INTEGRATED SURVEY DESIGN FOR A HOUSEHOLD ACTIVITY-TRAVEL SURVEY IN CENTRE COUNTY, PENNSYLVANIA

Michael L. Patten*
Center Manager
Transportation Survey Research Center
The Pennsylvania Transportation Institute
The Pennsylvania State University
201 Transportation Research Building
University Park, PA 16802-4710
Tel: (814) 863-0572
Fax: (814) 865-3039
E-mail: mlp2@psu.edu

Konstadinos G. Goulais, Ph.D.***
Professor
Department of Civil and Environmental Engineering, and
Director
Mid-Atlantic Universities Transportation Center
The Pennsylvania State University
201 Transportation Research Building
University Park, PA 16802-4710
Tel: (814) 863-7926
Fax: (814) 865-3039
E-mail: kxg2@psu.edu

Centre SIM3 Report

Submitted to McCormick Taylor Associates and Mid-Atlantic Universities Transportation Center

University Park, PA, 2004

*** He is now a professor at the University of California Santa Barbara. Email: goulias@geog.ucsb.edu

This report is re-issued as
GEOTRANS 2004-03-01
INTEGRATED SURVEY DESIGN FOR A HOUSEHOLD ACTIVITY-TRAVEL SURVEY IN CENTRE COUNTY, PENNSYLVANIA

ABSTRACT:
In this paper we outline an integrated method for conducting a household activity-travel survey that was used successfully in a household survey of Centre County, Pennsylvania. This method incorporates elements of the Dillman-tailored method and the Socialdata-KONTIV design with concepts developed by the Penn State study team. The procedure followed in the survey consists of a first stage of contact and introduction to the study, mailing of survey materials, and a series of reminders and clarifications. The entire process culminates with post-survey thank you letters, summary of the findings to the respondents, and a gift certificate reward structure. Our experiments with the Dillman-tailored method and the Socialdata-KONTIV design and survey administration are extremely encouraging and a testimony to the good design advocated by both traditions. The survey experienced a response rate of 38.8 percent for the household questionnaire portion of the survey and 28.5 percent for the diaries. Within each of these two response rates, however, we find specific segments and a sequence of actions that yield a response rate as high as 68.8% and a series of actions during survey administration that aid achieving this rate confirming the suggestions offered by researchers in Europe and Australia suggesting we should change the requirements for surveys in the U.S.
INTEGRATED SURVEY DESIGN FOR A HOUSEHOLD ACTIVITY-TRAVEL SURVEY IN CENTRE COUNTY, PENNSYLVANIA

INTRODUCTION

Collecting data via surveys, especially by mail, is a complex and expensive (in both time and money) undertaking. In order to maximize the return on the limited resources usually available to researchers, highly detailed systems have been developed to encourage participation in surveys. For example, Dillman (1) has developed the Tailored Design Method (originally called the Total Design Method) based on concepts of social exchange theory. Surveys utilizing Dillman’s process should be designed around the following three key elements:

1. Establish trust with the respondent (e.g., provide a token of appreciation in advance, make the task appear important, show sponsorship by legitimate authority);
2. Increase the respondents’ expectation of receiving a reward from participation (e.g., show positive regard, say thank you, give tangible rewards, make questionnaires interesting); and
3. Reduce the social costs to the respondent (e.g., avoid subordinating language, make the questionnaire short and easy, and minimize requests for personal information).

In the realm of transportation-related surveys, several design concepts have been developed incorporating ideas similar to Dillman’s as well as the experience of the researchers involved. Brög, in his Socialdata-KONTIV Design (2), begins with the premise that in good survey design “the researchers must adjust to the respondents, not the respondents to the researchers.” The Socialdata-KONTIV design uses questionnaires and activity diaries that are simple in design and layout, minimize involved definitions and instructions, and stress the collection of “complete information instead of formally correct” information. The Socialdata-KONTIV design also incorporates a high level of contact with the respondents through multiple mail and telephone contacts. This design, however, contains a travel diary instead of the more recent activity diaries that we need for the application in our survey. Activity surveys require a somewhat different design because of the additional respondent burden and the sensitivity of the questions.

