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**Workshop synthesis: Conducting travel surveys using portable devices - role of technology
in travel surveys**Kouros Mohammadian, PhD^a, Stacey Bricka, PhD^b *

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Abstract

The aim of this paper is to synthesize discussions of a workshop that was developed as part of the ISCTSC10 conference. Workshop attendees discussed the role of technologies such as GPS, smartphones and life-logging cameras in travel surveys, post-processing of location and time data collected by those technologies, their usability, and future opportunities and challenges.

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1. Structure of the Workshop

The purpose of this workshop was to provide attendees an opportunity to focus on the role of technology in travel surveys. The main focus was on contributions of GPS, smartphones and life-logging cameras in the gathering of location and time data to either validate self-reported information and/or reduce respondent burden by automatically providing subsets of relevant travel data. The workshop provided an opportunity to compare these technologies with respect to usability and data quality, as well as to discuss how they can improve, complement or replace typical transport survey methods. The workshop was supported by four paper presentations and five posters. These are listed at the conclusion of this report.

A total of 27 attendees participated in the workshop, which centered about paper presentations and breakout

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groups on the key topics of:

- Survey Design
- Respondent Experience
- Post-processing of data
- Sharing the Experience

2. Survey Design

In this breakout group, the discussion centered about the topic of designing surveys using portable devices. It was agreed that the current use of technology is heavily influenced by the traditional household travel survey design: using technology to replace paper logs rather than looking at what technology could do and designing a survey around that technology. As a result, we may be limiting ourselves in terms of both leveraging the power of the various technologies as well as discovering new methods and techniques that move us far beyond current designs. In addition, with the use of technology comes new issues, such as loss of devices (one US study noted a device loss rate of 30%). Therefore, the survey design should consider such strategies like retrieving the equipment.

Beyond the question of technology itself, there are other design issues that require more consideration. First, sample size: how does the minimum sample size vary based on the length of data collection? If technology enables the collection of multiple days of data, do we need less sample? What new issues emerge with multi-day data collection? It was noted that in most cases, new surveys with portable devices still need face-to-face or other focused recruitment strategies as well as incentives. Therefore, trade-off between recruitment strategies and sample size should be considered. Second, how do we evaluate the quality of data collected through prompted recall surveys? For the workshop attendees the quality of data obtained through that method was debatable. Finally, what is the impact of our instructions and design elements on respondents? Do they read our detailed instructions? How do they define a trip and how does that differ from how algorithms identify trips in the passively collected data collection streams?

3. Respondent Experience

Workshop participants acknowledged that despite our best effort in designing the “perfect” survey, we need respondents to agree to participate for a successful venture. For those who agree to participate, their perceptions about the survey task can vary greatly from what the design was intended to elicit (e.g. a mother dropping a child to school and returning home may be perceived as one trip and not a tour). In addition, there are cultural differences that may influence respondent perceptions regarding what data is being requested.

To that end, workshop participants discussed how to maximize the respondent experience (for maximum participation rates and data collection success). The group identified the following as important considerations with respect to maximizing the respondent experience:

- Include in the survey design tools to train respondents on the technology along with on-call support. In addition, providing incentives was also identified as important.
- Consider sampling and communication for those populations that do not own devices or have a technology bias (such as children, the elderly, low income, and those living “off the grid”)
- Public outreach is important to educate the public on the survey and provide legitimacy for those asked to participate in the survey.
- Identify and monitor metrics associated with respondent burden.
- Consider how new technologies like Google glasses or Life-long Cameras would affect respondent experience and can change our surveys.

Respondent interaction can be impacted by varied privacy laws and best practices in the region conducting the survey (and vary across the world). There continues to be a stated desire to design new surveys that include both the old (paper) and the new (GPS, Smartphone) technologies. This increases respondent burden and also makes it difficult to leverage the power of the new technologies into new and more powerful survey designs.

4. Post-Processing of data

Workshop participants agreed that as we are learning how to process and prepare the data for further analysis, we also need to document and update procedural and process documentation for others just beginning work in this area. This helps to keep the survey technology community on the same page in terms of lessons learned (and what not to do) as well as allowing researchers to use these documented practices and focus their funding on furthering the practice in new areas rather than re-inventing the wheel. This documentation should include details on:

- Transferring data
- Cleaning the data
- Map matching
- Identifying trips
- Identifying attributes of trips
- Recognizing accompanied travels

Research in the area of post-processing passively collected data has been underway for almost 20 years. In that time, the community has achieved reasonable level of trip and mode identification accuracy, but not sufficient purpose detection or occupancy detection algorithms. We are also working on combining a sample of observed data (such as GPS records) with massive passive databases (such as cell phone network providers). We have identified how to use horizontal location accuracy in smartphones as well as FM radio station triangulation to clean GPS records. However, different smartphones use different technology and operating systems make it impossible to develop a single algorithm that works for all.

With respect to GPS data collection, we have begun to address smartphone battery life leveraging the introduction and research regarding newer better batteries to optimize the battery usage as appropriate for the data collection objectives. At this point, the workshop participants agreed that battery life can be managed by the frequency of data logging. However, it was argued that the interval of data collection is an important element of the survey design and can significantly impact the post-processing step.

