

Appendix A.

Early Tests and Equipment Evaluation

(NATDAC Paper)

GLOBAL POSITIONING SYSTEMS FOR PERSONAL TRAVEL SURVEYS

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ABSTRACT

Personal travel and how it changes is of continuing concern to transportation planners and policy makers. Information about daily travel patterns and trip purposes, time of day decisions, mode choice decisions, and trip chaining decisions are generally captured using self-reported information using a written diary and telephone retrieval. This project developed a small, user-friendly, mailable unit including a Global Positioning System (GPS) element that does not need a trained technician for installation in a private vehicle. The unit was developed to capture variables that would be entered by the vehicle driver using a menu, such as trip purpose and vehicle occupancy, and to capture automatically-recorded variables such as date, start time, end time, and latitude and longitude at frequent intervals. Finally, after mail-back return of the units, the data are processed to include variables such as travel speed by road classification, trip distance, and trip time. The unit allows for collection of travel data over several days to avoid potential short-term, survey-induced travel behavior changes.

This method of data collection has two potential benefits: improving the quality of travel behavior data, and reducing respondent burden, e.g., time on the telephone for reporting travel. Using GPS technology, while increasing privacy concerns, may improve overall survey responses in travel behavior studies. Technical issues for hardware, software, and comparison of results between self-reported travel and machine-recorded travel are provided.

Keywords: GPS, travel behavior, household travel surveys

INTRODUCTION

Personal travel and how it changes is of continuing concern to transportation planners and policy makers. Information about daily travel patterns and trip purposes, time of day decisions, mode choice decisions, and trip chaining decisions, are generally captured using **self-reported** information using a telephone recall method, or some kind of diary.

Transportation professionals and other users of the collected data surmise that people likely omit very short trips using self-reported methods. The current trend in collecting this type of data is to use an activity, rather than a travel diary, to attempt to both capture these short trips as well as to

identify at-home activities that are substituting for traditional at-work activities. Nonetheless, self-reporting is used for this approach as well. Other problems with self-reporting include the tendency to round travel times to 10, 15, and 30 minute intervals.¹ Similar tendencies to round may be occurring in reporting trip distances as well. It may be that overall, VMT reporting is fairly complete using self-reporting methods, but that people neglect to report the short stops made during a journey, like stopping at the post office, ATM, or video store. Another issue with the trend toward activity reporting is the burdensome nature of telephone interviews that are averaging close to one hour per household for a 1-day household travel survey.²

Vehicle instrumentation, including a GPS has been used in various Intelligent Transportation Systems (ITS) projects, for example in the Orlando TRAVTEK project, the Chicago ADVANCE project, and an EPA-sponsored research project at Georgia Tech. In the TRAVTEK and ADVANCE projects, GPS has been used to assist drivers in routing. That is, the GPS "knows" where the vehicle currently is, and the on-board computer can then "direct" the driver to their destination, potentially with the ability to include real-time information to direct the driver around congestion or accidents. These two projects rely on specially designed vehicles and combine GPS with other in-vehicle instrumentation (such as transmission sensors) to support dead-reckoning or map-matching techniques to pinpoint vehicle position. In the Georgia Tech project, the transponders are attached to personal vehicles to also provide information on engine operations and emissions.

This project would combine self-reported information with GPS recorded information and will provide recommendations about the potential usefulness of this technology for measuring changes in personal travel behavior. This technology has the potential for both improving the quality of data on travel behavior and reducing respondent burden for reporting this behavior.

OBJECTIVES

This project has three overall objectives.

1. Develop a method and hardware to integrate GPS technology with self-reported travel behavior to improve travel behavior data.
2. Document the differences between self-reported travel and GPS recorded travel and document the pros and cons of each method.
3. Determine potential for using GPS technology with regional and national travel behavior surveys, with particular regard to subjective responses to privacy.

The project is being conducted in three phases. Phase One defined a functional specification for the data collection device and compiled vendor and other technical information about GPS receivers, hand held and palm top computers and personal digital assistants (PDAs), and other equipment that might prove useful in this application. Phase Two performed a series of bench tests

using several GPS receiver configurations to test the ability of the GPS equipment to collect position data that would be useful to support the personal travel data studies. Phase Three of the project is a larger field demonstration of the complete data collection device, collecting actual data from at least 100 households for subsequent analysis.

GENERAL DESCRIPTION OF THE DATA COLLECTION UNIT

The result of the Phase One activity established the general definition of the data collection device. The key components include the GPS receiver, the user interface, and the control unit. The user interface and control unit are made up of a single component, a hand held PDA equipped with touch screen for user inputs. The GPS receiver will likely use PCMCIA technology with an antenna mounted on the vehicle dashboard or roof top.

Operationally, the data collection unit is envisioned as a “plug and play” concept, requiring minimal installation and set up effort on the part of the user. The touch screen user interface, to be used for the self-reported portion of the travel information, is being designed to mimic the operation of an ATM, which is very familiar technology for a large segment of the population.

Travel data would be collected over a period of five to six days. Both user inputs and GPS position data would be stored internally or on a PCMCIA memory card. Principal power for the unit would be supplied via the vehicle’s cigarette lighter, with internal batteries to sustain the unit’s operating system when the vehicle is inoperative. The unit’s control software is designed to collect GPS data only when the vehicle is operating to conserve available memory capacity, and to place the entire unit in a “sleep” mode when the vehicle is not operating in order to conserve the internal batteries. This operating protocol will be fully tested before use in the broader field demonstration.

BENCH TEST OF GPS CONFIGURATIONS

Phase two of the project examined two issues. First, can the GPS positional data be collected with the continuity required for the personal travel survey using only a GPS receiver? There are many obstructions (overpasses, tall buildings) to the line-of-sight reception of the GPS signals and there is no opportunity for reliance on a second, independent positional data source (such as dead reckoning).

Second, what type of GPS receiver technology is better suited for this application? There is a wide variety of GPS receiver and ancillary equipment available. Phase two focused on a series of bench tests in order to address these two questions.

Receiver Selection

Three relatively high-performance, low-cost, off-the-shelf GPS receivers were chosen for use in the bench tests. The receivers were generally representative of existing, general-use GPS receiver technologies. The receiver set was comprised of a low-power 5-channel PCMCIA Type II receiver,

a powerful 12-channel all-in-view serial kit receiver, and a 3-channel integrated receiver-antenna serial reception unit. Table 1 provides a brief summary of characteristics descriptive of the three GPS technologies.

Table 1. Features of the GPS Receivers Used in the Bench Tests

Receiver Feature	GPS Receiver		
	All-in-view Serial Receiver	PCMCIA (Type II) Receiver	Integrated Receiver & Antenna
Horizontal Position Accuracy	30 meters per axis (with SA inactive) 100 meters per axis (with SA active) <3 meters per axis (with differential correction)	50 meters per axis (with SA inactive) 100 meters per axis (with SA active)	50 to 100 meters
Time-to-First-Fix (TIFF)	5 to 10 minutes (almanac initialization) <60 seconds (with current almanac, position, time) <30 seconds (with current almanac, position, time, ephemeris)	30 seconds to 8 minutes	15 to 30 minutes (almanac initialization) 30 seconds to 2 minutes (power up)
Signal Reacquisition Time (typical)	2 sec (60 sec obscuration) 10 sec (60 min obscuration)	<10 sec (single satellite obscuration of < 15 sec)	not listed
Number of Tracking Channels	12	5	3
Satellites Tracked	all in view	9	8
Message Frequency	1 per second	1 per second, resettable 1 to 5 second intervals	1 per second, resettable to 5 or 10 seconds
Message Protocols	NMEA 0183 Proprietary Binary	NMEA 0183 Proprietary Binary	NMEA 0183 Proprietary Binary
Unit Size (inches)	4 W x 6 L x 1.5 H	2.2 W x 5.4 L x 0.25 H	3.2 W x 5 L x 1.7 H
Unit Weight (lbs)	1.3	0.2	0.75

The three receivers were configured into different test arrangements for the purpose of making comparisons. These configurations focused on using different GPS antennas, using different GPS

antenna mount locations, and differential correction of the GPS data. Table 2 illustrates the various test configurations used in the bench tests.

Table 2. Test Configurations for the Bench Tests

Test Configuration	GPS Receiver	Antenna Type		Antenna Mount		Differential Correction	
		Active	Passive	Roof	Dash	Yes	No
#1	Integrated Receiver & Antenna				✓		✓
#2	PCMCIA (Type II)		✓	✓			✓
#3	All-in-view Serial	✓		✓			✓
#4	All-in-view Serial	✓		✓			✓
#5	All-in-view Serial	✓			✓		✓
#6	All-in-view Serial		✓	✓			✓
#7	All-in-view Serial	✓		✓		✓	

Seven bench test trials were performed to collect data over the test route. In trials #1 through #3, each of the three receivers was configured in an arrangement which was thought to yield the best performance or was most likely to be used because of its inherent capabilities. Trials #4 through #7 explored different configurations using only the 12-channel serial receiver box. Differential corrections were made available to the 12-channel GPS receiver using a special cable provided with the receiver development kit. The differential corrections were provided through a separate, battery-operated pager-type FM subcarrier receiver, capable of providing sub-meter accuracy corrections.

Test Route

All seven test configurations used the same test route. The route was chosen previous to the bench tests in an effort to be as representative as possible of the travel segments and roadway obstructions afforded in the metropolitan Columbus, Ohio area. Some examples of included travel segments are

- older neighborhood with mature trees and relatively narrow streets,
- newer subdivision-style neighborhood with typically wider streets,
- suburban business district with relatively wide streets,
- central business district streets in an urban “canyon,” and
- state route limited access and interstate highways.

Some obstructions that are featured in the test route included natural terrain (e.g., hills and trees), manmade structures (e.g., short, tall, and skyscraper-type buildings), and overhead structures (e.g., automobile overpasses, rail trestles, and pedestrian walkways). The test route travel distance is

approximately 19 miles and travel time is 45 to 60 minutes, depending on time of day and traffic conditions.

Bench Tests

The same type of data was collected for each receiver configuration at the same rate so that comparisons across receiver configurations could be made. These data were collected from each receiver at 1 pulse per second (1 Hz) and recorded directly to the control unit hard drive. The same control unit, a laptop PC with a 486 MHZ processor, was used in each trial. The GPS receivers were powered through the test vehicle cigarette lighter port, except for the PCMCIA receiver. The PCMCIA receiver was powered directly from the laptop PC, which was powered by its own NiCad battery.

Prior to the tests, each of the receivers was programmed to output a common RMC NMEA 0183 ASCII text output message. RMC is a standardized NMEA 0183 output message which delivers a set of the recommended minimum specific GPS data. These specific data includes time, date, position, course, and speed information. Though all of the receivers could be programmed to provide a more efficient binary output of raw data, NMEA ASCII output was chosen to facilitate the bench tests and subsequent data analyses, principally for the following reason.

The NMEA 0183 output message format is standardized. This is not true of the binary output messages provided by each receiver, where message format was proprietary and differed significantly in format from manufacturer to manufacturer. Working with a standardized output permitted a single, internally-developed data manipulation program without making modifications for each receiver. These data manipulations consisted of cleaning up bad records (data skip, message appendages, records taken during a loss of fix, etc.), making distance calculations, and translating output messages to position data files which could be later read by GIS plotting software.

Because binary output generally can store the same information more efficiently, actual GPS/PTS field tests will likely use a binary output message format since only one type of receiver is used.

Issues Regarding the Collected Data

There are several factors that prevent the bench trials from representing identical conditions for each of the receiver configurations.

First, the bench test trials were conducted over a number of days. Each trial typically lasted 50 to 55 minutes and consumed over an hour from pre-trial setup to securing the data following each trial. Consequently, the different geometries of the satellites in view (and of those satellites being used to obtain position information) relative to the GPS receiver affected the positional calculation for each receiver. Because of the rapidly changing geometry of the NavStar satellites over time and days, this reality could not be avoided.

Second, the length of each trial was somewhat dependent upon the traffic conditions along the test route. Relatively small changes in the amount of traffic experienced in the test route could significantly affect travel time. While direct comparison of travel times over the test route are not possible due to the changing conditions, this is not a significant issue from the viewpoint of the bench tests.

Some additional factors that may have affected the comparability of the collected data include the uncertainty of the broadcast update rate for differential correction (only in Trial #7), the imposition of selective availability by the Department of Defense (which dilutes the accuracy of the GPS receivers), and potential interference to signal acquisition that may have emanated from the test vehicle (e.g., automobile electronics) or outside sources.

While these issues were identified and considered in the head-to-head comparison for the bench tests, they represent real conditions that will be present for any field data collection effort.

Results of the Bench Tests

These results are of two types. First are the calculated route and segment distances using the positional data obtained from the GPS receivers. Distance calculations were based on the one-second data collected during the tests, and additional files were created to simulate 3, 5, and 10 second data for additional distance calculations for the total route. All distance calculations were compared to the odometer reading of the vehicle used in the tests. The accuracy goal for the distance calculations is 5% of the total trip length or $\frac{1}{4}$ mile.

