Computing in Civil Engineering:
Proceedings of the First Congress held in conjunction with A/E/C Systems 1994, Volume 2
Sponsored by the Committee on Coordination Outside ASCE of the Technical Council on Computer Practicesof the American Society of Civil Engineers
Washington, DC, June 20-22, 1994

STUDYING ROUTE CHOICE BEHAVIOR USING COMPUTER-AIDED TELEPHONE INTERVIEWS AND GIS

Mohamed A. Abdel-Aty[1], Ryuichi Kitamura[2], Paul P. Jovanis[2]
Prasuna Reddy[1] and Kenneth M. Vaughn[1]

ABSTRACT

The survey approach is often used in studying drivers' route choice behavior. Surveys enable the researcher to analyze the effects of traffic information directly from reported behavior and perceptions of the respondent. A large scale survey could achieve a sample size that adequately supports quantitative modeling and forecasting of route choice and traffic information use. A better representation of the population in a survey could also facilitate better understanding of actual drivers' behavior and decision processes. In this paper two innovative techniques in developing route choice surveys are introduced. The first is using computer-aided telephone interviews (CATI), and the second utilizes geographic information systems (GIS) capabilities.

INTRODUCTION

Advanced Traveler Information Systems (ATIS) are those vehicle features which assist the driver with planning, perception, analysis, and decision-making to improve the convenience and efficiency of travel. Information is a key to decision-making, and route choice is one of the most important decisions that the driver

[1] Post Graduate Research Engineer, Institute of Transportation Studies, University of California, Davis, CA 95616

[2] Professor of Civil Engineering, Institute of Transportation Studies, University of California, Davis, CA 95616

makes either before starting his trip or while driving en-route. Investigating drivers' perceptions and decisions regarding their routes are significant in developing an understanding of route choice behavior and to determine how ATIS information can be used to affect that behavior. These objectives could be achieved by conducting route choice surveys that: determine the amount of information the driver has about his route(s) and how much of this information is used to choose routes, evaluate the information desired by travelers, and to analyze en-route diversion decision as a decision made under uncertainty.

COMPUTER-AIDED TELEPHONE INTERVIEWS

Computer-aided telephone interviewing employs interactive computing systems to assist interviewers and their supervisors in performing the basic data-collection tasks of telephone interview surveys (Groves et al., 1988). In typical applications the interviewer is seated at a computer terminal, wearing a telephone headset. As survey questions are displayed on the computer screen, the interviewer reads them to the respondent and enters responses on the computer keyboard. In most systems, question wording and branching between items are computer controlled, based on prior entries or case input, and answers as entered can be checked to prompt correction of edit failures and reconciliation of apparent inconsistencies.

CATI I

A route choice survey was developed targeting Los Angeles area morning commuters. A mail-out/mail-back survey instrument was initially designed to gather detailed information on commuters' main and alternate routes, to determine the level of information commuters have about these routes, to measure commuters' attitudes toward, and perceptions of, these routes, and to determine how existing traffic information affects their route choice behavior. The mail survey instrument required several branchings, increasing its level of complexity, potentially jeopardizing the response rate and response accuracy. Therefore, it was decided to perform a CATI survey. A CATI survey allows interviewer/respondent interaction and automatically handles branchings with complete reliability and lower interviewer error. Also, since data is saved to a computer file simultaneously as the interviewer type the codes of the respondent's answers, there is no need for questionnaires to be coded as in the case of mail surveys, which lead to several problems including coding errors and increased administration costs. CATI surveys is also believed to yield a higher response rate. As the proposed survey called for an involved survey structure, and collecting information on commute routes can be best achieved through interviewer-respondent interaction, it was determined that a CATI survey would lead to a significant improvement in the survey results.

The survey yielded 944 completed interviews contacted between mid May and early June 1992. The following information was obtained from each respondent:

- Identification of specific primary commute route by segment (each different road/freeway in sequence for the whole commute route).

