SEGMENTING A TRANSPORTATION MARKET
BY DETERMINANT ATTRIBUTES OF MODAL CHOICE

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Research Memo 6
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COUNCIL FOR ADVANCED TRANSPORTATION STUDIES
THE UNIVERSITY OF TEXAS AT AUSTIN
Segmenting a Transportation Market
by Determinant Attributes of Modal Choice

by

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Preface

This is the sixth in a series of research memos describing activities and findings conducted under the research project entitled, "Transportation to Fulfill Human Needs in the Rural/Urban Environment". The project is divided into five topics, and this is the third research memo under the topic "Human Response in the Evaluation of Modal Choice Decisions".

Shane Davies
Mark Alpert

Acknowledgements

The contents of this research memo reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Department of Transportation. This memo does not constitute a standard, specification, or regulation.

The advice and constructive comments of members of the following agencies is gratefully acknowledged.

Texas Association for Public Transportation
(Lyndon Henry and Philip Sterzing)

Austin Traffic and Transportation Department
(Joe Ternus, John German, and Bill Bullock)

Austin Transit System
(Clyde Malone)
Austin City Planning Department
(Milton Rube, Joshua Farley, and Oliver Wilson)

Austin Amtrak Agency
(John Imburgin)

San Antonio Amtrak Agency
(Richard Johnson)

Duluth-Superior Transit Authority
(Harvey Benson)

Head of the Lakes Council of Governments
(Richard Cihoski and Stephen Jacobs)
This report will summarize progress on the transportation study, with principal investigators, Drs. Shane Davies and Mark Alpert, of Topic V, "Human Response in the Evaluation of Modal Choice Decisions." The work period covered in this report is mainly June 6, 1973 through September 6, 1973. The report will detail actions undertaken in the following areas: problem definition and research goal delineation; conferences with interested agencies and personnel, literature survey; questionnaire design and pre-testing; sample design; analytical procedures, and on-going work and follow-up for future reports. The focus will be on the methodology and research design developed for the Austin area transportation survey.

PROBLEM DEFINITION AND RESEARCH GOALS

While transportation research is receiving a good deal of emphasis, particularly regarding systems hardware design and selling mass transit in urban areas, little has been done which explores designing systems to meet transportation needs in less urbanized areas.\(^1\) Moreover, we feel that considerable gain is possible through identifying transportation need

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\(^1\)Additional background rationale is contained in Research Memo 1, "Human Response in the Evaluation of Modal Choice Decisions," and the same-named section of the University of Texas Research Proposal and contract.
for a growing area, such as Austin, Texas, at a time when transportation planning may still influence orderly growth, rather than trying later to make "the best of a bad situation." Further, there are many key groups whose attitudes and needs are critical to the implementation of a balanced transportation system for moving people. These include users and potential users of high-density modes of transportation (anything that moves more people per day than the average attained by private autos is tentatively defined as "high-density" and would include anything from subways, buses, and even "dial-a-cabs"). However, designing a system to appeal to these persons is not sufficient. It is also important to identify their transportation needs and the features that they seek in a transportation mode, relate them to demographic characteristics, and determine how best to communicate information about transportation to them through media exposure data. Further, many non-riders who cannot be readily converted to riders can determine the success of high-density operations by being motivated to form car pools, and/or support tax subsidies for improved mass transit service. This implies a need for ascertaining community attitudes towards transportation, mass transit, and tax strategies for their support, as well as media exposure for identifying suitable advertising outlets for promoting bonds, mass transit, and the like. A "leaders" subset of the community should be similarly polled, so that ultimately support for transportation changes may be elicited from them, knowing their priorities for growth, transportation, and acceptable means of financing programs. By identifying relevant transportation attitudes and usage rates of various modes for different purposes, we intend to provide a systematic treatment of
the required linkages between modal attributes, rider characteristics, promotion of mass transit and public support, and communication with key community leaders, so that all interested parties may be involved in the planning and implementation of balanced transportation systems for Austin and similar communities.

Accordingly, a study has been undertaken with the following objectives:

1. develop a method for identifying the transportation mode features or attributes (e.g. ride comfort, flexibility, economy...) that determine modal choices for specified trip purposes, such as "to work" or "to shopping or personal business."

