Title: Know Your Audience: Conducting Effective Travel Diary Surveys at Colleges & Universities

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ABSTRACT

Despite being frequently underrepresented in travel diary survey efforts, colleges and universities—depending on their size, geographic location, and student body composition—can be major contributors to travel demand in their respective regions; therefore, researchers ought to study travel patterns and behavior at these educational institutions more often and in greater detail. This paper uses two case studies to detail the approach, design, and methodology of conducting travel diary surveys at colleges and universities. The first case study focuses on one stand-alone travel diary of students, faculty, and staff at Arizona State University, one of the largest universities in North America. The data collected (14,464 valid responses) will help support the Maricopa Association of Governments’ activity-based travel demand model. The second case study examines the survey administered at eight colleges (7,923 valid responses in total) across the state of Utah that was linked to the larger statewide household diary survey. This paper highlights the similarities and differences between the two approaches, notes the relative cost-effectiveness of both methodologies, and discusses the value of these datasets to regional travel demand modelers and strategic planners at educational institutions.
INTRODUCTION

Metropolitan Planning Organizations (MPOs) and statewide Departments of Transportation (DOTs) have long recognized the importance of conducting household travel diaries for the purpose of generating and updating travel demand models. Depending on the survey methodology and the prevalence of colleges and universities in the modeling area, household diary surveys have traditionally underrepresented these communities and their population’s travel patterns, especially those of the student body. Large college and university campuses impact regional travel; therefore, they must be adequately accounted for in diary surveys and travel demand models. Moreover, travel demand models typically use trip rates stratified by demographic variables that may not accurately characterize university students, such as household income, automobile ownership, and household size.

Conventional telephone interview surveys – an approach frequently used in household diary data collection – have become increasingly susceptible to coverage bias and plummeting response rates as a growing number of Americans abandon landline telephone service in exchange for cell-phone only service (1). Increasing numbers of Americans, particularly young and mobile college students, live in areas that do not correspond with their cell-phone area code, do not have a land-line telephone, and even with a telephone match are a population constantly on the move and disinclined to participate in a survey over the telephone. These biases are particularly prominent for students living in dormitories on university campuses.

In addition, college students are a population that is extremely reliant on computers, smartphones, and email. Recent studies show the rapid increase in smart-phone and cell-phone ownership (and therefore reliance) among college students. As of July 2012, 52% of Americans aged 18-29 owned a smartphone, and only 5% of college students did not own a cell phone at all (2).

With these challenges in mind, this paper aims to describe a cost-effective and administratively efficient approach to collecting travel diary information from university populations. This will be done using two recent case studies as examples. The first is a 2012 one-day travel diary of students, faculty, and staff at Arizona State University (ASU), one of the largest universities in America. The second is also a 2012 one-day travel diary administered to students at eight colleges and universities, of various sizes, around the state of Utah. The paper will highlight the similarities and differences between the two approaches, their relative effectiveness at collecting robust travel data for an often underrepresented portion of the population, and their potential applications.

RELEVANT LITERATURE

There is not immediately known to be a great deal of existing case studies regarding efforts to conduct targeted travel diary surveys to college student populations. Two recent examples are a web-survey to understand travel patterns at OSU (3). However while the OSU survey had a goal of obtaining preliminary data for the future use of developing a mode choice model, the OSU study did not conduct a travel diary, and rather focused on attitudinal and demographic questions, as well as questions regarding non-SOV options. A second example is in 2009-2010 where Virginia DOT purchased a large add-on to the National Household Travel Survey and in conjunction with that effort, Virginia DOT also decided to conduct a supplemental one day travel diary survey of university students at four universities (Virginia Tech, Old Dominion University, University of Virginia, and Virginia Commonwealth University) (4). Students were randomly sampled from enrollment lists and sent email invitations. Some students also received follow-up phone calls. In the study a travel date was initially assigned. Low response rates at all four colleges resulted in the decision to change the approach such that if the student didn’t respond promptly, the travel date instead became “yesterday.” The survey design was such that trips to various campus buildings were defined as separate trips, which is similar to the approach taken in our ASU case study. In Virginia, a further criterion used in defining trips was that these were movements of more than 300 feet.

