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ASIBILITY OF DEMAND INCENTIVES FOR NON-MOTORIZED TRAVEL

April 1981
Final Report

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Prepared for
FEDERAL HIGHWAY ADMINISTRATION
Offices of Research & Development
Environmental Division
Washington, D.C. 20590

FOREWORD

This report examines the potential of various strategies for increasing the use of walking and bicycling for utilitarian purposes. The analysis is based on attitudinal surveys conducted in five cities.

Research in pedestrian safety is included in the Federally Coordinated Program of Highway Research and Development under Project 1E, "Safety of Pedestrians and Abutting Property Occupants." Mr. John C. Fegan is the Project Manager.

Sufficient copies of this report are being distributed to provide a minimum of one copy to each regional office, division office, and State highway agency. Direct distribution is being made to the division offices.

For D. Solomon
Charles F. Scheffey
Director of Research
Federal Highway Administration

NOTICE

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16. Abstract

This report examines the potential of various strategies for increasing the use of walking and bicycling for utilitarian purposes. The analysis is based on extensive attitudinal surveys conducted in five locations across the U.S. Perception models are developed to identify underlying consumer perception of the transportation services offered by walking, bicycling, auto and transit. Subsequently, preference models are developed to identify the relative importance of each underlying dimension. Consumers' preferences are compared to their actual choice. Costs and benefits of improving the infrastructure for walking and bicycling are identified, and a methodology for their estimation is presented.

Limited copies of the Appendixes, FHWA/RD-80/049, to this report are available upon request to: Mr. David Solomon, HRS-41, Federal Highway Administration, Washington, D.C. 20590.

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1.
INTRODUCTION

In the last decade there has been a growing awareness of the impact of transportation on energy resources, on the environment and, ultimately, on the economy. The automobile consumes about one-half of all transportation energy (1, 2), produces over 60 percent of the combined transportation-related pollutants (3, 4), and is very demanding in terms of infrastructure. Thus, it is not surprising that a great deal of discussion has centered on the feasibility of reducing automobile use. To accomplish this reduction, a variety of measures have been proposed. They include, among others, encouraging greater utilization of mass transit, making more efficient use of the automobile (carpooling, vanpooling), improving or modifying auto technology (increasing mileage rating, refining the electric car), and restricting its use (auto-free zones, auto pricing disincentives). To date, the type of approaches described above have met only with moderate success. The limited impact of the various measures underscores the difficulty of the task, and it suggests that significant changes in travel habits are likely to occur only as a result of the simultaneous implementation of a wide variety of strategies. (Of course, catastrophic events and radical changes in fuel availability can also cause significant changes in travel habits.) Among the least publicly discussed strategies for reducing reliance on the automobile are the increased use of non-motorized modes: walking and bicycling. Walking and bicycling for utilitarian purposes have long been recognized in many countries, especially in Europe (5, 6, 7). In many cities in the Netherlands, trips to work by non-motorized modes exceed 50 percent. In Marseille the figure is close to 40 percent. Walking and bicycling are particularly appealing modes of transportation in an era of diminishing fuel reserves because they demand only a fraction of the energy requirements of the automobile. Also, their impact on the environment--aural, visual, as well as in their contaminant level—is clearly negligible when compared to the automobile.

This study, which deals with the feasibility of demand incentives for non-motorized travel, was performed for the U.S. Department of Transportation under contract DOT-0S-60183. It was initiated in October of 1976. Since that date, many economic and social changes have taken place and should be considered in the interpretation of the results of the study (e.g. fuel price increases, availability problems, etc.).

Study Objectives

The objectives of this study are: (1) to identify the problems associated with bicycling and pedestrian movement for utilitarian trips, (2) to identify a wide range of incentives that will assist in providing utilization of bicycling and pedestrian movement for work, school and shopping trips in urbanized areas, and (3) to establish techniques for evaluating, under various conditions, the cost-effectiveness of candidate facility systems and/or promotional programs for bicycling and pedestrian movement.

The approach used to accomplish the above objectives consisted of the identification of variables and conditions affecting the use of non-motorized modes, development and conduct of an extensive attitudinal and market research survey, development of perception and preference models to estimate the potential demand for nonmotorized travel, and estimation of the cost-effectiveness of various strategies based on their potential for encouraging the use of non-motorized modes.

The above approach recognizes that a large body of work exists which identifies the inherent advantages as well as limitations associated with walking and bicycling for utilitarian trips. It recognizes also that, given the overall low use of non-motorized modes for utilitarian trips, current mode choice is likely to be of limited use in predicting future mode share. This is particularly true if significant improvements in the attributes which define non-motorized transportation modes are introduced.

Finally, the approach recognizes that the most important element in measuring the effectiveness of a facility or program is its ability to attract and retain users, since benefits do not accrue unless the facility or program is accepted and utilized.

Summary of Results

This study analyzes consumers' current perceptions of the transportation attributes of walking, bicycling, auto and transit. Hypothetical scenarios that have the potential for increasing walking and bicycling are then developed, and the changes in consumers' perceptions and preferences for the various modes are once again analyzed. Current choices and preferences are exmained, and perceptions and preference models are developed to forecast future demand. Major findings of this study are:

1. The use of attitudinal rating techniques allows for the identification of mode attributes that cannot be easily ascertained by direct physical measurement.

2. The perception models, utilizing factor analysis, identified several common dimensions underlying perceived mode attributes. Some dimensions were common among both the motorized modes (car, bus) and the non-motorized modes (bicycle, walk). These were:

   - concerns about safety in heavy traffic
   - the ability to relax and enjoy the scenery
   - the extent of physical exertion and speed.

   Other attribute dimensions were unique to individual modes, such as:

   - for car--the extent of flexibility in route and travel time
   - for car--concerns about parking availability, cost, and access distances
   - for bus—the extent of waiting and delays

3. In rating the various modes, perons who choose a particular mode place their mode in relative advantage to modes not chosen. Thus, auto drivers perceive bicycling as slower and more tiring than bicycle users do.

4. Current preference is a good indicator of current mode choice. In general, however, indicated preference levels tend to underestimate choice of auto, transit and walk, while it overestimates actual bicycling.

5. Current level of non-motorized use appears to be related to the potential increases in walking and bicycling. Both the Austin precincts, with their relatively high current share of bicycle use, and the precincts in Philadelphia, with their high level of walking, exhibit the highest shifts towards bicycle and walking, respectively, with the introduction of facilities.

6. The following ordering shows the hierarchy of strategies, based on their potential for effecting shifts from the automobile:

   - Compact land use
   - Congestion fee
   - Fuel price increases
   - Pedestrian facilities
   - Bicycle facilities

7. The concept of a compact land use distribution which includes walk and bicycle facilities, with work, shopping, and other opportunities within walking and bicycling distance, produces the greatest shift in preference from automobile to walking and bicycling. The relative importance of this strategy underscores the realization that the most effective way of promoting use of non-motorized modes may not be responsive always to policy actions. This is not to say, for instance, that new economic forces such as that brought about by a limited gasoline supply, might not be able to influence how people choose their places of residence in relation to their places of employment. In such a case, gasoline supply or its cost could be set by policy.

8. Separate facilities play an important role in people's preference for non-motorized modes, second only to compact land use. The significance of facilities is further emphasized by the fact that the compact land use scenario contains not only the very important element of short trip distance, but also the element of separate facilities for non-motorized travel. Thus, it appears that facilities can play a prominent role in increasing non-motorized travel, particularly if they are provided in the context of compact land use configurations such as college campuses, residential areas near central business districts, and in areas where shopping opportunities are within walking or bicycling distance of medium to high density residential areas.

9. Pricing, either through congestion fees or increases in fuel prices, has the potential for causing significant shifts from the automobile. However, transit absorbs a large portion of the shift, thus reducing the potential non-motorized share.

10. An increase in the price of fuel to $1.50 per gallon is somewhat less effective in causing shifts from the automobile than is the application of a congestion fee of $2.00 per day. It does have the effect, however, of increasing consumers' preference for transit, especially for shopping and personal business trips.

11. With the exception of the compact land use scenario, the application of any strategy by itself causes a maximum hypothetical shift of approximately 20 percent to either walking or bicycling. Given the hypothetical and somewhat unrealistic nature of the scenarios, this value can be taken to represent the upper limit diversion from auto to walking and bicycling (for non-compact land use settings).

12. Perceived mode attribute factors contributed a large proportion of the total explanatory power of the <u>mode preference</u> models. A number of findings were common to all sites. Relaxation/scenery enjoyment and the extent of tiring physical exertion were both significant variables in the choice of bicycle and walk modes. Older persons showed an aversion to bicycling and

walking even after controlling for other explanatory variables. In addition, the effect of tiring perceptions on the choice of walking was significantly greater for persons over age 45 than for younger persons. The bus attributes of relaxation/scenery enjoyment and wait/delay considerations both had significant effects on mode choice in most cases. For car, safety and parking considerations were important explanatory variables. Route and schedule flexibility were also important, but for shopping travel only.

13. The motorized and non-motorized modes of travel are not strictly competitive for most travel distances, as walk and bicycle are predominantly used for short distance trips, while bus and car travel were predominantly used for longer distance travel. Within the limited distance range, travel time for walking and bicycling consistently had a significant negative effect on the choice of the corresponding modes for work trips, but no significant effect for shopping/personal business travel. This is consistent with a greater concern for schedule considerations for travel to work. It was not possible to estimate mode preference coefficients of travel time and cost for the motorized modes in these settings where parking is generally freely available and bus service coverage is limited. The preference models did, however, show that the probability of choosing both car and bus rose with increasing travel distances.

14. The preference models may be applied to predict preference changes in response to alternative policy strategies, using revised perception ratings for hypothetical scenarios. The preference models consistently predicted mode preference shifts that were far smaller than the dramatic preference shifts stated by the respondents in response to the described scenarios. Although there are potential sources of error in the preference model predictions, there is strong reason to believe that these predictions are more reasonable than the respondent-stated mode preference changes. The model predictions suggest that improvements to bicycle and pedestrian facilities will, by themselves, lead to very modest increases in the respective usage of bicycle and walking for work and shopping trips.

15. The results of the mode attribute perception models, the mode preference models, and the forecasting exercises all indicate some differences in variable definitions and effects between sites and between work and shopping purposes. Nevertheless, the significant variables in the preference models and the subsequent preference predictions made all indicate a general consistency across sites and travel purposes that support the use of these techniques for application to other geographic settings and a wider set of policy tests.

Report Outline

The study background is presented in Chapter 2. This chapter includes the assumptions and constraints underlying the study, description of survey instruments and survey methodology, as well as a description of the survey site selection and the areas surveyed. Chapter 3 examines the survey results, particularly as they relate to trip and tripmaker characteristics, mode choice and mode preference. In Chapter 4, perceived mode attribute ratings are analyzed, and perception models are developed using factor analysis on attribute ratings. The factors identified are then used as explanatory variables in the preference models. Chapter 5 presents cost and benefit measures associated with increased demand for non-motorized travel, and methods for estimating these costs and benefits.

2.

BACKGROUND

Assumptions and Constraints of the Study

In designing the study, constraints were established at the outset to ensure that the survey efforts would focus on the types of trips and population groups that exhibit the greatest potential for use of non-motorized modes of travel. These decisions, which are summarized next, should always be kept in mind when examining the results of this study.

1. While the study examines users of all basic transportation modes (automobile, transit, bicycle, pedestrian), the key focus is on the ability to achieve mode shift from motorized (particularly from the automobile) to non-motorized modes. This means that the study must focus on those transportation users who do not currently use the bicycle or pedestrian modes, or who use non-motorized modes infrequently. Because of this important premise, the survey questionnaire was designed to elicit as much information from auto and transit users about their views and attitudes concerning their chosen modes, as about their views and attitudes on walking and bicycling. As a consequence, the need for a large number of observations or responses from users of non-motorized modes was obviated to a great extent.

2. Emphasis was given to utilitarian trips, specifically work, school, shopping and personal business trips, rather than to recreation trips. This allows the study to focus on peak hour travel (particularly for work and school trips)

rather than non-peak hour travel. This choice is important since it is during the peak hour that a significant mode shift will have the greatest impact on congestion, use of the existing transportation system, air quality, noise, etc.

3. The survey was administered to persons 16 years of age and older since it is the typical entry age to drive a motor vehicle. Younger persons are currently significant users of non-motorized modes for school and shopping trips, and are not viewed as having significant potential for a mode shift away from the automobile.

4. Given the limited cargo-carrying capacity of non-motorized modes, major shopping trips involving heavy or large cargo were excluded. Other shopping trips were combined with personal business trips in one survey instrument because they exhibit similar characteristics from the point of view of market potential for non-motorized use: they are discretionary to a large extent, they do not require large cargo-carrying capacity, and they occur, mainly, during the off-peak hours.

5. Emphasis is placed on home-based trips since it is at the home end that the decision to bicycle or to walk, rather than to take the car, is made. It is recognized, however, that the number of trips that are made at the non-home end, as well as their characteristics, also affect that decision.

6. Given the dominance of short trips in non-motorized travel, rating and ranking of modes was constrained to work and school trips which were within 3 miles (4.8 km) for walking, and within 6 miles (9.6 km) for bicycling. For shopping and personal business trips, the distances were 2 miles (3.2 km) for walking and 4 miles (6.4 km) for bicycling.

7. The scenarios presented here represented "ideal" situations at the time of their selection. Subsequent developments have altered the meaning of these scenarios; e.g., separate bicycle facilities are less popular than they once were, fuel prices have already risen to some of the levels presented in the

scenarios, etc. These facts should be considered in the interpretation of the study results.

To summarize, this study examines the potential for shifts to non-motorized modes for home-based utilitarian trips, namely, work, school and shopping and personal business. It limits itself to persons 16 years of age or older, on trips not involving large or heavy cargo, nor exceeding 2-3 miles (3.2-4.8 km) for walking and 4-6 miles (6.4-9.6 km) for bicycling.

Survey Instruments

Because most mode choice demand models have dealt in the past with the choice between auto and transit, the explanatory variables used have been limited, for the most part, to measures of out-of-pocket costs, travel time and household income (or other socio-economic variables).

While the cost and time variables have been successfully used to predict choice between auto and transit, it was determined that such variables were inadequate in explaining the choice of non-motorized modes. It is clear that the costs and time associated with walking and bicycling cannot be easily affected by policy decisions. In fact, models using such variables alone would be unresponsive to the types of policies that could indeed encourage bicycling and walking. If it is found, for example, that safety and the ability to carry packages are important determinants of choice between motorized and non-motorized modes, then it is essential that the models include these variables. It would then be possible to increase the attractiveness of, for example, bicycling by providing a safer bicycling environment, and by encouraging a better carrier design and promoting its use. This need for representing walking and bicycling demand in terms of variables other than measurable variables led to the development of an attitudinal survey. This decision, in turn, led to attitudinal and choice modelling in which attitudes and perceptions are used to predict consumer choice.

A sample survey instrument can be found at the end of this report. Each of the component sections of the survey questionnaire is described next.

Cover Letter—The intention of the cover letter is to identify the organization sponsoring the survey, to provide a description of the objectives of the survey, and to motivate the respondent to cooperate. This letter, which is an integral part of the survey instrument, is written on City letterhead and carries the signature of the City Administrator or of its Mayor.

Most Recent Trip—This section helps the respondents identify and focus on their most recent trip for a stated purpose. The respondents are then asked to provide a complete description of the characteristics of the trip (purpose, distance, time of day, number of people, number of stops, etc.) and the chosen mode. This information, permits comparison of users' attitudes and preferences to actual choice, and it is valuable for stratification purposes.

Rating of Transportation Attributes—In this section respondents are asked to evaluate 18 to 22 transportation attributes of four modes: auto, walk, bicycle and bus. Through this process current rating of modal attributes are measured on a five-point "Likert scale." These ratings are then compared to ratings for the same mode after improvements or changes affecting the attributes are introduced. The degree of shift in the attribute perception ratings provides a measure of the effectiveness of various strategies or policies. The original transportation attributes were patterned after the results of similar work done previously (8). These attributes were then pretested and, as a result, additions and deletions were made, thus producing the final list of attributes.

Rank Order Preference and Choice Frequency—This section allows the respondents to indicate their rank order preference of the available modes. This information is used to determine differences between users' preferences and their actual choices, and it is used also for the preference models which identify the relative importance of the attributes and of the underlying factors determined by the perceptual models. Respondents are asked also to indicate their frequency of usage of all modes. These data provide an alternative method to estimate revealed preference.

Measures of System Characteristics—This section provides perceived level-of-service information such as travel time and cost which are needed to develop models based both on qualitative and quantitative measures. The subsection on bicycling found in this section is intended to identify bicyclists and bicycle use regardless of whether the "most recent trip" was made using a bicycle or not.

Concept Statement Rating of Attributes--Concept statements (also described as "scenarios") are hypothetical descriptions of transportation systems. In addition to the evaluation of existing systems, respondents are asked to evaluate the transportation modes whose characteristics are referred to in or are affected by the concept statements. Four concept statements are included in the survey instruments to obtain users' reactions to changes in the transportation systems: improved pedestrian facilities, improved bicycle facilities, auto congestion fee, and compact land use.

Concept Preference--In this block, respondents are asked to indicate rank order preference of all modes while keeping in mind the transportation changes or improvements specified in the concept statements. These rankings show whether or not there are changes in preference ordering as a result of the transportation changes, and are an indication of the type of shifts that can be expected from motorized to non-motorized modes under the most advantageous conditions. In addition to ranking of modes after the concept statements, respondents are asked to consider several levels of fuel pricing and rank order preference of all modes for each price level. This scheme provides a composite effect of transportation changes plus fuel price increases on the levels of walking and bicycling.

Demographics--The questions asked in this section are important in identifying the segments of the population surveyed (see following sections), in determining under or over-representation of the sample, in projecting the results to larger population sizes, and for market segmentation purposes.

Survey Site Selection

At the outset of the study, five prototype settings were identified for the purpose of selecting the survey sites. Each of these distinct settings was further defined in terms of level of walking and bicycling activity, residential density, and extent of shopping, working and school trip opportunities within walking and bicycling distance. These prototypical settings are described in Table 2-1.

In addition to the above guidelines, it was determined that the sites selected for surveying should be relatively small in size (4 to 6 square miles) and, whenever possible, they should be fairly well defined, homogeneous neighborhoods. As a result of these constraints, it is clear that the sites selected might not be representative of the areas in which they are located. The rationale behind these relatively strict criteria arose from the belief that it is very important to define the context within which non-motorized trips are made, given their relatively short distances and, thus, the reduced availability of alternative destinations. Areawide surveys, because of their aggregate nature, tend to obscure this relationship.

Starting from a list of approximately forty promising sites, the number was finally narrowed down to the five sites listed in Table 2-2. The selection process consisted of reviewing available material on the potential sites, discussion among staff members familiar with various sites, and direct telephone communication with representatives of City staff. Some of the original sites were not chosen to be surveyed because of their special status as successful bicycling areas, and because a significant amount of information about them already existed. Such was the case with Davis, California and Gainesville, Florida, where extensive bicycling activity exists at present.

Geographic Areas Surveyed

The sites were selected in conformance with the guidelines set forth in the previous section. It should be emphasized that the specific neighborhoods selected are not necessarily representative of the cities in which they are located.

The five neighborhoods chosen for surveying and analysis were identified because they possess a variety of characteristics unique from one another but which exemplify neighborhood types that could be found throughout the country. This selection was made so that study findings could potentially be transferred to other

TABLE 2-1 GUIDE FOR SELECTING PROTOTYPE SURVEY AREAS

Prototype Area	Qualifying Characteristics	Residential Density	Primary Walk/Bike Opportunities to be Investigated
1 Fringe CBD (0-2 miles from CBD core)	o High income o Low children population	Medium-high	Walk/bike to CBD for work; overall non-motorized activity
2 Central City (2-5 miles from CBD)	o Good shopping district in area o Low work opportunities in area o High owner-occupied housing	Low-medium	Biking to CBD; overall non-motorized activity
3 Suburban (5+ miles from CBD)	o Neighborhood shopping center o Non-work oriented	Low	Non-work walk/bike activity
4 Small Town (15,000-50,000 population)	o Self-contained (not within SMSA) o No major university (25% of population)	Low-medium	All non-motorized travel
5 Special District (0-2 miles from college campus)	o With a major university (over 15,000 students) o In central city of SMSA o Neighborhood shopping (center in district)	Medium-high	All non-motorized travel

TABLE 2-2 CHARACTERISTICS OF SURVEY SITES

Neighborhood Location	Prototype Site	Characteristics: Land Use	Characteristics: Principal Attractor of Non-Motorized Travel in District	Characteristics: Special Facilities
Austin, Texas	College Campus	Mixed apartments and single-family houses, renter occupied predominates. Concentration of commercial use in two census tracts. Married student housing predominant in one census track.	University of Texas in or adjacent to two of three census tracks. Concentration of commercial in two census tracks.	Sidewalks in most areas, extensive system of bike paths and lanes. Bike facilities do not connect all study areas to campus
Columbus, Indiana	Small City	Variety of land uses found in any small city of similar size. Housing typically single-family and owner-occupied some of the major industrial complexes within study area.	Two industrial plants, CBD, strip commercial, schools	Sidewalks in one-half of surveyed area, a few marked bike routes.
Denver, Colorado	Central City	Predominant housing single-family and owner occupied. Some mixture of commercial land uses and public facilities.	Shopping center, schools	Sidewalks throughout area, extensive system of bike paths and lanes.
Huntington Beach, California	Suburban	Predominant housing: single-family, and owner occupied neighborhood commercial areas	Commercial areas, schools and parks	Sidewalks on most collector streets, extensive bike lane system
Philadelphia, Pennsylvania	CBD Fringe	Row houses and apartments	Commercial activities	Sidewalks, off-street pedestrian ways, no bicycle facilities except use of a mall.

cities and therefore increase the usage of the findings. Two sets of characteristics are important. Those that describe the individual neighborhoods and those that describe the context of the neighborhood in the larger city or region. These two sets of characteristics are described separately below.

Overall, 8 percent of the households within the sites were surveyed (based on the 1970 Census household data). Individual rates for each site were as follows: Austin site—13.65 percent; Columbus site—8.56 percent; Denver site—5.16 percent; Huntington Beach site—11.78 percent; Philadelphia site—6.17 percent.

The neighborhood characteristics for the surveyed areas are recorded in Tables 2-2 and 2-3. Table 2-2 describes the major kinds of areas that were sought in selecting the neighborhoods. Each of these neighborhood types are found in most states. The residential nature of each area is its predominant characteristic. The residential concentration was chosen so that a large number of households could be identified from which trips were made for a range of purposes. In Columbus, the area surveyed contains a more mixed land use since the neighborhood intentionally included a major part of the built-up community. In all other areas far fewer trip attractors were present and they were generally located outside the neighborhood boundaries.

The principal attactors within the neighborhoods are also indicated in Table 2-2 because of their potential as a focus of travel. In most situations these attractors are related more to the shopping and personal business trips than to the work trips. Many convenience shopping and personal business trips are typically accomplished within a residential neighborhood. In the Philadelphia sites many work trips are oriented towards the CBD which is close to the study area but not part of it.

The presence of special facilities related to pedestrian and bicycle travel are also identified in Table 2-2. Obviously all areas have street systems that meet the travel requirements of the automobile to a large degree.

The characteristics of the immediate region that surrounds each study area are given in Table 2-3. The location of each neighborhood has been identified relative

TABLE 2-3 CHARACTERISTICS OF AREAS SURROUNDING SURVEY SITES

Neighborhood Location	Prototype Site	Precinct Location	Principal Attractor of Non-Motorized Travel Outside of Study Area
Austin, Texas	College Campus	North and west of CBD, one census track adjacent to CBD, one track one mile north, one three miles west.	CBD
Columbus, Indiana	Small City	Precinct covers most of contiguously built-up section of City	Major industrial plant six miles from study area
Denver, Colorado	Central City	Four miles southeast of CBD	CBD, industrial, and office areas. Major shopping centers.
Huntington Beach, California	Suburban	12 miles from Long Beach CBD	Industrial employment centers and major shopping areas.
Philadelphia, Pennsylvania	CBD Fringe	Two precincts 1/2 and 3/4 miles from CBD core	CBD employment area

to a major feature of the region such as the CBD. In addition, large attractors that may be the focus of trips from the study areas are identified.

The characteristics of the surveyed neighborhoods identified in Table 2-4 are total population, housing units, single family units, owner and renter occupied units land area, density and family size. (This data has been collected from the 1970 census and therefore may somewhat misrepresent the character of the neighborhoods. Whenever possible, more recent data have been collected and will be reported where appropriate).

The five areas are substantially different according to these features. This is pointed out by the densities which range from 1.32 housing units per acre in the Columbus site to 33 units per acre in the Philadelphia sites. When calculated in persons per acre, the densities vary from 3.74 to 53.82, respectively.

The average family size also varies from site to site. Those in Huntington Beach and Austin had similar family sizes of 3.77 and 3.74 respectively while the Philadelphia neighborhood reported the lowest with 1.63 persons per unit.

Housing characteristics are also quite dissimilar. Both the Philadelphia and Austin sites reported the lowest percentage of single family housing units which were accompanied by the lowest percentage of home ownership. While Austin had a higher percentage of single family units the ownership was lower than Philadelphia. The other three neighborhoods are composed principally of owner-occupied single family homes.

The accompanying Figures 2-1 through 2-5 show the boundary of the study areas within each city.

Survey Methodology

The survey instruments, after undergoing extensive review and pre-testing, were designed to be self-administered. All questionnaires were hand-delivered by

TABLE 2-4 NEIGHBORHOOD CHARACTERISTICS (BASED ON 1970 CENSUS)

Neighborhood Location	Population	Total Housing Units	Owner Occupied %	Single Family Units		Land Area (Acres)	Density (Gross)		Average Family Size
				Number	%		Units/ acre	Pop./ acre	
Austin	20,569	5,489	13.1%	1,826	33.0%	1,267	4.33	16.2	3.75
Columbus	22,891	8,053	63.2%	6,104	75.8%	6,120	1.32	3.74	2.84
Denver	25,108	10,402	64.2%	7,454	71.6%	2,843	3.66	8.83	2.41
Huntington Beach	24,972	6,616	78.2%	6,021	91.0%	2,167	3.05	11.52	3.77
Philadelphia	9,109	5,579	16.2%	892	16.0%	169	33.00	53.82	1.63