The second type of result from the bench tests are observations drawn from a visual inspection of the positional point data (using TransCAD GIS plotting software) compared to a map of the test route. This result relates to the goal of identifying the specific roadways traveled based solely on the positional data.

Distance Calculations

Table 3 contains the error in calculated distance for the entire test route and different data collection intervals (simulated in these analyses). A general observation across all test configurations is that shorter collection intervals (i.e., more data collected) result in a greater error in the calculated travel distance. The shaded boxes in the table identify those distance calculations that do not meet the stated accuracy goal.

Table 3. Distance Calculation Errors for the Entire Test Route (19 miles)

Data Interval	Bench Trial						
	#1	#2	#3	#4	#5	#6	#7
1 second	3.9%	11.5%	5.5%	3.4%	9.5%	4.7%	6.9%
3 second	3.2%	7.6%	4.9%	3.3%	8.8%	4.5%	5.6%
5 second	1.1%	6.3%	4.6%	2.8%	8.5%	4.2%	4.7%
10 second	1.4%	5.0%	3.8%	2.2%	6.9%	3.6%	2.9%

More frequent data are desirable to determine receiver position and ascertain which roadways are traveled. However, the positional data from a stationary receiver (such as when a vehicle is stopped at a red traffic signal) do not focus on a stationary point. These data are near the stationary point, but individual positional records are scattered around the location within an area dictated by selective availability and the accuracy of the individual receiver (which could be ± 100 meters). These position errors associated with each record add up arithmetically when performing point-to-point calculations to determine travel distances. The same effect is seen in all cases, including trial #7 which is differentially corrected data.

Table 4 shows the errors for calculated distances in the individual route segments. The $\frac{1}{4}$ mile error percentage is shown for reference and the shaded boxes identify those calculations that did not meet the accuracy goal. The greatest errors observed in the calculated distances are observed in test route segments where line-of-sight challenges were the most formidable (e.g., downtown urban canyon, segments #2 and #3). This is an expected result. All of the test configurations performed well outside these two segments, and test configuration #1 and #4 performed well even in the urban canyon.

Table 4. Distance Calculation Errors for Individual Segments of the Test Route (1-second data)

Route Segment	$\frac{1}{4}$ mile error	Bench Trial						
		#1	#2	#3	#4	#5	#6	#7
#1 (1.85 miles)	13.5%	2.7%	8.1%	1.6%	4.3%	3.8%	0.5%	7.6%
#2 (1.85 miles)	13.5%	1.1%	50.3%	6.5%	4.3%	65.4%	23.8%	28.1%
#3 (1.20 miles)	20.8%	19.2%	64.0%	34.1%	3.3%	7.5%	6.7%	9.2%
#4 (7.60 miles)	3.3%	4.6%	2.6%	3.6%	3.6%	3.7%	3.2%	3.8%
#5 (1.40 miles)	17.9%	0.7%	1.4%	1.4%	0.7%	1.4%	1.4%	7.1%
#6 (5.10 miles)	4.9%	1.6%	4.5%	3.9%	3.3%	2.2%	2.4%	2.9%

Another aspect of performance is important in comparing the test configurations. Each bench trial had some corrupted data resulting from loss-of-fix and other record errors in the test file. For each test configuration, the data were scrubbed to remove these corrupt records, thus only non-corrupt records providing valid time, distance, and position data are included in the travel distance calculations. Table 5 shows the number of valid data records from each test configuration for the individual route segments and the total route. The performance measure of interest is “percent of ideal,” where “ideal” is defined as one valid record for every second of travel time. Test configuration #1 exhibited poor performance compared to all other configurations, with just slightly over half of the collected records resulting in useful information.

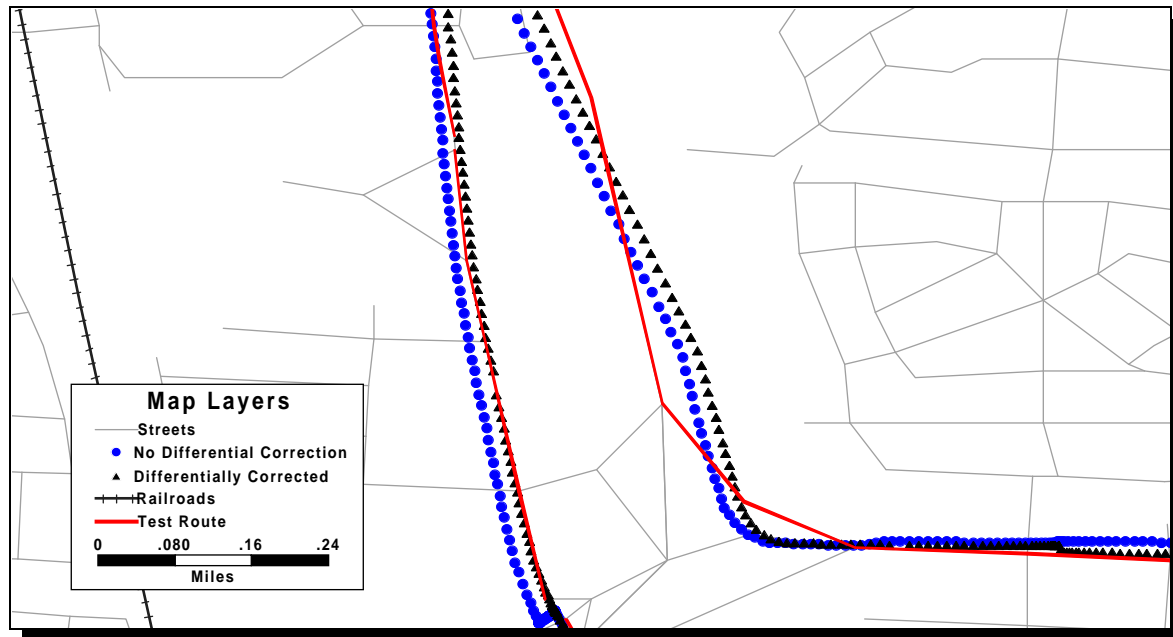
Table 5. Valid Records Collected for the Test Route (one-second data)

Route Segment	Bench Trial						
	#1	#2	#3	#4	#5	#6	#7
#1 (1.85 miles)	250	537	413	607	623	356	374
#2 (1.85 miles)	182	483	505	552	1,257	471	514
#3 (1.20 miles)	123	216	309	181	173	246	239
#4 (7.60 miles)	417	857	917	873	990	699	844
#5 (1.40 miles)	82	223	212	199	233	209	217
#6 (5.10 miles)	434	829	846	882	749	646	667
Total Route	1,483	3,140	3,197	3,289	4,020	2,622	2,850
% of Ideal	51.0 %	99.3 %	99.7 %	99.8 %	99.5 %	99.9 %	99.8 %

Positional Accuracy

Other projects using GPS in establishing vehicle location have generally relied on at least one other method of real-time measurement in addition to GPS for increased positional accuracy. Our ultimate purpose is to use the GPS data directly since additional real-time measurement methods are not feasible for a naive user-installed application. One method of increasing positional accuracy without increasing user difficulty is using differential GPS. Figure 1 shows a portion of test configuration #4, using absolute GPS, and test configuration #7, the same configuration with differential correction, plotted on a Tiger file backdrop of the Columbus metropolitan area.

Figure 1. Comparison of Absolute and Differential GPS Test Data



Generally, the positional results were found to be consistent with published accuracies. Absolute data were found to always be within approximately 150 feet left or right of the Tiger file roadway center lines, and often much closer. The differentially corrected data were significantly more accurate and ranged from being plotted right on top of roadway stretches to a maximum of approximately 75 feet from centerline, about $\frac{1}{2}$ the deviation exhibited by the absolute GPS plot.

Qualitatively speaking, the differentially corrected path plots always appeared to be significantly tighter around roadway bends and roadway changes. This is important in dense roadway areas, especially if those roads are traveled only for short distances. For these reasons, differential corrections may be necessary for broader use in field tests. However, the accuracy of the base map and the map-matching algorithm should be considered in conclusions related to positional accuracy. Also, as the Department of Defense relaxes the restrictions posed by selective availability, the absolute GPS data will become more positionally accurate.

Other Issues

Two issues related to the GPS receiver antenna were examined as part of the bench tests. These issues are active versus passive antennae and external versus internal mounts for the antenna. Also, the number of channels available in the receiver is important in establishing performance.

No significant advantages in positional accuracy were observed in test configurations that used active versus passive antennae. In fact, the term “active” is somewhat of a misnomer since the active antenna used in the tests was not driven by any power source. In general, this is not a significant issue for this application and using the antenna provided with the chosen receiver is probably the best approach to ensuring that the receiver will perform to manufacturer specifications.

Comparisons between test configurations using internally and externally mounted antennas generally shows that the externally mounted antenna test configuration performed better. Test configuration #4 (external, roof mount) and test configuration #5 (internal, dash mount) provide a direct comparison where the only difference in the test configurations is the antenna mount. The external mount is consistently better as measured by the distance errors for the entire test route (Table 3) and is substantially better in the urban canyon segment (Table 4). In general, the externally mounted antenna configurations do not have to contend with the line-of-sight blockages resulting from the test vehicle when encountering building obstructions and changes in direction of travel.

The biggest difference related to the number of channels is illustrated in Table 5. Test configuration #1 had only three channels that could track up to eight satellites sequentially. This combined receiver-antenna is not suitable for external mounting, thus the results shown for test configuration #1 may also reflect some effects from the internal mount as described above. However, the largest decrement appears to result from the number of channels since the other internal mount test (test configuration #5) recorded a high fraction of valid data. In general, the more channels available to track satellites, the quicker the receiver will recover from a loss-of-fix due to obstructed views and changes in direction of travel.

Power management is a significant issue because the objectives include collecting data over a period of five to six days. The 1990 NPTS data indicate that to capture 95% of vehicle trips, the unit would have to store up to 158 minutes (2.6 hours) of data per day. So, for a 6 day period, fully operational power is required for at least 15.6 hours. The device must be capable of sleeping and waking at the appropriate times both to conserve internal battery power and avoid draining the host vehicle battery. Good power management will also support more efficient use of available memory storage capacity by effectively shutting down the GPS unit when the vehicle is not being used.

Conclusions from the Bench Tests

The bench tests permit several conclusions related to the data collection unit.

The GPS data can be collected with sufficient continuity for personal travel survey information. One-second data is probably needed to provide a complete track of the route driven, especially when the travel is at relatively high speed, such as on an interstate highway. This one-second trace is also useful for determining the functional class of highway traveled. Less frequent data, however, is sufficient for collecting travel distance and travel time. In these test, the errors

associated with travel distance calculations were consistently smaller when less frequent data were used.

Differential GPS data provides increased positional accuracy that may be required to identify the highway functional class for each trip. Differential GPS would almost certainly be required if the post-processing to identify functional class is performed manually. If the post-processing can be performed automatically, absolute GPS may be sufficiently accurate for this identification. Differential GPS offers no advantage for the point-to-point travel distance calculation.

The chosen equipment must have sufficient tracking channels to consistently collect the GPS positional data. In these tests, both the five-channel and 12-channel receivers demonstrated good performance. Also, a roof-mounted antenna is the best option to avoid some line-of-sight tracking issues and to give the receiver a better opportunity to collect the positional data.

PLANS FOR PHASE THREE

Phase three of the project is now underway. The overall objective of phase three is to demonstrate the ability to improve the quality of travel behavior data through automatic data collection.

The principal data of interest are vehicle occupancy and trip purpose. The user interface to collect these data using touch screen menus is currently being developed.

Vehicle occupancy will identify the driver and the passengers in the vehicle. This entry will identify the individual household members and include a count of non-household members. The 1990 NPTS data show that for over 90 percent of vehicles, there is a primary driver.³ Many trips (67%) are also drive-alone,⁴ thus it is probably not much of a burden for the respondent to identify the driver and passengers. Since each household will be individually recruited to participate in the demonstration, the data collection unit will be personalized to show the names of the individuals in the household on these menus, making it easy to select the driver and household members who are in the vehicle. This approach should facilitate data entry through familiar cues rather than an abstract menu.

Trip purpose, on the other hand, is much more difficult to organize and to program into a simple menu system. The current design includes a two-stage trip purpose selection menu, with a total of 15 purposes for the driver, and 15 purposes for passengers. Results of recent activity-based self-reported diaries were used to select those activities that appear most frequently and to include these activities on the primary screen shown in Table 6.^{5,6} Since the unit is being designed for vehicle drivers, trips to day care and pre-school activities are confined to passenger trip purposes, shown in Table 7. These choices will be adjusted after additional testing, before use in the actual field test.

