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Workshop synthesis: Respondent/survey interaction in a world of Web and Smartphone apps

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Abstract

Web and smartphone surveys are increasingly being used to collect travel information. This workshop explored respondent interaction with these tools, covering a range of research concerns. While smartphone surveys facilitate real-time passive collection of continuous data, thereby reducing respondent burden, their use raises many issues common with those present in web surveys. These include survey design, sample representativeness, privacy, respondent burden, data quality and validation. Workshop participants considered possible areas for future research on these issues and others such as provision of feedback to respondents, linking with big data and focusing on attitudinal and behavioural motivations.

1. Introduction & Scope

Recent developments in information and communications technology have seen the growth of internet access and increasing penetration of smartphones. Together these developments present an innovative opportunity for use when surveying people on their travel activity.

The use of Web based surveys for this purpose continues to grow, driven by perceived advantages including: reduction in application costs and possible economies of scale (Roztocki, 2000; Deutskens et al, 2004; Bonnel and Madre, 2006; Alsnih, 2006; Bayart and Bonnel, 2008); error reduction and faster data processing (Roztocki, 2000; Bayart and Bonnel, 2008); and the increase in customization possibilities, which allow for instantaneous checking, dynamic program based controls and skipping over irrelevant questions (Hess and Rose, 2009; Alsnih, 2006; Bayart and Bonnel, 2008; Bonnel and Madre, 2006).
Although more recent, smartphone surveys are gaining acceptance and novel applications of smartphone transport surveys have been reported in the literature (e.g. Pereira et al. 2011; Safi et al., 2013; Nitsche et al., 2014; Rehr et al., 2007; Chen et al., 2010; Beckor et al., 2013). Smartphone surveys share several characteristics of web based surveys with additional advantages including continuous real-time data collection and an associated reduction in respondent burden. However, this comes at a cost; namely, the need for complementary surveys for data enrichment and validation. In parallel to the development of research oriented survey applications there has been an emergence of Smartphone apps that collect travel related data, with several tracking physical activity (e.g. MOVES, S. Health) or more general data (e.g. funfinabox).

Both web and smartphone surveys suffer from limitations due to access and penetration. According to the International Telecommunication Union (http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx), worldwide internet penetration for individuals using the internet was 38% in 2013 and estimated to be 40% in 2014. The penetration rate varies greatly by country, and in the developed world these levels are 76% and 78% respectively. Smartphone penetration is lagging behind, but is also increasing rapidly. In 2014 smartphones represented 37% of the total sales of new mobile phones (http://www.statista.com/statistics/218532/global-smartphone-penetration-since-2008/). In many countries smartphone penetration estimates are considerably higher; for example Deloitte estimates the current smartphone penetration in Australia to be 81% (http://frontieradvertising.com.au/homepage/deloitte-australia-media-usage-preferences-2014/).

As a result, limitations associated with the availability of these technologies are quickly diminishing, explaining the increasing attractiveness of these modes for collection of travel behaviour data.

However, this embrace of technologically driven data collection still faces methodological challenges. These are related to sample representativeness (Bayart and Bonnel, 2008; Roztocki, 2000; Alsnih 2006; Bonnel and Madre, 2006, Manfeda et al., 2006); data confidentiality and quality (Alsnih 2006; Roztocki, 2000); low response rates (Bonnel and Madre, 2006; Marta-Pedroso et al., 2007); dropout rates (Bayart and Bonnel, 2008); and, particularly acute in smartphone surveys, privacy and ethical issues (Safi et al., 2013).

Usually both internet users and smartphone users tend to be younger, richer, with higher education levels and technologically savvy (Alsnih, 2006; Nitsche et al., 2014). Inevitably, there appears to be a bias in smartphone survey participants towards individuals demonstrating these characteristics (Nitsche et al. 2014). It is possible that this group of people might be less conscious about their privacy and more willing to share data about their behaviour.

Therefore, the potential presented by these technologies to collect travel behaviour data naturally raises research issues related to the interactions between these tools and survey respondents. These include:

- Identifying important challenges in the design of web and smartphone tools;
- Issues associated with the moving respondents from one interface to the other to provide the full range of responses required;
- How other functionalities from these tools can be provided to simplify and improve user experience;
- Identifying the types of support that can be provided to respondents;
- How to provide respondents with information on the correct use of the interfaces;
- Identifying the possible ways to exogenously validate the results from these surveys;
- How respondent interactions with the interface can be monitored to assess the level of quality of data.