Additional recent research has found that the day-planner booklet format is extremely useful for time-use and activity diaries (3,4,5). The reasons reported for this include: flexibility, simplicity of completion, greater detail of the answers provided, and user-friendliness.

To summarize, a good design for a household activity-travel survey should incorporate the following concepts:

• The researcher should design the survey for the respondents;
• Survey instruments should be written in simple language and be easy to understand and complete;
• The research should establish trust with the respondents;
• Respondents should receive a reward from participation;
• The costs to the respondent should be minimized; and
• The day-planner booklet format is the most useful design for activity diaries.

In this paper we discuss a new method to maximize participation in travel-related surveys created by a team at the Transportation Survey Center, which is a unit within the Mid-Atlantic Universities Transportation Center at Penn State University. This method is based on the concepts discussed above and recent positive experiences with surveys for the Pennsylvania Turnpike Commission and the Pennsylvania Department of Transportation.

The procedure followed in the survey consists of a first stage of contact and introduction to the study, mailing of survey materials, and a series of reminders and clarifications. The entire process culminates with post-survey thank you letters, summary of the findings to the respondents, and a gift certificate reward structure.

THE STUDY

Between November 23, 2002 and May 30, 2003, the Penn State study team conducted a survey of Centre County, Pennsylvania residents to collect data about the county’s households and the activities of the household members. The survey is designed to meet the data needs of a multiyear model building research effort called CentreSIM (6), provide data for long range planning by local agencies, and to aid a Pennsylvania Department of Transportation (PennDOT) study known as the South Central Centre County Transportation Study (SCCCTS) area study. The household activity-travel survey covered the entire Centre County and also included residents that work...
in Centre County and reside elsewhere. The data from this survey will fill a critical gap in knowledge about Centre County and will provide the necessary information to develop models that can be used in regional simulation software necessary for forecasting and for alternatives exploration.

Each participating household was asked to provide, on a volunteer basis, information about household composition and facilities available to the household members. In addition, each household member was also asked to provide personal information such as employment status, educational level, and typical mode of travel to work or school. Activity and travel data were also collected from each person in the household using a two-day complete record of the activities in which each person engaged and the different transportation options taken. The survey also included a few questions about opinions and perceptions regarding the Centre County transportation system.

The Study Area
The survey was conducted in Centre County, Pennsylvania. This county, with an estimated 2001 population of 135,940 (7), is located in the geographic center of Pennsylvania. Centre County is predominately rural although State College borough and its adjacent areas have experienced a significant amount of urbanization. The University Park Campus of The Pennsylvania State University with more than 41,000 students and 11,000 faculty and staff (8) is also located in Centre County. The primary mode of travel in the county is motor vehicle although State College and the Penn State campus are well served by public transportation. The area immediately surrounding the Penn State campus also experiences a high level of foot and bicycle traffic.

SURVEY MATERIALS
The materials for the survey were divided into two components. The first component included those related to the household information survey (household questionnaire) and the second those related to the activity-travel diaries. Each group of materials is described below.

Household Survey Materials
The materials included in the household survey were:

• A cover letter describing the project and the purpose of the survey. It also provided a point of contact for additional information about the survey.
• A “Project Synopsis and Informed Consent Form,” as required by federal regulations, providing a point of contact for questions about the survey, describes the purpose of the survey, explaining any risks and/or benefits of participation, describing the confidentiality procedures, and indicating that the survey is voluntary.
• The questionnaire (survey instrument) was used to collect the data necessary for the study. It is in booklet form and designed to minimize the effort required on the part of the respondent. The majority of questions were “close-ended.” Figure 1 displays example pages from the questionnaire.
• A business reply envelope was included in the packet to facilitate return of the completed survey forms.
• Contest Flyer describing the lottery (see below) and a contest entry card.

Figure 1 about here.

The questionnaire design paid strict attention to providing a clear, easy to read format that minimized the effort to complete it. For example, we used a large type font (14 point) and incorporated much empty space. We also utilized a vertical flow for the question layout. The questionnaire also requested the first names, ages, and occupations of each household member. This information was used to personalize the activity-travel diaries for each member.