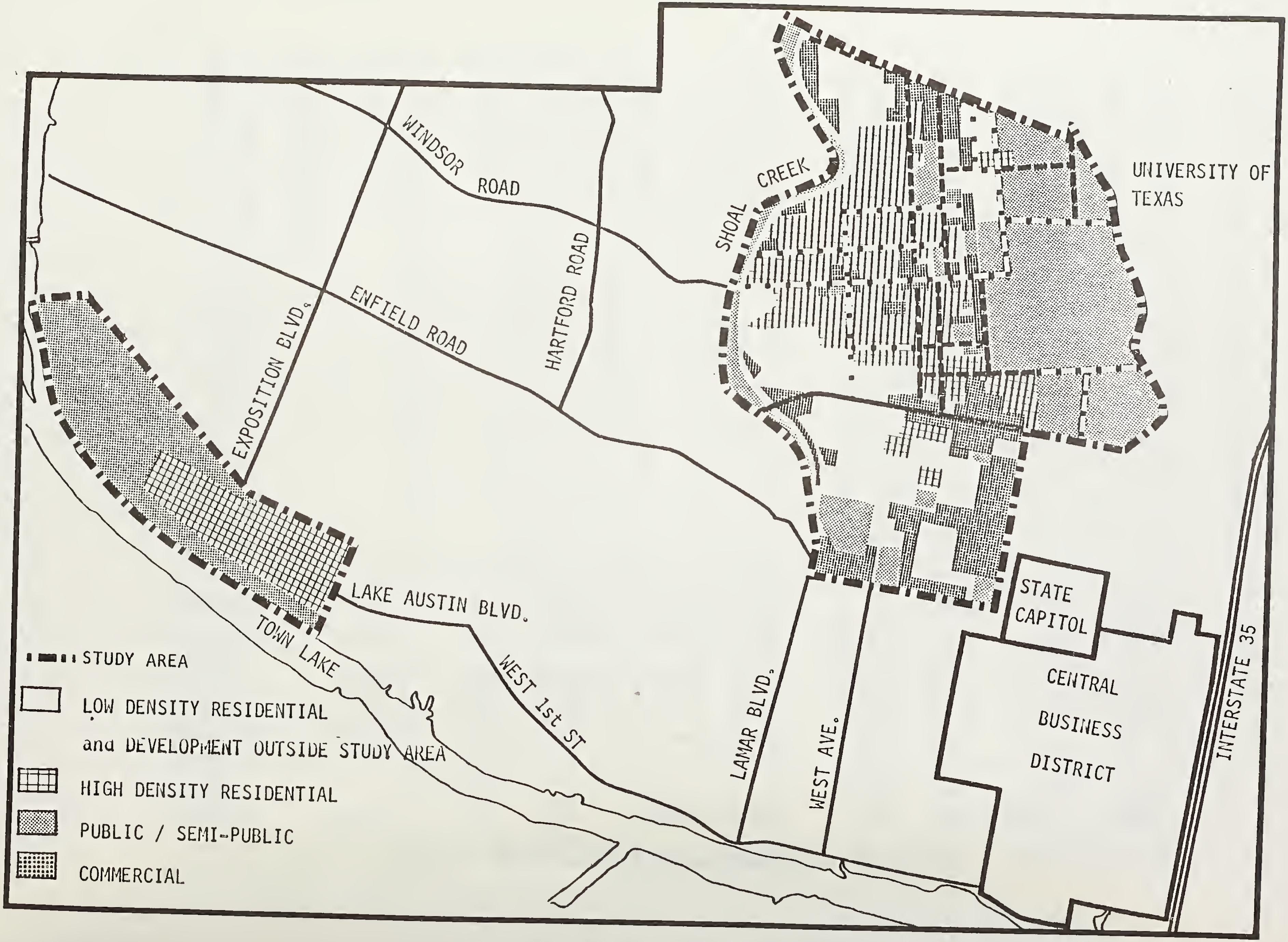

FIGURE 2-1 AUSTIN STUDY AREA LAND USE

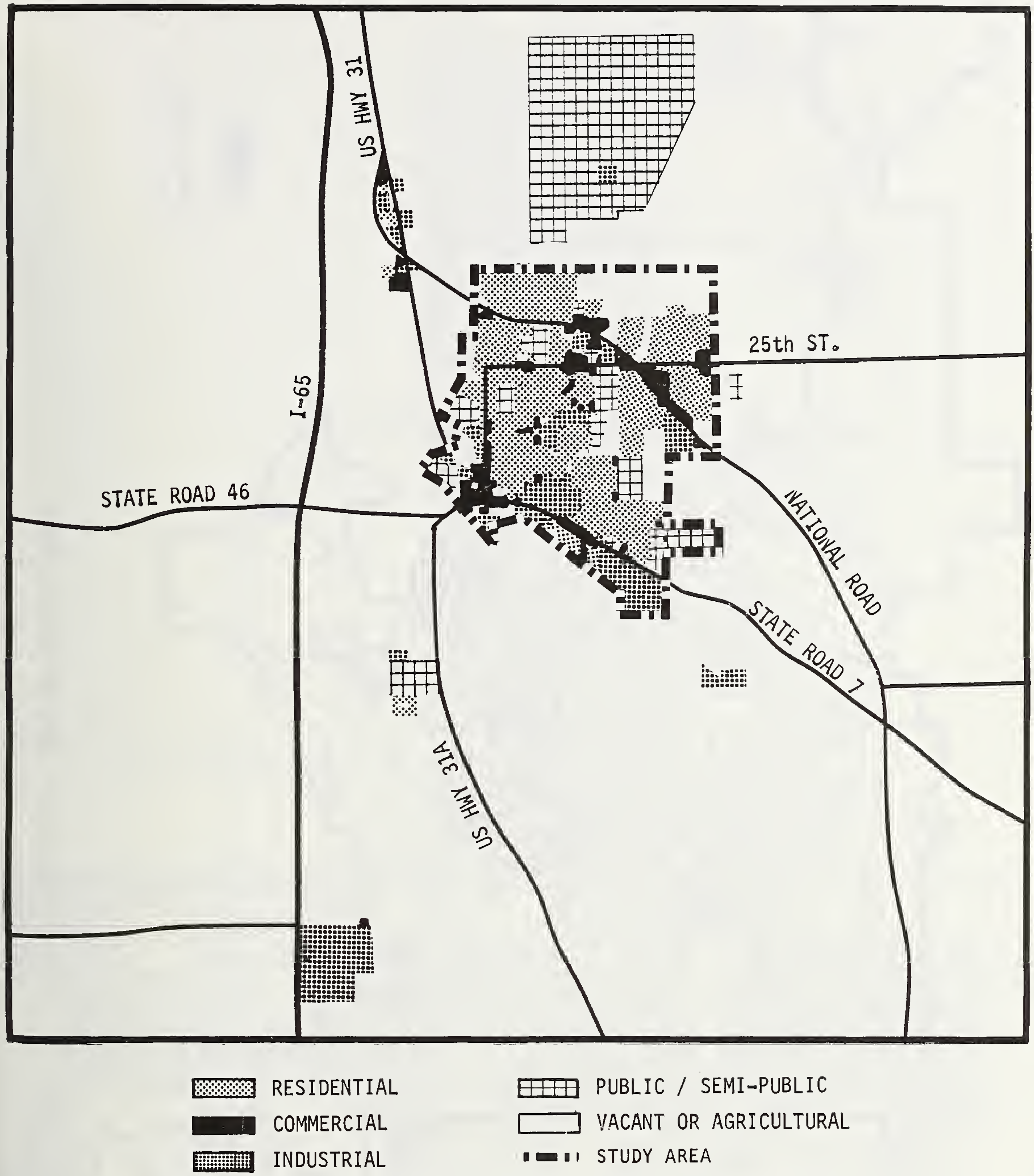

FIGURE 2-2 COLUMBUS IND. STUDY AREA LAND USE

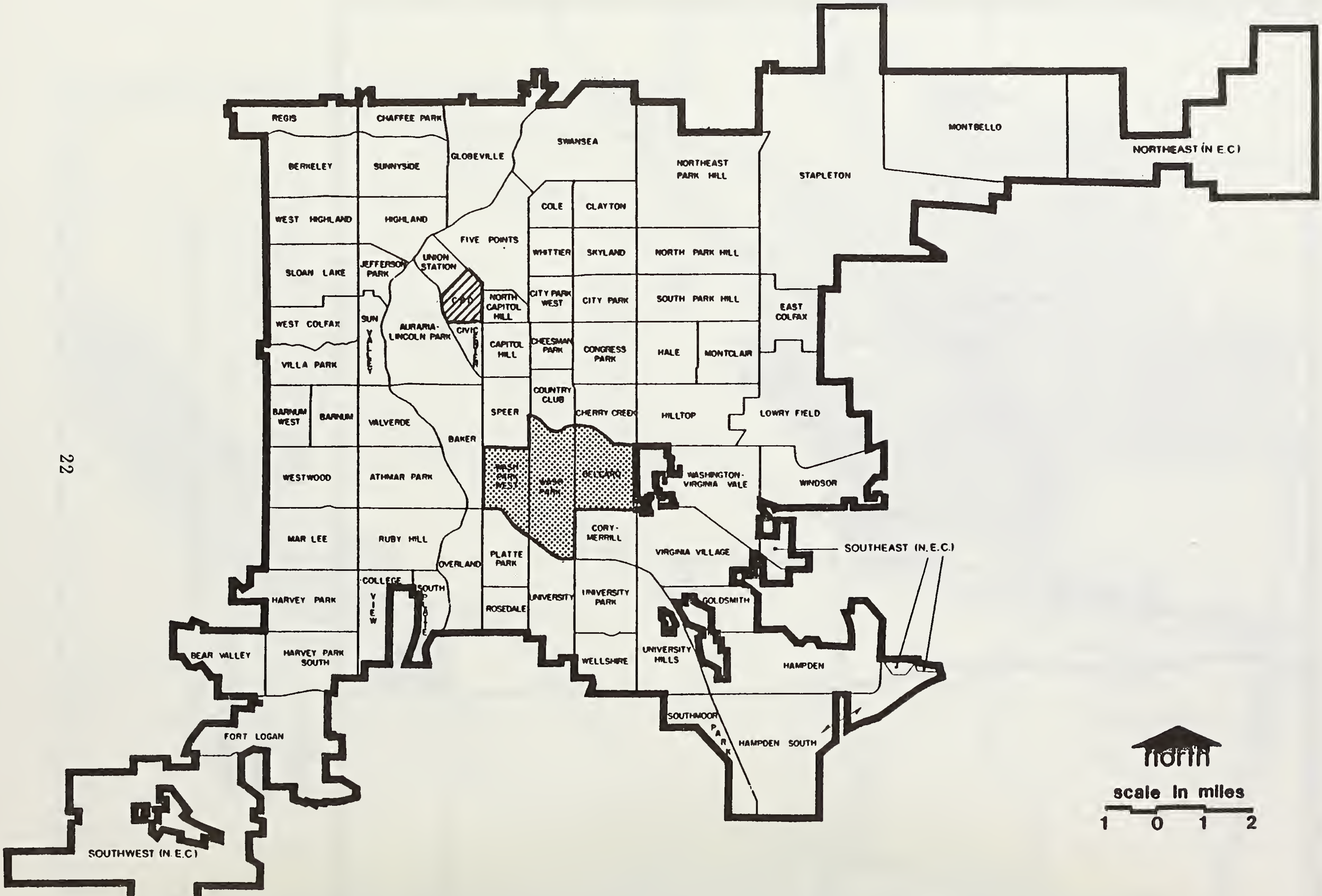

FIGURE 2-3 DENVER STUDY AREA

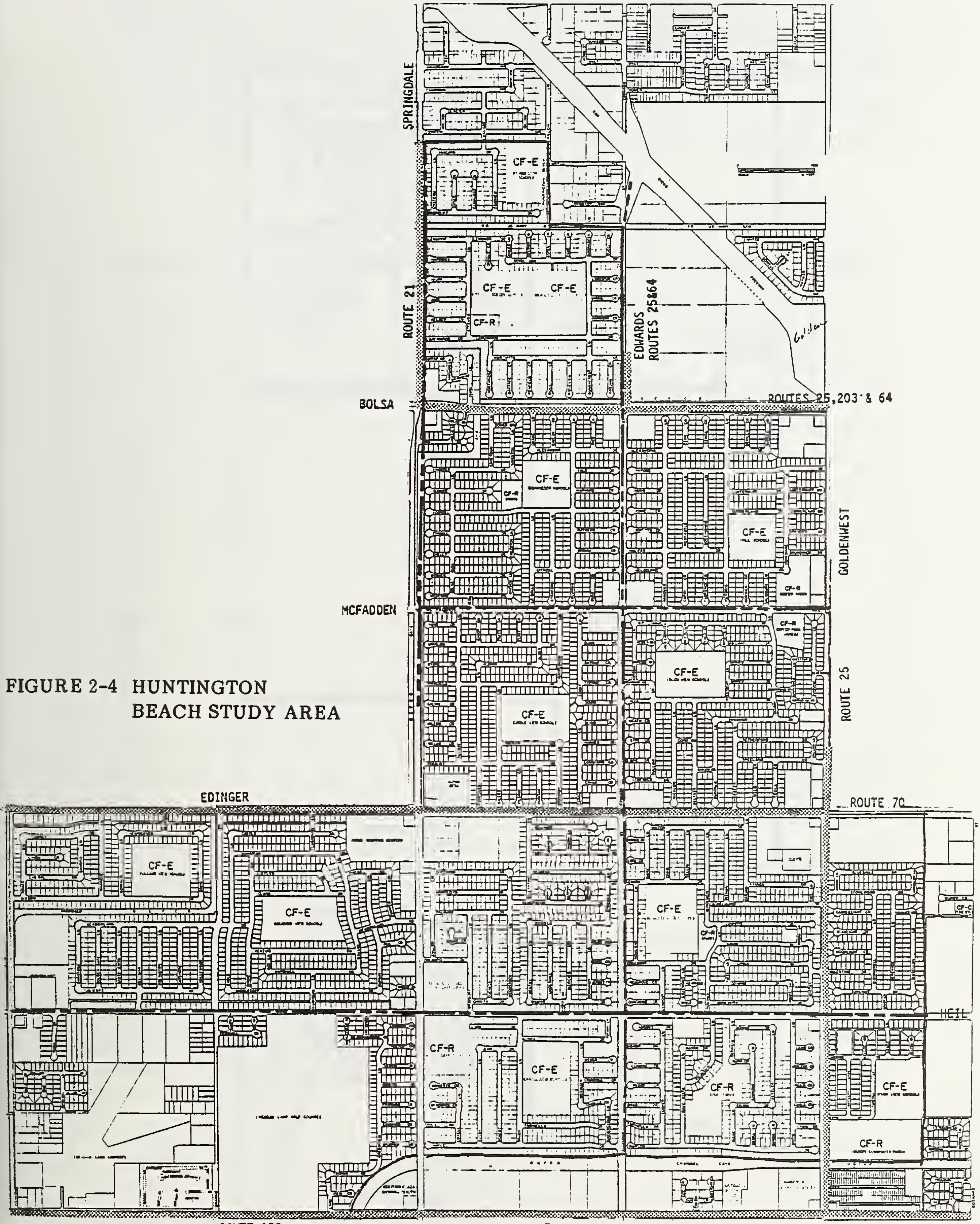

FIGURE 2-4 HUNTINGTON BEACH STUDY AREA

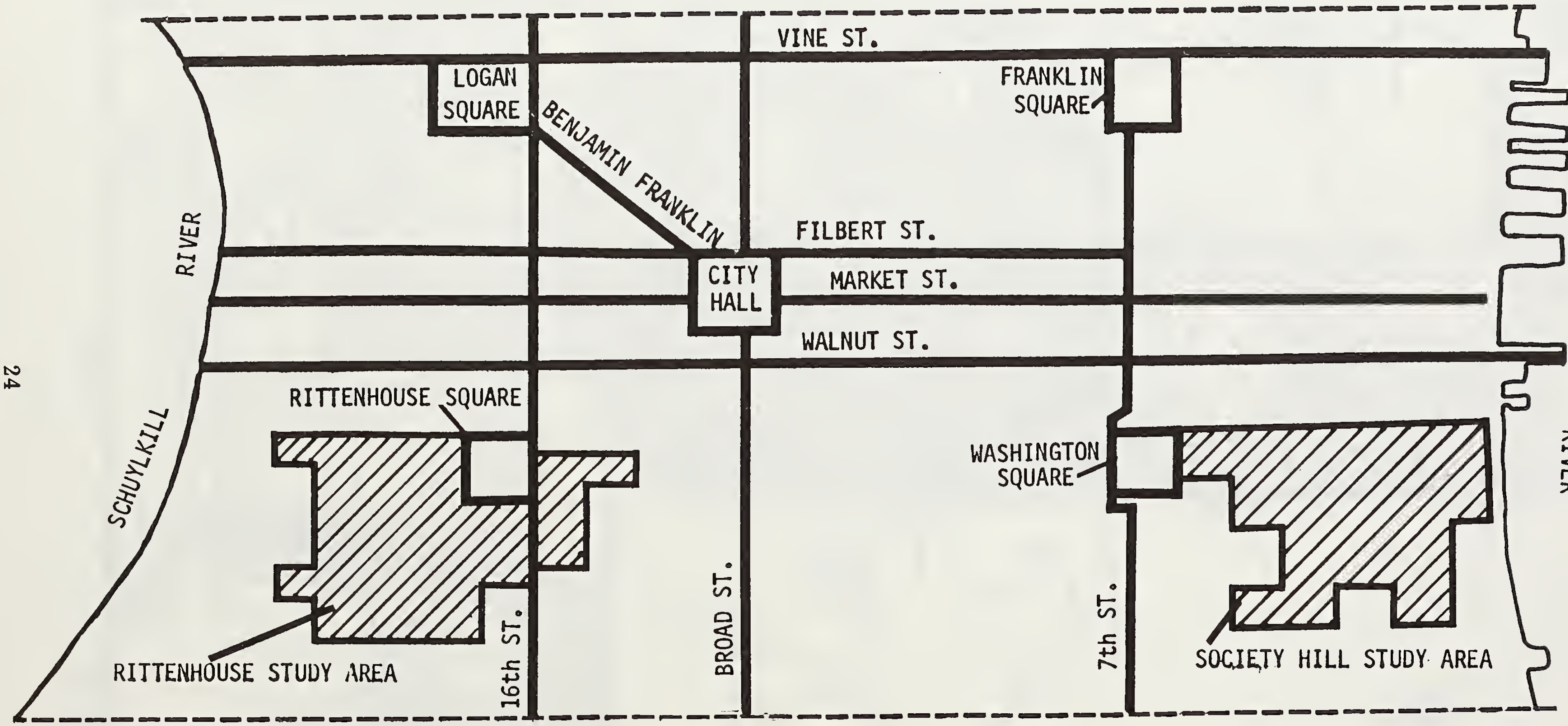

FIGURE 2-5 PHILADELPHIA STUDY AREAS

trained field interviewers to randomly selected households within the selected geographic areas. The method of delivery used, sometimes referred to as the "drop-off" technique, has the advantage of giving the field worker the opportunity to explain the purpose of the study, to review the survey form, to answer questions, and, in general, to engage the cooperation of the potential respondent to the survey.

At the time of dropping-off the questionnaire, the interviewer agreed with the respondent on a date, usually within three to four days, when the questionnaire would be ready for pick-up. To increase the rate of return, a reminder postcard was mailed to each participating household on the day following placement. Upon returning to the household on the day specified for pick-up, if the respondent was not at home, or had not completed the questionnaire, a second attempt was made to collect the form. If, at this point, no contact was made, a pre-addressed, postage prepaid envelope was left with instructions that the questionnaire be returned by mail. Contacts were made during the day as well as during evening hours, and approximately one-half of the questionnaires were placed with male members of the household, and one-half with females, 16 years of age or older.

Half of the surveys placed at all sites were for shopping/personal business trips, the other half were for work trips except in Austin, where the other half of questionnaires placed were for school trips.

Tables 2-5 and 2-6 summarize the returns. A total of 17,471 households were contacted in the five geographic areas, and 6,900 questionnaires were placed with potential respondents. Of the 6,900 surveys placed, 4,368 or 63.3 percent were returned. Finally, because of incompleteness and errors 3,866 questionnaires were finally processed.

Given the length of the survey questionnaire (16 to 18 pages), the return rate of 63.3 percent is quite acceptable when compared to surveys of similar length (9). Several factors are seen as contributing to this result. First, the "drop-off, pick-up" technique has been found to elicit a greater return rate than a mail survey. Second, the forms were attractive, printed clearly, were identified with each City's

TABLE 2-5 SUMMARY OF SURVEY CONTACTS

Contacts	Austin	Columbus	Denver	Huntington Beach	Philadelphia	Total
Not at home	1,739	1,650	2,742	947	1,066	8,144
No qualified respondent at home	88	195	294	231	99	907
Refusals	180	246	609	277	208	1,520
Placements	1,380	1,380	1,380	1,380	1,380	6,900
TOTAL CONTACTS	3,387	3,471	5,025	2,835	2,753	17,471

TABLE 2-6 SUMMARY OF SURVEY PLACEMENTS

	Austin	Columbus	Denver	Huntington Beach	Philadelphia	Total
Not returned	441	490	418	510	673	2,532
Unused returns	139	90	162	70	41	502
Processed	800	800	800	800	666	3,866
TOTAL PLACEMENT	1,380	1,380	1,380	1,380	1,380	6,900

letterhead, and were accompanied by an introductory letter signed by a high City official. Finally, the reminder postcard, second visit, and pre-addressed and stamped return envelope are all seen as contributing factors to the rate of return obtained.

3.
SURVEY RESULTS

This chapter examines the major components of the survey as they relate to current mode choices and mode preferences, the perception rating of transportation attributes, the changes in the transportation systems, and the changes in stated modal preferences induced by the introduction of selected non-motorized demand incentive strategies. To place the above results in perspective, an analysis of the characteristics of the trips surveyed as well as of the tripmakers is also included. For tabulation of survey results, refer to Appendix A, Volume 2, Appendices (FHWA/RD-80/049).

Tripmaker Characteristics

A summary of socioeconomic characteristics of respondents is presented in Table 3-1. Individual analysis of the significant factors and their effect on mode choice is given next.

Income - Table 3-1 shows that the average income in two of the sites surveyed (Columbus and Denver) was just below their state average incomes ($19,620 and $20,740 respectively); in two sites (Huntington Beach and Philadelphia) income was significantly above their state averages ($21,120 and $19,390 respectively) and, not surprisingly, the heavy student concentration in the Austin sites produced an average income of approximately $14,700, which is well below its state average ($18,190).

TABLE 3-1 SOCIOECONOMIC PROFILE OF RESPONDENTS

Site Location and Trip Purpose	Male %	Female %	Age Average	Age Mode	Average Number Autos Per Household	Average Number Autos Per Lic. Driver	Average Number Bikes Per Household	Average Number Bikes Per Lic. Driver	Predominant Structure Type 1	Predominant Structure Type 2	Education % High School	Education % College	Income Average	Income % Greater than $20,000	Occupation 1	Occupation 2
Austin																
School	50.7	49.3	24.0	21-25	1.7	0.8	1.3	1.9	Walk-up 47.6%	Single Family 16.0%	5	95	14,842	19%	-	-
Shopping/Personal Business (P.B.)	50.2	49.8	28.7	16-25	1.6	0.8	1.5	0.5	Walk-up 45%	SF 22%	9	91	14,555	20%	Student 29.8%	Professional/ Technical 29.3%
Columbus																
Work	55.0	45.0	38.2	36-50	1.9	1.0	1.6	0.5	SF 76.8%	Walk-up 11.8%	50	50	19,270	35%	Blue Coll. 31.3%	Prof/Tech 26%
Shopping/P.B.	41.8	58.2	44.2	26-35	1.8	0.9	1.6	0.5	SF 79.9%	Walk-up 8.8%	60	40	17,400	25%	Housewife 22%	Prof/Tech 16.5%
Denver																
Work	50.0	50.0	35.3	26-35	1.9	1.0	1.6	0.6	SF 77.9%	Duplex 12.0%	17	83	21,275	40%	Prof/Tech 49%	Blue Coll. 17.8%
Shopping/P.B.	48.8	50.9	45.1	26-35	1.8	0.9	1.3	0.5	SF 82.2%	Duplex 10.0%	30	70	18,060	28%	Prof/Tech 28.5%	Housewife 15.5%
Huntington Beach																
Work	50.0	50.0	37.7	36-50	2.4	1.0	2.2	0.6	SF 88.3%	Walk-up 3.0%	26	74	27,370	59	Prof/Tech 41.9%	Secretarial/ Clerk 18.3%
Shopping/P.B.	48.0	52.0	40.4	36-50	2.3	1.0	2.2	0.6	SF 88.4%	Walk-up 3.8%	32	68	25,220	51%	Housewife 27.0%	Prof/Tech 26.3%
Philadelphia																
Work	51.7	48.3	37.7	26-35	1.0	0.6	1.0	0.4	Townhouse 29.8%	High-rise 24.3%	9	91	31,975	59%	Prof/Tech 64.1%	Managerial 15.7%
Shopping/P.B.	42.7	57.0	40.3	26-35	0.9	0.6	1.1	0.5	Townhouse 33.9%	High-rise 24.1%	11	89	29,970	54%	Prof/Tech 46.3%	Manager. 11.7%
Total																
School	50.7	49.3	24.0	21-25	1.7	0.8	1.3	1.9	Walk-up 47.6%	other 16.8%	5	95	14,842	19%	-	-
Work	51.7	48.3	37.2	26-35	1.8	0.9	1.6	0.6	SF 66.3%	Walk-up 10.4%	26	74	24,720	46%	Prof/Tech 44.6%	Blue Coll. 17.6%
Shopping/P.B.	46.5	53.4	39.7	26-35	1.7	0.9	1.5	0.5	SF 59.6%	Walk-up 15.4%	29	71	20,590	35%	Prof/Tech 28.6%	Housewife 15.9%

The cumulative percent distribution of families by income and by mode chosen is shown in Tables 3-2 and 3-3 for work and for shopping/personal business trips respectively These tables show that a higher proportion of bicycle and transit users are found in the lower income ranges ($10,000 and less). For bicycle users, 18.4 percent of those reporting work trips and 41.2 percent of shopping/personal business trips belong in this category, compared to 12.5 percent and 27.4 percent respectively when the four modes are grouped. As will be seen later, this occurs in part because the Austin site, which exhibits the lowest average income, reports also the heaviest level of bicycle use.

Pedestrians, on the other hand, exhibit a higher proportion in the upper income ranges. Thus, 38 percent of pedestrians on work trips and 28.3 percent on shopping/personal business trips report average family incomes greater than $25,000, compared to 32.3 percent and 24 percent, respectively, for the four modes combined.

In all cities the family income of persons responding to the work trip questionnaire was higher than that of those responding to the shopping and personal business trip questionnaire. This can be accounted for, in part, by the number of retirees who would make shopping/personal business trips, but who do not make work trips. Since the income of retirees is typically lower than that of workers, the income of persons making shopping and personal business trips would tend to be lower also.

Specific differences in incomes between cities cannot be compared because of variations in their cost of living and in the prevalent wage rates. While occupations may be the same, wage rates could vary substantially among these five cities.

Age - The age distribution of respondents by trip purpose and mode used is recorded in Table 3-4 for all areas surveyed (see Table 3-1 also). Not surprisingly, a difference between the work and shopping and personal business trips is that few work trips are made by respondents over 65 years of age. This age group makes up 12.8% of shopping and personal business trips but only 1.7% of work trips. Obviously there were few workers over 65 surveyed.

TABLE 3-2 CUMULATIVE DISTRIBUTION OF FAMILIES BY INCOME AND MODE CHOSEN FOR WORK TRIPS

Income Range (000's)	Total Sample (%)	Auto Driver (%)	Walk (%)	Bike (%)	Transit (%)
0-5	3.0	2.8	3.1	2.6	6.1
5+-7.5	6.8	6.7	9.2	5.2	7.0
7.5+-10	12.5	12.1	14.1	18.4	16.6
10+-12.5	19.4	19.3	20.2	23.7	22.7
12.5+-15	28.5	28.2	29.4	34.2	30.5
15+-17.5	37.4	37.9	37.4	42.1	36.6
17.5+-20	45.7	46.4	42.9	50.0	47.9
20+-25	61.6	63.2	54.6	60.5	61.8
25+-50	87.4	89.1	82.2	92.1	85.3
50+	93.9	94.0	92.6	100.0	95.7
No Answer	6.1	6.0	7.4	-	4.3

TABLE 3-3 CUMULATIVE DISTRIBUTION OF FAMILIES BY INCOME AND MODE CHOSEN FOR SHOPPING AND PERSONAL BUSINESS TRIPS

Income Range (000's)	Total Sample (%)	Auto Drive (%)	Walk (%)	Bike (%)	Transit (%)
0-5	11.0	8.6	15.0	23.6	21.1
5+-7.5	19.3	16.6	23.4	37.3	29.0
7.5+-10	27.4	25.8	28.5	41.2	38.6
10.0+-12.5	33.7	32.3	35.6	41.2	43.0
12.5+-15	41.2	40.1	42.5	47.1	50.0
15+-17.5	48.2	47.6	48.6	54.9	54.4
17.5+-20	56.2	56.3	55.5	60.8	60.5
20.0+-25	67.1	68.5	63.6	68.6	69.3
25+-50	86.5	88.7	81.2	84.3	82.5
50+	91.1	91.4	91.9	84.3	90.4
No Answer	8.9	8.6	8.1	15.7	9.6

TABLE 3-4 AGE DISTRIBUTION BY TRIP PURPOSE AND CHOSEN MODE (PERCENT)

	Work						Shopping and Personal Business				
	Total	Auto Driver	Auto Pass	Walk	Bike	Transit	Total	Auto Driver	Walk	Bike	Transit
16-25	18.1	16.5	29.1	18.4	28.9	20.0	26.0	23.3	30.2	57.0	25.4
26-35	33.4	33.8	25.7	34.9	39.6	37.4	27.1	28.1	28.4	23.5	17.5
36-50	30.4	32.4	23.9	27.6	28.9	20.9	18.2	19.3	17.5	7.8	10.5
51-65	15.5	15.5	17.7	12.9	2.6	19.1	15.2	15.9	12.2	7.8	20.2
65+	1.7	1.3	2.7	3.7	-	1.7	12.8	12.9	10.7	3.9	24.6

The use of the bicycle is more likely to be made by those 35 years of age or under. (80 percent of shopping trips and 68 percent of work trips are in this age group). Very few workers (2.6%) between 51 and 65 use the bicycle but 12.9 percent continue to walk and 19.1 percent ride transit.

Persons between 15 and 25 years of age who make shopping and personal business trips are more likely to walk, bike or use transit than to drive a car. The bicycle trips are concentrated in age groups 15 to 25 (57%) and 26 to 35 (23.5%).

There does not appear to be substantial differences in the ages of auto drivers and pedestrians, for either trip purpose. Transit users were more likely to be younger (16-25) or older (over 50) than the total sample.

There is a significant difference between the age of bicyclists and the age of users of other modes. Even excluding school trips, the average age of bicyclists is 32 years for work trips and 29 years for shopping/personal business trips compared to 37 and 40 years respectively for auto users.

Sex - Table 3-1 reveals an over-representation of females for shopping/personal business trips, especially in the Columbus and Philadelphia sites. Table 3-5 shows the mode chosen stratified by sex, for work and shopping/personal business trips.

TABLE 3-5 PERCENT DISTRIBUTION OF TRIPS BY MODE CHOSEN AND SEX

	Auto	Walk	Bicycle	Transit
Male	48.6	49.4	67.4	38.4
Female	51.4	50.6	32.5	61.6

This table shows that, overall, there is an even distribution of auto and walk trips between women and men - 49% and 51% respectively. On the other hand, a full two thirds of the bicycle trips but only over a third of the transit trips were made by men.

Occupation - Table 3-1 shows that the most frequent occupations surveyed were "professional/technical", "blue collar" and "housewife." Philadelphia was the only site reporting "managerial" as a high frequency occupation, and of course, "students" was high in Austin.

Bicycle Ownership - Bicycle ownership per household varies from a low of 1.0 in the Philadelphia sites to a high of 2.2 in the Huntington Beach prototype area. The Philadelphia and Austin sites reported the least number of bicycles per household. Potentially this could be explained by the family composition although the survey data cannot substantiate this. Families with children would potentially exhibit a higher number of bicycles. Austin, with a large number of students, would probably not include as many families with children. Philadelphia households surveyed may have a larger number of single persons or families without children which is a common characteristic of higher income families living in inner city areas.

The other factor that may help to explain the low bicycle ownership is the type of housing in Philadelphia and Austin. These two areas report the lowest single family units of the five neighborhoods. While 72 to 91 percent of housing units in the Columbus, Denver and Huntington Beach neighborhoods were single family structures, the percentages in the Philadelphia and Austin neighborhoods were 16 and 33 percent respectively. Due to the problems of bicycle storage and access associated with apartment and townhouses, the ownership of bicycles could be reduced.

Automobile Ownership - Obviously automobile ownership is a significant factor in mode choice. From Table 3-6 it can be seen those walking, bicycling and using transit more likely did not own an automobile, or they owned fewer automobiles than auto drivers. The auto ownership pattern for the work trip survey was very similar to the shopping and personal business trip survey.

Auto ownership per household, as shown in Table 3-1, varied from 0.9 in Philadelphia to 2.4 in Huntington Beach. Ownership was lower in the two areas that reported the highest level of non-motorized travel (Austin and Philadelphia). On the other hand, the neighborhood surveyed in Huntington Beach reported the highest number of autos per household and the highest percent of auto trips as will be shown later. These results are consistent with the relationship between auto ownership and vehicle trips made found nationwide (10).

TABLE 3-6 AUTOMOBILE OWNERSHIP AND CHOSEN MODE

Autos per Household	Total Sample	Auto Users	Walk	Bicycle	Transit
0	8.7	1.4	26.3	15.7	35.4
1	33.2	28.6	48.2	43.8	44.2
2	40.3	48.7	16.8	24.7	15.9
3	11.8	14.5	4.3	6.7	3.1
4+	6.1	6.7	4.3	9.0	1.3

Characteristics of the Trip

A brief description of the characteristics of the trips surveyed and their effect on mode choice, particularly on choice of non-motorized modes, is given next.

Trip Distance — Trip distance is an important factor in mode choice. Tables 3-7 and 3-8 illustrate the trip cumulative distances by mode and city. In all cities, over 60 percent of walk and bicycle trips were one-half mile or less in length; 80 percent of walk trips and 60 percent of bicycle trips were less than one mile, and over 94 percent of walk trips were less than two miles. In the Philadelphia neighborhoods, 99 percent of walk trips and 85.7 percent of bike trips are two miles or less in length. (Data concerning bicycle use in these neighborhoods may not be statistically accurate due to small sample size. They are included to indicate general trend).

In comparison to non-motorized trips, auto trips are significantly longer. The largest percent of auto trips in any one area which were one-half mile or less in length was 23 percent. Similarly, at most 46 percent are one mile or less, and at most 72 percent are two miles or less in length.

