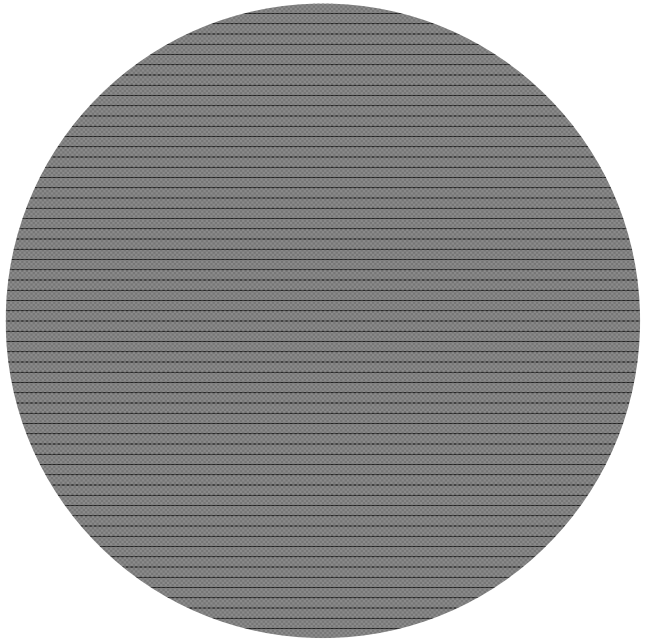
Using app-based and sensing methods for social science research



Dr Reka Solymosi (@r_solymosi)
Dr Michael Chataway (@DrChatz)

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- Thank you to Joshua Edgar of methods@manchester and Gill Meadows of the UK Data Service

Outline

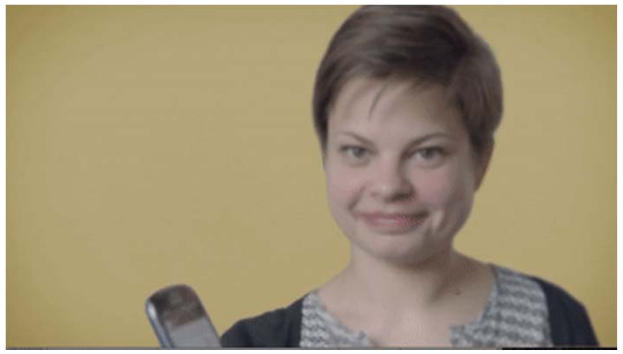
- Introductions
- Research Design
- Research Tools
- Analysing the data
- Ethical considerations
- Looking forward/where to from here
- Q & A

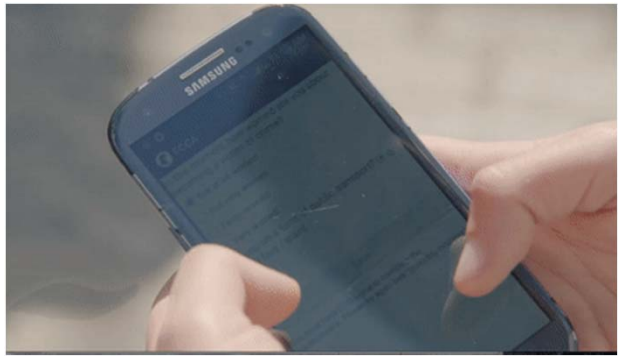
Type questions as you think of them in “the box”

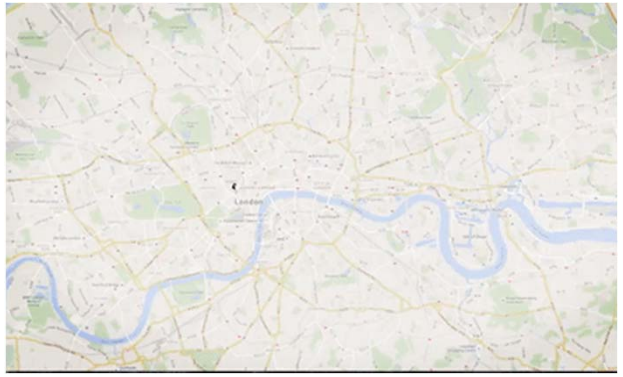
Dr Reka Solymosi

MANCHESTER 1824
The University of Manchester

- FOCA
- Self-build, android app
- Implement established survey Qs
- Collect location, time, answers, and demographics (pre-experiment survey)







Dr Michael Chataway

- iExperience (Griffith App Factory / CCJ)
  - Data Collection App
  - Perceptions of Crime in 10 Geofenced locations on GC, Australia
  - Testing risk perception models and worry
- MetricWire (MetricWire Inc.)
  - Commercial app
  - Perceptions of Crime
  - Triggering surveys at random times of day
  - Testing momentary models of victimization worry

Research Desig

Section 1

Studying Behaviour in the Real World

- Social scientists are often interested in people's "everyday real-world behaviour"
  - Yet behaviour is "seldom studied, assessed, or observed as it unfolds in the real world" (Shiffman et al, 2009)
- Instead researchers will often rely on summary and self-reports of behavior
  - Example: Retrospective worry measures "How often have you worried about being attacked in your neighbourhood over the last month?"
  - This keeps us from examining dynamic changes in behaviour and the context-dependent nature of attitudes

