Origin-Destination Travel Survey for Southeast Michigan

RAI PARVATANENI, PETER STOPHER, AND CLEVELAND BROWN

A small-sample origin-destination survey of randomly selected households was conducted for southeast Michigan to update the existing regional travel data base. The data obtained include records of all trips made by tripmakers 5 years old and older for a 24-h weekday period, demographic information about the sampled household, and attitudinal information on several transportation-related issues from a randomly selected adult in the sampled household. The sample was drawn as a three-stage, stratified random sample of about 2500 households for a region containing approximately 1.6 million households. Despite the small size of the sample (0.16 percent), the trip rates were estimated to ±5 percent accuracy with 90 percent confidence. The rationale for the survey, the method of establishing the sample size, and the procedures for drawing the sample and executing the survey are described; a summary of some of the results is given. Of particular note, the survey measured an overall increase of 17 percent in trip rates over those reported in 1965, although the trip-rate changes varied significantly by both purpose and area type. In addition, compared with 1965, the survey measured a significant increase in car ownership but a decrease in household size. Some of the results of the attitudinal questions are provided, particularly those relating to fuel conservation, price increases, and supply limitations and to attitudes relating to financing of transit improvements. The attitudes measured in the survey in September through November 1980 are in contradiction to changes in federal policy.

During the past decade, large-scale surveys conducted in the 1960s have served as the source of household travel data used in local and regional transportation planning. However, the geographic and demographic characteristics of most urban regions have undergone substantial change, which has resulted in altered travel behavior. A technical council committee of the Institute of Transportation Engineers (1), through an analysis of trip rates of eight U.S. cities along with five Canadian and European cities, has shown a considerable increase in average household trip rates from the 1960s to the 1970s. Greater automobile availability and disposable income and resultant land development shifts have been identified as some of the factors that have caused altered travel behavior.

In recognition of changes in regional travel, supplemental surveys have been initiated to collect detailed current travel information for southeastern Michigan. The collection of this information has been approached in a manner that will enhance the utility of 1980 census data. The supplemental surveys include an on-board transit user survey, a transit screenline count survey, and a major regional travel survey, which is the subject of this paper. These efforts will result in an expanded and updated regional travel data base and provide a data source for transportation planning and implementation activities in the 1980s. The objectives of the regional travel survey are as follows:

1. To gather information on socioeconomic, demographic, and travel characteristics of members of selected households for enhancing the predictability of regional travel-demand models;
2. To evaluate the impact of the changing energy situation on individual travel habits;
3. To obtain such attitudinal data from automobile users about potential ridesharing and transit use as may be useful in the regional travel-demand models;
4. To gather information on the effectiveness of current transit and ridesharing promotional activities; and
5. To gather limited attitudinal data on issues relating to regional transportation policies.

This paper provides a discussion on limitations of previously existing regional travel data, new data requirements for alleviating some of these limitations, survey methodologies for gathering needed new data, and subsequent analyses of the newly acquired data.

LIMITATIONS OF EXISTING TRAVEL DATA

Prudent transportation planning relies on current descriptions of segmented households or individuals and their behavior at a selected level of aggregation that primarily includes socioeconomic and travel data. Further, an understanding of individual attitudes and perceptions towards various transportation-related issues would enhance the planning process in its effort to more precisely simulate individual travel needs. With such data as input, travel-demand models are used to forecast future travel volumes on specified transportation systems. Because development and operation of transportation systems involve large expenditures of funds, reliable travel-demand data should be employed carefully so that decisions on expenditures of capital funds are accomplished effectively and efficiently. The following discussion provides a detailed evaluation of the presurvey status of the travel-demand and related data needs, sources, and applications in southeast Michigan.

1965 Regional Origin-Destination (O-D) Survey

A comprehensive inventory of regional travel patterns was developed in southeast Michigan by the Detroit Regional Transportation and Land Use Study (TALUS) in 1965 as a special project of the Detroit Metropolitan Area Regional Planning Commission (RPC). The TALUS survey gathered O-D data from more than 40 000 households, which resulted in information on more than 340 000 trips. The survey area included Wayne, Oakland, Macomb, and parts of Washtenaw, Monroe, St. Clair, and Livingston counties from which a 4 percent sample of all households in the study area was obtained. Since 1965, this information has provided the basis for all regional land use and transportation planning, which includes the adopted Regional Transportation Plan. The data have served as primary input for current forecasts of regional population and employment. Since 1965, southeast Michigan has been subject to changes in demographic and socioeconomic characteristics. Changes include an increase in automobile availability, increased household disposable income, changes in composition of the work force, and deterioration of off-peak transit service. Such changes have had substantial effects on the travel volumes and patterns in the region.