TABLE 3-7 CUMULATIVE TRIP LENGTH DISTRIBUTION—SHOPPING AND PERSONAL BUSINESS TRIPS

Distance in Miles	Austin			Columbus			Denver			Huntington Beach			Philadelphia			All Cities		
	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike
0-0.25	4.7	18.3	9.1	3.4	14.3	20.0	1.7	31.4	0	5.8	40.9	37.5	0.0	33.5	-	3.8	28.7	11.8
0.25-0.5	18.7	65.5	45.6	19.4	75.0	60.0	11.8	80.3	33.4	22.8	72.7	75.0	15.7	71.5	28.6	18.3	71.5	47.3
0.5-1.0	40.0	87.0	59.2	46.4	96.4	80.0	28.2	86.2	44.5	46.5	81.8	87.5	35.2	91.5	28.6	40.6	89.5	58.9
1.0-2.0	57.4	94.5	86.5	71.9	100.0	80.0	50.0	98.0	66.7	71.1	100.0	100.0	50.9	99.0	85.7	63.0	97.9	84.4
2.0-4.0	82.5	96.7	91.0	91.7	100.0	100.0	75.5	100.0	77.8	88.9	100.0	100.0	62.7	100.0	100.0	84.3	09.2	92.2
4.0-6.0	91.4	98.9	95.5	95.1	100.0	100.0	90.6	100.0	88.9	92.8	100.0	100.0	74.5	100.0	100.0	91.9	99.7	96.1
6.0-10.0	98.0	98.9	100.0	95.7	100.0	100.0	96.3	100.0	100.0	94.7	100.0	100.0	84.3	100.0	100.0	95.6	99.7	100.0
10.0+	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.1	100.0	100.0

TABLE 3-8 CUMULATIVE TRIP LENGTH DISTRIBUTION—FOR WORK TRIPS

	Columbus			Denver			Huntington Beach			Philadelphia			Four Cities		
	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk
0-0.25	1.8	-	15.0	0.7	-	15.8	0.6	-	40.0	1.2	-	12.2	1.1	-	14.4
0.25-0.5	7.3	8.3	45.0	2.7	3.8	37.5	3.3	3.0	50.0	2.4	16.7	43.9	4.4	7.1	43.3
0.5-1.0	27.0	33.3	85.0	5.4	7.6	53.1	8.3	6.0	90.0	10.7	33.4	74.8	13.7	19.5	73.1
1.0-2.0	54.5	72.1	95.0	17.7	15.3	62.5	14.5	15.1	90.0	27.4	55.6	96.4	29.2	39.9	90.5
2.0-4.0	79.7	88.8	100.0	44.0	30.7	87.5	21.6	30.3	90.0	38.1	61.2	98.6	47.7	54.1	96.5
4.0-6.0	88.8	91.6	100.0	64.5	65.4	100.0	31.7	36.4	100.0	59.6	72.3	100.0	81.3	66.5	100.0
6.0-10.0	93.6	97.2	100.0	82.6	76.9	100.0	47.7	42.5	100.0	78.8	94.4	100.0	74.6	76.2	100.0
10.0+	99.7	97.2	100.0	99.7	100.0	100.0	99.7	97.0	100.0	97.6	100.0	100.0	99.5	98.2	100.0

With the exception of the Philadelphia neighborhoods, over 76 percent of shopping and personal business trips made by the automobile were four miles or less in length, a distance which is feasible by bicycle and many are feasible by walking. This suggests potential for use of non-motorized modes for a large segment of shopping/personal business trips. Only about 63 percent of the trips in Philadelphia are in this category. The lower number no doubt accounting for the fact that many of the shorter trips are already being made by walking.

If a reasonable walking distance for shopping/personal business trips is one half mile, 12 to 23 percent of auto trips in the areas surveyed are feasible by walking. When the distance is increased to one mile the percentage of auto trips which could be made by walking increases to 28 to 46 percent. Assuming two miles is the maximum distance a person would walk for shopping or personal business reasons the percent of trips that could shift from the automobile ranges from 50 to 72 percent.

Very few auto work trips are one-quarter mile or less in length and no auto passenger trips were made which were less than one-quarter mile. It is obviously more convenient to use another mode than get a ride. Only slightly more than one percent of auto driver work trips were made for a trip distance of one-quarter mile or less.

The use of non-motorized modes for these short trips is illustrated in the fact that 43 percent of all walk and bike work trips in the four cities are one-half mile or less in length. While 90 percent of all walk and bike trips are two miles or less in length only 29 percent of auto driver and 40 percent of auto passenger trips are accomplished within a distance of two miles. All walk and bike work trips in the four cities are 6 miles or less in length. In comparison, 61 percent of auto drivers and 66 percent of auto passenger trips are 6 miles or less in length.

The distance characteristics of the four cities vary substantially. In Huntington Beach the distance of the auto work trip is substantially longer than in any of the other cities. Only 47.7 percent of auto driver and 42.5 percent of the auto passenger work trips are 10 miles or less in length.

The distance of the work trip is typically longer than the shopping and personal business trip no matter which mode is used. Table 3-9 records a comparison of the trip distance for all cities and all modes for the two categories of trips. While 70 percent of shopping and personal business trips are accomplished within a distance of two miles or less, only 39 percent of work trips are made within this distance.

TABLE 3-9 COMPARISON OF CUMULATIVE TRIP LENGTH FOR WORK AND SHOPPING/PERSONAL BUSINESS TRIPS

	Work	Shopping and Personal Business
0 to 1/4	2.8	9.0
1/4 to 1/2	9.4	29.4
1/2 to 1	22.1	50.3
1 to 2	39.1	70.2
2 to 4	56.3	87.1
4 to 6	68.0	93.7
6 to 10	78.9	96.5
10+	99.2	99.6

Number of Stops — The likelihood of pedestrians or bicyclists making additional stops on a shopping or personal business trip varies by city. While only 20 percent of the walk/bike trips in Huntington Beach included additional stops, close to 60 percent of the trips in Philadelphia had other stops (see Table 3-10). When the statistics of the five cities are combined, approximately 60 percent of the auto driver and 50 percent of the bike/walk trips involved one or more additional stops. However, if the Philadelphia sites are excluded, the percentages change to approximately 60 percent of auto trips and 40 percent of bike/walk trips.

The question posed of those making work trips differed from that asked for shopping and personal business trips because of the numerous "lunch time" trips that might be included by the worker. The question asked was: "How many side trips did you make which required you to travel one or more miles out of your way on your last trip to work?" The results are recorded in Table 3-11. Consistently, auto drivers make substantially more trips out of their way than the auto passenger or those choosing to walk or ride a bicycle. When the four cities are combined, the auto drivers are seen to make three times as many trips out of their way than auto passengers, pedestrians or bicyclists. The one mile route deviation obviously is a substantial penalty for those walking, biking or traveling as auto passengers.

Nevertheless, it should be pointed out that the areas surveyed in Philadelphia and Denver report over 12 percent of walk/bike trips with the one-mile deviation. While the low percent implies that side trips can inhibit the use of non-motorized modes, the 12 percent indicates that not all walk/bike trips are deterred because of it.

Time of Day — As shown in Table 3-12, it appears that, regardless of mode, most persons choose the period from 9 a.m. to 2 p.m. for making their shopping/personal business trips. In Austin, however, the most frequent time for making such trips is between 2 p.m. to 6 p.m. This is true for auto users, walkers and bicyclists, and most likely reflects the fact that students shop after class (or that schedules are different for students).

In four of the areas surveyed, a lower percent of walk or bicycle trips than auto trips are made after 6:00 p.m., for shopping and personal business. By 6:00 p.m., 91 percent of walk trips have been made compared to 85 percent of auto trips (in all areas). The possible reasons for the fewer non-motorized trips might stem from personal safety concerns. Philadelphia is the only exception to this pattern.

While the four city totals illustrate that fewer walk and bike trips than auto trips were made before 6:00 a.m., the percentage exceeded the auto trips in both Columbus (work trips) and Huntington Beach (Shopping/Personal Business trips).

TABLE 3-10 DISTRIBUTION OF TRIPS BY NUMBER OF STOPS (SHOPPING AND PERSONAL BUSINESS TRIPS)

	Austin		Columbus		Denver		Huntington Beach		Philadelphia		All Cities	
No. Added Stops	Auto	Bike/ Walk	Auto	Bike/ Walk	Auto	Bike/ Walk	Auto	Bike/ Walk	Auto	Bike/ Walk	Auto	Bike/ Walk
0	52.3	54.8	35.1	66.6	37.9	55.0	42.9	80.0	41.2	39.7	41.4	50.3
1	31.0	28.7	33.5	18.2	35.9	23.3	30.4	6.7	35.3	28.0	32.8	25.4
2	10.9	11.3	20.3	6.1	16.8	13.3	15.5	10.0	13.7	15.9	16.0	13.3
3+	5.4	5.2	10.0	6.1	9.4	6.7	10.3	3.3	7.8	16.4	8.9	10.5

TABLE 3-11 SIDE TRIPS OVER ONE MILE (WORK TRIPS)

Area	Auto Driver	Auto Passenger	Bike/ Walk
Columbus	26.7	8.3	0
Denver	34.5	11.5	12.5
Huntington Beach	31.4	3.0	0
Philadelphia	41.7	22.2	12.2
Total	31.6	9.7	10.4

TABLE 3-12 DISTRIBUTION OF TRIPS BY TIME OF DAY—SHOPPING AND PERSONAL BUSINESS

	Austin			Columbus			Denver			Huntington Beach			Philadelphia			All Cities		
	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike	Auto	Walk	Bike
Before 9:00	5.8	5.4	4.5	5.7	7.1	20.0	6.4	7.8	-	6.1	4.5	12.5	5.9	2.0	-	6.0	4.1	5.9
9:00 a.m. to 2:00 p.m.	29.8	30.1	36.4	49.6	46.5	40.0	56.7	51.1	44.4	54.9	45.5	25.0	56.8	56.0	42.9	49.0	48.0	37.3
2:00 p.m. to 6:00 p.m.	42.7	52.7	54.6	31.2	35.7	40.0	24.5	33.3	55.6	27.0	40.9	50.0	29.4	34.0	57.1	30.7	38.852.9	
After 6:00 p.m.	21.7	11.8	4.5	13.2	10.7	-	12.4	7.8	-	12.0	9.1	12.5	5.9	8.0	-	14.1	9.1	3.9

As would be expected the great majority of all work trips were made before 9:00 a.m. (Table 3-13). Philadelphia exhibits the lowest percent of trips before 7:00 a.m. and the highest between 8:00 and 9:00 a.m. and 9:00 and 10:00 a.m. This potentially reflects the working hours of the predominant occupations in the Philadelphia precincts (management/professionals).

Number of Persons Accompanying Traveler — Although there is no significant difference among areas in the number of persons accompanying the traveler for the shopping and personal business trips, some differences do exist between modes. Twenty-eight percent of auto drivers reported having two or more additional persons in the vehicle when making shopping/personal business trips. Only 20 percent of those using non-motorized modes for this purpose had two or more additional persons accompanying them.

The percentage of those making the work trip with others illustrates the extent of carpooling and ridesharing that takes place in the four areas surveyed. As Table 3-14 shows, the lowest percentage of drivers traveling alone occurs in Philadelphia where 76.2 percent were not accompanied by others. In the remaining cities over 85 percent of travel by auto drivers was alone. Very few auto drivers were accompanied by two persons. The highest percent was in Philadelphia where 4.8 percent of auto driver work trips were made with two other people.

In the four areas where work trips were surveyed, only 8.5 percent of the pedestrians traveled with someone else. Practically all bicyclists surveyed travel alone.

Although no causal relationship is implied, the results do suggest that the number of persons on a trip might inhibit the use of non-motorized modes. This is especially true where more than two persons are involved in the trip.

Climate — Recorded in Tables 3-15 and 3-16 are various statistics which portray the climatic conditions in the five cities where surveys were taken. The survey attempts to determine the effect of sustained weather conditions on the use of non-motorized modes by analyzing the respondents' perception of modal

TABLE 3-13 DISTRIBUTION OF TRIPS BY TIME OF DAY—WORK

	Columbus				Denver				Huntington Beach			
	Auto Driver	Auto Pass	Walk	Bike*	Auto Driver	Auto Pass	Walk	Bike	Auto Driver	Auto Pass	Walk*	Bike*
Before 7:00	32.4	19.4	39.9	40.0	23.5	15.4	11.8	13.3	27.2	27.2	-	-
7:00 to 8:00	35.9	16.7	26.7	20.0	36.7	61.6	29.4	40.1	28.5	29.7	-	33.3
8:00 to 9:00	9.1	27.7	-	-	18.1	11.5	23.5	13.3	18.5	19.8	42.8	33.3
9:00 to 10:00	2.4	5.6	-	-	5.1	7.7	11.8	13.3	5.8	5.9	14.3	-
10:00 to 2:00	3.9	2.8	20.0	-	5.8	-	17.6	6.7	5.3	5.0	14.3	-
2:00 to 6:00	11.8	22.2	6.7	40.0	7.8	3.8	5.9	13.3	9.0	8.3	28.6	33.3
After 6:00	4.5	5.6	6.7	-	2.7	-	-	-	3.3	3.8	-	-

	Philadelphia				All Cities			
	Auto Driver	Auto Pass	Walk	Bike	Auto Driver	Auto Pass	Walk	Bike
Before 7:00	9.5	0	4.8	-	26.4	21.2	8.6	10.5
7:00 to 8:00	33.3	22.2	18.5	20.0	33.7	32.8	19.6	28.9
8:00 to 9:00	28.6	66.6	54.1	33.3	16.7	23.9	45.5	21.1
9:00 to 10:00	14.3	5.6	10.5	13.3	5.3	5.3	9.8	10.5
10:00 to 2:00	9.5	-	7.3	26.7	5.3	3.5	9.8	13.2
2:00 to 6:00	2.4	-	3.2	6.7	8.8	10.6	4.9	15.8
After 6:00	2.4	5.6	0.8	-	3.6	2.7	1.2	-

*Not statistically accurate due to sample size.

TABLE 3-14 DISTRIBUTION OF NUMBER OF PERSONS ON WORK TRIPS

	Columbus			Denver			Huntington Beach			Philadelphia			All Cities		
	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk	Auto Driver	Auto Pass	Bike Walk
Traveled Alone	85.8	8.3	100.0	87.4	3.9	90.6	86.9	6.1	100.0	76.2	5.6	89.2	85.8	6.2	91.0
With one Person	11.2	69.5	-	10.2	73.2	9.4	10.7	66.6	-	19.0	33.3	10.1	11.4	63.7	8.5
With two Persons	2.1	19.4	-	1.4	11.5	-	1.2	15.2	-	4.8	33.3	-	1.8	18.6	-
With three or More Persons	0.3	2.8	-	1.0	11.5	-	0.9	9.1	-	-	27.8	-	0.7	10.6	-

TABLE 3-15 MONTHLY NORMAL TEMPERATURE AND PRECIPITATION

	Austin, Texas (San Antonio)		Columbus (Indianapolis)		Denver		Huntington Beach California (Los Angeles)		Philadelphia Pennsylvania	
	Temperature (F^{O})	Precipitation*	Temperature (F^{O})	Precipitation	Temperature (F^{O})	Precipitation	Temperature (F^{O})	Precipitation	Temperature (F^{O})	Precipitation
January	51	1.7	28	2.9	30	0.6	57	3.0	34	3.9
February	55	2.1	31	2.4	33	0.7	48	2.8	34	3.0
March	61	1.5	40	3.8	37	1.2	59	2.2	47	3.5
April	70	2.5	52	3.9	48	1.9	6.2	1.3	53	6.7
May	76	3.1	62	4.1	57	2.6	65	0.1	60	4.1
June	82	2.8	72	4.2	66	1.9	68	L	75	7.9
July	84	1.7	75	3.7	73	1.8	73	L	78	2.4
August	85	2.4	73	2.8	72	1.3	74	L	79	2.0
September	79	3.7	66	2.9	63	1.1	73	0.2	71	3.4
October	71	2.8	56	2.5	52	1.1	68	0.3	59	2.2
November	60	1.8	42	3.1	39	0.8	63	2.0	48	0.6
December	53	1.5	31	2.7	33	0.4	58	2.2	39	6.3

Source: National Climatic Center, NOAA, Department of Commerce (These normals are based on records from 1941 to 1970).

*Precipitation in inches.
L = Less than .05 inch

TABLE 3-16 ANNUAL CLIMATIC DATA

City	Mean Number of Days/Year			
	Clear	Cloudy	Partly Cloudy	Precipitation (0.01" or more)
Los Angeles (34 years)	185	74	106	34
Denver (42 years)	115	119	131	87
Indianapolis (45 years)	90	174	101	123
Philadelphia (36 years)	92	160	113	115
Austin (35 years)	115	134	116	82

Source: Comparative Climatic Data through 1976. U.S. Department of Commerce, April 1977. (1976 data was most recent data available).

vulnerability to inclement weather as revealed by the attribute ratings. The climatic data recorded here are not used to calculate the effect of weather, but instead are presented for the convenience of the reader who might want to compare other geographic areas with the five cities surveyed.

Mode Choice and Mode Preference

To determine how users evaluate the transportation services available to them, respondents to the survey were asked to indicate the choice of mode on their last trip, and to rank their preferences for the modes as well. Table 3-17 shows the percent of respondents choosing each mode as well as the percent that ranked each mode as their most preferred.

Modes Chosen—With some interesting exceptions, the results of the survey show, not surprisingly, that auto is used as the primary mode for work and shopping/personal business trips. The exceptions are the areas surveyed in Philadelphia (Society Hill and Rittenhouse neighborhoods) where 35 percent of the work trip respondents and 63 percent of the shopping/personal business trip respondents walked to their destination. This outcome is likely to be related to the availability of shopping/personal business and work opportunities within reasonable walking distances from home. As one might expect, the other exception is the area surrounding the University of Texas in Austin where walk trips accounted for 23 percent of the shopping/personal business responses and 36 percent of the school trips. Given the concentration of students around the University area, it is not surprising that 51 percent of the respondents to the school trip survey used non-motorized means for their trips. Austin also exhibits a significant amount of bicycling for school trips but has a low share of shopping and personal business trips (work trips were not surveyed). A significant number of shopping/personal business trips in the Denver site are also made by walking (13 percent).

Despite the large number of bicycles per household found in Huntington Beach (2.2 bikes/household) few utilitarian trips were made using bicycles. It appears that bicycles are being used, for the most part, for recreation and school trips (grade and high school).

TABLE 3-17 SUMMARY OF MODES CHOSEN AND PREFERRED MODES (PERCENT)

	Auto		Walk		Transit		Bicycle		Other[b]	No
	Chosen	Pref.	Chosen	Pref.	Chosen	Pref.	Chosen	Pref.	Chosen	Response
Austin										
School[a]	18	26	36	28	28	19	15	25	3	2
Shopping/Personal Business (P.B.)	64	62	23	19	6	5	6	14	1	-
Columbus										
Work	91	86	4	6	1	2	1	4	3	2
Shopping/P.B.	87	86	7	5	2	2	1	4	3	3
Denver										
Work	80	74	4	6	10	8	4	10	2	2
Shopping/P.B.	74	73	13	11	10	8	2	6	1	2
Huntington Beach										
Work	92	89	2	3	1	4	1	4	3	-
Shopping/P.B.	90	90	6	5	1	1	2	4	1	-
Philadelphia										
Work	29	34	35	44	26	10	4	9	6	3
Shopping/P.B.	16	24	63	60	13	8	2	7	6	1
Total										
Work	75	72	11	14	9	6	3	7	2	1
Shopping/P.B.	68	69	21	18	6	5	3	7	2	1
School	18	26	36	28	28	19	15	25	3	2

[a] Survey of school trips was done in Austin only.
[b] Respondents were asked to rank preference for the four modes indicated.

Sizable transit usage was found in Austin for school trips (28 percent), in Philadelphia both for work trips (26 percent) and for shopping/personal business trips (13 percent), and in Denver, where 10 percent of work and 10 percent of shopping/personal business respondents used transit to reach their destination. Huntington Beach exhibits the highest percent of respondents using auto for their trips. This is a reflection of the fact that they are a suburban community which depends on the automobile heavily. The survey shows that 80 percent of the shopping/personal business survey respondents and 63 percent of the work survey respondents fulfill their needs outside of Huntington Beach. This result is consistent with the fact that they have the highest auto ownership per household and per licensed driver among the areas surveyed (2.3 and 1.0 respectively). Columbus closely parallels Huntington Beach. The largest difference between the two areas is the number of respondents who walk to work: 6 percent in Columbus versus 3 percent in Huntington Beach.

Comparison of Chosen Modes to Preferred Modes—Among the many factors that affect the choice of mode for a given trip, one has to do with the degree to which the individual is captive of a particular mode of travel. Some persons who currently walk might do so because an automobile is not available to them; or some auto users might drive because the trip length or the need for sharing a ride prevent them from using a bicycle. The extent to which choice and preference differ is an indication of the potential for mode shift that might be accomplished if conditions were to change, or if the chosen mode attributes were to be modified. Several observations can be made about the comparison of chosen and preferred modes shown in Table 3-17.

Preference is a good indicator of choice. For example, 72 percent of respondents would prefer auto for their trip to work and 75 percent actually do choose auto, similarly, 18 percent would prefer to walk to their shopping destinations and 21 percent in fact walk. Using similar survey techniques, Koppelman, Hauser and Tybout have reached similar conclusions regarding the relationship between mode preference and choice (11). However, not everyone chooses the preferred mode. For example, overall, 14 percent of respondents identified walk as their first preference, yet only 11% actually used it. In fact, in areas of high auto usage (Columbus, Denver and Huntington Beach) a lower number of respondents indicate auto as their preferred mode than actually choose it. In areas of low auto usage or, conversely, of high transit and walking activity (Austin, Philadelphia) a higher number of people show auto as their preferred mode than actually choose it. On the other hand, fewer respondents show walk and transit as their preferred modes than are currently using them. Of all modes, bicycle is the only one for which preference is consistently greather than choice. This is true regardless of the current level of bicycle use, or the purpose of the trip, or the site surveyed. This finding regarding bicycling is probably related to the fact that this mode is perceived to be a source of needed excercise.

The above findings seem to indicate that, as a result of mode availability and individual circumstances, there are a certain number of captive users associated with auto, walk and transit. Policy makers could benefit from the knowledge of the conditions that would bring people's use of bicycle for utilitarian trips more in line with their indicated preference for bicycling. (See discussion in Chapter 4).

Consumer Response to Strategies for Increasing Non-Motorized Travel--Ranking of Modes

In keeping with the fundamental objective of the study, which was to identify the types of demand incentives that can be applied to increase the levels of walking and bicycling, a series of strategies were identified early in the course of this study that were considered--a priori-- to contain many of the important factors that can explain potential shifts to non-motorized modes. Because of questionnaire length and time constraints, the strategies tested in the survey were limited to the following:

- Encouragement of self-contained development where trip generators are in relatively close proximity to each other ("compact land use"). Also tested with this strategy were lowering of speed limits and reduction of parking space availability.

- Provision of improved bicycle facilities (bikeways, bicycle lanes, ancillary bicycle facilities).

- Provision of improved pedestrian facilities (sidewalks, pathways, ancillary facilities).

- Implementation of pricing mechanism to discourage vehicular traffic in the downtown areas during peak periods ("congestion fee"). Availability of flexible work hours was also tested concurrently with the "congestion fee" strategy.

- Increases in fuel prices. Fuel price increases were tested alone as well as in combination with the above strategies.

As previously indicated, subsequent social and economic changes may affect the interpretation of some of the results of the study.

The major strategies tested were presented in the form of "stretcher" scenarios. This technique, described by Urban and Hauser (12), involves brief descriptions of hypothetical scenarios for the range of new transportation alternatives. It should be pointed out that although the concept statements might not be representative of widespread facilities or policies, it is possible to find, at home and abroad, similar conditions in existence. With consumer preference responses to the stretcher scenarios, it is possible to interpolate consumer preferences to alternative future conditions that lie between current conditions and the stretchers, rather than merely extrapolating from current conditions.

After describing each of the strategies listed above, respondents were asked to rank order their preference for the four modes examined. The changes in preference can be interpreted as the result of people's rearrangement of their perceptions of the attributes of the various modes in response to the innovations. A common finding in attitudinal studies is that stated intentions or preferences do not always agree with subsequent behavior (13). In fact, stated preferences have tended to overestimate actual mode shifts (14). Therefore, the responses should be interpreted as indicative of the relative shifts that might be accomplished when comparing alternate strategies. The absolute value of the resulting shift to non-motorized modes not only represents extreme values attainable only under the hypothetical conditions described in the statement, but may also include an overestimate of actual shifts due to the inability of respondents to predict future behavior accurately. Development of perception and preference models in the next chapter provide a truer measure of the magnitude of modal shifts that can realistically be expected to occur.

Each scenario will be described next, followed by an analysis of their effect on modal preference, where effects are measured in terms of the degree of change from present preferences. The description of the first concept statement read as follows:

COMPACT LAND USE SCENARIO

"Many planners maintain that the use of automobiles has greatly increased the levels of air pollution, energy consumption, traffic congestion, and costly street and highway expenditures. It has been suggested that in order to reduce these problems, people must live nearer to their places of employment, shopping, school, and recreation.

Some communities have been designed with this compact land-use arrangement in mind. Their layout is such that most shopping and personal business trips can be accommodated within a six-block (1/2 mile) distance and most work trips are within two miles of home.

Suppose you live in or moved to one such community. Suppose further that special bicycle paths and pedestrian pathways are provided so that it is possible to walk or bicycle to all shopping and personal business destinations without having to cross streets that carry heavy motor vehicle traffic; bicycle storing and lock-up facilities are provided in large numbers, free of charge, throughout the area; convenient bus service is available; and there are no special restrictions on the use of automobiles."

This statement contains two major elements which explain why such a scenario is responsible for the highest shifts from the automobile to walking and bicycling (see Table 3-18). These two elements are (1) "acceptable" distances for walking and bicycling, and (2) walking and bicycling facilities separated from motorized traffic. This separation carries with it the connotation of increased safety.

As can be seen from Figure 3-1 and Table 3-18, there is a significant reduction in the number of respondents that select auto as their preferred mode (although not shown, the shift is particularly dramatic for Denver, Columbus and Huntington Beach; moreover, even in Philadelphia, where auto usage is relatively low, the shift in preference from auto to non-motorized modes is appreciable).[1]

Although these results might seem unrealistic at first glance, it should be noted that, at present, the neighborhoods surveyed in Philadelphia--both of which exhibit short walk distance to the employment center, and extensive sidewalk network, such as described in the land use statement given--show a significant amount of walking activity. In these neighborhoods, approximately 40 percent of respondents to the work survey, and 65 percent of the respondents to the shopping/personal business survey, walked to their destination. The 1970 census shows that 44% of those who work in Center City live within 6 miles (9.6 km) of City Hall, 30% live within 4 miles (6.4 km), and 14% live within 2 miles (3.2 km). A survey conducted in 1973 indicated that assuming bike lanes and bike parking were available, 38% of bicycle owners and 17% of non-owners would commute to work by bicycle (15). This result is consistent with our survey which shows approximately a 30% preference level for bicycle under the compact land use scenario--which includes bicycle paths and lanes as well as parking facilities. The importance of bicycle facilities for attracting utilitarian trips, when provided in connection with specific

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[1] A set of figures has been prepared for all areas and trip purposes to illustrate changes in preference ranking as a result of the testing of strategies. Several of these figures are shown in this section; the complete set can be found in Appendix B, Volume 2, Appendixes, Report No. FHWA/RD-80/049.

TABLE 3-18 EFFECT OF STRATEGIES ON MODAL PREFERENCE - PERCENTAGE SELECTING MODE

Mode	Present Performance		Improved Pedestrian Facil.		Improved Bicycle Facil.		Congestion Fee of $2.00		Compact Land Use		Increase In Fuel Price ($1.50)	
	Work	Shop/ p.b.[a]	Work	Shop/ p.b.	Work	Shop/ p.b.	Work	Shop/ p.b.	Work	Shop/ p.b.	Work	Shop/ p.b.
Auto	72%	69	52	51	56	56	42	32	23	20	47	36
Walk	14%	18	30	33	17	17	18	28	34	45	16	25
Bicycle	7%	7	10	10	18	21	16	19	33	29	14	13
Transit	6%	5	5	3	5	4	21	17	7	4	12	19

[a] p.b.: personal business trips

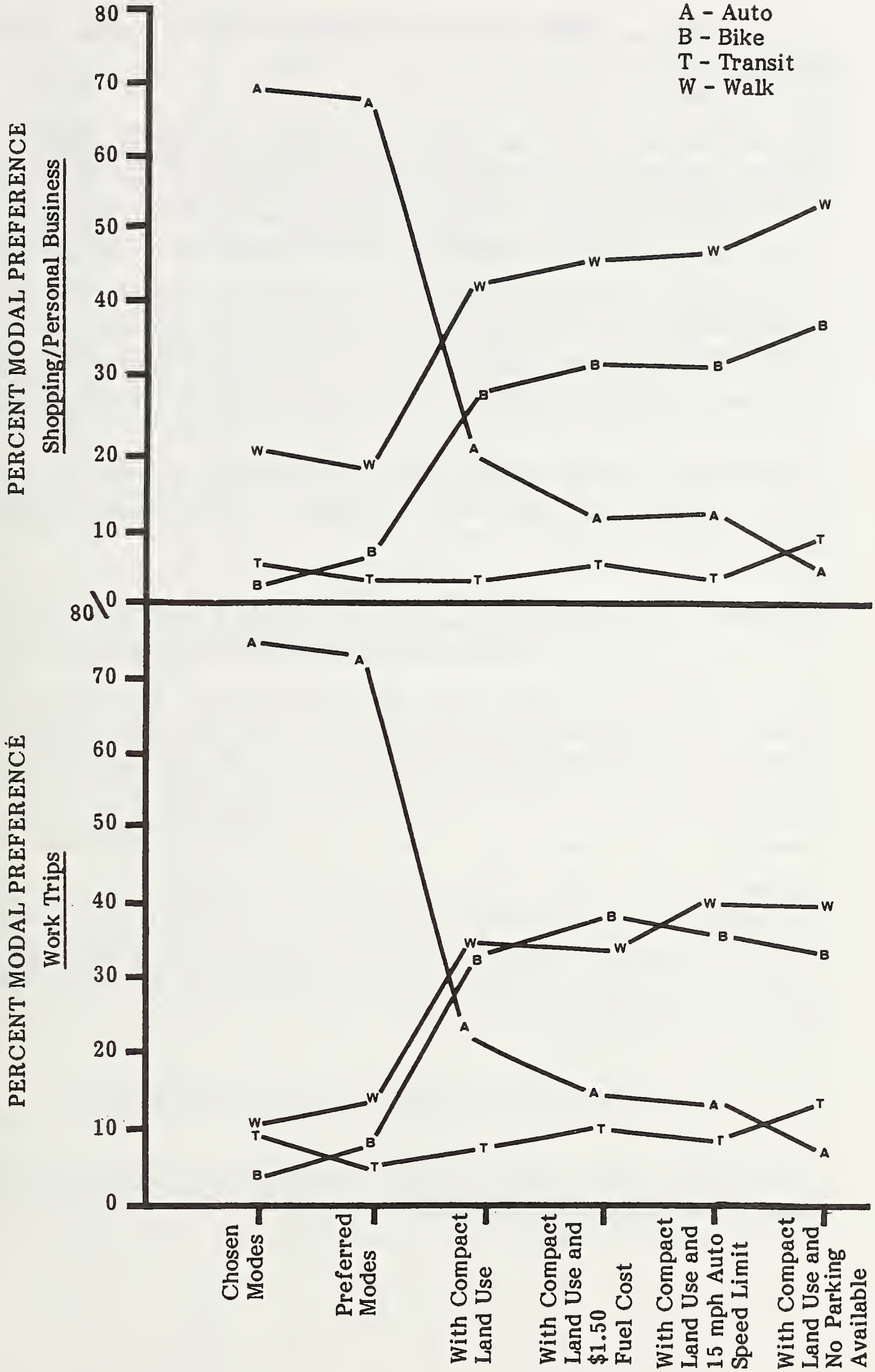


FIGURE 3-1 CHANGE IN MODAL PREFERENCE UNDER COMPACT LAND USE SCENARIO (ALL CITIES)

compact land uses such as university campuses, or central business districts has been recognized and documented widely (16, 17, 18).