Activity-Travel Diaries
The materials included with activity-travel diaries were:

• A cover letter describing the project and the purpose of the survey. It also provided a point of contact for additional information about the survey.
• A “Project Synopsis and Informed Consent Form,” as required by federal regulations, providing a point of contact for questions about the survey, describes the purpose of the survey, explaining any risks and/or benefits of participation, describing the confidentiality procedures, and indicating that the survey is voluntary.
• Two personalized activity-travel diaries for each household member. The diaries were for two consecutive days. Figure 2 displays an example of the diary format.
• A business reply envelope was included in the packet to facilitate return of the completed survey forms.
• Contest Flyer describing the lottery (see below) and a contest entry card.

Figure 2 about here.

As shown in figure 2, the activity-diaries utilized a modified day-planner format. The respondents were free to provide what level of detail they felt necessary. A key component of our method is the personalization of the diaries for each household member. The personalization consisted of two items. First, each diary has the name of the appropriate household member on the cover (figure 3). Additionally, we used four different diaries depending on the reported employment status of the members as follows:

- Employed (full- or part-time) outside the home—White cover
- Not employed outside the home—Peach cover
- Children age 18 and under—Blue cover
- University students—Blue cover

The four dairies were identical except for the color of the cover and an example diary that would be relevant to the subject’s demographic group. For example, the “employed” diary example shows an individual traveling to work, working throughout the day with a lunch break, travel home, and some other activities in the evening. The “university student” diary example, on the other hand, shows attendance at classes, study time, and work at a part-time job and the “child” diary shows time at school and participation in an athletic activity. Figure 3 displays an example of a diary cover with personalization and figure 4 a portion of the example from the “employed” diary example (Note: This is also fairly representative of the information contained in the returned completed diaries.).

Figure 3 about here.

Figure 4 about here.

THE LOTTERIES

As noted in the introduction, we incorporated a reward structure to encourage responses. We utilized two different reward structures each of which provided total prizes of $1,000 in gift certificates redeemable at the local shopping mall. During the remainder of this paper Lottery One refers to the period November 23, 2002 to March 6, 2003 and Lottery Two refers to the period March 7 to May 31, 2003. In both lottery pools a household was eligible to win a prize if it returned a completed household questionnaire, completed diaries, and a contest entry card. The winners were randomly drawn from all the eligible households for that pool.

Lottery One: 2002
The first lottery was used during the first survey period of November 23, 2002 to March 6, 2003. A total of $1,000 in gift certificates was awarded as follows:
- 1 Grand Prize of $500 in gift certificates
- 2 Second Prizes each for $150 in gift certificates
- 4 Third Prizes each for $50 in gift certificates

Lottery Two: 2003
The second lottery was used during the second survey period of March 7 to May 31, 2003. A total of $1,000 in gift certificates was awarded as follows:
- 4 First Prizes each for $150 in gift certificates
- 8 Second Prizes each for $50 in gift certificates
SAMPLE SELECTION

The sample for the survey was drawn from several pools. The first was a database of 46,448 household addresses in Centre County purchased from a commercial mailing list vendor in early October 2002. This list provided the name of the current resident, the complete mailing address and in many cases the telephone number. This list has, however, two weaknesses. First, it does not include households that have made formal requests to be removed from mailing lists. This weakness had to be accepted since there is no other legal way to gather these addresses.

The second weakness results from the highly transient nature of the 40,000 students attending the University Park campus of Penn State University. The study team was able to alleviate this problem by using student address lists available through Penn State. The following three address lists of students where acquired: students residing in on-campus housing, students living off-campus, and students living in Penn State operated family housing.

In addition to the above mailing lists, a fifth one was obtained from Penn State. This list contained University Park Campus employees of Penn State who reside outside of Centre County. It was important to include members of this group in the sample since they commute longer distances to work.

We randomly selected a sample from each pool. There was not enough information to ensure that the sample units selected was representative of the Centre County residents. Table 1 shows the size of each pool and the sample selected from each.

