

Open Trackers for (Open) Science

Daniela Gawehns, Froscon 2020.



Universiteit
Leiden
The Netherlands

Outline

Using Activity Trackers for Research

Participating in Research

Activity: Alarm bells

Conducting Research

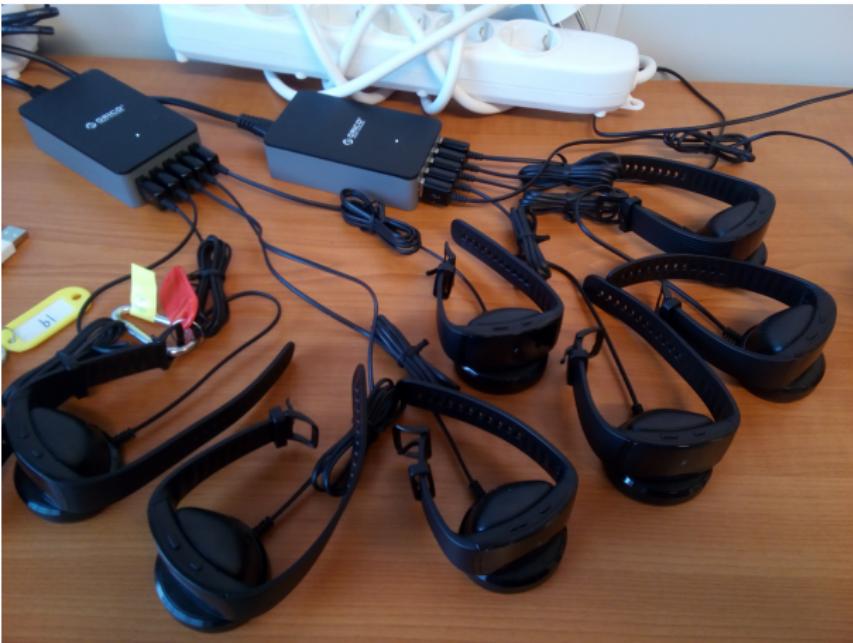
Which hardware and software options exist?

What are current solutions?

What's next?

Activity: Next steps and avenues

Wrist-worn



Wrist-worn

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Are you wearing an activity tracker atm?

Three Personas I

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Persona I : Mark



Three Personas II

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Persona II : Janine



Three Personas III

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Persona III : Karla



Three Personas

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Three Personas

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<https://hackmd.io/@DGawehns/rylqLQpMv/edit>

Summary Feedback

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The Why

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What makes those activity trackers so attractive?

- tracking of activity, heart rate, location, interactions,
Ecological Momentary Assessment
- passively, (almost) non-intrusive
- longitudinal studies (several weeks)
- real life data

Summary of Use Cases

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	Children	Ex-Detainees	Nursinghome
Data Collection			
Accelerometer	X	X	X
EMA	X		
GPS/Location	X	X	X
Call Logs		X	
Participants			
Age	< 13	20-60	> 65
Somatic Health	healthy / hoh	healthy	geriatric patients
Mental Health	some special education schools	some psychiatric patients	dementia

Open Trackers for (Open) Science
Which hardware and software options exist?

The How - Balancing Acts

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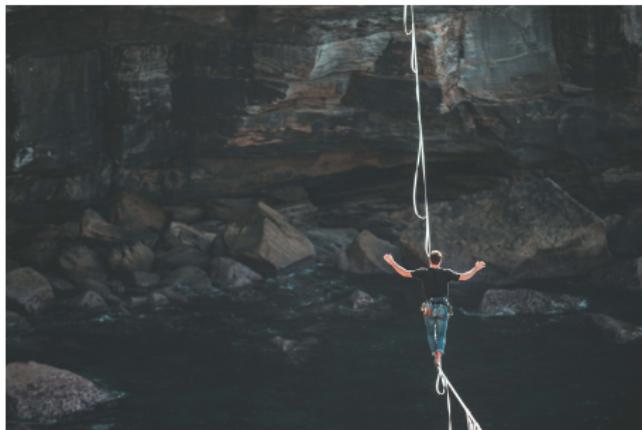