Whether changes in land use distribution can be accomplished in areas such as Huntington Beach in order to increase non-motorized level of use significantly, is a matter of further analysis. It appears, however, that residents of the area perceive such arrangements as very conducive to reducing dependence on the automobile. It is interesting to note that in response to the direction to indicate their agreement or disagreement with the statement "I would like to live in this type of community" in reference to the compact land use concept statement, approximately 70 percent of all persons surveyed either agreed or strongly agreed with the above statement.

The simultaneous effect of instituting policies related to fuel price increases, and speed and parking restriction under the compact land use scenario are described next.

The effect on mode shift of combining an increase in fuel price ($1.50 per gallon) with the compact land use scheme is only marginal (see Figure 3-1). Most of the shift is accomplished with the land use concept and only an additional 5 to 10 percent of the respondents indicate that they would shift their preference from auto to non-motorized modes with the juxtaposition of the gas price increase. The superposition of a speed limit of 15 mph upon the compact land use concept has no detectable effect on mode shift. This is probably because, under such a land use arrangement, respondents might reason that trips are quite short and thus attaining high speeds becomes unnecessary. Restricting the availability of parking in the land use arrangement concept causes approximately a 10 percent shift in the number of respondents that select auto as their first preference. This shift is taken up by the remaining modes.

IMPROVEMENT OF BICYCLE FACILITIES SCENARIO

The following concept statement related to improvements in bicycle facilities was included in the survey questionnaire:

Bicycle-Related Facility Improvements

"Suppose the City introduces several improvements to bicycle-related facilities designed to increase the comfort and safety of cyclists. The improvements consist of (1) providing bicycle paths, (2) reserving street lanes for bicycle use, (3) improving road surfaces, (4) installing secure bicycle lock-up facilities in many areas, and (5) providing better lighting.

On most local streets, a yellow stripe is painted near the right-handside of the road marking a lane reserved strictly for bicycle use. Separate bicycle paths are built adjacent to all major roadways. These bicycle paths are separated from automobile traffic by a metal guardrail or a grass median. All these paths and street lanes are smoothly paved for better riding. In addition, high-intensity lights are added along the bikeways to provide excellent visibility at night. A large number of secure bike lock-up facilities are provided and, in high activity areas, these consist of enclosed storage lockers manned by a full-time attendant. Finally, convenient locker, shower and changing facilities are made freely available."

Respondents were then directed to indicate their ranked preference for the four major modes (auto, bicycle, transit and walk). Results are plotted in Figure 3-2. The current mode split (chosen mode) as well as the preferred modes, are also plotted for reference purposes.

On the basis of the concept statement given above, 15 to 20 percent of the respondents shifted their preferred mode from auto to bicycle. The pattern of decreased auto usage and increased bicycle use is consistent, generally, among the areas surveyed. However, it is Austin, which currently exhibits a relatively high level of bicycle use, that appears to have the greatest potential for increased shift to the bicycle (see Figure 3-3). This is clearly a result of the proximity of the University for school trips, the availability of shopping/personal business opportunities nearby and a familiarity of bicycle use at present. The element of social acceptability appears to play an important role in the propensity for increased bicycle use. The relationship between high bicycle use for utilitarian

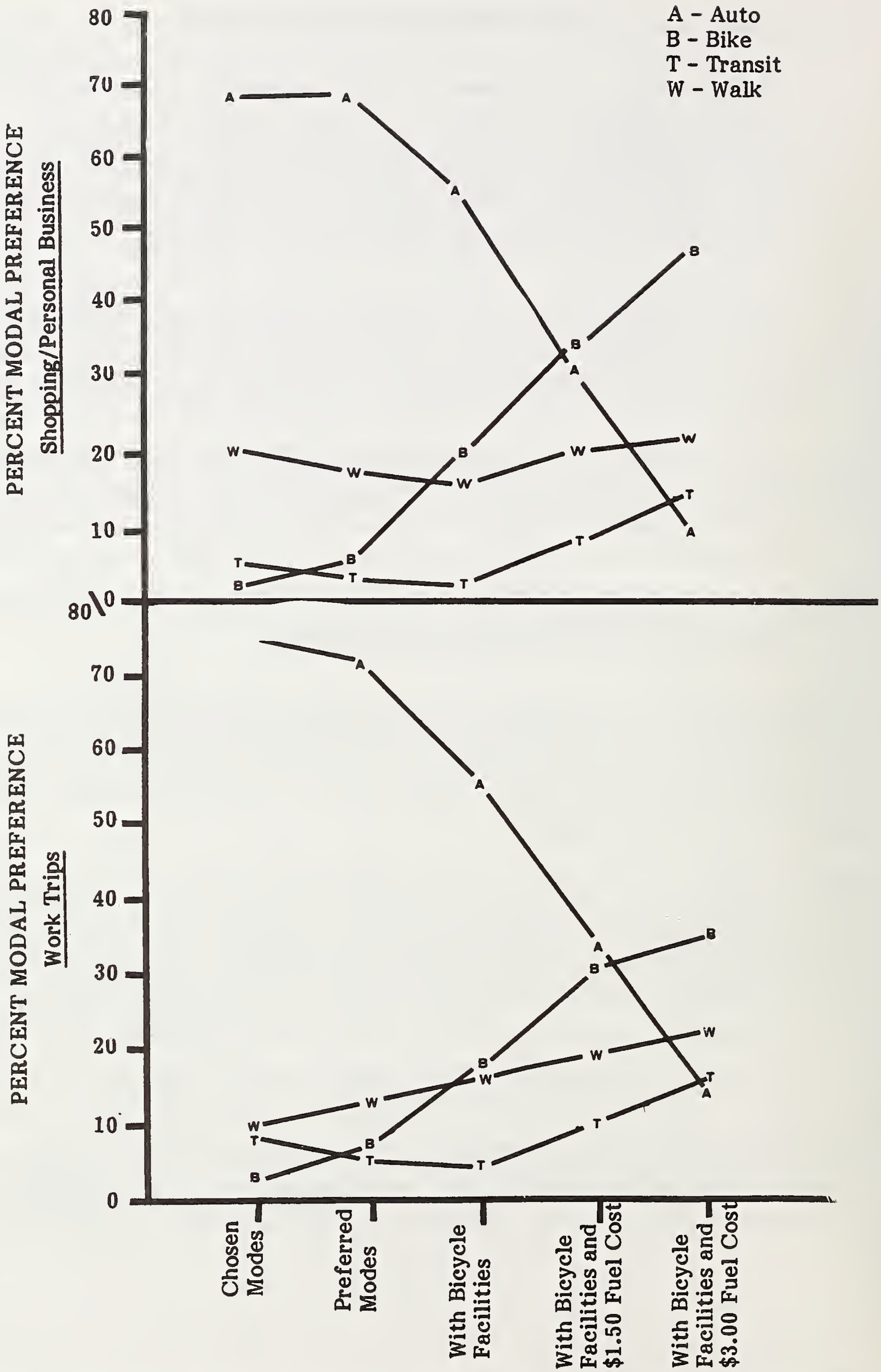


FIGURE 3-2 CHANGE IN MODAL PREFERENCE WITH IMPROVED BICYCLE FACILITIES (ALL CITIES)

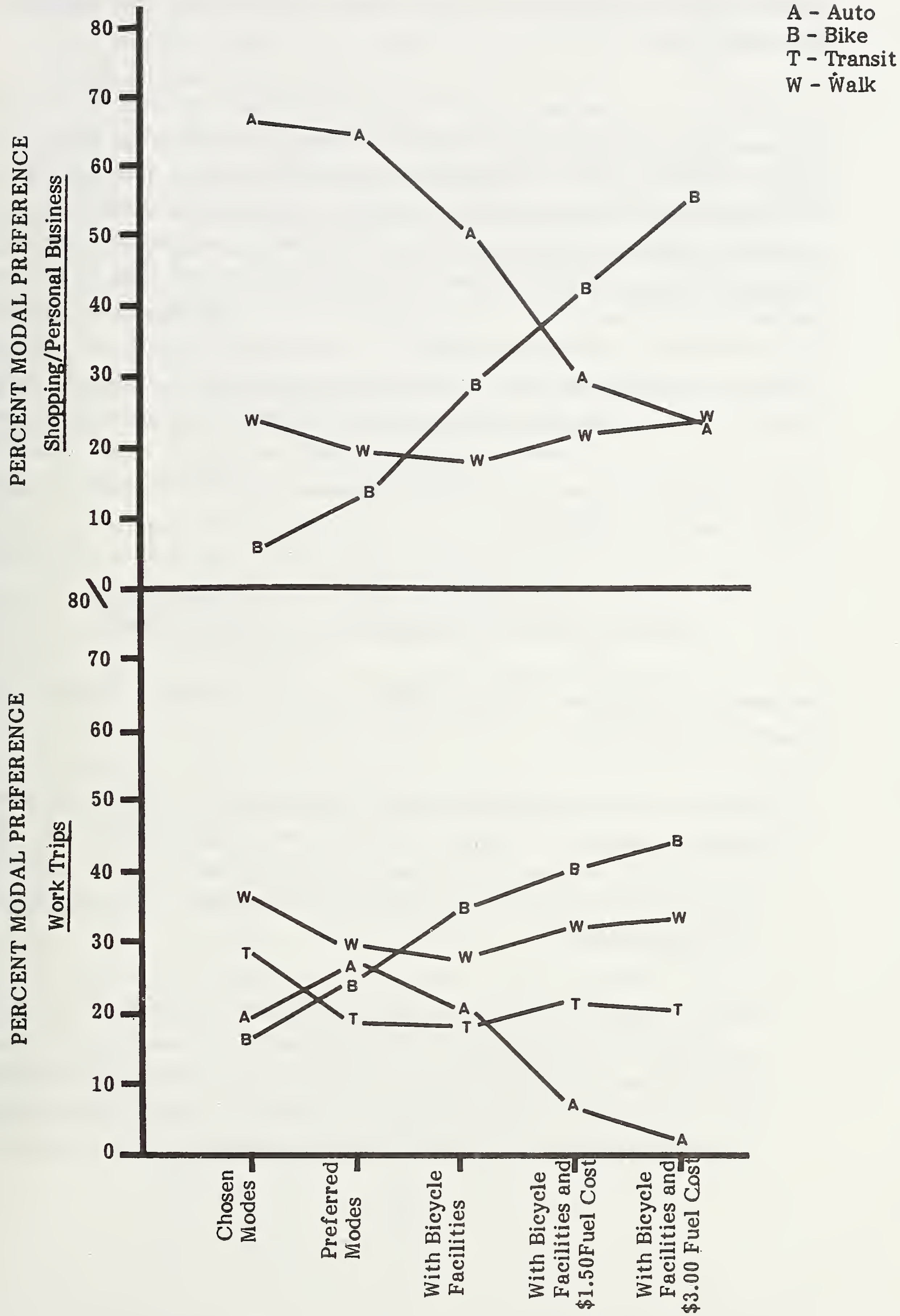


FIGURE 3-3 CHANGE IN MODAL PREFERENCE WITH IMPROVED BICYCLE FACILITIES (AUSTIN)

purposes and the availability of bicycle paths and lanes has been documented previously (5, 19).

To determine the simultaneous effect of bicycle facility improvement and fuel increase, survey participants were asked to repeat the ranking of modes with bicycle facilities in place, but assuming also that the price of fuel increased to $1.50 (a doubling of price) and $3.00 per gallon. The additional burden placed on automobile use by the added fuel cost has the effect of reducing the number of respondents that select auto as their preferred mode. At the $1.50 price level, approximately 25 percent of the respondents to the shopping/personal business survey shifted their preference from auto to other modes (15 percent shifted their preference to bicycle, and the other 10 percent selected walk and transit). On the work trip survey, 20 percent of the respondents shifted their preference to other modes (13 percent to bicycle and 7 percent to walk and transit). Almost identical results are obtained when the fuel price increases to $3.00 per gallon as were obtained above for work trips.

IMPROVEMENT OF PEDESTRIAN FACILITIES SCENARIO

The survey contained the following stretcher scenario related to the improvement of pedestrian facilities:

> "Suppose the City introduces several improvements to pedestrian-related facilities designed to increase the comfort and safety of pedestrians. The improvements consist of: (1) providing pedestrian pathways, (2) improving sidewalks, (3) providing better lighting, and (4) making traffic signals more pedestrian-oriented.
>
> Separate pedestrianways or walkways are built adjacent to all major roadways. These pathways from automobile traffic by trees or grass median. All busy streets crossings, pedestrians will be able to change traffic lights in their favor. All existing sidewalks are repaired to make walking easier. High-intensity lights are added along the pathways to provide excellent

visibility at night. Finally, the walkways are enhanced by the presence of water fountains, shade trees, benches, and pedestrian-oriented stands with flowers, newspapers and refreshments."

Respondents were directed to proceed with the questions related to this statement only if their most recent trip destination was within the distance limit for walking 2 miles (3.2 km) for shopping/personal/business, and 3 miles (4.8 km) for work. The respondents were then asked to rank the four major modes, assuming that the improved pedestrian facilities were in place. The results are plotted in Figure 3-4, and summarized in Table 3-18.

On the average, 15 to 20 percent of those using auto at present indicate that they will switch to walking if the pedestrian facilities are in place.

While differences exist, it is interesting to note the similarity and consistency of response found among the different areas and trip purposes surveyed. In the areas surrounding the University of Texas and in Philadelphia, where there is a significant amount of walking at present, the effect of providing the improved facilities for walking is to shift an additional 15 to 20 percent auto users to walking (see Figure 3-5 for the results in Philadelphia). In contrast, results in Huntington Beach show that only about 5 percent of the auto trips will shift to walking (see Appendix B, Vol. 2, Appendixes, Report No. FHWA-RD-80-049.) As indicated earlier, there is heavy dependency on the automobile in Huntington Beach because of the suburban nature of that area, which no doubt explains in part the low propensity for walking found there. This finding is similar to that encountered for the bicycle facilities scenario: areas showing the highest current level of bicycling also shows the greatest potential for increased bicycling. The corollary is that the greater the level of auto use, the greater will be the tendency for continued auto use. A peculiar finding is that a slight diversion of auto trips to bicycling is observed (in the order of 5 percent), although no specific mention is made of bicycles in the pedestrian facilities concept statement. Apparently some respondents are assuming that the pedestrian paths and ancillary facilities will be available to bicyclists.

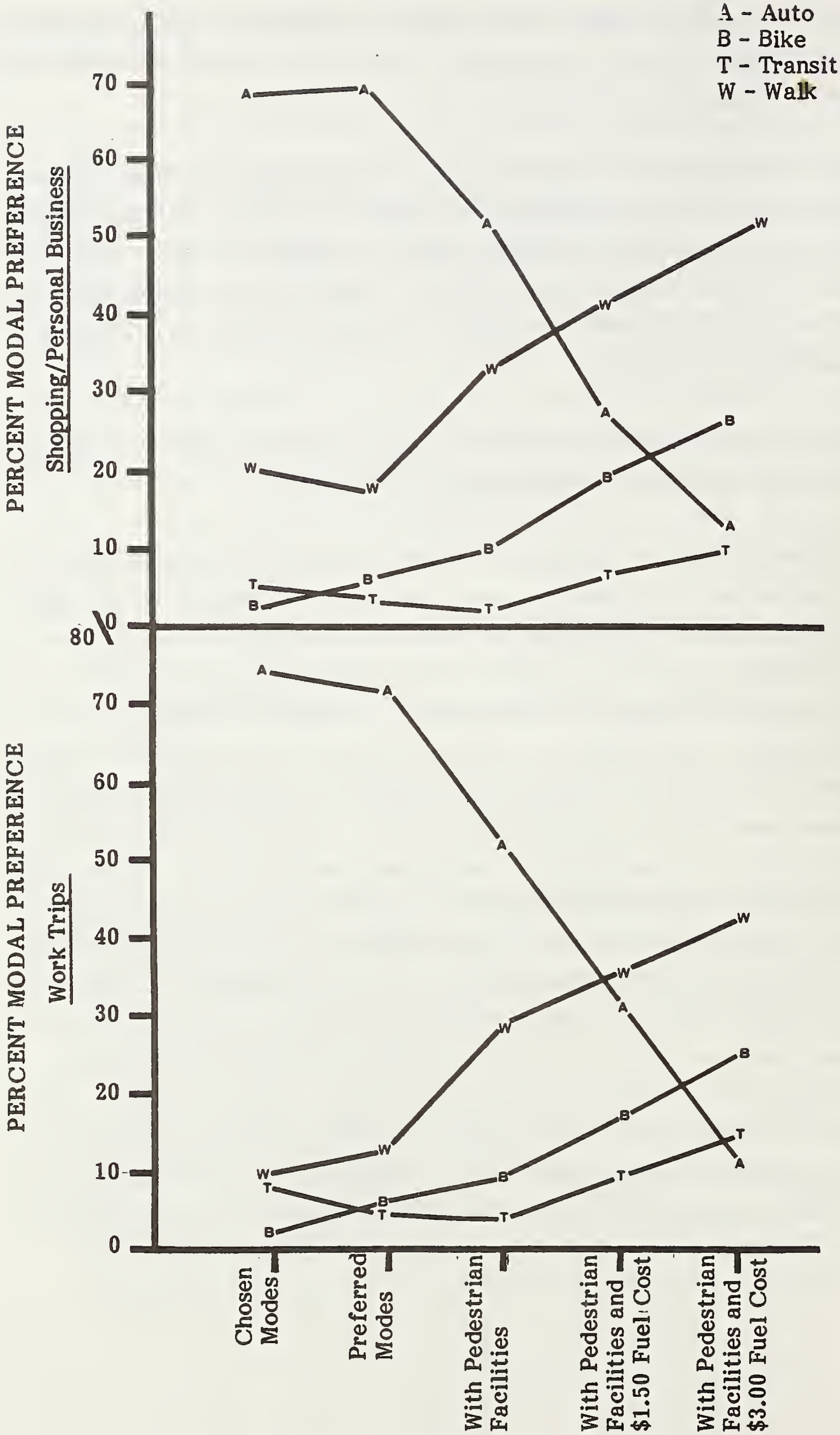


FIGURE 3-4 CHANGE IN PREFERENCE WITH IMPROVED PEDESTRIAN FACILITIES (ALL CITIES)

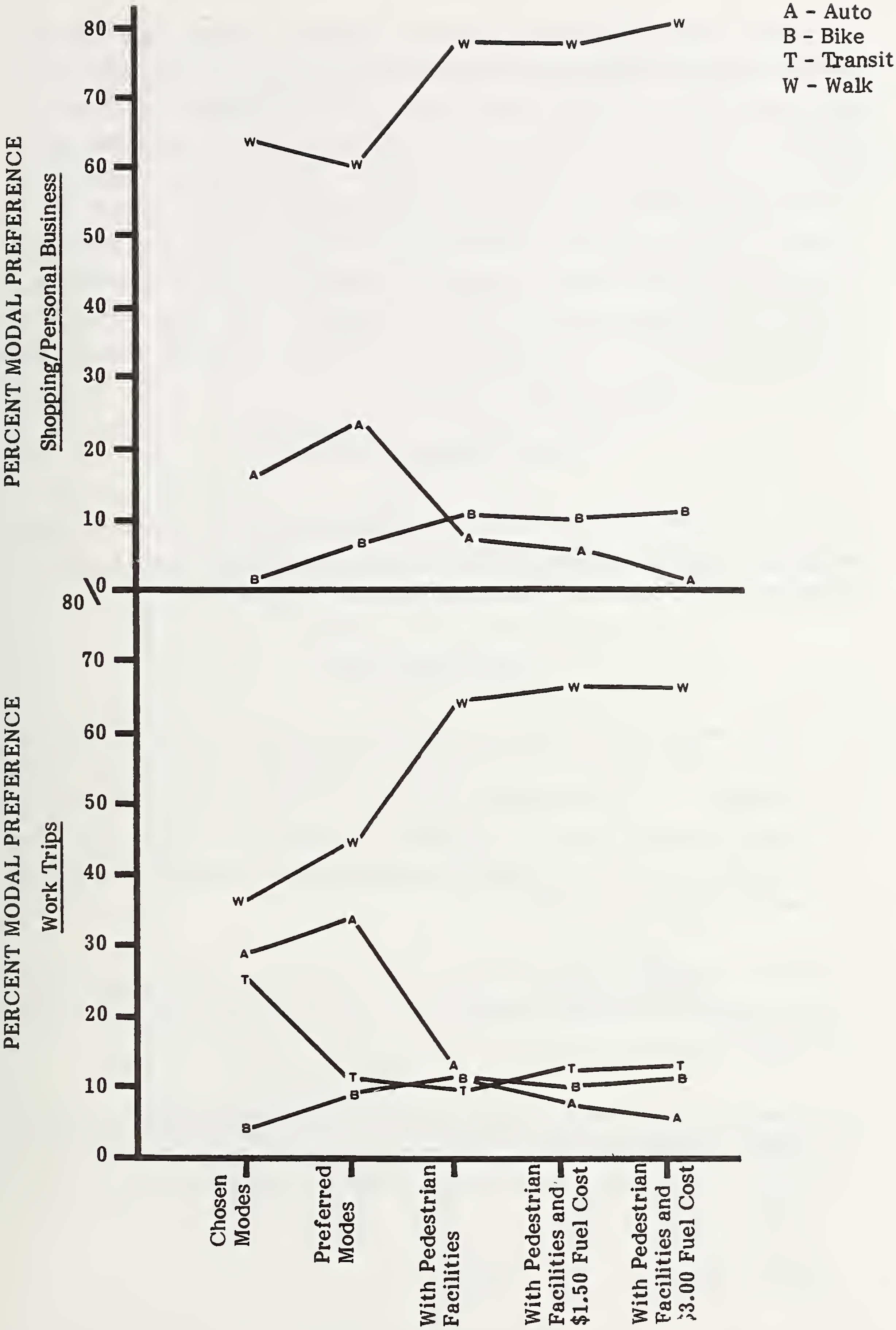


FIGURE 3-5 CHANGE IN MODAL PREFERENCE WITH IMPROVED PEDESTRIAN FACILITIES (PHILADELPHIA)

In general, the simultaneous provision of pedestrian facilities and fuel price increases have the effect of shifting additional trips from auto to all other modes, but particularly to non-motorized modes. Over all areas surveyed, about 20 percent of respondents to the work trip survey shift from auto when fuel price is $1.50 per gallon, and an additional 20 percent shift at $3.00 per gallon. The shopping/personal business survey shows a shift of 25 percent at $1.50 and 15 percent at $3.00 per gallon. These reductions in auto usage are somewhat higher than when fuel pricing alone is tested. The increased fuel price in areas where walking is currently at a high level has a negligible effect upon the amount of walking that is already taking place. Instead, the reduction in auto usage is taken up by increased bicycle and transit usage.

AUTO CONGESTION FEE SCENARIO

In order to test the effect of implementing policies that can act as disincentives to automobile use and thus cause shifts to non-motorized use, the following concept statement was included in the survey questionnaire:

Auto Congestion Fee

> "It is decided that in order to reduce congestion and lower fuel usage, a fee of $1 will be assessed to the owners of automobiles operating during the morning (7-9 a.m.) and evening (4-6 p.m.) rush hours. This means that you would be charged up to a $2.00 per day if you operate a motor vehicle during these peak travel periods. Billing would be made on a monthly basis using an automated billing process."

As with the preceding concept statement, respondents were directed to rank the modes in order of preference. The resulting modal distribution is plotted in Figure 3-6 and summarized in Table 3-18.

The congestion fee strategy has the potential for effecting significant shifts away from auto. A congestion fee of $2.00 per day causes a reduction of 35 percent in the number of respondents that select auto as their preferred alternative. Walk

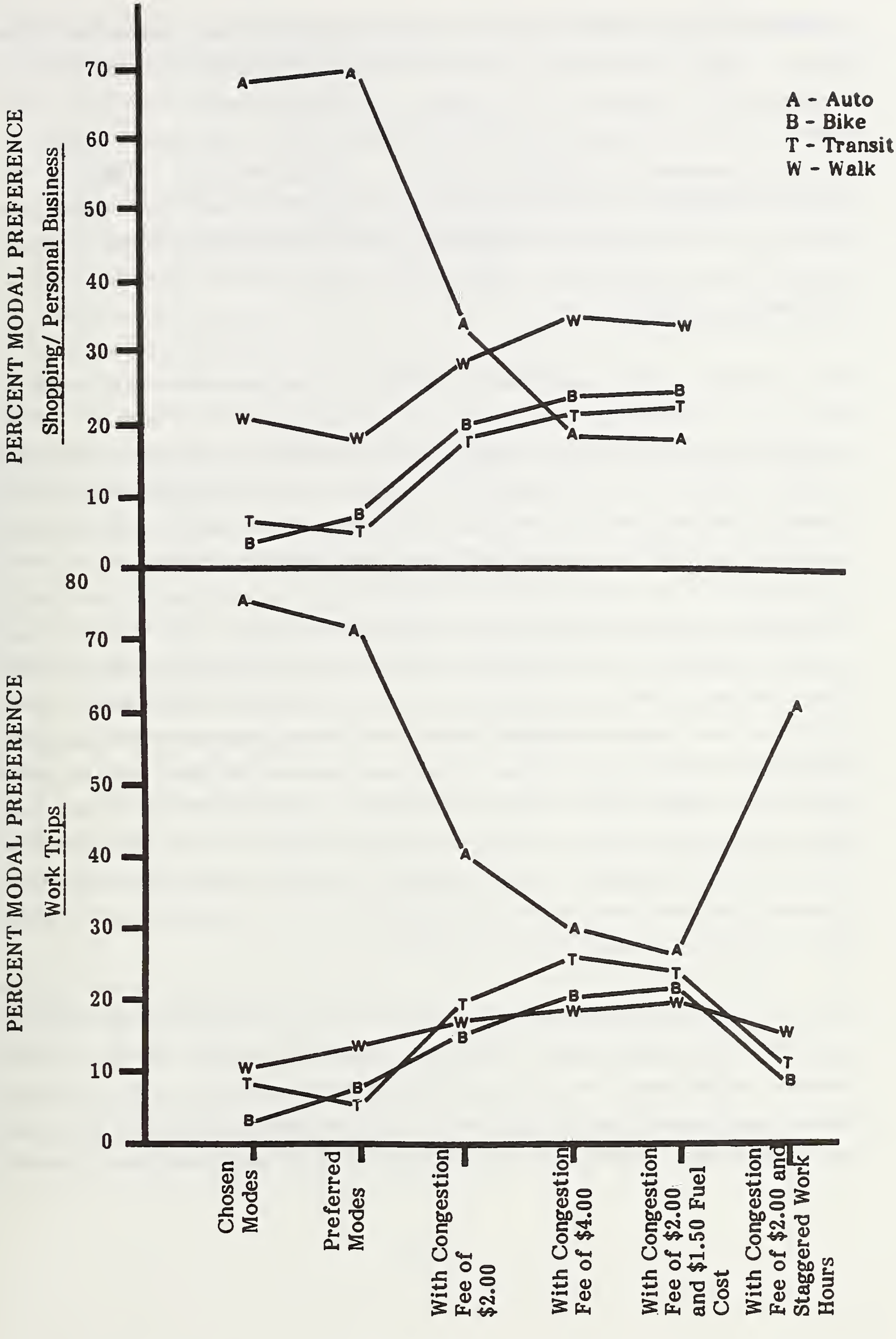


FIGURE 3-6 CHANGE IN MODAL PREFERENCE UNDER CONGESTION FEES SCENERIO (ALL CITIES)

and bicycle take up most of this shift for the shopping/personal business trips; for the work trips, transit takes up half of the shift and the non-motorized modes account for the other half. The pattern of decrease in auto usage due to the congestion fee of $2.00 per day is fairly predictable from area to area except for work trips responses in Huntington Beach. Although about 30 percent of the respondents indicate a shift to another mode, auto still remains the number one preference for 60 percent of the respondents. When the congestion fee is increased to $4.00 per day, an additional 10 percent shift in the number of respondents occurs in all areas surveyed.

When, in addition to the congestion fee of $2.00 per day, an increase in the price of fuel to $1.50 is introduced in the concept statement, the effect on mode shift from auto to other modes is almost negligible. This somewhat unexpected result might be explained by the fact that the level of auto use is already fairly low when the increase in the fuel price is introduced. In order to give respondents an option to avoid the congestion fee assessed during peak hours by either arriving early to work and leaving early or, arriving later and leaving later, they were asked to indicate their ranked modal preferences under a flexible hours scheme. The results, as can be seen in Figure 3-6, indicate that respondents who had shifted from auto to other modes in response to the congestion fee, revert to using their automobiles for their work trips. As a result, the percent of work-trip survey respondents who use their auto increases from 40 percent when the congestion fee of $2.00 is in effect, to 60 percent when flexible work hours are introduced. It is interesting to note that transit which picks up much of the shift away from auto, becomes less attractive when flextime is introduced. This points out the fact that when developing policies to increase non-motorized use, care should be taken to avoid running counter to the positive aspects of existing policies or practices.

It is important to note that the application of an auto "fee" during peak periods is only one method among many which can accomplish similar results. Other measures might involve the institution of parking restriction, tolls, even-odd license plates for every-other-day access, or license stickers (20). The latter has been successfully put into operation in Singapore (21). Under this scheme, a special sticker which costs approximately $2.00 daily must be displayed during the morning rush hours within a cordoned area of downtown.

