WEB-BASED ORIGIN-DESTINATION SURVEYS: AN ANALYSIS OF RESPONDENT BEHAVIOUR

Pierre-Léo Bourbonnais, Ph.D. Candidate, Department of Civil, Geological and Mining Engineering, École Polytechnique de Montréal, C.P. 6079, Station Centre-Ville, Montréal (Quebec) CANADA H3C 3A7, Phone: (514) 340-4711 ext. 4235, Email: leo.bourbonnais@polymtl.ca

Catherine Morency, Ph.D., P.Eng., Associate Professor, Holder of the Mobility Research Chair, CIRRELT and Department of Civil, Geological and Mining Engineering, École Polytechnique de Montréal, C.P. 6079, Station Centre-Ville, Montréal (Quebec) CANADA H3C 3A7, Phone: (514) 340-4711 ext. 4502, Email: cmorency@polymtl.ca

ABSTRACT

Using data from a web-based survey conducted in parallel with a phone-based travel survey, this paper focuses on respondent behaviour. It examines the features of web-based survey respondent's namely demographic features, withdrawal patterns, duration and temporal patterns of participation and how it compares with features of phone-based surveys.

Keywords: travel survey, web-based tool, respondent, survey duration

INTRODUCTION

Phone-based travel surveys are currently facing a set of issues with respect to their ability to fulfill their role. Decreasing response rates, reducing completeness of sampling frame based on phone numbers, increasing number of people solely owning cell phones combined to widespreading access to internet network is promoting the use of the web to reach various population segments and collect travel data.

In Quebec, large-scale travel surveys have been conducted for multiple years in the five main

metropolitan areas. These surveys have been conducted by phone since their first occurrence. CATI tools have been introduced in the mid-nineties but mentioned issues are increasingly challenging.

In this context, the Quebec Ministry of Transportation financed a study to experiment a web-based travel survey tool in the context of large-scale regional surveys to complement the classical phone-based approach. A first experience was conducted using a person-based survey (a single respondent per household) and a second one using a household-based survey (adaptation of the typical questionnaire administered through the phone in regional surveys). This paper focuses on the person-based experience.

This paper's objective is to analyse response behaviours during a web-based Origin-Destination survey. Hence, this research seeks to get a better understanding of the process of responding to a transportation web-based survey as well as observe differences in respondent behaviour when they are faced with a person-based or household-based questionnaire.

The web-based tool was previously presented by Bourbonnais and Morency (2013). This paper focuses on the respondent behaviour. Using a recent experience where a phone and web-based surveys were conducted concurrently, this paper seeks to get a better understanding of the respondent behaviour when faced with a web-based person questionnaire.

The paper is organised as follows. First, background elements related to travel surveys and the potential role of web-based tool are presented. Then, the web-based survey tool is briefly presented as well as the general project methodology. The case study is then presented, namely the study area, details regarding the regional phone survey and the experimentation conducted using the web. Then, results regarding respondent behaviour are presented. The research is then concluded.

BACKGROUND

Typical methods

There are three classical travel survey modes: face to face, by mail and by phone. Face to face surveys are known to provide high quality data from in-depth interviews. But, this comes at high price and low sample size. Moreover, they sometimes have difficulty reaching some population segments that are not available at typical survey periods or that do not accept to welcome strangers at their home. Mail surveys are self-administered and require less human resources. Mailing and post-processing, that can be more complex, are the main costs. Response rates are often lower than by phone for instance and the complexity of the question needs to be kept low to allow respondent to understand how to answer. Phone surveys are the intermediate solution:

they are interesting tradeoffs since they can provide high quality data and high sample size at a reasonable price. The complexity and length of the questionnaire has to stay reasonable also to maintain adequate duration and respondent burden. Still, their increasing occurrence on various topics, for public of private purposes, is making people less incline to participate.

Current challenges

Typical survey methods have been facing series of challenges in the recent years. For various reasons, it is becoming harder to gather travel data using classical survey methods and other methods are being examined to see how they can help in meeting the need for detailed and precise data on travel behaviours. Various trends and issues are contributing to this increasing need for varied and combined survey methods.

Cell phones. In many regions, at different scales, an increasing proportion of people are disconnecting from landline, choosing to depend only on their cell phone. Considering that many regions are basing their sampling frame on directory of residential telephone land-lines, it is becoming an issue since cell phones are rarely listed in phone directories, making this source less representative of the entire reference population. According to the 2010 Residential Telephone Service Survey of Statistics Canada, "*…in 2010, 13% of households reported they used a cell phone exclusively, up from 8% in 2008*". Moreover, 50% of Canadian Households aged 18-34 years reported exclusive use of a cell phone.

