When survey science met online tracking:

Presenting an [error framework] for metered data

ORIOL J. BOSCH | THE LONDON SCHOOL OF ECONOMICS / RECSM-UPF

MELANIE REVILLA | RECSM-UPF

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Tracking online behaviours using a meter

Definition

Metered data is obtained from a meter willingly installed or configured by a sample of participants on their devices (PCs, tablets and/or smartphones).

A **meter** refers to a heterogeneous group of tracking technologies that allow sharing with the researchers, at least, **information about the URLs of the web pages visited by the participants**.

Sample of participants

Collected from a designed sample of individuals

Nonreactive

Collected by tracking the traces left by individuals when interacting with their devices online.

Tracking online behaviours using a meter

Benefits of metered data

- Objective and free of recall errors
- Continuously collected in real time
- Pre-designed sample of participants

BACKGROUND

Metered data in past research

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Metered data in past research

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

The sources and correlates of exposure to vaccine-related (mis)information online ☆

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Keywords:
Vaccine hesitancy
Vaccine skepticism
Online
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ABSTRACT

Objectives: To assess the quantity and type of vaccine-related information Americans consume online and its relationship to social media use and attitudes toward vaccines.
Methods: Analysis of individual-level web browsing data linked with survey responses from representative samples of Americans collected between October 2016 and February 2019.
Results: We estimate that approximately 84% of Americans visit a vaccine-related webpage each year. Encounters with vaccine-skeptical content are less frequent; they make up only 7.5% of vaccine-related pageviews and are encountered by only 18.5% of people annually. However, these pages are more likely to be published by untrustworthy sources. Moreover, skeptical content exposure is more common among people with less favorable vaccine attitudes. Finally, usage of online intermediaries is frequently linked to vaccine-related information exposure. Google use is differentially associated with subsequent exposure to non-skeptical content, whereas exposure to vaccine-skeptical webpages is associated with usage of webmail and, to a lesser extent, Facebook.
Conclusions: Online exposure to vaccine-skeptical content is relatively rare, but vigilance is required given the potential for exposure among vulnerable audiences.

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Exposure to untrustworthy websites in the 2016 U.S. election

Andrew M. Guess[1], **Brendan Nyhan**[2,*], **Jason Reifler**[3]

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[2]Department of Government, Dartmouth College, Hanover, NH, USA

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Abstract

Though commentators frequently warn about "echo chambers," little is known about the volume or slant of political misinformation people consume online, the effects of social media and fact-checking on exposure, or its effects on behavior. We evaluate these questions for the websites publishing factually dubious content often described as "fake news." Survey and web traffic data from the 2016 U.S. presidential campaign show that Trump supporters were most likely to visit these websites, which often spread via Facebook. However, these sites made up a small share of people's information diets on average and were largely consumed by a subset of Americans with strong preferences for pro-attitudinal information. These results suggest that widespread speculation about the prevalence of exposure to untrustworthy websites has been overstated.

Article

Predicting Voting Behavior Using Digital Trace Data

Ruben L. Bach[1], Christoph Kern[1], Ashley Amaya[2], Florian Keusch[1], Frauke Kreuter[1,3,4], Jan Hecht[5] and Jonathan Heinemann[6]

Social Science Computer Review
1-22


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DOI: 10.1177/0894439319882896
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SAGE

Abstract

A major concern arising from ubiquitous
be trained to predict personal sensitive i
information. Although previous researcl
sociodemographic characteristics, little i
sitive outcomes. Against this backgroun
predict voting behavior, which is conside
to strict privacy regulations. Using recor
online users eligible to vote in the 2017
the same individuals, we find that online
population. These findings add to the del
information flows.

ELSEVIER journal homepage:

The sources and correlates of exposu (mis)information online ☆

Andrew M. Guess [a,*], Brendan Nyhan [b], Zachar
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Is Facebook Eroding the Public Agenda? Evidence From Survey and Web-Tracking Data

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Silvia Majó-Vázquez[3]

The consequences of online partisan media

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Edited by Christopher Andrew Bail, Duke University, Durham, NC, and accepted by Editorial Board Member Margaret Levi February 17, 2021 (received for review June 29, 2020)

What role do ideologically extreme media play in the polarization of society? Here we report results from a randomized longitudinal field experiment embedded in a nationally representative online panel survey (N = 1,037) in which participants were incentivized to change their browser default settings and social media following patterns, boosting the likelihood of encountering news with either a left-leaning (HuffPost) or right-leaning (Fox News) slant during the 2018 US midterm election campaign. Data on ≈ 19 million web visits by respondents indicate that resulting changes in news consumption persisted for at least 8 wk. Greater exposure to partisan news can cause immediate but short-lived increases in website visits and knowledge of recent events. After adjusting for multiple comparisons, however, we find little evidence of a direct impact on opinions or affect. Still, results from later survey waves suggest that both treatments produce a lasting and meaningful decrease in trust in the mainstream media up to 1 y later. Consistent with the minimal-effects tradition, direct consequences of online partisan media are limited, although our findings raise questions about the possibility of subtle, cumulative dynamics. The combination of experimentation and computational social science techniques illustrates a powerful approach for studying the long-term consequences of exposure to partisan news.

Oberta de Catalunya, Spain;
t Autònoma de Barcelona, Spain;
niversity of Oxford, UK

s social integration, minimizing
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Ps for a representative sample of
of our findings for the public

2016 U.S. election

niversity, Princeton, NJ, USA
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argues that media primarily reinforce existing predispositions (16). At the same time, more recent research strongly implies that newspapers and especially cable news can change people's voting behavior, especially those without strong partisan attachments (17–20). We propose an internet-age synthesis that views people's information environments through the lens of choice architecture (21): frictions, subtle design features, and default settings that structure people's online experience. In this view, small changes (or nudges) could disproportionately affect information consumption habits that have downstream consequences.

To that end, we designed a large, longitudinal online field experiment that subtly but naturalistically increased people's exposure to partisan news websites. Our choice of treatment is ecologically valid: Despite the importance of social media for agenda-setting (22) and public expression (23), more Americans continue to say that they get news from news websites or apps than social media sites (24). The intervention thus served as a nudge, boosting the likelihood that subjects encountered news framed with a partisan slant during their day-to-day web browsing experience, even if inadvertently. The powerful, sustained nature of the intervention and our ability to track participants with survey and behavioral data for months provided the opportunity to test a range of hypotheses about the long-term impact

Though commentators frequently warn about "echo chambers," little is known about the volume or slant of political misinformation people consume online, the effects of social media and fact-checking on exposure, or its effects on behavior. We evaluate these questions for the websites publishing factually dubious content often described as "fake news." Survey and web traffic data from the 2016 U.S. presidential campaign show that Trump supporters were most likely to visit these websites, which often spread via Facebook. However, these sites made up a small share of people's information diets on average and were largely consumed by a subset of Americans with strong preferences for pro-attitudinal information. These results suggest that widespread speculation about the prevalence of exposure to untrustworthy websites has been overstated.