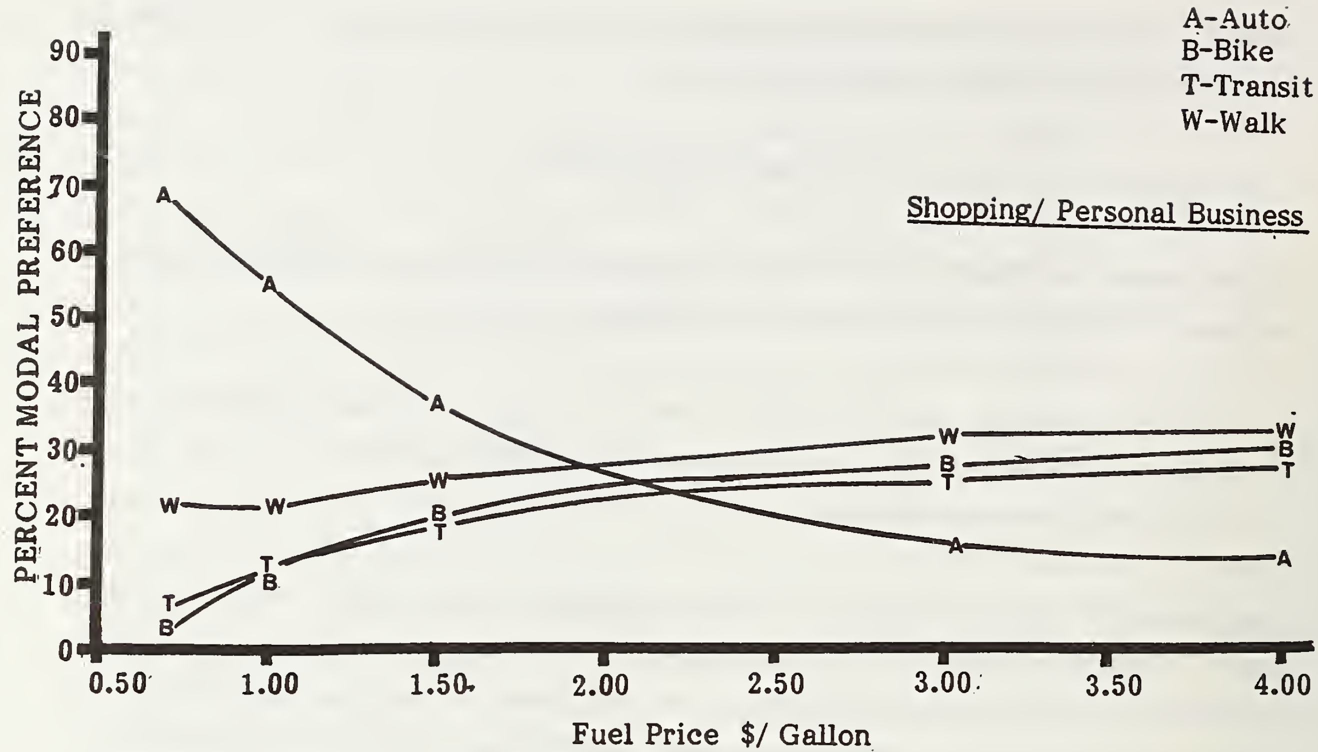
FUEL PRICE INCREASE

To determine the effect that gasoline price increases might have on shifts in modal preference, the following directions were included in the survey:

> "Assume that on your next trip to work all travel conditions remained the same as present except that the price of gasoline increased to one of the price levels indicated below."

Respondents were then directed to rank the specified modes (walk, auto, bicycle transit) from most preferred to least preferred for each of the following price levels: $1.00, $1.50, $3.00 and $4.00 or more per gallon (at the time of the survey gasoline was approximately $0.70 per gallon.) The results are plotted in Figure 3-7.

Given present income levels, the survey indicates decreased auto usage in response to increases in fuel price, both for work and shopping/personal business trips. This is true even in areas where auto use is currently low (Austin school trips and Philadelphia work and shopping/personal business trips) although in these areas the decrease in auto usage is much less pronounced. The decrease in auto use for work trips is lower than for shopping/personal business trips. This was to be expected, and it indicates that a higher priority is placed on work than on non-work, discretionary tripmaking. Fuel price increases have practically no effect on the distribution of trips by mode in Philadelphia areas surveyed. Even at the very highest price level tested ($4.00 or more per gallon) auto work trips in the Huntington Beach precincts still attract more than 35 percent of the trips. For shopping/personal business the percentage is reduced to about 20 percent. It is interesting to observe that auto usage decreases fairly rapidly as fuel price increases up to $2.00 per gallon. After that point, the rate of decrease slows down considerably. The non-motorized modes, on the other hand, show fairly rapid gains up to the $2.00 per gallon price level, and then taper out quite rapidly, suggesting a



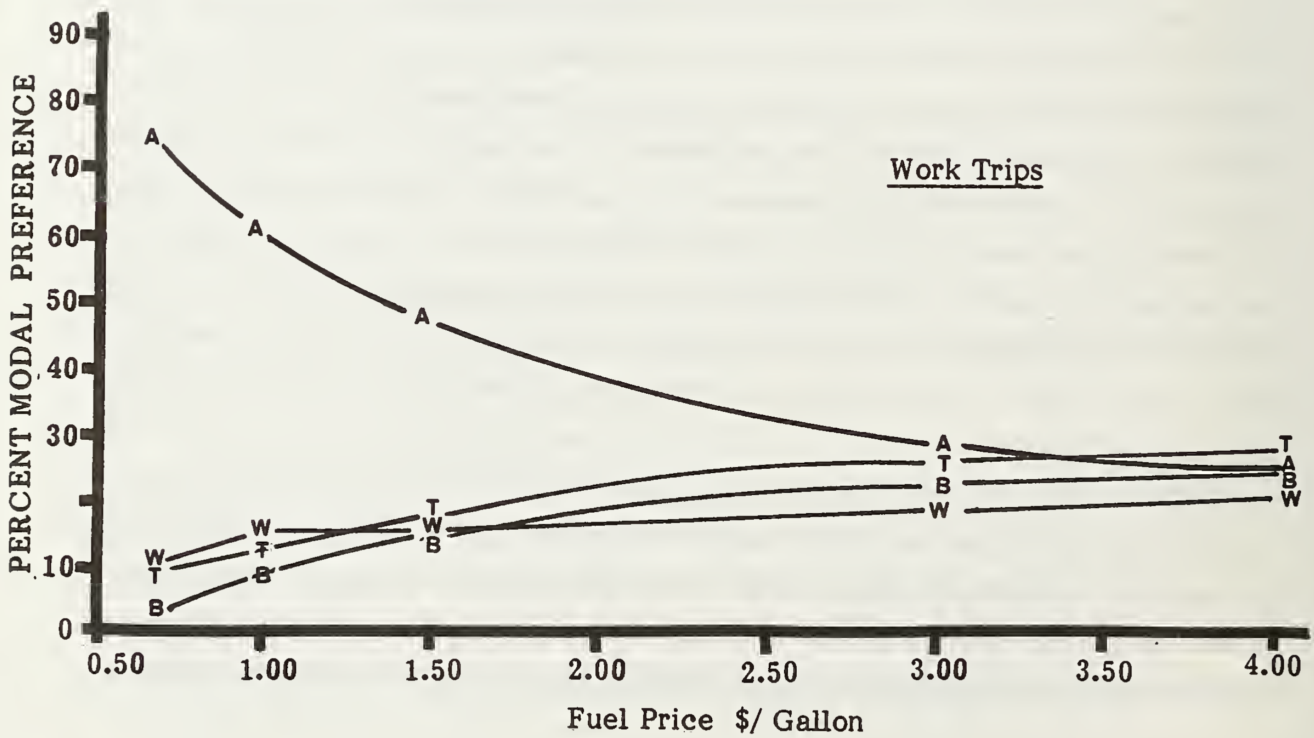


FIGURE 3-7 MODE PREFERENCE VS. FUEL PRICE (ALL CITIES)

plateau. Further increases in the gasoline price beyond this level translate into diminishing gains for non-motorized modes.

A great deal of caution must be exercised when examining the above results. In addition to the uncertainties associated with translating perceptions into preferences, the additional question of timing is critical when discussing demand changes in response to fuel price increases. Whereas respondents generally react to a doubling in the price of fuel by assuming that such increase occurs instantaneously, in reality price increases take place over a period of time, thus giving the consumer time to adjust to the small incremental increases. For this reason, elasticities of demand estimated from the above modal preferences are certain to be considerably greater than would occur under actual conditions.

Rating of Attributes

The ratings of transportation attributes for all modes are examined next. These attribute ratings will be examined further in Chapter 4 when factor analysis will be performed.

Figures 3-8 through 3-19 show the average rating given each attribute for the three trip purposes examined and for the combined data from all areas surveyed. (See Appendix B in Volume 2, Appendixes, Report No. FHWA/RD-80/049, for detailed ratings by area surveyed.) On the left of the figures are shortened versions of the statements describing the attributes. We will examine the ratings of walk and bicycle modes for each trip purpose surveyed, stratified by the mode chosen by the respondent: auto driver and non-motorized. Also, we will compare the ratings of walk and bicycle attributes before and after the improved pedestrian and bicycle facilities are in place.

Rating of Bicycle Before Facility Improvements—Examination of Figures 3-8 through 3-10 shows that there are sharp differences between the manner in which auto drivers and non-motorized users rate bicycle attributes. For all trip purposes surveyed, auto drivers find bicycling more tiring and unable to get them quickly to their destination than do respondents who chose a non-motorized mode on their

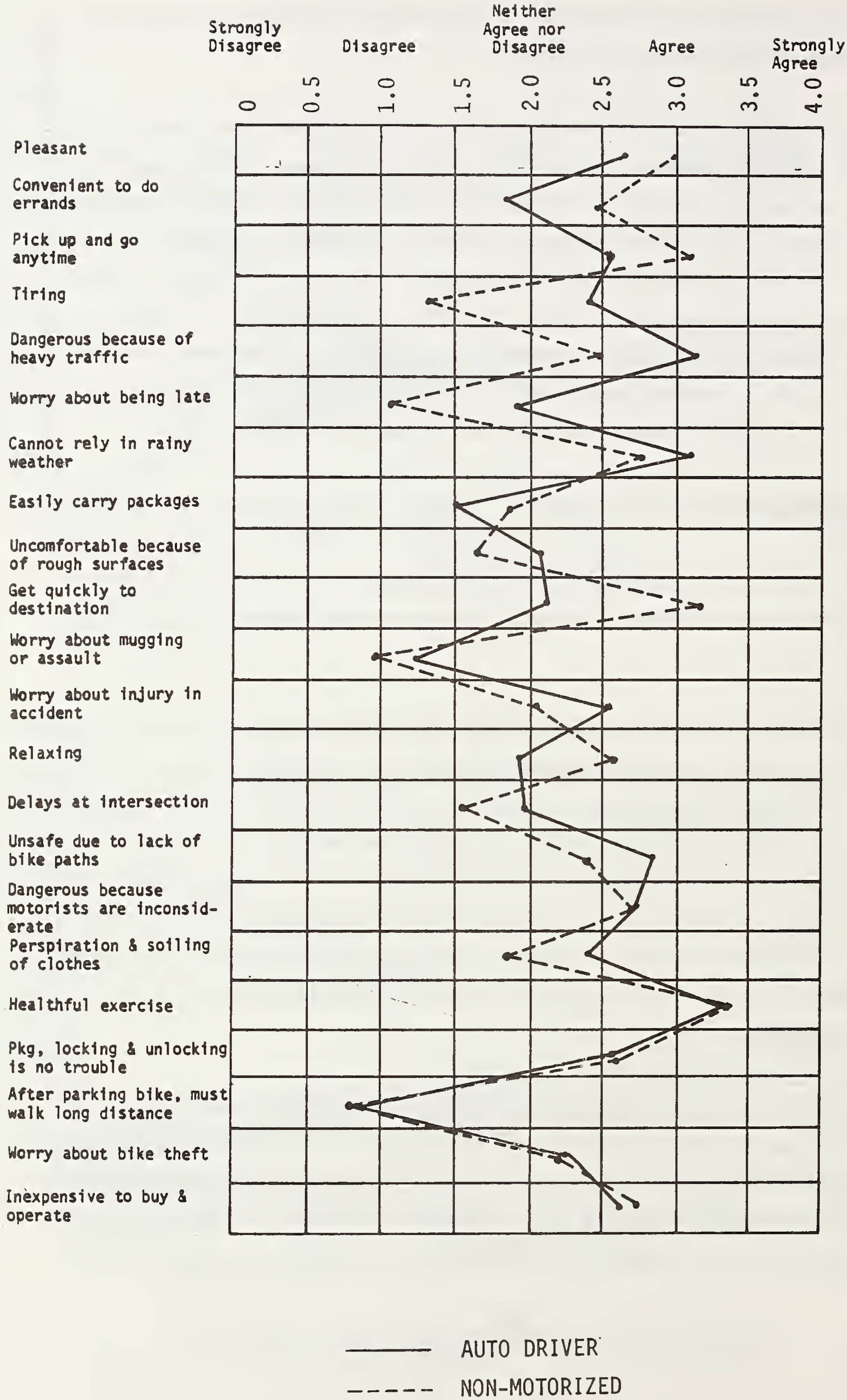


FIGURE 3-8 SCHOOL TRIPS: RATING OF BICYCLE

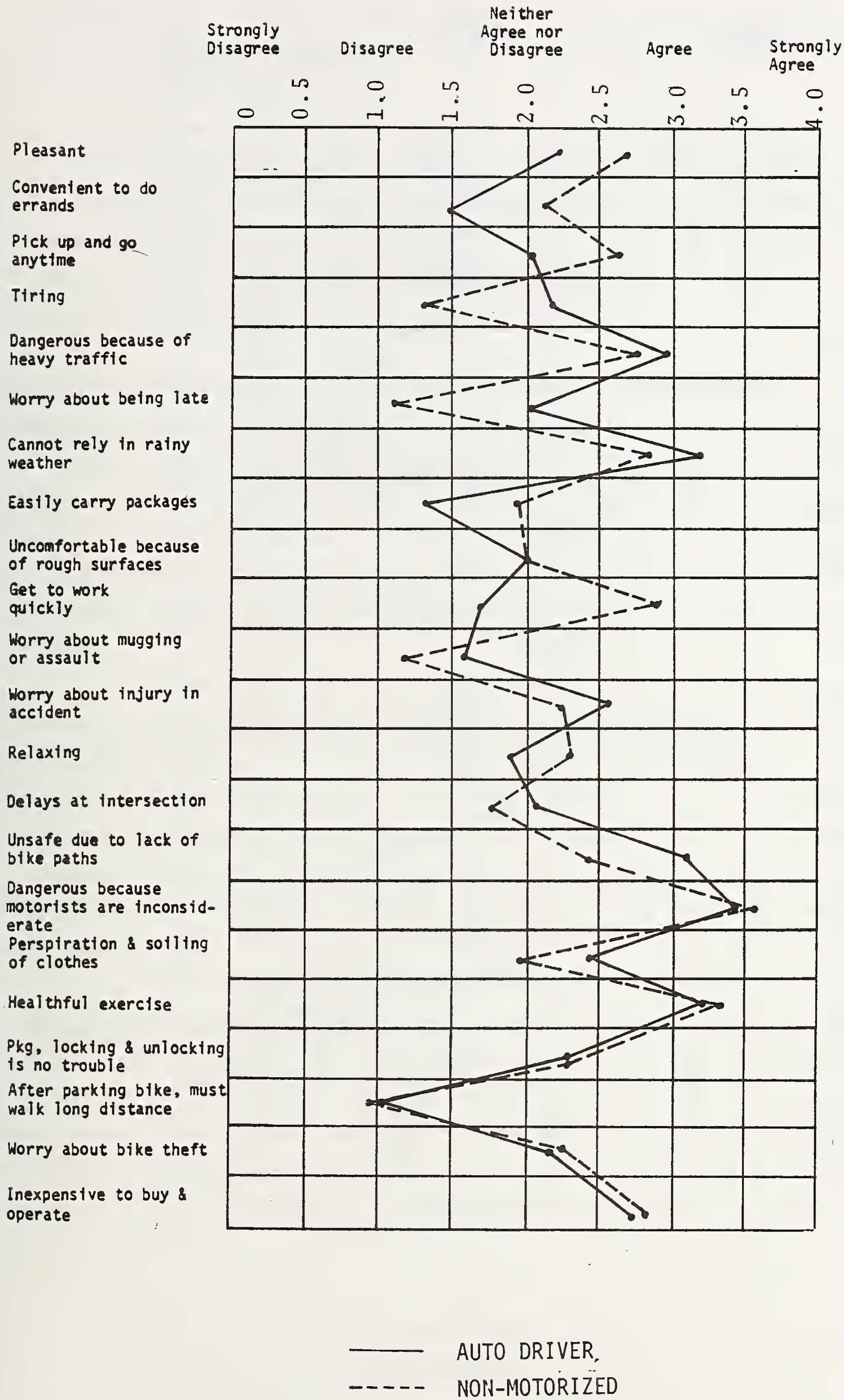


FIGURE 3-9 WORK TRIPS: RATING OF BICYCLE

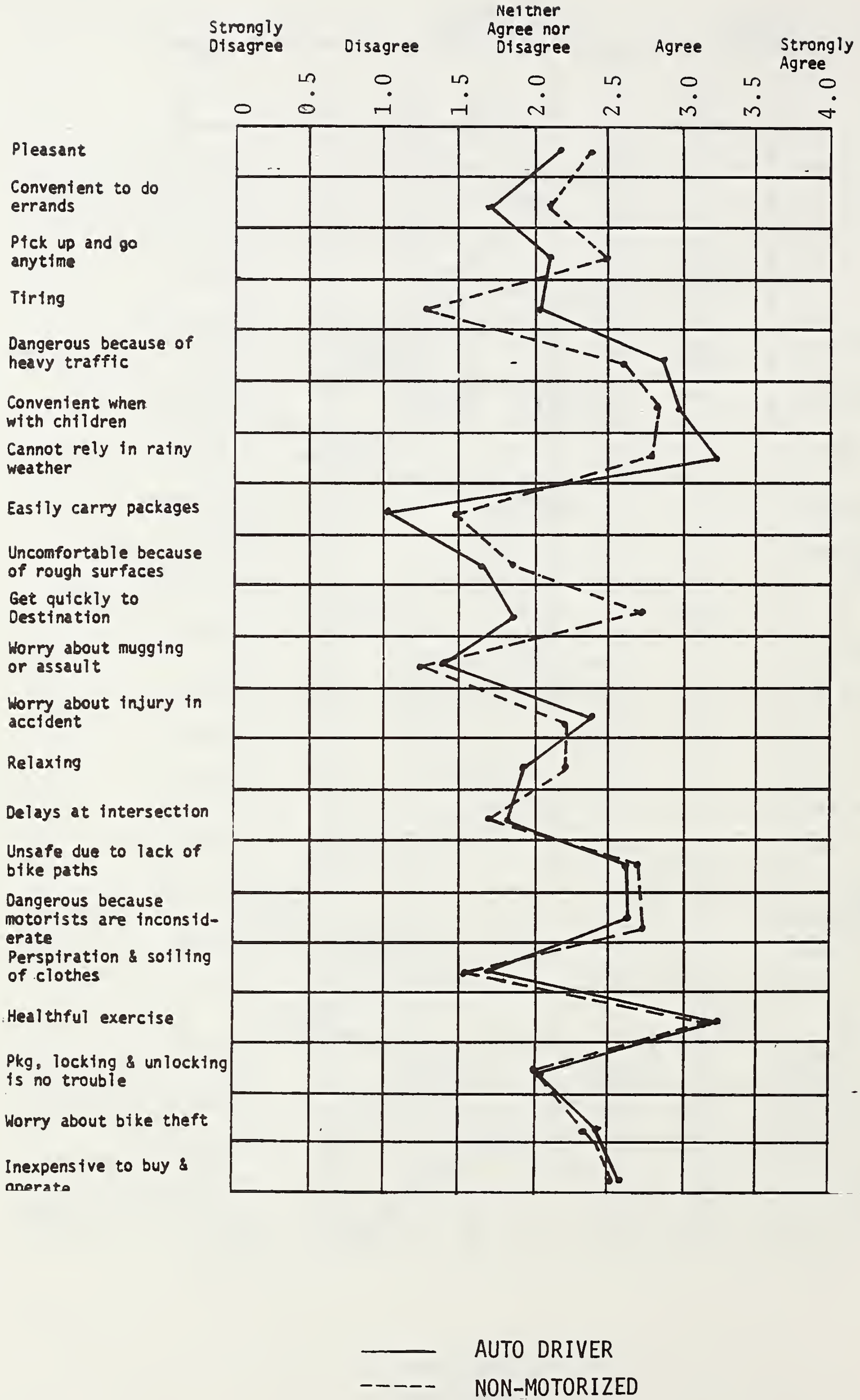


FIGURE 3-10 SHOPPING/PERSONAL BUSINESS: RATING OF BICYCLE

most recent trip. In addition, auto drivers worry about being late if they take a bicycle to work or on shopping/personal business trips; users of non-motorized modes show less concern.

The above phenomenon, indicates a desire to reduce "cognitive dissonance", which suggests that those who choose a particular mode place their mode in a relative advantage to those modes not chosen (22). As a result, the difference in the attribute ratings for the modes are generally larger than they might be if the person were objective about the modes.

Several attributes stand out because they express concern on the part of the consumers. There is general agreement on safety concerns about bicycling because of "heavy traffic", "lack of bicycle paths", because "motorists are inconsiderate". Concerns are also expressed about the inconvenience aspects of bicycling: unreliability in "rainy weather", difficulty in "carrying packages" for shopping. On the other hand there is universal agreement on some of the beneficial aspects of bicycling: "pleasant", provides "healthful exercise", "inexpensive to buy and operate".

The above results begin to suggest the direction that improvements in the bicycling environment must take in order to increase bicycle use: provision of safe-riding bicycle facilities, greater promotion of the beneficial or positive aspects of bicycling. Concerning the disadvantages of bicycling, special raingear can be developed for use in imclement weather; at the same time the ability of the bicyclist to carry packages could be improved by popularizing the use of well designed carriers.

<u>Rating of Walk Before Pedestrian Facility Improvements</u>—Figures 3-11 through 3-13 show the ratings of walk attributes as perceived by users of non-motorized modes and by auto drivers. As can be seen from these figures, the cognitive dissonance effect is more pronounced in the rating of pedestrian transportation attributes than was found in the rating of bicycle. Not only are the differences in rating wider, but the number of attributes affected is greater, as is the variation

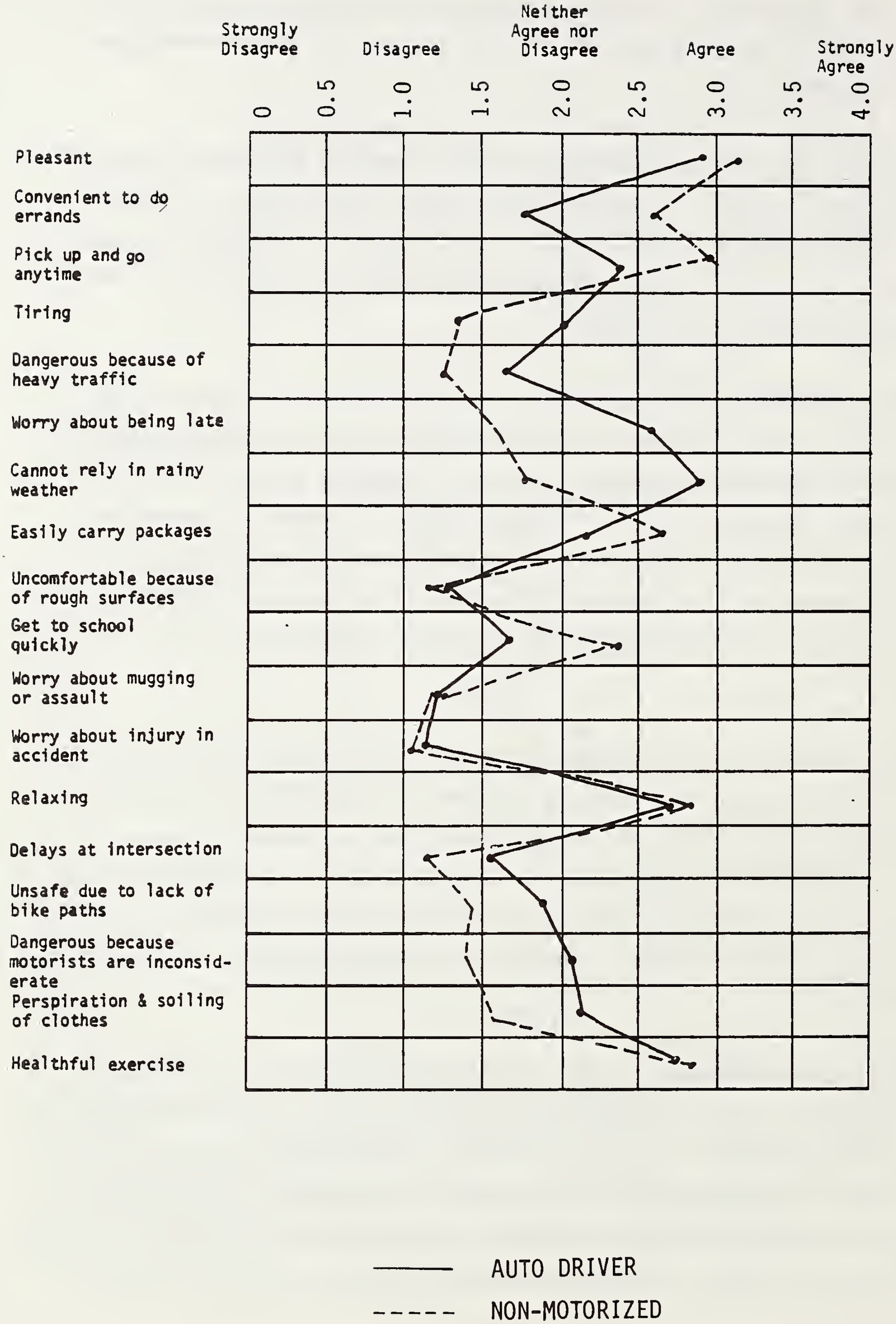


FIGURE 3-11 SCHOOL TRIPS: RATING OF WALK

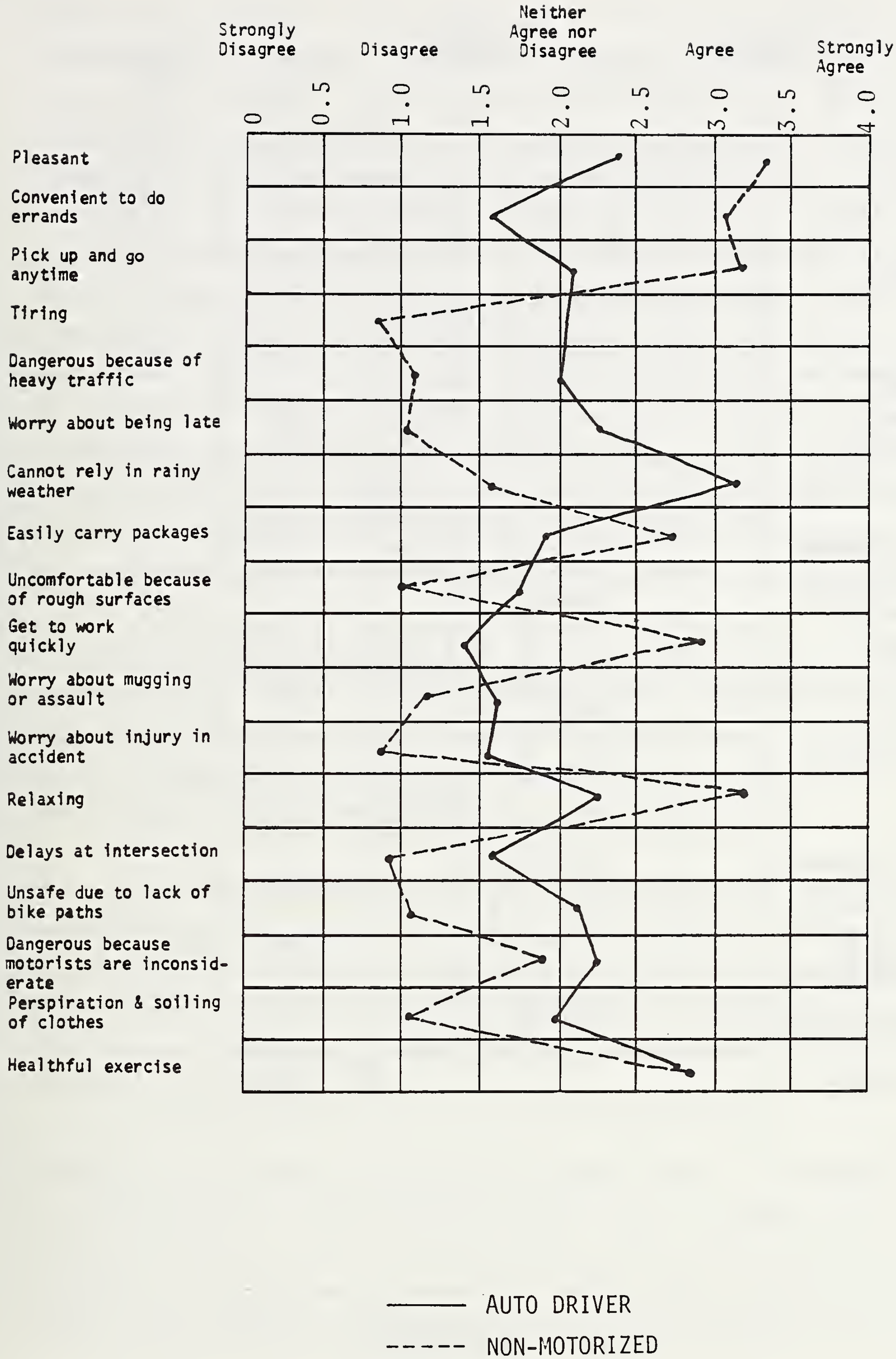


FIGURE 3-12 WORK TRIPS: RATING OF WALK

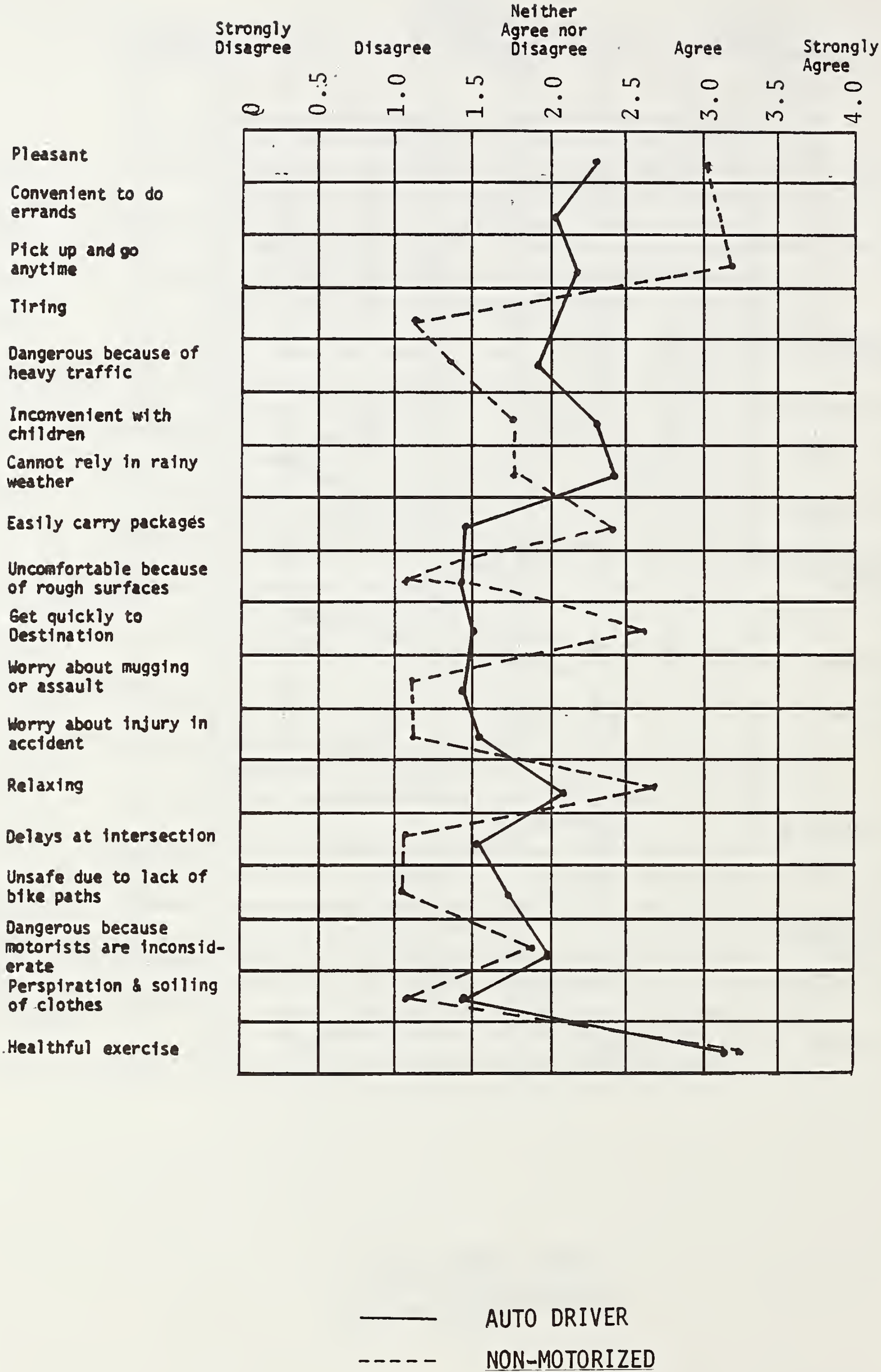


FIGURE 3-13 SHOPPING/PERSONAL BUSINESS: RATING OF WALK

among trip purposes. The disagreements deal with convenience aspects ("convenience to do errands", "pick up and go anytime"), comfort aspects ("cannot rely in rainy weather", "rough surfaces" for trips to work, "tiring", safety ("dangerous because of heavy traffic", "unsafe due to lack of paths", "motorists are inconsiderate"), and time-related convenience ("worry about being late", "getting to destination quickly"). The differences may be due in part to the fact that the average trip length experienced by auto drivers is significantly greater than that of walkers. In the case of shopping/personal business trips these averages are 2.4 miles (3.8 km) and 0.70 miles (1.1 km) respectively. This situation might cause the auto drivers to rate his trip as tiring if he were to walk. The survey design sought to minimize this problem by limiting the responses of auto users to those whose most recent trip was 2 miles or less for shopping trips, and 3 miles (4.8 km) or less for work and school trips. The survey shows that there is a significant difference in the number of packages carried by users of non-motorized modes and auto users. As a result, this will be reflected in questions dealing with convenience aspects.