Table 6. Trip Purpose Menus for the Driver

Primary Menu	Secondary Menu Choices
Pick Up or Drop Off Passengers	-Pick Up Passenger -Drop Off Passenger
Work or School	-Work Place -Work-related Business -School, College, University
Shopping & Personal or Household Business	-Shopping -Errands and other personal business, such as bank, post office, dry cleaner, video rental, barber, car repair, etc.
Eat Out	<i>none</i>
Social or Recreational	<i>none</i>
Medical or Dental	<i>none</i>
Return Home	<i>none</i>
Other	-Religious Activities -Volunteer Work -Community Meetings, Political or Civic Events -Other

Our goal is to have respondents select their immediate destination on the trip purpose menu. This immediate destination may differ from their ultimate destination. Trip chaining has become an important topic in the travel behavior research community. Some research indicates that as many as 30 percent of trip chains are complex, containing more than one stop.⁷ It is difficult for someone in the general public to determine a trip purpose, if their ultimate destination is to return home after work, but with a stop at the dry cleaner along the way. The respondent may select “Return Home” for both trips, instead of selecting “Personal Business - Errands” for the first destination to the dry cleaners.

Telephone interviewers can probe respondents for corrections during a telephone interview, but the in-vehicle palm top unit will not have the same ability to judge reasonable choices. Reminding respondents of their last choice when a new trip purpose is selected, and allowing the respondent to correct their choice, may be one way of reducing these errors.

The in-vehicle data collection units are planned to be in operation for 5 or 6 days in each vehicle. A “recall” telephone interview with the respondent will be conducted on one day during the data collection period. This telephone interview will be similar to the travel day portion of the 1995 Nationwide Personal Transportation Survey, where information on trips for a 24-hour period is collected. The recalled travel data will be compared to the machine-recorded travel data, in terms

of overall number of trips, trip purpose, travel time, and travel distance. In addition, the machine-recorded travel data will allow measurement of travel distance for each trip by roadway functional class, something that respondents are not able to report.

Table 7. Trip Purpose Menus for the Passenger

Primary Menu	Secondary Menu Choices
To Day Care or Preschool	<i>none</i>
Go Along for the Ride	<i>none</i>
Work or School	-Work Place -Work-related Business -School, College, University
Shopping & Personal or Household Business	-Shopping -Errands and other personal business, such as bank, post office, dry cleaner, video rental, barber, car repair, etc.
Eat Out	<i>none</i>
Social or Recreational	<i>none</i>
Medical or Dental	<i>none</i>
Return Home	<i>none</i>
Other	-Religious Activities -Volunteer Work -Community Meetings, Political or Civic Events -Other

Finally, the user's acceptance of this type of data collection device is key to the future use of this technology for large scale data collection efforts. Ease of use issues are being addressed by incorporating a touch screen interface in the device for user input. Operationally, the device will mimic a ATM machine which is probably familiar to most of the people that will participate in the field test.

Many other differences exist between this automated data collection device versus a travel diary or telephone interview. Since this device essentially tracks every movement of the vehicle (and thus the person), privacy issues are expected to be raised as a point of concern for the respondent. There are other concerns, principally liability issues, related to the physical installation of a device in a private vehicle. These and other issues will continue to be examined as a part of this technology demonstration in phase three.

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Appendix B.

Respondent Questionnaires

CASE ID	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> . 1	01
DATE	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> MM DD YY	07
INT#	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	15
TOTAL TIME	<input type="text"/> <input type="text"/>	20
EDITOR	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	22

GPS Methodology in Personal Travel Surveys Field Demonstration Study

Post-Usage Interview Eligible Primary Driver

Conducted By:

Battelle/Survey Research Associates

Conducted For:

U.S. Department of Transportation
Federal Highway Administration

September, 1996

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TIME BEGAN :

A1. I'd like to ask some questions about your travel on (TRAVEL DAY DATE). Please understand that we define a trip as any time you went from one address to another in a vehicle or by walking or biking. Each stop you make is a separate trip, including picking up or dropping off someone.

COMPLETE COLUMN A BELOW. PROBE FOR EACH TRIP REMINDING ABOUT STOPS ALONG THE WAY. AFTER THE ENTIRE DAY'S TRAVEL IS LISTED, ASK B-H FOR EACH TRIP.

	A.	B.	C.	D.	
	Think about when you awoke that morning. Where is the first place you went? Where did you go next? ACCOUNT FOR ALL TRIPS.	What is the address or nearest road intersection for (TRIP IN A)? LEAVE HOME ADDRESS BLANK.	What time did you begin your trip?	What was the means of transportation? 1 = DRIVER (ASK E) 2 = RIDER (ASK E) 3 = WALK (SKIP TO F) 4 = BIKE (SKIP TO F) 5 = OTHER (SKIP TO F)	
			AM PM		
1.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	31
2.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	37
3.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	43
4.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	49
5.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	55
6.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	61
7.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	67
8.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	73
9.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	79
10.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	85
11.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	91 END 01
12.	_____	_____	<input type="text"/> : <input type="text"/> 1 2	1 2 3 4 5	07

REC 02

	E.		F.	G.	H.		
	Did you (drive/ride in) the vehicle with the device?		How long did it take you to get there?	Who was with you?	How many miles or blocks did you travel?		
	YES	NO	MINUTES				
1.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	13
2.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	20
3.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	27
4.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	34
5.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	41
6.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	48
7.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	55
8.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	62
9.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	69
10.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	76
11.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	83
12.	1	2	<input type="text"/>	_____	<input type="text"/>	MILES 1 BLOCKS ... 2	90 END 02

I'd like to ask some questions about the installation of the Global Positioning System or GPS device.

REC 03

- B1. Did you yourself install the GPS device?
 - YES (SKIP TO B2) 1
 - NO 2

- A. Who installed the device for you?
 - PROJECT STAFF 1
 - HOUSEHOLD MEMBER 2
 - RELATIVE NOT IN HH 3
 - FRIEND/NEIGHBOR 4
 - MECHANIC 5
 - OTHER (SPECIFY) 6

07

08

SPECIFY: _____

- B. Why did you not install the device yourself?

RECORD: _____

SKIP TO SECTION C

- B2. Which of the following installation instructions did you utilize when installing the GPS device into your vehicle?
READ CATEGORIES AND CODE ALL THAT APPLY.
 - Written guide 1
 - Video 2
 - Hotline 3
 - In-person help 4
 - OTHER (SPECIFY) 5

09

10

11

12

13

SPECIFY: _____

- B3. IF ONLY ONE ANSWER CIRCLED IN B2, SKIP TO B5.
Which installation instructions did you consult first?
 - WRITTEN GUIDE 1
 - VIDEO 2
 - HOTLINE 3
 - IN-PERSON HELP 4
 - OTHER 5

14

- B4. Which installation instructions did you find most helpful?
 - WRITTEN GUIDE 1
 - VIDEO 2
 - HOTLINE 3
 - IN-PERSON HELP 4
 - OTHER 5

15

For each type of instruction you used, I'd like you to tell me how clear the instructions were.
IF 1 NOT CODED IN B2, SKIP TO B7.

- B5. How clear were the installation instructions in the written guide? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?
 - VERY CLEAR 1
 - SOMEWHAT CLEAR 2
 - SOMEWHAT UNCLEAR 3
 - VERY UNCLEAR 4

16

- B6. Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The written instructions alone were sufficient to allow me to successfully install the GPS device.
 - STRONGLY AGREE 1
 - AGREE 2
 - DISAGREE 3
 - STRONGLY DISAGREE 4

17

B7.	IF 2 NOT CODED IN B2, SKIP TO B9. How clear were the installation instructions in the video tape? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	REC 03 18
B8.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The video tape alone was sufficient to allow me to successfully install the GPS device.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	19
B9.	IF 3 NOT CODED IN B2, SKIP TO B11. Was the hotline staff able to answer your installation questions clearly? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	20
B10.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The GPS device cannot be installed without hotline answers.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	21
B11.	IF 4 NOT CODED IN B2, SKIP TO B13. Was the person who came to your home able to answer your installation questions clearly? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	22
B12.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The GPS device cannot be installed without people coming to your home.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	23
B13.	Did you experience any problems in installing the GPS device?	YES (DESCRIBE) 1 NO 2	24

DESCRIBE: _____

B14.	Did you use anyone else's help to install the device?	YES	1	
		NO (SKIP TO B15)	2	25
A.	Who helped you? CODE ALL THAT APPLY.	PROJECT STAFF	1	26
		HOUSEHOLD MEMBER	2	27
		RELATIVE NOT IN HH	3	28
		FRIEND/NEIGHBOR	4	29
		MECHANIC	5	30
		OTHER (SPECIFY)	6	31
	SPECIFY: _____			
B.	How did the other (person/people) give you assistance?			
	RECORD: _____			
C.	Could you have installed the device without assistance from others?	YES	1	32
		NO	2	

B15. How could the installation process be improved?

RECORD: _____

The next group of questions are about your usage of the hand held computer.

C1.	Did you ever use the hand held computer.	YES 1 NO (SKIP TO C23) 2	33
C2.	How did you learn to use the hand held computer? Did you read the written guide, watch the videotape, call the hotline, have project staff teach you in-person, or did you learn from someone else? CODE ALL THAT APPLY.	WRITTEN GUIDE 1 VIDEO 2 HOTLINE 3 IN-PERSON HELP 4 LEARNED FROM OTHER 5	34 35 36 37 38

IF ONLY 5 CODED IN C2, SKIP TO C13.

C3.	IF ONLY ONE ANSWER CIRCLED IN C2, SKIP TO C5. Which instructions did you consult first to learn to use the hand held computer?	WRITTEN GUIDE 1 VIDEO 2 HOTLINE 3 IN-PERSON HELP 4 OTHER PERSON 5	39
C4.	Which usage instructions did you find most helpful?	WRITTEN GUIDE 1 VIDEO 2 HOTLINE 3 IN-PERSON HELP 4 OTHER PERSON 5	40

For each type of instruction you used, I'd like you to tell me how clear the instructions were.
IF 1 NOT CODED IN C2, SKIP TO C7.

C5.	How clear were the usage instructions in the written guide? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	41															
C6.	Do you strongly agree, agree, disagree, or strongly disagree with the following statements?	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;"></th> <th style="text-align: center; border-bottom: 1px solid black;">Strongly Agree</th> <th style="text-align: center; border-bottom: 1px solid black;">Agree</th> <th style="text-align: center; border-bottom: 1px solid black;">Disagree</th> <th style="text-align: center; border-bottom: 1px solid black;">Strongly Disagree</th> </tr> </thead> <tbody> <tr> <td style="padding-left: 20px;">a. The written instructions alone were sufficient to allow me to successfully learn how to use the hand held computer</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="padding-left: 20px;">b. The written instructions alone were sufficient to allow me to successfully teach other drivers how to use the hand held computer .</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> </tr> </tbody> </table>		Strongly Agree	Agree	Disagree	Strongly Disagree	a. The written instructions alone were sufficient to allow me to successfully learn how to use the hand held computer	1	2	3	4	b. The written instructions alone were sufficient to allow me to successfully teach other drivers how to use the hand held computer .	1	2	3	4	42 43
	Strongly Agree	Agree	Disagree	Strongly Disagree														
a. The written instructions alone were sufficient to allow me to successfully learn how to use the hand held computer	1	2	3	4														
b. The written instructions alone were sufficient to allow me to successfully teach other drivers how to use the hand held computer .	1	2	3	4														
C7.	IF 2 NOT CODED IN C2, SKIP TO C9. How clear were the usage instructions in the video tape? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	44															

		Strongly Agree	Agree	Disagree	Strongly Disagree	
C8.	Do you strongly agree, agree, disagree, or strongly disagree with the following statements?					
a.	The video tape alone was sufficient to allow me to successfully learn how to use the hand held computer	1	2	3	4	45
b.	The video tape alone was sufficient to allow me to successfully teach other drivers how to use the hand held computer	1	2	3	4	46
C9.	IF 3 NOT CODED IN C2, SKIP TO C11.					
	Was the hotline staff able to clearly answer your questions about using the hand held computer? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?					
						47
C10.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The hand held computer cannot be used correctly without hotline advice.					
						48
C11.	IF 4 NOT CODED IN C2, SKIP TO C13.					
	Was the person who came to your home able to clearly answer your questions about using the hand held computer? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?					
						49
C12.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The hand held computer cannot be used correctly without people coming to your home.					
						50
C13.	Overall, how easy was it for you to use the hand held computer before each trip? Would you say very easy, somewhat easy, somewhat difficult or very difficult?					
						51
C14.	How often were you able to enter trip data into the hand held computer? Would you say all the time, most of the time, some of the time, almost never or never at all?					
						52
C15.	How much time was needed, on average, for data entry before each trip?					
					□□□.□□	53