A comparison of 1970 forecast work-trip attractions to 1970 census journey-to-work trip attractions has shown that estimates based on the TALUS data do not adequately predict travel in the region's outlying counties. The value of TALUS data alone for conducting on-going planning activities appears questionable.

1980 Decennial Census Survey

The 1980 Decennial Census Survey provides detailed socioeconomic descriptions of the region's households. Most of these data are obtained from a 100 percent sample. The data will be extensive, cur-

rent, and reliable, and thus their use in conducting planning studies is warranted. In addition to socioeconomic data, the census survey collects limited journey-to-work information. These data are obtained from a 20 percent sample for metropolitan areas and will include information on travel modes for work trips, locations of primary work places, the total portal-to-portal travel times, and some information on ridesharing. Although this information provides for sound input to the development of regional transportation plans (particularly during the peak period because the data pertain to work trips), there are still many limitations to the census data. ITE Committee 6A-12 has reviewed both potential applications and limitations of the census data, the findings of which were presented in a paper entitled Preparation for the 1980 Census in the ITE Journal in March 1979 (2). The expected limitations of the 1980 census travel data are discussed briefly as follows.

Desired Aggregation of Travel Data

Although April 1, 1980, was census day, much of the travel-related tabulations will not be released by the Census Bureau until 1982 at the earliest. Further, because of the confidentiality protection given to respondents, data disaggregated to the household level cannot be released. Rather, the data are made available only at an aggregate level (census block, tract, etc.). Because disaggregate models are used predominantly in regional planning, this limitation severely compromises the maximum utility of census data.

Atypical Data Gathered

The Census Bureau does not obtain typical travel-to-work data. The census-reported data provide an overestimation of actual travel on a typical day, because on a typical day some 10-20 percent of workers may not commute to work from home for some reason or other. Adjustments have to be made to factor down the work travel reported by the census. Further, the census does not obtain work-schedule information, which can be very helpful in developing ridesharing promotional efforts. Thus, special efforts must be extended to gather additional information through supplemental surveys and monitoring of employment data.

Secondary Work Travel Data

The census survey does not obtain data on non-home-based work trips such as those from work to other places to execute work-related activities. Similarly, persons holding more than one job do not furnish information on secondary job-related trips.

Travel Data on Submodes

The census journey-to-work information does not adequately identify access and egress travel modes. In transit system planning, submodal information is essential. For example, in the design of park-and-ride services, it is necessary to estimate the volume of drivers who use park-and-ride lots to store their vehicles as contrasted with those who use the lots in a walk-and-ride or kiss-and-ride mode of travel.

Nonwork Travel Data

Discretionary nonwork travel accounts for more than 60 percent of the trips made in southeast Michigan. The census does not collect information on nonwork travel. Such information must be obtained through supplemental means.

Attitudinal Data

Last, even though issues such as energy concerns do play an important role in developing regional transportation policies and plans, the census does not gather information on individual or household attitudes and perceptions toward various transportation-related issues.

OTHER PERTINENT REGIONAL SURVEYS

Other transportation-related surveys have been conducted within the region for special purposes and generalized use, but these surveys have not collected information of sufficient detail and sample size for use in comprehensive transportation studies. The given data limitations suggested a need for conducting supplemental information-gathering activities in 1980 if having current and detailed information on regional travel behavior for all modes and trip purposes was desired and valuable.

SUPPLEMENTAL DATA NEEDS AND APPLICATIONS

In order to address limitations of the current data sources, a need exists to collect additional travel information. The supplemental data needs can be classified broadly into three categories and subclassified as detailed below:

1. Household characteristics
   a. Household composition
   b. Information on household members 16 years or older
   c. Gross household income
   d. Household vehicle availability
2. Person/trip data
   a. Tripmaker identification
   b. Trip O-D locations and starting and ending times
   c. Trip purpose
   d. Mode of travel
3. Attitudes and perceptions
   a. Related to transit use
   b. Transportation strategies
   c. Energy considerations

DETERMINING SAMPLE SIZE

In recognition of funding restraints, extra care was given to the design of a small sample that provides statistically accurate results. The critical variable for sample size determination was the household tripmaking rate. The existing trip-generation forecasting procedure consists of four linear regression equations with the independent variables of family life cycle, income, household size, and automobile availability. The four equations are for four area types defined as follows:

Area type 1: 10 or more employees per acre of usable land,
Area type 2: less than 10 employees and more than 5 dwelling units per acre of usable land,
Area type 3: less than 10 employees and from 0.5 to 5.0 dwelling units per acre of usable land, and
Area type 4: less than 10 employees and less than 0.5 dwelling unit per acre of usable land.