<table>
<thead>
<tr>
<th>Subject Pool</th>
<th>Size of Pool</th>
<th>Number Selected</th>
<th>Percent of Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Database</td>
<td>46,448</td>
<td>6,700</td>
<td>68.8%</td>
</tr>
<tr>
<td>Penn State Students Residing On-Campus</td>
<td>12,714</td>
<td>1,200</td>
<td>12.3%</td>
</tr>
<tr>
<td>Penn State Students Residing Off-Campus</td>
<td>17,942</td>
<td>1,200</td>
<td>12.3%</td>
</tr>
<tr>
<td>Penn State Students Residing in PSU Family Housing</td>
<td>402</td>
<td>140</td>
<td>1.4%</td>
</tr>
<tr>
<td>Penn State Employees Residing Outside Centre County</td>
<td>1,464</td>
<td>507</td>
<td>5.2%</td>
</tr>
<tr>
<td>Totals</td>
<td>78,970</td>
<td>9,747</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Subject Pool for Lottery One: 2002

The subject pool for Lottery One was comprised of the 6,700 households selected from the purchased database. Initially, as described below, the study team mailed survey materials to the 1,478 households for which no telephone number was available. The remaining 5,222 were to be contacted by telephone. Of these 821 were contacted by telephone. There was no contact with the remaining 4,401 households were not contacted during the Lottery One portion of the survey.

Subject Pool for Lottery Two: 2003

The subject pool for Lottery Two included the 4,401 households remaining from Lottery One plus the two groups of Penn State students, the households residing in the Penn State family housing, and the Penn State employees. In total, 7,447 households were included in this phase.

THE SURVEY PROCESS

The study team recruited households via two mechanisms: telephone and mail. The processes used for each are outline below.

Phone Recruiting

The study team called households for which there was a telephone number available. If the call was answered the team member asked to speak with the head-of-the-house or another responsible adult. The purpose of the study and
survey was explained and participation requested. If the household declined to participate they were removed from the respondent pool. If they agreed to participate, they were asked to provide the names, ages, and employment status of all members of the household. This information was used to produce the personalized diaries. The respondent was informed of the days on which they would participate and their mailing address verified. The appropriate diary materials were produced and mailed the next day.

Those numbers with no answer were rescheduled to be called at a later date. When an answering machine was reached, an appropriate message was left noting the reason for the call and that the study team would attempt to contact them at a later date. If a number was called three times without actually talking to a household member it was dropped from the pool.

Mail Recruiting

Mail recruiting in both lotteries was done as follows:

- Advance notice of the survey was sent by mail one week prior to the survey;
- Questionnaire packet was sent by mail (main mailing);
- A reminder letter was sent to the entire sample one week after the main mailing; and
- A reminder letter including a complete survey packet was mailed to all non-respondents. For Lottery One it was mailed eight weeks after the main mailing and for Lottery Two four weeks after.

When a household returned their questionnaire they were added to the pool to receive activity diaries. During both survey periods activity-travel diaries were mailed to each household as they returned completed household questionnaires. The survey dates for the diaries were seven days after they were mailed. On a typical day, diaries were mailed to approximately 40 households per day broken down as follows: 25 to the purchased group, 5 each to the on- and off-campus students, 1 to the Penn State housing, and 9 to the Penn State employees. No follow-ups were made for the diaries.

DATA ENTRY

Activity surveys generate an extremely large amount of data. Because of this, it is also important to minimize the burden on the personnel responsible for data entry. It is also important to provide a data entry process that will minimize the number of data entry errors. For this study, the Survey Center developed an integrated database with an interface that closely resembled the questionnaire and diary formats. A comparison of figures 5 (questionnaire) and 6 (diary) to figures 1 and 2 shows that this was very successful. The incorporation of “pull-downs” for many of the fields allowed for quick and accurate entry of repeated data such as home addresses and activities such as sleeping and eating.

Figure 5 about here.

Figure 6 about here.

RESPONSE RATES

The two lotteries experienced very different levels of participation. The telephone recruiting did not prove to be very successful, although, as can be expected, households that agreed by telephone to participate responded at a very higher rate. Lottery One had a much higher response rate than Lottery Two.

Lottery One: 2002

As noted earlier, during the first survey lottery (November 2002 to March 2003) subjects were recruited both by telephone and mail.

Telephone Recruiting

Study team members contacted 821 households via telephone to request participation in the study. Of these, only 190 agreed to participate. The other 631 households refused participation, did not have in-service telephone numbers, or were called three times without speaking to a resident. The contact rate (participants/contacts) was 23.1 percent. Telephone recruiting was stopped on January 3, 2003.