EMA/ESM

Ecological Momentary Assessments (EMAs)/ Experience Sampling Method (ESM) allow participants to report repeatedly on their experiences in real-time, in world settings, over time and across contexts (Shiffman et al, 2009, Csikszentmihalyi , 1985; Csikszentmihalyi & Larson, 2014)

- Diaries (paper-pencil, electronic etc) (Green et al., 2006; Shiffman et al., 1996b)
- Interaction Diaries (Reis & Wheeler, 1991)
- Smartphone Assessments (Shiffman et al, 2009)
- Ambulatory Physiological Monitoring (Kop et al., 2001; Shoval et al., 2018)

All of these studies involve different methods, targets, and data collection schedules. However, ***they all measure behaviour over time and in multiple contexts/situations.***

Benefits Smartphone EMAs/ESM

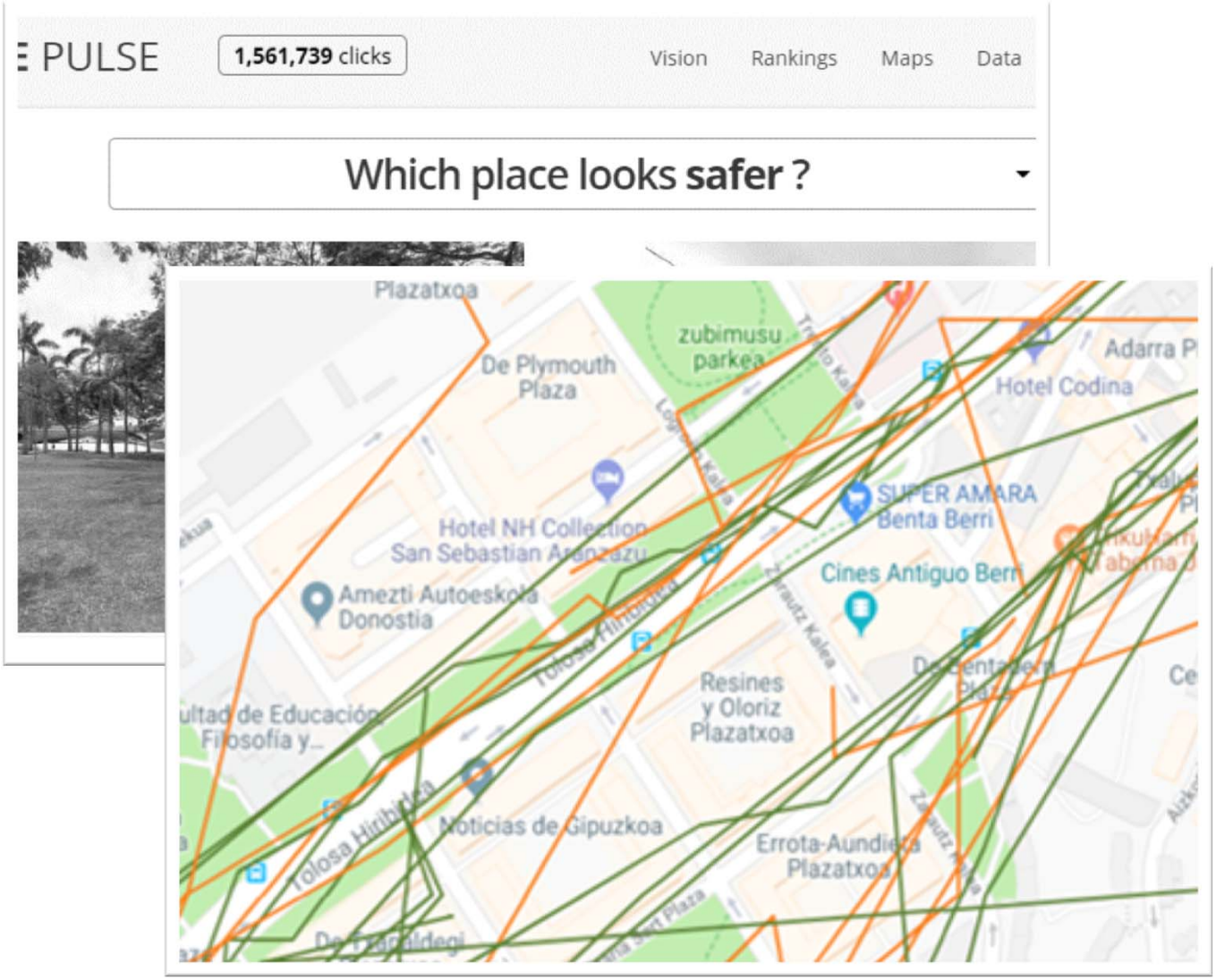
- Cost efficient in comparison to paper-pencil methods / diaries
- Adaptable to many different research designs
- Complex triggers and sensor capability
- Smartphone use increasing in both developed and developing countries (projected 3 billion smartphone owners in 2020)
- Examples:
  - Fear of Crime (Solymosi et al., 2015; Chataway et al., 2017)
  - Activity Patterns (Borsellino et. al., 2018; Corcoran, et al., 2017)
  - Happiness (MacKerron & Mourato, 2013)
  - Mental Health Problems (Magallon-Neri et al., 2016)

Operationalisation & Conceptualisation: Example “Fear of Crime”

