UNIVERSITY OF MANNHEIM
School of Social Sciences

Collecting Individual-level Digital Behavioral Data via Data Donation

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Mannheim Center for Data Science
Data Science in Action Lecture Series
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Outline

- What are digital behavioral data?
- Ways to collect individual-level digital behavioral data
- The idea of data donation
- Data donation case studies
- Challenges of data donation studies
- Summary & outlook

What Are Digital Behavioral Data?

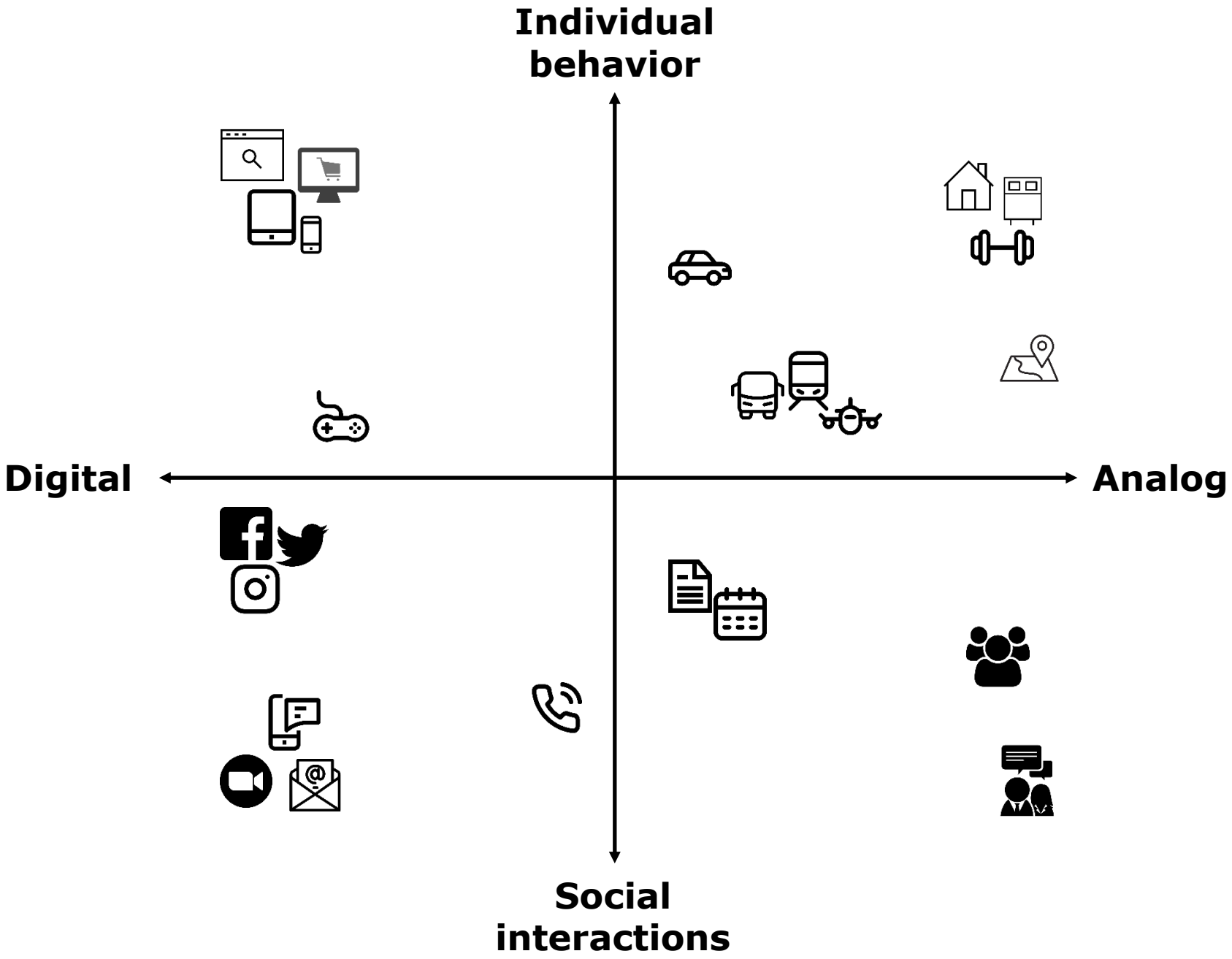
What Are Digital Behavioral Data?

"Records of activity (trace data) undertaken through an online information system (thus, digital)"

(Howison et al. 2011:769)

"Behavioral residue [individuals leave] when they interact online"

(Hinds & Joinson 2018:2)



Keusch & Kreuter (2022)

Benefits of Digital Behavioral Data

- Allow measurement of behavior (in-the-moment) at high frequency
  - Evaluation of moment-to-moment changes
  - Without increasing burden on participants
  - Scalable

- Measurement is nonreactive, i.e., without direct solicitation of subject studied
  - Digital behavioral data should be unaffected by measurement itself
  - Reduced measurement error when measuring…
    - smartphone use (Kobayashi & Boase 2012; Boase & Ling 2013; Andrews, et al. 2015; De Reuver & Bouwman 2015; Revilla et al. 2017; Jones-Jang et al. 2020)
    - online media consumption (Araujo et al. 2017; Haenschen 2020; Revilla et al. 2017; Scharkow 2016)
    - mobility (Stopher et al. 2007; Scherpenzeel 2017)

How to Collect Individual-Level Digital Traces

How to Collect Individual-Level Digital Traces

- Use APIs

Meta

An Update on Our Plans to Restrict Data Access on Facebook

April 4, 2018

Chesnot / Getty Images

SCIENCE / TWITTER / TECH

Twitter just closed the book on academic research / Twitter was once an indispensable resource for academic research. That's changed under Elon Musk.

By Justine Calma, a science reporter covering the environment, climate, and energy with a decade of experience. She is also the host of the Hell or High Water podcast.

May 31, 2023, 3:19 PM GMT+2 | 23 Comments / 23 New

https://www.theatlantic.com/technology/archive/2023/02/elon-musk-twitter-ethics-algorithm-biases/673110/

FEATURE

Reddit pricing: API charge explained

Providing a free API was becoming costly for Reddit. Enterprise-scale developers now have to pay for access to Reddit's data.

By Ben Lutkevich, Technical Features Writer Published: 11 Jul 2023

Shutterstock

How to Collect Individual-Level Digital Traces

- Use APIs
- Collaborate with industry

How to Collect Individual-Level Digital Traces

- Use APIs
- Collaborate with industry
- Have users install meters and apps that continuously…
  - …track information on web browsing
  - …logs usage behavior, (native) mobile browsing, and sensor readings

- Allows tracking of individual behavior over longer periods of time
- Various commercial and non-commercial tools available
  - e.g., Wakoopa, Movisense, Mumuras, Ethica, Aware, Beiwe, ResearchStack, ResearchKit, …
- Some (market) research organizations maintain "metered panels"
  - e.g., Netquest, Gapfish, YouGov, GESIS Panel.dbd, …

Browsing and App Use Data

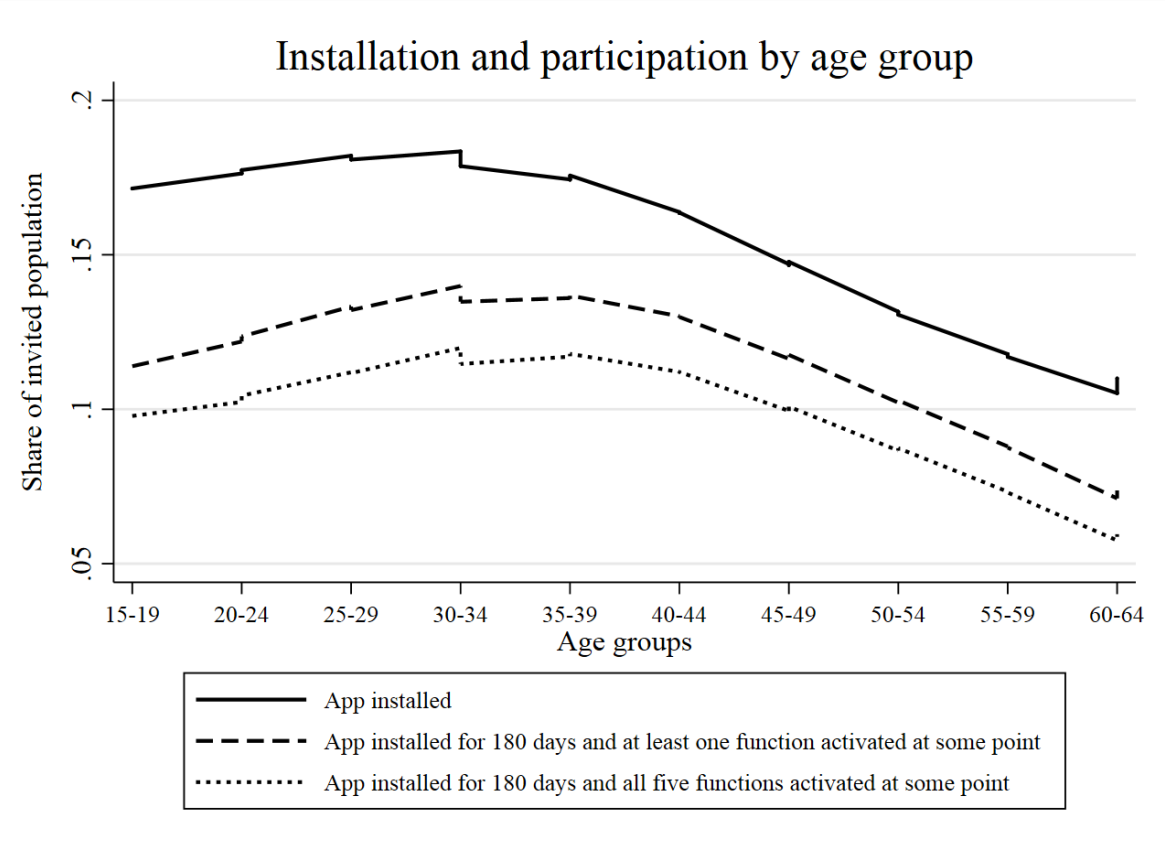
ID	URL	used_at	active_seconds
1	tipico.de/de/online-sportwetten	2017-09-12 10:45:15	83
1	rib-software.com/de/loesungen/architektur-und-bauplanung/arriba-ava.html	2017-09-12 10:45:19	40
1	wetteronline.de/wettertrend/cala-d-or	2017-09-12 10:45:23	182
1	facebook.com/messages/t	2017-09-12 10:45:36	2
1	facebook.com/messages/t/Peter.Mustermann	2017-09-12 10:45:44	74
1	severin-produkttest.de	2017-09-12 10:45:55	8
1	severin-produkttest.de/bewerbung	2017-09-12 10:46:05	46
1	sparda-b.de	2017-09-12 10:46:37	6
2	rp-online.de/nrw/staedte/duesseldorf/airport-duesseldorf-flughafen-nicht-verantwortlich-fuer-das-was-dort-passiert-aid-1.7075717	2017-09-12 11:19:48	9
2	autoscout24.de/ergebnisse?mmvmk0=29&mmvmd0=15537&mmvco=1&body=5&pricefrom=0&priceto=8000&cy=D&zipr=50&fuel=B&powertype=kw&offer=U&offer=J&offer=O&offer=D&lat=49.15148&lon=9.17345&zip=Heilbronn&atype=C&ustate=N%2CU&sort=standard&desc=0&page=1&size=20	2017-09-12 12:01:10	28
2	trauer.weser-kurier.de	2017-09-12 12:06:45	5
2	amazon.de/Kee-Hearts/dp/B072Z8DMRY/ref=sr_1_1?ie=UTF8&qid=1505211277&sr=8-1&keywords=kee+of+hearts	2017-09-12 12:14:44	10
2	sat1gold.de/tv/zwei-bei-kallwass/video/117-brunos-geheimnis-ganze-folge	2017-09-12 12:15:10	49
2	bibeltv.de/livestreams	2017-09-12 12:28:40	1
2	arbeitsagentur.de/meine-eservices	2017-09-12 12:36:46	11
3	facebook.com	2017-09-12 12:55:35	6
3	bild.de/news/ausland/hurrikan-irma/irma-live-ticker-karibik-puerto-rico-domrep-haiti-florida-usa-53130320.bild.html	2017-09-12 12:55:41	2
3	spiegel.de	2017-09-27 09:56:46	14
3	https://www.spiegel.de/politik/deutschland/wolfgang-schaeuble-ueber-grosse-koalitionen-kann-auf-dauer-nur-schiefgehen-a-1299654.html	2017-09-27 09:57:00	195