A procedure based on sampling-error computation was recently developed by M.E. Smith (3) for calculating the sample sizes from prior data on trip-generation rates. (Smith also showed that the samples

calculated for trip rates will be more than adequate in general for trip distribution and mode-split modeling.) The procedure takes into account the contributions of different subgroups of the data to the total sampling error and produces an estimate of the minimum sample size needed to attain the required accuracy. The procedure requires that a sample size be computed on the basis of the required accuracy at the specified confidence level and that these calculations be done by estimating a pooled coefficient of variation over the identified subgroups (cells). Subsequently, the sample size may be readjusted on the basis of the subsample size in the "critical cell," which is defined as the cell that has the largest coefficient of variation. Application of the sampling procedure generates a sample size for each cell based on its contribution to the overall coefficient of variation. However, by using the distribution of households by cell from the base data, the expected sample size in each cell can be estimated. This will usually be different from the sample size based on the cell's contribution to the coefficient of variation and hence follows the need for readjustment. By applying Smith's procedure within the four area types treated as independent entities, the following sample sizes were computed. At the outset, a uniform accuracy level in each area type was assumed by specifying that the trip rates be estimated to within ±5 percent with 90 percent confidence for each area type. The sample sizes are given below:

Area Type	No. of Households
1	610
2	450
3	343
4	404
Total	1807

In no case does the expected sample provide a sufficient subsample in the critical cell of an area type. After a correction factor has been applied, again following Smith's procedure to give the optimum sample size for each critical cell, the adjusted sample sizes became as follows:

Area Type	No. of Households
1	1157
2	660
3	481
4	524
Total	2822

After the initial sample size had been derived, consideration was given to two other factors, namely, the magnitude of tripmaking in each area type and the political jurisdictional balance within the region, primarily between the counties. The number of households based on the regional forecasts was 84 484 for area type 1, 191 886 for area type 2, 1 034 090 for area type 3, and 344 023 for area type 4. A relatively large number of households in area type 3, coupled with the fact that the average trip rate for this area type is larger than the others, revealed that the trip-rate accuracy levels should be higher for area type 3 in order to improve the overall accuracy levels. Second, the sample should be somewhat spread more uniformly between political jurisdictions to be able to draw meaningful conclusions from the attitudinal data. Based on these factors, adjustments were made to the above sample sizes. The final sample consisted of the following:

Area Type	No. of Households
1	681
2	675
3	621
4	625
Total	2604

MULTISTAGE SAMPLING TECHNIQUE

To achieve a true random sample, a complete sampling frame consisting of a list of all households in the study region stratified by zonal area type should be used. However, no current listing exists of households for all seven counties of southeast Michigan. To overcome this problem without undertaking a complete, in-field enumeration of all households in the region, a three-stage random sampling process was used, in which the stage designs permitted use of extant lists of aggregations of households until the final stage, when enumeration would be a greatly reduced activity.

In the first stage, a stratified random sample of zones was selected with varying sampling fractions for four strata comprising the four area types. The population for this sample consisted of 1446 analysis zones, each of which was classified by area type. The second-stage sample was a sample of blocks from those zones selected in the first stage. This and the third stage used property description maps from the tax assessment and equalization departments of the counties. Although these maps varied from county to county in style, content, scale, and referencing system, all had a common system of delineating developed and partly developed land into blocks of land area that were completely surrounded by streets and had no streets passing through them. Also, the maps provided a numeric code for every subdivided parcel of land either by lot or by current property boundaries. All maps of this nature are kept reasonably current; most are current to within a matter of months. Traffic analysis zone boundaries were drawn on these maps and blocks within the zone enumerated. A random sample of blocks was drawn for each zone by using different sampling rates for each area type.

The third-stage sample consisted of parcels from the selected blocks. Each selected parcel was then located in the current tax records of the local taxing authority (city or county), from which its use could be established. If the use was found to be residential, the address was recorded from the tax records, and the parcel became part of the sample.

At each stage, the sampling was continued beyond the designated sample size to provide backup against in-field failures to obtain an interview from an original sample. In some instances a zone or a block contained no or too few residential units; this necessitated use of additional zones or blocks to complete the sample. In order to avoid potential bias, the random sampling procedure within each stage was extended to allow for such eventualities.

