

# Open Trackers for (Open) Science

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Universiteit  
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## Outline

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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



## 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>

Open Trackers for (Open) Science

Using Activity Trackers for Research: Activity: Alarm bells

## 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, momentary emotional assessment
- passively, (almost) non-intrusive
- longitudinal studies (several weeks)
- real life data

# Summary of Use Cases

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	Children	Ex-Detainees	Nursinghome
<b>Data Collection</b>			
Accelerometer	X	X	X
EMA	X		
GPS/Location	X	X	X
Call Logs		X	
<b>Participants</b>			
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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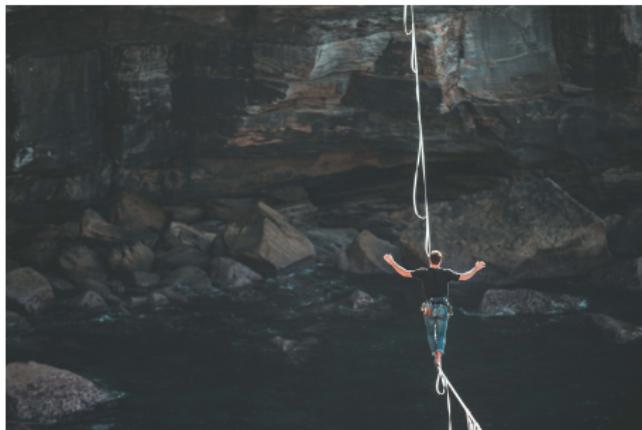


Photo by Loic Leray on Unsplash

## The How - Current Hardware Options

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### Medical Research Devices

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

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### Consumer Grade Devices

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

## The How - Apple Watch

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- Partner with the Apple Research App
- Researchkit and Carekit frameworks

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- Partner with the Apple Research App
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  - access health data, access to "tasks" and their outcomes
  - bring your own data storage (?!)
  - locked into what the frameworks allow (e.g., no background data collection)
  - locked into Apple Watches

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13 | 33

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  - locked into Apple Watches
- Apple Watch App (e.g. Apple Watch SensorLog)
  - locked in by certification/ app store process
  - locked in to Apple Watches

## The How - Fitbit

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- Use Fitabase
- Use web API
  - Companion Application to Watch Application file transfer
  - locked in certification
- Use bulk download via fitbit account

## The How - Garmin

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- Use Fitabase - a company providing research support
- Use the Health API
- Use the Health SDK

## 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
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- 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

## The How - Choices

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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
<b>Soziodemografische Daten</b>						
Größe & Gewicht	✓	✓	✓	✓	✓	
Geschlecht & Alter	✓		✓			✓
<b>Aktivitäten</b>						
<b>Aktivitätsinformationen</b>						
Aktiv	✓	✓	✓	✓	✓	
Aktivitätsdetail (Laufen, Radfahren, Sport etc.)	✓	✓	✓	✓	✓	
Ruhe	✓	✓	✓			
Schritte	✓	✓	✓	✓	✓	✓
Kalorienverbrauch	✓	✓	✓	✓		
Zurückgelegte Strecke	✓	✓	✓	✓	✓	
Gestiegene Treppen	✓	✓		✓		
Schlaf	✓	✓	✓	✓	✓	✓
<b>Vitaldaten</b>						
Puls	✓	✓	✓	✓	✓	✓
Körpertemperatur				✓	✓	
Gewicht	✓	✓	✓	✓	✓	

## The How - Summary

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Summary: We have solutions for:

- Lab Studies

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Summary: We have solutions for:

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

## The How - Case Studies

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Photo by Eduard Militaru on Unsplash

## 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**.

## Open Science - at last

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- **collaborate** and **contribute**
- **redistribution** and **reproduction** of the research and its underlying data and **methods**

## The How

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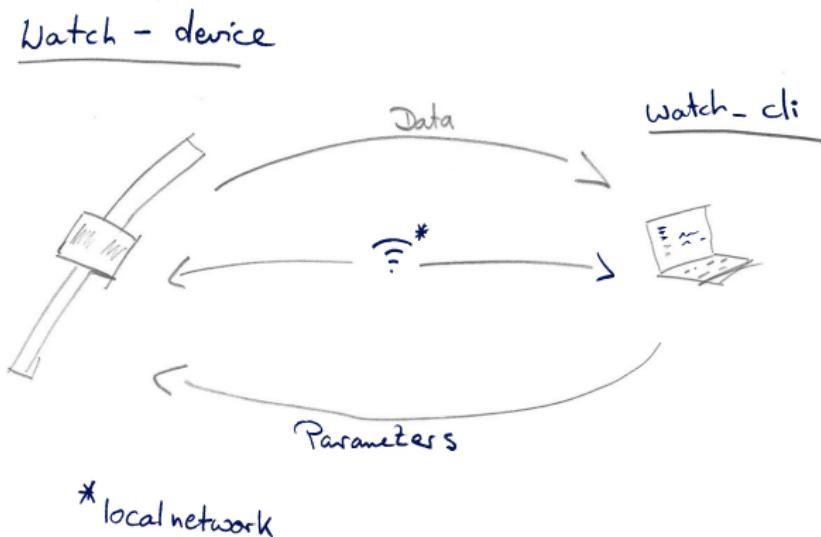
- Wear OS / Android for wearables
- Tizen for Wearables
- astroid

## 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

## The How - Homebrew



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

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- 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

Open Trackers for (Open) Science  
What are current solutions?

## Open Source Operating System

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<https://asteroidos.org/news/>

## The Future

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- Data Privacy is paramount - Research platforms allow access to some but not all data - API's do not allow access to all data
- Interoperability - Robust Findings - independent of tech - Validity of measurements - Research questions independent of tech/ pre-trained black boxes - Modularity to ensure only those sensors that are needed are included (and that they ARE included) - Costs are high - open science might be an answer? - Using big tech at exploratory research level might be fine - but where are you going with this – access only to those who can afford it and dependent on companies to not change the modeling? - Usually we are working towards sth - let's make sure it is in accordance with what we want to create with the tech– also already at exploratory levels

## The Future

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- Show design process until now - mission and network of stakeholders
- Multifaceted problem - Difficult to get people on board, who commit and stay on board - certainly at beginning
- How do you build a OS / Open Hardware community?
- What are the benefits - especially when trying to get academics involved
- incentive structure is not built for such projects

Open Trackers for (Open) Science

What's next?: Activity: Next steps and avenues

## Wake-up Activity

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Activity with Audience: collect possible solutions to move forward