- Availability of alternate commute routes, and identification of secondary route by segment.
- Detailed information on both primary and secondary routes, including perceived traffic conditions.
- Individual's perception of the severity of different types of delays and other problems.
- Information that the respondent receives before and during the commute, and its effect on his behavior and awareness of the highway/street network.
- Demographic and socioeconomic data, including household income, gender, employment status, and education level.

As mentioned above, one of the main objectives of this survey was to collect the exact commute route(s) of the respondents (i.e., collect each segment of the route), and to capture the respondents' perceptions and knowledge about these routes. The design of the survey needed to be flexible enough to allow each respondent to describe the number of routes he used, the number of segments on each route and the name or number of the street or freeway, and the traffic conditions on each segment, requiring several branchings and interviewer/respondent interaction. Such a design requires efficiency and timely interaction which could only be achieved by using a computer. The CATI survey is programmed such that sequences of questions appear to the interviewer on the computer screen promptly according to each respondent's answers.

CATI II

A route choice survey was developed targeting the same sample of 1992, which consisted of the Los Angeles area morning commuters. The survey design also required many branchings, therefore, it was decided to perform a computer-aided telephone interview (CATI).

The survey yielded 563 completed interviews contacted in May 1993. The survey was designed to obtain the following information:

- Measure any changes within the last year, including home and work locations, and primary and secondary routes. In the case of any changes the exact primary route (and secondary route if the respondents uses one) is identified by segment.
- Study Carpoolers' decision process.
- In-depth understanding of commuters' perceptions and decisions.
- Study the effect of travel time uncertainty on route choice

This survey design did not only require capturing the exact commute route and its segments as the previous survey, but it required capturing any changes, which complicated the design to a large extent. For example, some commuters changed their origin, destination, primary commute route, secondary commute route, or mode of travel, or a combination of these cases. The survey design had to follow each path of questions according to each commuter circumstances. Again The CATI design would be the only method to achieve this objective efficiently and promptly.

MAIL SURVEY USING GIS CAPABILITIES

A third and final survey was designed and conducted in October/November 1993. It is a mail-out/mail-back customized survey instrument targeting the same respondents interviewed in the CATI surveys. Based on each respondents origin (home) and destination (work), and using GIS capabilities, the Navigation Technology databases are used to generate minimum path routes. Navigation Technology databases are detailed databases that include all the highways/streets network of the study area (Los Angeles and Orange counties, California). Several friction factors enter into the algorithm calculating the minimum path (e.g., stops, U turns, one way streets, speed limits, etc.), together with the experience of a large number of drivers that are acquainted with the area, and according to their chosen routes each route are designated a weight that also enter in calculating the fastest route.

Figures 1 and 2 illustrate two computer screens from the GIS process. Figure 1 shows the map that includes the respondent's origin, destination and his generated fastest route highlighted. Figure 2 shows a printout of the fastest route by segment, which is presented to the respondent in the questionnaire. The actual commute route generated for each respondent is presented in the questionnaire together with the generated fastest route. Several attitudinal and hypothetical questions about both the actual commute route and the generated fastest route are designed to develop models of route choice and the possible impact of information on this choice. The subject is asked to compare the generated minimum path route and the actual route to see if they differ substantially, and to understand why commuters doesn't use the minimum path route.

SUMMARY AND CONCLUSIONS

In this paper two original techniques in developing route choice surveys are introduced. The paper addresses the use of computer software, GIS applications, and network databases in designing and undertaking route choice surveys, which yield data for modeling route choice decision-making and for network analysis. The work introduces new application of computers and GIS in transportation engineering. The potential of these methods in collecting detailed information on commuters' routes are discussed. Analyses of the data collected from the CATI surveys proved the viability of this method (see Abdel-Aty et al., 1993 and 1994). Analyses of the results from the third mail survey is underway. In general, these suggested techniques in surveying commuters route choice behavior could be extended to study different aspects of drivers' behavior and transportation planning.

ACKNOWLEDGEMENT

The authors wish to thank Navigation Technologies for providing the software and databases used in developing the mail survey. Special thanks to California Department of Transportation (Caltrans) and PATH for funding this research.