ID	app_n	used_at	active_seconds	app_cat
1	To-Do Calendar Planner	2017-09-12 10:45:15	83	Email, Messaging & Telephone
1	WhatsApp Messenger	2017-09-12 10:45:19	40	Email, Messaging & Telephone
1	Kleiderkreisel	2017-09-12 10:45:23	182	Lifestyle, food & nightlife
1	Camera	2017-09-12 10:45:36	2	Audio, video & entertainment
1	eBay Kleinanzeigen for Germany	2017-09-12 10:45:44	74	Lifestyle, food & nightlife
1	dm glÃ¼ckskind	2017-09-12 10:45:55	8	Lifestyle, food & nightlife
1	GMX Mail	2017-09-12 10:46:05	46	Email, Messaging & Telephone
1	WhatsApp Messenger	2017-09-12 10:46:37	6	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 11:19:48	9	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 12:01:10	28	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 12:06:45	5	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 12:14:44	10	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 12:15:10	49	Email, Messaging & Telephone
2	WhatsApp Messenger	2017-09-12 12:28:40	11	Email, Messaging & Telephone
2	GMX Mail	2017-09-12 12:36:46	11	Email, Messaging & Telephone
3	GMX Mail	2017-09-12 12:55:35	243	Email, Messaging & Telephone
3	GMX Mail	2017-09-12 12:55:41	24	Email, Messaging & Telephone
3	Period tracker	2017-09-27 09:56:46	14	Health & fitness
3	Pedometer	2017-09-27 09:57:00	195	Health & fitness

See Clemm von Hohenberg et al. (2024) on how to analyse web browsing data

Challenges When Using Meters and Apps

- Coverage & nonparticipation
  - Who uses the technology and is willing to share their data?



Keusch et al. (2022)

Reasons not to participate	
Privacy, data security concerns	44%
No incentive, incentive too low	17%
Not enough information provided	12%
Do not download any apps	8%
Not interested	6%
Not enough time/Study too long	5%
Don't use smartphone enough	5%
Not enough storage	1%
Other reasons	6%
n=1,154	

Keusch et al. (2019)

Challenges When Using Meters and Apps

- Coverage & nonparticipation
- Ethics, privacy, & data security
  - Passively collected data might be considered very sensitive
  - Users might not (fully) understand what data are collected and how they are being used
  - To comply with GDPR…
    - …multiple consent steps required (trade-off between informed consent and burden)
    - …data needs to be stored in Germany/EU
  - ➢ "Whitelisting" of URLs, pre-processing data on device before transfer to server, option to temporarily turn-off tracking, privacy nudging,…

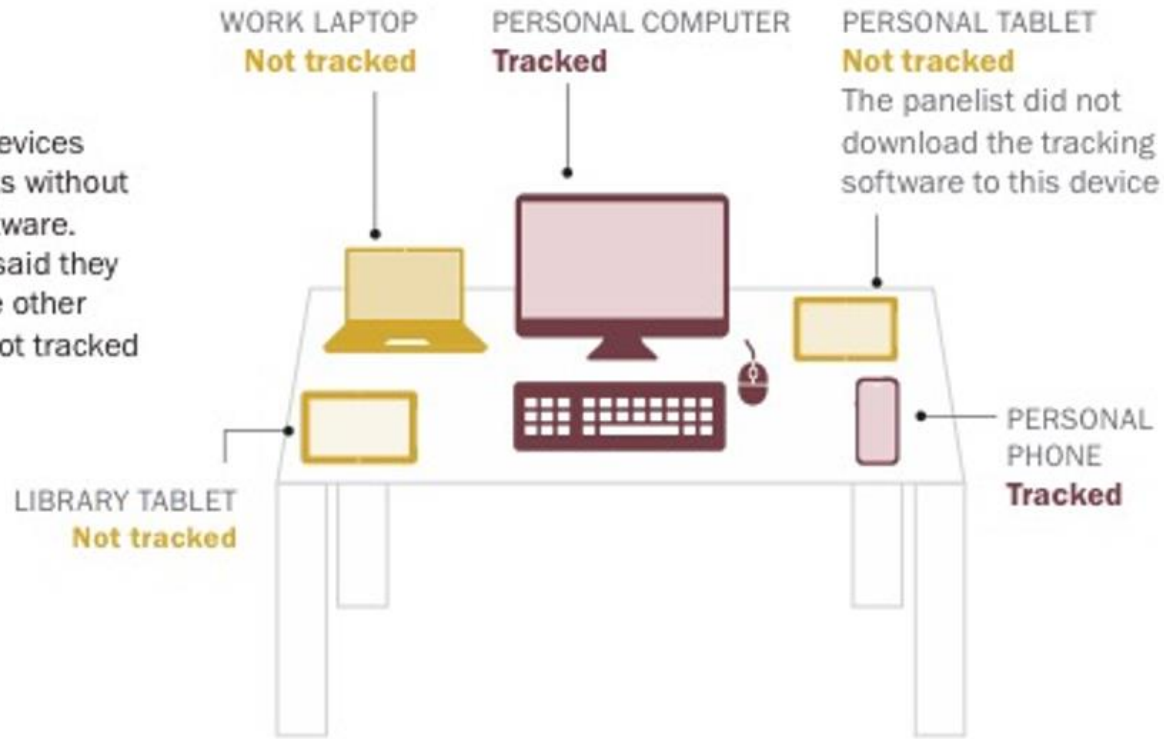
Challenges When Using Meters and Apps

- Coverage & nonparticipation
- Ethics, privacy, & data security
- Missing data

DEVICE TRACKING

Tracked:
Devices tracked in this study included computers, tablets and mobile phones used by panelists that they downloaded tracking software onto

Not tracked:
Any additional devices used by panelists without the tracking software. Many panelists said they had one or more other digital devices not tracked



Source: https://www.pewresearch.org/journalism/2020/12/08/measuring-news-consumption-in-a-digital-era/

See also Bosch et al. (2024)

Challenges When Using Meters and Apps

- Coverage & nonparticipation
- Ethics, privacy, & data security
- Missing data

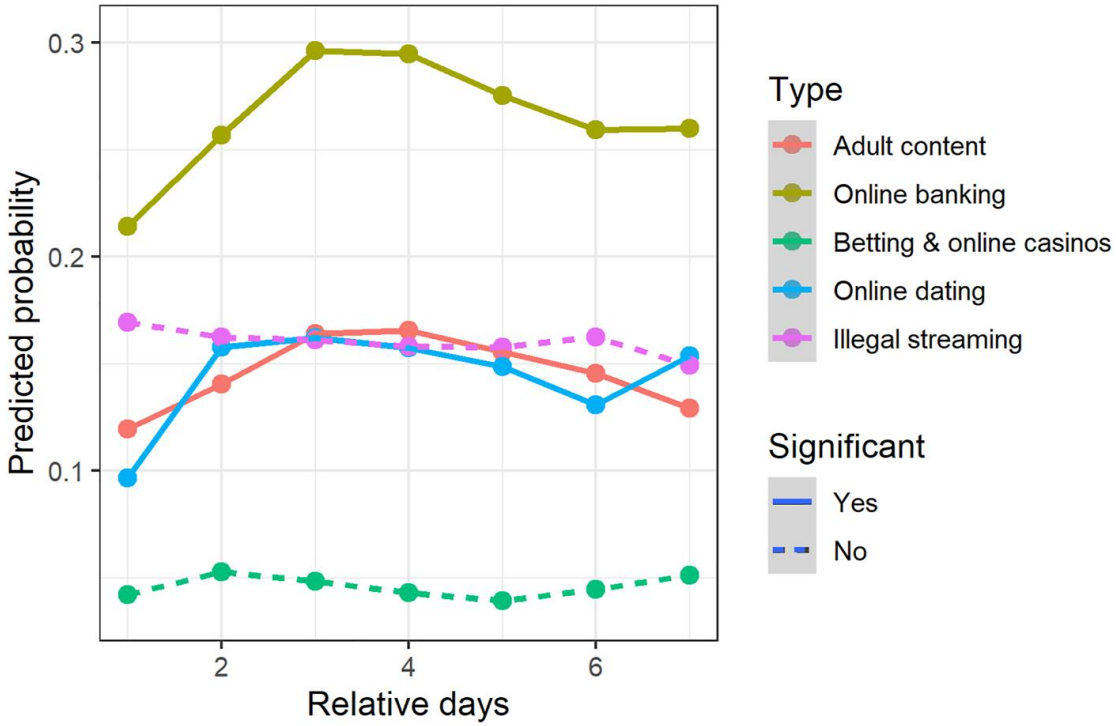
- Comparison of traced FB use to self-report (Pankowska et al. under review)
  - Frequent (C2) and infrequent users (C3) relatively equal
  - One class (C1) with large inconsistencies, especially if smartphone data missing

	Class		
	1	2	3
Size	0.38	0.33	0.29
FB use survey			
Once a month or less	0.00	0.00	0.30
Several times a month	0.01	0.02	0.31
Several times a week	0.10	0.13	0.37
Daily	0.46	0.35	0.02
Several times a day	0.44	0.50	0.00
FB use tracking app			
Once a month or less	0.52	0.01	0.61
Several times a month	0.13	0.02	0.14
Several times a week	0.23	0.17	0.20
Daily	0.10	0.00	0.05
Several times a day	0.01	0.80	0.01