Photo by Loic Leray on Unsplash

The How - Current Hardware Options

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Medical Research Devices

- Shimmer
- Actigraph
- Empatica
- ... and many more

The How - Current Hardware Options

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Consumer Grade Devices

- Apple Watch
- fitbit
- Garmin
- Android Watches
- Tizen
- astroid

The How - Using Big Tech

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- Apple Watch
 - Apple Research App
 - Health Kit and Care Kit Frameworks
 - built your own

The How - Using Big Tech

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 - bulk download

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- Garmin
 - fitabase
 - (web) Health API
 - Health SDK

The How - Using Big Tech

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- granularity (temporal and compounds)

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The How - Using Big Tech

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- granularity (temporal and compounds)
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- possibly certification issues

The How - Using Big Tech

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- Availability, Scalability
 - <https://corona-datenspende.de>

The How - Using Big Tech

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- Availability, Scalability
 - <https://corona-datenspende.de>
- Design Choice - Working with participants or patients

The How - Choices

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"To **enhance acceptability** and minimize user burden and stigma, widely available consumer-oriented technologies were therefore considered. The user groups favored the wrist-worn Fitbit Charge HR (Fitbit Inc, San Francisco) due to its **appearance as a lifestyle device** that is acceptable to both younger and older users and the **ability to view metrics** relating to sleep and activity via the Fitbit app."

Meyer N., et al (2018): Capturing Rest-Activity Profiles in Schizophrenia Using Wearable and Mobile Technologies: Development, Implementation, Feasibility, and Acceptability of a Remote Monitoring Platform

Locked-in : Intent

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"Do these devices, therefore, have a role as tools for clinical prediction?

We suggest that they do, **depending on the question being asked [58]**. Our goal is not to draw conclusions about sleep parameters (eg, total sleep time, sleep efficiency) per se, for which the use of unvalidated devices would be inappropriate. Rather, our **objective is to ask whether changes in longitudinal rest-activity patterns** at the within-person level, captured using wearable device and smartphone sensors, **predict deterioration** in clinical status."

Open Trackers for (Open) Science

Which hardware and software options exist?

Locked - in: corona-datenspende

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	Fitbit	Garmin	Polar	Withings	GoogleFit	Apple Health
Soziodemografische Daten						
Größe & Gewicht	✓	✓	✓	✓	✓	
Geschlecht & Alter	✓		✓			✓
Aktivitäten						
Aktivitätsinformationen						
Aktiv	✓	✓	✓	✓	✓	
Aktivitätsdetail (Laufen, Radfahren, Sport etc.)	✓	✓	✓	✓	✓	
Ruhe	✓	✓	✓			
Schritte	✓	✓	✓	✓	✓	✓
Kalorienverbrauch	✓	✓	✓	✓		
Zurückgelegte Strecke	✓	✓	✓	✓	✓	
Gestiegene Treppen	✓	✓		✓		
Schlaf	✓	✓	✓	✓	✓	✓
Vitaldaten						
Puls	✓	✓	✓	✓	✓	✓
Körpertemperatur				✓	✓	
Gewicht	✓	✓	✓	✓	✓	

The How - Summary

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Summary: We have solutions for:

- Lab Studies

The How - Summary

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 - bulky, precision technology and access to the raw data

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- Real life Data Collection

The How - Summary

Summary: We have solutions for:

- Lab Studies
 - bulky, precision technology and access to the raw data
- Big Data Studies
 - wide spread use of consumer grade devices and access to summary statistics
- Real life Data Collection
 - if the data supplied by platforms are in accordance with what you want to achieve

Open Trackers for (Open) Science

Which hardware and software options exist?

