Using Mobile Devices to Enhance and Extend Measurement

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Overview

- What is mobile measurement?
- What is “passive” measurement?
- What are the issues?
- What do we know (so far)?
- What are the gaps in our knowledge (what don’t we know)?

Mobile Measurement

- A growing number of people use smartphones
  - We're already dealing with these in survey data collection
- Smartphones enable "passive" measurement of location (GPS), movement, app use, sound, pictures, video, etc.
  - Plug-ins enable additional measurements
- Standalone wearable devices enable focused measurement of movement, activity, alcohol use, stress, heart rate, air quality, etc.
- How can these devices be exploited to enhance survey measurement?

Dimensions of Mobile Measurement

- What device?
- Whose device?
- Degree of respondent involvement ("active" vs. "passive" measurement)
- Degree of respondent control
  - Can they mediate transmission of data
- Frequency of measurement (one time, intermittent, periodic, continuous, etc.)
- Technical capacity and demands on devices
  - Storage, battery, data costs, etc.

What is Passive Measurement? (1)

- Also called unobtrusive or nonreactive measurement
- The term “passive” is misleading
  - Relative to surveys where researcher has active control over design of the measurement and respondent actively provides information
- Passive includes a wide range of activities, e.g.,
  - Activity trackers where users actively wear devices but the data are passively transmitted
  - Health apps where users actively enter information
  - Apps or devices where data are provided to users who then actively report this to researchers

What is Passive Measurement? (2)

- Degree of participant involvement varies
  - E.g., agreeing to wear a device versus downloading an app on their smartphone
  - Initial compliance versus ongoing adherence
- Range of passive measurement vary in space and time
  - Space: whole-household sensors (static) versus single-measure wearables (dynamic)
  - Time: one-time versus continuous versus intermittent
- We need to be careful about treating all types of passive measurement the same

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Why Passive Mobile Measurement?

- New measures
  - Measure things we couldn't (easily) do before
- Increased granularity in time and space
  - "Real-time," continuous measurement
  - Richer detail in terms of content
- Improved measurement
  - "Objective" rather than subjective measurement
  - Reduce recall errors, social desirability biases, etc.
- Reduced burden on participants
  - Passive measurement replacing survey questions
- The claim: better, faster, cheaper

Approaches to Mobile Measurement

- Three broad approaches
  - So-called "naturally-occurring data" or "big data"
    - E.g., data generated by Fitbits, health apps, accelerometers in smartphones, social media use, etc.
  - Volunteer users
    - Including RCTs
  - Part of ongoing survey measurement
- Our focus here is primarily on the third approach
  - But the challenges we discuss next apply to all three approaches

Challenges of Mobile Measurement (1)

- Selection biases (coverage)
  - Who has/uses the technology?
  - How do users differ from users?
  - Do Android and iOS users differ?
- Consent, compliance, and adherence (nonresponse)
  - "Passive" is a misnomer: users make active decisions about using the devices and when and where to do so
  - Who agrees to participate, and who continues to do so?
  - How "informed" is consent?
    - How many read EULAs?

Challenges of Mobile Measurement (2)

- Measurement and analysis issues
  - Quality (validity, reliability) of measurement
  - Effect of feedback on measurement
  - Data analysis challenge of handling unstructured data
  - Potential for much missing data (technical failures, non-compliance, etc.)
- Disclosure risk
  - Where do the data go? Who has access?
  - Ownership/curation of the data
  - Increased detail brings potential for increased risk
  - Challenge of creating public use data sets

What We Know: Mobile Technologies (1)

- Two broad approaches
  - Provide devices to respondents
  - Have respondents use own devices
- Two broad types of technology use
  - Active measurement: e.g., have respondents use technology to report data in a different way
    - E.g., Web surveys; text message surveys; EMA; electronic diaries; pictures of meals
  - Passive measurement: use technology to collect data directly
    - E.g., accelerometry; GPS; browser tracking

What We Know: Mobile Technologies (2)

- Some methods involve a mix of active and passive measurement
  - E.g., ask respondent to use online financial tools and consent to linkage; use of loyalty cards to capture expenditures
- All approaches require active consent from participants
  - Willingness, consent, initial compliance, and ongoing adherence vary by nature of task and characteristics of respondents
- Using these tools in surveys is a different proposition to using among volunteers

How Do We Learn More

- Deploying new technologies at scale is costly
- Small scale feasibility testing only answers some questions
- Need to focus on people rather than the technology
  - Technology changes faster than people
- Several approaches
  - Measure stated (hypothetical) willingness and explore correlates
  - Test actual willingness in ongoing surveys