The ratings made by workers show large differences between auto drivers and non-motorized users. Again, this might be due to a general reluctance on the part of auto drivers to walk to work (as when they neither agree nor disagree with the statement that walking is dangerous due to heavy traffic). On the other hand, their concern about not being able to get to work quickly might be genuine.

In terms of what attributes of walking are seen needing improvement, it varies according to the trip purpose. For school trips, the problem of walking in the rain is expressed as the major concern, especially by auto drivers. Shoppers who currently use motorized modes indicate the problem of getting "quickly to their destination". Workers on the other hand, are concerned about "rain" and getting "quickly to work".

<u>Rating of Bicycle Before and After Improvements</u>—Figures 3-14 through 3-16 show the actual ratings of bicycle attributes before and after improvements, and the absolute differences between the before-after ratings. These figures show that, regardless of trip purpose, the attributes which exhibit the largest change in ratings, after facilities are improved, deal with safety and security. The inclusion

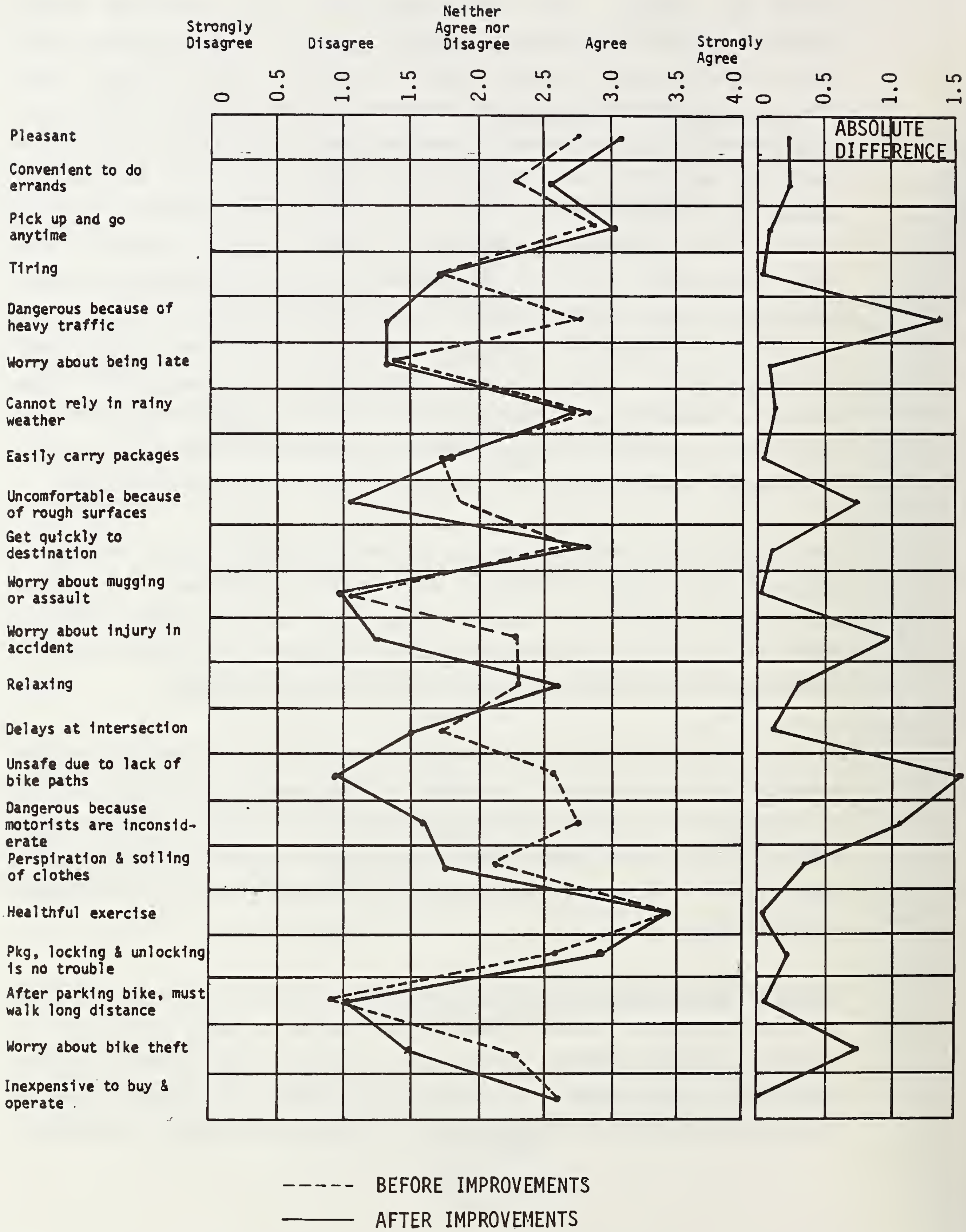


FIGURE 3-14 SCHOOL TRIPS: RATING OF BIKE BEFORE AND AFTER IMPROVEMENTS

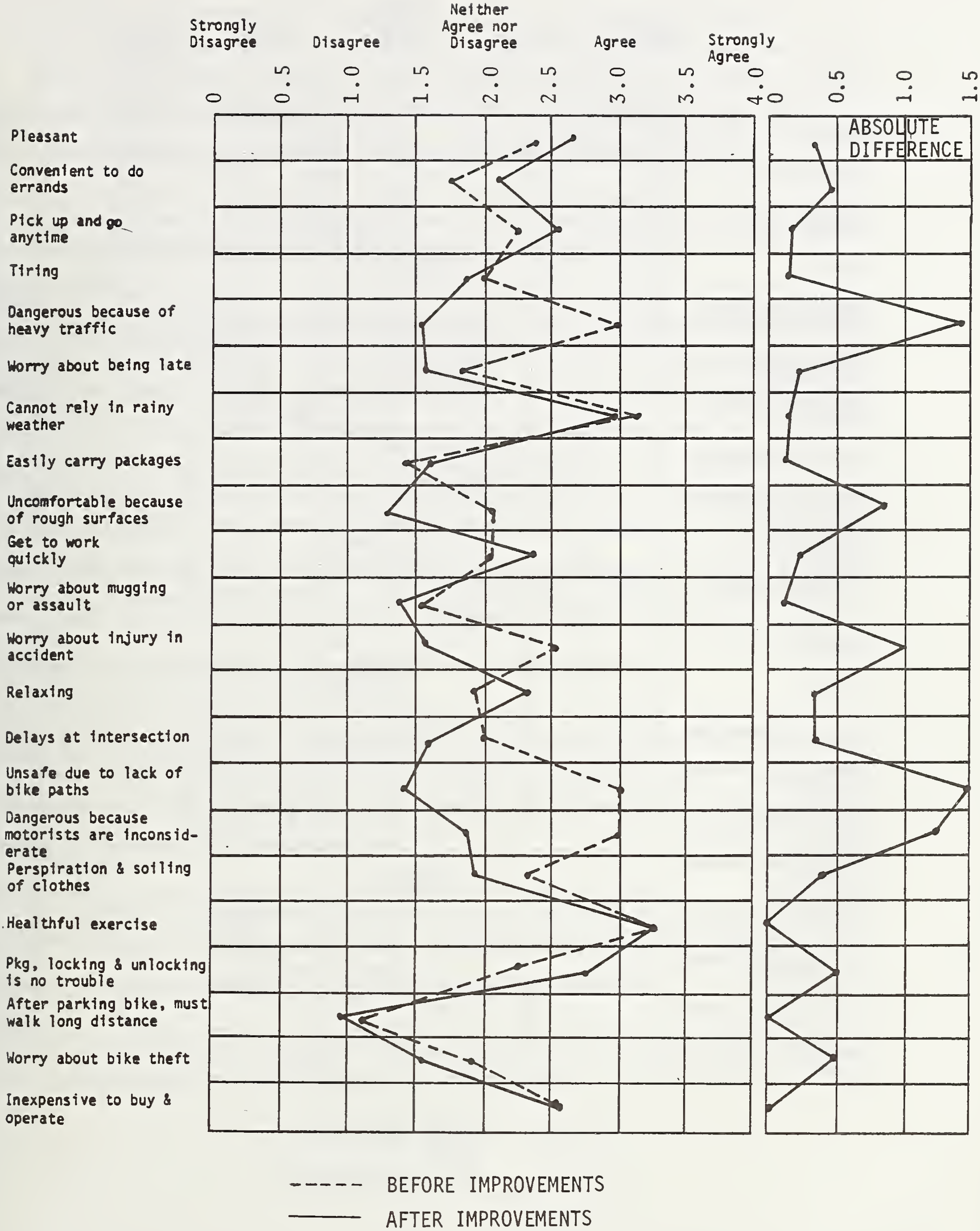


FIGURE 3-15 WORK TRIPS: RATING OF BIKE BEFORE AND AFTER IMPROVEMENTS

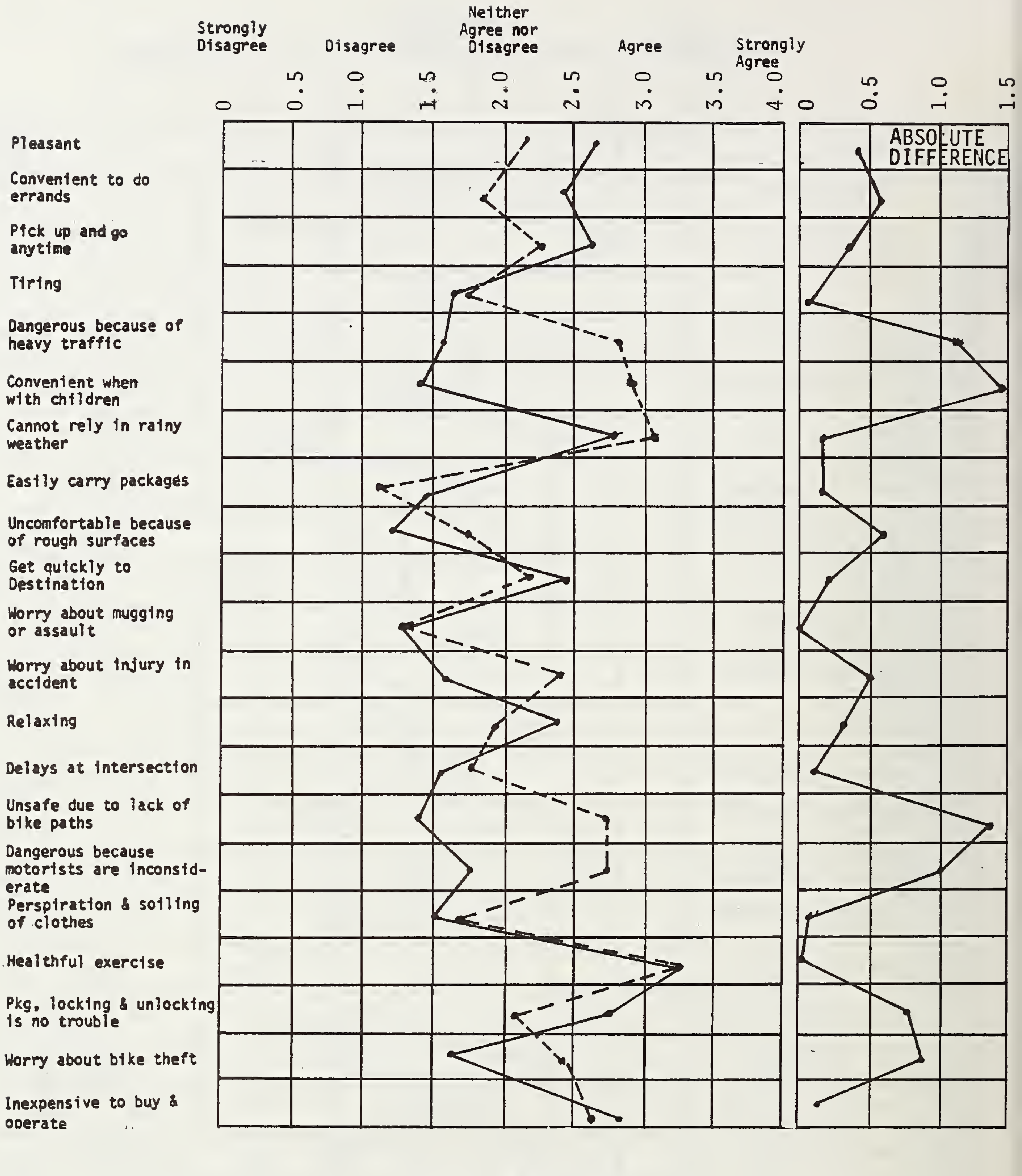


FIGURE 3-16 SHOPPING/PERSONAL BUSINESS: RATING OF BIKE BEFORE AND AFTER IMPROVEMENTS

of bicycle improvements favorably changes the respondents' perception of the bicycle mode, especially in the areas of safety, security and some aspects of comfort/convenience. Safety perceptions experience by far the greatest changes. These include reduced worry about the need to travel in heavy traffic, about the associated "accidents", "dangerous motorists", and "unsafe" conditions.

Concerns about bicycle theft are reduced, and the convenience to do errands and to shop when with children are enhanced with the improvements.

Rating of Walk Before and After Improvements—Unlike bicycle ratings, the ratings of pedestrian transportation attributes show that the walk-related facility improvements do little to change people's perception of walking (see Figures 3-17 through 3-19). The only attributes that rated more positively after facility improvements were "walking to school is dangerous because motorists are inconsiderate," (this rating goes from "neither agree nor disagree" before the improvements, to close to "disagree" after the improvements); and for work trips, "dangerous because motorists are inconsiderate" and "unsafe due to lack of paths" show movement toward less concern once the improvements are in place.

Summary of Results and Conclusions

A summary of findings is provided below. These deal mainly with results of the analysis of respondents' stated preferences, the relationship between mode choice and stated mode preference, and respondents' stated preference in response to the introduction of the strategies tested.

1. Current preference is a good indicator of current mode choice. In general, however, indicated preference levels tend to underestimate choice of auto, transit and walk, while it overestimates actual bicycling.

2. The following ordering shows the hierarchy of strategies, based on their potential for effecting shifts from the automobile:

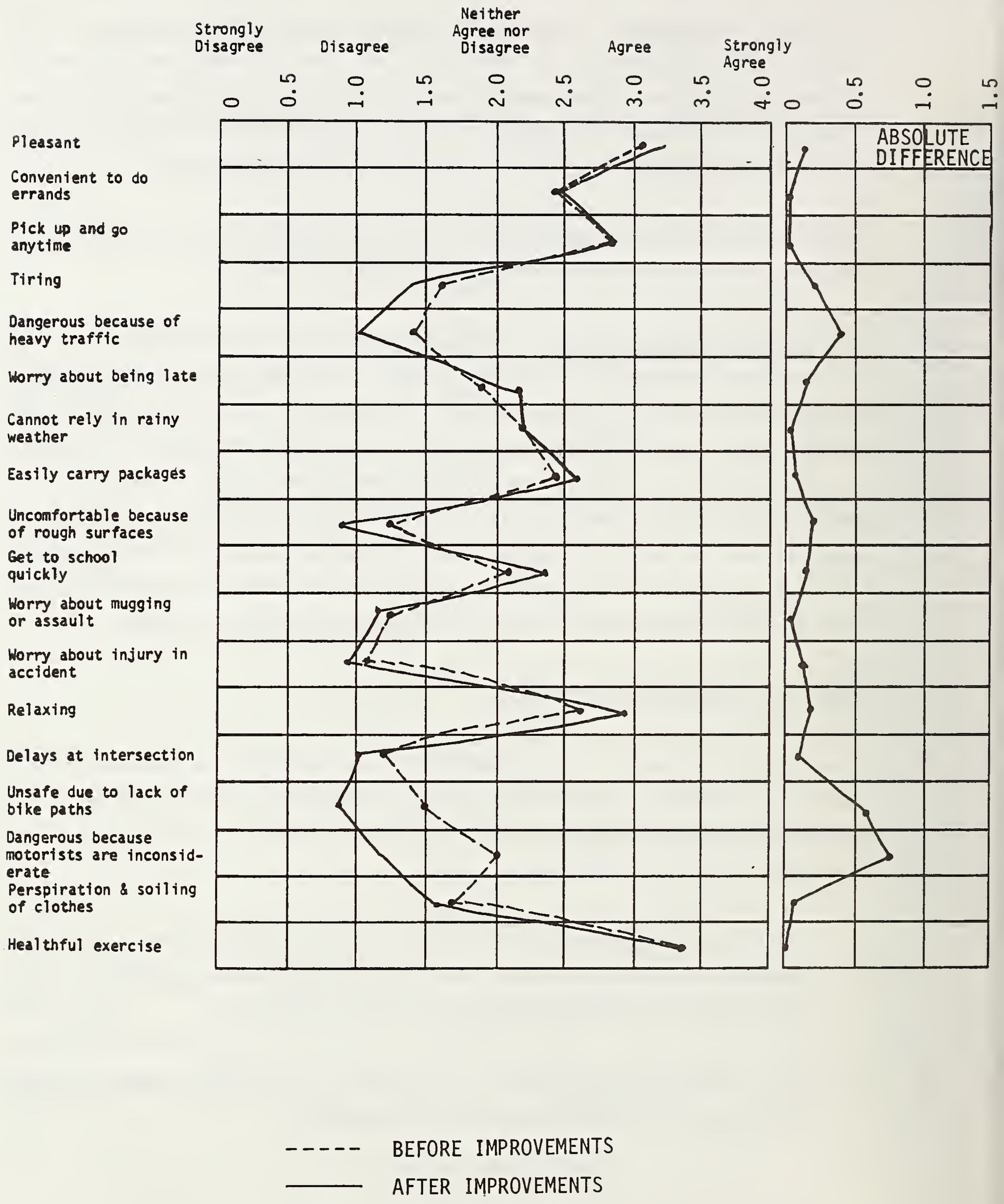


FIGURE 3-17. SCHOOL TRIPS: RATING OF WALK BEFORE AND AFTER IMPROVEMENTS

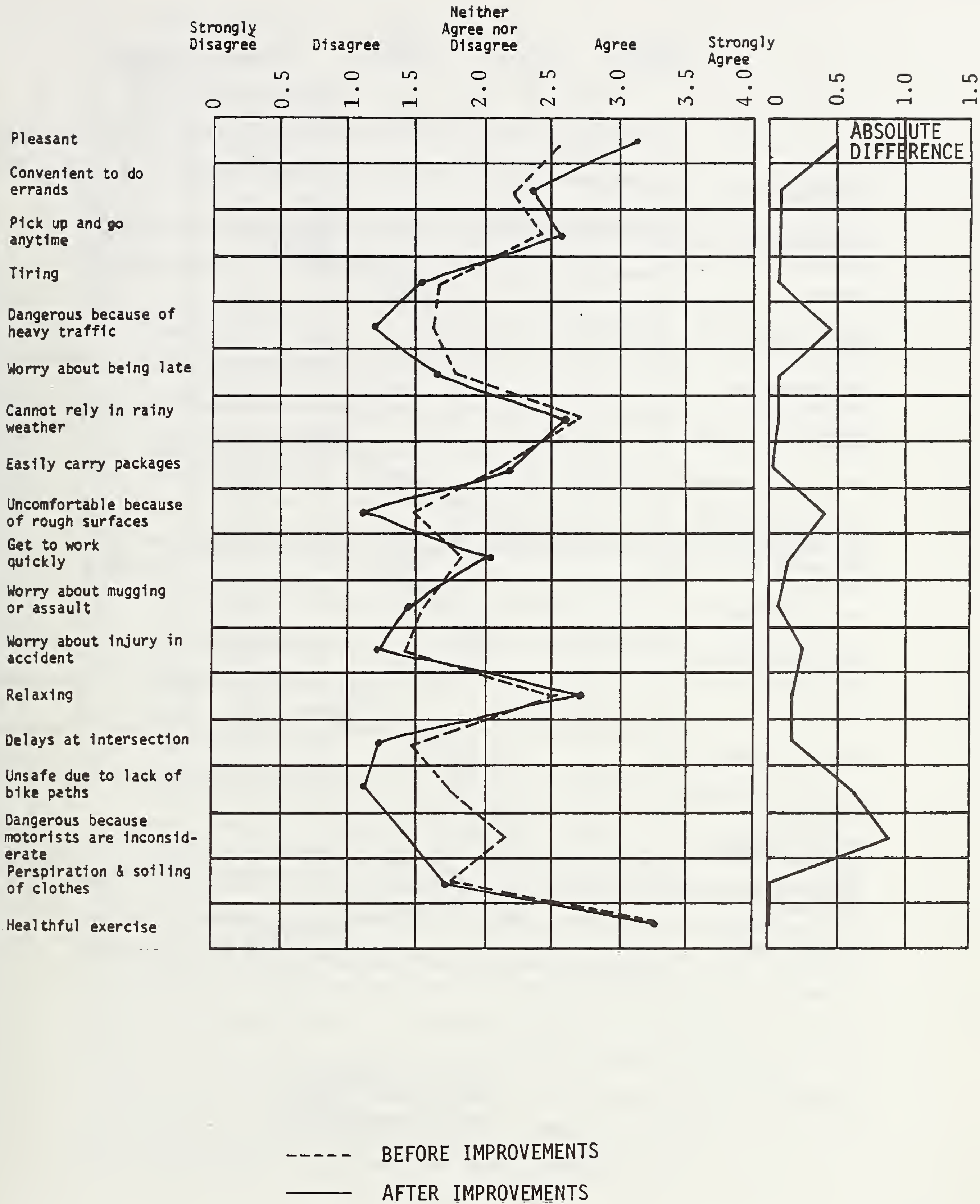


FIGURE 3-18 WORK TRIPS: RATING OF WALK BEFORE AND AFTER IMPROVEMENTS

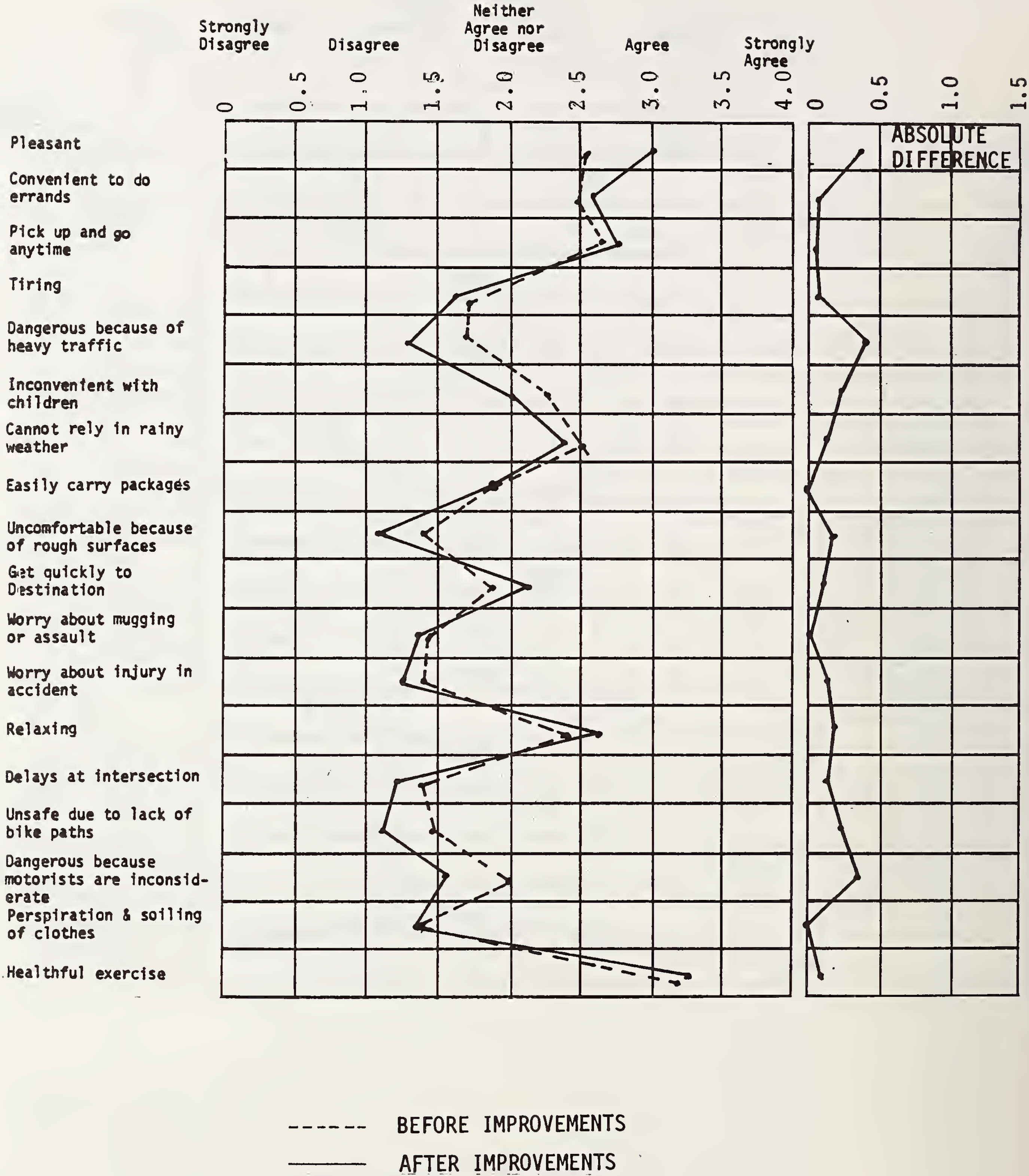


FIGURE 3-19 SHOPPING/PERSONAL BUSINESS: RATING OF WALK BEFORE AND AFTER IMPROVEMENTS

- o Compact land use
- o Congestion fee
- o Fuel price increases
- o Pedestrian facilities
- o Bicycle facilities

3. The hierarchy of strategies tested for their ability to increase walking is as follows:

   - o Compact land use
   - o Pedestrian facilities
   - o Congestion fee
   - o Fuel price increase
   - o Bicycle facilities

4. The hierarchy of strategies tested for their ability to increase bicycling is as follows:

   - o Compact land use
   - o Bicycle facilities
   - o Congestion fee
   - o Fuel price increase
   - o Pedestrian facilities

5. The concept of a compact land use distribution which includes walk and bicycle facilities, with work, shopping, and other opportunities within walking and bicycling distance, produces the greatest shift in preference from automobile to walking and bicycling. The relative importance of this strategy underscores the realization that the most effective way of promoting use of non-motorized modes may not be responsive always to policy actions. This is not to say, for instance, that new economic forces such as that brought about by a limited gasoline supply, might not be able to influence how people choose their places of residence in relation to their places of employment. In such a case, gasoline supply or its cost could be set by policy.

6. Separate facilities play an important role in people's preference for non-motorized modes, second only to compact land use. The significance of facilities is further emphasized by the fact that the compact land use scenario contains not only the very important element of short trip distance, but also the element of separate facilities for non-motorized travel. Thus, it appears that facilities can play a prominent role in increasing non-motorized travel, particularly if they are provided in the context of compact land use configurations such as college campuses, residential areas near central business districts, and in areas where shopping opportunities are within walking or bicycling distance of medium to high density residential areas.

7. Pricing, either through congestion fees or increases in fuel prices, has the potential for causing significant shifts from the automobile. However, transit absorbs a large portion of the shift, thus reducing the potential non-motorized share.

8. An increase in the price of fuel to $1.50 per gallon is somewhat less effective in causing shifts from the automobile than is the application of a congestion fee of $2.00 per day. It does have the effect, however, of increasing consumers' preference for transit, especially for shopping and personal business trips.

9. Current level of non-motorized use appears to be related to the potential increases in walking and bicycling. Both the Austin precincts, with its relatively high current share of bicycle use, and the precincts in Philadelphia, with their high level of walking, exhibit the highest shifts towards bicycle and walking, respectively, with the introduction of facilities.

10. With the exception of the compact land use scenario, the application of any strategy by itself causes a maximum hypothetical shift of approximately 20 percent to either walking or bicycling. Given the hypothetical and somewhat unrealistic nature of the scenarios, this value can be taken to represent the upper limit diversion from auto to walking and bicycling (for non-compact land use settings).