See also Bosch et al. (2024)

Challenges When Using Meters and Apps

- Coverage & nonparticipation
- Ethics, privacy, & data security
- Missing data
- Reactivity



Keusch et al. (2023)

Source: https://twitter.com/mbrennanchina/status/1128201958962032641

How to Collect Individual-Level Digital Traces

- Use APIs
- Collaborate with industry
- Have users install meters and apps
- Ask users to “donate” data
  - User-centered approach for retrospective digital behavioral data collection

The Idea of Data Donation

Data Donation

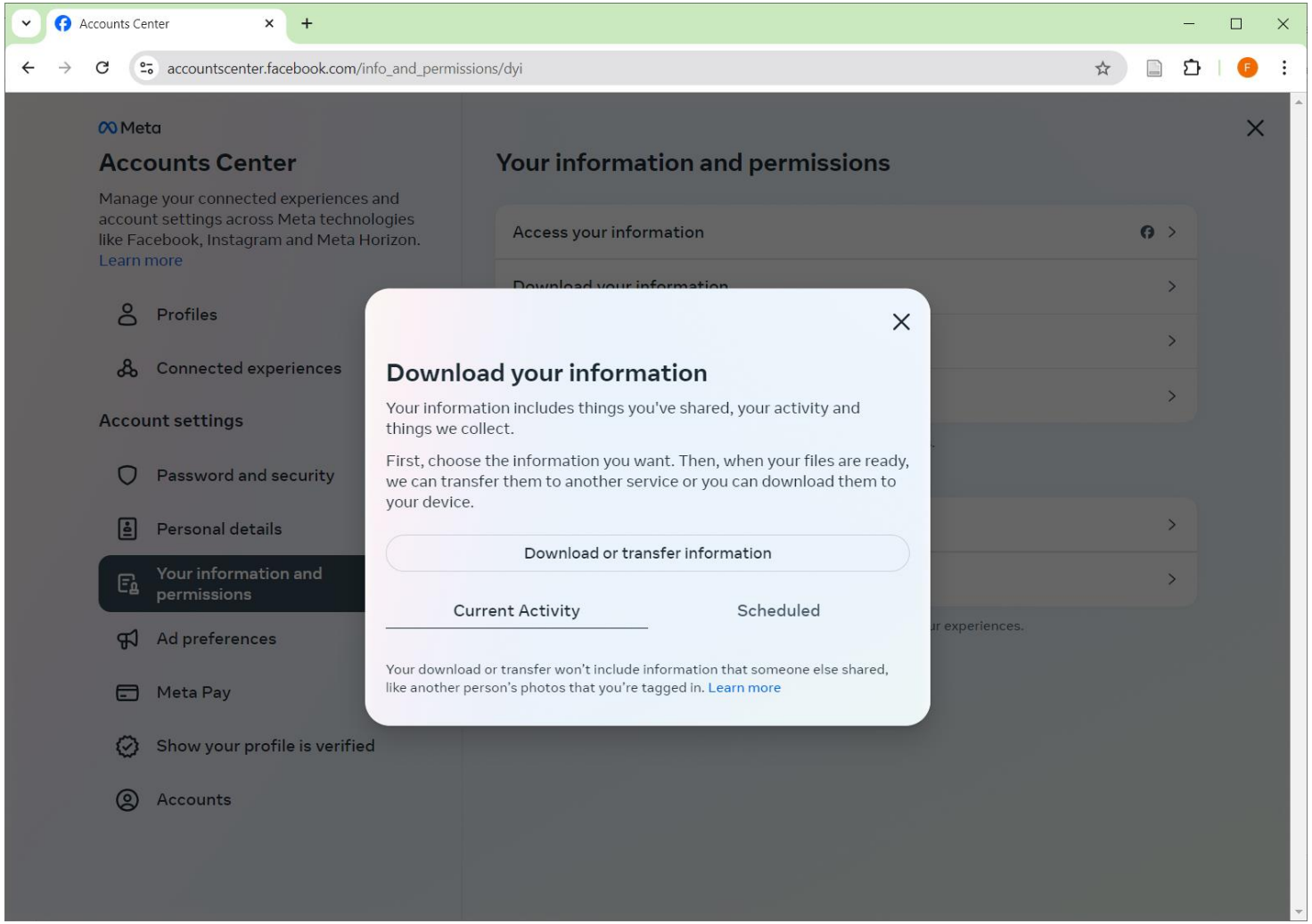
- Takes advantage of legislation such as *General Data Protection Regulations* (GDPR), *California Consumer Privacy Act* (CCPA), and *Lei Geral de Proteção de Dados* (LGPD) in Brazil
  - GDPR Art. 15: Right of access by the data subject
  - GDPR Art. 20: Right to data portability

- Now often implemented in online surveys (see Haim et al. 2023)
  - Respondents asked for willingness to donate data at end of survey
  - Respondent requests data download package (DDP) from data controller
  - Respondent donates DDP to researcher
    - Via direct sharing (e.g., ftp server, email)
    - Privacy-preserving data donation platforms