1. Evaluate the momentary sense of security from 1 to 5
2. Green or red tag to indicate locations where they feel comfortable or uncomfortable
3. Choose “which place looks safer?” from two images
4. Frequency of worry on a scale
5. Trace a polygonal area on a map and quantify the level of risk and uncertainty between 0 and 10
6. Choose between two scared/safe emoticons
7. “In this moment, how worried are you about becoming a victim of crime?”
8. Note level of immediate happiness in relation to personal safety
9. Locate on a map all possible fearful places and danger locations
10. “Indicate [with polygons on a map] those places where you feel fear of crime”

Unit of Analysis

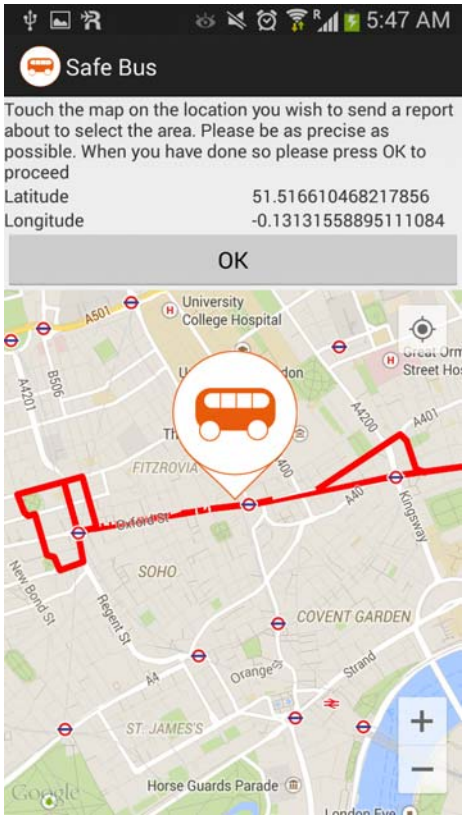
- What is it that we're interested in?
- Person?
- Other options:

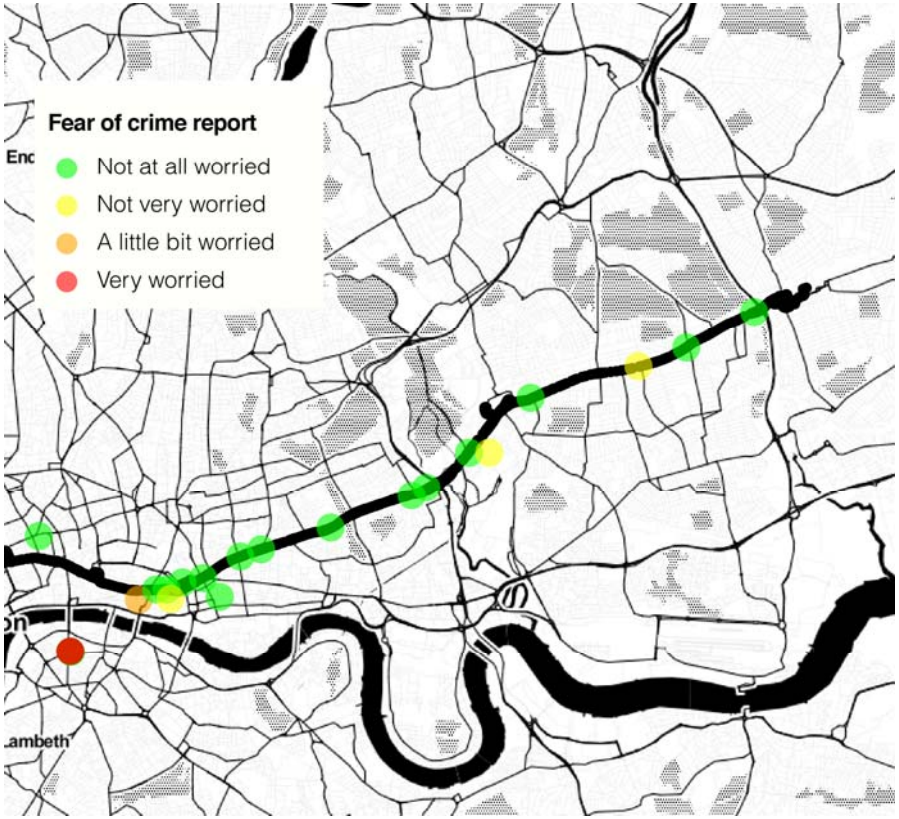


Sample

- Possible to get large sample size (Mappiness : 66,000 participants)
- But often not the case (8/27 papers mentioned small sample as limitation)
  - Lack of incentives - Motivations:
    - app helped in the past
    - concern about neighbourhood safety
  - Registration as a barrier