Research on Stated Willingness

- Preliminary research focusing on stated willingness to use technology for a variety of measures
  - Using different samples and approaches
  - Looking at variation in willingness across tasks
  - Exploring correlates of willingness
  - Examining reasons behind (un)willingness
- Examples:
  - Revilla, Couper, & Ochoa (2017)
  - Keusch et al. (2017)
  - Wenz et al. (2017)

Summary on Stated Willingness

- Willingness varies across task
  - Intensity of measurement (effort)
  - Sensitivity of information
  - Degree of respondent control
- Willingness varies across respondents
  - Demographic differences
  - Effects of comfort, familiarity with technology, trust
- Stated willingness not always strongly predictive of actual compliance

Research on Consent and Compliance (1)

- Selected examples by type of capture
- GPS capture
  - Early GPS examples
  - McCrorie (2017): Growing Up in Scotland
  - Joh (2017): Regional HH travel survey
  - Gruschwitz & Schönduwe (2017): Multimo travel study in Germany
- Accelerometry/actigraphy
  - Early research on waist and wrist actigraphy in NHANES, NSHAP, HSE, and Whitehall II
  - Millennium Cohort Study
  - NCI FLASHE study
  - Howie & Straker (2016) review

Research on Consent and Compliance (2)

- Tracking apps
  - De Reuver and Bouwman (2015)
  - Van Duivenvoorde & Dillon (2015)
  - Kissau & Fischer (2016)
- Receipt scanning app
  - Jäckle et al. (2017): *USOC* IP spending study
- Financial aggregator study
  - Angrisani, Kapteyn, & Samek (2017): UAS study
- Multiple examples:
  - Scherpenzeel (2017): LISS studies

Research on Consent and Compliance (3)

- Survey apps
  - Wells, Bailey, & Link (2014): testing survey app
  - McGeeney and Weisel (2015): experience sampling
- Linkage to social media
  - Richards et al. (2014): Twitter linkage
  - Jessop (2017): Twitter linkage
  - Shakya and Christakis (2017): Facebook linkage
  - Deal et al. (2017): Facebook versus SMS message consent

Summary on Consent and Compliance

- Key challenges are getting respondents to download apps or activate features of their devices
- If active participation required, additional drop off or missing episodes likely
- Little research to date has focused on:
  - Reasons behind compliance with request
  - Barriers to participation
  - Differences between those who do comply and those who don't
  - How to increase informed consent rates
  - Understanding adherence to protocol
- Emerging research is focusing on these issues
  - Moving from feasibility tests to scaling up

Research on Measurement Quality

- Given the challenge of implementing large-scale passive measurement in surveys, very little research to date has focused on data quality
- Small-scale studies using volunteers raise inferential questions
  - Likely to be better self-reporters too
  - CPAM example studies
- Many unknowns
  - Focus on the known unknowns

Research Gaps: Selection Issues (Coverage and Nonresponse)

- How do those who have/use the technology differ from those who don't?
  - How do Android users differ from iOS users (and others)?
- Who complies (both initial consent and ongoing adherence)?
  - What motivates people to participate?
  - How do compliers differ from non-compliers?
  - How does compliance differ across different types of passive measurement?
  - How to define/measure compliance or adherence?
- How informed is consent?

Research Gaps: Measurement Issues

- What are the measurement qualities of passive measurement?
  - Under what conditions is optimal measurement achieved?
  - What is sufficient quality?
- How long/often should measurement occur?
  - Risk of breakoff or attrition
  - Declines in adherence
- How do we best combine active (e.g., survey) and passive measurement
  - Especially in a mixed-mode survey environment, e.g., FTF and Web

Research Gaps: Logistical

- How do we scale mobile measurement to large samples?
- Custom-built versus generic tools (consumer products)
- Specialized/bespoke tools (e.g., wearable accelerometer) versus generic devices (e.g., smartphones)
  - Is it cost-effective to provide equipment or pay people to use their own devices?
  - Measurement tradeoffs
- Technical capabilities of devices (battery life, storage, durability, etc.)
- Dealing with massive quantities of data

Common Misconceptions About Mobile Measurement

- Mobile device ≠ mobile user
- Despite widespread adoption, use of digital mobile devices still uneven
  - Digital divides
  - Especially true of consumer use of wearables
- "Passive" measurement involves some degree of active participation
- It's not about the technology, it's about the people using (or not) the technology

Summary

- Many exciting new opportunities for using mobile measurement to enhance survey data collection in different domains
- Lots of hype about the promise of these methods, often based on small-scale feasibility testing
- Many gaps in knowledge, especially for population-based inference
- Research must focus on both the methodological and substantive issues
- Use multiple methods and approaches (triangulate)
- To repeat: it's more about the people than the technology

Questions?

Comments?

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