Acceptability of the use of new technologies by interviewees in surveys

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Abstract:
Mobile communication and positioning technologies including the Global Positioning System (GPS), the Global System for Mobile communications (GSM) and Radio Data System (RDS) have advanced rapidly and their costs are decreasing. They demonstrate great potential as survey instruments for tracking individual mobility and travel behaviour, by enabling to conduct surveys for longer periods and providing more accurate data on the spatial and temporal frameworks of travels. Beside these improvements, the utilisation of new technologies may reduce respondent burden and the survey cost which should have first-class impacts on data accuracy and quality.
Moreover, the relatively low burden for the respondent allows substantially extended survey duration: at least one week with GPS, compared to one day with the conventional questionnaire.
We took the opportunity of the French National Travel Survey to have the first nationwide experience with embedding such a “GPS package” in a traditional survey, with a sub-sample of approximately 750 voluntary interviewees. The main problem is that, those who are willing to participate in a GPS based-survey have a particular profile e.g. GPS survey participation is positively correlated with higher education, higher income and therefore higher access to cars and greater mobility. This means that when we ask interviewees to use new technologies in surveys we should face non-ignorable nonresponse.

Keywords
Global Positioning System, travel survey, acceptability, non-ignorable nonresponse

The French National Travel Survey
Once per decade, the Ministry of Transport and the National Institute of Statistics use to conducting a National Household Travel Survey with the scientific support of INRETS. It is the data source providing the most transverse and consistent overview of mobility, whatever the modes and the transport situations of people living in France may be. The 2007-2008 one has started on May 1st. The aim of these surveys is the description of short and long distance trips made by households living in France, as well as their access to and use of public and private transport means. Figure 1 gives an overview of French National Travel Survey (FNTS 2007-2008).

The survey is organized around the three following topics:
• Description of trips;
• Vehicle ownership and use;
• Accessibility to public transport.
Six survey instruments are used:

1. During the first visit a CAPI questionnaire is designed to collect at household level (including household members) the socio-demographic variables, characteristics of commuting trips to work, school or kindergarten; driving licenses and car use, traffic accidents; season tickets and discounts in public transport; description of vehicles available in the household and the housing environment;
2. A 7-days vehicle diary is attributed to one of the household's vehicles (selected with unequal probability distribution to give more chance to be drawn to motor two wheelers, which are particularly interesting on the point of view of road safety) to be filled by the vehicle users;
3. During the second visit, a "Kish" individual above 6 years old, selected with unequal probability distribution giving more chance to highly mobile persons, is asked to describe her/his long distance trips made during the last three months (as recalled from memory);
4. The same "Kish" person will describe her/his trips made one weekday before the interview, and one weekend day (either Saturday or Sunday);
5. A sub-sample of approximately 1300 individuals will fill a biographical grid in order to describe the transport means used throughout their whole past life;
6. A sub-sample of approximately 750 volunteers will be given a GPS receiver.
The sample size is about 19,000 responding households (including 5 regional add-ons). Data collection is spread over six waves covering 12 months, in order to neutralize the seasonal variations which affects mobility (especially for long distance travel). Taking into account the overall length of the interviews (approximately a total of 115 minutes), the data will be collected in two visits. This double date also makes it possible to distribute the vehicle diary and the GPS receiver (for volunteers) at the first visit, and to collect them at the second one.

Limitations due to the general scheme of the GPS in the FNTS and the GPS units selected

As the FNTS is being running on a full year (from May 1st 2007 to April 30 2008) and we will have about 450 interviewers (an interviewee will not “stay” a full year on the FNTS) and we have bought 170 GPS receivers therefore we had to put a strategy to attend the goal of 5% of the FNTS sample with the GPS component.

The large number of interviewer means that we have to manage a large number of laptop that was supposed to be identical in term of software level. After a time of learning the GPS component the interviewers handle it correctly and are quite proud of using new technologies and showing to the interviewees their high quality.

For road safety reasons and to avoid an influence of GPS on travel behaviour, it is a passive monitoring tool: the respondent has no graphical interface. It has only one button (on/off). The respondent has the possibility to skip some trips, if desired for confidentiality reasons. In the FNTS, data are recorded every 10 seconds. No data are transmitted on real-time: the device is only a datalogger. Data are downloaded to the interviewer's laptop during the second visit, and deleted inside the unit.