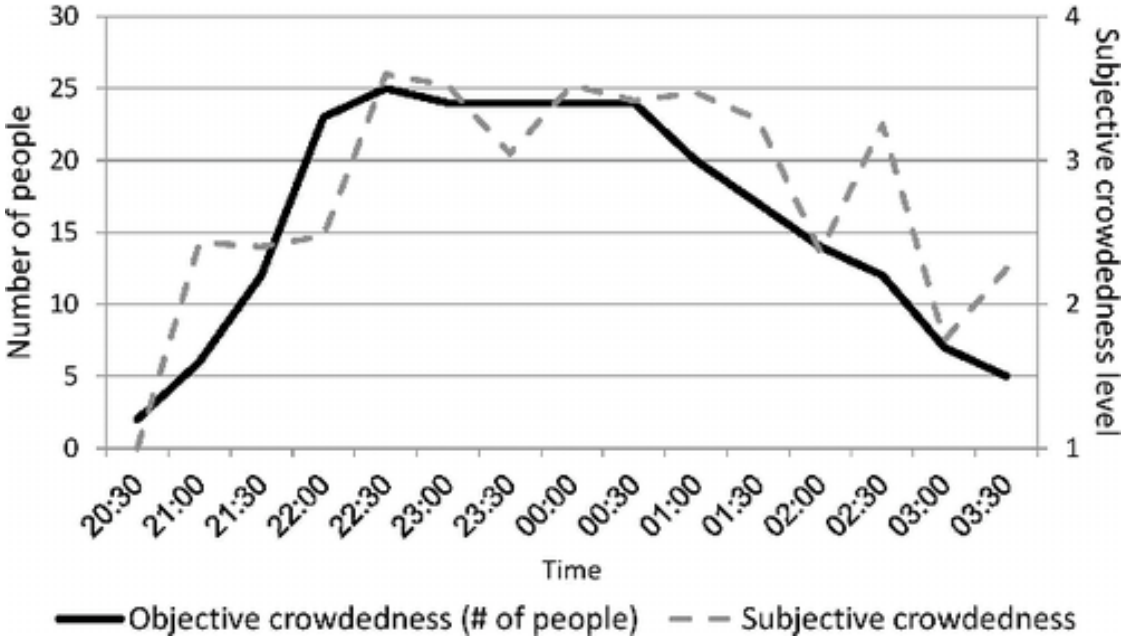
Sample: Motivation Example

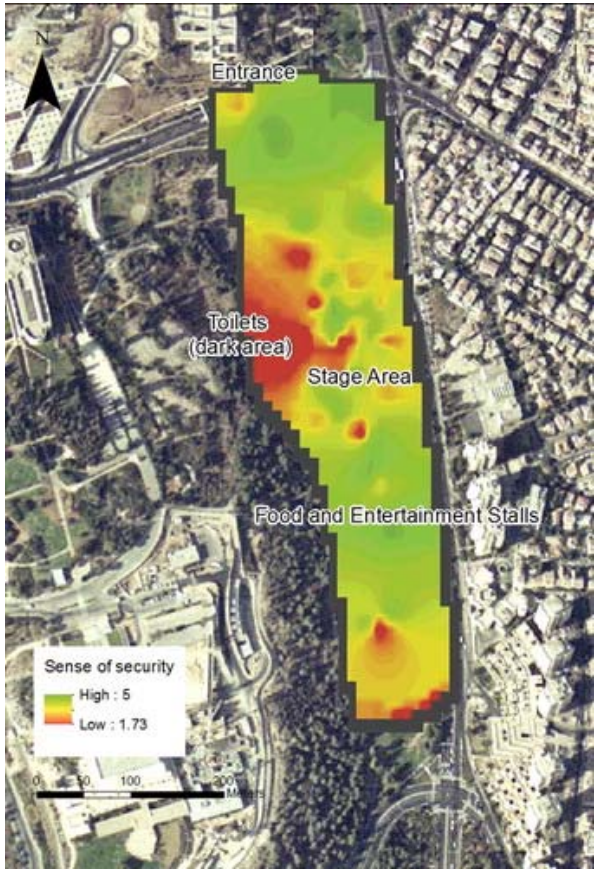




Duration of Study

- Ranges from hours …

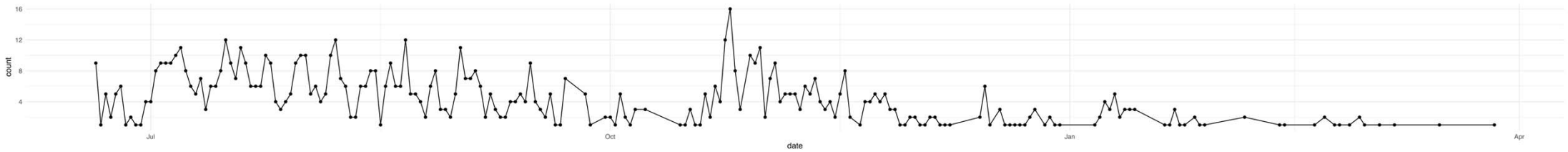




Amit Birenboim (2016) New approaches to the study of tourist experiences in time and space, Tourism Geographies, 18:1, 9-17, DOI: 10.1080/14616688.2015.1122078