2. estimate the percentage of people now using private cars who would be quite likely to switch to a public transportation system if it were improved to suit their needs.

3. evaluate existing low-density (cars) and high-density transportation modes (buses) to spot critical gaps between perceived features of buses vs. cars, along determinant attributes of modal choice. Recommend ways in which high-density mode features should be changed and/or communicated to potential riders identified in Step 2.

4. determine local media (newspaper sections, radio and T.V. spots, community organizations) most utilized by potential high-density rider "converts" and recommend advertising appeals and appropriate media for maximally effective promotion of the re-designed high-density transportation modes to suit their travel needs.

5. survey the general community and a "leaders" subset for attitudes towards high-density transportation and appropriate means of financing improvements. Provide local officials with a ranking of acceptable financing alternatives for each group, and indicate advertising strategies for appealing to public attitudes.
CONFERENCES WITH TRANSPORTATION AND RELATED AGENCIES

While the above goals represent general research objectives, it was recognized that additional insight, as well as greater probability of successful implementation of the research findings, would result if we instituted close coordination of our efforts with those of local agencies concerned with planning and transportation. Accordingly, a series of interviews and conferences were held with officials from various agencies.

A number of useful suggestions for our research, recommended literature, and experiences of other cities were obtained from these conferences. In addition, the two-day workshop, sponsored by the Council for Advanced Transportation Studies at the University of Texas at Austin, held June 28-29, 1973, produced additional useful contacts and problem areas for transportation study. Those we talked with at this stage of the project were asked to indicate specific information needs in connection with transportation and planning. We received oral and written suggestions for our survey questions from everyone we contacted. Many were subsequently integrated into our questionnaire instrument. (Our working draft questionnaire is appended to this report and will be discussed below.) Bus company officials, for example, are interested in determining public awareness of recent improvements in the service, as well as areas in which further improvements are desired. City planners indicated concern for public attitudes towards growth, transportation habits and needs, attitudes towards positive and negative incentives for increasing mass transit utilization, and indicated strong interest in our plans to survey community business leaders' views on transportation,
tax supports, etc. More detailed analysis of our experiences in interviewing local agency personnel (including evidence of modal rivalries and defensive behavior) will be covered in the more complete discussion of our findings and recommendations, which will appear later in the project year, following further data collection and analysis.

LITERATURE SURVEY

While gathering information from persons knowledgeable and interested in transportation and planning, an extensive literature search was conducted concerning three main topics: identification of determinant attributes and attitudes of choice decisions, modal choice research in transportation, and promotion campaigns to increase public support of high-density transportation in other geographical areas.

The first area of literature concerns research into methods of identifying determinant attributes that underlie or determine buying or riding decisions. There are a host of studies and proposed methods for ascertaining the attitudes that motivate particular buying or riding decisions. Many have been suggested in contexts other than transportation decisions, but are relevant for these decisions as well. Some highlights of the literature will be briefly summarized here and greater details are found in Myers and Alpert (1968), Alpert (1971), and Golob and Dobson (1973).

Of the many attitudes which people may have towards a transportation mode, not all will be involved equally in making modal choice decisions. Determinant attitudes are those attitudes towards features of the mode
which determine whether or not the mode is chosen for a particular trip. Other attitudes towards features that are irrelevant to the decision process, no matter how strongly held, are non-determinant. For example, consider freedom from accidents as a feature in transportation modal selection. While most people would probably claim this an important feature in transportation choice, it is not likely to determine which mode is chosen, since most modes are probably perceived as equally safe or unsafe. Thus it is likely to prove more fruitful to concentrate less on advertising buses' freedom from accidents and more on those attributes which differentiate among modes and may thus be used as a basis for selection.

Determinant attributes are thus those product (or transportation mode) features or attributes that are both perceived as "important" and also as possessed in differing degrees by alternatives which compete for buyer choices. Among the many types of approaches that have been proposed for identifying these determinant attributes are observation, experimentation, direct questioning of respondents, dual questioning of respondents and indirect questioning (including "motivation research", covariate analysis, and multidimensional scaling). The varying costs and probabilities of successful identification of key attributes are discussed elsewhere (e.g., Alpert, 1971). This research project will use a combination of direct dual questioning and covariate analysis of respondent data.