The How - Case Studies

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The How - Case Studies

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Open Trackers for (Open) Science
Which hardware and software options exist?

The How - Privacy

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Photo by Eduard Militaru on Unsplash

The How - Privacy

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- Which path does the data take?
- Privacy statement between participant and producer, or between researcher and producer?

Open Science - at last

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Definition by FOSTER:

Open science is the practice of science in such a way that others can **collaborate** and **contribute**, where research data, lab notes and other research processes are freely available, **under terms** that enable reuse, **redistribution** and **reproduction** of the research and its underlying data and **methods**.

<https://www.fosteropenscience.eu/foster-taxonomy/open-science-definition>

Open Science - at last

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- **collaborate** and **contribute**
 - collaboration on closed projects?
 - contribution on closed projects?

Open Science - at last

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Open Science - at last

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 - replication of experiments based on black-box algorithms?
 - robustness of findings between black-box algorithms?

Open Science - at last

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Preprint regarding HR: Nelson et al. (2020): Guidelines for Wrist-Worn Consumer Wearables: Assessment of Heart Rate in Biobehavioral Research; <https://psyarxiv.com/3wk65>

The How

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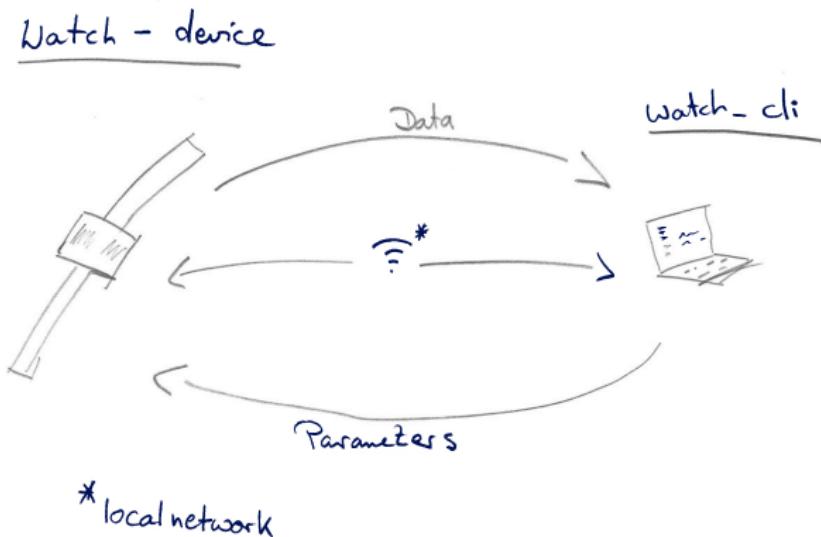
- Wear OS / Android for wearables
- Tizen for Wearables
- astroid

The How - Android Watches

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- cheap-ish option
- <https://github.com/abumondol/WaDa>
 - Accelerometer, Gyroscope, Light
 - apk that can be installed offline, no accompanying phone needed
- locked into one version of the OS and the hardware that runs this one version
- bulk download of health data possible

The How - Homebrew



The How - Homebrew

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- Positives
 - gets us raw data (yay, we can do DATAscience)
 - possible to extend to: bluetooth/proximity; HR; EMA

The How - Homebrew

30 | 43

- Positives
 - gets us raw data (yay, we can do DATAscience)
 - possible to extend to: bluetooth/proximity; HR; EMA
- Negatives
 - under construction (still....)
 - needs good programmers
 - locked in to Samsung Devices