Duration of Study

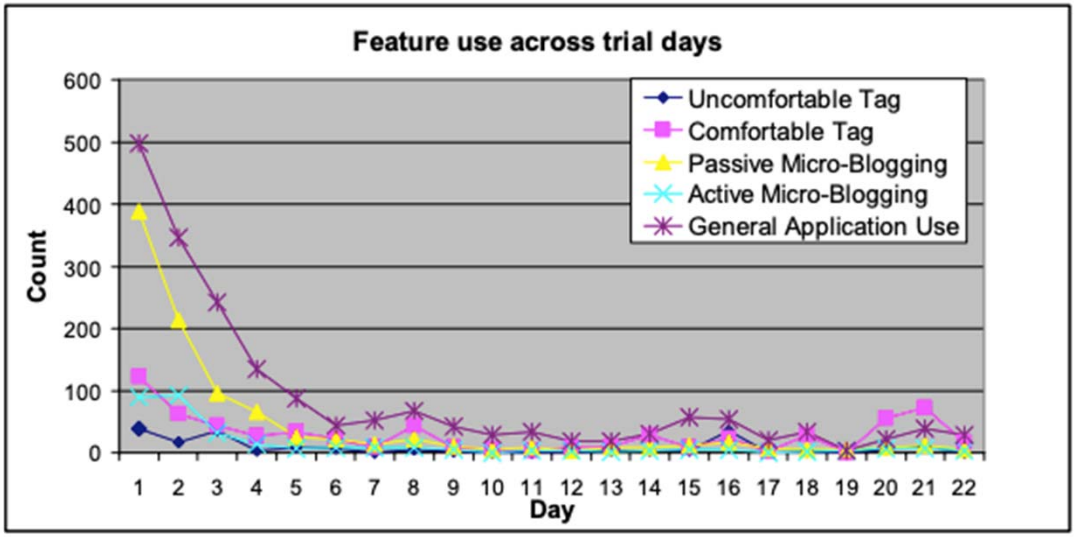
- … to months



Source: Solymosi, R. (2017). *Exploring spatial and temporal variation in perception of crime and place using crowdsourced data*(Doctoral dissertation, UCL (University College London)).

Duration of Study

- Important to consider the drop off in participation (engagement/compliance with an EMA/ESM)



Blom, J., Viswanathan, D., Spasojevic, M., Go, J., Acharya, K., & Ahonius, R. (2010, April). Fear and the city: role of mobile services in harnessing safety and security in urban use contexts. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1841-1850). ACM.

Research Tool

Section 2

Self Built or Off the Shelf?

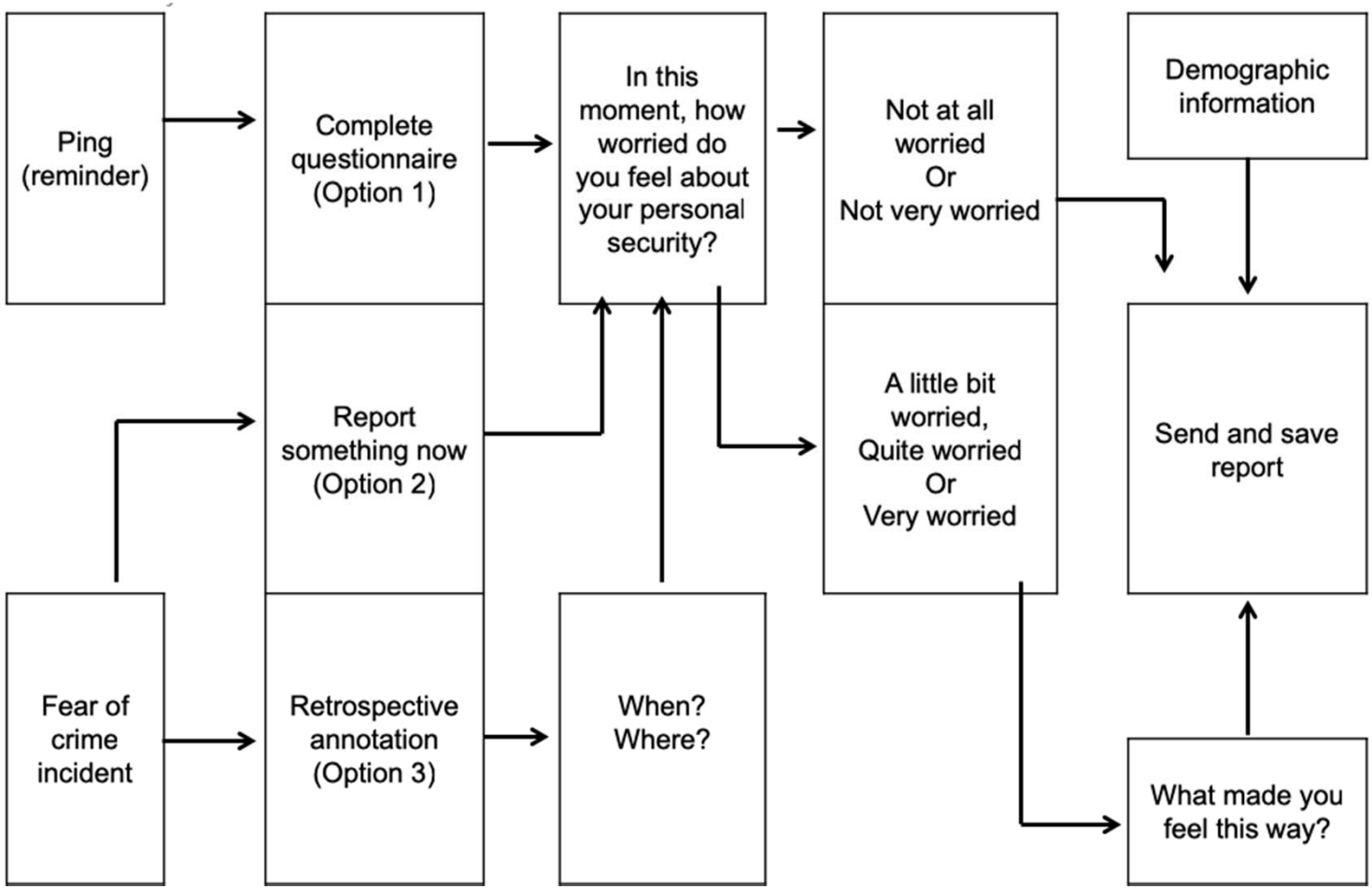
EpiCollect

For simple projects:

Features:

- Drag and Drop form Builder
- Define a single form for survey
- Any number of text questions
- Add a single GPS location + pho

- View / chart with Maps
- Download all data



MetricWire

- Platform developer in Canada
- MetricWire's platform allows researchers to integrate surveys onto the metricwire mobile app
  - Sensors I have used in my work include: temporal triggering, location tracking, accelerometer
- Transition effortlessly from pilot projects to full scale studies.
- Gather important and multi-layered insights with a powerful, secure, compliant and dynamic solution.

- https://www.metricwire.com

Self Built Apps

PROS	CONS
Control	Price (maintenance / bug fixes)
Flexible updating	Need technical expertise

Off the Shelf Apps

PROS	CONS
Easy Interface	No flexibility
Require no tech knowledge	

Data Analysis

Section 3

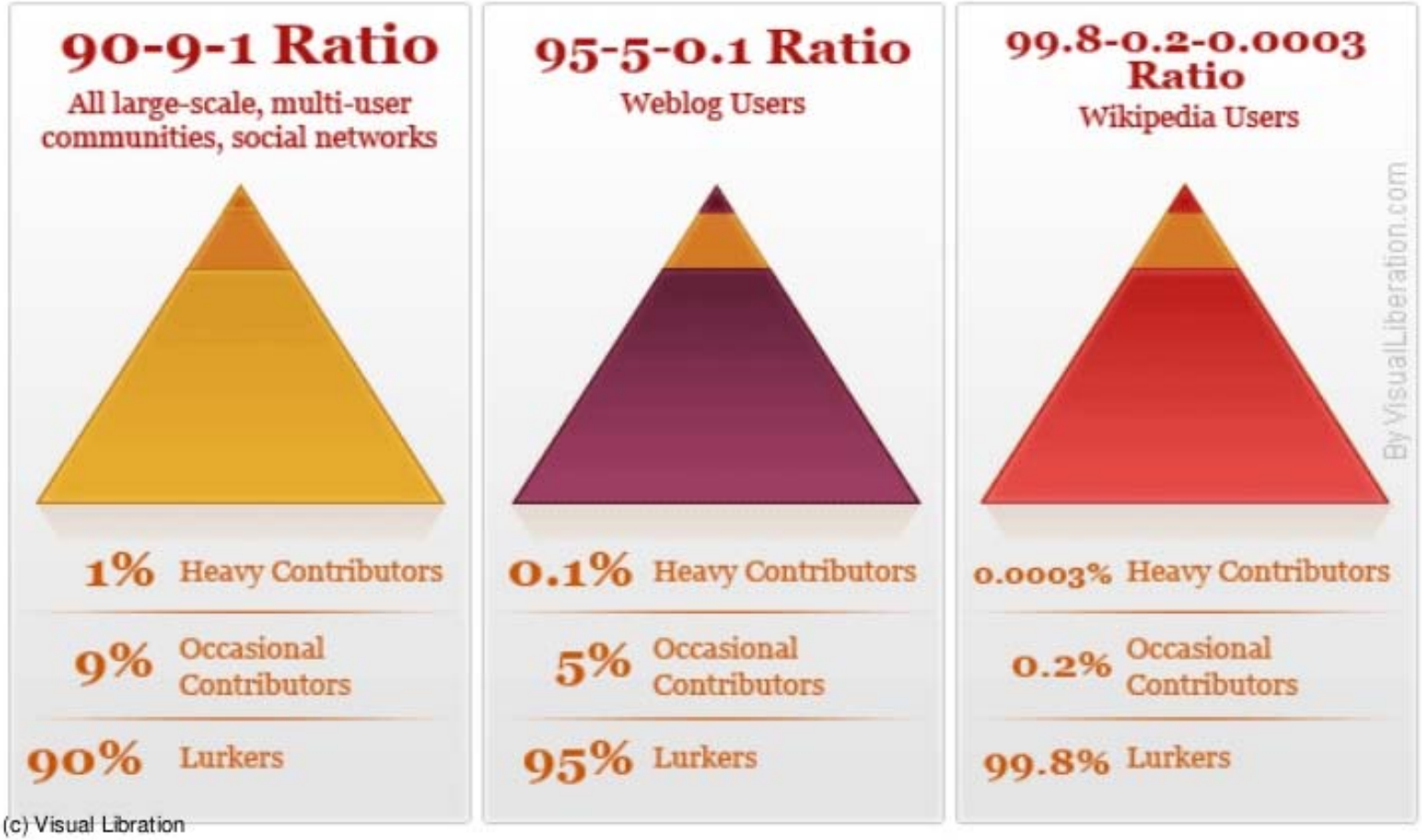
Sampling Issues & Generalisability

- “Many of the limitations identified can be subsumed into the overarching category of issues around sampling. While a common and widely researched problem with sample surveys, this issue is revisited each time a new platform for collecting data is introduced”.
  - Solymosi, Buil-Gil, Vozmediano, Guedes (forthcoming) ‘Towards a place-based measure of fear of crime: A systematic review of app-based and crowdsourcing approaches’