Our basic procedure will involve requesting respondents to indicate how important each of a list of transportation features are in choosing a mode for a given trip and also the extent to which various modes have different amounts of the particular feature. Determinance is operationa-
lized as important time differences. The covariate analysis involves obtaining a set of ratings towards a particular transportation mode (e.g., private car, bus) for a specific trip purpose, and then separating users vs. non-users of the mode with a discriminant analysis of their profiles of the attributes of the mode. Those attributes that discriminate users from non-users are said to be determinant attributes of selection. For example, if non-users of buses indicate that buses afford less safety from dangerous people than do frequent users, then it appears that this attribute should be improved and communicated to potential riders in order to improve ridership.

The second literature area includes modal choice studies. While some were encountered in reviewing literature on determinant attributes, modal choice studies are primarily concerned with applying a particular methodology to identifying determinant attributes of transportation choice decisions (rather than the generalized choice decisions in the previous literatures. A selected bibliography is appended for key studies in this area, much of which has been discussed in our previous Research Memo 1, "Human Response in the Evaluation of Modal Choice Decisions".* Typically these studies relate user characteristics to mode selected (e.g., higher income correlated with passenger car (selection), city characteristics (size, income, density), to transportation facilities, and methods of identifying specific modal attributes that determine ridership (through some sort of determinant attribute identification procedure). Nearly all of these studies have been done in large urban areas. Further, the determinant attribute methods typi-

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ally measure trade-offs between particular attributes (travel time vs. cost...) or between particular modes (buses vs. cars).* Moreover, by considering modal choices as their focus, linkages are not made to attitudes toward growth and transportation subsidies, leader surveys, and media habits for communication of transportation strategies. While the literature therefore does not apply directly to our attempt to apply a "systems" approach to transportation needs in a non-urban area, a number of important variables have been suggested as determinants of modal choice decisions. These might be quite appropriate for inclusion in our study project. In addition, while perceived differentiation is not explicitly considered in that modal choice literature which asks people to indicate the importance (only) of various transportation features, these "importance-only" studies provide a suitable background for the dual-questioning in our approach.

A third literature area concerns projects which have been attempted in promoting various types of high-density transportation utilization, again largely in heavily urban areas. This report's selected bibliography indicates some of these projects. The general impression one gets is that scientific controls have not frequently been employed (cost constraints are a factor) and that findings have been mixed. Since we feel that investigation of the attitudes and needs of potential riders and supporters of high-density transportation are prerequisite to instituting any successful promotion campaign in a particular situation, this literature provides background for suggestions in our study area, rather than specific attributes, media, and appeals to be used. These need to be

* Shinn, Allen M., Jr. and Shane Davies, "Measuring the Utility of Housing and Transportation," a Research Report supported by the National Science Foundation, (Summer 1971).
generated by appropriate measures and sampling of key groups in each region. Implementation experiments which are scheduled to follow in Year 2 of the project will build on this literature, as well as our specific findings in Year 1.

QUESTIONNAIRE DESIGN AND PRE-TESTING

Having reviewed relevant literature and approached important local agencies, we obtained tentative lists of key attitudes to probe, as well as possible determinant attributes of modal choices. Some preliminary interviewing of area transportation consumers was now appropriate. Accordingly, an exploratory questionnaire was designed and administered to a quota sample of Austin residents, including bus riders, students, and a mix of ethnic and income groups. Responses to these questions indicated several transportation features were considered important that prior thinking and literature has also stressed. Moreover, the patterns of indicated attributes lent support to assertions by Hille, et al. (1968) that two major trip purpose categories produce different choice criteria—in this case, transportation to work or school, and for shopping or personal business. Within city, social and pleasure trips may not have sufficient difference from these two to warrant the questionnaire lengthening needed to research three trip categories. Open-ended questions were used to facilitate generating a range of response for content analysis and structuring in later questionnaires. Preliminary response on Amtrak questions indicated low "brand awareness" and people seemed to underestimate the amount of passenger service that is available. (Amtrak surveys will resemble those of intracity transportation patterns and
choices reported here. Details will be developed in reports to be issued later in Year 1.