Response rates. Surveys have seen decreasing response rates. It is becoming harder to reach people and fewer accept to participate. Larger sampling frames are required to meet the required quotas. Various factors can explain this decline in response rate: increasing number of surveys and telemarketers, spreading use of call screening services or systematic availability of answering machines. Also, these figures are not necessarily uniformly distributed among the population. For instance, very active population in small households can be harder to reach at their home location. Resulting sample can be biased.

Also, the fact that phone survey relies on proxy responding is also identified as a drawback.

Advantages of web-based surveys

Bourbonnais and Morency (2013) summarize a list of advantages related to web-based tools:

- When development is complete, conducting the survey is at low cost and marginal cost is approaching zero (Armoogum et al., 2009);
- Survey is flexible : respondent can answer at the time of their convenience (Armoogum et al., 2009);
- Data availability can be fast and tools can include a large set of real-time validation, that can improve quality of collected data (Timmermans and Hato, 2009);

- The questionnaire can have various path depending on previously provided answers;
- It is possible to easily monitor the conduct of the questionnaire;
- Updating the questionnaire during survey administration is easy;
- Administration of the survey is easy and can be decentralised;
- It is possible to provide instant feedback to the respondent;
- A lot of surveys can be conducted simultaneously: limitations depend on server capacity;
- Interactivity with the respondent can be very high (Bonnel et al., 2009).

GENERAL METHODOLOGY

In the spring of 2011, the Quebec Ministry of transportation conducted its second large-scale household travel survey in the Trois-Rivières urban area, eleven years after the first occurrence. In parallel to the typical phone survey, a web experience was conducted to assess its potential to complement the classical method and to provide opportunity to fill the gaps in phone-based sampling.

Case study

The experience was conducted in the Trois-Riviere Region, Quebec. This region has an area of some 2000 square kilometers and a population of some 170000 people. The preset sample size for the phone survey was 10 000 households or some 13% of residing households (MTQ, 2012). Quotas were met.

The phone survey was conducted between March 15th and April 21st 2011. In parallel, the web-based survey started gathering data on April 5th and the last respondent filled the online questionnaire on October 15th. Hence, web-based data were concentrated between April 15th and May 5th.

Figure 8 present the study area as well as the resulting sampling rates for the phone survey. We see that sampling rates vary across space and that they are smaller in central areas. We will see, in the next sections, if patterns are similar or complementary in the web-based experience.

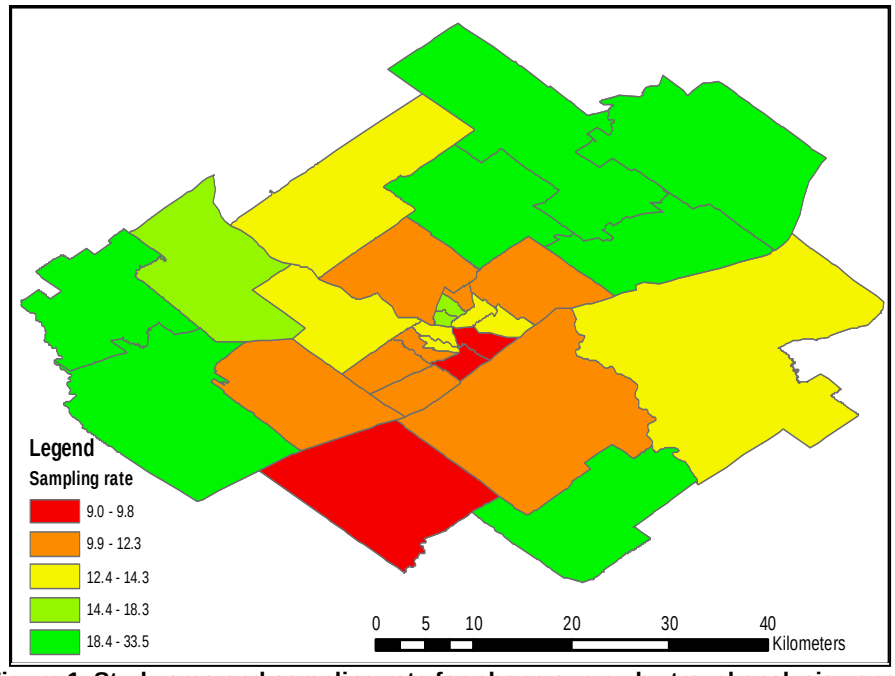

Figure 1. Study area and sampling rate for phone survey by travel analysis zones

Web-based survey: a prototype

In the fall of 2010, the research team administered a first web-based survey in a trip generator context. The first version of the web-based tool was inspired by the typical questionnaire used in large-scale travel surveys. This tool was adapted to fit the requirements of this project. The structure of the questionnaire is summarized in Figure 2:

- First, the welcome screen provides information on the objective and content of the survey; it also mentions the expected filling time: 10 to 15 minutes.
- Then, when a participant agrees to start the questionnaire, the first information gathered is its own characteristics (age, genre, main occupation).
- After, even if it is a person-based survey, some attributes of the belonging household are collected (number of people, number of cars, type of dwelling and availability of a landline) as well as home location (address – along with interactive map to pinpoint or validate the information).
- Then, some questions are asked with respect to available mobility tools: driving license, transit pass.
- Gathering of trips for one day of the weeks is afterward addressed:
    - First, a sorted list of all spatial location visited during the day is first developed;
    - Then, scheduling of the movements between these location is declared (time of departure from origin and arrival at destination);
    - Mode sequence is finally selected for each trip.

- An opportunity for the respondent to provide comments or answer to some opinion questions is finally offered.

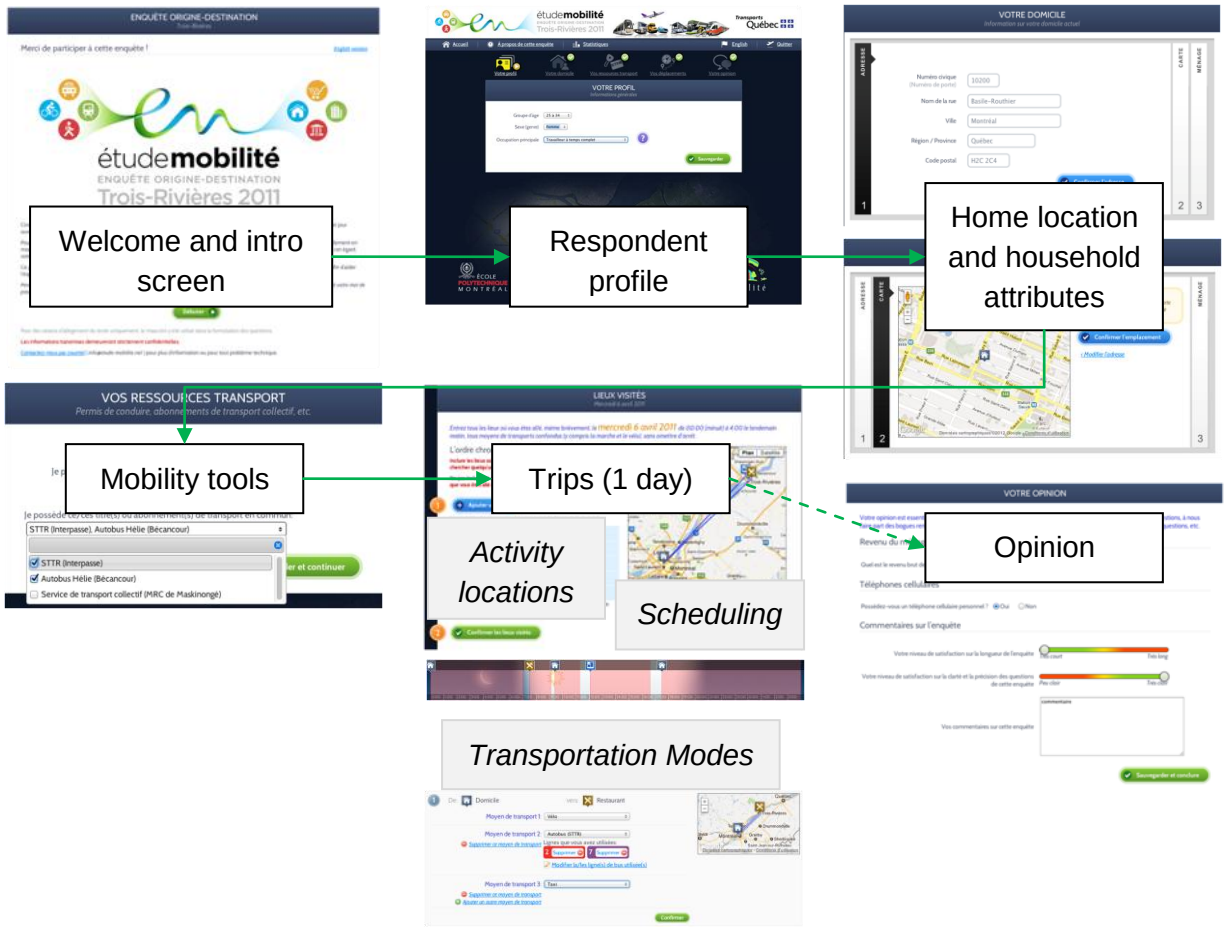

Figure 2. Structure of the web-based questionnaire

KEY FACTS ON THE WEB SURVEYS

Concurrent to the phone survey, a research project aiming to assess the opportunity of a web-based survey tool to complement the phone sample was conducted. Three recruitment methods were used to invite people to participate in the web-based survey. Table 1 summarises the scale of the sampling frame, the number of respondents as well as the number of days for which data on travels were collected. Recruitment methods were:

- Using a **list of cell phone numbers**, participants were invited to provide their emails to participate in a survey on travel behaviors. They then received an electronic invitation containing the required information to fill the online questionnaire. The list of cell phone numbers had, of course, to be acquired. Some 20% of those who where contacted accepted to participate and one third of them actually started the questionnaire.