Article

COMMUNICATION METHODS AND MEASURES
2017, VOL. 11, NO. 3, 173–190
http://dx.doi.org/10.1080/19312458.2017.1317337

How Much Time Do You Spend Online? Understanding and Improving the Accuracy of Self-Reported Measures of Internet Use

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Amsterdam School of Communication Research (ASCoR), University of Amsterdam, Amsterdam, The Netherlands

ABSTRACT

Given the importance of survey measures of online media use for communication research, it is crucial to assess and improve their quality, in particular because the increasingly fragmented and ubiquitous usage of internet complicates the accuracy of self-reported measures. This study contributes to the discussion regarding the accuracy of self-reported internet use by presenting relevant factors potentially affecting biases of self-reports and testing survey design strategies to improve accuracy. Combining automatic tracking data and survey data from the same participants (N = 690) confirmed low levels of accuracy and tendencies of over-reporting. The analysis revealed biases due to a range of factors associated with the intensity of (actual) internet usage, propensity to multitask, day of reference, and the usage of mobile devices. An anchoring technique could not be proved to reduce inaccuracies of reporting behavior. Several recommendations for research practice follow from these findings.

Article

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Two Half-Truths Make a Whole? On Bias in Self-Reports and Tracking Data

Pascal Jürgens[1], Birgit Stark[1], and Melanie Magin[2]

Abstract

The pervasive use of mobile information technologies brings new patterns of media usage, but also challenges to the measurement of media exposure. Researchers wishing to, for example, understand the nature of selective exposure on algorithmically driven platforms need to precisely attribute individuals' exposure to specific content. Prior research has used tracking data to show that survey-based self-reports of media exposure are critically unreliable. So far, however, little effort has been invested into assessing the specific biases of tracking methods themselves. Using data from a multimethod study, we show that tracking data from mobile devices is linked to systematic distortions in self-report biases. Further inherent but unobservable sources of bias, along with potential solutions, are discussed.

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Andrew M. Guess [a,*], Brendan Nyhan [b], Zachary

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COMMUNICATION METHODS AND MEASURES
2016, VOL. 10, NO. 1, 13–27
http://dx.doi.org/10.1080/19312458.2015.1118446

The Accuracy of Self-Reported Internet Use—A Validation Study Using Client Log Data

Michael Scharkow

University of Hohenheim

ABSTRACT

The vast majority of empirical research on online communication, or media use in general, relies on self-report measures instead of behavioral data. Previous research has shown that the accuracy of these self-report measures can be quite low, and both over- and underreporting of media use are commonplace. This study compares self-reports of Internet use with client log files from a large household sample. Results show that the accuracy of self-reported frequency and duration of Internet use is quite low, and that survey data are only moderately correlated with log file data. Moreover, there are systematic patterns of misreporting, especially overreporting, rather than random deviations from the log files. Self-reports for specific content such as social network sites or video platforms seem to be more accurate and less consistently biased than self-reports of generic frequency or duration of Internet use. The article closes by demonstrating the consequences of biased self-reports and discussing possible solutions to the problem.

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Inferences for finite populations

Metered data can potentially suffer from different types of errors

Shared devices and observation of only part of the activity

- 60% of desktops, 40% of laptops and tablets, and 9% of smartphones shared to some degree(Revilla et al., 2017)
- 28% with the meter installed in all devices (Pew Research Center, 2020)

Technical issues and reactivity / social desirability bias (Jurgens et al., 2020; Toth and Trifonova, 2020)

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Technical issues and reactivity / social desirability bias (Jurgens et al., 2020; Toth and Trifonova, 2020)

Systematic **categorization** and **conceptualization** of metered data errors not available

THIS STUDY

Main goals and contribution

web data opp

Total Error Framework for metered data

#1 **Summarize** the data collection and analysis process for metered data.

#2 **Conceptualize and categorize** all errors components (e.g. *measurement errors*) and causes (e.g. *social desirability*) that can occur when using metered data.

THIS STUDY

Main goals and contribution

web data opp

Total Error Framework for metered data

#1 **Summarize** the data collection and analysis process for metered data.

#2 **Conceptualize and categorize** all errors components (e.g. *measurement errors*) and causes (e.g. *social desirability*) that can occur when using metered data.

1) Choose the best design options for metered data.

2) Make better informed decisions while planning when and how to supplement or replace survey data with metered data.

3) Help assess research using metered data.

THIS STUDY

Main goals and contribution

web data opp

Total Error Framework for metered data

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#2 **Conceptualize and categorize** all errors components (e.g. *measurement errors*) and causes (e.g. *social desirability*) that can occur when using metered data.

Bosch, O.J., and M. Revilla (2021). **"When survey science met online tracking: presenting an error framework for metered data."** RECSM Working Papers Series, 62

Approach

Adapting instead of reinventing

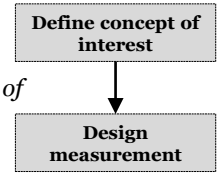
- Follow approach by Amaya et al (2020) with their **Total Error Framework** for **Big Data**
- 7 error components of the **TSE (Groves et al., 2009)** as starting point:
  - Coverage errors, sampling errors, *missing data errors*, adjustment errors, *specification errors*, measurement errors and processing errors

RESULTS

Data collection and analysis process

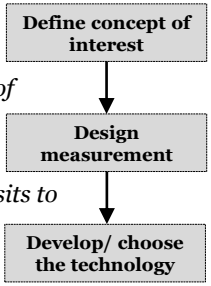
Define concept of interest

Average hours of consumption of online political news



Average hours of consumption of online political news

Average time recorded of the visits to online political outlets' URLs.



Average hours of consumption of online political news

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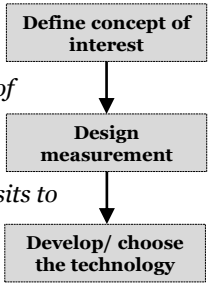
Proxy for IOS/ App for others



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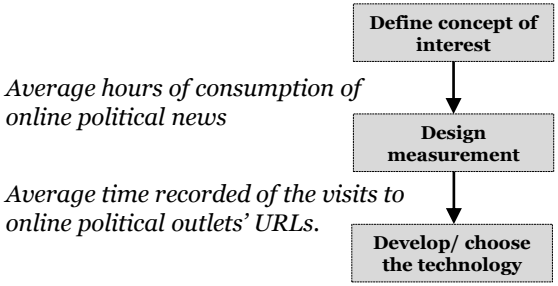
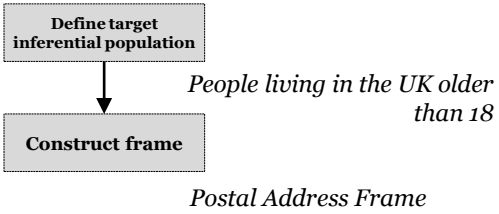
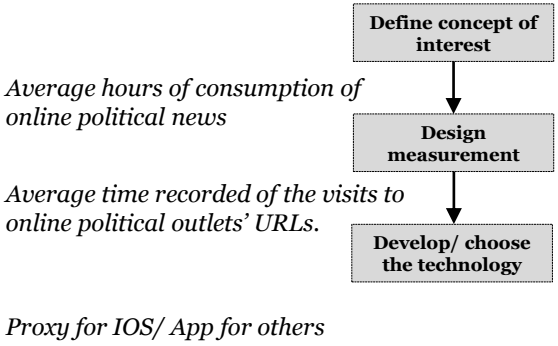
Proxy for IOS/ App for others