CASE STUDY: ARIZONA STATE UNIVERSITY
Arizona State University, with a 2010 total enrollment of 70,440 (56,562 undergraduate students and 13,878 graduate students), is one of the largest universities in North America. It is located in the Phoenix Metropolitan Area and spread across four campuses: Tempe, West, Polytechnic, and Downtown. The university also employs over 12,000 individuals. Although the university is expected to grow in the coming decades, the current size is enough to generate a large amount of travel demand both on and off campus. Given that all four campuses are located within the boundaries of the Maricopa Association of Governments (MAG), it is crucial for MAG’s activity-based travel demand model to incorporate ASU-generated travel demand and mode usage patterns. Ultimately, accurate and robust ASU data will help MAG strengthen its ability to predict the impacts of ASU activities on modal usage and performance in the region (5).

ASU last conducted a travel diary survey in 2007. The updated 2012 version was conducted with the goal of improving data collection efficiency by leveraging technological improvements in web-retrieval surveys as well as more accurately reflecting the 2012 ASU community and travel patterns of its population.

Given the extent of research interests and the complexities involved with collecting trip-level information of students (both ones that live on campus and ones that live off campus), faculty, and staff, the questionnaire design process focused on minimizing survey length and reducing respondent burden as much as possible. This was accomplished in five ways. First, the survey length was reduced by removing selected questions and instead filling that void with other data sources. For example, rather than ask each individual student about his or her daily class schedule, the project team procured class schedule and enrollment data from the university. Again, given the population, the project team felt that the number one thing to encourage complete surveys and higher response rates was a short survey (6). In addition, the survey instructed students to report all movements on campus, which included a class schedule for one typical weekday. Second, by simplifying question wording and strategically ordering the questionnaire to create a better flow within the survey, respondents are less likely to perceive a high burden. Third, improving the on-screen layout of individual pages and particularly challenging questions helps to reduce confusion and, therefore, survey length. Fourth, by introducing logic-checking and on-screen validation, respondents were not asked unnecessary questions based on previous answers already provided. This improves the user experience not only by reducing the total number of questions asked, but also by minimizing the frustration associated with seeing questions that are irrelevant or otherwise redundant. What is more, these logic checks and data validation help improve data quality overall. Finally, all respondents could use the interactive, real-time Google mapping technology by searching for an address, a business name, or placing the market on the map to find each trip end (Figure 1). Once the location was selected, its latitude and longitude coordinates were automatically geocoded by the survey software. The primary benefit for respondents was that if a location was visited more than once – for example, a student returned to his or her dorm three times on one weekday – that location only needed to be geocoded once.
The questionnaire itself consisted of three major sections. After being introduced to the survey and its purpose, respondents filled out basic demographic information on which they were segmented (affiliation, campus, and whether they live on or off campus). Section two was the most substantial because it included a comprehensive one-day travel diary. In this section, respondents were first asked whether or not they made any trips yesterday (or the most recent weekday). The survey software used dynamic language based on the date and time that the respondent was completing the survey: if the respondent was completing the survey on a Sunday or Monday, respondents were asked to report trips from “Friday (the most recent weekday)” whereas all other respondents were asked to report trips from “yesterday”. This allowed students to participate on any day of the week and still report weekday travel. It is also a departure from the traditional household diary approach of pre-assigning each household with a specific travel date. This method simplifies administration considerably and by staggering the survey invitations, the distribution of trips across the five weekdays was reasonably spread out (Table 1).

Table 1: Travel day of week

<table>
<thead>
<tr>
<th>Travel Day</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>10%</td>
</tr>
<tr>
<td>Tuesday</td>
<td>39%</td>
</tr>
<tr>
<td>Wednesday</td>
<td>11%</td>
</tr>
<tr>
<td>Thursday</td>
<td>14%</td>
</tr>
<tr>
<td>Friday</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>
Defining the trip remains the most important and challenging exercise of designing a travel diary questionnaire, especially at a university like ASU, with multiple campuses and a mix of students living on and off campus. In this study – with an emphasis on capturing all trip types, including intra-campus – a trip was defined as any change in physical address; that is, a movement from one place to another, regardless of mode or duration. On screen, the trip was presented as follows: “A trip consists of any movement by car, bus, bike, walking, or other means AND any change of address or location. Some example trips include: walking from the library to class, biking to an off-campus coffee shop, going for a run in South Mountain Park, taking the bus to a volunteer job, riding the intercampus shuttle to another ASU campus, etc.” If respondents indicate that they made a trip yesterday (or the most recent weekday), they were asked to list all the places they went (Figure 2) before geocoding each of those locations.