C16.	How easy was it for you to read the screen on the hand held computer? Would you say very easy, somewhat easy, somewhat difficult or very difficult?	VERY EASY 1 SOMEWHAT EASY 2 SOMEWHAT DIFFICULT 3 VERY DIFFICULT 4	56
C17.	What problems did you have in using the hand held computer? RECORD		
	RECORD: _____		
C18.	Did anyone else help you to use the hand held computer?	YES 1 NO (SKIP TO C19) 2	57
A.	Who helped you? CODE ALL THAT APPLY.	PROJECT STAFF 1 HOUSEHOLD MEMBER 2 RELATIVE NOT IN HH 3 FRIEND/NEIGHBOR 4 MECHANIC 5 OTHER (SPECIFY) 6	58 59 60 61 62 63
	SPECIFY: _____		
B.	How did the other (person/people) give you assistance?		
	RECORD: _____		
C.	Could you have used the hand held computer without assistance from others?	YES 1 NO 2	64
C19.	Was the use of the hand held computer easier or harder than you thought it would be?	EASIER (SKIP TO C20) ... 1 HARDER 2 ABOUT WHAT I EXPECTED (SKIP TO C20) ... 3	65
A.	In what ways was it harder? DESCRIBE		
	DESCRIBE: _____		
C20.	Were there occasions, such as quick trips or when you were running late, when you did not have time to input trip data?	YES 1 NO 2	66
C21.	Would you have preferred keeping a written log of driving instead of using the hand held computer?	YES 1 NO 2	67

C22. Would you be willing to use this device again in a similar study? YES (SKIP TO C23) 1
 NO 2

68

A. Why would you not use it again? DESCRIBE

DESCRIBE: _____

C23. While you were driving the vehicle, how much of a distraction was created by having the device in use? Would you say a great deal, some, very little or no distraction at all? GREAT DEAL 1
 SOME 2
 VERY LITTLE 3
 NONE 4

69

C24. Did you change your driving habits in any way because the device was in the vehicle? YES 1
 NO (SKIP TO C25) 2

70

A. In what way did your driving change?

DESCRIBE: _____

C25. In what way could we improve the device and its usage? Please consider the hand held computer, the menus that appeared on the screens, the satellite receiver, the instructions and the help that was available. RECORD

RECORD: _____

D1. Did you have any personal concerns about having your vehicle's movement recorded by the device? YES 1
 NO (SKIP TO D2) 2

71

A. What are those concerns? RECORD VERBATIM.

RECORD: _____

D2. Do you have any concerns about the government collecting personal travel data? YES 1
 NO (SKIP TO D3) 2

72

A. What are those concerns? RECORD VERBATIM.

RECORD: _____

D3. Did you have any concerns about the safety of your vehicle while the device was installed? YES 1
 NO (SKIP TO SECTION E) 2

73

A. What are those concerns? RECORD VERBATIM.

RECORD: _____

REC 03

E1. Now I have some final questions. What is the highest grade of school that you have completed?

GRADE 00 01 02 03 04
 05 06 07 08
 HIGH SCHOOL 09 10 11 12
 COLLEGE 13 14 15 16
 POSTGRAD 17

74

E2. Approximately how many miles do you drive in a year's time?

MILES |

76

E3. What was the total income for your household for the past year? That is the total income for everyone living in your household including salary, wages, interest and any other income. Please stop me when I reach the category that is appropriate. Was it (READ CATEGORIES)?

Under \$15,000 01
 Under \$25,000 02
 Under \$35,000 03
 Under \$45,000 04
 Under \$55,000 05
 Under \$65,000 06
 Under \$75,000 07
 \$75,000 or more 08
 RF 97
 DK 98

81

E4. Who else in your household drove the vehicle with the device on (DATE)?

	NAME	DRIVER # FROM SCREENER	
OTHER DRIVERS:	2. _____	<input type="text"/> <input type="text"/>	83
	3. _____	<input type="text"/> <input type="text"/>	85
	4. _____	<input type="text"/> <input type="text"/>	87
	5. _____	<input type="text"/> <input type="text"/>	89
	6. _____	<input type="text"/> <input type="text"/>	91

END 03

Thank you very much for helping us with this important study. Your final payment of \$30 will be sent to you once the mini computer and satellite receiver are received by the Lexington Area Metropolitan Planning Organization.

TIME ENDED :

07

RECORD DATE OF TRAVEL RECALL:

| |

MM DD YY

11

OFFICE USE: RECORD DATA FROM PRE-USAGE INTERVIEW

REC 04

2A.	VEHICLE MAKE	<input type="text"/>	<input type="text"/>		
2B.	VEHICLE MODEL	<input type="text"/>	<input type="text"/>	<input type="text"/>	
2C.	VEHICLE YEAR	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2D.	VEHICLE TYPE	<input type="text"/>	<input type="text"/>		

19

21

24

28

END 04

2. We would like you to install the device in the vehicle you primarily drive. I'd like to know some details about that vehicle.

A. What is the make of your primary vehicle? RECORD

RECORD: _____

B. What is the model of that vehicle? RECORD.

RECORD: _____

C. What year is the vehicle?

YEAR OF VEHICLE

D. What type of vehicle is that? Is it (READ CATEGORIES)?

- An automobile 01
- A minivan 02
- A utility vehicle 03
- A pickup truck 04
- Some other type of truck or large van 05
- OTHER (SPECIFY) 06

SPECIFY: _____

3. We would like to send you the device on or about (DATE). Are you planning on being in town then to receive the device and use it for a week? YES (SKIP TO 4) 1 NO 2

A. When would be a better time for you to receive the device?

DATE
MM DD YY

4. We will be sending the device along with a written and illustrated guide and videotape. There will also be a local phone number you can call for additional help.

What address can we use to send the device? We'd like a location where someone is available all day to sign for the package. To whose attention should we address the package?

ADDRESS _____

5. Can you please list for me all members of your household and any expected visitors during the field period who may either drive or ride in the study vehicle? Please include car pool participants and other regular passengers.

I.

	NAME (ASK FOR EXACT SPELLING) (ASK I)	Could this person ever be a driver?	
		YES	NO
1.	_____	1	2
2.	_____	1	2
3.	_____	1	2
4.	_____	1	2
5.	_____	1	2
6.	_____	1	2
7.	_____	1	2
8.	_____	1	2
9.	_____	1	2
10.	_____	1	2

Those are all the questions we have for today. You will be receiving a consent form in the mail in a few days. We will need you to sign the consent form and return it to us in the envelope provided as soon as possible. You will receive the device and instructions, along with your \$20 payment, when the signed consent is returned.

Thank you for agreeing to participate in our study.

H. Now, I would like to ask you some questions about motor vehicles owned or used by the household. Please **do not** include the vehicle of anyone visiting or staying with you if they usually live somewhere else, such as a college student away at school. How many licensed vehicles were owned or available for regular use, by members of your household during the past two weeks? **INCLUDE LEASED OR COMPANY-OWNED LICENSED MOTORIZED VEHICLES IF THEY ARE USED BY HOUSEHOLD MEMBERS ON A REGULAR BASIS.**

VEHICLES
 NONE, CODE 11 AND SKIP TO END 4 0

30

I. How many of the members of this household are licensed drivers?

DRIVERS

31

J. For each licensed driver I'd like to know their first name, age, and sex. So that we don't miss anyone, please start with the oldest licensed driver in your household. **ASK J1-J5 FOR ALL DRIVERS IN I.**

	J1.	J2.	J3.		J4.	J5.		
	What is their first name?	How old is (NAME)?	Is (NAME) male or female?		On average, how many days per week does (NAME) drive one of the household vehicles?	Does (NAME) use a house-hold vehicle to perform work-related activities through-out the day?		
	NAME	AGE	MALE	FEMALE	DAYS/WEEK	YES	NO	
01	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	33
02	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	41
03	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	49
04	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	57
05	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	65
06	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	73
07	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	81
08	_____	<input type="text"/> <input type="text"/>	1	2	<input type="text"/> <input type="text"/>	1	2	89

MATCH DRIVER INFORMATION TO CHART OF DRIVERS STILL NEEDED FOR THE STUDY, FOLLOWING ELIGIBILITY RESTRICTIONS.

NO MATCH IN HOUSEHOLD, CODE 12, SKIP TO END 400

MATCH IN HOUSEHOLD, RECORD DRIVER NUMBER FROM CHART IN J

DECK 01

97

99

We would like to have (NAME OF SELECTED DRIVER) participate in our study and install the device in the vehicle (he/she) primarily drives.

K1. Is that vehicle an automobile, van or truck? YES (GO TO K2) 1
NO 2

101

IF NO, TRY TO SELECT ANOTHER ELIGIBLE DRIVER IN HOUSEHOLD.
IF OTHER DRIVER MATCHED, CHANGE HH NUMBER ABOVE.
IF NO OTHER DRIVER CAN BE MATCHED, CODE 13 AND SKIP TO END 4.

K2. Is that vehicle one that the household owns or leases? YES (GO TO NEXT BOX) . . . 1
NO 2

102

IF NO, TRY TO SELECT ANOTHER ELIGIBLE DRIVER IN HOUSEHOLD.
IF OTHER DRIVER MATCHED, CHANGE HH NUMBER ABOVE.
IF NO OTHER DRIVER CAN BE MATCHED, CODE 13 AND SKIP TO END 4.

IF SPEAKING TO SELECTED R, GO TO CONSENT SCRIPT FOR PRE-USAGE INTERVIEW.

OTHERWISE, ASK TO SPEAK TO SELECTED R.

R NOT AVAILABLE SKIP TO END 5
R COMES TO PHONE SKIP TO CONSENT SCRIPT FOR PRE-USAGE INTERVIEW

FOLLOWING THE PRE-USAGE SCRIPT:

R REFUSES TO PARTICIPATE, CODE 21 AND SKIP TO END 3000

103

R AGREES TO COMPLETE PRE-USAGE INTERVIEW, RECORD CASE ID FROM
CHART OF DRIVERS

--	--	--

RECORD R'S FULL NAME: _____

CODE 20 ON DIALING SHEET. MARK CASE ID AS TAKEN.

END 01

SCREENING ENDINGS

END 1: Thank you for your time. We are only speaking to residences today. DIAL NEXT NUMBER.

END 2: I need to speak to a household member who is aged 18 or older. When could I call back to reach someone that age? RECORD CALL BACK TIME ON DIALING SHEET. Thank you for your time. DIAL NEXT NUMBER.

END 3: I'm sorry to have disturbed you today. DIAL NEXT NUMBER.

END 4: No one in your household qualifies for our study at this time. Thank you for speaking with me. DIAL NEXT NUMBER.

END 5: When could I call back to speak to that person? RECORD CALL BACK TIME ON DIALING SHEET. Thank you for your time. MARK CASE ID ON CHART AS ON HOLD.

CASE ID	<input type="text"/>	01
DATE	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	07
	MM DD YY	
INT#	<input type="text"/>	15
TOTAL TIME	<input type="text"/>	20
EDITOR	<input type="text"/>	22

GPS Methodology in Personal Travel Surveys Field Demonstration Study

Post-Usage Interview Other Household Member

Conducted By:

Battelle/Survey Research Associates

Conducted For:

U.S. Department of Transportation
Federal Highway Administration

September, 1996

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TIME BEGAN :

AA1. I'd like to ask some questions about your travel on (TRAVEL DAY DATE) using the vehicle with the computer device. Please understand that we define a trip as any time you went from one address to another. Each stop you make is a separate trip, including picking up or dropping off someone.

COMPLETE COLUMN A BELOW. PROBE FOR EACH TRIP USING THE STUDY VEHICLE REMINDING ABOUT STOPS ALONG THE WAY. AFTER ALL TRIPS ARE LISTED, ASK B-F FOR EACH TRIP.

A.	B.	C.	
Think about when you awoke that morning. Where is the first place you went in the vehicle with the device? Where did you go next? ACCOUNT FOR ALL TRIPS.	What is the address or nearest road intersection for (TRIP IN A)? LEAVE HOME ADDRESS BLANK.	What time did you begin your trip?	
		AM PM	
1. _____	_____	<input type="text"/> : <input type="text"/> 1 2	31
2. _____	_____	<input type="text"/> : <input type="text"/> 1 2	36
3. _____	_____	<input type="text"/> : <input type="text"/> 1 2	41
4. _____	_____	<input type="text"/> : <input type="text"/> 1 2	46
5. _____	_____	<input type="text"/> : <input type="text"/> 1 2	51
6. _____	_____	<input type="text"/> : <input type="text"/> 1 2	56
7. _____	_____	<input type="text"/> : <input type="text"/> 1 2	61
8. _____	_____	<input type="text"/> : <input type="text"/> 1 2	66
9. _____	_____	<input type="text"/> : <input type="text"/> 1 2	71
10. _____	_____	<input type="text"/> : <input type="text"/> 1 2	76
11. _____	_____	<input type="text"/> : <input type="text"/> 1 2	81
12. _____	_____	<input type="text"/> : <input type="text"/> 1 2	86

REC 01

	D. How long did it take you to get there? MINUTES	E. Who was with you?	F. How many miles or blocks did you travel?	
1.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	91 END 01
2.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	07
3.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	13
4.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	19
5.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	25
6.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	31
7.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	37
8.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	43
9.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	49
10.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	55
11.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	61
12.	<input type="text"/>	_____	<input type="text"/> MILES 1 <input type="text"/> BLOCKS . . . 2	67

I'd like to ask some questions about the installation of the Global Positioning System or GPS device.