All of the 190 households agreeing to participate were mailed survey packets as outlined above. Of these 80 households (43.5%) returned completed, usable questionnaires and diaries. The overall response rate for the telephone recruiting is 10.0 percent (returns/contacts).
Mail Recruiting

In lottery one 1,478 households were contacted by mail. Of these, 422 households were dropped as undeliverable yielding a net mailing of 1,056. A total of 647 household questionnaires were returned yielding a 61.3 percent response rate.

Of the 647 households returning household questionnaires 568 were mailed activity-travel diaries. Time constraints prevented inclusion of all responding households. Sixty-six were dropped as undeliverable (these packets were returned by the U.S. Post office without a valid forwarding address in Centre County) yielding a net mailing of 502. A total of 208 households returned completed diaries yielding a 41.4 percent diary response rate.

With 203 households returning usable diaries the overall response rate for the Lottery One mail recruiting is 13.7 percent.

Lottery Two: 2003

Lottery two was done completely by mail. The response rates for this phase of the study are reported below with details for each sub-set of the sample.

Household Questionnaire

Overall, questionnaires were mailed to 7,447 households. Of these, 617 households were dropped as undeliverable yielding a net mailing of 6,830. A total of 2,414 household questionnaires were returned yielding a 35.3 percent response rate. Table 2 displays the mailing and response rates by sub-group.

<table>
<thead>
<tr>
<th>Subject Pool</th>
<th>Mailed</th>
<th>Dropped</th>
<th>Net Mailed</th>
<th>Number Returned</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Database</td>
<td>4,401</td>
<td>432</td>
<td>3,969</td>
<td>1,603</td>
<td>40.4%</td>
</tr>
<tr>
<td>PSU Students Residing On-Campus</td>
<td>1,200</td>
<td>27</td>
<td>1,173</td>
<td>258</td>
<td>22.0%</td>
</tr>
<tr>
<td>PSU Students Residing Off-Campus</td>
<td>1,199</td>
<td>129</td>
<td>1,070</td>
<td>304</td>
<td>28.4%</td>
</tr>
<tr>
<td>PSU Students Residing in Family Housing</td>
<td>140</td>
<td>4</td>
<td>136</td>
<td>50</td>
<td>36.8%</td>
</tr>
<tr>
<td>PSU Employees from Outside Centre Co.</td>
<td>507</td>
<td>25</td>
<td>482</td>
<td>199</td>
<td>41.3%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>7,447</strong></td>
<td><strong>617</strong></td>
<td><strong>6,830</strong></td>
<td><strong>2,414</strong></td>
<td><strong>35.3%</strong></td>
</tr>
</tbody>
</table>

Activity-Travel Diaries

Of the 2,414 households returning household questionnaires 1,969 were mailed activity-travel diaries. Six were dropped as undeliverable yielding a net mailing of 1,963. A total of 494 households returned completed diaries yielding a 25.2 percent diary response rate. Table 3 displays the mailing and response rates by sub-group. With 494 households returning usable diaries, the overall response rate for lottery two is 8.9 percent.
Table 3. Lottery Two–Activity-travel diary return rate.

<table>
<thead>
<tr>
<th>Subject Pool</th>
<th>Mailed</th>
<th>Dropped</th>
<th>Net Mailed</th>
<th>Number Returned</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Database</td>
<td>1,348</td>
<td>5</td>
<td>1,343</td>
<td>401</td>
<td>29.8%</td>
</tr>
<tr>
<td>PSU Students Residing On-Campus</td>
<td>131</td>
<td>1</td>
<td>130</td>
<td>16</td>
<td>12.3%</td>
</tr>
<tr>
<td>PSU Students Residing Off-Campus</td>
<td>247</td>
<td>0</td>
<td>247</td>
<td>34</td>
<td>13.8%</td>
</tr>
<tr>
<td>PSU Students Residing in Family Housing</td>
<td>60</td>
<td>0</td>
<td>60</td>
<td>11</td>
<td>17.5%</td>
</tr>
<tr>
<td>PSU Employees from Outside Centre Co.</td>
<td>183</td>
<td>0</td>
<td>183</td>
<td>32</td>
<td>18.3%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>1,969</td>
<td>6</td>
<td>1,963</td>
<td>494</td>
<td>25.2%</td>
</tr>
</tbody>
</table>

