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**Putting Behavior in Household Travel
Behavior Data: An Interactive GIS-Based
Survey via the Internet**

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University of California Transportation Center

**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.

Initial Interview (Click at the yellow page to get online help)

Household Information:
 You have the option of not answering these questions. If you don't feel comfortable answering any of them or they do not apply to you, please select Undisclosed/NA. Help

Click within each box and type in your address. →

Please enter your home address:

Street Address

City

State Zip

Don't type in the following boxes, click at the triangle to select your answers ↓

Do you own or rent the house?

What's the type of your house?

How long have you stayed at the current residence?

What's your annual household income?

Exit for now and continue later < Back Next > Finish

1. Household Data

Initial Interview (Click at the yellow page to get online help)

Household Members: Help

Please enter the names of your household members (beginning with yourself) to the following list:
 (Note: The first person to run this program should enter names of all household members.)

1. Click on the [Add Person] button
2. Type in your first name on the small box called "Enter Name"
3. Repeat steps 1 and 2 for each remaining household member (if you have children, please enter their names as well)

Add Person Household Members

Name
▶ John
Mary

** If you added a person by mistake, click at the name of the person and click the [Delete Person] button.

Delete Person

Exit for now and continue later < Back Next > Finish

2. Household Members

Initial Interview (Click at the yellow page to get online help)

Member Information: Help

Please enter information about <-- If this person is under 18 years old, parents please answer these questions for him/her.

Gender Age (yrs) Check this box if this person is licensed to drive

Relation to Heads of Household

Education Level

Employment Status

Hours worked in a typical week Example: 40

Occupation

Is this person a student?

Student Level School Name School City

Exit for now and continue later < Back Next > Finish

3. Person Data

Initial Interview (Click at the yellow page to get online help)

Household Vehicles: Help

Please add the vehicles in your household to the following list:

1. Click on the [Add Vehicle] button
2. Click at each box to enter required information (see Example below)
3. Repeat steps 1 and 2 for each additional vehicle
4. If you entered a vehicle by mistake, click at the vehicle and click [Delete Vehicle]

Add Vehicle Delete Vehicle

Example:

Make	Model	Year	Seats
▶ Toyota	Camry	1988	5
Honda	Accord	1998	4

* Make, Model, and Year of a vehicle are required.

Exit for now and continue later < Back Next > Finish

4. Vehicle Data

Initial Interview (Click at the yellow page to get online help)

Frequently Visited Locations:

- Please review the list of locations on the left. If there is one that you visit at least once per month, click at this location then click at the right-arrow button to move it to the list on the right.
- Be sure to move (Home) to your Frequent Locations !!!

Locations in the area

Location Description	City
Parkview Center on University Dr and Michelson (Ralphs, IHOP)	Irvine
The Crossroads on Barranca and Culver (Target, Mervyn's)	Irvine
UCI Campus	Irvine
University Park Center on Culver and Michelson (Ralphs, Chevron, ACE)	Irvine
University Town Center on Campus and Bridge (Post Office, In and Out)	Irvine
Walnut Village Center on Walnut and	Irvine

Frequent Locations

Frequently Visited Location

3. If you don't see a location here, click this button --> **Add a location not in the list**

Exit for now and continue later | < Back | Next > | Finish

5. Location Data

iChase Map

Full View | Zoom Out | Zoom In | Indicate | Help

Indicate the location of Office Depot

Instructions:

- To find the location: With [Zoom In] button pushed in, click on approximate location on map
- To pinpoint the location: Click on [Indicate], then click on the exact point on the map

Move Up | Move Left | Move Right | Move Down

Navigation Map

Exit for now and continue later | < Back | Next > | Finish

6. GIS Utility

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John (Parents when answering for your children, you can skip this form by clicking [Next>])

- Please check all the activities this person typically does (at least once per month):
- The activities currently checked are defaults. Please do not uncheck them.
- Be sure to review the list all the way to the end and select Work if you are employed !!!