Each of these topics was discussed during the workshop which was focused on respondent / survey interaction in web and smartphone surveys. The discussion was also anchored by the presentation of the following papers and posters:

- “A Web-Based Diary and Companion Smartphone app for Travel/Activity Surveys”. Stephen Greaves, Richard Ellison, Adrian Ellison, Dean Rance, Chris Standen, Chris Rissel and Melanie Crane (paper);
- “The Netherlands Mobility Panel: An innovative design approach for web-based longitudinal travel data collection”. Sascha Hoogendoorn-Lanser, Nina Schaap and Paul Van Beek (paper);
- “Design and usability concepts in a web-based prompted recall survey”. Inês Dias, Francisco Pereira, Caitlin Cottrill, Fang Zhao, Chris Zegras and Moshe Ben-Akiva (paper);
- “Patterning Web Respondent Behaviours from 10 Web-based Origin-Destination Surveys”. Catherine Morency and Pierre-Leo Bourbonnais (paper);
- “Household Survey of Intermodal Trips – Approach, Challenges and Comparison”. Jörn-Ole Schröder, Martin Kagerbauer and Peter Vortisch (poster);
• “The implementation of information-based mobility management measures in a smartphone travel survey. Conceptual and methodological issues related with its design”. João de Abreu e Silva, Francisco Pereira, Fang Zhao, Christopher Zegras and Moshe Ben-Akiva (poster).

The ensuing sections are organized as follows. First we discuss issues related to the challenges in designing web and smartphone tools. Secondly, we provide an in-depth discussion of respondent burden, bearing in mind that this issue pervaded all discussions over the course of workshop. This is followed by a discussion of the benefits that could result from other functionalities available in the technology. The fourth section deals with issues related to information and support that can be provided to respondents, as well as way to validate the collected data. The report ends with conclusions emerging from the breadth of workshop discussions.

2. Relevant challenges in designing web and smartphone tools

A range of challenges exist for designing smartphone tools, including technical and technological considerations as well as personal concerns.

2.1. Technical and Technological challenges

Several issues related to limitations of the technology have been reported in the literature, most of which relate to sensors used in smartphones to determine location and mode usage, and their drain on battery charge. Multiple apps and devices (e.g. GPS) tend to require intensive battery use (Safi et al. 2013; Nitsche et al., 2014). Although these issues currently pose a challenge to the design of smartphone survey apps it is expected that they could be solved in the near future. Research and technology development on both increasing battery life and optimizing energy consumption in smartphone operating systems should provide solutions to these limitations.

Other technological issues relate to the quality of data collection. GPS devices tend to suffer from precision problems associated with urban canyon effects (e.g. Safi et al., 2013; Nitsche et al., 2014) and time to first fix the satellite in GPS. Loss of GPS signal is also a problem, particularly in underground transportation systems or indoor positioning (Nitsche et al., 2014; Rehrl et al., 2007).

Further issues have been reported on the impact of running survey apps simultaneously with other software and the subsequent impact on smartphone use, including running other apps and being able to make calls, as well as the speed of the survey app (Safi et al., 2013). On a technical level, being able to design apps that are able to run on different operating systems and smartphone screen sizes is an additional challenge (Nitsche et al., 2014).

To solve the issues related to GPS usage (battery drainage and location precision issues), several researchers have resorted to other technologies and sensors. These include accelerometers; positioning from the cellular network (Nitsche et al., 2014, Pereira et al., 2013); wifi (Greaves et al., 2014) and Bluetooth (Rehrl et al., 2007). Thus, using GPS in smartphones surveys to collect respondent location could be overkill, and thus unnecessary. But, despite several advances, mode identification; particularly for motorised modes is still a challenge (Chen et al., 2010; Cotrill et al., 2012).