Spatial analysis, using the trip end coordinates and the boundaries of each campus, allowed for trips to be categorized into four segments: intra-campus, inter-campus, to/from campus (one trip end on-campus, the other off-campus), and exclusively off-campus. These trip segments, combined with respondent segments (student who lives on campus, student who lives off campus, staff, or faculty) and trip mode information provide the analyst with ample opportunity to dissect travel behaviors, for example: differences between trip rates, trip types, and mode usage of undergraduate students residing on the Tempe Campus and a graduate student who lives off campus.

**Figure 2: Trip locations**

Finally, the survey concluded with a debrief section, which included questions about general auto and transit use as well as attitudes about transportation-related statements.

A sampling plan was developed concurrently with the questionnaire. The purpose of this was to determine the sample size and the margin of error in travel characteristics for the ASU Travel Study. Target sample sizes were determined by considering two basic travel characteristics for which analysts would like to achieve a high degree of precision. The first is the overall average trip rate per person, which may be regarded as a measure of travel demand. The second is the percent of individuals driving alone to campus, which may be regarded as a measure of modal split. Target sample sizes were computed using standard sampling equations and assuming conservative values for confidence level, degree of precision, and standard deviation of the travel characteristic of interest. In general, it was found that target sample sizes were considerably smaller than expected number of respondents in the survey. As the ASU community includes approximately 80,000 faculty, staff, and students, even a modest 10 percent response
rate would yield 8,000 responses. This sample size is larger than that of many general-purpose metropolitan travel surveys and provides a high degree of precision for a wide range of travel characteristics. The intent of the sampling plan was to therefore determine target sample sizes for specific demographic segments including freshman, sophomores, juniors, seniors, graduate students, faculty, and staff. During the survey administration process, if it was found that the sample size for a specific segment was far below the desired target, then additional efforts could be directed towards enhancing response rates for the specific segment.

Members of the ASU community were invited to participate in several, cost-effective ways. Officials at the university first invited all members of the community to participate via an email campaign. The email contained an introduction to the project, a description of its purpose, instructions for how to participate, information about the incentive for participating (entry into a drawing for an Apple iPad), and notes about the privacy policy. Given that the survey was administered entirely online, students, staff, and faculty could click on the survey link and begin participating immediately. In subsequent weeks, reminder emails were sent out on different days of the week at different times of the day in order to notify those members of the university population that either missed the initial invitation or needed a reminder to participate. In addition to the email campaigns, the survey was placed as a “To Do” item in MyASU – a campus-wide portal where students, faculty, and staff manage their identities and activities at the university. The ASU Travel Survey also appeared in a flashy banner advertisement as well as in the “Announcements” section of the portal. Finally, paper flyers were distributed across campuses, at transit stops, and aboard intercampus shuttles. With an extremely low marginal cost, these combined methods yielded an overall response rate of approximately 18% across the entire community. Table 2 shows the response rates by university segment.

Table 2: Survey response rates

<table>
<thead>
<tr>
<th>Segment</th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate student</td>
<td>17%</td>
</tr>
<tr>
<td>Graduate student</td>
<td>13%</td>
</tr>
<tr>
<td>Faculty</td>
<td>20%</td>
</tr>
<tr>
<td>Staff</td>
<td>24%</td>
</tr>
<tr>
<td>Overall</td>
<td>18%</td>
</tr>
</tbody>
</table>

The data collected in the ASU travel survey are being used in a variety of ways to enhance transportation modeling and forecasting efforts in the region. ASU is treated as a special generator in the current travel demand model used by MAG for long range transportation planning purposes. The ASU special generator model is being completely updated with new trip rates, trip length distributions, and mode specific constants for the ASU community to better reflect the unique travel patterns of students, faculty, and staff at the university. With very accurate information about the geographic locations of respondents and their origins and destinations, it is possible to use the ASU travel survey data in an activity-based travel microsimulation model development context. The MAG activity-based travel demand model framework includes an ASU-specific model that requires the synthesis of the ASU student population in the region with the simulation of the students’ activity-travel patterns. The microsimulation model that is specific to ASU is being estimated, calibrated, and validated using the data collected in the web-based survey.