A second questionnaire was then prepared and pre-tested on a second quota sample of Austin residents, as well as submitted for the review of the local agencies previously contacted. Based on feedback from interviewers and local agency officials, several changes were made and reflected in the working questionnaire (appended as Transportation Survey) that has been submitted for approval to DOT and OMB, prior to gathering data from the general Austin samples. While specific parts of this questionnaire will be discussed in the data analysis section below, it differs from the second questionnaire in a few respects. The format has been changed to enable photo-reduction of the questionnaire by 41%, thus reducing its length from 24 to 4 pages. Although personal interviewing will be employed to increase response rate and answer respondent's question, it is desirable to make the instrument look less formidable than the second version implied. Pre-tests indicated that completion time should range between 30 and 50 minutes. The "cover letter" has been revised to encourage respondents to ask questions if the instructions or questions are unclear to them. This letter will be paraphrased orally by interviewers, but can be read by respondents who may also note its "official stationary", and can increase interviewer credibility. Changes on the questionnaire itself involve a shift from asking for relative desirability of attributes (nearly all had positive desirability) to importance of attributes in modal choices. The instructions have been streamlined and clarified, a few question deleted for brevity, others modified slightly, and a few added (e.g., "ease of traveling with children").
Sample Design

We intend to survey a random sample of over 250 adults (18 or over) in the Austin metropolitan area, with personal interviewers contacting each respondent, giving the cover statement, and assisting in questions concerning the survey forms. Respondents will fill them out themselves where possible, to insure a feeling of privacy as well as saving time.

In addition to the general Austin survey, we shall gather the same data from random samples (at least 50 each) of persons identified as "city leaders" (financial people, real estate planners, and Chamber of Commerce members), frequent bus riders, and students. Bus riders will be obtained in a two-stage process, interviewing them after first approaching a random sample of bus riders (on buses) to enlist their cooperation for a survey to be taken later at home. Relevant cross-comparisons can be undertaken for example, having analyzed the determinant attributes for increasing public support of mass transit, and the key customer groups for such improved service, we intend to report to the City Council a relative ranking of methods for financing any needed subsidies of the system, as measured by public attitudes, and especially those of the "leadership" group.

Analytical Procedures for Questionnaire Data

Part One of the appended Transportation Survey questionnaire measures the relative determinance (importance x perceived differentiation = determinance) of each transportation feature considered in the respondents' choices for transportation modes for trips to work (or school, for stu-
dents). Also, respondents will be classed as users or non-users of private cars or buses for these trips, and for these two dominant modes, we can compare the perceived features of the preferred mode vs. the non-preferred mode. Where the attribute is rated as highly determinant, as indexed by a high degree of importance and differences, we can examine differences between the perceived images of chosen modes vs. non-chosen modes. For example, differences between non-bus users ratings of buses vs. cars, along attributes seen by them as determinant (non-determinant attribute differences should not be concentrated upon, as gaps here are not determining patronage decisions) will point to needed changes in the features of buses (or other modes that can embody the features sought by car-users), as well as attributes that needs stress in promotion to potential switchers.

Part Two allows the same kinds of determinant attribute analyses and exploration of perceived car vs. bus features, this time for trips made for shopping or personal business. Previous studies have indicated some differences in key attributes for these trips vs. work-trips. If found here, it is expected that Austin (and similar cities) might choose to attract shopping and personal business ridership on non-car modes by stressing these determinant attributes in any mass transit modifications that are undertaken and promoted to the public.

Part Three covers a series of transit-related attitudes and also city goals and issues identified as desirable areas for our study by the Austin city planners. Data should be useful for evaluating the relative acceptability (both for the general Austin sample, as well as for the "city leaders" sample) of various proposed methods of financing public mass transit, and also various possible planning goals for the city.
Specific questions in this part also measure public awareness of the cost of mass transit and specific complaints about bus service. Question #224 is designed to separate persons who have fairly high probability of becoming riders of "improved" mass transit from low-potential riders. Likely riders can then be separated and analyzed in terms of their determinant attributes of modal choice, transit attitudes, demographics, and media exposure. Integrated marketing strategies would then be designed to appeal to these people, stressing desired modal features, through appropriate media, etc.