SURVEY

Selection of Survey Mechanism

A number of alternative mechanisms or techniques were considered for the survey, including a self-administered mail survey, a telephone interview, a combined telephone interview and mail survey, and an in-home personal interview. On balance, the in-home personal interview was deemed to be the preferred mechanism, in view of the purposes of the survey, the nature and length of questions to be asked, and

the probable response to the survey. However, the objective of obtaining travel information for a 24-h weekday period from each household member 5 years old and older necessitated further consideration of procedures.

The traditional historical-record method of collecting travel data (i.e., requesting data on the previous 24 h for each eligible family member) was not considered satisfactory for several reasons. Principally, past experience with the method suggests that a number of trips (particularly short trips and non-home-based trips) are seriously under-reported and that 1980 lifestyles seemed likely to make it difficult for the interviewer to find a majority of eligible household members at home at the desired time of the interview. As a result, a travel diary was adopted and designed to be used on an appointed day by an eligible household member to record his or her travel on that day.

By using the travel diary, the survey mechanism was designed as a two-step process. First, the interviewer completed an interview with a randomly designated household member (by using a selection grid where the designated individual was defined on the basis of the day of the week and the numbers of adults and adult males then at home) that gathered attitudinal and demographic data. After rapport had been established with the respondent, travel diaries were distributed for each eligible household member and an explanation was given of how to complete them, the day for completion was set, and an appointment was made for the interviewer to return to collect the completed travel diaries. The second step was the return visit to collect the completed travel diaries; that visit was an opportunity to check the travel diaries for completeness, probe for missing trips, and provide a promised incentive for completing the travel diaries.

Conduct of Survey

Travel surveys always pose problems with respect to timing during the year, particularly in northern cities of the United States. Travel is known to be atypical during major school breaks, in the period from Thanksgiving through New Year, and in the period of winter from January through March, when snowstorms and other specific weather occurrences may cause major disruptions in travel. This limits travel surveys primarily to the period between Labor Day and Thanksgiving and from the beginning of April through mid-June. Because of the desire to collect the data as close as possible to the 1980 census (for purposes of compatability), the survey was scheduled for fall 1980. Interviewing commenced on September 6, 1980, and concluded on November 23, 1980. Retrieval of travel diaries continued into December and some mail and telephone followups for missing critical data continued into February 1981.

The execution of a complete interview took a significant amount of time as a result of several factors. First, the interview and distribution of travel diaries generally took 30-50 min to complete. Second, the return call to pick up the travel diaries required generally some 10-20 min at the household and frequently necessitated one or more calls back to obtain a complete set of travel diaries. Third, interviewers were required to make three calls at a household initially (at least one call on a weekday and one on a weekend day) before the household could be deemed a "no answer" and replaced from the backup sample. Fourth, although the multistage sampling produced a somewhat clustered sample, significant travel distances were involved, particularly in the outer counties of the region. As a result, interviewer productivity was severely constrained.

In the 11-week period of the survey, 2706 interviews were completed, for which 2502 complete sets of travel diaries were obtained. (The other 204 interviews had one or more travel diaries missing at the conclusion of all data collection.) To obtain the 2706 interviews, a total of 5309 sample addresses was generated. Table 1 shows the disposition of this total sample. The 2502 complete interviews represent 77.7 percent of the successful contacts and 92.7 percent of those contacts that resulted in completion of the attitude and demographic interview. A brief explanation of a few of the dispositions is useful to clarify the survey results. "No such address" was recorded when both of the neighboring addresses were found and it was clear that no intervening property existed. These represent outright errors in the tax rolls and the consequences of recent redevelopment. "Cannot find" was recorded when the address could have existed but neither the interviewer nor the supervisor was able to locate it. Most of these occurred in the outlying rural areas. "Noneligible respondent" was recorded for two primary situations. The first was when all household members were unable to speak or understand English; the second was when no adults in the household could be interviewed. The latter included households where the only adults present appeared to the interviewer unable to provide a coherent response or not rational, i.e., potentially under the influence of drugs or alcohol. The 121 "contact recorded, no interview found" occurred where an interviewer indicated that an interview had been completed, but no interview forms were found. Some of these were forms that were not retrieved from interviewers who for one reason or another were removed from conducting the survey. Finally, short demographic interviews were conducted on refusing households, originally intended as a check for nonresponse bias. The number of successful short interviews, at less than 10 percent of the refusals, proved too few for a nonresponse analysis, however.

During the conduct of the survey, telephone verifications were carried out on 15 percent of each interviewer's work to make sure that a valid interview had taken place, that incentives were provided, and that the interviewer had been courteous and polite. In addition, any missed data were requested at this time and the respondent was asked how long the interview took and if he or she had any comments to offer.

Certain elements of the survey were defined as

Table 1. Disposition of household sample addresses.