- A **batch of address** from the sampling frame was dedicated to the recruitment of web-based respondent. **Letters** were sent with the required information. The experience was unfortunately slowed down and limited due to a strike at Posts Canada. Important delays in shipping were observed. Letters were sent to 1000 different addresses: some letters never reached their destinations and many were delayed. 55 interviews were started (app. 5,5 % of the complete sampling frame).
- One particular **student residence** was contacted to test how such population, who is typically excluded from landline based samplings, would respond to an email invitation. Little information is available regarding the realised process but it did not succeed.

Table 1. Sampling frame, number of respondents and sampled days of travel for each recruitment method

Recruitment method	Sampling frame	Respondents	Sampled days of travel
Cell phone	1644 persons contacted, 333 accepted to participate	109 interviews started	14
Mail	1000 contacted persons	55 interviews started	19
Trois-Rivières Cegep (email)	Unknown	8 interviews started	3
Total	*2644 contacted persons*	*172 interviews started*	*30 unique (all recruitment methods combined)*

ANALYSIS OF RESPONDENTS BEHAVIOUR

Various analyses are conducted to understand who are responding to web-based survey and how they are answering.

Who participates in the web-based survey?

Figure 3 compares the demographic composition of the phone and web samples of respondents with the reference population. We see that there young people are under-represented in phone surveys (15-34 years old), as respondents and that older people are over-represented (55 years and older). However, younger people are over-represented as respondents in the web-based survey while elderly are under-represented. From a population composition point of view, it seems that phone and web methods are complementary for population segments at both ends of the age spectrum.

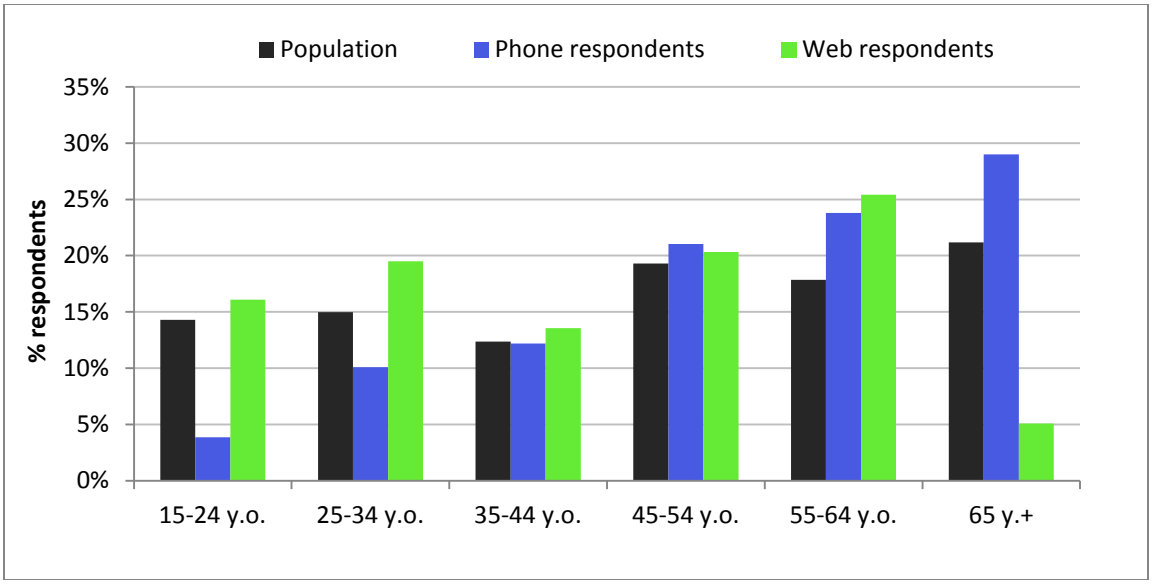

Figure 3. Comparison of population, phone sample and web sample composition

Are sample complementary in space?