In addition, the survey collected year, make, and model data on each available vehicle, which helps identify the types of vehicles that students own and use. As vehicle type choice is critical to energy and emissions analysis, these data will be used in the activity-based model to simulate vehicle fleet composition for the region’s population and more accurately estimate vehicle emissions resulting from personal travel demand.

The dataset also includes information on a number of variables that shed light on the attitudes and preferences of college students that may be important from the standpoint of offering services that meet their specific needs. These attitudinal variables also capture the perceptions of students with regard to
modal choices and preferences. This information will be used to group students according to their modal preferences and attitudes; by analyzing the travel characteristics of the different groups, it will be possible to identify the types of services and information campaigns that may enhance the use of alternative modes of travel such as walking, bicycling, and riding transit.

**CASE STUDY: UTAH COLLEGES AND UNIVERSITIES**

Utah last conducted a statewide household travel diary survey in 1993. In an effort to update this survey data and inform the Wasatch Choice 2040 long range development and transportation plan, a statewide effort was conducted in 2012 for the Wasatch Front Regional Council, in conjunction with the Mountainland Association of Governments, the Dixie Metropolitan Planning Organization, the Cache Metropolitan Planning Organization, the Utah Department of Transportation, and the Utah Transit Authority. With over 9,000 participating households, the 2012 household travel diary survey data collection was the basis for understanding current travel and future year scenarios across Utah.

In addition to the main household travel diary survey, the project team also conducted six supplemental and complementary surveys on a variety of topics such as a residential choice stated preference survey and a long-distance travel survey panel over several seasons. One of these supplemental surveys was a one-day travel diary for students at colleges and universities located within the MPO boundaries across the state. The eight participating colleges included: Dixie State College, LDS Business College, Salt Lake Community College, Utah State University, Utah Valley University, University of Utah, Weber State University, and Westminster College. At this time there is also an effort underway to conduct this identical survey at BYU (Brigham Young University) to obtain data for the Mountainland Association of Governments. The development of this college survey pivoted off the design of the household travel diary for the dual benefits of facilitating direct comparisons between the responses in the college survey and the household travel diary survey, as well as the efficiencies gained by already developing one survey. This coordination results in a cost-effective approach, which can yield additional response from are colleges and universities with a relatively low level of effort.

In Utah whenever possible, the college questionnaire mirrored the household diary questionnaire, with two main differences. The first is that college students as survey participants reported their own travel only, not the travel of each household member. The second is that survey participants are asked to describe off-campus trips only, which includes trips to or from campus as well as trips that occurred entirely off campus. Whereas in the household diary survey walking seven minutes from home to the corner store is considered a trip, in the college diary survey, if that same activity were to take place entirely within the boundaries of campus (from the dorm to the college cafeteria), it was not considered a trip such that the respondent was required to report it. The primary advantage of this approach is in reducing respondent burden among a population with a lower tolerance for long surveys because most participants would have fewer trips to report. Using this definition also focused on trips that occur on publicly maintained roadways and transit systems, which is sufficient when the data are to be used in supporting a four-step travel demand model.

The questionnaire itself consisted of four sections. Due to the fact that this survey was administered at eight colleges and universities, the first section asked students to choose their college/university from a list of participating colleges and then identify their college/school affiliation and primary campus. The survey software incorporated branching logic, custom questions, and dynamic language based on a student’s answers to these background questions, all of which simplified the survey administration process. Next, students provided demographic information, including their employment status, residential location, and year in school. Third, students were asked about the trips they made yesterday (or “Friday (the most recent weekday)” in the event that they were completing the survey on a Sunday or Monday). Unlike the household diary survey where households were pre-assigned a particular travel day and asked to report trips made on that day, students in the Utah college survey were instructed to report trips from yesterday (or the most recent weekday), just as they were in the ASU Travel Study. Again, this focuses on weekday trips but also on a recent day thus respondents are more likely to remember the details of those trips. This has a positive impact the overall accuracy and quality of the
collected survey data. Finally, a debrief section asked students about their general travel to and from campus (and to an off-campus job if employed) and opinions on a variety of transportation-related issues in the area. The debrief section also included a set of questions regarding bike and walking behavior (and reasons for and against walking and biking) that can now be compared to the same set of questions in the statewide household travel survey.