Data Donation

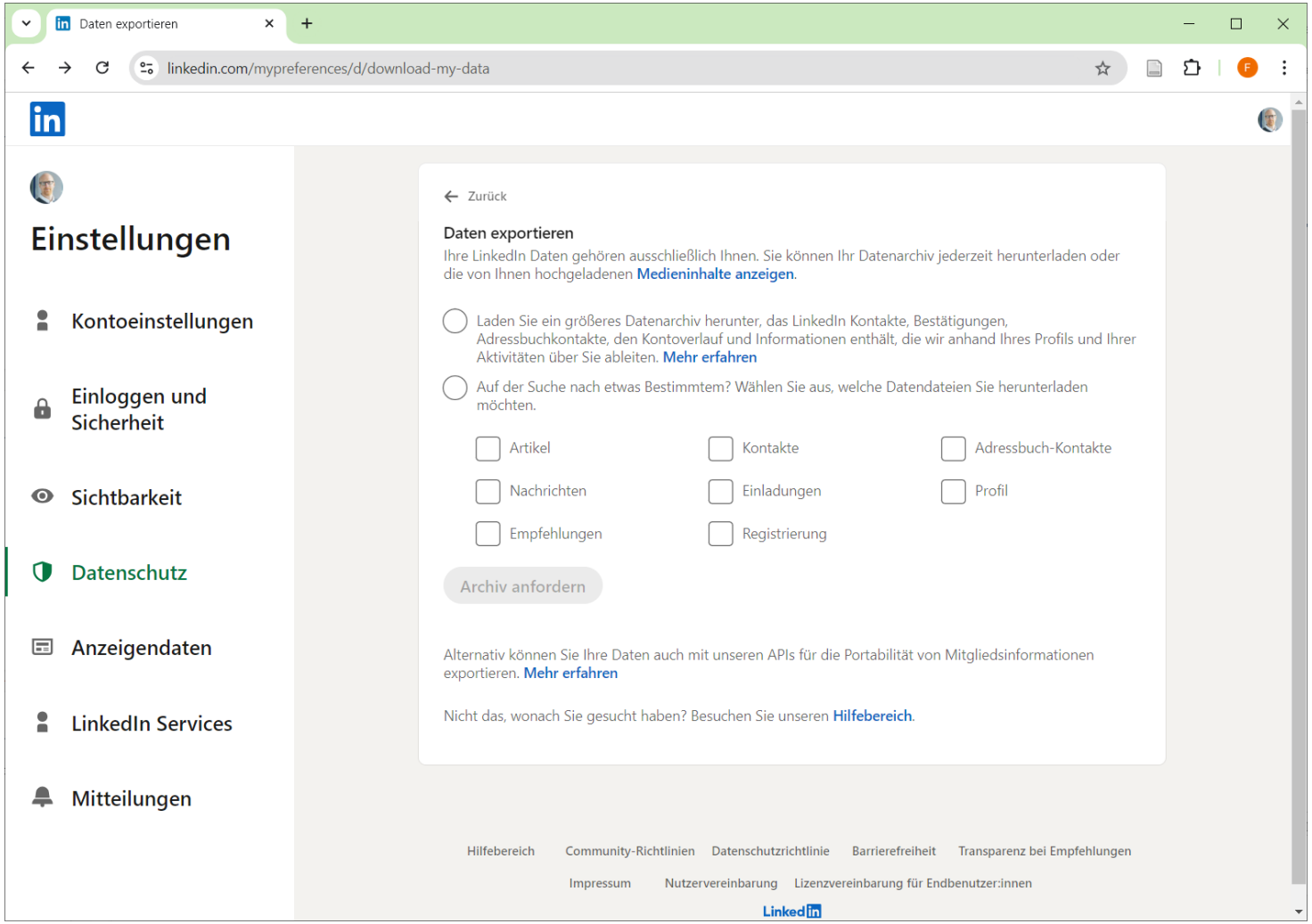
https://datadonation.eu/

Users Request DDP – Meta



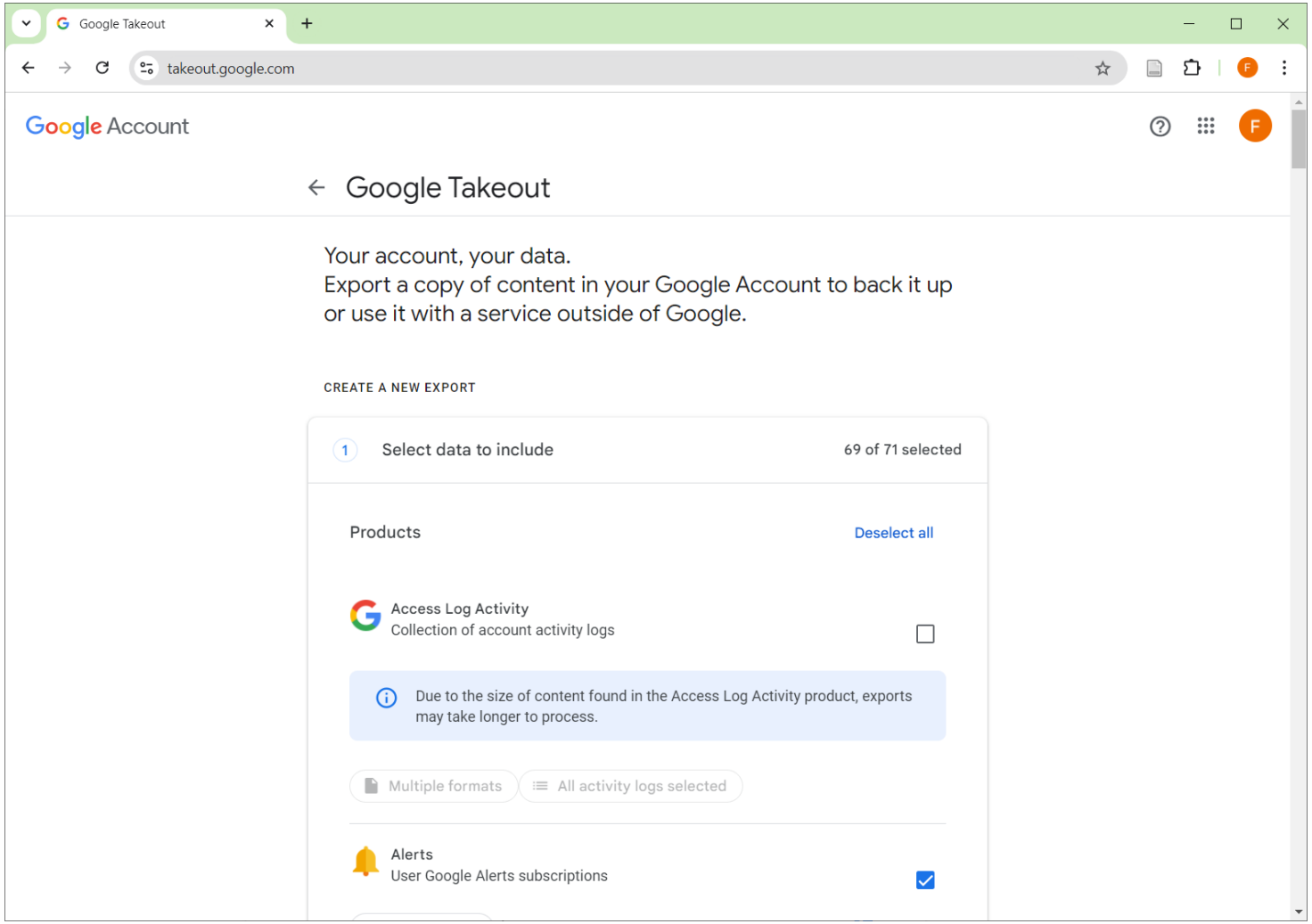
https://accountscenter.facebook.com/info_and_permissions/dyi

Users Request DDP – LinkedIn



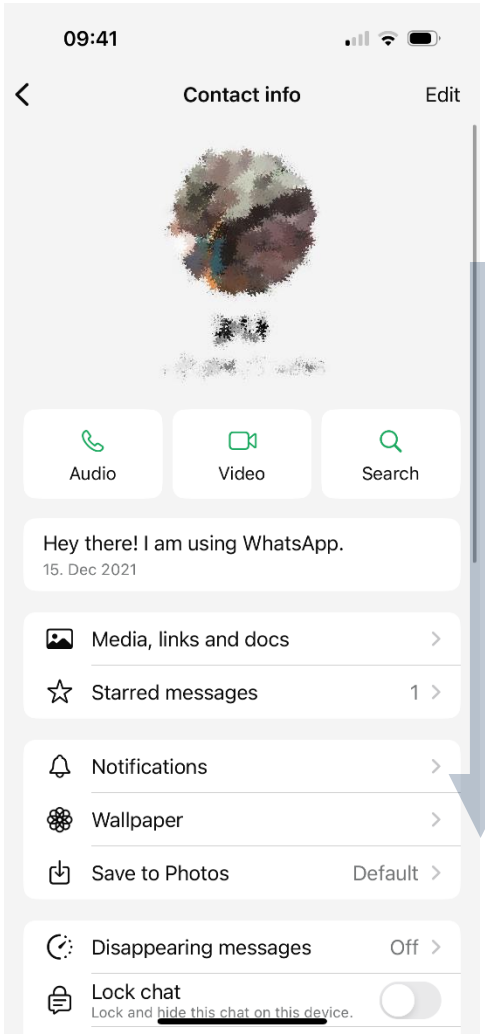
https://www.linkedin.com/mypreferences/d/categories/privacy

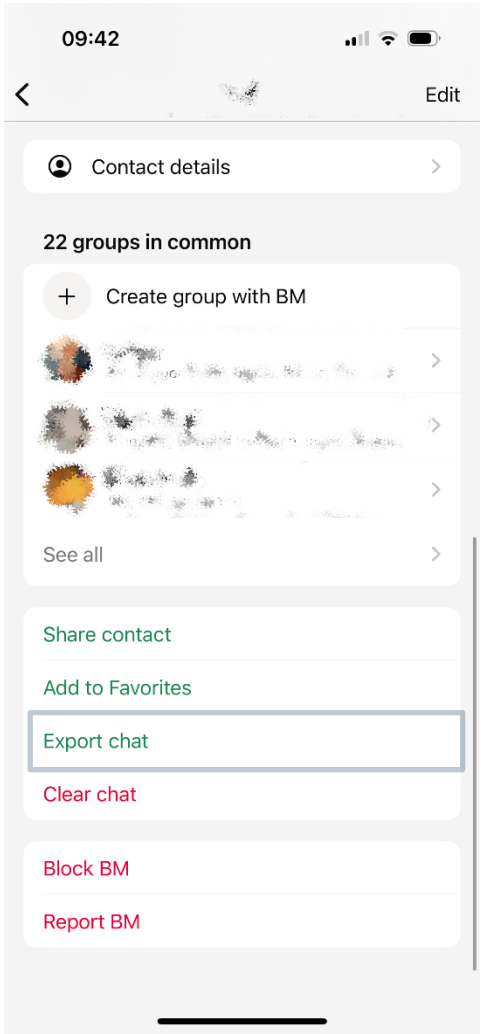
Users Request DDP – Google



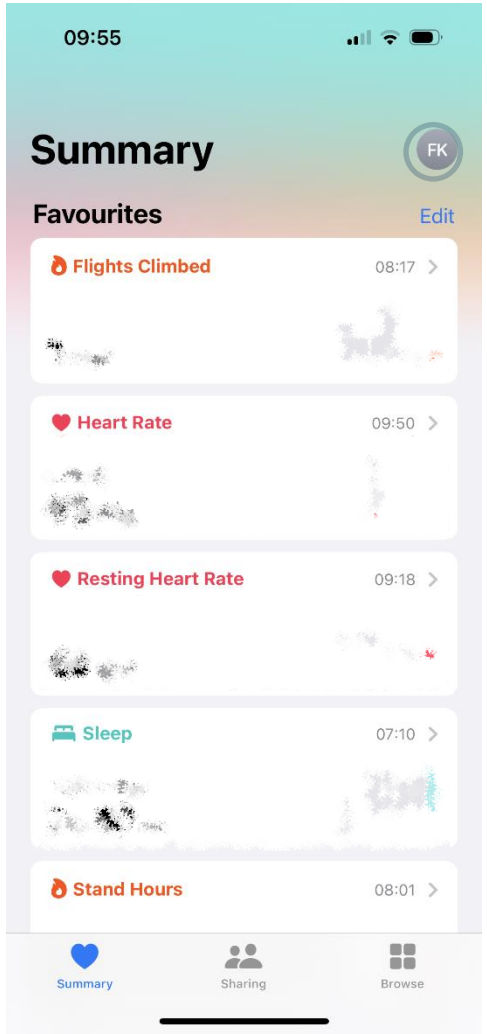
https://takeout.google.com/

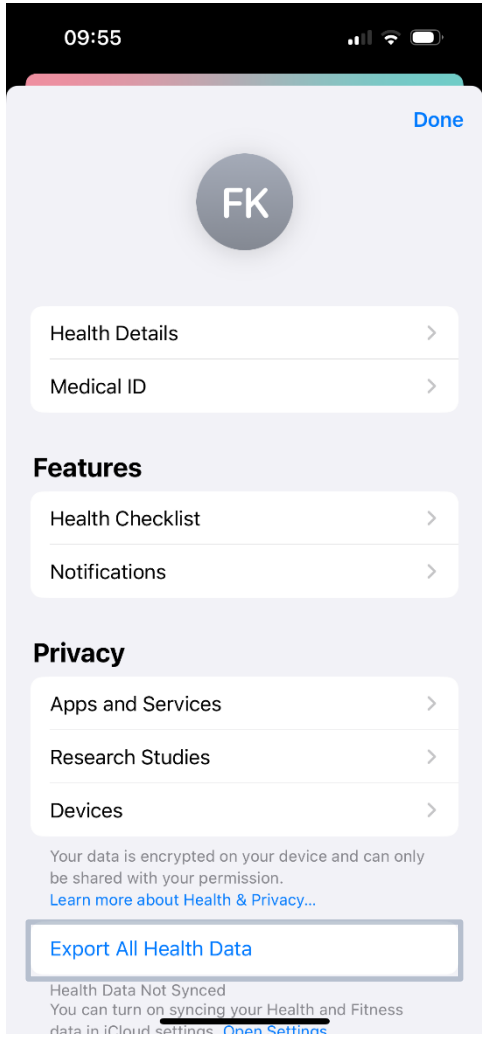
Users Request DDP – WhatsApp





Users Request DDP – Apple Health





What Data Are Available?

- In theory, everthing data controller collects about user needs to be provided back to them and can be donated
- Data available depends on type of data controller (i.e., social media platform, health app, etc.)
- For typical social media platforms (e.g., Facebook, Instagram, Youtube), data includes…
  - …digital user profiles (e.g., sociodemographics, privacy settings)
  - …digital activity (e.g., friends, likes, searches, privat messages, passive usage)
  - …digital targeting (e.g., ads, algorithmically inferred interrests)
  - …analoge activities (e.g., attandance at events, life events)

Job-related Data in DDPs

		Facebook	Instagram	TikTok	Google/ YouTube	LinkedIn	XING
DDP Request	File format of DDP	HTML or JSON	HTML or JSON	TXT or JSON	depends on service	CSV	HTML
	Time until participants can download DDP	< 24h	< 24h	< 96h	< 48h	< 48h	< 72h
	DPP arrives as single file	✓	✓	✓	✓*[1]	×*[2]	×*[3]
Data in DDPs	Exemplary variables: *Ties and social interactions*						
	Friends & followers	✓	✓	✓	✓	✓	✓
	Published posts & likes	✓	✓	✓	(✓)	✓	✓
	Exemplary variables: *Self-presentation*						
	CV-like information	×	×	×	×	✓	✓
	General profile information	✓	✓	✓	✓	✓	✓
	Exemplary variables: *Job-related activities*						
	Search history	✓	✓	✓	✓	✓	✓
	(Submitted) applications	×	×	×	×	✓	✓
	Exemplary variables: *Job-related microtargeting*						
	Targeted ads/algorithmically inferred interests	✓	✓	✓	×	✓	✓
	Consumed advertisement	✓	✓	(✓)	✓	✓	✓

*[1] only split if large, *[2] basic and advanced, *[3] internal and external

Source: own research

Hase et al. (2023)

Local Data Processing

- User receives DDP(s) (e.g., .csv, .json, .html) from data controller and temporarily stores them on their device