Although there is a tendency towards the use of self-learning algorithms in smartphone apps, some data items still need to be asked directly, either because the information is not able to be collected, or its precision level requires validation (e.g. trip purpose, with whom the trip is being made). All of these issues impose the need to balance resource efficiency, participant burden and data accuracy (Pereira et al., 2013; Cotrill et al., 2012). Past information (Greaves et al., 2014) and contextual information (Cotrill et al., 2012) is necessary to infer travel characteristics and to reduce respondent burden. The need to collect contextual information around land use and urban activities data with appropriate levels of accuracy and timeliness, as well as ways to combine it with the smartphone data is a particular challenge.

2.2. Respondent bias, experience and risks

While web and smartphone surveys present numerous functional advantages, there is a tendency towards using
them to simply replicate paper based surveys (Greaves et al., 2014). Questions in paper based surveys may be
ordered in a way that minimises respondent errors in following skip instructions at the expense of a more logical
question order. Computer based surveys have the ability to follow skipping and sequencing directions dynamically
meaning that questions can be ordered in the most appropriate way for ease of respondent comprehension and
recall. The ability to use the program driven web and smartphone platforms to process and infer information,
allowing customisation, reducing repetition and applying instantaneous data checking and validation to reduce
respondent burden, should be carefully considered in the design of surveys using these tools.

Care is needed to obtain an optimal balance between data quality through the use of in-survey validation and
verification, and respondent attrition due to the additional burden introduced by review and confirmation activities.
Different survey collection modes require different respondent skills and varying levels of concentration.

Although the issues of bias due to internet and smartphone penetration are potentially solvable in a near future,
there are still several issues that can affect sample representativeness. For example, while web/smartphone
respondents may be similar to other individuals on socioeconomic characteristics, they may have different
attitudes, perceptions and behaviours. Therefore, the use of alternative survey techniques and methodologies should
be pursued in order to understand, or rule out, these differences. Further challenges relating to representativeness
arise when using commercially available access panels, and consideration must be given to the trade-off between
sample representativeness and simply achieving larger sample sizes.

The introduction of smartphone surveys poses new challenges in how survey data is used as these surveys focus
on individuals, whereas traditional travel surveys have mostly focused on households.

Particularly relevant for smartphone surveys are questions associated with privacy and other ethical issues
including potential costs to the respondents in using their smartphones (Safi et al., 2013). Smartphones present the
opportunity to capture real-time data on respondent travel activity through traces as well as direct entry of
information into the survey app. The passive electronic capture of travel means survey participants are less engaged
in the provision of their travel data, raising additional concerns around privacy and potentially the willingness of
people to participate in a survey. It is important for researchers to always communicate to potential respondents
how this data will be used, gaining respondents’ trust that the data collected is protected and de-identified and that
the results will be used for the benefit of the community through a clear explanation (“selling”) of the social
relevance of travel surveys. Also, researchers involved in travel data collection should be aware of developments
related to privacy laws and ethical issues.

Attention is needed on a range of issues including respondent safety, for example, interaction with a smartphone
while driving, the potential for real-time tracking of respondent movement, and the potential for improper access to
respondent data by third parties. Consideration should be taken not only of the real risks posed by the data
collection method used, but also with the perceived risks respondents may have with it. Perceived risks can impact
on willingness to participate in the first instance, causing reduced response rates, and also on the extent to which
travel details are fully and correctly recorded.

3. Respondent Burden

Respondent burden, which was defined as the trade-off between the cost of completing the survey and the
benefits obtained from it, emerged as a relevant issue in this workshop discussion. Burden needs to be clarified and
evaluated, from the perspective of the potential impact on person non-response, item non-response, incorrect
answers and drop-out. Understanding aspects and mechanisms that influence drop-out is a key consideration if one
wants to increase the relevance of web and smartphone surveys in travel behaviour analysis.

Peytchev (2011), while studying breakoff and nonresponse in web surveys reported that drop-out could be due
to random issues or factors that could be controlled by the researcher. Furthermore, he found that while breakoff
and nonresponse share some commonalities they present different causal mechanisms. Other researchers have
identified aspects that could be related to burden and lead to survey breakoff, including the cognitive demands
associated with the questionnaire (Peytchev, 2009; Lenzner et al., 2010) and progress indicators and their relation to
respondent expectations (Conrad et al., 2010).