As with the ASU Travel Study, the Utah college diary survey was administered entirely online using email invitations. In order to target students at colleges and universities in Utah, the project team developed a list of institutions – both public and private – that represented numerous geographic regions within the state. The project team then worked with the client agencies to reach out to and recruit from among the list of identified institution, generally targeting high ranking officials. Most institutions agreed to participate and preferred to send the email invitations to their student bodies themselves. Students were incentivized to participate by the opportunity to enter into a drawing for the latest generation Apple iPad. One winner was to be randomly selected at each participating institution. Overall, this methodology and incentive combination yielded a response rate of approximately 5-12%. Response rate variability generally depended on the type of school and student body composition (percent of full-time students), as well as the number of email invitations and reminders distributed and the overall level of engagement from the college.

Figure 3: Vehicle details for Student Living Off-Campus

At this time the analysis work on the Utah college diary dataset is underway. Preliminarily it appears that the important predictors of travel and the means for weighting will be on- and off-campus status, whether a part-time or full-time student, and the campus where the student is primarily located.

CONCLUSIONS

This study attempts to advance the frequency of and methods for collecting travel diary information from members of college and university communities (and potentially in the future applying these methods to other similar populations such as military bases or very large employers). The opportunities for robust data and meaningful analysis are many. Given the recent advances in web-retrieval software and the large population of traveling – not to mention technologically savvy – students, faculty, and staff, these data can be obtained in a relatively cost-effective manner by using an online survey instrument and coordinating with university officials to invite participants via email.

Even still, there is room for improvement in designing surveys specifically for the university communities. More specifically, trip definitions have continued to evolve over the years and it has been a nontrivial challenge for transportation market researchers to get it right. This issue is confounded by the nature of campus travel patterns and confusion about what exactly constitutes a trip. In other words, much of the on-campus movements are hard to classify. With all of this in mind, properly and clearly conveying
the trip definition to the survey participant is a crucial exercise with major implications on trip rates and
data quality in general. While the type of application (four-step vs. activity-based travel demand model)
will largely dictate the approximate trip definition, communicating that on-screen to the respondent will
nonetheless be important.

Lastly, as we advance the technology and quality of data obtained as part of college and
university travel diaries, we also must continue to remain alert to how our methodologies impact data.
With a college population that often responds instantly to email invitations, in our case studies (both
Arizona State University and the colleges and universities around Utah), the project teams remained
extremely sensitive to the day of the week and hour of the day that email invitations were sent out and
tried to evenly stagger the days of the week and hour of the day so that the trips that were reported as
“yesterday” were well distributed and that students who checked email in the morning, afternoon,
evening, and late into the night were well represented in the dataset. An additional administration
consideration is the incentives offered – in both our case studies a raffle of the latest generation iPad was
an extremely cost-effective and enticing incentive to college students. And lastly, when designing an
online survey for college student populations – it is even more important to continue to advance the state
of the practice by designing surveys to be mobile or tablet optimized. This detail, although
straightforward for many questions, is a challenge for travel diaries and an opportunity for future
improvement beyond what was accomplished in these case studies.

In addition to applying these survey results in travel demand models, collected survey data can be
analyzed in other interesting ways. This is true because large university campuses, in general, are case
studies for densely populated areas with a diverse composition of trips. For example, campuses tend to
be friendly to alternative modes (shuttles, biking, walking, etc.) and are host to a variety of trip types
(commute, recreational, exercise, etc.). As such, examining the decision making, mode choice, and
general trip patterns of campus communities may shed light not only on the effectiveness of strategic
plans, campuses designs, and campus infrastructure, but also on those same features and pursuits outside
the campus boundaries.

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