REFERENCES

Abdel-Aty M., Vaughn K., Kitamura R. & Jovanis P., "Survey of Route Choice Behavior: Empirical Results From Southern California and their Implications for Advanced Traveler Information Systems", Research Report UCD-ITS-RR-93-12, Institute of Transportation Studies, University of California, Davis, California, 1993.

Abdel-Aty M., Vaughn K., Kitamura R., Jovanis P. & Mannering F., "Models of Commuters' Information Use and Route Choice: Initial Results Based on a Southern California Commuter Route Choice Survey", Presented at the 73rd Annual Meeting of *Transportation Research Board*, Washington D.C., Jan. 1994.

Groves R., Biemer P., Lyberg L., Massey J., Nicolls W. & Waksberg J., *Telephone Survey Methodology*, John Wiley & Sons, NY, 1988.

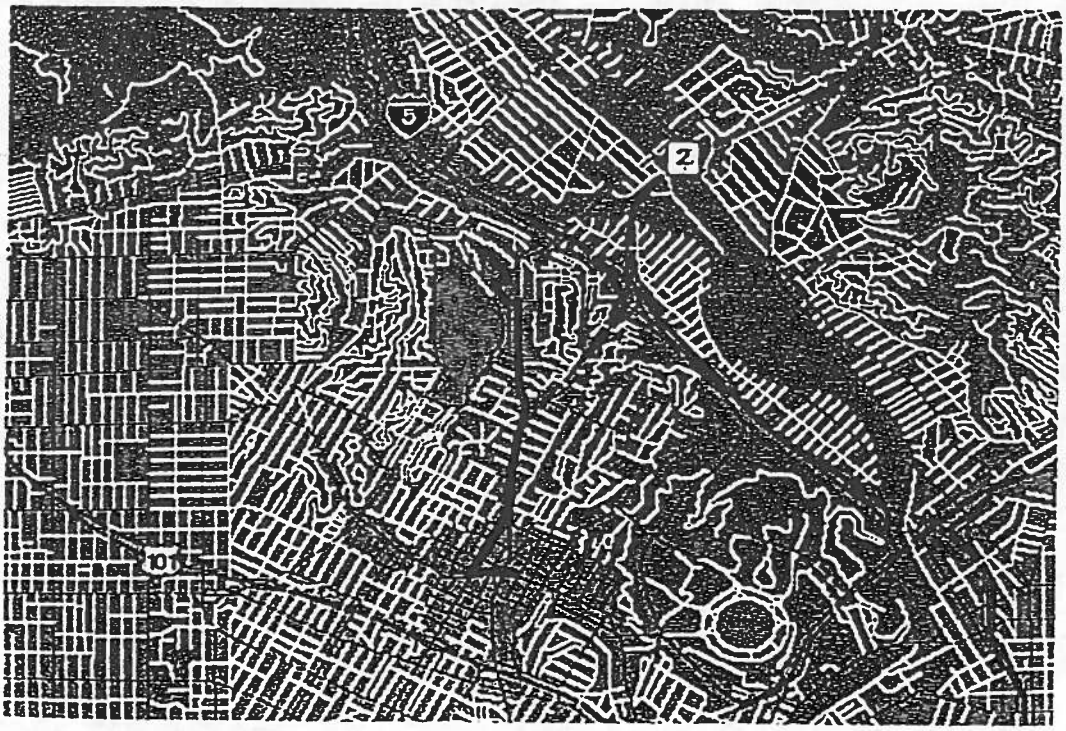
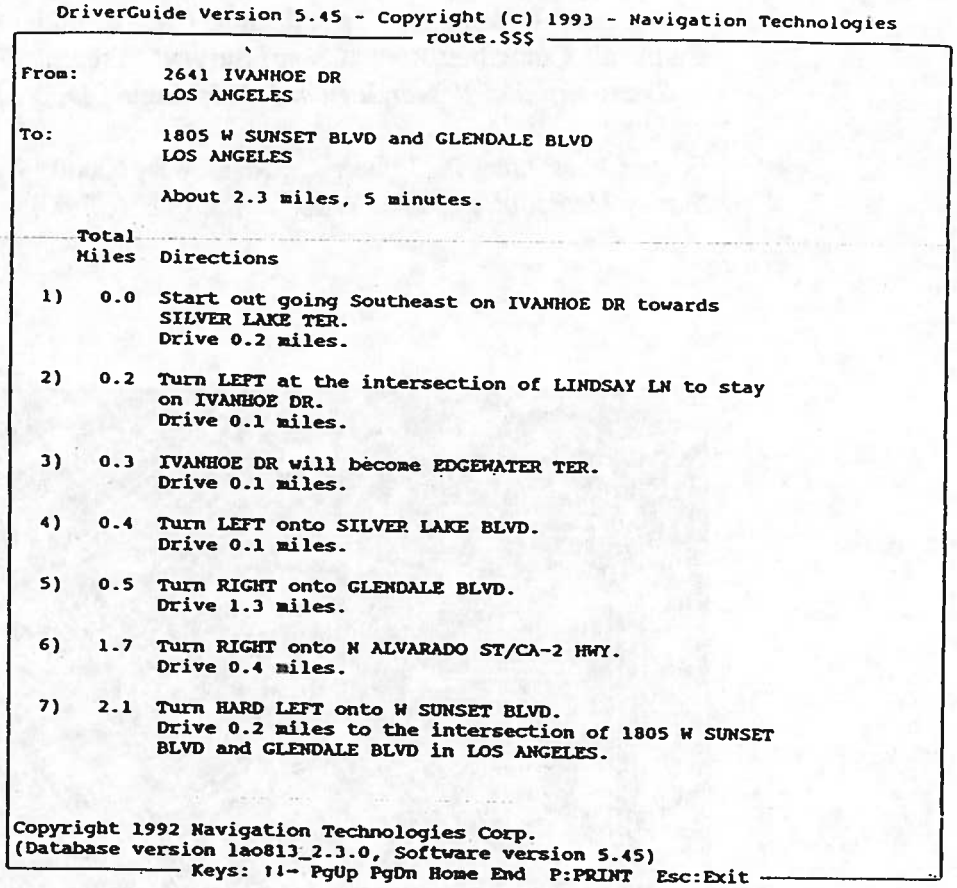