In order to facilitate the comparison between sampling rate between the two surveys, normalised distributions are used. In these cases, the more the rates are approaching the mean value, the more their value will approach zero. If values are negative then they are lower than average and vice-versa. Figure 4 presents the normalised values for the two surveys, estimated at the analysis zones (28 zones)[1]. The objective of this graph is to detect if these surveys are complementary in space i.e, if lower sampling rates in one survey are combined with higher sampling rate in the other survey. Of course, it remains theoretical for now due to the low sample available for the web survey but if provides insight into potential results at larger scales. We actually see reverse patterns for some zones (1, 3, 6, 8, 10, 11, 13, 18 and 21 for instance). The analysis only focuses on the respondent (and not the entire population reached by both surveys) but it seems that complementarity is occurring in some areas, at various scales. It is of course directly related to the demographic composition of the zones and knowing which segments are more inclined to answer to web or phone can assist in the development of combined, more efficient sampling frames.

[1] The average sampling rate per zone as well as the standard deviation of this value is used for the estimation

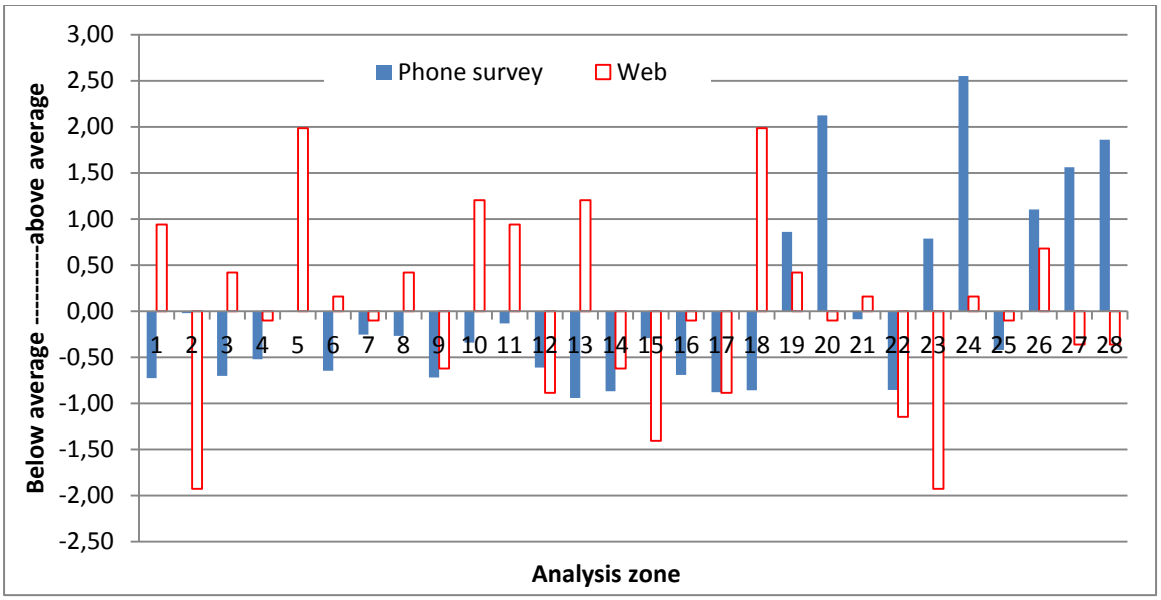

Figure 4. Normalised values for sampling rates in each analysis zone for both surveys

How many and when do respondent quit?

After recruiting people, it is important to make sure that they will participate and complete the survey. Table 2 provides statistics on the proportion of interviews that were completed, after initiation. Completeness rates are rather interesting, above 85% for cell phone and mail recruitments. Figure 5 helps understand at which phase of the questionnaire, respondents are choosing not to move on and complete it. It is easy to predict that the declaration of trips is the most burdening among travel surveys. And this is the case, notwithstanding the survey mode. For this web-based survey, some 5% of respondent withdraw at the beginning, when questions on home locations are asked. Then, an additional 8% is withdrawing at the trip screen.