B1.	Did you yourself install the GPS device?	YES (SKIP TO B2) 1 NO 2	73
A.	Who installed the device for you?	PROJECT STAFF 1 HOUSEHOLD MEMBER 2 RELATIVE NOT IN HH 3 FRIEND/NEIGHBOR 4 MECHANIC 5 OTHER (SPECIFY) 6	74

SPECIFY: _____

B. Why did you not install the device yourself?
RECORD: _____

SKIP TO SECTION C

B2.	Which of the following installation instructions did you utilize when installing the GPS device into your vehicle? READ CATEGORIES AND CODE ALL THAT APPLY.	Written guide 1 Video 2 Hotline 3 In-person help 4 OTHER (SPECIFY) 5	75 76 77 78 79
-----	--	--	----------------------------

SPECIFY: _____

B3.	IF ONLY ONE ANSWER CIRCLED IN B2, SKIP TO B5. Which installation instructions did you consult first?	WRITTEN GUIDE 1 VIDEO 2 HOTLINE 3 IN-PERSON HELP 4 OTHER 5	80
-----	---	--	----

B4.	Which installation instructions did you find most helpful?	WRITTEN GUIDE 1 VIDEO 2 HOTLINE 3 IN-PERSON HELP 4 OTHER 5	81
-----	--	--	----

For each type of instruction you used, I'd like you to tell me how clear the instructions were.
IF 1 NOT CODED IN B2, SKIP TO B7.

B5.	How clear were the installation instructions in the written guide? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	82
-----	---	--	----

B6.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The written instructions alone were sufficient to allow me to successfully install the GPS device.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	83
-----	---	--	----

B7.	IF 2 NOT CODED IN B2, SKIP TO B9.		REC 02
	How clear were the installation instructions in the video tape? Would you say very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	84
B8.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The video tape alone was sufficient to allow me to successfully install the GPS device.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	85
B9.	IF 3 NOT CODED IN B2, SKIP TO B11.		
	Was the hotline staff able to answer your installation questions clearly? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	86
B10.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The GPS device cannot be installed without hotline answers.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	87
B11.	IF 4 NOT CODED IN B2, SKIP TO B13.		
	Was the person who came to your home able to answer your installation questions clearly? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?	VERY CLEAR 1 SOMEWHAT CLEAR 2 SOMEWHAT UNCLEAR 3 VERY UNCLEAR 4	88
B12.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The GPS device cannot be installed without people coming to your home.	STRONGLY AGREE 1 AGREE 2 DISAGREE 3 STRONGLY DISAGREE 4	89
B13.	Did you experience any problems in installing the GPS device?	YES (DESCRIBE) 1 NO 2	90

DESCRIBE: _____

			<i>REC 02</i>
B14.	Did you use anyone else's help to install the device?	YES 1	91
		NO (SKIP TO B15) 2	
A.	Who helped you? CODE ALL THAT APPLY.	PROJECT STAFF 1	92
		HOUSEHOLD MEMBER 2	93
		RELATIVE NOT IN HH 3	94
		FRIEND/NEIGHBOR 4	95
		MECHANIC 5	96
		OTHER (SPECIFY) 6	97
	SPECIFY: _____		
B.	How did the other (person/people) give you assistance?		
	RECORD: _____		
C.	Could you have installed the device without assistance from others?	YES 1	98
		NO 2	

END 02

B15. How could the installation process be improved?

RECORD: _____

REC 03

The next group of questions are about your usage of the hand held computer.

C1. Did you ever use the hand held computer. YES 1 07
 NO (SKIP TO C23) 2

C2. How did you learn to use the hand held computer? Did you read the written guide, watch the videotape, call the hotline, have project staff teach you in-person, or did you learn from someone else? CODE ALL THAT APPLY. WRITTEN GUIDE 1 08
 VIDEO 2 09
 HOTLINE 3 10
 IN-PERSON HELP 4 11
 LEARNED FROM OTHER 5 12

IF ONLY 5 CODED IN C2, SKIP TO C13.

C3. IF ONLY ONE ANSWER CIRCLED IN C2, SKIP TO C5. Which instructions did you consult first to learn to use the hand held computer? WRITTEN GUIDE 1 13
 VIDEO 2
 HOTLINE 3
 IN-PERSON HELP 4
 OTHER PERSON 5

C4. Which usage instructions did you find most helpful? WRITTEN GUIDE 1 14
 VIDEO 2
 HOTLINE 3
 IN-PERSON HELP 4
 OTHER PERSON 5

For each type of instruction you used, I'd like you to tell me how clear the instructions were.
 IF 1 NOT CODED IN C2, SKIP TO C7.

C5. How clear were the usage instructions in the written guide? VERY CLEAR 1 15
 Would you say very clear, somewhat clear, somewhat unclear, or very unclear? SOMEWHAT CLEAR 2
 SOMEWHAT UNCLEAR 3
 VERY UNCLEAR 4

C6. Do you strongly agree, agree, disagree, or strongly disagree with the following statements?

Strongly Agree	Agree	Disagree	Strongly Disagree
----------------	-------	----------	-------------------

a. The written instructions alone were sufficient to allow me to successfully learn how to use the hand held computer 1 2 3 4 16

b. The written instructions alone were sufficient to allow me to successfully teach other drivers how to use the hand held computer . 1 2 3 4 17

C7. IF 2 NOT CODED IN C2, SKIP TO C9. How clear were the usage instructions in the video tape? VERY CLEAR 1 18
 Would you say very clear, somewhat clear, somewhat unclear, or very unclear? SOMEWHAT CLEAR 2
 SOMEWHAT UNCLEAR 3
 VERY UNCLEAR 4

REC 03

		Strongly Agree	Agree	Disagree	Strongly Disagree	
C8.	Do you strongly agree, agree, disagree, or strongly disagree with the following statements?					
a.	The video tape alone was sufficient to allow me to successfully learn how to use the hand held computer	1	2	3	4	19
b.	The video tape alone was sufficient to allow me to successfully teach other drivers how to use the hand held computer	1	2	3	4	20
C9.	IF 3 NOT CODED IN C2, SKIP TO C11.					
	Was the hotline staff able to clearly answer your questions about using the hand held computer? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?					
				VERY CLEAR	1	21
				SOMEWHAT CLEAR	2	
				SOMEWHAT UNCLEAR	3	
				VERY UNCLEAR	4	
C10.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The hand held computer cannot be used correctly without hotline advice.					
				STRONGLY AGREE	1	22
				AGREE	2	
				DISAGREE	3	
				STRONGLY DISAGREE	4	
C11.	IF 4 NOT CODED IN C2, SKIP TO C13.					
	Was the person who came to your home able to clearly answer your questions about using the hand held computer? Would you say their answers were very clear, somewhat clear, somewhat unclear, or very unclear?					
				VERY CLEAR	1	23
				SOMEWHAT CLEAR	2	
				SOMEWHAT UNCLEAR	3	
				VERY UNCLEAR	4	
C12.	Do you strongly agree, agree, disagree, or strongly disagree with the following statement? The hand held computer cannot be used correctly without people coming to your home.					
				STRONGLY AGREE	1	24
				AGREE	2	
				DISAGREE	3	
				STRONGLY DISAGREE	4	
C13.	Overall, how easy was it for you to use the hand held computer before each trip? Would you say very easy, somewhat easy, somewhat difficult or very difficult?					
				VERY EASY	1	25
				SOMEWHAT EASY	2	
				SOMEWHAT DIFFICULT	3	
				VERY DIFFICULT	4	
C14.	How often were you able to enter trip data into the hand held computer? Would you say all the time, most of the time, some of the time, almost never or never at all?					
				ALL THE TIME	1	26
				MOST OF THE TIME	2	
				SOME OF THE TIME	3	
				ALMOST NEVER	4	
				NEVER AT ALL (SKIP TO C16)	5	
C15.	How much time was needed, on average, for data entry before each trip?					
				MINUTES	<input type="text"/> <input type="text"/> <input type="text"/>	27

C16.	How easy was it for you to read the screen on the hand held computer? Would you say very easy, somewhat easy, somewhat difficult or very difficult?	VERY EASY 1 SOMEWHAT EASY 2 SOMEWHAT DIFFICULT 3 VERY DIFFICULT 4	30
C17.	What problems did you have in using the hand held computer? RECORD		
	RECORD: _____		

C18.	Did anyone else help you to use the hand held computer?	YES 1 NO (SKIP TO C19) 2	31
A.	Who helped you? CODE ALL THAT APPLY.	PROJECT STAFF 1 HOUSEHOLD MEMBER 2 RELATIVE NOT IN HH 3 FRIEND/NEIGHBOR 4 MECHANIC 5 OTHER (SPECIFY) 6	32 33 34 35 36 37
	SPECIFY: _____		

B.	How did the other (person/people) give you assistance?		
	RECORD: _____		
C.	Could you have used the hand held computer without assistance from others?	YES 1 NO 2	38
C19.	Was the use of the hand held computer easier or harder than you thought it would be?	EASIER (SKIP TO C20) ... 1 HARDER 2 ABOUT WHAT I EXPECTED (SKIP TO C20) ... 3	39
A.	In what ways was it harder? DESCRIBE		
	DESCRIBE: _____		

C20.	Were there occasions, such as quick trips or when you were running late, when you did not have time to input trip data?	YES 1 NO 2	40
C21.	Would you have preferred keeping a written log of driving instead of using the hand held computer?	YES 1 NO 2	41

C22. Would you be willing to use this device again in a similar study? YES (SKIP TO C23) 1
 NO 2

42

A. Why would you not use it again? DESCRIBE

DESCRIBE: _____

C23. While you were driving the vehicle, how much of a distraction was created by having the device in use? Would you say a great deal, some, very little or no distraction at all? GREAT DEAL 1
 SOME 2
 VERY LITTLE 3
 NONE 4

43

C24. Did you change your driving habits in any way because the device was in the vehicle? YES 1
 NO (SKIP TO C25) 2

44

A. In what way did your driving change?

DESCRIBE: _____

C25. In what way could we improve the device and its usage? Please consider the hand held computer, the menus that appeared on the screens, the satellite receiver, the instructions and the help that was available. RECORD

RECORD: _____

REC 03

D1.	Did you have any personal concerns about having your vehicle's movement recorded by the device?	YES 1 NO (SKIP TO D2) 2	45
-----	---	--	----

A. What are those concerns? RECORD VERBATIM.

RECORD: _____

D2.	Do you have any concerns about the government collecting personal travel data?	YES 1 NO (SKIP TO D3) 2	46
-----	--	--	----

A. What are those concerns? RECORD VERBATIM.

RECORD: _____

D3.	Did you have any concerns about the safety of your vehicle while the device was installed?	YES 1 NO (SKIP TO SECTION E) 2	47
-----	--	---	----

A. What are those concerns? RECORD VERBATIM

RECORD: _____

E1. Now I have some final questions. What is the highest grade of school that you have completed?

GRADE 00 01 02 03 04
05 06 07 08
HIGH SCHOOL 09 10 11 12
COLLEGE 13 14 15 16
POSTGRAD 17

REC 03
48

E2. Approximately how many miles do you drive in a year's time?

MILES [][] , [][][][]

50

Thank you very much for helping us with this important study.

TIME ENDED [][] : [][][][]

55
END 03

Appendix C.

Field Equipment Installation & Operating Instructions

Appendix C.

Field Equipment Installation & Operating Instructions

Lexington Area Travel Data Collection Test

EQUIPMENT INSTALLATION AND OPERATING INSTRUCTIONS

Inside the shipping box you should have found:

- The **travel data collection equipment** in its carrying case.
- A brief **video** that provides background information and operating instructions for the equipment.
- Illustrated **operating instructions** for the equipment (this document).
- An envelope labeled **Return Instructions**, containing instructions for returning the equipment at the end of your participation. Your return date is marked on the envelope.
- An envelope containing a **money order** for \$20. A second money order worth \$30 will be sent to you at the end of your participation.



Travel Data Collection Equipment

Getting Started

Locate the video tape and the equipment carrying case and remove them from the shipping box. Also remove the two envelopes included in the box. You need to save the shipping box and packing materials; they will be used to return the equipment to the test administrator at the end of your test period.

The equipment carrying case has three compartments. The hand-held computer and power plug are in the carrying case compartment marked with the U.S. Department of Transportation logo. The GPS receiver and its cable are in the carrying case compartment marked with the Battelle logo. The third carrying case compartment contains electrical and data connections for the equipment as well as additional cables. This compartment is not marked and you do not need to open the third compartment to install or operate the travel data collection equipment.