Part Four covers information on media habits, including amount of exposure to general program types and specific time periods and specific media. This data will aid in communicating with target customers for "improved" mass transit, as indicated above, and also in communicating with the general public, and/or community leaders concerning tax-related subsidies for mass transit programs.

**On-Going Work and Follow-Up**

During the next quarter, the questionnaires will be administered to the groups described in the sample design and data will be coded and analyzed as described above. Written reports of the findings and recommendations for changes in promotional appeals will be communicated to DOT and local agencies. It is anticipated that some findings will point to immediate corrective action and shifts in promotional emphases. For example, if survey results show that potential riders are unaware of some features that are perceived by current riders of high-density modes (indexed for example, by giving buses a lower rating on dependability, than frequent riders), then this feature can be stressed in advertisements
placed in media heavily used by potential riders.

Other changes in modal attributes may require more time and money to achieve. Accordingly, having identified a set of attributes believed to determine ridership, the second year of this study calls for experimenting with making these changes (or simulating them in advertisements and product concepts) and measuring their effect on ridership (or intention to ride, in a simulation, if actual change is infeasible in the transportation system at that time).

During the third quarter we shall also refine the Amtrak rider/non-rider survey, by modifying the questionnaire instrument thus far developed for intra-city transportation, explore determinant attributes for modal choices for inter-city trips of about 200 miles, and examine rider perceptions of Amtrak in this context.

In addition, we shall produce an annotated bibliography covering modal choice decisions, determinant attribute identification, and high-density transportation mode promotion campaigns. A partial bibliography selected for this report follows on the next page.
SELECTED BIBLIOGRAPHY


33. Shinn, Allen M., Jr. and Shane Davies, "Measuring the Utility of Housing and Transportation," a research report supported by the National Science Foundation, (Summer 1971).

**SELECTIVE BIBLIOGRAPHY ON MODAL SPLIT RESEARCH**


7. Budd, S., "Trip Generation, Distribution, Modal Split, and Assignment in Urban Traffic Planning," Royal Technical University (Denmark) and Department Road Construction Traffic Engineering Tour Planning (Research Agencies), (1974).


Appendix 1: Transportation Survey*

*This preliminary draft of the questionnaire entitled "Transportation Survey" is presently under scrutiny by DOT and OMB. Following their approval, it will be operationalized.
"Cover Letter" for TRANSPORTATION SURVEY

THE UNIVERSITY OF TEXAS AT AUSTIN
COUNCIL FOR ADVANCED TRANSPORTATION STUDIES
AUSTIN, TEXAS 78712

Division of Research
WAG 410
Phone (512) 471-5161

Dear Sir, or Madame:

I am a research associate for a University of Texas research project. We are interested in learning about public attitudes towards various forms of transportation, including buses, cars, and the like. We hope that by determining your views on this subject, better facilities can be provided for highways, buses and so forth.

There are a number of important questions on this survey - none of them call for long answers. Your views or your impressions are all that are needed. Just check a blank that best answers each question on these sheets. Your answers will be kept confidential - only the overall attitudes of the entire sample will be pursued. Therefore, please feel free to express whatever opinion you have. If you have any questions about the meaning of questions or instructions, please feel free to ask me about them.

We have a small budget and can only contact a limited number of people. You have been selected through a sample procedure and thus your answers are very important in order for us to obtain an accurate picture of people's attitudes towards transportation. May I take a few minutes of your time to get your opinions?

Sincerely yours,
### Differences Between Modes

**Transportation to Work (or School, if you are a Student)**

From your knowledge of various transportation modes, how much difference do you feel there is among modes for working or your usual commute, or bus, train, carpool, etc.? If you use more than one mode during your commute, please check in the system (one check only) which best indicates your opinion of the extent to which those differences are present.

#### Part 1

1. In a typical week, about how many trips do you take from home to work or school?  
   - None  
   - 1 to 5  
   - 6 or more  
   - (If none, go to Part 2.)