Table 2. Sampling frame, number of respondents and sampled days of travel for each recruitment method

Recruitment method	Started interviews	Completed interviews
Cell phone sample	109	96 (87%)
Mail sample	53	45 (85%)
Trois-Rivières Cegep	8	5 (63%)
Total	*170*	*146 (86%)*

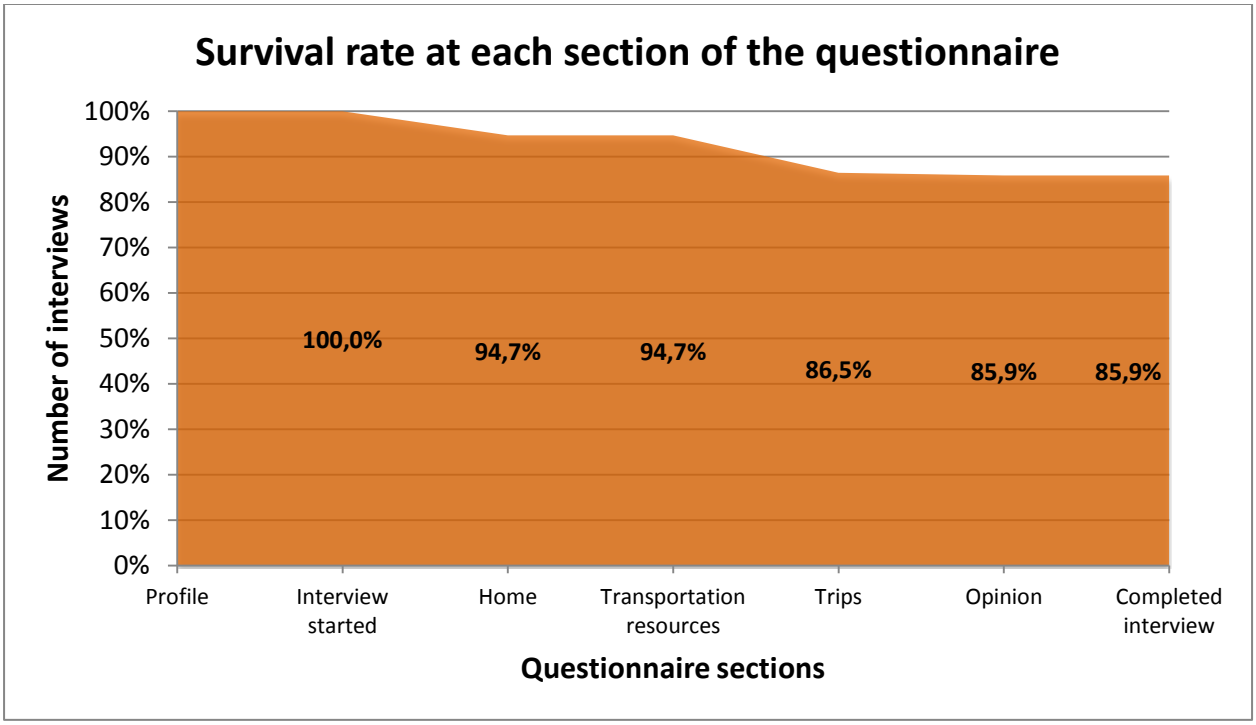

Figure 5. Withdrawals at each phase of the questionnaire

When do they fill the questionnaire?

The phone survey requires interviewers to call potential respondent. For the examined survey, interviews were conducted from Tuesday to Friday between 3:00 and 9:00 pm and on Saturdays from 10:30 am to 4:30 pm. Some argue that web survey provide higher flexibility to the respondent by allowing them to choose the best time for them to fill the questionnaire.

Figure 6 shows the temporal distribution of web surveys starts and ends. If we compare with the typical hours for phone interviews during a weekday, we see that a significant proportion of questionnaires are filled online outside this time frame (more than 56%). And some people choose to answer almost at any time of the day.