The enclosed video tape, which lasts about 12 minutes, instructs you on how to install and operate the travel data collection equipment. If you prefer written instructions, the following step-by-step narrative will guide you through the process.



As you watch the video or read the instructions, be sure to have the hand-held computer with you so you can follow along with the instructions for operating the touch screen. The computer's battery is sufficient to operate the computer while you watch the video. You do not need to be in your automobile to practice using the computer.

INSTALLATION

Installing the travel data collection equipment in your vehicle requires two simple steps:

1. You will place the GPS receiver on the roof of your vehicle.
2. You will plug the power cord into your vehicle cigarette lighter.

Step 1: Installing the GPS Receiver

Place the equipment carrying cases flat on the front seat of your vehicle with the painted logos facing up (Figure 1).



Figure 1

Remove the GPS receiver and its cable from the compartment marked with the Battelle logo and place it on the seat (Figure 2). Leave the other compartment closed until you are ready to install the power plug (Step 2).



Figure 2

The GPS receiver is equipped with a magnetic mount that allows you to install the GPS receiver on the roof of your vehicle. You can place the receiver in any position on the roof of the vehicle; however, placing the receiver near one edge of the roof (near a window or door frame) will minimize the length of cable that is outside.

We recommend that you install the receiver near a seldom-used rear door or window so that the cable can be placed through the rear door or window. The excess cable will be in the rear floor or seat area and out of the way of the driver and front seat passengers.

You may place the GPS receiver near a front door of the vehicle. The GPS cable can be placed around the door frame, or through a window, and across the floor of the vehicle. The cable should be placed under a floor mat or very near the seat, away from the driver's or passenger's feet.

CAUTION:

If your vehicle is equipped with air bags you must not place the cable near the air bag compartment on the vehicle dashboard or steering wheel. In the event of an accident, the cable could interfere with air bag operation.

The cable should be placed securely out of the way so that it does not interfere with normal vehicle entry and exit. If placed improperly, the cable could become a tripping hazard when entering and exiting the vehicle.

The GPS receiver is placed on the roof of the vehicle by simply setting the receiver in the chosen location (Figure 3). Be sure to place the receiver away from a sun roof or other roof top equipment, such as a luggage rack. The GPS receiver needs an unobstructed view of the sky to function properly, and placing the receiver near a luggage rack or other item may interfere with GPS receiver operation.



Figure 3

Place the cable through the door or window, and shut the door or close the window (Figure 4). You can store any excess GPS cable in the carrying case compartment and close the compartment using the Velcro closure.

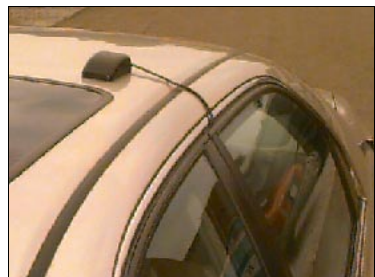


Figure 4

Step 2: Installing the Power Plug

The hand-held computer and power plug are in the carrying case compartment marked with the U.S. Department of Transportation logo. Remove these items from the carrying case and place them on the seat (Figure 5).



Figure 5

The power plug is designed to fit in your vehicle's cigarette lighter socket. First, remove the cigarette lighter from the socket and set it aside. The power plug is installed by firmly inserting the plug into your vehicle's cigarette lighter socket (Figure 6).



Figure 6

The power plug should remain plugged in for the duration of your test period (Figure 7). You can store any excess power cable in the carrying case compartment and close the compartment using the Velcro closure.



Figure 7

You have completed the installation of the travel data collection equipment.

Note: The travel data collection equipment does not require much power. The equipment will not drain your vehicle's battery, even when the vehicle is parked overnight and the equipment is left on.

OPERATIONS

To begin operating the system, remove the hand-held computer from the carrying case and open the cover by opening the Velcro closure between the tab and the front cover. Fold the cover front behind the computer so that you can see the screen. The cover front can be held in place behind the computer by folding the tab under the computer and reattaching the Velcro closure. You may need to adjust the lighting around you or shift the computer to achieve a comfortable viewing screen.

Control Panel

Place the computer in front of you so that the rabbit icon is to your right. The hand-held computer's controls are on the right hand side of the computer (the side opposite the cable connections). Three controls are available:

POWER ON/OFF: This switch controls the power to the hand-held computer. To turn the computer ON, push the power switch all the way to the right (toward the top of the computer) and release it. The switch has a spring that will return it to the initial position when it is released. The computer is turned off by moving the switch in the same manner. There may be a brief delay after the movement of the switch before the computer turns off.

BACK LIGHT OFF/ON: This switch controls back-lighting for the screen. The back light should be on when you receive the computer, and should remain on.

CONTRAST WHEEL (MARKED WITH L/H): The contrast wheel allows you to control the contrast of the screen for different lighting conditions. You will need to adjust the contrast periodically to have a clear image on the screen, as ambient light conditions change.

CAUTION:

Operating the hand-held computer requires your complete attention: Do not operate the computer while your vehicle is in motion.

Using the Computer

Turn the computer on and adjust the contrast wheel so you can clearly see the screen. The hand-held computer operates using a “touch screen”, which means that data are entered by touching specific items directly on the screen. Only light pressure is required for data entry.

A stylus that can be used for data entry is included with the computer in a compartment in the upper right corner (Figure 8a, 8b).



Figure 8a

Figure 8b

You may also use your finger for data entry if you prefer, or if the stylus is missing or has been lost (Figure 9).



Figure 9

Start Trip

The “Start Trip” screen (Figure 10) is the beginning point for your data entry. For this survey, a trip is defined as any driving activity from beginning to end that completes a single activity. For example, when you leave home in the morning to go to work and drop off your children at school along the way, you have completed two trips as defined in this survey. The first trip is from your home to the school with the activity of taking the children to school; the second trip is from the school to your work place with the activity of going to

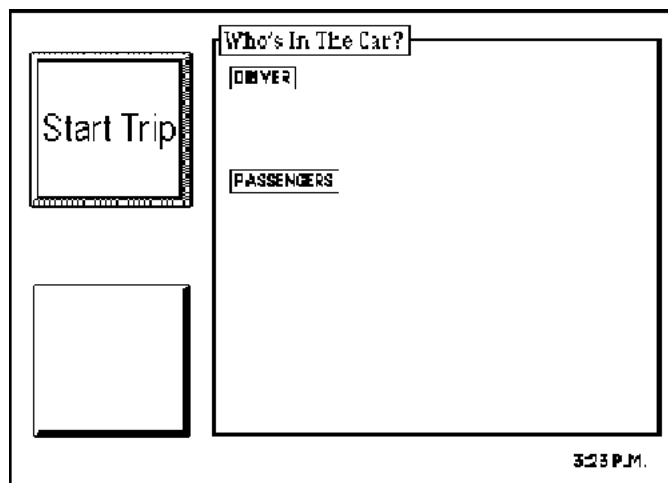


Figure 10

work.

To begin recording a trip, simply touch the “Start Trip” button in the upper left part of the screen. Your next screen will be a “Driver Activity” screen (Figure 11).

CAUTION:

Use this computer only when your car is properly parked. The survey does not require any data entry while your vehicle is moving.

Driver Activity

Once you have started a trip record, you need to identify the driver and the driver’s activity for this trip. The names of all licensed drivers in your household are included in the list shown in the left half of the screen under the heading “Choose the driver”. In addition, the list includes the choice “Other” to include drivers that may not be members of your household (for example, coworkers or members of a car pool).

The screenshot shows a software interface for selecting a driver and their activity. It is divided into two main columns. The left column is titled "Choose the driver:" and contains a list with the following items: "Other", "Steve", and "Doreen". The right column is titled "Driver's major activity" and contains a list of activities: "Pick Up or Drop Off Passengers", "Work or School", "Personal or Household Business", "Eat Out", "Social or Recreational", "Medical or Dental", and "Return Home". A small circular arrow icon is positioned to the right of the "Medical or Dental" activity. Below the activity list is a section titled "Driver's specific activity" which is currently empty. At the bottom of the screen are two buttons: "End Trip" and "Continue".

Figure 11

Select the driver by touching the name of the person that is driving the vehicle on this trip.

Next, you will select the driver’s activity for this trip. The driver’s activity should be for the immediate trip destination only. The possible choices are listed in the top portion of the right half of the screen under the heading “Driver’s major activity”. Touching the arrow enclosed in a circle allows you to scroll the list of major activities so that all selections are available. Some of the major activities will need a more specific definition. The lower portion of the screen will show the choices for these specific activities automatically when the major activity is selected. Not all of the major activities have more specific choices. The following table summarizes the choices available in the driver activity screens.

Select the driver’s major activity by touching the item in the list. If there are specific activities associated with the major activity (as shown in the right column of the table), the specific activity choices will automatically appear on the bottom portion of the screen. Select the specific activity by touching the item in the list. When the driver’s activity has been selected, touch the “Continue” button to exit this screen.

Your next screen will be a “Passenger activity” screen (Figure 12).

Note: Touching the “End Trip” button will erase all of the data you have input thus far and will return you to the “Start Trip” screen.

Driver’s Activity

Driver’s Major Activity	Driver’s Specific Activity
Pick Up or Drop Off Passengers	-Pick Up Passenger -Drop Off Passenger
Work or School	-Work Place -Work-related Business -School, College, University
Personal or Household Business	-Shopping -Errands and other personal business, such as bank, post office, dry cleaner, video rental, barber, car repair, etc.
Eat Out	<i>none</i>
Social or Recreational	<i>none</i>
Medical or Dental	<i>none</i>
Return Home	<i>none</i>
Other	-Religious Activities -Volunteer Work -Community Meetings, Political or Civic Events -Other

Passenger Activity

If there are no passengers for this trip, simply touch the “No passengers” button at the bottom of the screen to exit this screen and proceed directly to recording the trip data.

If passengers are in the vehicle for this trip, you need to identify them. The names of all members of your household are included in the list on the left half of the screen. In addition, the list includes the choice “Other” to include passengers that may not be members of your household (for example, coworkers, members of a car pool, children’s friends).

The screenshot shows a mobile application interface for recording trip data. At the top, it says "Choose a passenger:". Below this is a list of names: Other, Steve, Doreen (highlighted), Max, and Sammy. To the right, there are two sections for activity selection. The first section is "Passenger's major activity" with options: To Day Care or Preschool, Go Along For The Ride (highlighted), Work or School, Personal or Household Business, Eat Out, Social or Recreational, and Medical or Dental. The second section is "Passenger's specific activity" with a large empty text box. At the bottom of the screen are three buttons: "No Passengers", "End Trip", and "Continue".

Figure 12

Identify one passenger by touching the name of the person in the list. Next, select that passenger's major activity for this trip, just as you selected the driver's major activity (Figure 12). Remember, the trip major activity is for this passenger and should be only for the immediate destination for this trip. The possible choices are listed in the top portion of the right half of the screen and in the left column of the following table.

Passenger's Activity

Passenger's Major Activity	Passenger's Specific Activity
To Day Care or Preschool	<i>none</i>
Go Along for the Ride	<i>none</i>
Work or School	-Work Place -Work-related Business -School, College, University
Personal or Household Business	-Shopping -Errands and other personal business, such as bank, post office, dry cleaner, video rental, barber, car repair, etc.
Eat Out	<i>none</i>
Social or Recreational	<i>none</i>
Medical or Dental	<i>none</i>
Return Home	<i>none</i>
Other	-Religious Activities -Volunteer Work -Community Meetings, Political or Civic Events -Other

The passenger's activity is selected in the same manner as the driver's activity. Once again, touching the arrow will scroll the list of major activities so that all selections are available. Select the passenger's major activity by touching the item in the list. If there are specific activities associated with the major activity (as shown in the right column of the table), the specific activity choices will automatically appear on the bottom portion of the screen. Select the specific activity by touching the item in the list. When the passenger's activity has been selected, touch the "Continue" button to exit this screen.

Note: Touching the "End Trip" button will erase the data you have input thus far and will return you to the "Start Trip" screen.

If you indicated “No Passengers” for this trip, the computer will proceed directly to data recording. If passengers are indicated for the trip, your next screen is a “Passenger confirmation” screen (Figure 13).

Passenger Confirmation

The passenger confirmation screen lists the passengers and their activities in the center of the screen. If other passengers are in the vehicle, touch the “Add Passenger” button and repeat the steps above until all passengers and their activities are identified. When all passengers and their activities are identified, touch the “Continue” button to begin trip recording. Your next screen (Figure 16) will indicate that your trip is being recorded.