People living in the UK older than 18


Define concept of interest
Average hours of consumption of online political news
Design measurement
Average time recorded of the visits to online political outlets' URLs.
Develop/ choose the technology
Proxy for IOS/ App for others


Define target inferential population
People living in the UK older than 18
Construct frame
Postal Address Frame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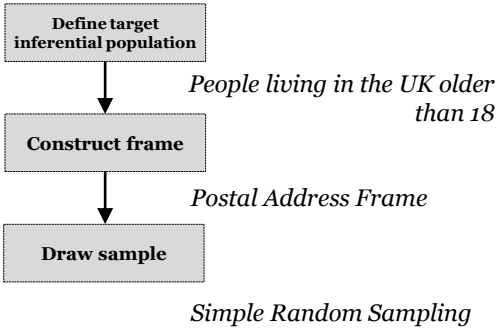
Define target inferential population
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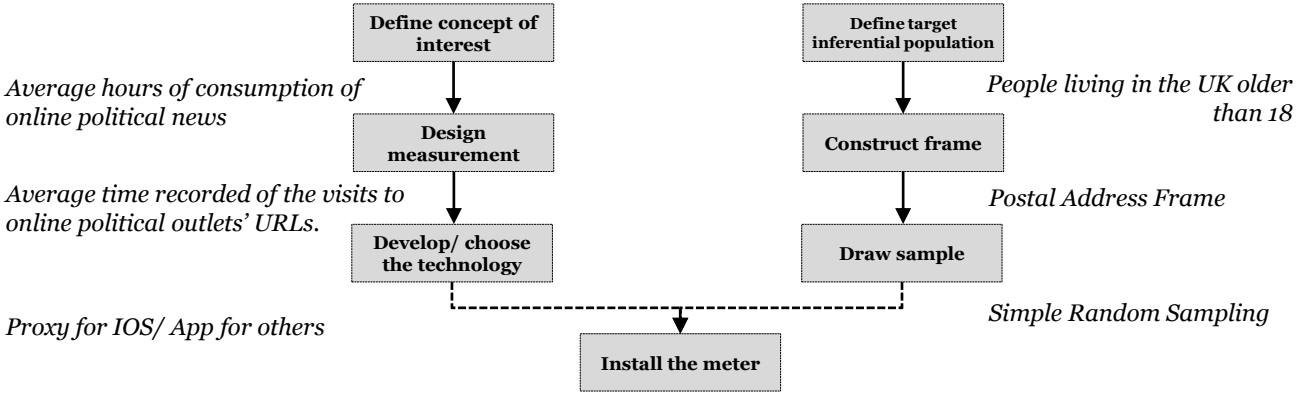