2. For these trips to work or school, how do you usually get there? (Please check one only.)  
   - Car  
   - Bus  
   - Train  
   - Bicycle  
   - Motorcycle  
   - Other

3. Do you usually travel alone?  
   - Yes  
   - No

4. In general, are you satisfied with the transportation you use for getting to work or school?  
   - Definitely yes  
   - Moderately yes  
   - Moderately no  
   - Definitely no

---

**IMPORTANT RATING FORM**

**Transportation to Work** 

The following list of criteria is intended to measure the attributes of your preferred method of transportation to work. Rate each of these attributes in accordance with your preference. 

1. Economy:  
2. Convenience:  
3. Time saved:  
4. Freedom from weather conditions:  
5. Flexibility:  
6. Lack of parking problems:  
7. Low noise levels:  
8. No crowdedness:  
9. Low risk of accidents:  
10. Low pollution:  
11. Easy to socialize:  
12. Smooth ride:  
13. Safe from dangerous surroundings:  
14. Low stress levels:  
15. Ability to control and watch environment:  
16. Ability to look to scenery:  
17. Few charging problems:  
18. Few parking problems:  
19. High status:  
20. Low convenience:  
21. High pollution:  
22. Usage to transportation:  
23. Hard to walk in:  
24. Frequent problems:  
25. Low availability:  
26. Low privacy:  
27. Low reputation:  
28. Low fare:  
29. High pollution:  
30. High fare:  
31. High convenience:  
32. High environment:**  
33. High pollution:  
34. High convenience:  
35. High environment:**  
36. High pollution:  
37. High convenience:  
38. High environment:**  
39. High pollution:  
40. High convenience:  
41. High environment:**  
42. High pollution:  
43. High convenience:  
44. High environment:**  
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46. High convenience:  
47. High environment:**  
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49. High convenience:  
50. High environment:**  
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94. High convenience:  
95. High environment:**  
96. High pollution:  
97. High convenience:  
98. High environment:**  
99. High pollution:  
100. High convenience:  

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**Part 2**

**Questionnaire**

### Questions

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<th>Question</th>
<th>Options</th>
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<tbody>
<tr>
<td>1. How do you usually get there?</td>
<td>Car, Bus, Train, Bicycle, Motorcycle, Other</td>
</tr>
<tr>
<td>2. Do you usually travel alone?</td>
<td>Yes, No</td>
</tr>
<tr>
<td>3. Are you satisfied with the transportation you use for getting to work or school?</td>
<td>Definitely yes, Moderately yes, Moderately no, Definitely no</td>
</tr>
</tbody>
</table>

**CONTINUE WITH QUESTION 53**
### Transportation for Shopping or Personal Business

Please place a check in the appropriate column to indicate how desirable you feel each of these traits would be in choosing a transportation mode for shopping trips or personal business. (Select just one choice, if none, circle "None".)

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<th>Trait</th>
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<th>Moderately Yes</th>
<th>Neutral</th>
<th>Moderately No</th>
<th>Definitely No</th>
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<td>Economical</td>
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<tr>
<td>Smooth Ride</td>
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<td>Freedom from Weather (Door to Door)</td>
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<td>Opacity to Feel of Scenery</td>
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We would like to find out some good ways of informing people about changes and improvements in the transportation system for roads, safety buses, etc. Please answer the following questions concerning your preferences in radio, TV, newspapers, and the like.

Reading the Newspaper

Reading Magazines

Listening to the Radio

Watching Television

---

230. What sections of the newspaper do you usually read (please check your 4 favorites)?

---

231. How much time do you spend each day using a newspaper, radio, etc?

---

232. Which radio stations do you usually listen to?

---

233. What TV stations do you usually watch?

---

234. What programs do you usually watch?

---

235. What clubs or organizations do you belong to and attend about once per month or more?

---

Finally, we would like to have some information about you, for analysis and tabulation purposes. Please answer the following CONFIDENTIAL questions.

---

252. Approximately how often do you shop ________ years or older 2 to 3 years __ 3 to 5 years __ 5 years or more

253. What is the highest level of education attained by you?

---

254. Which category best describes your total family income for 1972? 0 to $1,000 __ $1,000 to $1,999 __ $2,000 to $4,999 __ $5,000 to $9,999 __ $10,000 to $19,999 __ $20,000 or more

Your help and cooperation are greatly appreciated. If you would like a summary of the results of this study, please indicate yes and fill in your name and address. Yes. ___ No.

NAME AND ADDRESS (If results desired)