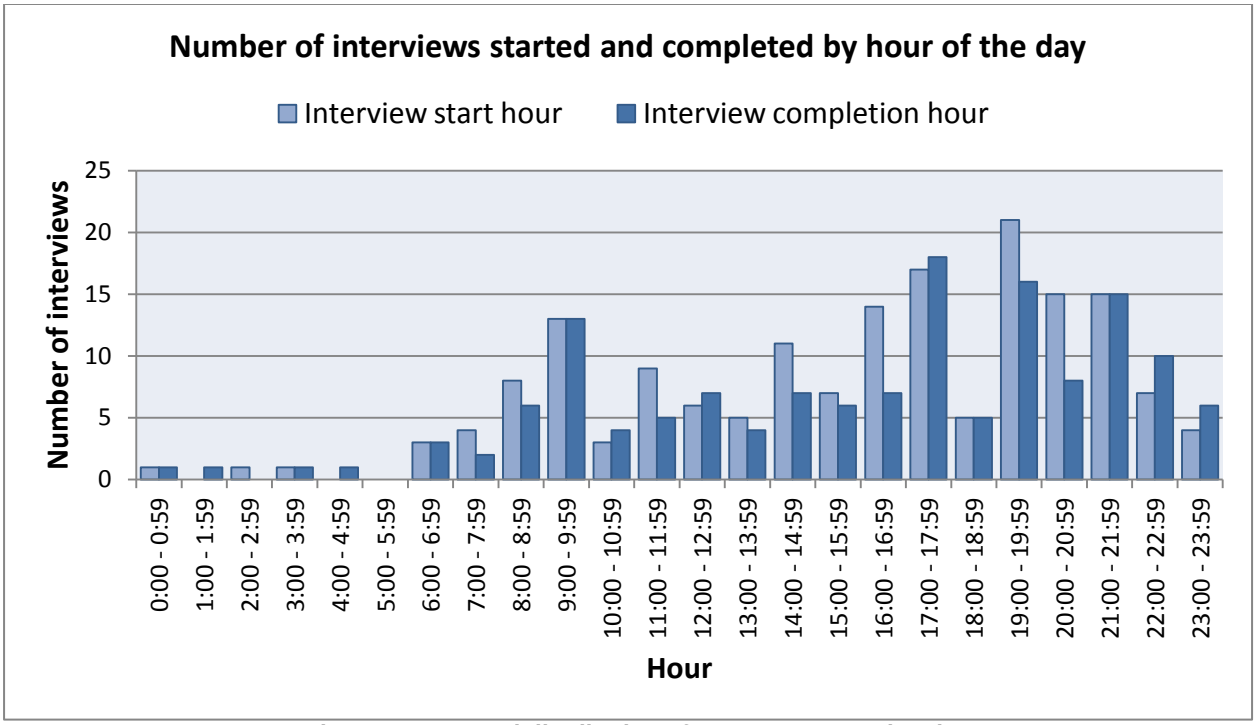

Figure 6. Temporal distribution of survey starts and ends

How long does it take to fill the questionnaire?

One of the questions raised with respect to the application of the web for travel survey is the time required to fill the questionnaire. Burden needs to stay acceptable from a respondent point of view or sample size will decrease and withdrawal rates will increase. Figure 7 presents the average survey duration by age group. It needs to be mentioned that measuring the duration of an online survey is not necessarily an easy task. Actually, this medium allows respondent to multitask, leave the survey for other purposes but keeping the browser open for eventual completion, etc. The following durations exclude all interviews which duration exceeded 40 minutes for this reason. We see that mean duration varies between 7.8 and 16.9 minutes. It is within expected brackets. Mean phone survey duration is around 12 minutes, for an entire household. It seems that answering through web takes longer. However, preliminary results on the comparison of travel behaviours show that people declare more trips on the web than on the phone. This would partially explain the longer duration.

With the available data, it will be possible to develop a model aiming to link duration with respondent features and travel behaviours (trips rate, travel modes, etc.). Figure 8 shows one application of detailed monitoring of the conduct of web interviews. It is possible to reconstruct the temporal structure of each survey and to see what proportion of the time was allocated to each task. Further analyses will be conducted using these data.