Construct frame
Postal Address Frame
Draw sample
Simple Random Sampling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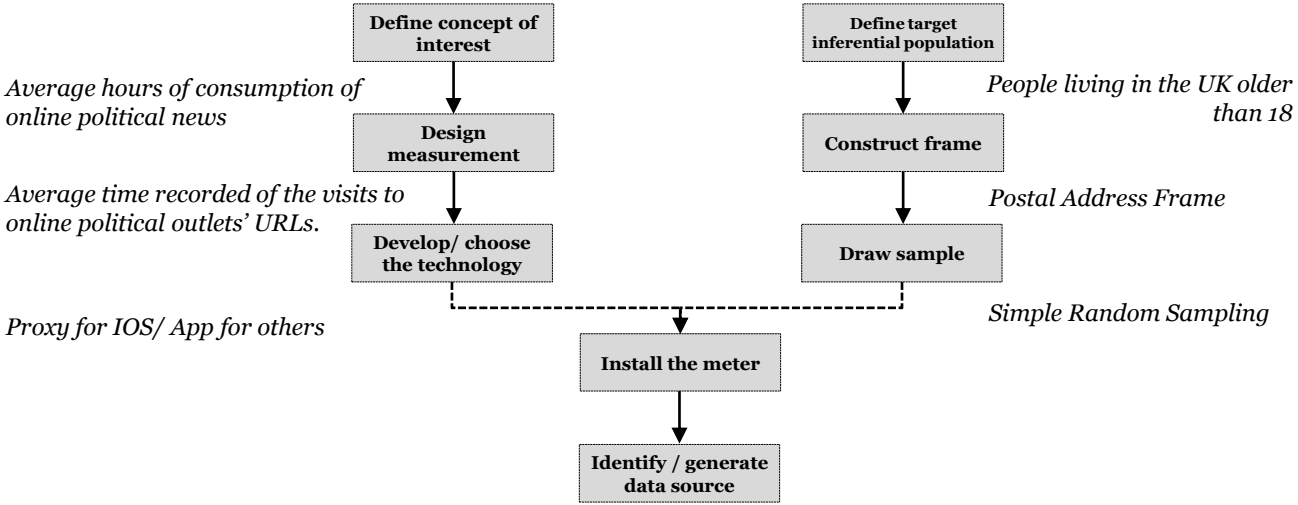
Install the meter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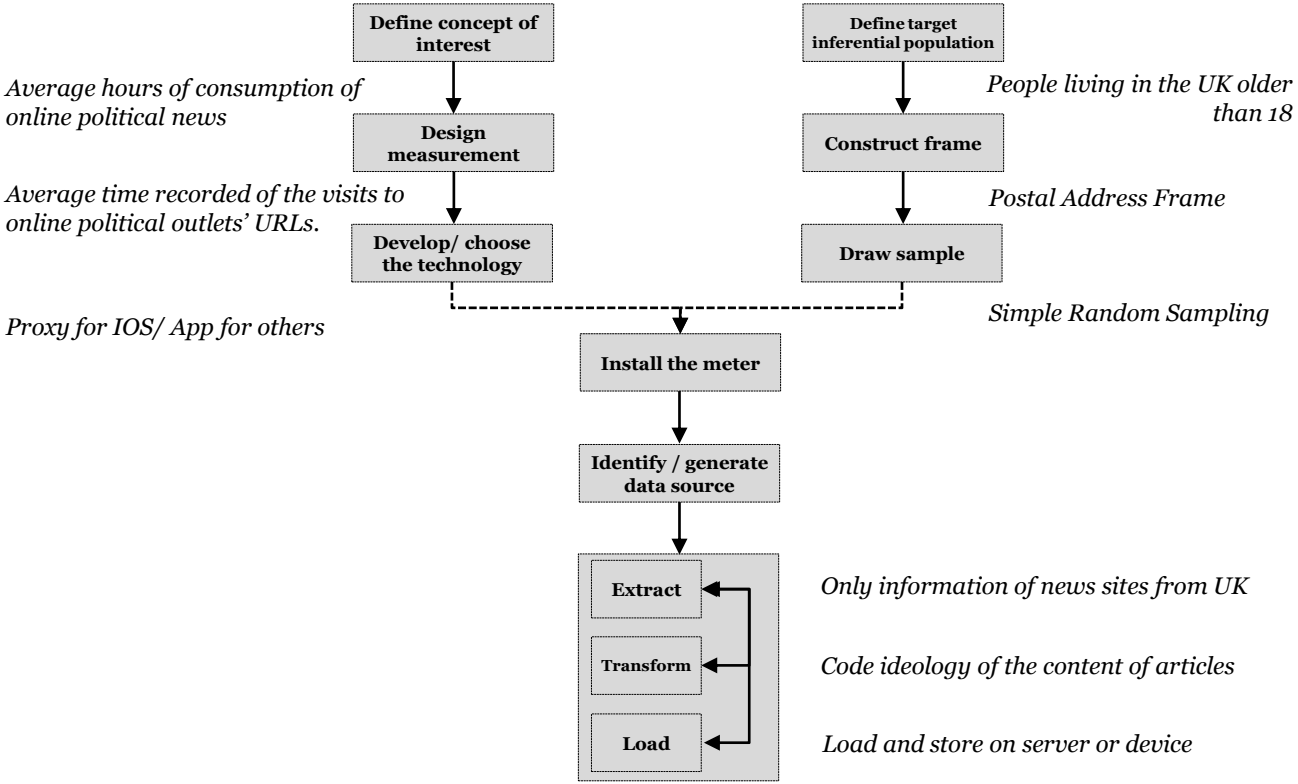
Draw sample
Proxy for IOS/ App for others
Simple Random Sampling
Install the meter
Identify / generate data source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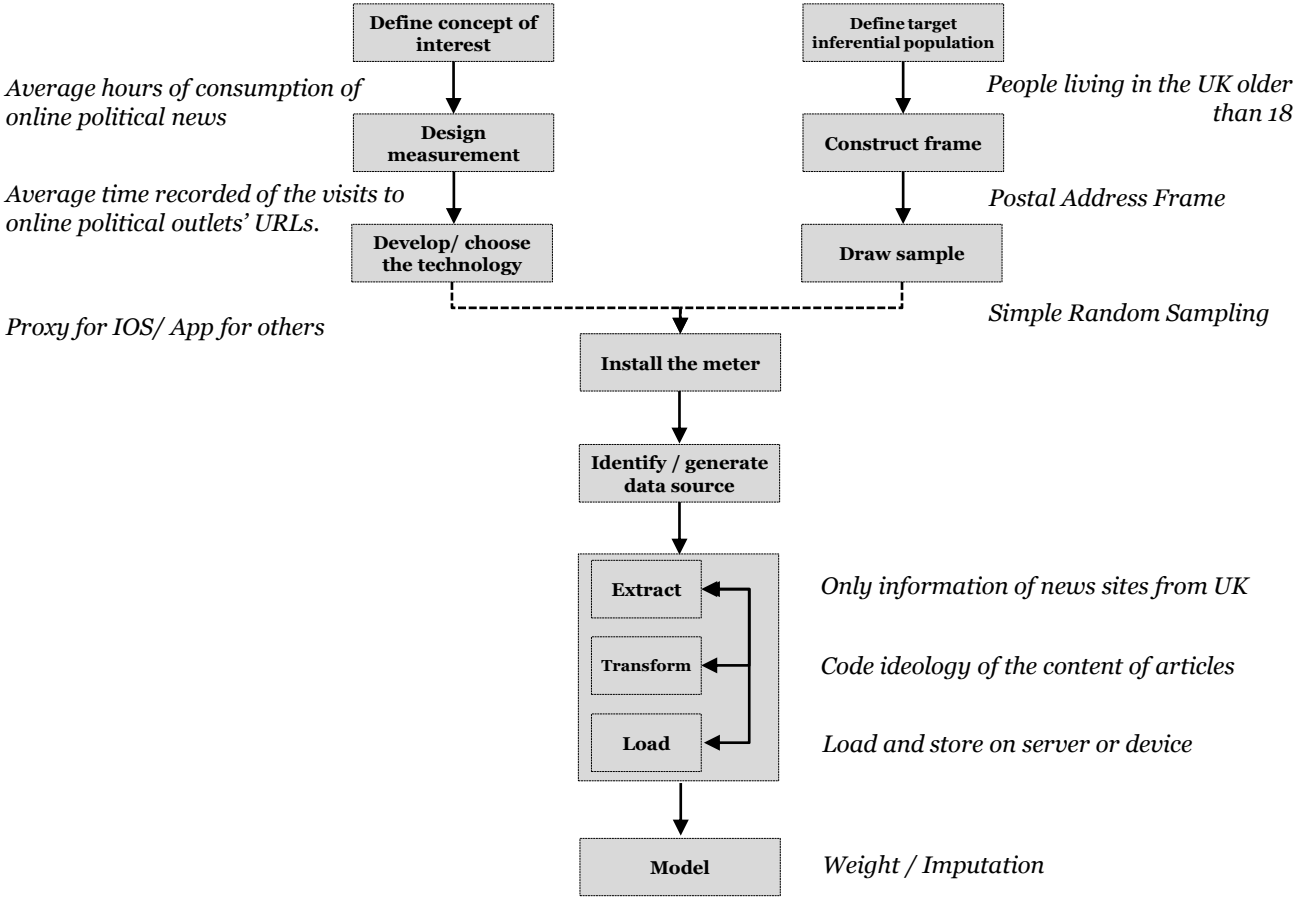
Identify / generate data source
Extract
Transform
Load
Only information of news sites from UK