5. Sharing the experience

As a whole, the workshop participants agreed that there is a need for a framework to better share data, algorithms and ideas among researchers and consultants, perhaps creating some type of open source community (where government regulations allow). This can help with comparisons of data quality across different types of equipment and across different brands within a specific type of equipment.

There was agreement that we are all independently developing the same “wheel”. Presumably, together, we could develop faster, further, and better answer but it was recognized that we would need to address privacy concerns, data sharing policies, IP issues, etc. At a minimum, the group agreed we should have a common Website for papers/resources, perhaps establish a list serve or use the ISCTSC community as a base. Finally, there was firm agreement on the need for a safe collegial forum for “Journal of Epic Fails” – a place where we can convey what did not work, so that others know to either avoid wasting resources repeating that process or at least know to approach with care.

A desire for an open source community to share methods, algorithms, documentation, and data (where allowed) was stated and agreed upon by all workshop participants. As an example of a start, ETH in Zurich has determined that all their algorithms are now open source.

6. Cross cutting themes

The key cross cutting themes identified in this workshop were:

- Respondent Burden
- Privacy
 - Differences in policy across nations

- Differences across respondents (culturally as well as demographically)
- De-identifying/anonymizing data
- Sharing information
 - Connecting people and resources
 - Open sharing of research results
 - Communicating progress through conferences and list serves (successes as well as failures).

7. Short term research needs and opportunities

The following short-term research needs and opportunities were identified (these were items we hope to have papers addressing at the next ISCTSC conference):

- A systematic and side-by-side comparison of different technologies, and within technology, different brands.
- An identification of what data can/should be used to identify ground truth.
- A synthesis of best practices for respondent interaction/engagement.
- A summary of the needs and legal concerns of sponsoring agencies.
- A method or approach to both define and measure respondent burden.
- A better understanding of privacy from the respondent perspective that enables us to better tailor study information to meet respondent concerns.
- A process for dissemination (de-identifying/anonymizing) the data.
- The development of standards to allow “connections” between apps and interfaces.
- A better understanding of scalability of surveys (e.g., small multi-day sample vs. large one-day sample; or small number of households but all members vs. more households with smaller number of individuals).

8. Long term research needs and opportunities

Longer term (but within the next decade), the workshop participants identified the following research needs and opportunities, while at the same time acknowledging the challenge in forecasting technological advancements:

- The privacy issues associated with new technologies.
- An approach for balancing meeting privacy regulations with obtaining desired data.
- Identifying what more can be done to increase participation across all demographics.
- Identifying a method for collecting emotions and stress levels that could impact travel decisions.

9. Conclusions

A workshop was organized at ISCTSC10 where attendees discussed the role of current and emerging technologies in travel surveys, including issues such as; survey design, respondent experience, post-processing of data, and sharing the experience. The primary product of the workshop was a list of short- and long-term research needs and opportunities that was developed and discussed by participants. The short-term research needs were mainly around developing syntheses of best practices and comparisons of different technologies, as well as research on scalability, respondents’ burden, and legal concerns. The long-term research opportunities that were identified included research on privacy concerns, overcoming the challenges of survey participation across all demographics, and new research direction such as measuring emotions and stress level along with real-time travel surveys.

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Appendix A. Papers presented during the workshop

Comprehensive Framework for a Smartphone-based Prompted-recall Travel Survey. Authors: Hamid R Safi, Mahmoud Mesbah and Luis Ferreira

An econometric analysis of the differences between a smartphone-based survey and a traditional travel survey. Authors : Carlos Carrion, Rudi Ball, Francisco C. Pereira, Maya Abou Zeid, Moshe Ben-Akiva and Chris Zegras

Field evaluation of a smartphone-based travel behavior data collection app “SmartMo”. Authors : Martin Berger, Mario Platzer and Rudolf Schamberger

Evaluation of travel behaviour data collected by smartphones: first results of the Dutch Mobile Mobility Panel project. Authors: Tom Thomas, Karst Geurs, Marcel Bijlsma and Maarten Streefkerk

Appendix B. Posters associated with the workshop

Analysis of human activity-travel patterns in travel surveys. Authors: Youngsung Kim, Carlos Carrion, Francisco Pereira, Christopher Zegras and Moshe Ben-Akiva

Quality of web based prompted recall responses in smartphone based travel survey. Authors: Ajinkya Ghorpade, Shuang Shuang, Fang Zhao, Francisco C Pereira, P. Christopher Zegras and Moshe Ben-Akiva

Improving recall of travel using smartphone capabilities. Authors: Stephen Greaves, Mark Davis and Stephen Roddis

The implementation of information-based mobility management measures in a smartphone travel survey. Conceptual and methodological issues related with its design. Authors: João de Abreu E Silva, Francisco Pereira, Fang Zhao, Christopher Zegras and Moshe Ben-Akiva

Asked and Answered: Insights Gleaned from Recent Travel Survey Tests. Authors: Stacey Bricka, Arash Mirzaei, Kathleen Yu, Behruz Paschai