Comparison of Response Rates for the Two Lotteries

While a significantly larger amount of data was collected during Lottery Two, Lottery One experienced a much higher response rate both for the household questionnaire and the activity diaries. This difference may be a result of the different incentive amounts offered for each. The respective rates for the household questionnaire were 61.3 percent returned for Lottery One and 35.3 percent for Lottery Two yielding an over all response rate of 38.8 percent for the household questionnaire. For the diaries, the response rate were 41.4 percent returned for Lottery One and 35.3 percent for Lottery Two yielding an over all response rate of 38.8 percent for the diaries. The overall response rate for the survey is 11.1 percent.

Table 4. Household questionnaire response rate via mail.

<table>
<thead>
<tr>
<th>Lottery</th>
<th>Total Mailed (A)</th>
<th>Dropped1</th>
<th>Net Mailed (C=A-B)</th>
<th>Total Returned (D)</th>
<th>Return Rate (E=D/C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lottery One (2002)</td>
<td>1,478</td>
<td>422</td>
<td>1,056</td>
<td>647</td>
<td>61.3%</td>
</tr>
<tr>
<td>Lottery Two (2003)</td>
<td>7,447</td>
<td>617</td>
<td>6,830</td>
<td>2,414</td>
<td>35.3%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>8,925</td>
<td>1,039</td>
<td>7,886</td>
<td>3,061</td>
<td>38.8%</td>
</tr>
</tbody>
</table>

1. Respondents dropped from the survey (e.g., Non-Deliverable, deceased, under age, etc.)

Table 5. Diary response rate via mail.

<table>
<thead>
<tr>
<th>Lottery</th>
<th>Total Mailed (A)</th>
<th>Dropped1</th>
<th>Net Mailed (C=A-B)</th>
<th>Total Returned (D)</th>
<th>Return Rate (E=D/C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lottery One (2002)</td>
<td>568</td>
<td>66</td>
<td>502</td>
<td>208</td>
<td>41.4%</td>
</tr>
<tr>
<td>Lottery Two (2003)</td>
<td>1,969</td>
<td>6</td>
<td>1,963</td>
<td>494</td>
<td>25.2%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>2,537</td>
<td>72</td>
<td>2,465</td>
<td>702</td>
<td>28.5%</td>
</tr>
</tbody>
</table>

1. Respondents dropped from the survey (e.g., Non-Deliverable, deceased, under age, etc.)
A review of the dates that the questionnaires seems to indicate that the follow-up mailing do have an impact on overall response rate. Figure 7 shows the percent of questionnaires returned by week for each of the lotteries. In both cases, there is a spike in the number of questionnaires returned approximately two weeks after the follow-up mailing of the complete survey packet.

**Figure 7 about here.**

**SYNTHESIS**

In this paper we outlined an integrated method for conducting a household activity-travel survey. This method has been used successfully in a household survey of Centre County, Pennsylvania. The survey experienced a response rate of 38.8 percent for the household questionnaire portion of the survey and 28.5 percent for the diaries. Within each of these two response rates, however, we find specific segments and a sequence of actions that yield a response rate as high as 68.8% and a series of actions during survey administration that aid achieving this rate. Our experiments with the Dillman-tailored method and the Socialdata-KONTIV design and survey administration are extremely encouraging and a testimony to the good design advocated by both traditions. However, many aspects are still obscure. Two preliminary multivariate analysis attempts were also made when writing this paper to shed light into the extremely different response rates. The first analysis examined response rate to the household questionnaire to understand which households were more likely to respond. This was done using a person-based (because a person is the mail or telephone recipient) probability of returning the questionnaire non-linear regression model that indicates that older recipients (50+), home owners, married, and of medium ($30K to $60K per year) or higher ($60K or more per year) household income are more likely to return their household questionnaires. Mail recruitment was also (as discussed above) significantly more successful in the household questionnaire response. Similar indications were also given by a second regression model for activity diary response. In fact, recruiting by telephone in the household questionnaire leads to lower response rate but given that a household was recruited by telephone and returned the household questionnaire, it has a higher probability of returning at least one activity diary. In addition, the presence of children in the household functioned as an inhibitor in the travel diary response.