Code ideology of the content of articles
Load and store on server or device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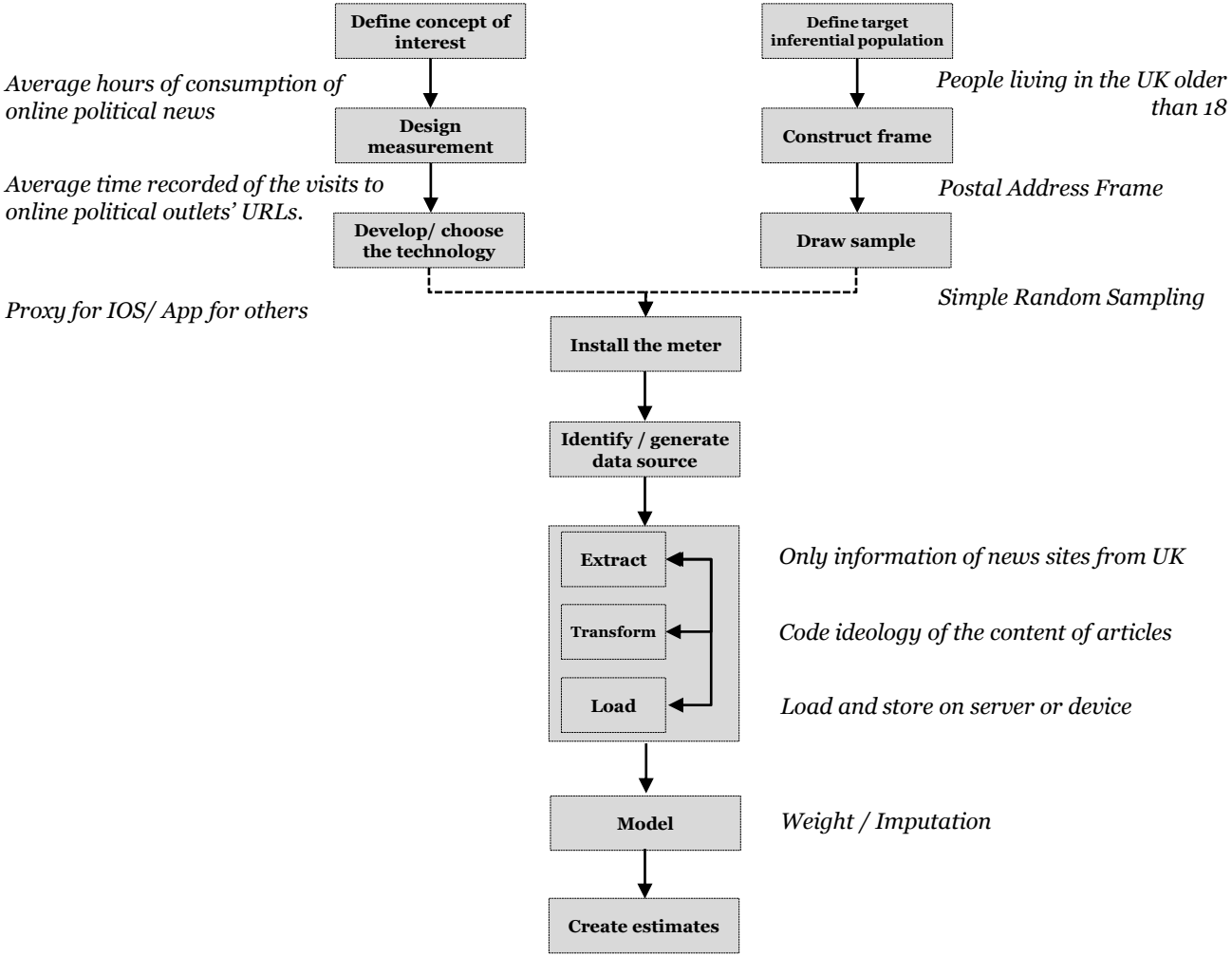
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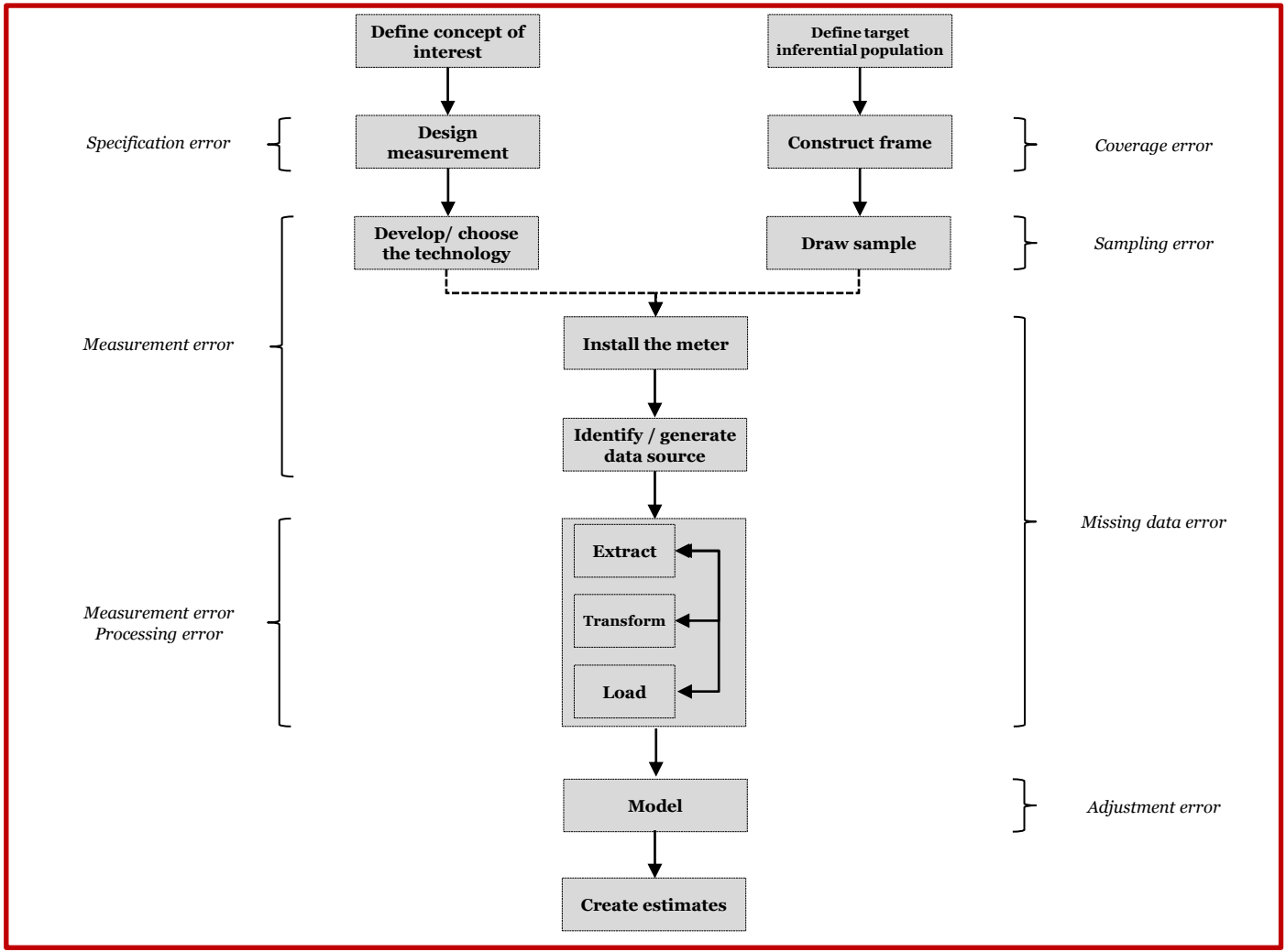
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Coverage error
Develop/ choose the technology
Draw sample
Sampling error
Measurement error
Install the meter
Identify / generate data source
Missing data error
Extract
Transform
Load
Measurement error
Processing error
Model
Adjustment error
Create estimates