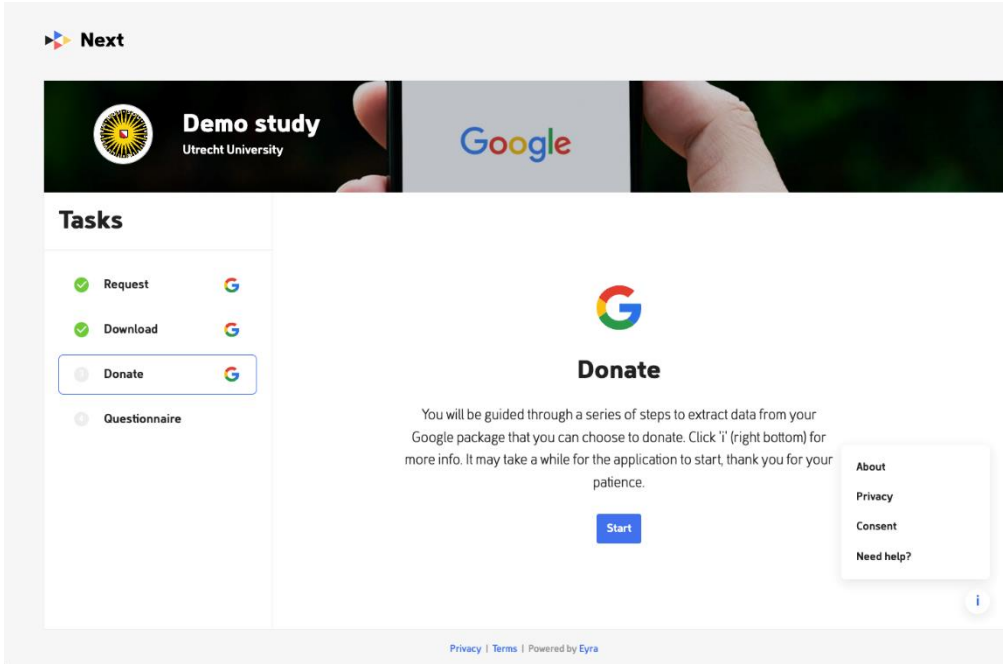
- Using data donation platform, DDPs can be locally processed
  - Script reads in DDP and selects relevant files to process
  - Data of interest extracted and potentially processed further (e.g., aggregating step count to day-level, whitelisting, striping any PII)
  - Interactive script elements might be used for respondent to engage with data (e.g., annotation, provide information about chat partner)
  - Processed data presented back to respondent as table or graph for review and respondent might delete certain data points

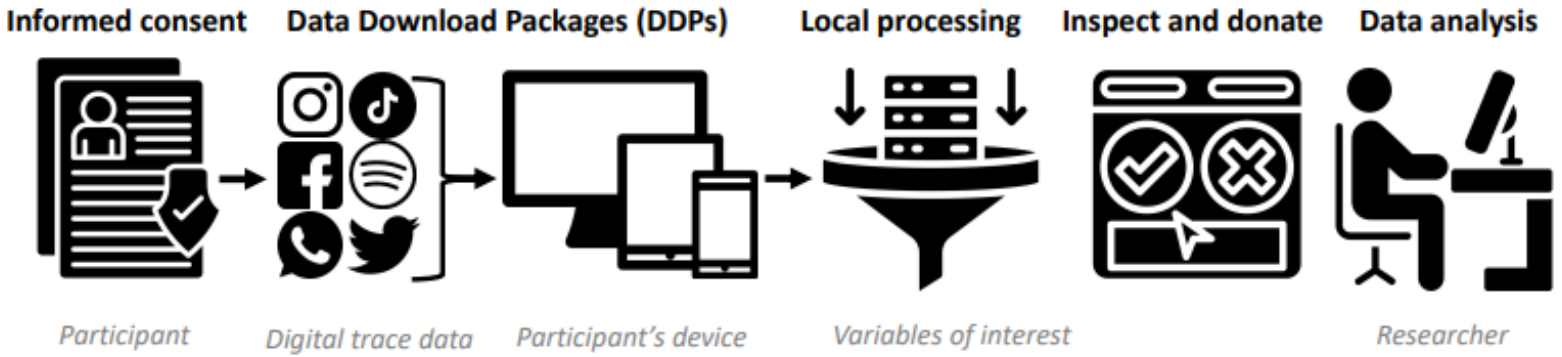
➢ Only final pre-processed and reviewed data set transmitted

Carrière et al. (2024)

Local Data Processing

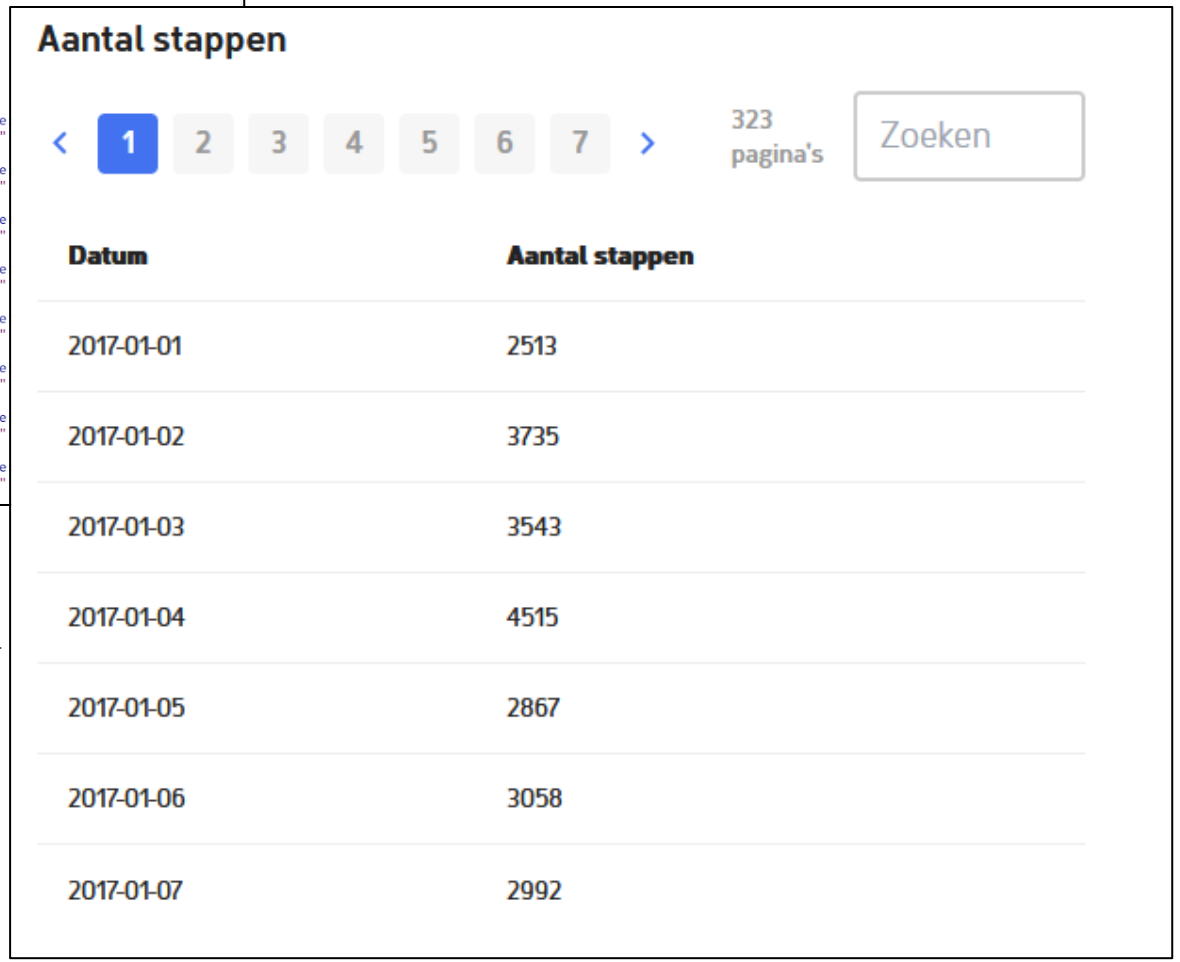
[Data Donation Task/Port](#) & [Next](#)





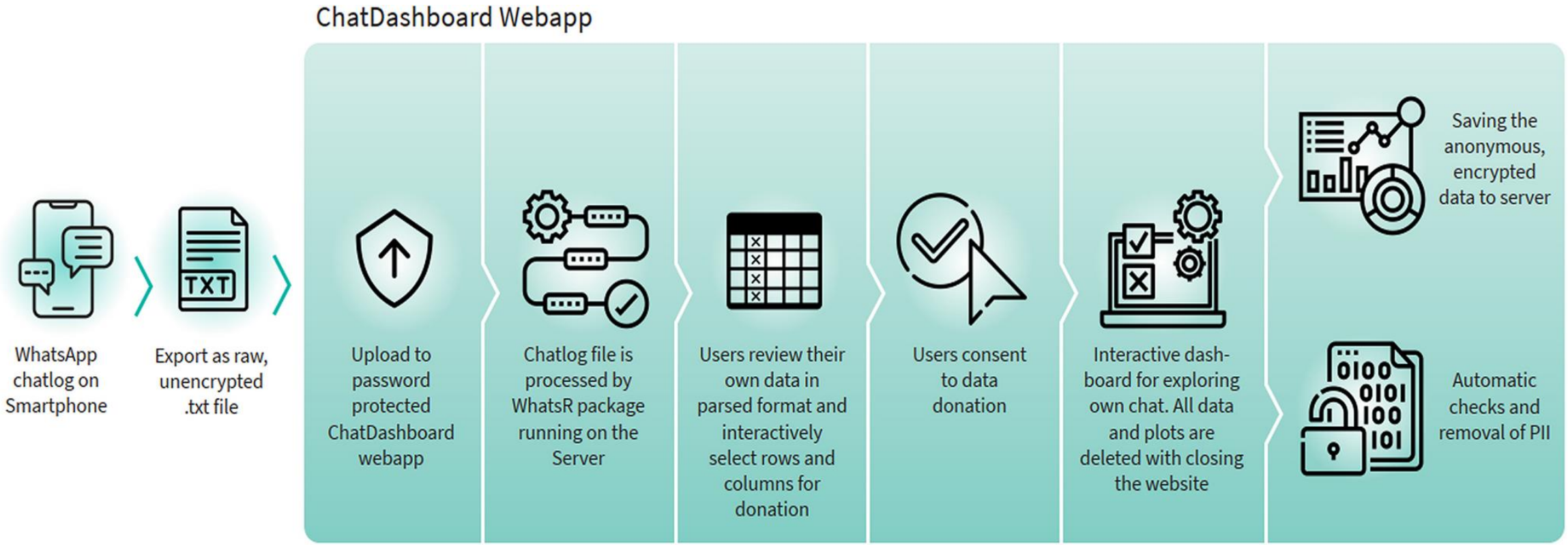
Boeschoten et al. (2023)