Disposition	Number	Percent
No answer	867	16.3
Uncompleted request for call back	83	1.6
No such address	336	6.3
Cannot find	53	1.0
Noneligible respondent	133	2.5
Under construction	5	0.1
Vacant	340	6.4
Business	113	2.1
Duplicate address	37	0.7
Contact recorded, no interview found	121	2.3
Subtotal	2088	39.3
Refusal	462	8.7
Termination	12	0.2
Short interview	41	0.8
Interview without complete travel diaries	204	3.8
Subtotal	719	13.5
Complete interview	2502	47.1
Total	5309	100.0

critical, and additional effort was made to obtain those elements. The critical elements were defined as (a) a completed travel diary from each eligible household member (i.e., if any travel diaries were not returned by a household, the interview was considered incomplete) and (b) completion of data on automobile availability, income, household size, and the variables used to define life cycle (ages of children and age of head of household). These elements were sought in follow-up activities. For the most part, collection of missing travel diaries continued through mid-December only. After that, the chances of recovering missing travel diaries were considered too low for the cost and effort required, and the probability of obtaining travel diaries containing information for some day outside the survey period would be too high and could lead to invalid results. Missing demographic data were sought by both mail and telephone follow-up. These procedures succeeded in completing an additional 48 surveys. An additional 95 interviews were missing income data only, and a multiple-classification analysis procedure was developed to estimate income for these interviews on the basis of area type, number of workers, and number of available vehicles.

The 2502 completed interviews, therefore, consisted of 2359 that were satisfactorily completed from the original interviews, 48 that were completed by additional solicitation for critical demographic data, and 95 that were complete except for income but for which income could be estimated from other data. In subsequent analysis, the computer was unable to match the interviews and travel diaries for 56 households, so the subsequent trip-rate analysis is based on 2446 of these complete interviews.

SURVEY DATA ANALYSIS

Although the trip-rate analysis is based on data from only 2446 households, information from 2706 households was used for the analysis of the attitudinal data. The data were expanded by political jurisdiction and area type based on the total number of households within each stratification.

Trip-Rate Data Results

By applying Smith's procedure to the trip data gathered from this survey, it was found that the accuracy levels achieved from the survey data are very much in concert with the assumptions made earlier during the design phases of the study. The results of home-based total vehicle trips, which were the key factor in the design of the survey, are shown in Table 2.

As seen from Table 2, there have been significant increases in average trip rates between 1965 and 1980 except for area type 2, which exhibited a decrease in trip rates. When the percent differences are weighted by the number of households in each area type, the home-based vehicular trips in 1980 are higher by about 17 percent than in 1965.

Demographic profiles relevant to trip-making behavior (automobile availability and household size) were generated and comparisons were made between 1965 and 1980. These comparisons indicated that the average household size has decreased from 1965 to 1980, i.e., from 3.5 persons per housing unit to 2.75. On the other hand, the distribution of automobile ownership as presented below indicates that the trends are toward owning two or more automobiles.

	Percent Who Own Automobiles			
	No. of Automobiles Owned			
Year	0	1	2	3+
1965	15.2	47.5	31.5	5.8
1980	11.6	37.8	38.2	12.4

Further analysis of the home-based vehicular trips broken down by home-based work and home-based other trips reveals that home-based work trip rates have decreased from those of 1965. It is doubtful that the drop in 1980 home-based work trip rates is due to fewer workers in the household. National trends show that the recent increase in workers per household is due to the increased numbers of working women. Lower home-based work trip rates cannot be attributed to high unemployment; in the surveyed sample, only 3.5 percent of the respondents were laid off from their regular jobs at the time of the interview. A plausible explanation for lower 1980 home-based work trip rates is the trip-chaining being done to offset the higher cost of gasoline. In other words, the non-home-based trip rates are higher in 1980 than they were in 1965. Whereas workers may have proceeded directly from work to home in the past, they are now more likely to stop for shopping or a visit with a friend rather than going home first. In fact, in the attitudinal part of the data, respondents indicated that they have been chaining trips due to the energy situation. A detailed analysis of the trip data has yet to be undertaken.

Attitude Survey Results

The survey included a variety of attitudinal questions. The following analysis presents some important issues related to energy and public transportation.

Conserving Energy (Behavior and Behavioral Intent)

The interviewer stated that he or she was going to read a list of things that people might do because of higher gasoline/diesel fuel prices or gasoline/diesel fuel shortages. After each one, please indicate whether

1. You started to do this regularly more than a year ago,
2. You started doing this regularly within the past year,
3. You would do this if gasoline/diesel fuel prices were to double next week,
4. You would do it if you could buy only 10 gallons (35 liters) of gasoline/diesel fuel a week for each registered vehicle starting next week, or
5. You would do it either if prices doubled or if gasoline/diesel fuel were rationed.