<input checked="" type="checkbox"/>	[Eat/Sleep/Wash]	Night sleep
<input checked="" type="checkbox"/>	[Eat/Sleep/Wash]	Shower/dress/pack
<input type="checkbox"/>	[Eat/Sleep/Wash]	Snack
<input type="checkbox"/>	[Household Obligation]	Attending to children (at home)
<input type="checkbox"/>	[Household Obligation]	Cleaning/Maintenance (at home)
<input checked="" type="checkbox"/>	[Household Obligation]	Filling out iCHASE survey
<input type="checkbox"/>	[Household Obligation]	Meal preparation
<input checked="" type="checkbox"/>	[Household Obligation]	Other household obligations
<input type="checkbox"/>	[Household Obligation]	Pick-up/drop off others
<input type="checkbox"/>	[Household Obligation]	Pick-up/drop-off kids
<input checked="" type="checkbox"/>	[Incidental Travel]	Incidental travel
<input checked="" type="checkbox"/>	[Incidental Travel]	Tag along travel
<input type="checkbox"/>	[Kids' Activities]	Homework

4. If an activity you typically do is not in the list, click this button to add this activity. **Add a New Activity**

Exit for now and continue later | < Back | Next > | Finish

7. Activity Types

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John

How often do you do the following activity? Activity 1 of 3

(*Parents when answering for your children, you can skip this form by clicking [Next>])

Activity Title: **Household Obligation : Cleaning/Maintenance (at home)**

Enter your answer here: time(s) every

Example: 5 time(s) every Month

Exit for now and continue later | < Back | Next > | Finish

8. Activity Frequency

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John Help

Typically, how long does it take every time you do the following activity?

(*Parents when answering for your children, you can skip this form by clicking [Next>])

Activity Title: Activity 2 of 3
Shopping : Major Grocery (10+ items)

Typical duration of this activity is: 50 Minute
Example: 5 Hours

Exit for now and continue later < Back Next > Finish

9. Activity Duration

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John Help

Typically, when would you do the following activity?

(*Parents when answering for your children, you can skip this form by clicking [Next>])

Activity Title: Activity 2 of 7
Household Obligation : Cleaning/Maintenance (at home)

Does this activity occur on fixed day(s) of the week? Yes No

Does this activity have a fixed start/end time? Yes No

What days could it occur on?
 Monday Thursday
 Tuesday Friday
 Wednesday Saturday
 Sunday

Enter earliest start and latest end times:
 Earliest Start: Hour: 1 Min: 00 AM PM
 Latest End: Hour: 1 Min: 00 AM PM

Exit for now and continue later < Back Next > Finish

10. Activity Scheduling

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John Help

Typically, where would you do the following activity?

(*Parents when answering for your children, you can skip this form by clicking [Next>])

Activity Title: Activity 1 of 2
Shopping : Major Grocery (10+ items)

Typical Locations for this activity:
Culver Plaza on Irvine Center Dr and Culver (99 University Park Center on Culver and Michelson)

Frequently Visited Locations:

Location	Description
<input type="checkbox"/>	University Town Center on Campus and Bridge (Post Office, In and Out)
<input type="checkbox"/>	South Coast Plaza
<input checked="" type="checkbox"/>	University Park Center on Culver and Michelson (Ralphs, Chevron, ACE)

If you cannot find the location in this list, click [More Locations] ->

Exit for now and continue later < Back Next > Finish

11. Activity Location

Initial Interview (Click at the yellow page to get online help)

This question should be answered by: John Help

Who are the other persons involved in the following activity?

(*Parents when answering for your children, you can skip this form by clicking [Next>])

Activity Title: Activity 2 of 2
Shopping : Major Grocery (10+ items)

If other persons occasionally do this activity for you (so you can do something else), please check them in the following list:
 Mary
 Others

If you usually do this activity with other persons, check them in the following list:
 Mary
 Others