Local Data Processing – Apple Health



Local Data Processing

ChatDashboard & WhatsR



Data Donation

Advantages

+ Allows access to longitudinal digital behavioral data that cannot be collected otherwise

+ Works for large range of platforms
  - WhatsApp, Facebook, Instagram, Google, LinkedIn, YouTube, Netflix, Apple Health, Fitbit,…

+ Fully GDPR-compliant
  - User retains full control over what data are donated

Challenges

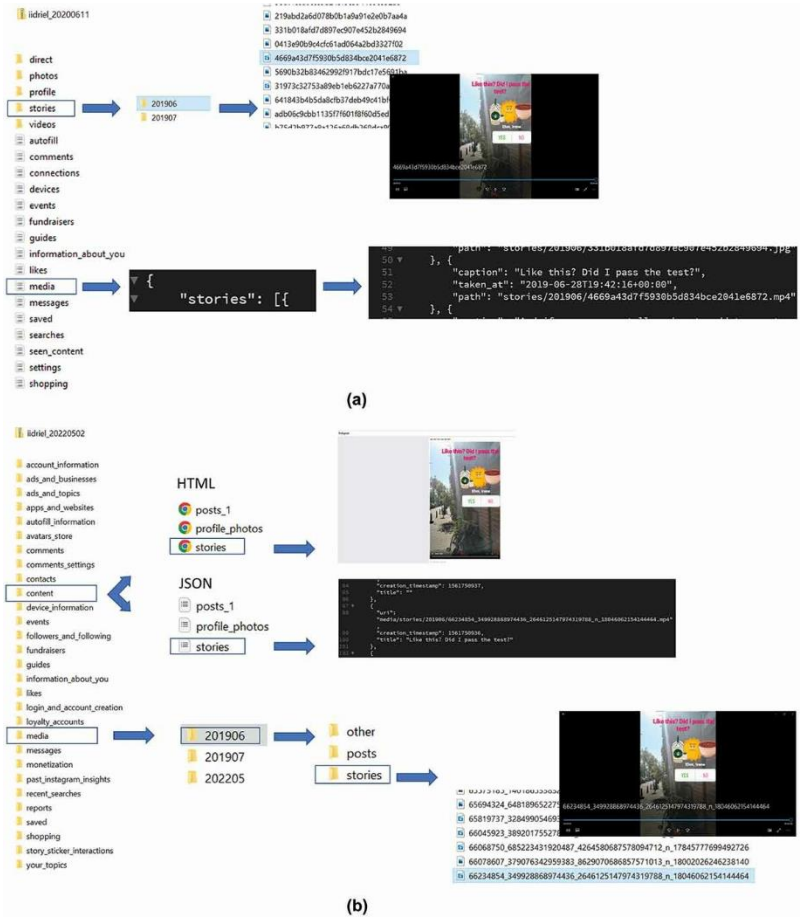
- Data donation process can be rather cumbersome for users (consent, data download, data storage, data upload)

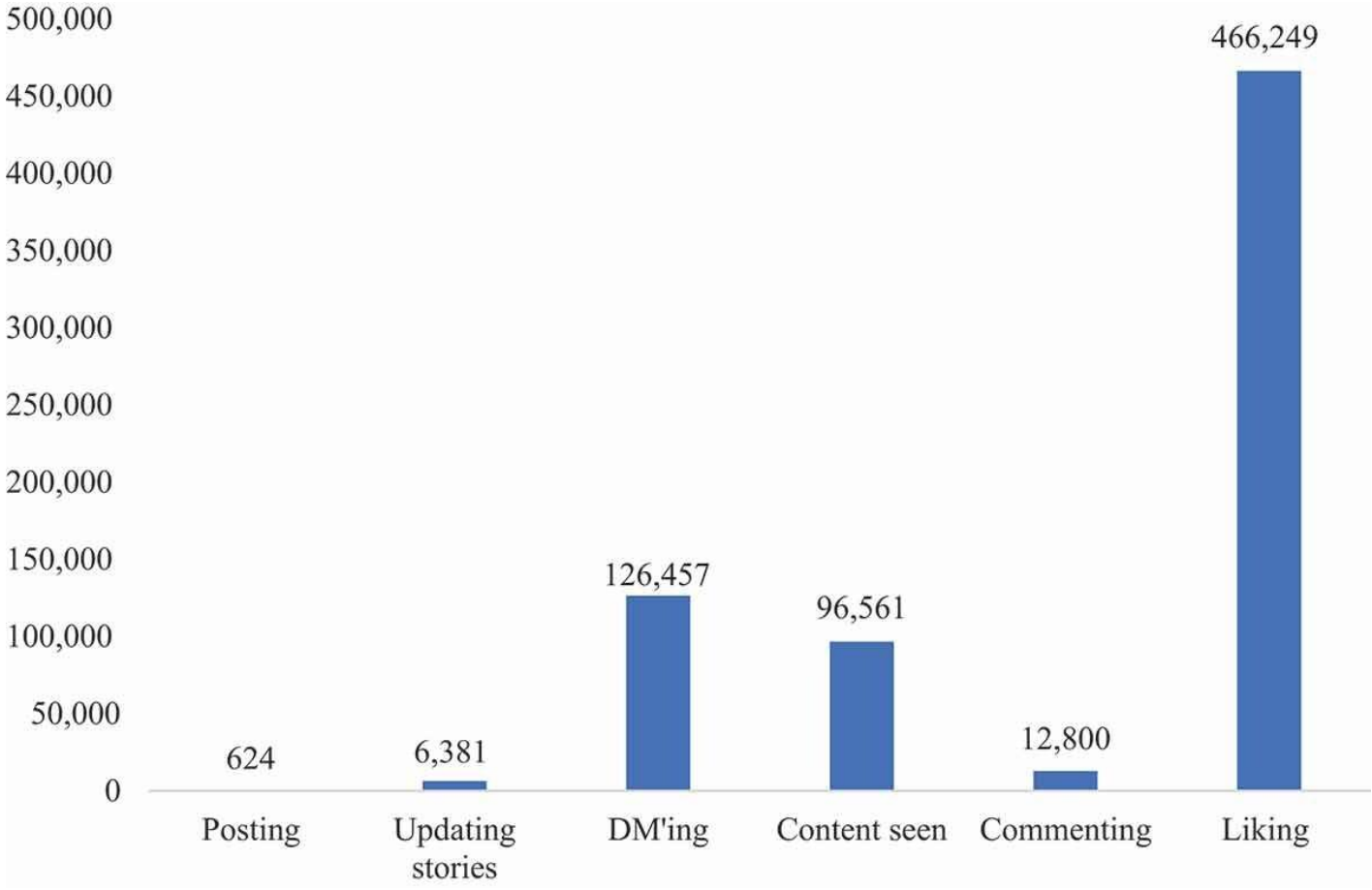
- (Basic) technical skills needed to participate

Data Donation Case Studies

Example Studies

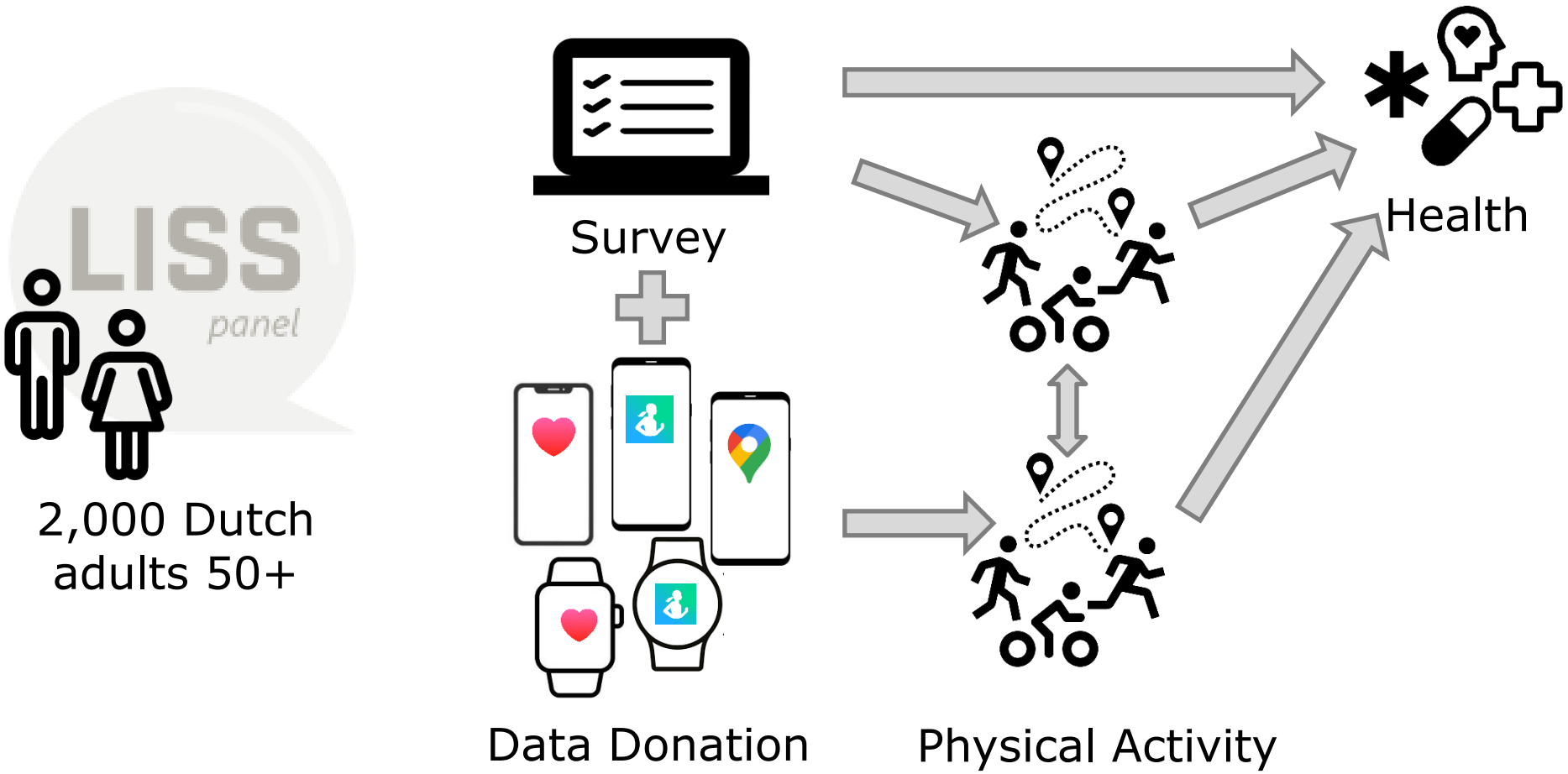
- Instagram activities among 8th and 9th graders (van Driel et al. 2022)