Summarized results are presented in Table 3. Responses to the first two items are combined to give the percentage of respondents who say they are already undertaking the stated action on a regular basis. The next three items are combined to provide the percentage of those who would consider taking the action regularly if the price or supply constraints became reality. It is useful to look at three sets of actions: Those that the majority (more than 50 percent) claim they are doing regularly now, those that the majority would expect to do if gasoline prices double or supply is restricted, and those that the majority would not expect to do under any of the stated conditions.

In the first category, as indicated by the "Am Doing" column (the sum of "more than a year" and "past year"), respondents claim that they are

Table 2. Comparison of trip rates: 1980 versus 1965.

Area Type	Total Sample Size	Accuracy Unadjusted (%)	Avg Home-Based Total Vehicle Trip Rate 1980	1965	Difference (%)
1	617	85	3.535	1.870	+89
2	574	90	3.428	3.915	-12
3	685	97	5.915	5.212	+13
4	570	96	6.605	5.188	+27

Table 3. Behavior and behavioral intent to undertake conservation actions.

Question	Percent Responding None	Am Doing	Would Do
Observe the 55-mph speed limit	4	89	7
Take a vacation closer to home	36	35	29
Shop less frequently	19	55	26
Carpool or vanpool to work or school	47	21	32
Cancel a vacation trip	44	15	41
Combine car journeys you used to make separately	13	62	25
Buy a car that gets better mileage	31	30	40
Take the bus or train to work or school	50	11	39
Have car tuned up regularly	4	90	7
Move closer to work or school	75	11	13
Walk or bicycle to work or school	69	15	16
Shop closer to home	14	69	16
Look for a job closer to home	68	17	14
Shop on the way to or from work or school	22	61	17
Cut down use of snowmobiles, power boats, or other recreational vehicles	57	22	22
Sell a car and not buy one in its place	77	5	19
Use a train, bus, or airplane for vacation trips	28	34	39
Take a bus or train more often for nonwork travel	46	11	42
Move to a place with better bus service	88	3	10

Notes: Due to rounding error, totals will not always be 100. N = 2180.

1. Having their cars tuned regularly (90 percent),
2. Observing the speed limit of 55 mph (89 percent),
3. Shopping closer to home (69 percent),
4. Shopping on the way to and from work or school (61 percent),
5. Combining car trips that used to be separate (62 percent), and
6. Shopping less frequently (55 percent).

Among these, not more than 22 percent of the respondents indicated that they had begun the action in the past year (which would encompass the sharp gasoline price increases in the fall of 1979), although actions 4, 5, and 6 were each reported as having been initiated in the past year by 17 percent or more of the respondents.

In the second category, as indicated by a combination of the "Am Doing" column and the "Would Do" column (the sum of "double price," "ration," and "either"), respondents indicated what they would expect to be doing if the price of gasoline doubled or if gasoline were rationed:

1. Using train, bus, or plane for vacation trips (72 percent);
2. Buying a car that gets better mileage (70 percent);
3. Taking a vacation closer to home (66 percent);
4. Canceling a vacation trip (56 percent);
5. Taking a bus or train more often for nonwork travel (54 percent);
6. Carpooling or vanpooling to work (53 percent); and
7. Taking a bus or train to work or school (50 percent).

Rationing seems to have much less effect on people's perceptions than price increase; at most, 10 percent of the respondents said that only rationing to 10 gallons would cause them to cancel a vacation.

The remaining six actions would not be considered by the majority of respondents. As indicated by the "None" column, respondents indicated they would not, under any of the stated circumstances, do the following:

1. Move to a place with better bus service (88 percent),
2. Reduce the number of cars they owned (77 percent),
3. Move closer to work or school (75 percent),
4. Walk or bicycle to work or school (69 percent),
5. Look for a job closer to home (68 percent), and
6. Cut down the use of recreational vehicles (57 percent).

These results tend to indicate, first, that trip-chaining and reductions in discretionary travel are the primary adjustments that people have been willing to make so far. This trend continues in those actions that people indicate a willingness to undertake next; three actions involve changes in vacation trips and one is nonwork travel. None of the energy scenarios is perceived as being harsh enough to produce a change in home location or job location, to reduce the number of cars owned, or to lead to dependence on nonmotorized travel for work trips. Even a shift to transit for the work trip is envisaged by only 39 percent of the respondents and 32 percent might carpool.