2. Bias in transport surveys vs GPS-based surveys

Data accuracy is a combination of sampling errors and non-sampling errors. Therefore it is not obvious to compute confidence interval due to the non-sampling errors such as non response errors and measurement errors. Because respondents are often not able to describe exhaustively their travel behaviour and have a vague or even biased perception of the main characteristics of their trips (for instance the distance travelled). Interviewees are generally unable to describe their mobility with the accuracy suggested in the questionnaire (e.g. in the FNTS 2007-2008, 1 min for departure and arrival time, 1 km for car annual mileage and in the car diary). For most analysis we do not need so much accuracy, but we have to be aware that roundings modify variables' distributions (for example see the figures 2; 3 & 4). Summarizing the main findings obtained by comparing different instruments used in previous NTSs, it appears that:

- Time variables are less rounded when reported in diaries than when collected by interview;
- Fortunately, memory effects affect time (of departure or arrival) more than duration, which needs to be known more accurately especially for modeling;
- The deterioration due to memory obviously increases when the facts reported have occurred a long time before the interview (during the last weekend or three months ago);
• The car-diary is more accurate than the other methods, probably because of the clock which is displayed on most car boards.

**Figure 2: minutes of departure time across the day**

![Graph showing minutes of departure time]

Sources: INSEE, French NTS 2007-08

**Figure 3: minutes of arrival time across the day**

![Graph showing minutes of arrival time]

Sources: INSEE, French NTS 2007-08

**Figure 4: trip duration (arrival date – date of departure)**

![Graph showing trip duration]

Sources: INSEE, French NTS 2007-08
In many surveys concerning car use a question is asked on the mileage driven on different types of network (generally motorways, urban networks and normal roads). Often it is only a yearly proportion, but it is sometimes more precise (e.g. during one week in the SECODIP panel). But households are reluctant to answer questions on types of network used, because they have a too vague idea of real figures, in the main part of the FNTS 2007-2008 we will derive this information from origin/destination through a network assignment software. The sub-sample of GPS data will allow to check for the quality of this assignment.

However a GPS datalogger allows the measurement of some details that are never given by respondents in conventional surveys:

- Description of very short trips, which are often forgotten;
- Route choice;
- Precise information on access/egress time and waiting time;
- The description of short trips made from an unusual place of residence (e.g. during holidays or long professional trips).

Moreover, the relatively low burden for the respondent (once she/he is trained) allows substantially extended survey duration: at least one week with GPS, compared to two days with the conventional questionnaire. The gain in accuracy is less because of cluster effect (travel patterns are quite similar on weekdays for the same person).

We should point out, that there are some drawbacks such as:

- A device problem such as energy (battery last about 15 hours);
- A signal reception problem;
- A problem from the interviewee, for example:
  - The interviewee may forgot to take the GPS receiver with him (for some trips; some days, ...);
  - The interviewee may borrow the GPS receiver to another person;
  - The interviewee may want “to play” with the device and therefore we record more trips than it should be.

But the last item may happen also in “conventional” survey, especially in face to face interview, where the selected individuals want to appear socially well integrated and therefore may not describe what they think it is not acceptable and may invent some other records.

3.1. Acceptability of the GPS component in the FNTS

In small scale study on GPS the interviewer have generally a large degree of freedom to “choose” those who are willing to cooperate and therefore this rate of participation is much higher than in a large random case study. This clearly means that we have to pay attention in the weighting procedure to the non-response mechanism (is this due to socio-demographics or due to the mobility behaviour of the interviewees?). As we will have the behaviour (of the same individual) with the FNTS, it should be interesting to analyze the type of non-response, ignorable or non-ignorable we gathered in large scale GPS study.

In the FNTS questionnaire we have a question on the acceptability of the GPS component (with the following possible answers: “Yes, without condition”; “Yes, if it’s possible to turn it off”, “Yes, but with other condition” and “No”). Among the responses of the FNTS the “No” had 66% and the “Yes, but with other condition” had 1,2% which is rather different from the
FNTS pilots and other small scale study on GPS, about 60% in the FNTS pilots (with about 200 Households) and about 50% in the test on 200 Households conducted in Lille by ISL. Among the households that said “Yes, without condition” or “Yes, if it’s possible to turn it off” in the FNTS when the interviewer propose them a GPS 19% refuse the receiver (12 out of 63). Higher income households would accept more a GPS survey, as well as those having at least two cars. The participation would be more important for households equipped with a computer or a cell phone. The men and in general the young people would agree to participate in a GPS survey. The farmers and the artisans, dealers or business managers would be less willing to collaborate in a GPS-based survey. The most embarrassed persons to move, as well as those with a bad health would not wish to take a GPS during all their trips. The lower the number of short or longer distance trips, the lower the participation in this type of survey.