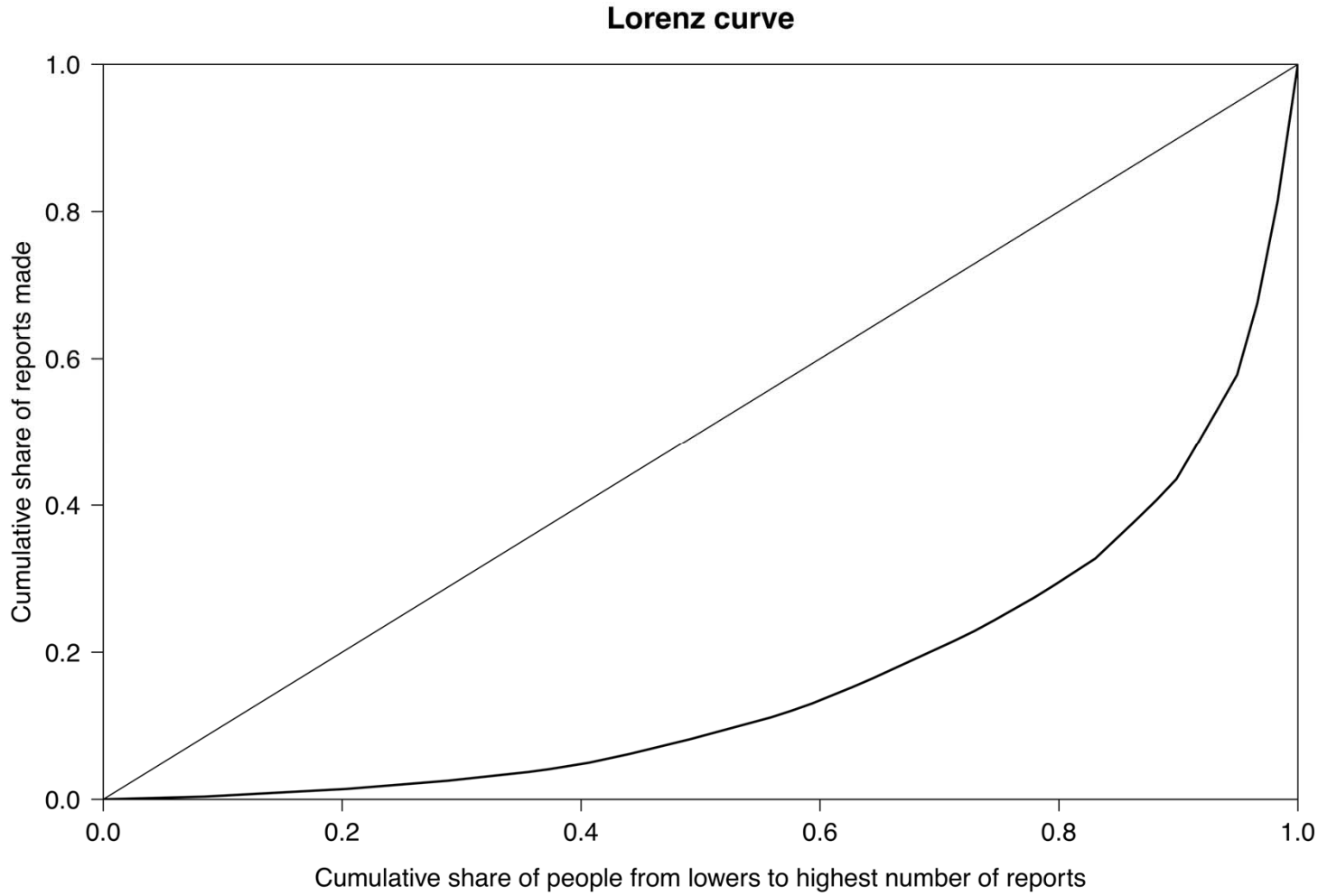
Sampling Issues & Generalisability

Sample issues	Participation inequality.	13	Unequal contribution between participants
	No screening questions.	3	Many apps don't require pre-selection questionnaires
	Participation decrease	1	Drop off over time
	Small sample sizes and low response rates.	8	Often difficult to motivate large groups

Participation Inequality



Participation Inequality



Analytical Approaches (Quantitative)

- Traditional statistical approaches are not always appropriate for EMA/ESM data due to assumptions of independence among observations
- Some possibilities
  - Temporal heat maps, trend plots over time (descriptive approach)
  - Multi-level models
  - Regression Tree Models (exploratory approach)
- Possible alternatives for statistical modelling (with small N's)
  - Bayesian multi-level models
  - Case study oriented approach

Analytical Approaches (Qualitative)

- Thematic Analysis of Textual Data collected from App
- Visual Methods
  - Geotagged images – linked images to specific places (Lemieux, 2015)
  - Image feature extraction