Exit for now and continue later < Back Next > Finish

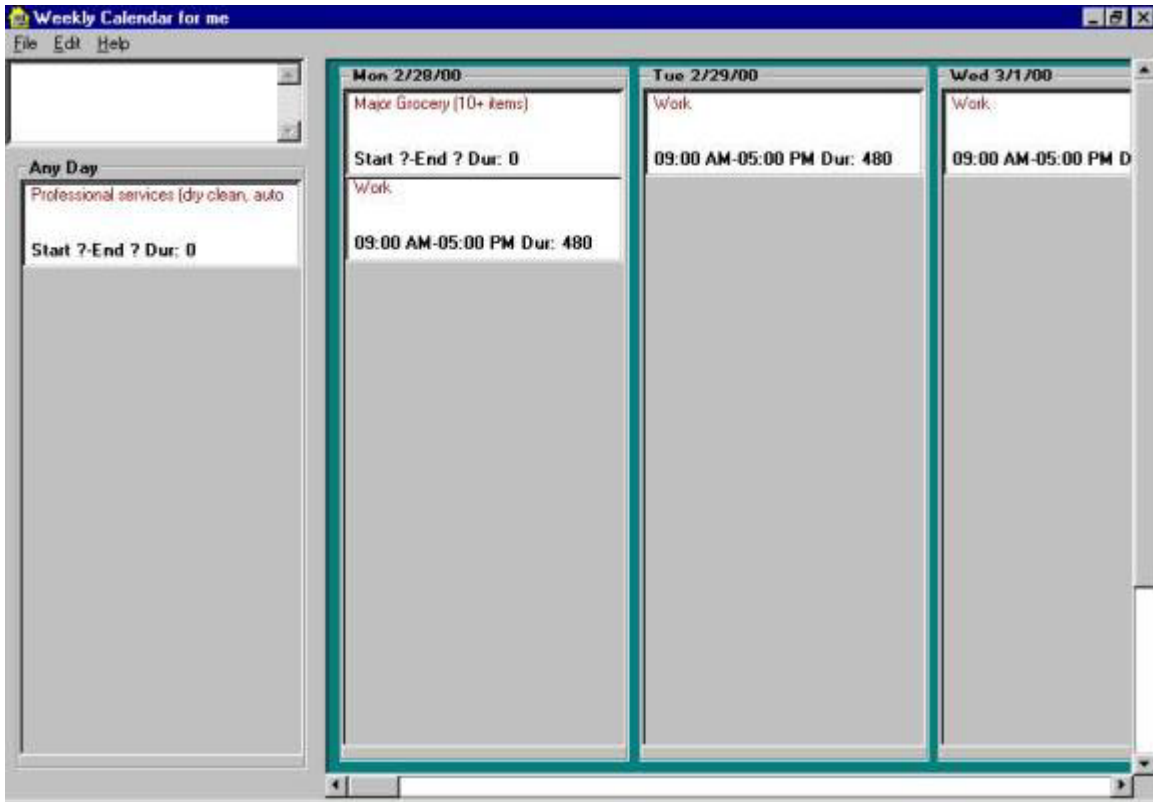
12. Involved Persons

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.