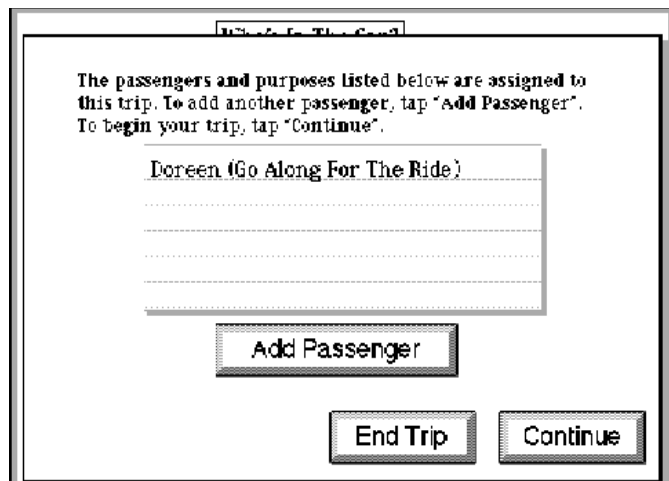


Figure 13

Note: Touching the “End Trip” button will erase the data you have input thus far and return you to the “Start Trip” screen.

Data Recording

The data recording screen (Figure 16) lists the driver, passengers, and activities for each as they were entered. The spinning globe in the upper left portion of the screen means that data entry has been completed and trip recording has begun.

You should now set the computer aside and begin your trip. The computer can lay on the seat next to you, or you may use the carrying case as a “saddlebag” to hold the computer out of the way while you are driving (Figures 14 and 15). When handling the computer, please be careful not to grip the hand-held computer on the “touch screen” surface or you may accidentally enter data that was not intended.



Figure 14

Figure 15

The computer does not require any attention while you are driving. Your next interaction with the computer will be when you reach your destination and complete your trip activity.

End Trip

When you reach your destination, park your vehicle before picking up the computer.

If you reach your destination and all the information shown on the screen is still correct, simply touch the “End Trip” button in the lower left portion of the screen (Figure 16). This will complete data recording for this trip and return you to the “Start Trip” screen.

If you reach your destination but the information shown on the screen is no longer correct because you changed your mind about where you were going, you can use the “Change” button in the lower right corner of the screen to correct the information. The “Change” button allows you to change the data entry if you should change your destination along the way, and should be used before you touch the “End Trip” button.

For example, when you leave your work place, you enter a trip activity of “Return Home”. However, during the drive home, you remember that you need to stop by the bank. When you arrive at the bank, touch the “Change” button and you will be returned to the driver activity screen. Then simply change the driver activity from

“Return Home” to “Personal or Household Business/Other Errands” and touch the “Continue” button and verify the information for each of the passengers (if any) in the vehicle. Be sure to include information for all passengers in the vehicle, including any changes in passenger trip activities resulting in your stop at the bank. When you return to the “End Trip” screen, simply touch “End Trip” to complete the trip record for the travel just completed. When you finish your business at the bank, you would then start a new trip with the activity “Return Home”.

Touching “End Trip” returns you to the “Start Trip” screen. The computer is ready to accept information for your next trip. When you touch “Start Trip”, the computer will assume that the driver is the same as for the previous trip. You may now repeat the process for your next trip.

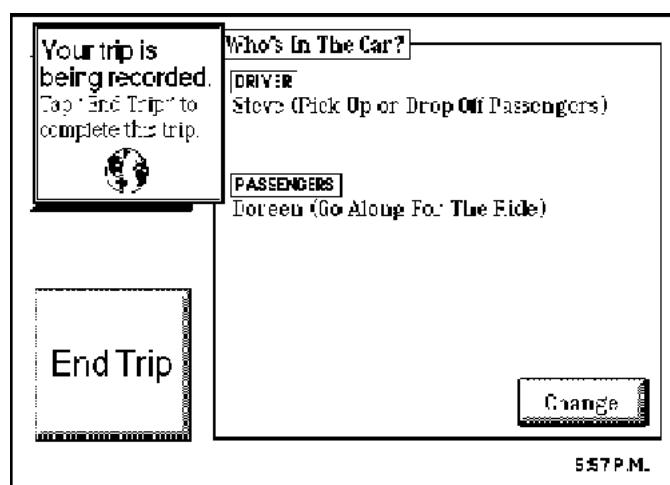


Figure 16

CAUTION:

Operating the hand-held computer requires your complete attention: Do not operate the computer while your vehicle is in motion. The survey does not require any data entry while your vehicle is moving.

DISCONNECTING THE COMPUTER

When your test period is complete, you will need to disconnect the computer and return it to the test administrator. This process requires three simple steps.

1. Turn off the hand-held computer. Please return the stylus to its place in the upper right portion of the computer. Close the cover using the Velcro tab to protect the screen.
2. Unplug the power plug from the cigarette lighter. Both the hand-held computer and the power cable can now be returned to their carrying case and secured using the Velcro closure.
3. Remove the GPS receiver from the roof of your vehicle and remove the cable from under the floor mat and other areas. Coil the cable and place the GPS receiver and the cable in their carrying case, securing them with the Velcro closure.

REPACKING AND SHIPPING

After completing the disconnection of the computer and the GPS receiver, place the equipment, in the carrying case, in the original shipping package. Please include the instructional video tape also. Remove the return address label for the package, and tape the package closed for shipment. Attach the return address label to the outside of the package.

Blue Chip Express of Lexington is providing courier services for the test. When the package is ready to return, just telephone Vivian Tufono or Skip Kraemer at 233-2233 to arrange pick up of the equipment package. Generally, the package should be picked up at the same address where it was delivered to you. If another address is required for pick up, be sure to give the correct pick up address when you call Blue Chip Express. All delivery and pick up services have been pre-paid. There is no cost to you for this service.

TEST ADMINISTRATOR

The test administrator for the Lexington Area Travel Data Collection Test is Mr. Marc Guindon of the Lexington Area MPO. If you should have any questions about the test, you may contact Mr. Guindon at the address and telephone listed below.

Lexington-Fayette Government Center
200 East Main Street
Lexington Kentucky 40507-1310

Telephone (606) 258-3178

THANK YOU

Thank you for participating in the Lexington Area Travel Data Collection Test. Your household is one of only 100 households in the Lexington-Fayette and Jessamine County area to participate in this test. Your participation and feedback provides us with valuable information about the use of new technologies for the collection of personal travel data needed by your local and national transportation planners.

We hope that this has been an enjoyable experience for you.

Program Host:

Lexington Area Metropolitan Planning Organization
Lexington-Fayette Government Center
200 East Main Street
Lexington Kentucky 40507-1310

Project Sponsor:

Federal Highway Administration
U.S. Department of Transportation
400 Seventh Street
Washington, D.C. 20590

Prime Contractor:

Battelle
Transportation Division
505 King Avenue
Columbus, Ohio 43201-2693

Appendix D.

Field Test Materials

Appendix D

Field Test Materials

Several items were used in the Lexington Area Travel Data Collection Test to communicate with the respondents. This appendix includes examples of those materials. The following materials are included, in the following order.

Exhibit	Description
1	Presolicitation letter, sent to approximately 1,300 commercially-obtained addresses with listed telephone numbers.
2	Local newspaper article describing the field test. This article was included as a part of the presolicitation letter.
3	Informed consent to participate in the field test. The respondent was required to sign and return this form before the equipment was released for their use.
4	Thank you letter to the respondents, sent immediately after the equipment was returned, accompanied by the final portion of the incentive payment.
5	Follow up letter to the respondents, including a tri-fold information brochure with preliminary results from the field test.

LEXINGTON AREA METROPOLITAN PLANNING ORGANIZATION
TRANSPORTATION PLANNING FOR FAYETTE AND JESSAMINE COUNTIES



LEXINGTON-FAYETTE GOVERNMENT CENTER
DIVISION OF PLANNING
200 EAST MAIN STREET
LEXINGTON, KENTUCKY 40507-1310

September 3, 1996

Dear Lexington Resident:

Your involvement in an upcoming field test to assist local and federal transportation planners is important to the future of our community.

Planners at the U.S. Department of Transportation recognize that transportation is much more than streets and highways, public transit, walkways, bike paths, and carpool services. Transportation is really about your ability to get where you need to go, whether it is to work, school, shopping, or someplace else. Occasionally, officials need to ask residents about their daily travel so they can determine if government policies and activities are moving in the right direction to meet these needs.

The traditional methods of obtaining daily travel information are costly and time consuming. The Federal Highway Administration has therefore selected Lexington, KY as a site to conduct a field test of a new methodology for collecting these data.

As explained in the enclosed newspaper article, the field test will use a mini-computer and satellite receiver placed in a personal vehicle to record the vehicle's movement over six days. Telephone interviews with the drivers will also be used to check the accuracy of the equipment and its ease of use.

Households in Lexington will be called at random and asked to help with this project. If your home is called, the interviewer will determine if anyone in the household over the age of 18 is eligible to participate. If an eligible participant is found, the interviewer will ask to speak to them. After providing some background information over the phone, and having the opportunity to ask questions about the field study, arrangements will be made for delivery of the recording device. A signed consent by a person at least 18 years of age will be obtained prior to delivery. Following the return of the unit and a second telephone interview, participants will be paid \$50.

Participation in this study is strictly voluntary and will not entail any major risks. Participants may refuse to answer any question during the interviews, or discontinue participation entirely. All information gathered in this study is completely confidential. Responses will be used for study purposes only and will not be released to anyone. Individual names will not appear in any reports which result from this study.

If you have any questions you can contact me by telephone at 258-3160. We hope that when the interviewer calls your home you will support and cooperate with our research efforts.

Thank you.

A handwritten signature in black ink, appearing to read "H. Robert Kennedy". The signature is written in a cursive style.

H. Robert Kennedy
Transportation Planning/MPO Manager

PHONE (606) 258-3160

FAX (606) 258-3163

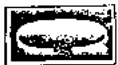
Federal Reserve chairman tells House panel that interest rates staying same Page C7

LOCAL NEWS

LEXINGTON HERALD LEADER

WEDNESDAY

July 24, 1996
Lexington, Ky.
* * *



SECTION
Obituaries
Short Takes

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Satellite to monitor drivers' moves

Lexington survey will help U.S. test new technology

By Chris Probst
Herald-Leader Staff Writer

Starting in August, the federal government plans to pick residents of 100 Lexington homes at random and track by satellite every move they make in their vehicles.

Talk about Big Brother: Every time drivers circle Fayette Mall looking for a parking place... Every time they run to McDonald's for a burger... And every time they go to the liquor store... The government will have a record of it. But there's no need to pull out your stash of anti-vernament literature. Potential participants will be selected at random

from the telephone book. People who agree to take part will have to sign a consent form allowing the government to track their every move. And they'll get \$50 for their trouble.

The results will be used to measure traffic patterns in Lexington.

The Federal Highway Administration picked Lexington out of about a dozen cities that expressed interest. The reason: Lexington officials were more enthusiastic than others to learn about the new technology and run the survey, said David P. Wagner, a consultant for the technical company that's doing the work for the federal government. Lexington has also worked hard to develop com-

puter mapping systems called Geographic Information Systems.

"That all helps," Lexington's selected Wagner said. "The federal government is doing this for one reason to try out its new technology. This survey, which should determine how well the technology works, will cost about \$250,000. And it will determine what glitches need to be worked out in the future."

Lexington officials wanted to be part of it because it represents the future of transportation planning, said Bob Kennedy, Lexington's transportation planning manager. It won't be long before governments across the country are using such technology to help plan where new roads and schools and government build-

ing should go.

TRAFFIC: Government survey to monitor drivers' citywide travels

From Page C1

Phanore, he wanted to be a part of the game, Kennedy said. "We were very pleased to be selected," he said.

Harris' driver carries a mini-computer and a receiver that transmits signals back and forth to a government satellite system. Every time drivers, Kofstetter said, they punch in their information about the trip they're about to take. After six days, they return the equipment.

The government downloads information from a small disk in the computer to map out the driver's daily travel.

This is not "real time" technology. The only way to map out the driver's traffic patterns is to download information from the disk.

But such technology would bring obvious benefits to planners in a city like Lexington, Kennedy said. "Traditional driver surveys are costly and time-consuming. And in the past, those surveys have even caused traffic headaches.

An attempt to survey motorists on Versailles Road in 1993 resulted in long traffic backups. Drivers were furious. And transportation planners were forced to postpone the survey.

This technology also has obvious advantages over surveys where drivers keep their own travel logs. In those logs, drivers are likely to neglect writing down short trips and round off travel times and travel distances, Wagner said. And they're more likely to edit out certain trips that they might not want other people to know about.

In these surveys, vehicles are promising that privacy will be protected. The individual habits of drivers will not be released to the public.

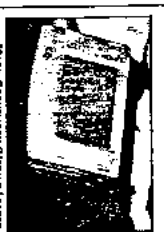
The results of the survey are scheduled to be released in December.

Lexington is not getting to gain much knowledge about traffic patterns from this survey, Kennedy said. The sample of drivers is unlikely to be representative of Lexington.

The kinds of people who are likely to volunteer might also skew the results, Wagner said. For instance, older drivers might be unwilling to mess with the computers and younger drivers might not want to take the time.