Perceived Effectiveness and Favorableness of Imposed Conservation Strategies

The interviewer stated: "I am going to read some suggested ways to reduce gasoline/diesel fuel consumption. For each one, please tell me how much you think each one would reduce your household's gasoline/diesel fuel consumption (column A) and whether or not you think it is a good idea as a way to reduce fuel consumption (column B)...." Results of this question are given in Table 4. In terms of reducing gasoline consumption, improved bus service (items F and G in Table 4) and gasoline rationing (C) are seen to be the most effective, while taxing gas-guzzling cars (B) and asking people to drive less (D) are likely to be the least effective. On the other hand, the strategies respondents favor most are discretionary ones and those that would return money to them, such as items D (yes, 73 percent), E (yes, 67 percent), F (yes, 81 percent), and G (yes, 85 percent). Likewise, disapproval is high for mandatory and economic disincentives, as shown by the responses to items A (no, 84 percent), B (no, 68 percent), and C (no, 77 percent).

General Awareness of Regional Transit Services

In reply to the question "How much would you say you know about public transit services in the southeast Michigan region?" the following responses were found (N = 2706):

Response	Percent
Very much	5.5
Some	26.9
Very little	43.9
Nothing	23.7
	100.0

Table 4. Perceived effectiveness and favorableness of imposed conservation strategies.

Item	Percent Responding: Column A: Very Much 1	2	3	Not at All 4	Column B: Yes	No
A. Add a 50¢/gal nationwide gasoline tax	27	17	16	40	16	84
B. Add a $100/year tax on gas-guzzling cars	23	12	12	53	32	68
C. Introduce nationwide gasoline/diesel fuel rationing of 10 gal/registered vehicle/week	33	19	14	34	23	77
D. Ask people to drive one-fifth less than now but not force them to do so	20	22	22	36	73	27
E. Give a $100/year tax rebate on cars that get more than 30 mpg	27	19	11	44	67	33
F. Twice as frequent bus service	32	19	10	39	81	19
G. No more than a 5-min walk to a bus stop	38	18	10	35	85	15

Notes: Due to rounding error, totals will not always be 100. N = 2180.

Table 5. Regional attitudes toward financing public transportation.

Item	Percentage: Strongly Agree 1	2	3	4	5	Strongly Disagree 6	Agree Total	Disagree Total
A. All costs for running and improving public transportation should come from fares paid by passengers	29	13	18	12	13	15	60	40
B. Federal government should subsidize running and improving local public transportation	31	24	15	8	6	16	70	30
C. In addition to fares, running and improving public transportation should be paid for by increase in gasoline taxes	5	7	10	9	14	55	22	78
D. In addition to fares, running and improving public transportation should be paid for by increase in sales tax	4	5	9	9	15	58	18	82
E. In addition to fares, running and improving public transportation should be paid for by increase in property tax	1	1	2	5	11	80	4	96
F. In addition to fares, running and improving public transportation should be paid for by increase in other vehicle taxes	5	9	10	9	13	52	24	74
G. In addition to fares, running and improving public transportation should be paid for by increase in income tax	2	4	5	6	11	72	11	89
H. Public transportation should be made free of fares for all riders	9	4	6	7	15	60	19	82

Notes: The first six columns represent all answers and will sum to approximately 100 percent, except for rounding errors. The last two columns are summaries of the first six and also add up to 100 percent. N = 2706.

The majority of the sample (67.6 percent) knows very little or nothing at all about public transit. (It was also noted that 67.4 percent have not used transit in southeast Michigan for at least one year, if ever.)

Importance of Major Improvements in Public Transit

In reply to "How important do you think it is to make major improvements in public transportation in southeast Michigan?" the following was found (N = 2706):

Response	Percent
Very important	63.5
Somewhat important	26.3
Not important	4.5
No opinion	5.7
	100.0

A majority of the respondents (89.8 percent) thinks it is very or somewhat important to make major improvements in public transportation. Interestingly, respondents admit to not knowing much about the existing transit system, but a majority thinks it is quite important to improve it.

Regional Attitudes Toward Financing of Public Transportation

"I am going to read some statements about paying for public transportation here in southeast Michigan. Please tell me how strongly you agree or disagree with each statement." Results of this question are given in Table 5. Respondents generally disagree with all of the suggested financing mechanisms. The majority agrees in only two cases: fares paid by the passengers (item A, 60 percent) and local public transit system subsidies by the federal government (item B, 70 percent). The majority of respondents disagrees with the other six financing options. An increase in the property tax is the most unpopular financing mechanism (item E, 96 percent disagree). These data indicate that most people in the region believe that someone else should pay for public transportation.