Figure 1: A computer screen showing the optimal route



```
DriverGuide Version 5.45 - Copyright (c) 1993 - Navigation Technologies
                                    route.$$$

From:       2641 IVANHOE DR
            LOS ANGELES

To:         1805 W SUNSET BLVD and GLENDALE BLVD
            LOS ANGELES

            About 2.3 miles, 5 minutes.

     Total
     Miles  Directions

 1)   0.0   Start out going Southeast on IVANHOE DR towards
            SILVER LAKE TER.
            Drive 0.2 miles.

 2)   0.2   Turn LEFT at the intersection of LINDSAY LN to stay
            on IVANHOE DR.
            Drive 0.1 miles.

 3)   0.3   IVANHOE DR will become EDGEWATER TER.
            Drive 0.1 miles.

 4)   0.4   Turn LEFT onto SILVER LAKE BLVD.
            Drive 0.1 miles.

 5)   0.5   Turn RIGHT onto GLENDALE BLVD.
            Drive 1.3 miles.

 6)   1.7   Turn RIGHT onto N ALVARADO ST/CA-2 HWY.
            Drive 0.4 miles.

 7)   2.1   Turn HARD LEFT onto W SUNSET BLVD.
            Drive 0.2 miles to the intersection of 1805 W SUNSET
            BLVD and GLENDALE BLVD in LOS ANGELES.


Copyright 1992 Navigation Technologies Corp.
(Database version lao813_2.3.0, Software version 5.45)
            Keys: ↑↓→ PgUp PgDn Home End  P:PRINT  Esc:Exit
```

Figure 2: A printout of the optimal route