHMS: OBSTACLES

• Stress detection: false positives
ALGORITHMS: OBSTACLES

- Stress detection: false positives
To improve stress detection:
- Deeper analysis of skin conductance reaction necessary
- Machine learning and data mining

But: more labelled data needed

User input required:
- Confirm stress event
- Indicate positive/negative event

Intra- & interindividual differences
End users
Professionals
↓
Wireframes
↓
Members of the user committee
↓
Development platform
CAREWEAR PLATFORM: DEMO

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CAREWEAR PLATFORM: OBSTACLES

1. Software development
   - Data visualisation & analysis
   - Comprehensible overview for the end-user
   - Added value for clinical practice
   - Integrate in daily used applications

2. Need for more data
   - Improve algorithms + long term results
   - Determine trends

3. Data security + Privacy
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CAREWEAR – PARTNERS

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THANK YOU FOR YOUR ATTENTION

Carewear Team
**Expertise Unit Psychology, Technology & Society**
- Nele De Witte, PhD
- Tom Van Daele, PhD
- Tim Vanhoomissen, PhD

*Mobilab*
- Romy Sels
- Bert Bonroy, PhD
- Glen Debard, PhD
- Marc Mertens

More information
- [www.carewear.be](http://www.carewear.be)
- [@care_wear](https://twitter.com/carewear)
- Nele.dw@thomasmore.be
- Romy.sels@thomasmore.be