Ethics

Section 4

Ethical Considerations

- Mere-measurement effect
- Privacy and personal identification
- Data storage ethics (especially for off-the-shelf apps where data may be stored on the cloud)
- Safety mapping as a service
  - Possible stigmatizing effects (labelling people who belong in places perceived as “dangerous”)
  - Subjective experiences vary (two people can be in close proximity but have very different perceptions of the same environment)

Looking Forward

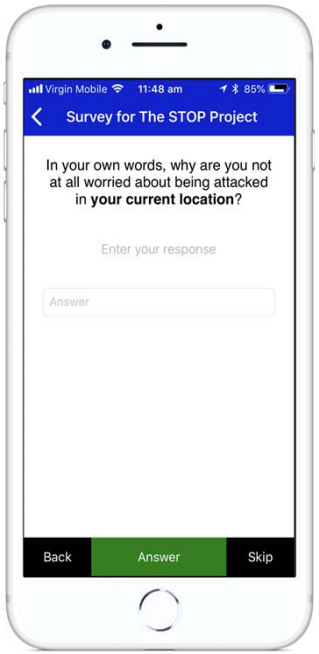
Section Five

Technological Developments

- Advanced Dynamic Sensors in Wearable + Standard Devices
  - Location tracking
  - Altitude
  - Ambient Temp / Light
  - Accelerometer
  - Magnometer
  - Bluetooth monitoring

Multi-Layered Questioning in EMAs

Multiple Choice



Text Response

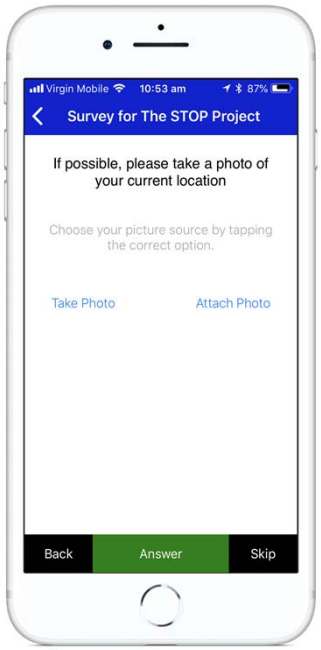
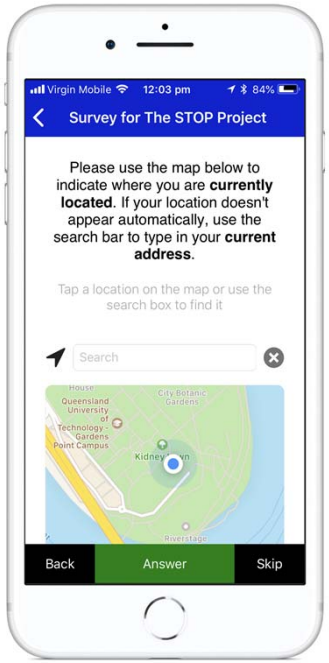


Image Response



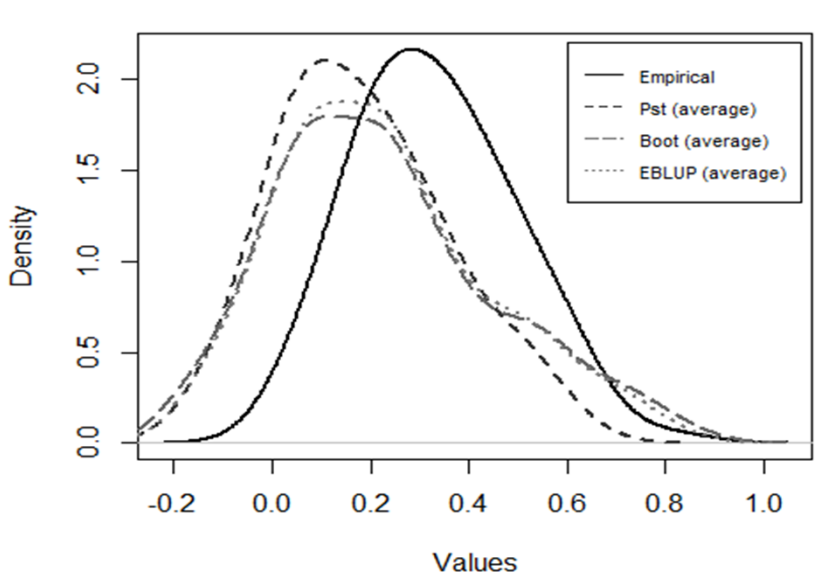
Location Response

MetricWire Inc App Images for Survey in Development by Dr Chataway, QUT & Dr Hart, Uni Tampa

Sensing Methods

- Physiological & contextual factors

Improving Generalisability



- Address the issues of sample bias
- Small Area Estimation: Buil-Gil, D., Solymosi, R. & Moretti, A. (in press). Non-parametric bootstrap and small area estimation to mitigate bias in crowdsourced data. Simulation study and application to perceived safety. In C. Hill, P. Biemer, T. Buskirk, L. Japec, A. Kirchner, S. Kolenikov & L. Lyberg (eds.) *Big data meets survey science*. Wiley.

Q & A

Have any questions? Post them to the chat thread OR Email

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Dr Michael Chataway – michael.chataway@qut.edu.au (twitter: @DrChatz)

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