RESULTS

Error components and their causes

Error components	Specific error causes
Specification error	– Measuring concepts from which not enough data is available – Inferring attitudes – Defining valid information
Measurement error	– Non-trackable target – Meter not installed – Uninstalling the meter – New non-tracked device – Technology limitations – Technology errors – Hidden behaviours – Shared device – Social desirability – Extraction error
Processing error	– Coding error – Aggregation at the domain level – Data anonymization
Coverage error	– Non-trackable individuals
Sampling error	– Same error causes than for surveys
Missing data error	– Noncontact – Non-consent – Non-trackable target – Meter not installed – Uninstalling the meter – New non-tracked device – Technology limitations – Technology error – Hidden behaviour – Social desirability – Extraction error
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Most specific error causes on the side of measurement

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Coverage error	– Non-trackable individuals
Sampling error	– Same error causes than for surveys
Missing data error	– Noncontact – Non-consent – Non-trackable target – Meter not installed – Uninstalling the meter – New non-tracked device – Technology limitations – Technology error – Hidden behaviour – Social desirability – Extraction error
Adjustment error	– Same error causes than for surveys

Sampling and adjustment errors have no specific error causes

RESULTS

Practical recommendations

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Measure: *average time recorded of the visits to online political outlets' URLs.*

- What is considered a visit?
- Which online outlets?
- Which URLs should be considered political?
- What time frame to use to compute an average?

Practical recommendations

2. Consider the impact of the chosen technologies on data quality.

RESULTS

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Apps	Plug-in A	Plug-in B	Proxy
Where? Device	**Where?** Browser	**Where?** Browser	**Where?** Network
Devices Not iOS	**Devices** Only PC & MAC	**Devices** Only PC & MAC	**Devices** All
Continuous? Yes	**Continuous?** Yes	**Continuous?** No	**Continuous?** Yes
Types of data URLs, Time, Device, Search terms, Incognito,	**Types of data** URLs, Time, Device, Search terms, Incognito, HTML	**Types of data** URLs, Time, Device	**Types of data** URLs, Time, Device

RESULTS

Practical recommendations

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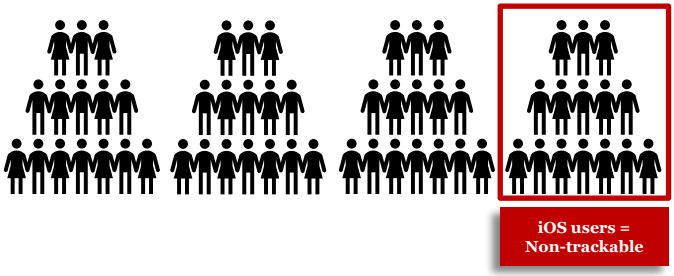
Apps

Where?
Device

Devices
Not iOS

Continuous?
Yes

Types of data
URLs, Time, Device, Search terms, Incognito



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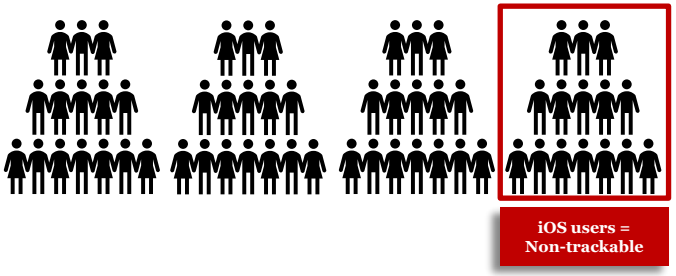

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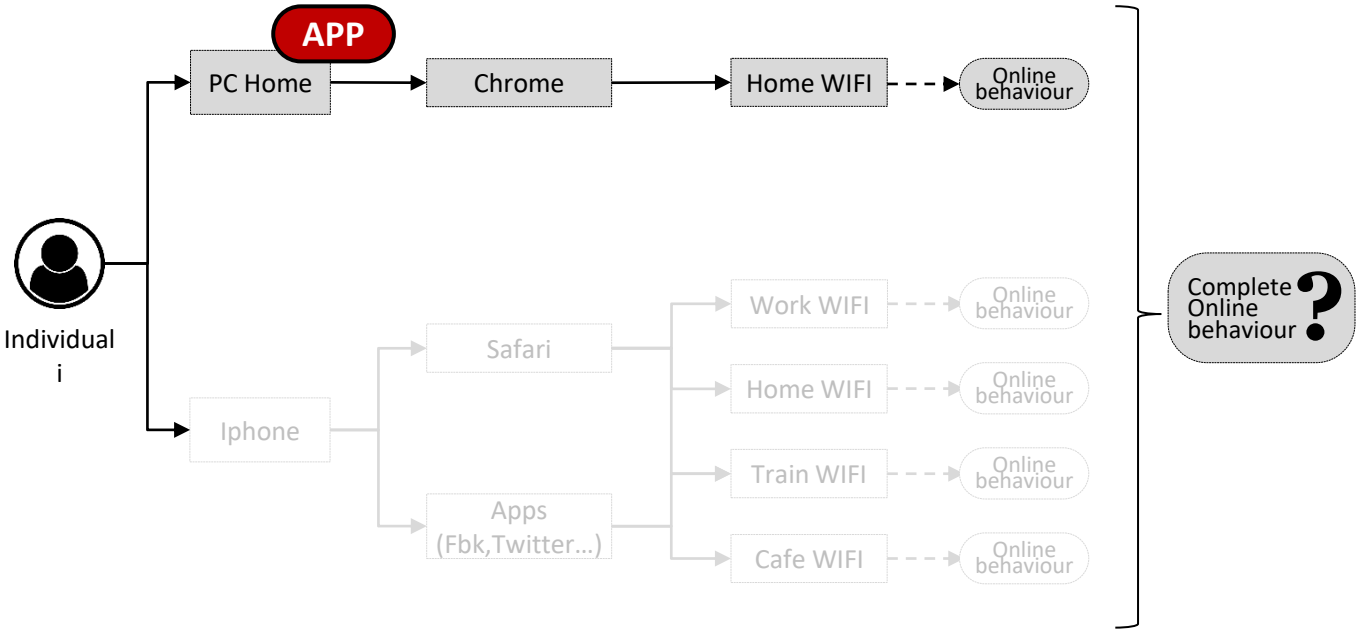