Future Work

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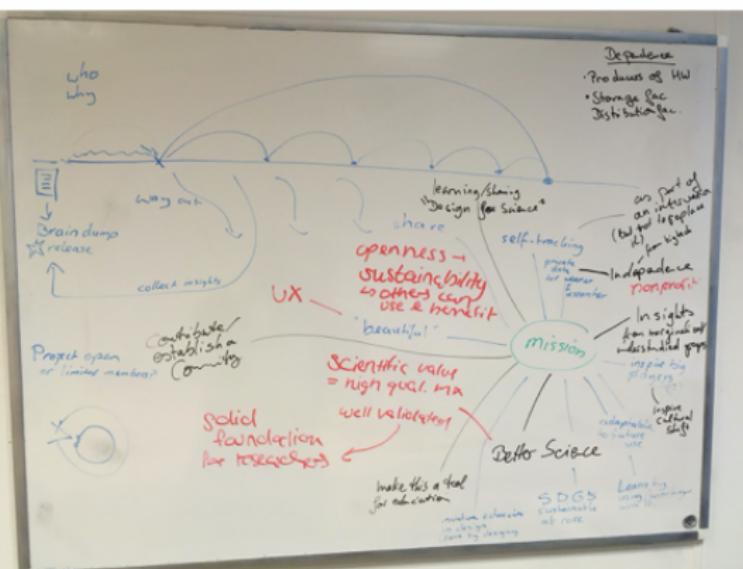
<https://asteroidos.org>

- locked in to a handful (android) devices
- limited lifestyle apps
- other disadvantages??

Open Trackers for (Open) Science What's next?

The Future?

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A Mission

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An independent community of researchers and other stakeholders evoking cultural shift towards sustainable research. The community works towards a common toolkit, which is transparent, flexible to use and open for improvements and changes.

Sustainable research is better privacy, adaptable design, affordable, transparent.

Transparency allows everyone in the community to take their own decisions and draw their own conclusions about the product.

What do you think?

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Is a truly open Activity Tracker an option?

What do you think?

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Which solution has most potential?

- A: Homebrew, Samsung
- B: Android App
- C: Astroid OS
- D: other (leave answer in chat)

What do you think?

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Is it worth to explore the astroidOS + custom smartwatch route?

What do you think?

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Do you know of other people working on opening activity
trackers for research?

Contact

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Contact:

Daniela Gaweihns

gaweihnsd@liacs.leidenuniv.nl

Twitter: @dgaweihns

Some people behind the Mission Statement and Platform Work:

Assia Kraan (Hogeschool van Amsterdam, Digital Society School)

Daphne Tona (CURIUM, Leiden)

Ricarda Proppert (Leiden University)

References and Links

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- Case Studies:
 - Focus on Emotion Lab at Leiden Uni:
<https://www.focusonemotions.nl>
 - Exodus Project:
<https://digitalsocietyschool.org/project/intention-mirror/>
 - Dementia Project:
<https://www.universiteitleiden.nl/en/research/research-projects/data-science-research-programme/data-science-research-programme-project-daniela-gawehns>

References and Links

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- Consumer Grade Wearables
 - Apple: <https://github.com/researchkit/researchkit>
 - fitbit: <https://healthsolutions.fitbit.com/researchers/>
<https://healthsolutions.fitbit.com/researchers/faqs/>
 - garmin:
 - fitabase (for fitbit and garmin):
<https://www.fitabase.com/how-it-works/faq/>
<https://www.fitabase.com/resources/knowledge-base/learn-about-fitbit-data/data-resolutions/>
 - <https://www.elektralabs.com/solutions/evaluation>

References and Links

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- Using big Tech
 - Meyer N., et al (2018): Capturing Rest-Activity Profiles in Schizophrenia Using Wearable and Mobile Technologies: Development, Implementation, Feasibility, and Acceptability of a Remote Monitoring Platform
 - corona-dataspende.de
 - Stanford Health Study:
<https://innovations.stanford.edu/wearables>

References and Links

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- Suggested Solutions
 - <https://github.com/abumondol/WaDa>
 - <https://github.com/DanielaGawehns/SamsungDataCollection>
 - <https://asteroidos.org> + homebrew

References and Links

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- Pipelines to analyze data
 - <https://dbdp.org>
 - <https://github.com/wadpac/GGIR>
 - many, many more!