11. While current preferences are good indicators of current mode choice, no assurances can be made at this point about the reliability of future preferences for predicting future choice. The modified preferences result from changes in the perception of the mode attributes as a result of the scenarios introduced. Whether this modified perception will lead to changes in behavior as reflected by actual shifts to other transportation modes is the subject of perception and preference modeling work reported in Chapter 4.

4.
MODEL DEVELOPMENT

The objective of this section is to develop an analytic model of mode choice behavior that identifies the most important modal attributes and human variables determining the choice between walking, bicycle, car and bus riding as a means of travel. It is intended that the results of these findings will assist in the development of programs and facilities for pedestrian and bicycle travel that are better tailored to the concerns of potential users.

The approach, as described in the pages following, is a two-stage process in which individual perceptions of the attributes of each mode are first analyzed, and then a model of individual mode preference is calibrated. The relationship between stated preferences and subsequent choice is then discussed.

In general, the determinants of car and bus mode choice are better understood than those of the walk and bicycle modes. The strategy of modelling perceptions and preferences is common to the area of new product market analysis. The purpose of this disaggregate and attitudinal modelling approach is to provide the consumer response information necessary for planners to develop and refine alternative policies. Thus, in a study of pedestrian and bicycle use for utilitarian travel, the key question is "How do consumers perceive the non-motorized modes?" For instance, are comfort, convenience and safety important considerations and if so, what specific elements of the characteristics of bicycling and walking constitute "comfort" or "safety"? Moreover, it is important to know the relative importance of these attribute dimensions: Is (the lack of) convenience a more important consideration in the consumer's choice process than (the lack of) safety? Or is the reverse true? These are the types of questions addressed by attitudinal research techniques and more specifically, by perception models and preference models.

The perception analyses are based on the application of factor analyses to identify underlying dimensions of perceived modal attributes and the extent to which these perception dimensions differ between geographic areas. The preference models are in the form of discrete choice models to indicate the relative importance of each of the factor dimensions and other mode attributes in determining preference among the motorized and non-motorized modes of travel.

This study separately examines the human factors involved in mode perceptions and preferences along three dimensions:

1. differences between work and shopping travel
2. differences among age subsets of the population
3. differences among geographic areas

Since most walking and bicycling trips are relatively short in distance, the geographic dimension was examined through the study of three different types of neighborhoods in different parts of the United States. These are:

a. a small town—Columbus, Indiana
b. a large central city setting—Denver, Colorado
c. a suburban neighborhood—Huntington Beach, California

Previous Models of Pedestrian and Bicycle Travel

In modelling mode split, most disaggregate model applications have described the individuals/choice process in terms of:

- cost
- in-vehicle travel time
- out-of-vehicle travel time (e.g., walk to transit)
- household income and other socioeconomic effects.

Most mode split models in the United States have been limited to various car and transit alternatives, largely because most travel surveys have contained information only about motorized vehicular travel. One exception was the mode split model developed by Tardiff (23), which included bicycle. Since the operating costs of a bicycle are negligible and there is little variation in speeds, the only level of service effect on bicycle choice was represented by trip distance. In addition, the model included a number of alternative-specific socioeconomic variables, and revealed that age was the most important personal attribute influencing the probability of choosing bicycle as the means of travel.

Most applications of logit choice models that include walk and bicycle travel have occurred in The Netherlands, where bicycles account for as many trips as cars (24). A pioneering application of the multinomial logit model to the non-motorized modes was the Ben-Akiva and Richards study of the Eindhoven area (25). In that model, explanatory variables for bicycle and walk choices were limited to total travel time and income effects. The model showed that the choice of both bicycle and walk declined with increasing travel time and increasing household income. Similar models and findings emerged from the SIGMO study of the Amsterdam area (26). The Zuidvleugel study of The Hague-Rotterdam region, still underway, is developing models of walk and bicycle preference based on distance, trip purpose and socioeconomic characteristics. However, the high level of bicycle ownership in The Netherlands, together with the prevalence of special facilities for bicycles, makes the results of Dutch studies of questionable usefulness for the United States.

Motivation for the Attitudinal Approach

While the representations of mode attributes based on travel time and cost have been successfully used in predicting the choice between car and transit alternatives, it is not clear that this limited description of modal characteristics can adequately describe the factors ultimately influencing the choice of bicycle or walk for utilitarian trips. Such models are also of limited applicability for predicting demand responses to many bicycle and pedestrian-related policies. For example, to predict the effects of constructing a system of reserved lane bikeways, it would be necessary to represent the policy in terms of the resulting change in bicycle trip cost (which for all practical purposes would be zero), out-of-vehicle time (also zero) and in-vehicle time (which may well be minimal). In all but the most congested areas, infrastructure is not the determining factor of bicycle speed. Construction of reserved lane bikeways would, however, have an effect on bicycle safety and perhaps comfort and it is these factors which might ultimately result in a shift towards bicycle use. The implication here is that it is useful to develop choice models which explain choice in terms of the full range of explanatory factors which are sensitive to control by policy makers.

Factors such as comfort and safety, which could be affected by alternative policies, would thus be important to represent in a choice model. The logical connection between attitudinal models are most appropriate for identifying which explanatory factors are important in explaining preferences among alternatives. This information can then be applied to predict consumer choice. One problem with the use of attitudes and perceptions is that past studies have revealed that reported attitudes toward the modes are themselves affected by mode choice decisions already made (22, 27, 28, 29). Nevertheless, attitudes and perceived attributes can be useful as tools for measuring those mode choice factors that are not easily measured by standard objective measurement techniques. In many cases, attributes and mode perceptions have been found to predict mode choice behavior significantly better than exclusively objective measures of travel time and cost attributes (14, 30, 31).

<u>Perception Models</u>

To evaluate perceived similarities and differences between the different motorized and non-motorized modes of travel, it was necessary to collect ratings of the fundamental attributes for each alternative mode. A few of the attributes of travel can be measured directly, such as travel time and cost. In addition, however, there are numerous attributes that are less easily measurable but perhaps of equal or greater importance as factors in determining mode preferences. These range from convenience and comfort to safety and weather protection. The present analysis is based on the section of survey in which respondents were asked to rate the attributes of each mode by rating their intensity of agreement or disagreement with strongly worded statements about the attributes of each mode. These attribute perception ratings were based on a five-point "Likert scale," where the value '5' signifies 'strong disagreement' with the given statement, '4' signifies 'disagreement,' '3' signifies 'neither agreement nor disagreement,' '2' signifies 'agreement,' and '1' signifies 'strong agreement.' Altogether, 25 mode attributes were rated, although not all of the attribute perception questions were relevant to all four modes. The attribute perception questions asked of each mode are summarized in Table 4-1. (The full survey questions are shown at the end of this report.)

The most obvious method of representing consumer perceptions of walk, bicycle, car and bus travel is to use the complete set of measured perceptions. If properly generated, this set of scales provides a complete description of the perception process and is relatively easy to use because no further data collection or statistical manipulation is required. However, the sheer size of this list of mode attributes can provide too much information for a planner to evaluate and thus, perhaps, prevents insightful analysis. In addition, the list of attribute perceptions often has a large number of partially redundant scales. This is not necessarily an indication of redundant survey questions. Rather, it is a common problem in market analysis that the fundamental attributes of alternatives for a given consumer choice decision are frequently highly correlated. This resulting multicollinearity undermines the predictability of statistical models to estimate importance weights for each attribute in determining preference. More realistically, consumers themselves often reduce "cognitive strain" by basing their choice decisions on the evaluation of a small number of major factors instead of the simultaneous evaluation of the larger set of all fundamental attribute characteristics.

There are a variety of approaches for identifying dimensions underlying consumer decisions. These include non-metric scaling, discriminant analysis, and factor analysis. In a review and analysis of all three types of perception models, Hauser and Koppelman (32) conclude that factor analysis is the preferred technique due to its interpretability and predictability. While the Likert scales, like almost all attitudinal rating techniques, are strictly ordinal in a psychological sense, past experience has shown that the rating scales can still yield useful results when factor analysis manipulations are applied to them.

TABLE 4-1 SUMMARY OF MODE ATTRIBUTE MEASURES

Mnemonic	Question	BIKE	WALK	BUS	CAR
GREATOUT	Traveling by ... to work is pleasant because I can enjoy the scenery and surroundings.	✓	✓	✓	✓
CNVERRND	When traveling by ..., it is convenient to stop and do errands on my way to and from work.	✓	✓	✓	✓
SKEDFLEX	I can pick up and go anytime I like when I travel by ... to work.	✓	✓	✓	✓
TIRING	Traveling by ... to work is tiring.	✓	✓	✓	✓
DANGER	Traveling by ... to work is dangerous because of the heavy traffic.	✓	✓	✓	✓
LATEWORY	When I go by ... to work I worry about being late.	✓	✓	✓	✓
RAINRELY	I cannot rely on traveling by ... to work in rainy weather.	✓	✓	✓	✓
PCKAGES	I can easily carry my briefcase or other packages when I travel by ... to work.	✓	✓	✓	✓
BUMPY	It is uncomfortable to travel by ... to work because of rough or bumpy road surfaces.	✓	✓	✓	✓
SPEED	I can get to work quickly when I travel by	✓	✓	✓	✓
MUGGED	I worry about being mugged or assaulted when I travel by ... to work.	✓	✓	✓	✓
INJURY	I worry about being injured in an accident if I travel by ... to work.	✓	✓	✓	✓
RELAX	It is relaxing to travel by ... to work.	✓	✓	✓	✓
INSCTDLY	I dislike traveling by ... to work because of the many delays at intersections.	✓	✓	✓	✓
UNSAFE	...ing to work is unsafe because of the lack of (bike paths, pathways) that are separated from motorized traffic.	✓	✓		
INCONSID	Going by ... to work is dangerous because motorists are inconsiderate of...	✓	✓		
SWEAT	When ...ing to work I worry about perspiring or soiling my clothes.	✓	✓	✓	
HEALTHY	...ing to work gives healthful exercise.	✓	✓		
PRKATWRK	Parking (locking and unlocking) my ... at work is no trouble.	✓			✓
WLKAFPRK	After parking my ... I must walk a long distance when I to to work.	✓			✓
THEFT	I worry about my ... being stolen at work.	✓			✓
COST	It is inexpensive to buy and operate a	✓			✓
BUSDIST	I must walk a long distance to get to and from the bus when I go to work.		✓		
BUSKWAIT	There is generally a long wait involved when I go to work by bus.			✓	
PRKGXPNS	Parking the car at my place of work is expensive.				✓

Review of the Factor Analysis Technique

Factor analysis is based on the assumption that there exist some common dimensions underlying consumer perception of a commodity or service. In simplest terms, factor analysis may be viewed as a technique for data reduction and for studying the correlation structure of variables. In this study, factor analysis was used to reduce a potentially large number of fundamental attributes of bicycle, walk, car and bus into a manageable number of underlying perceptual dimensions (e.g., comfort, convenience, etc.). It allows the analyst to know which fundamental attributes are associated with each of the underlying dimensions. Finally, it provides a simple technique for estimating (by factor scores) a measure of consumers' perceptions of alternative transportation modes along the underlying dimensions.

Factor analysis seeks to identify a common set of factors that can adequately "explain" the variation in a larger set of attribute ratings (or "variables") being evaluated. This is accomplished by examining correlations between attribute ratings. The resulting factors are linear transformations defined such that attributes with high inter-correlations are grouped together to contribute most of the factor variance. In theory, there are "common" factors that are present in (i.e., correlated with) more than one of the variables, and "unique" factors that are present in only a single variable. The fundamental theorem of factor analysis can be expressed as:

$$Y = XF' + U$$

where

Y = an (NxL) matrix of data in standardized form (mean = o, variance = 1)
X = the (NxK) matrix of factor score values
F = the (LxK) matrix of factor loading coefficients
U = the (NxL) matrix of unique contributions of variables to factor scores

and N = number of individuals
K = number of common factors
L = number of variables (attribute ratings)

The objective of factor analysis is to determine the coefficients (F) of the common factors, known as "factor loadings." The two most popular techniques for determining factors are "Common Factoring" (Classical Factor Analysis) and "Principal Components" Analysis. The former is the more commonly used factor analysis technique. Principal Components Analysis involves a simplification of the factor analysis assumptions, in that it does not recognize the existence of unique factors (i.e., assumes U= 0) and attempts to explain the total variance of attribute variables. As such, it is more useful as a data reduction technique than as a means of studying the structure of the variables.

The recognition of a unique component to variable variance clearly involves a more realistic underlying model than that of Principal Components. This requires, however, an estimate of the common proportion of total variance for each variable, known as the "communality." This estimate of communality involves an element of random error. The resulting error variance for Common Factor scores increases as the total variance explained by the common factors drops, although this is not considered a potential problem until total variance explained drops below the 80 percent range (12). For purposes of examining the structure of travellers' perceptions, Common Factor Analysis will be used in this study.

The first stage in factor analysis involves the selection of factor coefficients for each variable. Factors are determined one at a time, in order of their importance in explaining total variance in the raw data. Each successive factor is selected so as to maximize the sum of contributions of the factor relative to the remaining common variance. The second major stage involves "rotation" of the factor matrix to simplify interpretation of the factors, usually by minimizing the extent to which each variable loads on multiple factors. Numerous algorithms can be used for this latter task. In this analysis we have used VARIMAX rotation, which is perhaps the most common of the techniques employed.

Issues in Model Stratification: The Ability to Generalize Across Modes, Sites and Purposes

As listed earlier in Table 4-1, the survey contained perception ratings for between

16 and 22 mode features that were identified as fundamental attributes for travel by walk, bicycle, car and bus. There were separate ratings for work and shopping travel purposes. The object of the perception modelling is to identify common dimensions (factors) correlating those perceived modal attributes. The simplest and most generalizable result would be the identification of a number of perceived mode attribute dimensions that are similarly defined for all modes, travel purposes and geographic sites. This would be the outcome of a single factor analysis that pools the individual perception ratings for all modes, purposes and sites. Of course, it is likely that factor dimensions underlying mode perceptions differ significantly between modes, travel purposes and the geographic sites. For example, we might expect the ease of carrying packages to be associated strongly with an overall "convenience" rating of a mode used for shopping travel, whereas for work, the "packages" variable might not load strongly at all. As another example, in different geographic areas, the effects of climate and topography might lead to differential perceptions of the extent to which bicycling is tiring and unpleasant. In order to test for such similarities or differences, it is necessary to conduct separate factor analyses for each combination of the four modes, two travel purposes and three sites that are the subject of this section of the study.

The issue remains as to whether or not the modal perceptions should be pooled across modes and/or across sites. As with any statistical technique, separate factor analyses for each of a number of population segments will in the aggregate be more meaningful than one application of the analysis to the total group, since inter-group variation is controlled by the stratification. On the other hand, while separate factor analyses of perceptions for each of the four modes at each of three sites are useful as a means of highlighting differences in the composition of perception dimensions between the 12 combinations of sites and modes, it can be difficult to interpret and generalize from them.

One use for obtaining mode-generic factors and combined-site factors is that they may be applied to develop "perceptual mappings" common in market research studies. These mappings graphically illustrate respective mode and site differences in average perceptions ratings along common scale dimensions. For example, Figure

4-1 illustrates a perceptual map for the average position of four modes relative to two mode-generic factors:

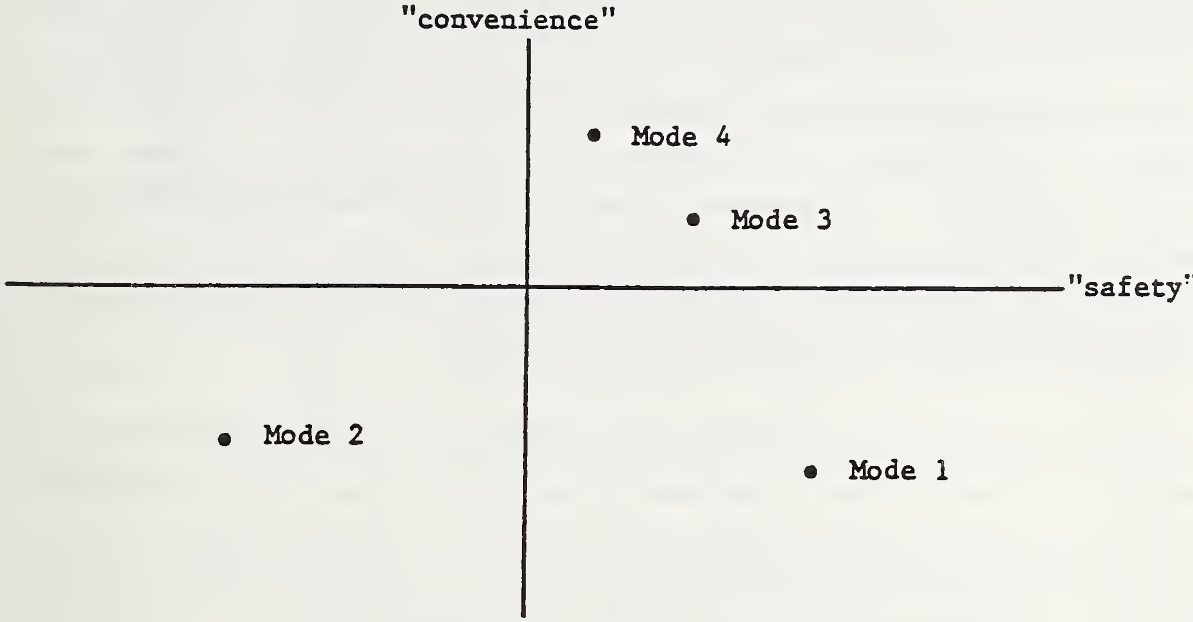


FIGURE 4-1 PERCEPTUAL MAPPING OF FACTORS

In this example, "convenience" and "safety" are the labels for two factors that are each a linear combination of various attribute perception ratings. Since these factors are defined the same for all modes, it is possible to examine average mode positions on these scales. From the given example, it can be concluded that mode 4 is usually perceived as more "convenient" but less "safe" than mode 3.

The application of separate factor analyses for each mode precludes any direct comparison of the relative positions of the modes in a perceptual map, since the factors are no longer defined identically for all the modes. Continuing the above example, even if a factor that could be interpreted as reflecting overall "convenience" is defined for each of the modes, it is likely that the components of "convenience" and their relative factor loadings differ between the modes. It is then inappropriate to compare mode positions on a perceptual map when "convenience" is defined differently for each mode. Although the use of mode-specific factors is more complex, this may nevertheless be the more realistic view of mode attribute perceptions.

The issues surrounding whether or not to estimate factors separately by site are similar to those surrounding separation by mode. The estimation of a set of factors defined common to all of the sites facilitates direct comparison of site differences in the perceived position of any given mode. On the other hand, the estimation of separate factors for each site is useful for examining the extent to which there really are site differences in the definitions of the dimensions underlying mode attribute perceptions. For purposes of identifying product positioning in a market analysis framework, generic mode and common site factor analysis would be preferred. For understanding more complex perception behavior, however, mode and site-specific factors potentially yield more information.

There are additional problems and limitations involved with the application of factor analysis to a data set that pools observations across modes. In particular, the extraction of "generic mode" factors requires that the perception ratings made for each mode by a given individual be treated as separate observations. Thus, a factor analysis for all modes would have $\sum_{i=1}^{N} M_i$ observations, where N = number of respondents and M_i = number of modes rated by (i.e., available to) individual i. (Not all modes were considered available to all individuals; in particular, perceptions about walking and bicycling were not collected for persons whose travel exceed three and six miles, respectively). This approach makes no distinction between perceptions of the same mode by different people and perceptions of different modes by the same person. High correlations between variables may be augmented by perceived differences between modes, thus confounding any conclusions about underlying perception dimensions.[1]

A further problem with the use of a generic mode factor analysis is that it is only useful for those perceived attribute variables that are defined for every mode. This

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[1]For example, the respondents rated walking as more tiring than riding in a car, and car as easier for handling packages than walking. The result is a higher intercorrelation between these variables than occurred for any single mode, resulting in a single factor incorporating both variables with mixed signs.

is because the mode-specific variables would have to be defined as constants for the modes to which they are not applicable, causing each of these variables to have strong intercorrelations with the other variables that are defined specific to the same mode(s). Thus, factors would be created uniting some variables solely because they were defined specific to the same modes.

Factor Analysis Results--Introduction

The previous section highlighted the potential problems resulting from pooling the mode perception ratings for different modes and from different geographic sites. The perception analysis in this report therefore is structured as a series of separate factor analyses performed for each mode and travel purpose combination at each of three sites.

Because of budget constraints, a limit of twenty-four separate factor analyses were run representing each combination of the four modes (bicycle, walk, car and bus), three sites (Columbus, Denver and Huntington Beach) and two travel purposes (work and shopping/personal business). The results of these individual factor analyses are presented and discussed in later sections. By way of introduction, however, it is of interest to examine the results of factor analyses that combine sites and modes. These pooled factor analyses tend to highlight differences between modal perceptions, saving the more complex issue of mode/site interactions for analysis later in the chapter. Accordingly, the section that follows presents the results of factor analyses that combine sites and that combine sites and modes for work travel.

For each run, the most important factors were identified according to a modified "Screen test," in which results are presented only for those factors that had an eigenvalue exceeding one (i.e., those that explained at least as much of the total variance as any single standardized attribute variable) or explained at least 8 percent of the total variance. The results of each of the factor analyses, the complete factor loadings (correlations between the factors and each attribute variable), variable communalities, and factor variance explained are presented in Appendix C, Volume 2, Appendixes, Report No. FHWA/RD-80/049.

Factor Analysis Results: Pooling Modes and Sites For Work Travel

As an initial exercise, to simplify the analysis to a single set of factors without regard to mode or geographic differences, common factor analysis was performed for all modes pooled and for each of the four modes on a sample combining work travel observations for all available sites—Columbus, Huntington Beach and Denver, plus an additional site—Philadelphia.[1] The major factor components (i.e., those variables with loadings greater than 0.5) for each factor are listed in order of their factor loadings in Table 4-2. The complete factor loadings, communalities and variance explained are presented in Appendix Tables C-1 through C-5 (Volume 2, Appendixes, Report No. FHWA/RD-80/049).

The generic mode factor analysis revealed three major dimensions underlying the 14 fundamental attributes that were defined for all of the modes.[2] The major factors that were created can be summarized in terms of their key (highest loading) components. It is clear that Factor 1 reflects safety attributes. Factor 2 represents a general convenience dimension, relating to speed, reliability and ability to carry packages. Factor 3 reflects the aesthetic dimension of health and relaxation attributes.

The application of separate factor analyses for each mode generally revealed many of the same underlying dimensions as revealed by the generic mode analysis, although there were some key differences. The three factors for both bicycle and bus respectively represent safety concerns, travel effort and time reliability concerns, and aesthetic enjoyment. The three major car factors represent parking concerns, travel enjoyment and safety concerns. A fourth perception factor for car

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[1] The survey was also conducted for the university district in Austin but attitudinal ratings were collected there only for shopping trips. All further analysis in this report is restricted to observations from the first three sites listed above.

[2] As noted earlier, although there were as many as 22 fundamental attributes for individual modes, only a core set of 14 variables was commonly defined for all modes.

TABLE 4-2 SUMMARY OF MAJOR FACTOR COMPONENTS FOR WORK TRAVEL (SITES COMBINED)

	Factor	Major Components*
Mode-generic		
	FACTOR1 (Safety)	Danger, Injury
	FACTOR2 (Convenience, Travel Time)	Latewory, Rainrely, Pckages, Speed
	FACTOR3 (Enjoyment)	Greatout, Relax
Mode-specific		
	BIKE1 (Safety)	Danger, Injury, Inconsid, Unsafe
	BIKE2 (Travel Time)	Tiring, Latewory, Speed
	BIKE3 (Enjoyment)	Healthy, (Greatout)
	CAR1 (Parking)	Prkexpns, Wlkafprk, Prkatwrk
	CAR2 (Enjoyment)	Greatout, Tiring, Relax
	CAR3 (Safety)	Danger, Injury
	BUS1 (Safety)	Danger, Mugged, Injury
	BUS2 (Travel Time)	Speed, Distobus, Buswait
	BUS3 (Enjoyment)	Greatout, Tiring, Relax
	WALK1 (Safety)	Danger, Bumpy, Injury, Insctdly, Unsafe, Inconsid
	WALK2 (Travel Time)	Tiring, Latewory, Rainrely, Speed
	WALK3 (Enjoyment)	Greatout, Relax, Healthy

*Refer to Table 4-1 for the definition of the mnemonics. Only variables whose factor loading (correlation with the factor) is 0.5 or greater are listed.

travel represented travel time and convenience concerns, but explained much less of the common variable variance than did the first three car factors. The factors for walk mode were somewhat more difficult to interpret than those for the other modes, as WALK1 combined safety concerns (Danger, Injury, Unsafe, Inconsid) with inconvenience factors (Bumpy, Insctdly). Intersection delay (Insctdly), in particular, might be expected to more naturally be correlated with the travel time concerns (Latewory, Rainrely, Speed) that dominate the factor WALK2 (see Table 4-2).

Factor Analysis Results: Site and Mode-Specific Factors, for Work Travel

Separate factor analyses of work travel perceptions were run for each of the four modes at each of three sites—Columbus, Indiana, Denver, Colorado, and Huntington Beach, California. These three sites represent distinctly different physical environments including a small town, a large central city and a suburban area. The key component variables in each factor for work travel are summarized in Table 4-3. The complete factor loadings, variable communalities and variance explained are presented in Appendix Tables C-6 through C-17, in Volume 2, Appendixes, Report No. FHWA/RD-80/049.

There was general consistency across the sites, particularly for the non-motorized modes, walk and bicycle. To a large degree, attributes that loaded together at one site (for a given mode) also loaded together in the other sites. In some cases the relative strength of the factor groupings (in terms of percent variance explained) differed between sites. In a few cases, specific attributes that loaded highly on a factor at one site did not load highly at another site.

Major Themes

Looking at the non-motorized modes, a factor grouping of perceived safety aspects—including danger, injury, unsafe and inconsiderate drivers—consistently emerged as

TABLE 4-3 SUMMARY OF MAJOR FACTOR COMPONENTS - WORK TRIPS (Mode and Site - Specific Factors)

Mode Factor	Major Component Variables: Columbus	Denver	Huntington Beach
BIKE1	Danger, Unsafe, Inconsid, Injury	Danger, Injury, Unsafe, Inconsid	Danger, Injury, Unsafe, Inconsid
BIKE2	Greatout, Converrnd, Relax	Greatout, Healthy	Greatout, Converrnd, Pckages, Relax
BIKE3	Tiring, Latewory, Speed, Sweat	Tiring	Tiring, Latewory, Sweat
CAR1	Tiring, Danger, Bumpy, Injury, Insctdly	Prkexpns, Wlkafprk, Prkatwrk	Danger, Latewory, Injury
CAR2	Converrnd, Skedflex	Rainrely	Prkexpns, Wlkafprk, Theft, Prkatwrk
CAR3	Wlkafprk, Prkatwrk	Greatout, Tiring, Relax	Skedflex, Converrnd
BUS1	Latewory, Speed, Insctdly	Danger, Bumpy, Injury	Danger, Mugged, Injury
BUS2	Danger, Mugged, Injury	Latewory, Buswait	Greatout, Relax
BUS3	Bumpy	Greatout, Tiring, Relax	Buswait, Skedflex
WALK1	Danger, Bumpy, Unsafe, Inconsid	Danger, Injury, Insctdly, Unsafe, Inconsid, Latewory, Rainrely	Danger, Bumpy, Injury, Unsafe, Inconsid, Tiring, Latewory
WALK2	Skedflex, Greatout	Tiring, Latewory, Rainrely	Skedflex, Latewory, Rainrely
WALK3	Speed	Greatout, Relax	Tiring, Mugged, Relax

the first factor for both bicycle and walk modes at all three sites.[1] A variation on this theme, including danger and injury, emerged as the first or second factor for bus at all three and for car at two of the three sites. A positive factor grouping incorporating scenery enjoyment ("Greatout") and ability to relax emerged as a factor for bicycle and bus each at two of the three sites. For car travel, concerns about the availability and location of parking at work emerged for all three sites, together with concerns about parking expense at two of the sites. The positive aspects of car travel--convenience for doing errands and schedule flexibility--were a major factor at two of the sites.

Notable Site Differences

The major factors for Columbus and Huntington Beach had more in common with each other than with the factors for the Denver neighborhood. In relation to perceived bicycle attributes, the Denver residents appeared to link scenery enjoyment more closely with health and less with relaxation and convenience for errands than respondents at the other two sites (refer to factor BIKE2 in Table 4-3). In general, however, site differences between the factor groupings were minor among the non-motorized modes, only slightly greater for bus, but relatively large for car travel.

Among the car factors, parking considerations were the strongest group for Denver (i.e., the factor explaining the greatest variance), but relatively less important at the other sites. Note that this does not necessarily imply any significance or importance of the factor as a determinant of mode choice, but merely indicates that parking difficulty, expense and inconvenience all tended to have a stronger inter-correlation in the minds of the Denver respondents than the others. In fact, the standard deviations of the parking-related attribute ratings were higher for Denver

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[1] It should be stressed that this does not imply that this dimension is necessarily the strongest influence on mode choice. Subsequent preference analysis will determine the relative importance of the relevant factors.

than for the other sites, indicating that the Denver residents had greater disagreement as to the rating of parking convenience or expense, but greater agreement that all of these parking attributes were related to the same underlying issues. The strength of this factor uniting parking concerns for Denver is not surprising considering that the Denver precinct was a central city neighborhood, in contrast to the suburban or small town settings at the other two sites.

The Denver factor analysis for car is also interesting because, unlike its counterparts for the other two sites, there was no major factor highlighting the safety concerns (danger and injury). Actually, such a factor did emerge as the fourth car factor, but was excluded because it failed the eigenvalue cutoff rule. Also surprising was the singular dominance of reliability in rain for the second car factor. Analysis of the mean and standard deviation of this attribute rating for Denver showed no great difference with those for the other sites.

Factor Analysis Results: Site and Mode Specific Factors for Shopping/Personal Business Travel

Paralleling the work travel perception analysis in the previous section, separate factor analyses of shopping/personal business perceptions were run for each mode at the same three sites. For the most part, the underlying dimensions of perceived attributes were similar to those that emerged for work travel. The key component variables in each factor for shopping/personal business travel are summarized in Table 4-4. More complete factor analysis results are presented in Appendix C, Tables C-18 through C-29, in Volume 2, Appendixes, Report No. FHWA/RD-80/049.

As for work travel, the three common factor themes were safety concerns, aesthetic enjoyment features and travel time/convenience concerns. Within these broad labels, however, there were frequently significant differences in the components of those factors between sites and compared to the work travel factors.