Practical recommendations

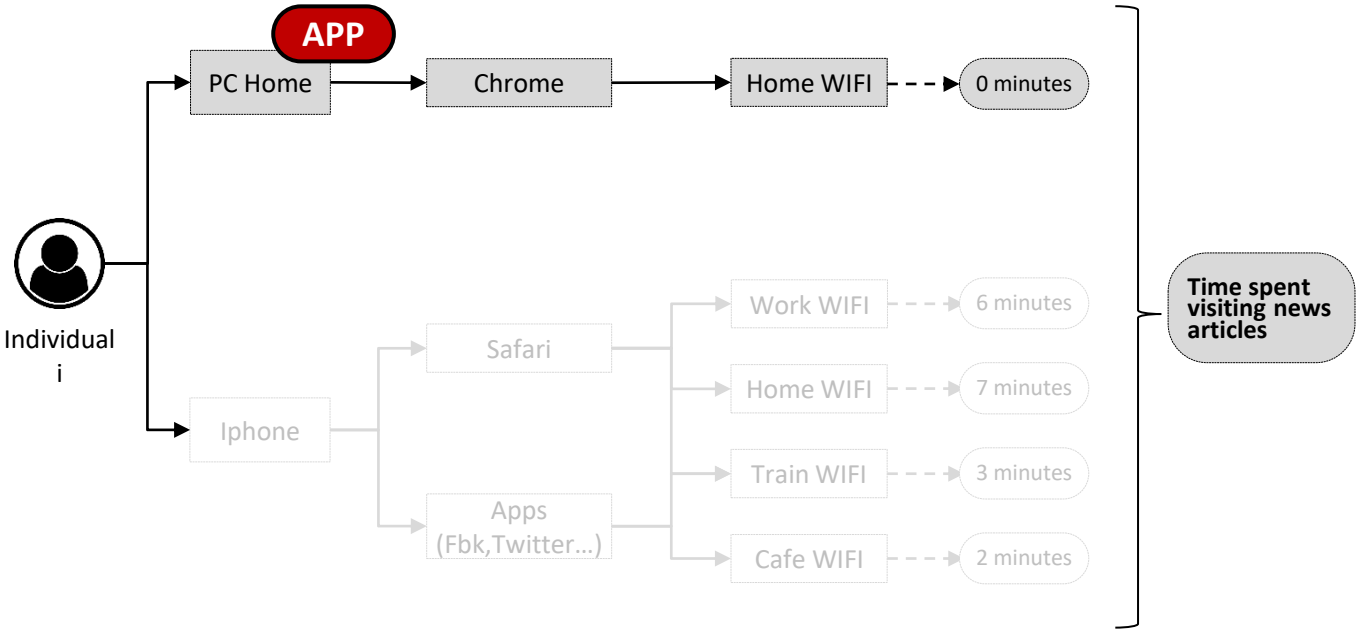
3. Explore strategies to increase the willingness of individuals to install the meter in all targets.

- Tracking technologies present different installations processes.
- Multiple tracking technologies might need to be installed for the same participant.
- Targets (devices / browsers / networks used) are unknown.

RESULTS

Practical recommendations

4. Define strategies to maximise the information available to identify missing data.



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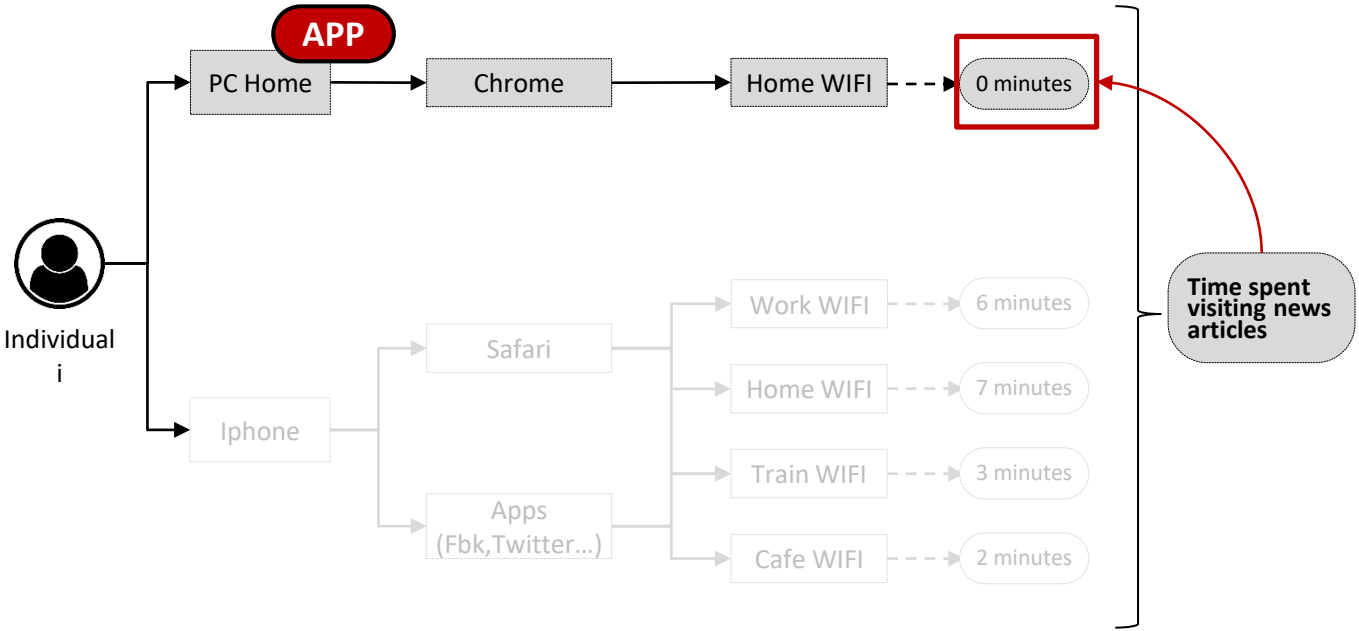

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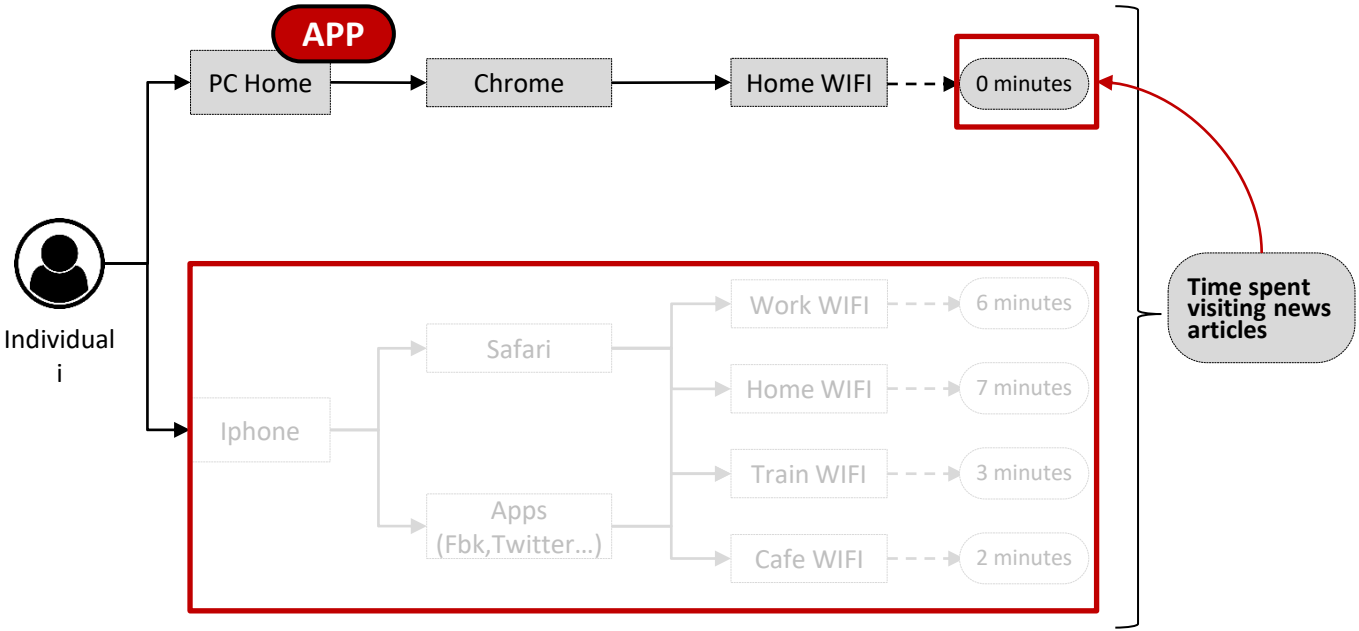