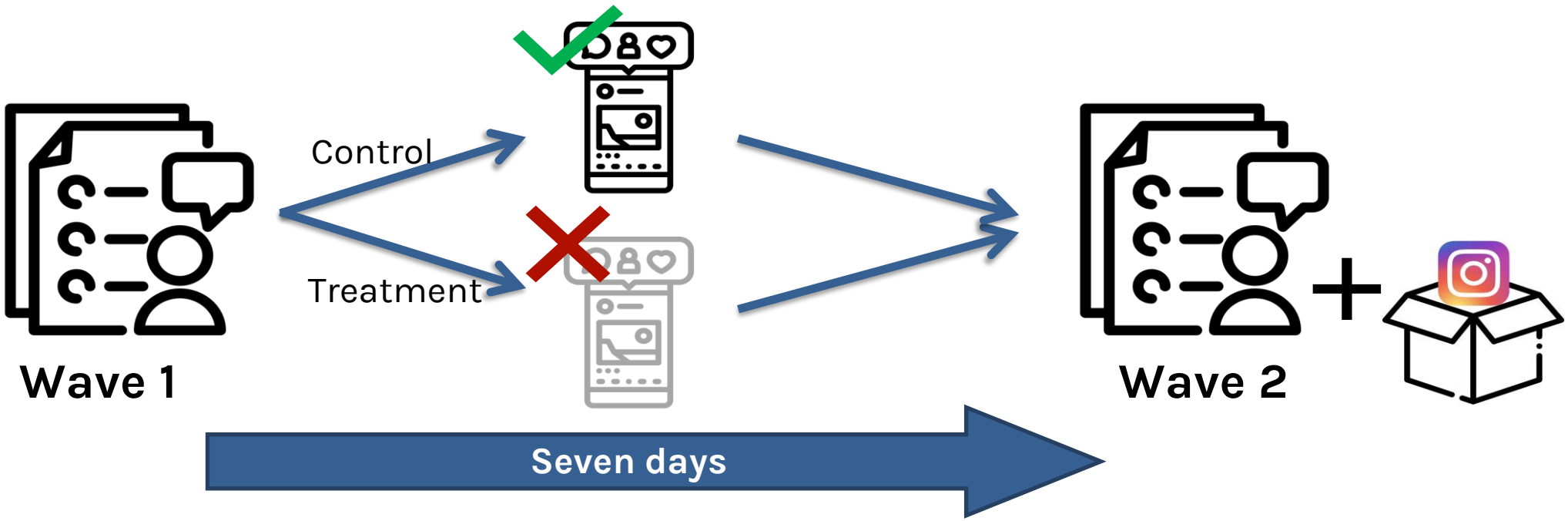
Example Studies

- Physical activity of older adults (Keusch & Struminskaya in preparation)

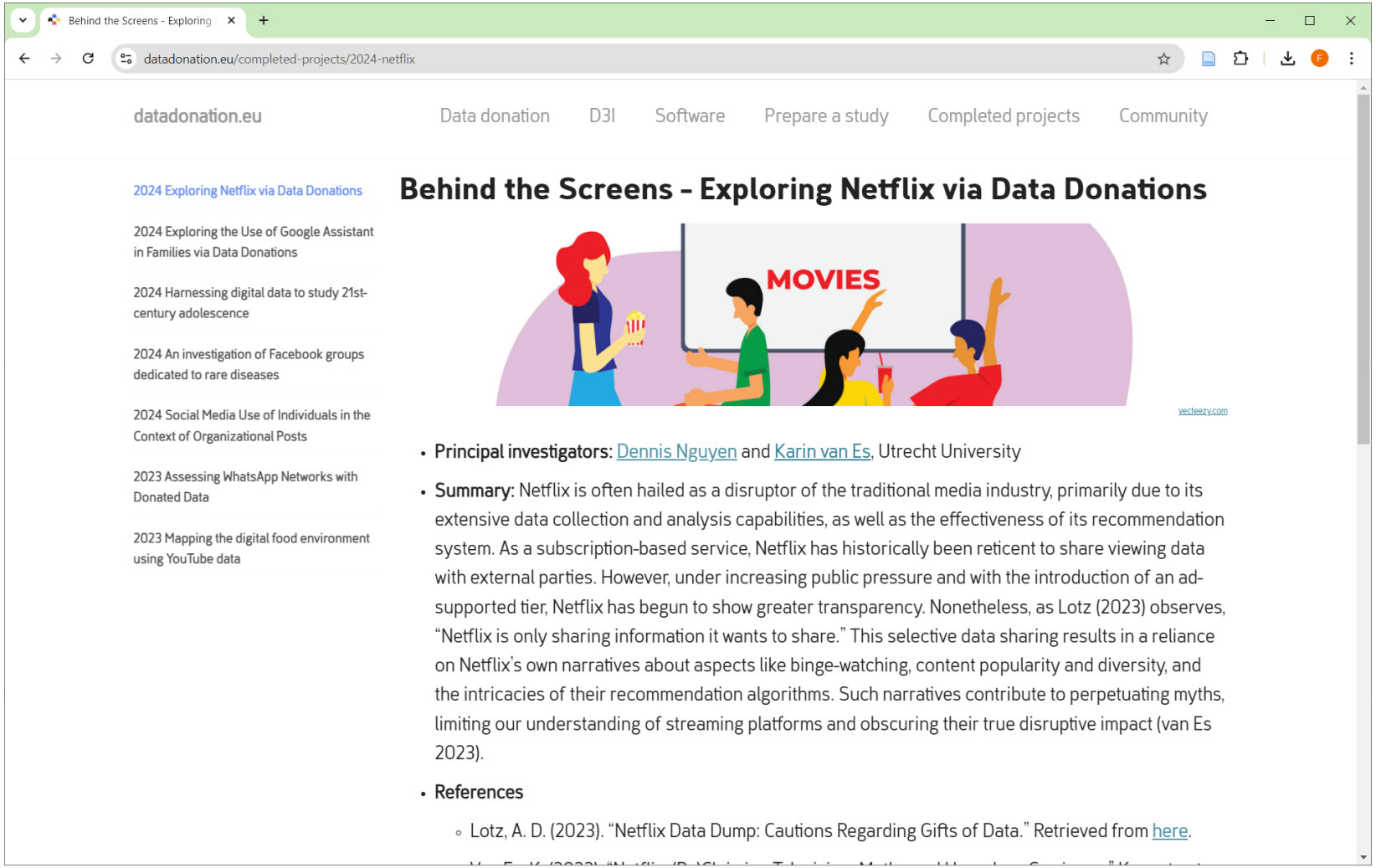


Example Studies

- Effect of Instagram abstinence on body image (Szafran et al. in preparation)



Example Studies

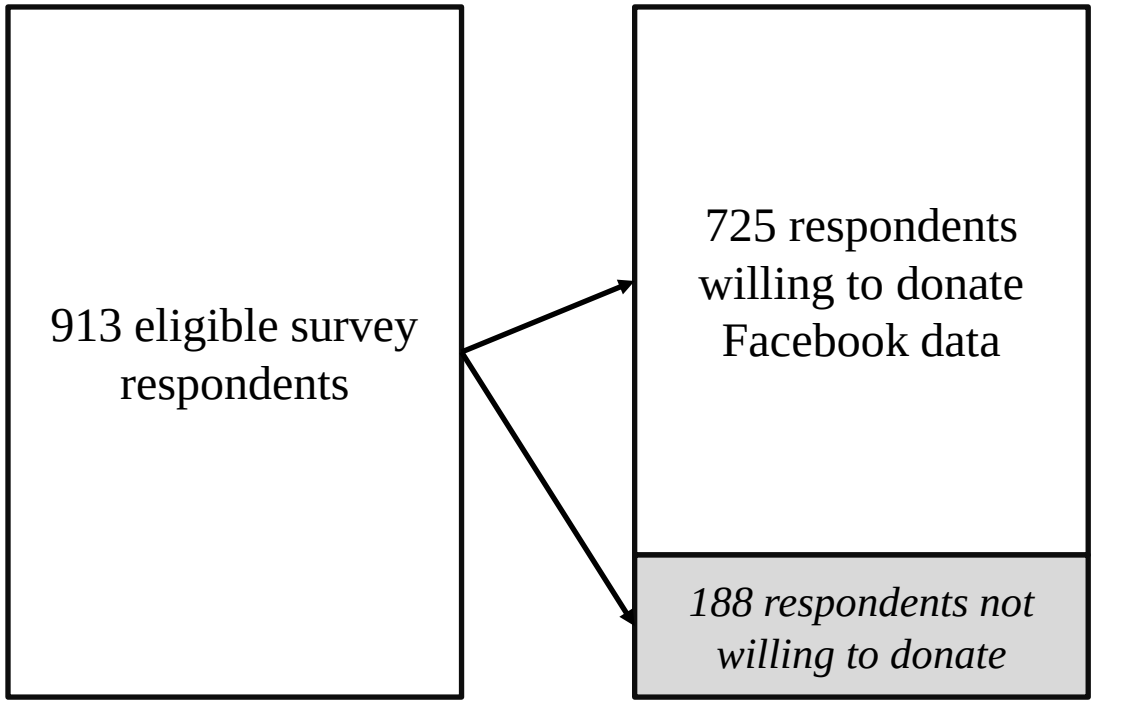


https://datadonation.eu/

Challenges of Data Donation Studies

Willingness to Donate Data

- Compared to request to download meters and apps, users report relativly high willingness to donate data (30-80%)
  (Hase & Haim 2024; Keusch et al. 2024; Ohme et al. 2021; Pfiffner and Friemel 2023; Silber et al. 2022; van Driel et al. 2022)



Willigness to Donate: 79%

Keusch et al. (2024)

Privacy Concerns

- Compared to request to download meters and apps, users report relativly high willingness to donate data (30-80%)
  (Hase & Haim 2024; Keusch et al. 2024; Ohme et al. 2021; Pfiffner and Friemel 2023; Silber et al. 2022; van Driel et al. 2022)
  - Main reason for not being willing: <u>privacy concerns</u> (Keusch et al. 2024)