Summary of Observations

A brief summary of observations from the regional attitude survey data follows:

1. Trip-chaining and elimination of discretionary travel are behaviors that people assume to control the amount of energy they consume and save money rather than change their place of residence, the number of cars they own, their mode of transportation from automobile to walking or bicycling, or their use of recreational vehicles.

2. As a means of energy conservation, incentives to users of energy-saving modes (e.g., bus or carpool) are preferred by respondents to economic disincentives to people who do not use such modes.
3. Respondents agree that carpooling and bus travel save money and energy, but the majority of them view these modes as impractical for themselves.
4. Travel time and convenience to the traveler are favored over saving money and energy in the choice of a mode of transportation.
5. The majority of respondents thinks it is important to make major improvements to public transportation in southeastern Michigan, but when they were questioned about financing mechanisms, fares paid by passengers and federal government subsidy were the only two financing options favored by a majority of the sample. Thus, the respondents recognize a need for public transportation but feel that someone else should pay for it.

CONCLUSIONS

A small-sample, supplemental O-D survey was conducted successfully by using a personal home interview to collect attitudinal and demographic data and a travel diary to collect a 24-h travel record for all household members 5 years old and older. The sample size and distribution were based on the trip-rate variances estimated from 1965 data, with some modifications; a sample of about 2500 households was generated that achieved the desired accuracy of ±5 percent error with 90 percent confidence.

The trip rates exhibited from this survey show a 17 percent increase over the rates measured in 1965, which seems to be consistent with other recent surveys measuring trip rates. Within this 17 percent overall increase, a decrease was found in home-based work trips and increases in all other trips, particularly non-home-based trips. It is not clear, however, to what extent these measured increases are the result of real increases in trip-making or are the result of a different survey mechanism (the travel diary), which could be expected to provide a more accurate picture of trip-making.

The results of the attitude survey are, for the most part, unsurprising but serve to confirm a number of prevailing professional expectations and assessments, particularly in relation to transportation energy and the use of carpools and transit. Two points that deserve particular emphasis are, first, that 68 percent of the sample know very little or nothing about transit in the southeast Michigan region (this percentage does not change when the data area is expanded to the entire region), whereas less than 6 percent consider that they are very familiar with regional transit services and that federal subsidies are seen as the preferred mechanism to fund transportation improvements. This second finding is particularly relevant given current changes in policy occurring at the federal level with respect to transportation funding. It is also noteworthy that lack of knowledge of regional transit services seems to have little impact on the perception that transit improvements are needed; these are favored by almost 90 percent of respondents.

ACKNOWLEDGMENT

The opinions, findings, and conclusions expressed in this paper are ours and not necessarily those of the U.S. Department of Transportation, Federal Highway Administration, Urban Mass Transportation Administration, or the State of Michigan.

REFERENCES

1. Consistency of Origin-Destination (O-D) Characteristics through Time. ITE Journal, Oct. 1979, pp. 32-39.
2. Preparation for the 1980 Census. ITE Journal, March 1979, pp. 41-47.
3. M.E. Smith. Design of Small-Sample Home-Interview Travel Surveys. TRB, Transportation Research Record 701, 1979, pp. 29-35.

Pilot Testing of Alternative Administrative Procedures and Survey Instruments

IRA M. SHESKIN AND PETER R. STOPHER

Traditionally, pilot surveys have involved pretests of the survey instrument and administrative procedures to be employed in the main survey. Such pilot surveys usually have attempted to pretest a single version of the survey instrument and the administrative procedures and to seek appropriate refinements. By using examples from the Dade County On-Board Transit Survey and a Midwest regional travel survey, it is argued that an important and underused part of a pilot study is comparisons between various alternative administrative procedures or survey-instrument components, in which each alternative is foreseen to have both advantages and disadvantages. The pilot study is likely to provide considerable information on the relative merits of the alternatives tested and will lead to improved design of the final instrument or procedure. Such testing may lead frequently to decisions that can have extensive impacts on response rate, response quality, or survey cost.

Survey research is in many ways as much an art as it is a science. While it is possible to transfer general procedures from one spatial and temporal setting to another, each survey effort is to a large extent unique. Thus, every survey should be preceded by a pilot study (1, p. 205). Often, pilot studies have consisted only of a pretest of the questionnaire, perhaps even administered to a sample not representative of the population to be sampled in the main survey. In a university setting, this usually translates to the testing of the questionnaire on a captive classroom audience; in other settings often only an in-house test is performed. Four reasons may be seen for the employment of cursory pilot studies in most cases. First, it is