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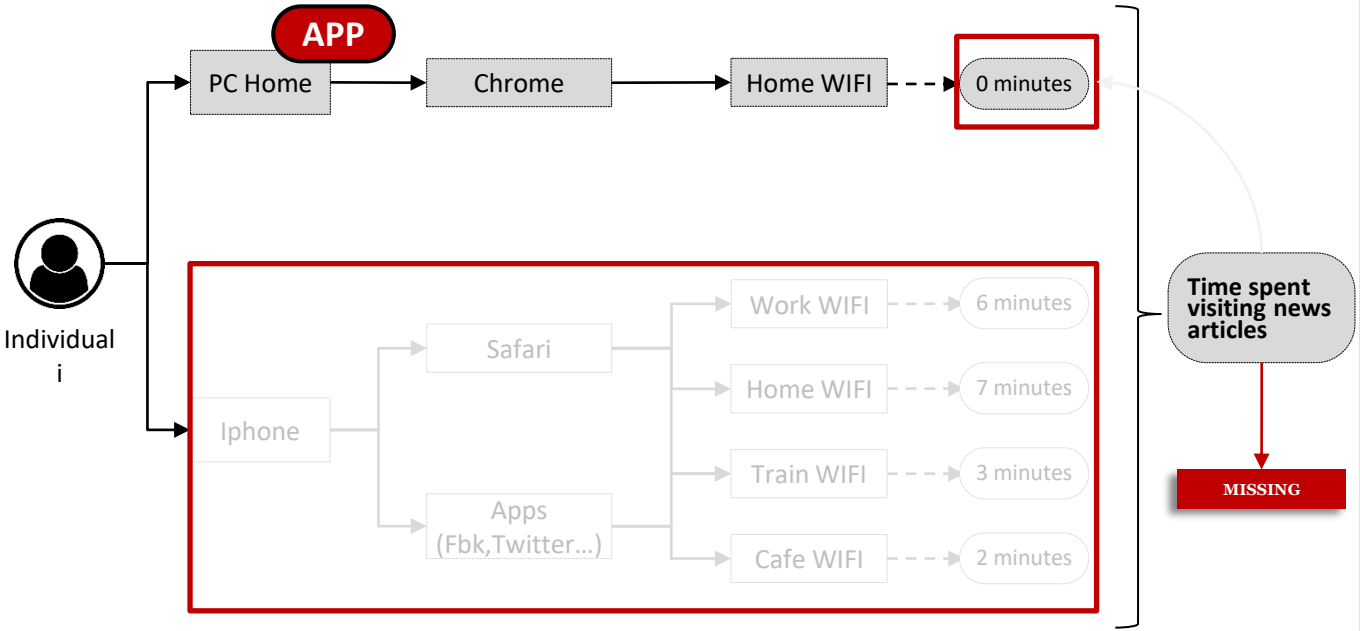

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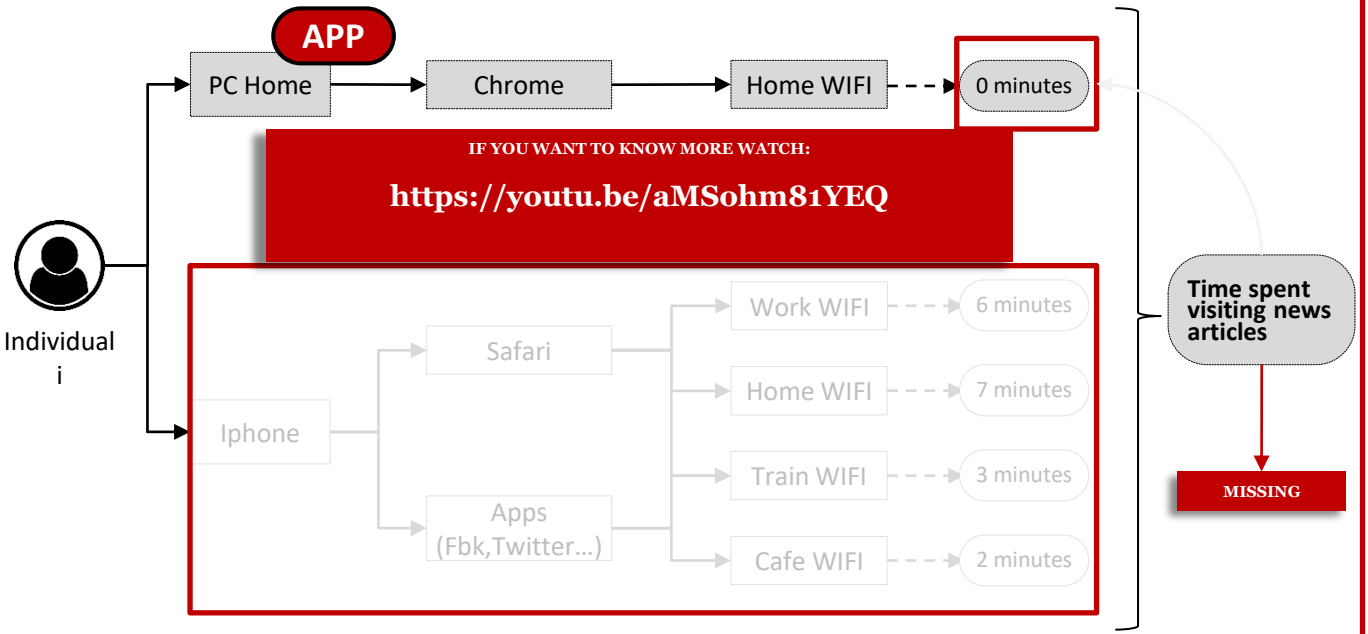

Limits

1. One specific definition of data quality.
2. Lack of previous empirical research.
3. Tracking technologies are constantly evolving.
4. Metered data errors are considered independently.

Take-home messages

1. Using metered data is complex and many decisions must be taken.
2. Reporting these decisions and conducting robustness checks is necessary.
3. More empirical research is needed.
4. This framework can help on all these aspects.

Thank you

Questions?

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