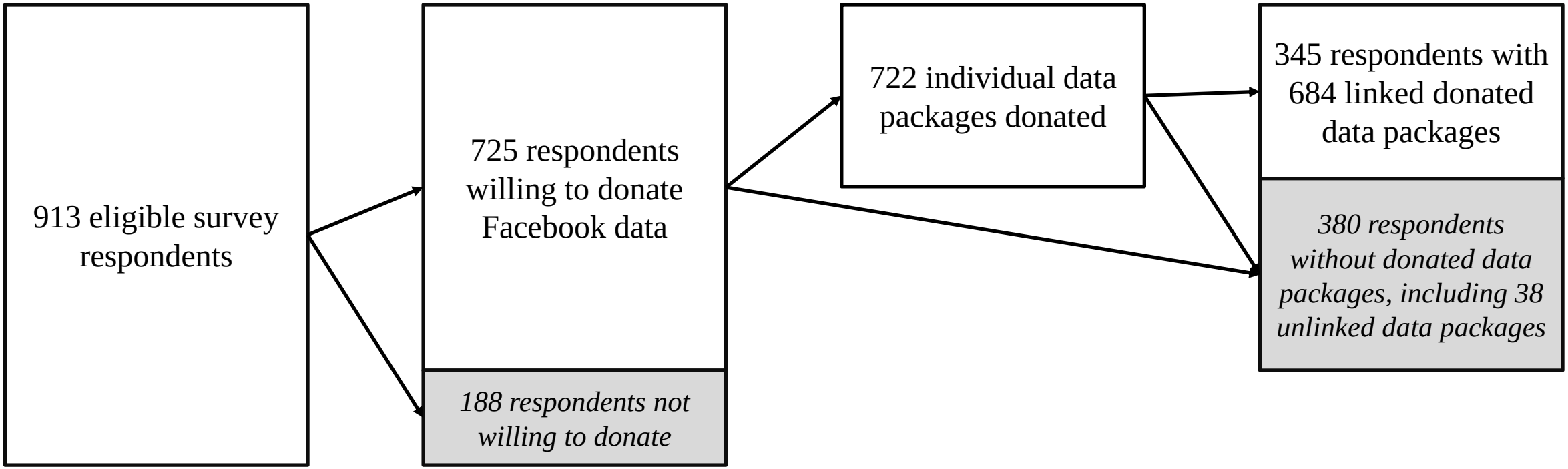
Table D1. Coded answers to open-ended question on reasons for not being willing to donate Facebook data.

Code	Reason	n	%[1]
1	*Need to protect privacy*	*34*	24.2
1.1	Generally not willing to provide data	(32)	
1.2	Fear that personal data are never protected anyways	(2)	
2	*Concern about data misuse/data breach*	*29*	20.7
2.1	General data protection concerns	(17)	
2.2	Missing information on how data will be protected	(9)	
2.3	Worries about third party access to data	(3)	
3	*Anticipating difficulties with data donation*	*19*	13.6
3.1	Anticipated technical problems	(1)	
3.2	Too complicated	(4)	
3.3	Too cumbersome	(8)	
3.4	Other practical issues	(6)	
4	*Perceived usefulness and potential personal consequences of data donation*	*13*	9.3
4.1	Do not use Facebook often enough	(10)	
4.2	Study goal seems not useful	(2)	
4.3	Concern about some personal disadvantage	(1)	
5	*No trust in researchers/university*	*5*	3.6
6	*Not enough information*	*2*	1.4
7	*No reasons provided*	17	12.1
7.1	No reason/DK	(12)	
7.2	No useful/sensical response	(5)	
8	*Incentive too small*	5	3.6
9	*Concerns related to Facebook*	*9*	6.4
10	*Unconcrete refusal*	*23*	16.4
10.1	Don't want to	(14)	
10.2	General concern	(5)	
10.3	Uncertainty	(4)	

Notes: n=140
[1]Each answer could be coded in multiple categories, thus percentages can add up to more than 100.

Drop-out During the Donation

- Large share (up to 50%) drop out during data donation process
  (Hase & Haim 2024; Keusch et al. 2024; Ohme et al. 2021; Silber et al. 2022; van Driel et al. 2022)

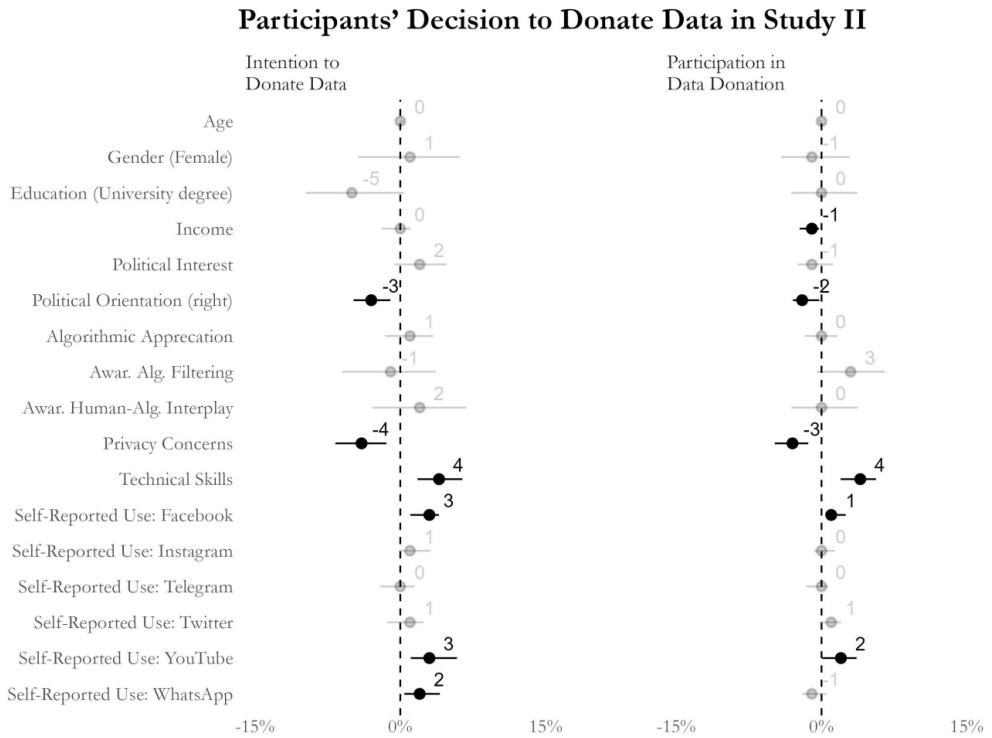


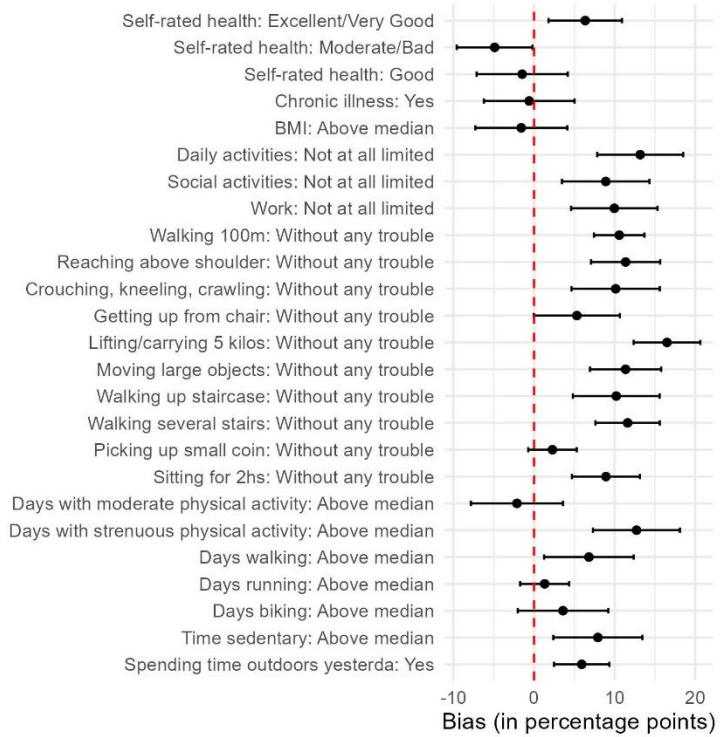
Keusch et al. (2024)

➢ Rather cumbersome process that requires some technical skills

Bias

- So far, few studies have assessed nonparticipation bias
  - Some evidence for higher social media use (Hase & Haim 2024; but not Keusch et al. 2024), political interest (Hase & Haim 2024), and "healthy donor" bias (Keusch & Struminskaya in preparation)



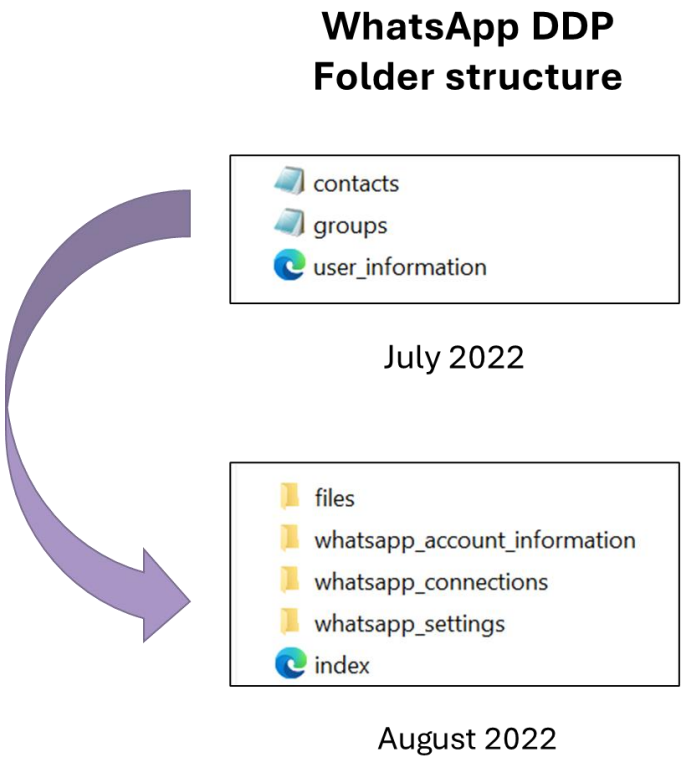


Hase & Haim (2024)

Keusch & Struminskaya (in preparation)

Volatility of DDPs

- Platforms/data controllers keep changing structure of and access to DDPs



Example provided by Thijs Carriere

➢ Constant monitoring (by researchers) and/or standardization (by legislators) (Hase et al. 2024)

Open Methodological Questions

- How to best communicate idea of data donation to participants
  - e.g., stressing data privacy advantages for participants, showing examples of data
- How to effectively integrate data donation into survey infrastructure
  - e.g., when to ask for donation, how to frame, how to incentivize
- How to design efficient data donation process for participants
  - Reduce friction of downloading, processing, and uploading data
- How to unpacking full potential of digital behavioral data
  - In combination with self-reports, e.g., measurement error models (Cernat et al. 2024)

Summary & Outlook

Summary & Outlook

- In post-API age, data donation is viable alternative for collecting individual-level digital behavioral data
  - Provides access to data not available otherwise
  - Gives users agency in deciding exactly what data to be shared

- Limitations (still) exist around willingness and privacy concerns, UX barriers, and potential bias

➢ Opens avenues to address further research questions
  - ➢ Methodological: e.g., reducing nonparticipation bias, measurement properties
  - ➢ Substantive: e.g., recommendation algorithms, close social relationships

Thank You!

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