Title
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Putting Behavior in Household Travel Behavior Data: An Interactive GIS-based Survey Via the Internet

Final Report

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Abstract

This two-year project focused on obtaining travel behavior data that more truly reflected underlying behavior. In the first year of the project a prototype of REACT!, a web-based, self-administered survey instrument for collecting household travel/activity data was produced. REACT! documents not only the resultant behavior but also the scheduling process that produces that behavior by having each respondent record activities as they are initially planned, updated, and executed. In the second year, following a beta test of REACT! and final program modification, a formal REACT! field study was completed for 47 households who used REACT! to provide 24 hours of travel/activity data over a 7 day period. Ensuing analyses focused on the activity scheduling process.

Work Completed to Date
All proposed tasks have been successfully completed (although continued development and refinement of REACT! continues). The REACT! software was developed, subject to substantial internal and beta testing, followed by a full field survey. Formal analysis of the resulting REACT! data was completed, with results presented at several conferences and papers being submitted to journals. Results include the identification of distinct spatial and temporal behaviors for planned and unplanned activities, with defined gender differences observed. Classification and structural models were developed to identify regularities in scheduling behavior. Follow-on research is focused on integrating REACT! with data from TRACER, a GPS-based vehicle tracking system, and extending the range of REACT! project applications.

Key Words: REACT!, household travel/activity surveys, activity diaries, household activity scheduling, time use.
1. OVERVIEW

The evolving requirements of transportation modeling have created a greater need for higher quality data on complex travel behavior. This need has generated an increasing demand for new technologies and approaches for household activity/travel surveys. Many of the new technologies, such as the application of Global Positioning Systems (GPS) and handheld computers to obtain high resolution travel data, promise to advance existing travel models (and may even assist in a paradigm shift for travel forecasting). The data, however, are the outcomes of the decision process, often termed activity scheduling, that determines when, where, with whom, and for how long people engage in various activities.

It has been convincingly argued that this decision process is at the core of travel behavior changes. The effectiveness of policies such as congestion pricing and travel demand management depends on how people adjust their daily activity and travel patterns to the changes being implemented. This process is largely unknown, thus, additional technologies and approaches need to be directed toward the in-depth study of this activity scheduling decision process.

An initial step in this direction was CHASE, developed by Sean Doherty. In response to Doherty's initial experiments with CHASE, the design of an improved survey technology was launched, with the goals of automating the initial household interview, reducing scheduling bias, improving location identification and geo-coding, automating data transfer, and providing for server-based or client/server architectures. The result was the REACT! survey software.

2. The REACT! Survey

A web-based travel/activity survey, REACT! is designed as a Computer Aided Self-administered Interview. REACT! elicits both travel/activity plans as well as revealed travel patterns as a step toward revealing the household scheduling process. REACT! comprises two linked components.

The first is the Initial Interview, a self-administered series of screen interfaces which is completed the day before the diary period begins. This initial interview concludes with completion of the first pre-travel survey. During this phase, all travel and activity that is planned for the survey period (typically a week) is identified at a level of detail corresponding to the level of planning -- only those attributes actually planned are recorded.

The second component is the Daily Interview, a self-administered survey of the preceding 24 hours of travel and activity. Planned activities can be moved from the pre-travel plans to the current day's survey, adding any unplanned characteristics and updating as necessary. With any Daily Interview, additional pre-travel planning for the remainder of the week may be recorded.

2.1 The REACT! Initial Interview

The following screen captures depict REACT!s self-administered initial interview. These interfaces collect standard demographic variables (household, person, and vehicle characteristics) as well as information describing "typical" activity types and locations.
1. Household Data

2. Household Members

3. Person Data

4. Vehicle Data
5. Location Data

6. GIS Utility

7. Activity Types

8. Activity Frequency
2.2 The REACT! Daily Planning and Update

The following screen captures illustrate REACT!'s self-administered daily activity updating and recording. The first interface screen allows for the recording of planned activities to the degree that they are planned (the "Anyday" column is used to record activities when no set day is planned). The second interface screen allows for the completion of a daily activity schedule via "sliding" planned activities from the planned day (or from "Anyday") and adding those details that were not planned (or updating those that have changed).

Every distinct task that you do each day is an activity (whether it is sleeping, eating, working, picking up your children, watching TV, seeing a movie, etc.). Before your week starts, you typically have some of these activities planned to varying degrees. REACT! incorporates a two-part Activity Diary which records your activities. First, it records your planned activities for the coming week, then, as the week proceeds, it will record what you have actually done each day during the week. Typically, the
survey period is a full week, beginning on a Sunday evening and ending with the next Sunday evening.

14. Pre-travel Planning

2.3 REACT! Post-travel Activity Updating:
On Monday through Saturday evening REACT! sessions, you will enter the full details of all activities that you have actually performed during the day (including in-home activities). You should also enter any travel (whether walking, biking, or taking a car or bus) completed in accessing activity locations. REACT!'s second scheduling form, the **Daily Calendar**, will be used.

After you have completed your Daily Calendar, you will be taken back to the Weekly Calendar to review your week's remaining planned activities. If any of these plans changed (a cancelled or postpones activity, or a different time or location), or if further activity details have been determined, update this information. These updates should reflect changes to your plans but you should not use the REACT! session as a "Day Planner" to actively develop your plans.
15. Post-travel Updating

2.4 Decision Tracing Dialogs
REACT! is implemented with mechanisms intended to trace decisions involved in everyday activity scheduling. When a respondent manipulates a specific activity record in a certain way, a series of dialog boxes will appear to trace the decision process underlying the manipulation. These queries appear as soon as respondents change or add an activity record in their Daily Calendars. Depending on the response, subsequent dialogs may be triggered to trace the decision process, including asking whether the respondent thought about the benefit of the manipulation.