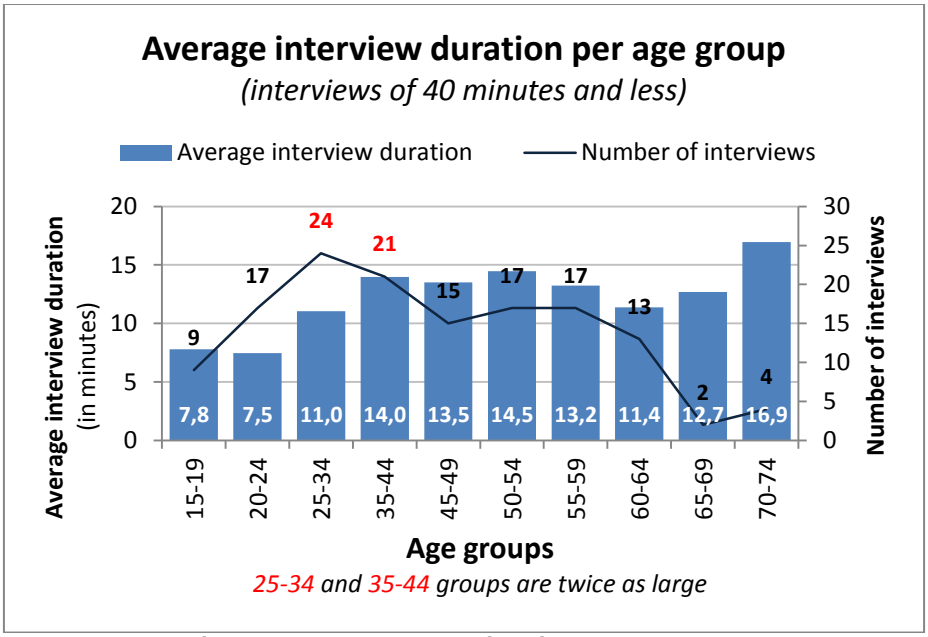

Figure 7. Average survey duration per age group

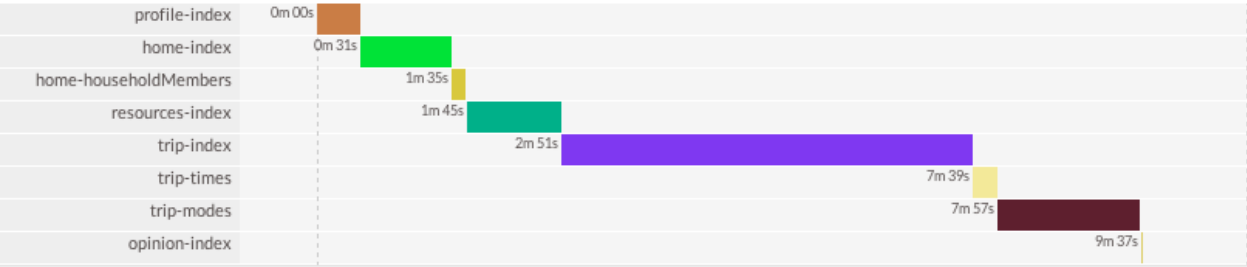

Figure 8 : Temporal structure of one survey

CONCLUSIONS

This paper has provided some figures on respondent behaviour in the context of a regional web-based travel survey. It has confirmed that:

- Younger cohorts are more inclined to act as respondent in web surveys that in phone surveys;
- Phone and web surveys can be complementary with respect to segments they attract;
- An important element in web based survey is how to recruit people; when they start the questionnaire, their withdrawal rate remains low.
- Travel related questions are the more complex and are responsible for most of the withdrawals.
- Web-based surveys provide more flexibility with respect to when respondent decide to participate.

ACKNOWLEDGEMENTS

The authors would like to thank the Ministère des transports du Québec (Service de la modélisation des systèmes de transport) for their support and contributions. We also wish to thank the technical committee on O-D travel surveys in the Montreal region for providing access to data for research purposes.

REFERENCES

Agence Métropolitaine de Transport. (2010). Origin-Destination Survey: 1998, 2003 and 2008 Retrieved April 11, 2010, from http://www.amt.qc.ca/agence/mobility_profile/od_survey.aspx

Armoogum, J., W. Axhausen, K., Madre, J.-L. (2009) Lessons from an Overview of National Transport Surveys, from Working Group 3 of COST 355: " Changing Behavior Toward a More Sustainable Transport System", in Transport Survey Methods: Keeping Up with a Changing World, Emerald. pp.621-634.

Bonnel, P., Lee-Gosselin, M., Madre, J.-L., Zmud, J. (2009). Keeping Up with a Changing World: Challenges in the Design of Transport Survey Methods, in Transport Survey Methods: Keeping Up with a Changing World, Emerald. pp.3-13.

Bourbonnais, Pierre-Léo, Morency, Catherine (2013). Web-based travel survey: a demo, in Zmud, Lee-Gosselin, Carrasco and Munizaga « Transport Survey Methods: Best Practice for Decision Making », Emerald, Chapter 10.

MTQ (2012). Informations on Trois-Rivieres origin-destination surveys, http://www.mtq.gouv.qc.ca/portal/page/portal/ministere/ministere/recherche_innovation/modelisation_systemes_transport/enquetes_origine_destination/trois_rivieres

Statistics Canada (2010). 2010 Residential Telephone Service Survey, http://www.statcan.gc.ca/daily-quotidien/110405/dq110405a-eng.htm, page consulted December 11h, 2011.

Timmermans, H.J.P., Hato, (2009) E. Electronic Instrument Design and User Interfaces for Activity-Based Modeling, in Transport Survey Methods: Keeping Up with a Changing World, Emerald. pp.437-461.