But when such technology becomes more widely available, Lexington's planning officials see all kinds of advantages that will come from it.

"Besides that, it will be fun," said Marc Ainsford, a senior transportation planner.



MARK COMBES/HERALD-LEADER
One of these receivers will be put in about 1,000 cars in Lexington for the study.

How the survey will keep track

The survey used to track traffic patterns in Lexington will use the Global Positioning System, or GPS, which consists of 24 satellites in orbit around the earth.

Here's how it works: Satellites that are more than 11,000 miles from the earth emit a constant radio signal that can be received by devices that will be placed on vehicles in Lexington. The receiver's pick up signals from several satellites and can determine within a few yards the exact position of the vehicle. The equipment will pick up signals every 1-5 seconds. The information gathered will be plugged into a computer mapping system that charts it on a map.

—Chris Probst

C4 Lexington Herald-Leader, Lexington, Ky. ■ WEDNESDAY, JULY 24, 1996

LEXINGTON AREA METROPOLITAN PLANNING ORGANIZATION
TRANSPORTATION PLANNING FOR FAYETTE AND JESSAMINE COUNTIES



LEXINGTON-FAYETTE GOVERNMENT CENTER
DIVISION OF PLANNING
200 EAST MAIN STREET
LEXINGTON, KENTUCKY 40507-1310

**Informed Consent to Participate
in Lexington Area Travel Data Collection Test**

You are being asked to participate in the test of a travel data collection device (hereafter referred to as the "device") to be conducted in the Lexington, Kentucky metropolitan area. The device consists of a small hand-held computer, a Global Positioning System (GPS) receiver, and connecting cables and packaging. The device must be installed in your personal vehicle for up to six days to record daily travel information.

In addition to the usage of the device, participation includes the completion of two telephone interviews. The first interview has already been completed to determine eligibility for full study participation. The second interview will be completed following the six-day usage of the device. You will be called at a time and place convenient for you and asked to answer questions about your travel on a specific day (chosen at random from among the six) and about the use of the device in general. The interview will take about 30 minutes.

The device is being developed to assist local and Federal government transportation planners by improving data collection methods and data accuracy through the use of automatic data collection devices. The interview will provide comparison data for an alternate method of data collection.

The device will contain a computer system and display screen, which will be used to enter information about the occupants of your vehicle and purposes of the travel. The device requires no data input or other interaction while driving the vehicle. You have the responsibility to operate the vehicle safely, in the same manner as you operate any vehicle, obeying all traffic signs, signals and laws.

As part of the travel data collection test, the position and progress of your car and your interaction with and operation of the device will be recorded. The data collected will be used to evaluate the potential of the device for improving travel data collection. The data collected will not be used for any other purposes and individual data will not be released to anyone outside of the study team. Although the results of this research will be published, the data generated from individual use of the vehicle and from personal interviews will be kept confidential.

For your participation in this test you will receive \$50. An initial payment of \$20 will be made upon completion of the initial telephone eligibility interview and receipt of the device for the test. The balance of \$30 will be paid after completion of the follow-up interview and upon return of the device at the completion of your participation in the test.

PHONE (606) 258-3160

FAX (606) 258-3163

I understand that this consent covers all drivers in my household who may drive the vehicle while the device is installed. Any additional drivers in my household who drove the vehicle on the travel day to be studied will also be called and asked to complete the follow-up telephone interview. At the time that they are called they will be given their own chance to agree or refuse to complete the interview.

I have been given an opportunity to ask questions about the device and the test, the procedures to be used, the operating instructions, and I believe that I have sufficient information to give this informed consent.

I agree and understand that I will maintain adequate insurance on my vehicle in accordance with applicable state law and that I will remain responsible for any destruction or damage to my vehicle as a result of my participation in this study. I understand that Battelle expressly assumes any and all risks associated with the device including its malfunction, breakage, theft, or other accident that may cause damage to the device.

If I have additional questions about the study, I may call Marc Guindon at (606) 258-3178. If I have any concerns about my rights as a research participant I may call Margaret Pennybacker, Ph.D. at (919) 544-3717.

I understand that I may withdraw this consent at any time and discontinue my participation in this project. However, until I do, I consent to the procedures described above.

PRINT NAME: _____

ADDRESS: _____

PHONE: _____

SIGNATURE: _____

DATE: _____

Please sign and return one copy of this consent in the enclosed postage paid, pre-addressed envelope so that your travel device can be delivered to you as soon as possible. You should keep the second copy of the consent for future reference.

Thank you for your participation.

LEXINGTON AREA METROPOLITAN PLANNING ORGANIZATION
TRANSPORTATION PLANNING FOR FAYETTE AND JESSAMINE COUNTIES



LEXINGTON-FAYETTE GOVERNMENT CENTER
DIVISION OF PLANNING
200 EAST MAIN STREET
LEXINGTON, KENTUCKY 40507-1310

Dear

Thank you for participating in the Lexington Area Travel Data Collection Test. Enclosed is the \$30 money order as the final payment of our "thank you" for your time and effort.

Only 100 households in Fayette and Jessamine counties participated in the field test. As indicated at the beginning of the project, no individual information is ever released, and your name, address and phone number are not attached to the data. Your participation has provided us with valuable information about how new technology will assist transportation planners in gathering travel data. This project will keep our area on the leading edge of transportation planning in the United States.

At the completion of the project, we will send you a copy of the project summary. We expect this to be completed in March, 1997.

Once again, we appreciate your support and participation in this important research study.

Marc Guindon
Senior Transportation Planner
Lexington Area MPO

MG:mg

Enclosure

PHONE (606) 258-3160

FAX (606) 258-3163

LEXINGTON AREA METROPOLITAN PLANNING ORGANIZATION
TRANSPORTATION PLANNING FOR FAYETTE AND JESSAMINE COUNTIES



LEXINGTON-FAYETTE GOVERNMENT CENTER
DIVISION OF PLANNING
200 EAST MAIN STREET
LEXINGTON, KENTUCKY 40507-1310

July 18, 1997

Dear Citizen:

Last fall you took part in an experiment hosted and coordinated by the Lexington Area Metropolitan Planning Organization and sponsored by the Federal Highway Administration. You volunteered to put an automatic data collection device in your personal vehicle as we tried to learn how to improve sources of personal travel data for municipal and transportation planning. We recently completed the analysis of the results from the Lexington area field test, and we thought you might like to know what we have learned.

The enclosed brochure provides some highlights from the study results. Overall, the experiment has provided some interesting results and insights into personal travel data that will benefit both transportation planners and drivers. Also, because of your willingness to participate in the experiment and your overwhelming acceptance of this technology, other similar applications are being planned or are underway.

The success of this experiment is a credit to the citizens of Fayette and Jessamine counties. I join our friends at the Federal Highway Administration and other participating organizations in saying thank you for your willingness to participate in this research study.

Sincerely,

A handwritten signature in black ink, appearing to read "H. Robert Kennedy". The signature is written in a cursive style with a large initial "H".

H. Robert Kennedy
Transportation Planning/MPO Manager

PHONE (606) 258-3160

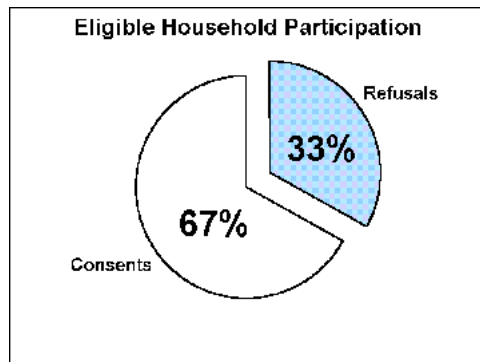
FAX (606) 258-3163

Lexington Area Travel Data Collection Test

Participation

The citizens of Fayette and Jessamine counties were instrumental in the success of this research program. The Federal Highway Administration (FHWA) and the test administrators were surprised, and very pleased, with the response that we received.

Approximately 2 out of 3 eligible households that we telephoned agreed to participate in the field test, exceeding our expectations. The automatic data collection devices



generally worked very well during the field test in the Lexington area. You took excellent care of our equipment and returned it promptly and in good order.

Several of you had some problems with the device. The most commonly reported problem was the need to adjust the screen contrast frequently so you could read the menu choices on the screen. A second issue related to the menu choices. Several of you indicated that you were sometimes unsure

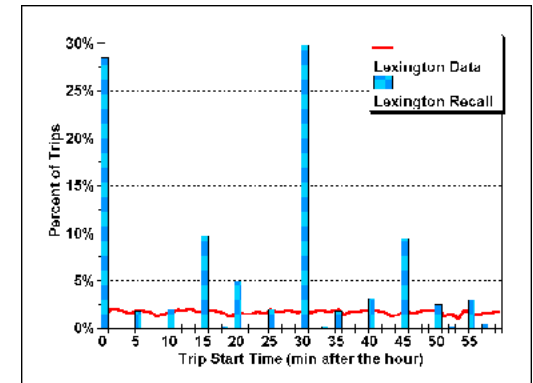
which option was appropriate for your activity, leading to confusion when selecting from the menu choices. Thanks to you, we are able to solve these problems before the devices are used again.

Travel Comparisons

As a group, you are probably not surprised to know that the people in Lexington drive about the same as other people across the country. On average, you take about 4.5 trips a day with 1.6 people in your car. An average trip is about 6 miles, which is a little less than most of the United States, and you'll travel about 27 miles a day. Analysis of the electronic data indicates that, on average, your trips are a little shorter and take less time than trips included in the national surveys. We expected this result because the automatic data collection device has the potential to be more accurate than most interviews.

You also helped us to demonstrate something that we often believed. Generally, when interviewed about their travel habits, people tend to round travel times to 10, 15, and 30 minute intervals. In fact, when you were interviewed after you had used the data collection device, you rounded your time estimates to 10, 15, and 30 minute intervals, as shown in the following figure. However, the other line at the bottom of the figure shows the trip times recorded by the data collection device during the field test. As you can see, they are quite different, and this result supports the notion that the real distribution of trip times may be very different from the interview results. Similar tendencies to round occur in reporting trip distances as well, so this result is important to our understanding of personal travel habits.

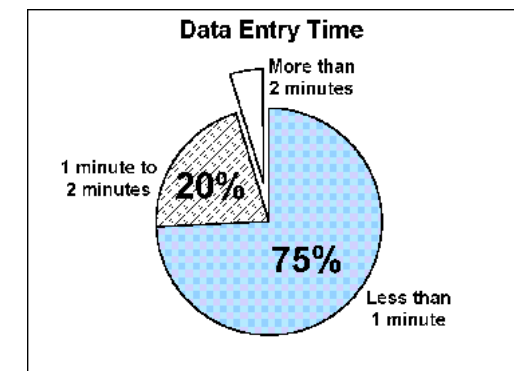
Another important result focused on the



amount of time needed to enter data into the hand held computer before each trip. The following figure shows that about 75% of the time this process took 1 minute or less. About 95% of the data entry tasks were completed in two minutes or less. For a household that takes about 6 trips per day, only 6 to 12 minutes are required for data entry. This is important because the time required to retrieve the same information in a telephone interview may require 20 to 30 minutes.

New Information

A big advantage of this technology for travel



data collection is the ability to match it with electronic maps provided by your local government. This allows travel planners to determine the types of roads you travel on, in addition to how much you travel. An example of this information for the Lexington study is shown in the following table. This type of data was impossible to collect using traditional methods.

Percent of Daily Travel	
Freeway	2.9%
Arterial Highway	10.4%
Major Arterial	32.8%
Minor Arterial	29.5%
Collector	8.8%
Local-Thru Street	15.6%

Method Acceptance

In general, you were overwhelmingly favorable in your acceptance of the data collection device. You preferred the automatic device over a written travel diary by a 9 to 1 margin. Only 1 in 20 participants had concerns about the government collecting personal travel data. Those concerns were personal privacy issues. When asked if you would participate again in a similar study, you responded yes by a 50 to 1 margin.

Future Applications

This technology will continue to be used for travel data collection. The equipment used in the Lexington test has already been

reprogrammed and is now being used in a study of truck activity in California. Other planning organizations are also starting to use this technology in their travel surveys.

Once again, thank you for your participation.

The Lexington Area Data Collection Test was a proof-of-concept experiment to test new, electronic methods of collecting personal travel data. This experiment, and its successful conclusion, was possible only through the cooperation and active participation of the citizens of Fayette and Jessamine counties, Kentucky.

Host Lexington Area Metropolitan
Planning Organization
200 East Main Street
Lexington, KY 40507

Sponsor Federal Highway Administration U.S.
Department of Transportation
400 Seventh Street, SW
Washington, D.C. 20590

Contractor Battelle
Transportation Division
505 King Avenue
Columbus, OH 43201

Lexington Area Travel Data Collection Test



Federal Highway Administration
U.S. Department of Transportation



Division of Planning
Lexington Fayette Urban County
Government

July 1997