**Table 1: Results of the logit model on the acceptability**

<table>
<thead>
<tr>
<th>Model Fit Statistics</th>
<th>Intercept Only</th>
<th>Intercept and Covariates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criterion AIC</td>
<td>24193.976</td>
<td>22455.323</td>
</tr>
<tr>
<td>Criterion SC</td>
<td>24201.807</td>
<td>22690.239</td>
</tr>
<tr>
<td>Criterion -2 Log L</td>
<td>24191.976</td>
<td>22395.323</td>
</tr>
</tbody>
</table>

**Testing Global Null Hypothesis: BETA=0**

<table>
<thead>
<tr>
<th>Test</th>
<th>Khi 2</th>
<th>DF</th>
<th>Pr &gt; Khi 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likelihood Ratio</td>
<td>1796.6537</td>
<td>29</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Score</td>
<td>1611.4164</td>
<td>29</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Wald</td>
<td>1402.3764</td>
<td>29</td>
<td>&lt;.0001</td>
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</tbody>
</table>

**Analyse des effets Type 3**

<table>
<thead>
<tr>
<th>Effet</th>
<th>DF</th>
<th>Khi 2 de Wald</th>
<th>Pr &gt; Khi 2</th>
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</thead>
<tbody>
<tr>
<td>Income</td>
<td>4</td>
<td>11.7272</td>
<td>0.0195</td>
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<tr>
<td>Household car fleet</td>
<td>3</td>
<td>63.7589</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Household with computer</td>
<td>1</td>
<td>47.1339</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Household with mobile phone</td>
<td>1</td>
<td>19.2039</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Age groupe</td>
<td>5</td>
<td>300.0219</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Gender</td>
<td>1</td>
<td>19.8963</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>General health</td>
<td>3</td>
<td>17.3687</td>
<td>0.0006</td>
</tr>
<tr>
<td>Number of trips (made the day before)</td>
<td>4</td>
<td>95.3180</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Number of long distance journeys</td>
<td>3</td>
<td>53.7495</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Strate</td>
<td>4</td>
<td>108.3757</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Sources: INSEE, French NTS 2007-08
A logit model shows the influence of each dimension, all else being equal. The logit model shows the willingness to participate in a GPS-based travel survey, and the results show:

- Income, those with high income are more willing to participate;
- Household car fleet, high number of car is correlated with participation;
- Household with high-tech equipment (computer, mobile phone) are more disposed to participate;
- Age, younger person are more enthusiastic to be in GPS-based travel survey;
- Gender, the female are more reluctant to such survey;
- General health, people with bad health do not want to contribute;
- Mobility (number of trips short and long distance), low mobile person are reluctant to join in such survey;
- Strata, people living in high density area are more disposed to be involved in such project.

As the level of mobility (number of trips) is correlated with the participation, in a large scale survey we need to care in the nonresponse correction. Indeed the nonresponse mechanism is non-ignorable.

**Conclusion**

GPS is certainly a promising technology for surveying travel behaviour, because it provides much more accurate spatial and temporal data than conventional methods. But raw data are not directly usable:

- Traces are not segmented;
- There are missing segments;
- There is information neither on transport means nor on trip purposes.

Thus, for post-processing these data, more or less sophisticated software packages have to be elaborated depending on the accuracy needed by the users (e.g. much more spatial accuracy for the assessment of advertising by posters than for other users of travel survey results).

The introduction of a large scale sub-sample of follow-up by GPS in a conventional National Travel Survey prepares the transition toward more use of cheaper new technologies, which are less burdensome for the respondent and allow surveying on a longer period. Our experimental design takes advantage of the general characteristics of a long survey (with two face-to-face interviews) to get through the CAPI-GPS additional information on the reliability of the device and on more detailed characteristics of a few trips, which will be useful for the calibration of the post-processing software. However, this experience can hardly be generalized, if the response rate remains so low. A first analysis will show the characteristics of the individuals who have accepted to carry the GPS unit during the one to two weeks survey period.

The comparability with previously collected data is essential for the assessment of long term trends. The FNTS 2007-2008 is designed to prepare correctly for this transition. Moreover, the comparability with data collected in the other countries is also important. EUROSTAT harmonizes several surveys in most of Member States in Europe (e.g. on time use or family expenditure), but nothing seems to be planned for surveys on daily mobility.
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References