2.5 Filing Daily REACT! Survey Results
When the household is finished recording the daily activity diaries, the last person is prompted to establish an Internet connection and activate REACT!'s Send Data utility. In the field test, the program databases reside on the client end to achieve privacy and efficiency with a minimum deployment cost. When Send Data is activated, REACT! compresses the database of the entire household with encryption. The data package is sent to the survey administrative server via FTP. The Send Data process is performed automatically without user intervention and when completed, users are notified to exit REACT!.

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3. KEY FINDINGS:

The REACT! program was tested in a pilot study in Irvine, California. Preliminary analyses validate the program's capability of guiding participants to complete data entry tasks on their own, thus the initial objective of reducing the resource requirements of such a computerized survey was achieved. Further, the objectives of reducing instrumental bias and expanding program capabilities were also achieved.

3.1 REACT! Technical Performance
A total of 47 households comprising 81 adults participated in a full week REACT! survey and completed a total of 6738 activities and 1602 trips. In-home activities comprised 76 percent of the total activities. No obvious trends exist over the course of the week for different types of activities, except for the decrease of work/school activities over the weekend and the increase of shopping activities on Saturday. On Sunday, respondents finished their schedules up to the time they ran the program. As for average number of trips, the most notable fluctuation was the increase in car trips on Saturday and the decrease in total trips on Sunday.

The initial, self-administered household interview took 25-45 minutes, depending on household size. Respondents spent between 15 and 20 minutes entering daily activity data and planning subsequent activity for the week.

Following the survey week, each household was asked to assess, from a user viewpoint, whether the program design had achieved its goals. The majority of the responding households indicated that the program's features did properly convey the survey designer's instructions.

3.2 REACT! Behavioral Analyses
Data collected with REACT! were used to examine the structure of activity patterns. The term structure refers to the outcome of a set of decisions facing individuals as they conduct their daily activities. At a minimum, structure can be interpreted as the sequence by which various activities enter one's daily activity scheduling process.

The analyses validated that the hypothesized "activity-peg" phenomenon does exist. Two-way contingency tables show that shorter duration activities were more likely to be inserted opportunistically in a schedule already anchored by longer duration counterparts. An analysis of tour structure revealed that many tours were also opportunistically formed with the proportion of opportunistic stops increasing with the sequential position of an activity in a tour, but with this proportion decreasing as travel time increased. These results demonstrate that a significant portion of trip chains are opportunistically formed and not simultaneously planned and executed chains as suggested in many activity-based models. Travel time required to reach an activity was positively related to the scheduling horizon for the activity, with more distant stops being planned earlier than closer locations.

Dichotomous location and activity type variable (in-home versus out-of-home and work/school versus other) were each included in three-way contingency tables to validate two-way relationships in the presence of a third controlling factor. These results supported the contention that the structures revealed in two-way tables are still valid in the presence of the third factor.
3.3 Overall Assessment
The analyses completed suggests two potential directions to improve current travel demand models. First, in terms of data collection, the conventional activity/travel diary approach needs to be augmented. It is found that a certain portion of out-of-home activities actually occurred spontaneously. Thus, taking "snapshots" of the revealed activity patterns for a day or two does not necessarily capture consistent patterns. Asking questions related to an individual's typical activity program is a potential way of addressing this. For example, based on the finding that individuals tend to adjust the timing of events rather than the locations, it may be worthwhile to consider adding questions to conventional travel diaries addressing whether there are frequently visited locations. If the set of alternative activity locations were known, it would improve the chances to deduce the decision strategies that resulted in the revealed patterns. Second, the analyses demonstrated that the behavioral strategy behind everyday activity scheduling is closer to the viewpoint of transactional opportunistic (i.e., the activity-peg theory) than it is to a simultaneous utility-maximization structure. Instead of contemplating the optimal choices before action, individuals are often improvising in an environment with certain spatial and temporal constraints.
4. JOURNAL PAPERS AND CONFERENCE PRESENTATIONS


5. INNOVATIONS

REACT!, a computer-aided self-administered interview (CASI) software package for surveying travel and activity behavior, was developed by the project team led by Professor Michael McNally and Ming S. Lee with support from a 1999-2001 UCTC faculty grant. REACT! is currently being utilized in several projects including the evaluation of travel behavior impacts resulting from participation in ZEVNET, a shared-use station car program in Irvine, California. ZEVNET, a unique public/private partnership, is utilizing electric vehicles provided by Toyota to local corporations for use in daily business travel as well as to access rail service at the Irvine Transportation Center. A GPS-based vehicle monitoring system (Tracer) provides tracings of vehicle use as part of the REACT! survey.

6. ACKNOWLEDGEMENTS

The genesis of this research project and the REACT! program was the CHASE software package developed by Sean Doherty as part of his dissertation work at the University of Toronto. While visiting at UC Santa Barbara, Sean met with UC Irvine's Center for Activity Systems Analysis (CASA) research group and, in subsequent meetings in Irvine, assisted in the development of a two-year research proposal to UCTC which featured selected enhancements to CHASE, including porting CHASE to a web-based format (iCHASE). It became clear that starting from scratch would be easier and cleaner than the major revisions that would be required for CHASE. Led by Ming Lee (with assistance from Ramesh Sabetiashraf), REACT! was developed as a web-based Computer-Aided Self-Administered Interview (CASI). Ming is not only the primary author of REACT! but was also a partner in defining and executing all research tasks. He tested the REACT! prototype as fielded the final survey to 47 households, the results of which are presented in his dissertation. Michael G. McNally and Ming S. Lee are the authors of this report. The authors acknowledge the support of the University Transportation Centers program, in general, and the University of California Transportation Center, in particular, for support and encouragement on this and prior studies leading to this research.