**ISSUES FOR FURTHER RESEARCH**

Several issues arouse during this study that warrant further exploration. The telephone recruiting was not very successful. The study team could not determine if this was a result of the recruiting method used or related to larger societal factors. Also, the large difference in the response rates for the two lotteries is somewhat of a puzzle. The difference in the amount of the reward offered in each lottery most likely had a significant impact on the response rate although this study did not collect data to determine what effect the reward levels had. Initial multivariate analysis experiments showed we need to explore further the response rate but we also need to study the completion and missing data patterns. The effect of children on response rate also requires further study. This is particularly important for travel behavior analysis because of the effect children have on activity and travel patterns and the risk of loosing the more interesting from research viewpoint behaviors due to non-response. All this is left as a future study that has already began.

**ACKNOWLEDGEMENTS/DISCLAIMERS**

Funding for this paper was provided by the federally funded Mid-Atlantic Universities Transportation Center (MAUTC) and the Center for Intelligent Transportation Systems (CITRANS) at the Pennsylvania State University. Partial funding for the CentreSIM survey is provided by the Pennsylvania Department of Transportation (PennDOT) through a contract with McCormick Taylor and Associates (MTA). The survey was conducted at the Transportation Survey Research Center at the Pennsylvania Transportation Institute (PTI) by a team of persons that include: Mark Hallinan, James Lee, Devani Perera, Aviroop Mukherjee, Julie Whitt, and Brian Hoffheins. Their dedication is greatly acknowledged. Li Guan at PTI programmed the databases for the CentreSIM survey and Tae-Gyu Kim at PTI estimated the response rate models. Jean-Robert Micaeli and Ondrej Pribyl have also worked on data cleaning algorithms documented elsewhere.

The contents of this paper reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Commonwealth of Pennsylvania at the time of publication. This paper does not constitute a standard, specification, or regulation of the Pennsylvania Department of Transportation.
REFERENCES


List of Figures

Figure 1. Example pages from the household questionnaire. ................................................................. 12
Figure 2. Example pages from the activity-travel diaries…………………………………………………………. 15
Figure 3. Example of a personalized cover from an activity-travel diary. .................................................. 16
Figure 4. Example of a “completed” activity-travel diary ........................................................................ 17
Figure 5. Weekly survey return rate. ........................................................................................................ 18
Figure 6. Example of a household questionnaire data entry screen ......................................................... 19
Figure 7. Example of a diary data entry screen. ......................................................................................... 20
Figure 1. Example pages from the household questionnaire (continued).

<table>
<thead>
<tr>
<th>Employment Status</th>
<th>Employment Status</th>
<th>Employment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently Unemployed</td>
<td>Currently Unemployed</td>
<td>Currently Unemployed</td>
</tr>
<tr>
<td>College/University</td>
<td>College/University</td>
<td>College/University</td>
</tr>
<tr>
<td>Grades K-6</td>
<td>Grades K-6</td>
<td>Grades K-6</td>
</tr>
<tr>
<td>Pre-School or Day Care</td>
<td>Pre-School or Day Care</td>
<td>Pre-School or Day Care</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently Employed</td>
<td>Currently Employed</td>
<td>Currently Employed</td>
</tr>
<tr>
<td>Full-Time Work</td>
<td>Full-Time Work</td>
<td>Full-Time Work</td>
</tr>
<tr>
<td>Part-Time Work</td>
<td>Part-Time Work</td>
<td>Part-Time Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently Unemployed</td>
<td>Currently Unemployed</td>
<td>Currently Unemployed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently Employed</td>
<td>Currently Employed</td>
<td>Currently Employed</td>
</tr>
<tr>
<td>Full-Time Work</td>
<td>Full-Time Work</td>
<td>Full-Time Work</td>
</tr>
<tr>
<td>Part-Time Work</td>
<td>Part-Time Work</td>
<td>Part-Time Work</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Please answer the following questions for all persons in the household.**
Figure 2. Example pages from the activity-travel diaries.
Figure 3. Example of a personalized cover from an activity-travel diary.
Figure 4. Example of a "completed" activity - travel diary.
Figure 5. Weekly survey return rate.
Figure 6. Example of a household questionnaire data entry screen.