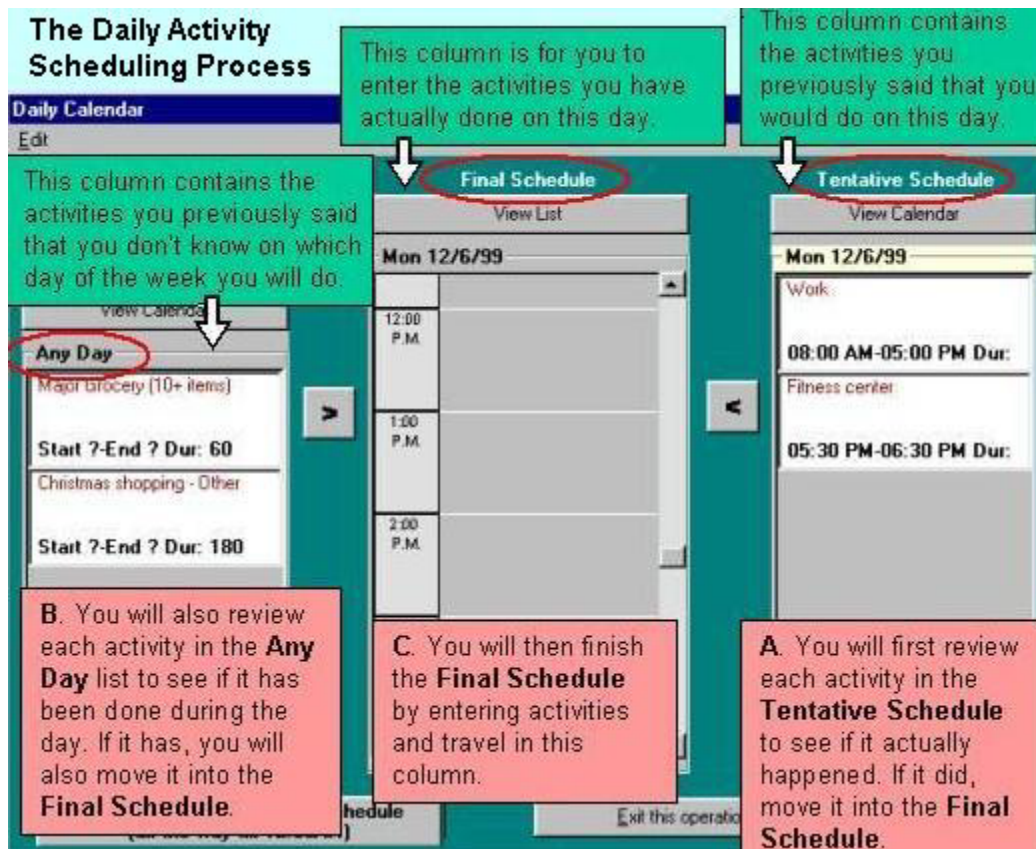


14. Pre-travel Planning

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.

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4. JOURNAL PAPERS AND CONFERENCE PRESENTATIONS

1. Lee,MS and McNally,MG (2002). "On the Structure of Weekly Activity/Travel Patterns", presented at the *81th Annual Meeting of the Transportation Research Board*, Washington, DC.
2. Lee,MS and McNally,MG (2001). "Experiments with A Computerized Self-Administrative Activity Survey", *Transport Research Record*, 1748, 125-131.
3. Lee,MS (2001). "Experiments with A Computerized Self-Administered Activity Survey: Evaluation of a Pilot Study", PhD dissertation, Department of Civil and Environmental Engineering, University of California, Irvine, March 2001.
4. Lee,MS, Marca,JE, Rindt,CR, Koos,AM, and McNally,MG (2001). "A Shared-Use Electric Vehicle Program: Integrating a Web-based Survey with In-vehicle Tracking", presented at the *17th PacRim Regional Science Association Meeting*, Portland, July 2001.
5. Kulkarni,AA and McNally,MG (2001). "A Microsimulation of Daily Activity Patterns", presented at the *80th Annual Meeting of the Transportation Research Board*, Washington, DC.
6. Marca, JE, Rindt, CR, and McNally, MG (2000). "A Simulation Framework and Environment for Activity-based Transportation Modeling", presented at the *79th Annual Meeting of the Transportation Research Board*, Washington.
7. Lee, MS, Doherty, ST, Sabetiashraf ,R, and McNally, MG (2000). "iCHASE: An Internet Computerized Household Activity Scheduling Survey", presented at the *79th Annual Meeting of the Transportation Research Board*, Washington, DC.
8. Kulkarni, AA and McNally, MG (2000) "An Activity-based Travel Pattern Generation Model", presented at the *39th Annual Meeting of the Western Regional Science Association*, Kauai, Hawaii, February 2000.
9. Marca, JE, Rindt, CR, and McNally, MG (2000) "A Latent Factor Model of Observed Traveler Activity Sequences", presented at the *9th International Association of Travel Behavior Research Conference*, Queensland, Australia.
10. Kulkarni, AA and McNally, MG (2000) "An Activity-based Microsimulation Model for Generating Synthetic Activity-Travel Patterns: Initial Results," presented at the *9th International Association of Travel Behavior Research Conference*, Queensland, Australia.
11. Lee, MS, Doherty, St, Rindt, CR, and McNally, MG (2000) "Extending the Scope of Computerized Household Activity Scheduling Surveys", presented at the *9th International Association of Travel Behavior Research Conference*, Queensland, Australia.
12. ITS Review (2000). "High-Tech Answers to Travel Behavior Questions", *ITS Review*, Vol. 23, No.1-3, pp 6-7, May 2000.

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.