As a consequence, two diverging development paths emerge to reduce respondent burden and its impact in
smartphone surveys: either reduce interaction through the increase of passive data collection; or increase
respondent enjoyment and interest (e.g. through gamification) thereby increasing engagement and reducing burden.
The need for more research on how to measure burden, understanding the extent of its impact and assessing burden levels during survey administration emerged as recommendation from this workshop.

4. Benefits from other functionalities

Data collected from web and smartphone surveys can be rapidly and easily processed. Therefore the ability to provide rapid feedback to respondents is relatively easy. This feedback could have different aims ranging from keeping respondents engaged to contributing to behavioral change. Information provided to respondents could include:

- Access to their current location, past routes and other past trip characteristics (Safi et al., 2013);
- Descriptive statistics on collected behavior;
- Enriching these statistics with meaningful information for users (e.g. the amount of energy spent in travel, costs, estimates of CO₂ emissions, calories burned by using non-motorized modes). Indeed, some smartphone apps are already providing individuals with information about their physical activity levels (e.g. MOVES, S Health);
- Awareness of and comparison with other individuals or socio-demographic groups;
- Providing information about more efficient alternatives (e.g. routes, modes) considering either individual or societal efficiency, using smartphones as information based travel demand management tools.

The ease of employing these technologically driven benefits associated with web and smartphone surveys should be tempered by their capacity to affect user behavior. Indeed, these benefits may well change the objectivity of a travel survey by modifying the behavior which the survey is attempting to measure, causing it to no longer be representative of the population. Thus caution should be used in determining the point at which this information is provided to the respondent to ensure measurement is completed before potential behavior changing information is supplied.

Another functionality that could be included in smartphone surveys is the use of voice recognition. Whilst this technology has been embedded into smartphone operating systems and some applications, its use in survey applications has not been reported. This technology has the potential to reduce burden and increase the levels of interaction with the respondent and, therefore, increase the levels of respondent engagement. This was identified as an area for future investigation during the workshop.

Consideration should also be given to allowing survey participants to choose the level and type of interaction they would like with the smartphone application. Providing such a choice can offer a positive experience and prevent respondent disengagement through frustration.

The emergence of several smartphone apps that collect travel related data as an input to their main function provides potential opportunities for collaboration with their developers and adaptation of these apps to collect travel survey data.

5. Information and support provided to respondents and exogenous validation of data

Information validation and capture of additional data beyond that collected from smartphone surveys is often undertaken through the use of complementary web surveys (Safi et al. 2013; Pereira et al., 2013; Greaves et al., 2014, Ferreira et al., 2014). These complementary surveys increase precision at a cost of increased respondent burden (Cotrill et al., 2014). As a result, they can lead to more survey dropouts. Several authors present strategies to reduce burden in the validation tasks. These include attention to the survey design aspects (Pereira et al., 2014; Greaves et al., 2014; Ferreira et al., 2014); use of maps as a way to simplify the diary completion and validation (Greaves et al., 2014) as well as to improve recall by the respondents (Ferreira et al., 2014); and using pre-filled fields with a higher probability of being known – repetitive trips and return home trips (Greaves et al., 2014).
User friendliness and making respondents understand the concepts and purpose of these applications contribute to reducing attrition rates and survey drop outs as well as minimizing response error. Thus informing respondents of survey concepts (which could be complex) in an easy and intuitive manner is paramount. The design of an interactive web interface is challenging (Pereira et al., 2013) and poor design can impose greater burden on respondents.

More complex and elaborate web interfaces might be counterproductive. Good design considerations for web based surveys, including those complementary to smartphone applications, include (Pereira et al., 2013):

- Making respondents aware of the entirety of their travel over the entire survey period;
- Making visualization of traces easier and understandable;
- Making interfaces more intuitive;
- Careful choice of font types and sizes; and
- Maintaining the amount of information provided on screen to a manageable level by respondents.

Diaries should be quick, intuitive and with a shallow learning curve (Greaves et al., 2014), and while respondents should be provided with tutorials (Ferreira et al., 2014), a FAQ might be more relevant than lengthy tutorials (Pereira et al., 2013). Personalized desktop help (Pereira et al., 2013) is also useful to engage respondents although it may significantly increase implementation costs. Making simple and attractive tutorials using video, for example, could be a less burdensome way of providing respondents instructions for survey completion. The provision of helpline support to participants should also be considered in these surveys, although it reduces the cost advantages associated with the implementation of smartphone and web surveys.

Devising algorithms that either, reduce the need for validation, or reduce the amount of time dedicated to these tasks, is a relevant research direction which should run parallel with the development of more precise algorithms for inferring trip extremes, routes, mode and purpose.

This activity could be pursued by comparing pre-validated and validated data for each respondent. Also, although it could raise privacy issues, smart ticketing data could be used to validate smartphone surveys, although this would be limited mainly to public transport users.

The use of multiple sources of data to infer travel behavior (e.g. GPS traces and smartcard data) and the capabilities of algorithms to infer several relevant travel variables, opens the possibilities for surveys to focus more on understanding motivations, attitudes and perceptions of respondents, since the task of collecting a description of their behavior can be made using other data sources.

6. Conclusions

This workshop discussed a range of issues associated with respondent/survey interaction in completing web and smartphone surveys. These survey modes are becoming increasingly common data collection tools, each with their own particular challenges. In the case of smartphone surveys these relate to the quality of the collected data and the ability to infer relevant information without the need to ask questions of survey participants. Therefore this collection mode is still heavily dependent on complementary surveys for validation purposes. This increases respondent burden and can contribute to survey dropouts, thus reducing some of the potential advantages presented by passive measurement. Issues of privacy, sample bias and representativeness continue to be significant topics in the development of web and smartphone travel survey tools. In particular, the measurement of potential attitudinal differences between survey respondents and non-respondents with similar socioeconomic characteristics is necessary to ascertain sample bias.

Smartphone collected data can be easily and rapidly processed. As a result it is possible to provide respondents with feedback about their current behavior. This possibility can be used with two main objectives in mind. The first is aimed at keeping respondents engaged in the survey and reducing dropout rates. The second is related to the possibility of designing feedback aimed at changing individual behavior.

Furthermore, smartphone and web based surveys are being used at a time which also sees the emergence of multiple sources of data from an array of passive sensors. This prodigious amount of data could be used to infer travel behavior, thus creating the opportunity for surveys to concentrate on questioning individuals about their
motivations for pursuing specific types of behaviour, their perceptions and attitudes. Or, more simply, since big data has the possibility of allowing observation of “what people are doing”, surveys could focus on collecting more detailed information on “why they are doing it”. Relevant research challenges identified in the workshop discussion included:

- More in-depth research on respondent burden measurement and the extent of its impacts;
- Research on algorithms aimed at reducing respondent interaction in order to reduce respondent burden and/or devising techniques to make validation as easy as possible;
- Research on privacy, sample bias and representativeness of this mode;
- Research into how gamification and the provision of feedback to respondents might reduce respondent drop-out and improve survey acceptance;
- Research to define standards for Smartphone survey applications and create benchmarks that could be helpful in reducing development costs. The ability to build on previous work in this way will reduce the need to develop and conceptualize an application from scratch, and avoid repetition of design errors previously made by others.

A final consideration raised in this workshop was a challenge to the many and varied organisations undertaking simultaneous research into the development and refining of smartphone surveys and associated validation tools. There is still much to do to achieve a low burden, high data quality, passive data collection tool. Is there a way for developers to collaborate and build on each other’s successes and failures in order to reach this goal faster, or will we continue to see development replicate the efforts of others and move at a pace which may see the technology become obsolete before the full benefits can be realised?

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Appendix A. Papers presented during the workshop

A Web-Based Diary and Companion Smartphone app for Travel/Activity Surveys. Authors: Stephen Greaves, Richard Ellison, Adrian Ellison, Dean Ranee, Chris standen, Chris Rissel and Melanie Crane
The Netherlands Mobility Panel: An innovative design approach for web-based longitudinal travel data collection. Authors: Sascha Hoogendoorn-Lanser, Nina Schaap and Paul Van Beek
Design and usability concepts in a web-based prompted recall survey. Authors: Inês Dias, Francisco Pereira, Caitlin Cottrill, Fang Zhao, Chris Zegras and Moshe Ben-Akiva

Appendix B. Posters associated with the workshop

Household Survey of Intermodal Trips – Approach, Challenges and Comparison. Authors: Jörn-Ole Schröder, Martin Kagerbauer and Peter Vortisch.
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.
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