TABLE 4-4 SUMMARY OF MAJOR FACTOR COMPONENTS - SHOPPING/PERSONAL BUSINESS TRIPS
(Mode and Site-Specific Factors)

Mode Factor	Major Component Variables Columbus	Denver	Huntington Beach
BIKE1	Greatout, Converrnd Skedflex, Relax	Danger, Unsafe, Inconsid	Danger, Injury, Unsafe, Inconsid
BIKE2	Bumpy, Injury, Mugged	Greatout, Converrnd Skedlfex	Greatout, Relax
BIKE3	Danger, Unsafe, Inconsid	Mugged, Injury	Tiring, Speed
CAR1	Danger, Injury	Danger, Bumpy, Injury, Theft	Danger, Mugged, Injury, Insetdly, Theft
CAR2	Converrnd, Skedlfex	Wlkafprk, Prkexpns Prkatwrk	Converrnd, Skedflex
CAR3	Rainrely	Pckages, Speed	Rainrely, Pckages
BUS1	Danger, Bumpy, Injury	Danger, Mugged, Injury, Sweat	Danger, Bumpy, Mugged, Injury, Sweat
BUS2	Greatout, Relax Converrnd	Speed, Buswait	Greatout, Relax
BUS3	Distobus, Buswait	Greatout, Relax	Buswait
WALK1	Danger, Bumpy, Injury, Insetdly, Unsafe, Inconsid	Greatout, Converrnd Relax, Healthy	Danger, Bumpy, Insetdly, Inconsid
WALK2	Tiring, Pckages, Speed, Relax	Bumpy, Mugged	Tiring, Rainrely, Pckages, Speed
WALK3	-	Danger, Injury, Safe, Inconsid	Greatout, Relax

Major Themes and Site Differences

For car travel, safety concerns formed a significant factor at all three sites. The other two main factors for both Columbus and Huntington Beach were flexibility (Cnverrnd, Skedflex) and convenience (Rainrely, Pckages). Denver was different in that parking considerations formed a major factor only at that site. The third major car factor for Denver was a combination of travel time and convenience for packages.

The factor analyses for walk travel to shopping showed a variety of safety concerns at all three sites. As for work travel, these concerns included fear of injury, poor pavement surfaces and danger from inconsiderate drivers. Health and aesthetic advantages were a major factor for walk in Denver and Huntington Beach, but not in rural Columbus. Travel time concerns about speed, flexibility and fatigue formed a major factor in Columbus and Huntington Beach, but not in Denver. It is most notable that fear of being mugged or assaulted emerged as a significant factor dimension only in Denver, which is the only one of the three sites representing a central city neighborhood.

Among bicycle travel factors, safety concerns and aesthetic enjoyments each emerged as major factors at all three sites. At Columbus and Denver, flexibility features were linked with aesthetic enjoyment features, and fear of injury or being mugged formed a separate third factor. Travel time and effort was a major factor for walk travel only at Huntington Beach.

For bus travel, the major factors at all three sites were safety concerns, aesthetic enjoyment, and out-of-vehicle time ratings.

Differences Between Mode Perceptions for Work and Shopping Travel

The factor dimensions underlying the perceived mode attributes of shopping travel were largely similar to those previously presented for work travel. There were, however, a few key differences between the travel purposes that were generally consistent among the three sites.

For bicycle travel, fear of being mugged was associated with other safety concerns for shopping trips but not for work trips at all three sites. On the other hand, the tiring (and to a lesser degree, sweat) aspects of bicycling formed a major factor for work trips at all three sites, while this concern was a major factor for shopping trips only at Huntington Beach (situated in a relatively hot climate).

For car travel, the ability to carry packages was a major factor for shopping travel at two of the sites, but was not associated with any major car factor for work trips. For bus travel and walk travel, concern about being late was a key factor component for work trips at two of the sites, but was not associated with any major factor for shopping trips.

The major factor dimensions of mode attributes that were identified in this chapter will be utilized as explanatory variables in the mode preference models in the next chapter. In an attempt to maintain a comparable set of explanatory variables among the preference models, individual perceived attribute variables are used to represent certain dimensions for those site and travel purpose combinations where no major factors corresponding to those dimensions were defined. This strategy is explained in greater detail in the following section.

Preference Models

While it is useful to identify the perceptual dimensions underlying consumers' evaluation of transport services, it is also necessary to know the relative importances of each dimension. To develop effective transport policies, transportation planners must know whether policies should concentrate on comfort, safety, reliability or other mode attribute dimensions. Preference models estimate the relative importances of each attribute or factor in determining mode preferences. Thus, while perception models (e.g. factor analysis) may identify several underlying dimensions with which consumers perceive the attributes of alternative transport modes, preference modelling may indicate that only one or two of these dimensions have any significant importance.

Preference Model Techniques

All preference modelling techniques attempt to estimate coefficients representing importance weights for each mode attribute (or dimension). The usual form is the linear compensity model:

$$P_{im} = \sum_k (W_k d_{imk})$$

where:

P_{im} = preference of consumer i for mode m

W_k = weight for attribute k

d_{imk} = rating of attribute k of mode m for consumer i

The dependent variable (P_{im}) is some measure of stated mode preference or actual mode choice. Expectancy value models obtain the importance weights (W_k) directly through asking consumers to themselves estimate the relative importances. Preference regression statistically estimates the coefficients (W_k) using the rank order of each given mode as the dependent variable. It has the disadvantage that it assumes a metric scale to the preference rank measure. Preference regression has more recently been replaced by logit choice models, which have the advantage of being formulated with discrete choice among alternatives as the dependent variable. A preference logit analysis models the stated "choice" of a first preference among a given set of alternatives. A mode choice logit analysis models the actual mode chosen from a given set of alternatives. This is a preference model in the sense that actual choices may be interpreted as "revealed preferences."

Stated preferences have an advantage over observed choices in that they can be measured for hypothetical future scenarios. This makes it possible to validate the sensitivity of preference models to such alternative futures, something which is not possible with models of actual mode choice. Stated first preferences and subsequent actual choices are highly correlated, although not always identical. The distribution of second, third and lower preferences may also contribute to the prediction of actual mode choice. It has been shown previously that actual choices of individuals can often be predicted fairly well from the distribution of their stated preferences

(12). This study focuses on the development and calibration of logit models of rank order preferences, although the relationship between preferences and subsequent choice is addressed in later sections.

Structure of the Logit Model for Rank Order Preferences

The following logit model estimates the probability of each person (i) choosing a given mode (m) as:

$$\text{Prob }(m) = \exp(U_{im}) / \sum_{m=1}^{M} \exp(U_{im}),$$

where U_{im} is the relative attraction (or "utility") of a given alternative (m) for consumer (i). It is typically estimated in the linear form:

$$U_{im} = a + \sum_{k} (w_k \, d_{imk}) + \varepsilon_i,$$

where a = constant

w_k = coefficient for attribute k

d_{imk} = rating of attribute k of mode m for consumer i

ε_i = error term.

In the case of a preference model, the dependent variable has been taken to be the stated first preference among a given choice set. This has lead to the criticism that logit preference models only use information about the first preference (32). There is however, no reason why second, third and lower preferences cannot also be modelled within a logit framework. To see why, first consider that it is possible to estimate separate coefficients for, and make predictions of, first, second and third preferences by the following strategy:

1. Estimate coefficients for the choice of a first preference among the full choice set,

2. then estimate separate coefficients for a choice model of the second preference among a choice set that omits the first preference, and

3. then estimate yet another set of coefficients for a choice model of the third preference among a choice set that omits the first and second preferences.

Each of these models will yield coefficients for weighting the importance of every independent mode attribute. This complexity is not necessary, however, if one accepts the Independence of Irrelevant Alternatives (IIA) assumption underlying logit.

The IIA assumption states that the relative probabilities of choosing between any given pair of alternatives is not affected by the deletion or addition of other alternatives in the choice set. If this assumption is true, then the coefficient weights for the independent variables should be stable among the first, second and third preference choice models, since these models are identical except for the inclusion or exclusion of some alternatives in the choice sets. In that case, it is more efficient to estimate a single set of preference coefficients for a new choice set that pools the first preference choice set (i.e., the full set of available atlernatives), the second preference choice set (which omits the first preference) and the third preference choice set (which omits the first and second preferences). This is the strategy used for the preference models presented in this chapter. This strategy makes particular sense for this study because survey data revealed that car mode was almost universally stated as the first choice, and bus, in particular, was almost always second or lower in order of preference. (The distribution of third and fourth preferences were, of course, nearly the reverse of the first preferred distribution.) It is generally difficult to estimate alternative-specific effects in a choice model when certain alternatives are seldom or never chosen. The logit models presented in this report thus assume stability of importance weights (coefficients) among first, second, and third preference choices.

Explanatory Variables

The preference logit model may be applied to estimate importance weights not only for perceived mode attributes (or underlying dimensions), but also for a variety of objective mode attributes and socioeconomic variables. The objective of the preference model analysis in this study was to account for all of the significant explanatory variables from a set that included:

A. the perceived attribute ratings for each mode

B. objective level of service measures—actual cost, travel time (in and out of vehicle), and/or travel distance for each mode

C. age and income characteristics of the individuals

The mode attribute variables in a preference choice model may be expressed in either generic or alternative-specific terms (or a mixture of the two). The generic formulation estimates coefficients for measures that are common to several or all of the choice alternatives, thus assuming that the importance weights of the variables as determinants of preference choice are the same for all the applicable mode alternatives. This approach is useful when the choice set is large and there is no special interest in any particular alternatives, as is commonly the case for destination choice models. Since this study focuses particular attention on preferences for walking and bicycling relative to car and bus travel, it is important to estimate separate effects of the mode attribute variables for each mode.

Perceived Attribute Ratings—Among the four modes, there are a total of 90 perceived attribute ratings, of which up to 22 apply to any single mode. Clearly, it is not possible to enter all of these ratings as independent variables in the mode preference model, for several reasons. Such a large set of independent variables would be expensive to run and would use a large number of statistical degrees of freedom for the coefficient estimation. But most importantly, it would suffer from severe multicollinearity. This latter reason was one of the principal motivations for factor analysis; that is, to reduce the variable set to three principal factors for each mode. The mode-specific factors for work and shopping trips at each of the three sites and their key components were summarized in Tables 4-3 and 4-4. The factors are, of course, not merely clusters of variables, but are linear combinations of all of the perceived attribute variables. Each factor incorporates a large proportion of the variance of its "key component" variables (upon which the factor labels are based), and also a smaller element of the other variables—to the extent that they share some of their variance with the underlying factor dimension. As independent variables for the preference model, total factor scores are used.[1]

While common factor scores are a very useful means of summarizing a larger number of variables, those variables having low inter-correlations with the other variables (communalities) may not load strongly on any of the major factors. These variables may be important, nevertheless, as determinants of mode preference. The strategy adopted here, as in the earlier study by Recker and Stevens (31), was to include these individual attributes in addition to the factor scores as explanatory variables in the preference models. It is true that these separate mode attribute variables are not completely orthogonal to the factor scores, but some small element of inter-correlation is acceptable. Collinearity between independent variables may at worst raise the standard errors of the estimates, but will cause no bias. Nevertheless, in designing the model specifications, consideration was given to correlations between independent variables.

Table 4-5 lists the categories of mode attribute dimensions that were generally in common across sites and travel purposes and shows the corresponding factor name from each factor analysis. While there was general consistency in factor dimensions among the sites and travel purpose categories, there was not always a factor corresponding to each of the attribute dimension categories for all of the site and travel purpose combinations. In cases where one of these attribute dimension categories was not reflected by any of the major factor scores for a particular site and travel purpose, an attempt was made to insert an individual variable that would be representative of that dimension in the preference model. In every such case, this single variable was one that did not load (i.e., correlate) highly on any of the

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[1]The factor score for a given individual is computed from the factor score coefficients and the individual's perceived attribute ratings. Note that these factor score coefficients are different from the factor loadings (correlations) reported earlier.

TABLE 4-5 VARIABLE REPRESENTATIONS FOR VARIOUS EXPLANATORY DIMENSIONS

Mode Attribute Category	Representation in the Preference Models					
	Work Trips			Shopping Trips		
	Columbus	Denver	Huntington Beach	Columbus	Denver	Huntington Beach
Bicycle						
Safety	BIKE1	BIKE1	BIKE1	BIKE3	BIKE1	BIKE1
Effort (tiring)		BIKE3	BIKE3	Bike	Bike	BIKE3
Enjoyment: scenery, relaxation	BIKE2	BIKE2	BIKE2	BIKE1	BIKE2	BIKE2
Theft	Theft	Theft	Theft	Theft	Theft	Theft
Packages				Pckages		Pckages
Car						
Safety	CAR1	Danger Injury	CAR1	CAR1	CAR1	CAR1
Convenience: flexibility, errands	CAR2		CAR3	CAR2	Convenrnd Skedflex	CAR2
Parking	CAR3	CAR1	CAR2	Prkatshop	CAR2	Prkatshop Wlkafprk
Perceived Cost	Cost	Cost	Cost	Cost	Cost	Cost
Packages				Pckages	CAR3	CAR3
Bus						
Safety	BUS2	BUS1	BUS1	BUS1	BUS1	BUS1
Speed/Delay	BUS1	BUS2	BUS3	BUS3	BUS2	BUS3
Enjoyment: scenery, relaxation		BUS3	BUS2	BUS2	BUS3	BUS2
Packages				Pckages	Pckages	Pckages
Walk						
Safety	WALK1	WALK1	WALK1	WALK1	WALK3	WALK1
Enjoyment: scenery, relaxation	WALK2	WALK3		Relax	WALK1	WALK3
Effort (tiring)	Tiring	WALK2	WALK3	WALK2	Tiring	WALK2
Packages				WALK2	Pckages	WALK2

NOTE: Capitalized variable names denote composite factor scores; lower-case variable names denote individual perception ratings.

major factor scores. For similar reasons, the attribute variable reflecting "ease for carrying packages" was added to each shopping travel preference model for which there was no major factor score to reflect that variable.

It is important to note that the labels for the attribute variables and factors are meant to indicate only the issues being addressed, and not the direction of their respective measurement scales. For ease of interpretation in the preference model, the attribute rating scales and factor scores have been adjusted as necessary to insure that a high rating number consistently reflects a positive (desirable) rating of a mode. Therefore, all of the perceived attribute factors and individual perception variables are expected to have positive sign coefficients in the logit preference models.

Level of Service Measures—Measurement of travel time and cost effects on preference were a particular problem for the preference models at its three sites. There were several reasons for this. First, there was very little variation in out-of-pocket costs for bus at any of the sites.[1] Second, parking costs were most frequently zero.[2] This meant that the computed out-of-pocket cost for car would usually be perfectly colinear with distance (with an assumed constant gas mileage and price per gallon). Moreover, with the low level of congestion in the sampled sites, travel time was highly colinear with distance (and car costs). Respondent-estimated cost measures were also unsuccessful in model estimation. While all respondents were asked to estimate their cost to commute to work by car or bus, neither of these measures had statistically significant coefficients. The only cost element in the set of explanatory variables in the preference models is thus the perceived cost ratings for car and bus.

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[1] The stated bus fare cost by those travelling to work by bus was the same for over 80 percent of the sample in Columbus and Denver, and within a 10 cent range for over 80 percent of the sample in Huntington Beach.

[2] For those travelling to work by car, parking costs were zero for over 90 percent of the sample in Columbus and Huntington Beach, and for over 75 percent of the sample in Denver.

The motorized modes (car and bus) and the non-motorized modes (walk and bicycle) are not truly competitive with each other for all classes of travel. Travel time and distance are clearly important limiting factors in the choice between motorized and non-motorized modes, as was discussed previously. Walk and bicycle travel are usually limited to relatively short distances. Bus travel, on the other hand, is usually not a serious alternative for trips under one-half mile. Thus, walk, bicycle and bus travel may each be considered most desirable for a different distance range. Such relationships are to some extent built into the model structure, since walk mode was not considered an available alternative in the choice set of those whose home-to-work distances exceeded three miles. For bicycling, the limiting distance was six miles. Nevertheless, it is still likely that increasing travel time and distance will increase the preferences for car and bus travel relative to the non-motorized modes.

While travel time and trip distance are clearly related, travel time is traditionally the preferred explanatory variable in behavioral mode choice models because of its sensitivity to transportation policy changes. Both time and distance measures were tried in the preference model formulation. The measures of vehicular travel time for car and bus alternatives were estimated in the survey by the respondents themselves, and were judged to be of dubious reliability. The relationship between travel time and trip distance (for all three sites) is shown for each of the four modes in Table 4-6. On the basis of these tables and the fact that the coefficients for the vehicular travel time estimates yielded wide standard errors, distance was chosen as the more reliable measure of true in-vehicle travel time for car and bus. Respondent-estimated times were utilized, however, for measuring the typically shorter distance travelled by the non-motorized modes and out-of-vehicle time for the motorized modes.

<u>Age and Income Characteristics of the Individuals</u>--Separate variables to measure the effect of household income on preferences for each mode all yielded small and insignificant coefficients. The unimportance of income is not surprising insofar as income-related perceptions are reflected in the perceived attribute ratings and factors. The usual positive relationship between income and car ownership or availability was not an issue here because the car mode was defined as travelling in car as either the driver or passenger, the latter applying for those not owning a car.

TABLE 4-6 DISTANCE-TRAVEL TIME RELATIONSHIP BY MODE

a. Distance - Travel Time Relationship for Bicycle

Distance	% Distribution of Bicycle Time				
	0-9 min.	10-19 min.	20-29 min.	30-39 min.	50+ min.
¼ mi. or less	80.0	20.0	0.0	0.0	0.0
¼ to ½ mi.	59.3	22.2	3.7	14.8	0.0
½ to 1 mi.	26.2	38.1	17.9	14.3	3.6
1 to 2 mi.	15.3	31.5	23.4	26.1	3.6
2 to 4 mi.	12.8	7.4	18.1	48.9	12.9
4 to 6 mi.	0.0	4.0	7.0	56.0	33.0

b. Distance - Travel Time Relationship for Car

Distance	% Distribution of Car Time (IVTT)				
	0-9 min.	10-19 min.	20-29 min.	30-49 min.	50+ min.
¼ mi. or less	100.0	0.0	0.0	0.0	0.0
¼ to ½ mi.	77.8	18.5	3.7	0.0	0.0
½ to 1 mi.	78.6	19.0	1.2	1.2	0.0
1 to 2 mi.	54.1	39.6	4.5	1.8	0.0
2 to 4 mi.	19.1	61.7	17.0	2.1	0.0
4 to 6 mi.	18.8	46.9	28.1	6.2	0.0
6 to 10 mi.	22.2	0.0	38.9	33.4	5.6
Over 10 mi.	10.0	5.0	10.0	45.0	20.0

(expressed as row percentages)

TABLE 4-6 DISTANCE-TRAVEL TIME RELATIONSHIP BY MODE (CONTINUED)

c. Distance - Travel Time Relationship for Bus

Distance	% Distribution of Bus Time (IVTT)				
	0-9 min.	10-19 min.	20-29 min.	30-49 min.	50+ min.
¼ mi. or less	66.7	33.3	0.0	0.0	0.0
¼ to ½ mi.	25.0	12.5	37.5	25.1	0.0
½ to 1 mi.	29.4	32.4	17.6	20.6	0.0
1 to 2 mi.	15.4	23.1	30.8	26.9	1.9
2 to 4 mi.	0.0	11.4	22.7	59.9	6.8
4 to 6 mi.	0.0	16.7	8.3	58.3	16.6
6 to 10 mi.	0.0	0.0	0.0	100.0	0.0

d. Distance - Travel Time Relationship for Walking

Distance	% Distribution of Walk Time				
	0-9 min.	10-19 min.	20-29 min.	30-49 min.	50+ min.
¼ mi. or less	50.0	40.0	10.0	0.0	0.0
¼ to ½ mi.	14.8	33.3	18.5	25.9	7.4
½ to 1 mi.	3.6	7.1	27.4	51.2	10.8
1 to 2 mi.	8.1	2.7	3.6	63.9	21.6
2 to 3 mi.	0.0	0.0	0.0	28.0	72.0

(expressed as row percentages)

Age is the one demographic factor that clearly does have a strong impact on the choice between the motorized and non-motorized modes of travel. In particular, older segments of the population tend to avoid bicycling and to a lesser extent, walking. The importance of age in the choice between bicycle and the motorized modes has been shown in the mode choice model by Tardiff (23). The expected importance of age in affecting the importance weights for various attribute dimensions led to the formulation of a model in which the estimated effects of the various perception ratings were stratified for three age groups: 18-30 years, 31-45 years, and 45+ years of age. There was insufficient sample at all of the sites to support a higher age group. Earlier preference models were estimated separately for each of the three age groups. These indicated no signficiant differences in the coefficients of any of the perceived attribute variables between the lower and middle age groups, but differences between the older age group and younger groups in some coefficient effects. The final preference model formulations include terms for the additional preference effect of some variables for the older age group. Such variables are included when they are statistically signficant in the preference models for at least one site or travel purpose.

Preference Model Results

Tables 4-7 through 4-12 present the final logit results for the three sites and two travel purposes. These models include as explanatory variables all of the major factor dimensions from the perception analysis, selected other perceived attribute variables (as described under "Perceived Attribute Ratings", travel time and distance measures, age shifts for the model constants, and age interactions with the perceived attribute variables and factors. Variables which were shown to be significant for at least one of the sites or travel purposes were left in all of the models, even when they were insignificant for purposes of comparison. The resulting models achieved very good explanatory power, with a goodness of fit measure exceeding p^2=.4 in all cases.[1] This is appreciably better than that typically achieved

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[1]Rho-squared indicates the proportion of total sample log-likelihood variation that is explained by the logit equation. It is analogous to the R^2 measure of goodness of fit for linear regression.

TABLE 4-7 MODE PREFERENCE MODEL FOR WORK TRIPS - COLUMBUS

	Variable - Age Group	β	(t)
Perceived Attribute Ratings	BUS1 (travel time/delay)	.691	2.700*
	BUS2 (Safety)	.228	.819
	BUS3 (bumpy)	- .020	- .084
	WALK1 (Safety)	.183	1.162
	† WALK2 (flexibility/Scenery)	.593	2.907*
	† WALK3 (travel time)	1.056	4.754*
	BIKE1 (Safety	.090	.544
	BIKE2 (enjoy/convenience)	.726	3.437*
	CAR1 (Safety)	.565	2.416*
	† CAR2 (convenience)	.381	1.588
	CAR3 (parking)	.340	1.707*
	BUS2 x Age > 45	1.207	1.844*
	BIKE2 x Age > 45	- .134	- .302
	Bike Theft	.311	2.318*
	† Car Cost (perceived)	.359	2.189*
	Walk tiring	.672	3.890*
	Walk tiring x Age > 45	1.053	3.032*
	Bus Constant	-5.026	-6.012*
	Walk Constant	-5.513	-5.479*
	Bike Constant	-3.888	-4.438*
	Walk Constant x Age > 45	-3.949	-3.257*
	Bike Constant x Age > 45	-1.038	-2.619*
	Car Dist (miles)	.299	1.408
	Bus Dist (miles)	.175	1.072
	Bike IVTT (hours)	-1.344	-2.898*
	Walk Time (hours)	- .971	-2.016*
	Bus/Bike/Car OVTT (hours)	- .219	- .449

LnL (0) = -527.2
LnL ($\hat{\beta}$) = -285.6

ρ^2 = .458

Total observations = 547
Total alternatives = 1486

* Significant at the .05 level for a one-tailed best

NOTE: All perceived mode attribute ratings have been scaled so that a high value signifies a positive (desirable) perception of the mode. The symbol "†" denotes variables for which the scale has been reversed from the original definition used for the factor analyses (Appendix C).

TABLE 4-8 MODE PREFERENCE MODEL FOR WORK TRIPS - DENVER

	Variable - Age Group	β	(t)
Perceived Attribute Ratings	BUS1 (Safety)	.593	2.583*
	BUS2 (travel delay)	.621	2.725*
	† BUS3 (enjoyment)	.920	4.343*
	WALK1 (Safety/delay)	.636	2.317*
	WALK2 (tiring/delay)	1.304	4.297*
	† WALK3 (enjoyment)	1.194	4.125*
	BIKE1 (Safety)	.818	3.999*
	† BIKE2 (enjoyment)	1.447	5.492*
	BIKE3 (effort)	1.364	5.765*
	CAR1 (parking)	.545	2.613*
	CAR2 (reliability)	.897	3.244*
	CAR3 (enjoyment)	.017	- .032
	BUS1 x Age > 45	.158	.243
	WALK2 x AGE > 45	-1.277	-1.592
	† BIKE2 x Age > 45	.368	.345
	Bike Theft	.112	.803
	† Car Cost	.039	.257
	Car Danger	.566	2.634*
	Car Injury	- .998	-2.067*
	Bus Constant	-2.805	-1.493
	Walk Constant	-2.179	-1.146
	Bike Constant	-2.506	-1.290
	Walk Constant x Age > 45	- .767	-1.055
	Bike Constant x Age > 45	-1.753	-2.477*
	Car Dist (miles)	.453	2.947*
	Bus Dist (miles)	.345	2.280*
	Bike IVTT (hours)	-1.211	-2.132*
	Walk Time (hours)	-2.331	-3.092*
	Bus/Bike/Car OVTT (hours)	- .901	-1.800*

LnL (0) = -424.4
LnL ($\hat{\beta}$) = -228.5
ρ^2 = .462

Total observations = 449
Total alternatives = 1197

* significant at the .05 level for a one-tailed test

NOTE: (See Table 4-7)

TABLE 4-9 MODE PREFERENCE MODEL FOR WORK TRIPS - HUNTINGTON BEACH

	Variable - Age Group	β	(t)
Perceived Attribute Ratings	BUS1 (Safety)	.924	2.102*
	BUS2 (enjoyment)	.321	.743
	BUS3 (delay)	1.256	2.687*
	WALK1 (Safety)	.620	1.766*
	WALK2 (delay/flexibility)	2.272	4.818*
	WALK3 (effort/enjoyment)	.902	2.147*
	BIKE1 (Safety)	.426	1.465
	† BIKE2 (enjoyment)	.847	2.443*
	BIKE3 (effort)	1.377	3.311*
	CAR1 (Safety)	1.000	1.968*
	CAR2 (parking)	.218	.578
	† CAR3 (convenience)	.312	.786
	BUS1 x Age > 45	.207	.132
	WALK3 x Age > 45	2.504	2.643*
	† BIKE2 x Age > 45	4.366	3.013*
	Bike Theft	.299	1.210
	† Car Cost	.085	.357
	Bus Constant	-5.131	-4.037*
	Bike Constant	-3.229	-2.547*
	Walk Constant	-3.226	-2.806*
	Walk Constant x Age > 45	- .225	- .237
	Bike Constant x Age > 45	-1.167	-1.397
	Car Dist (miles)	.050	.217
	Bus Dist (miles)	.162	.707
	Bike IVTT (hours)	-2.616	-2.392*
	Walk Time (hours)	-2.494	-2.047*
	Bus/Bike/Car OVTT (hours)	- .494	.354

LnL (0) = -251.7
LnL ($\hat{\beta}$) = -104.3

ρ^2 = .586

Total observations = 280
Total alternatives - 712

* significant at the .05 level for a one-tailed test

NOTE: (See Table 4-7)

TABLE 4-10 MODE PREFERENCE MODEL FOR SHOPPING/PERSONAL BUSINESS TRIPS - COLUMBUS

	Variable - Age Group	β	(t)
Perceived Attribute Ratings	BUS1 (Safety)	.686	2.610*
	† BUS2 (enjoyment/convenience)	1.109	4.566*
	BUS3 (delay, access)	.254	1.257
	WALK1 (Safety)	- .329	-1.587
	† WALK2 (effort/packages)	.475	2.057*
	† BIKE1 (enjoyment)	.551	2.375*
	BIKE2 (Safety1)	.434	2.089*
	BIKE3 (Safety2)	- .308	-1.677*
	CAR1 (Safety)	- .029	- .084
	† CAR2 (convenience)	.980	3.265*
	† CAR3 (delay)	.270	.797
	BUS1 x Age ≥ 45	- .356	- .958
	† BIKE1 x Age > 45	.189	.518
	† Car Cost	- .265	-1.515
	† Walk Relax	.181	1.524
	Bike Tiring	.234	1.432
	† Bike Packages	.207	1.154
	† Car Prkatshp	.178	.607
	† Car Packages	.079	.195
	† Bus Packages	- .055	- .311
	Walk Tiring	.368	2.562
	Walk Tiring x Age > 45	.200	1.048
	Bus Constant	-2.932	-2.342*
	Walk Constant	-3.366	-2.713*
	Bike Constant	-2.560	-1.680*
	Walk Constant x Age > 45	- .455	- .869
	Bike Constant x Age ≥ 45	-1.116	-3.181*
	Bus Dist (miles)	.219	1.502
	Bus/Bike/Car OVTT (hours)	- .102	- .262
	Car Dist (miles)	.253	1.025
	Walk Time (hours)	.059	.118
	Bike IVTT (hours)	- .200	- .430
	Bike Theft	.169	1.088

LnL (0) = -530.2
LnL ($\hat{\beta}$) = -304.9
ρ^2 = .425

Total of observations = 527
Total of alternatives = 1503

* significant at the .05 level for a one-tailed test

NOTE: (See Table 4-7)

TABLE 4-11 MODE PREFERENCE MODEL FOR SHOPPING/PERSONAL BUSINESS TRIPS—DENVER

	Variable - Age Group	β	(t)
Perceived Attribute Ratings	BUS1 (Safety)	.111	.400
	BUS2 (travel time/delay)	.287	1.040
	† BUS3 (enjoyment)	.828	3.582*
	† WALK1 (enjoyment/convenience)	1.413	5.501*
	WALK2 (Safety-crime)	- .988	-3.677*
	WALK3 (Safety)	.412	2.073*
	BIKE1 (Safety)	.265	1.491
	† BIKE2 (enjoy/convenience)	1.794	6.556*
	BIKE3 (Safety-crime)	.566	2.199*
	CAR1 (Safety)	.471	2.204*
	CAR2 (parking)	.260	.144
	† CAR3 (travel time/packages)	- .132	- .491
	BUS1 x AGE > 45	- .088	- .184
	BIKE2 x Age > 45	.530	1.080
	Bike Theft	- .076	- .491
	† Car Cost	.163	1.200
	† Walk Packages	.591	3.371*
	Bike Tiring	.726	3.720*
	Car Rain	.047	.151
	† Car Cnverrnd	.287	1.365
	† Car Skedflex	.799	3.325*
	† Bus Packages	.802	3.936*
	Walk Tiring	1.181	5.326*
	Walk Tiring x Age > 45	.132	.430
	Bus Constant	-2.876	-1.567
	Walk Constant	-6.465	-3.305*
	Bike Constant	-7.139	-3.774*
	Walk Constant x Age > 45	.078	.074
	Bike Constant x Age > 45	-1.909	-3.995*
	Bus Dist (Miles)	.185	1.340
	Bus/Bike/Car OVTT (hours)	- .377	- .746
	Car Dist (miles	.093	.600
	Walk Time (hours	- .700	-1.405
	Bike IVTT (hours	.081	.191

LnL (0) = -509.9
LnL ($\hat{\beta}$) = -281.7
ρ^2 = .448

Total observations = 533
Total alternatives = 1440

* significant at the .05 level for a one-tailed test

NOTE: (See Table 4-7)

TABLE 4-12 MODE PREFERENCE MODEL FOR SHOPPING/PERSONAL BUSINESS TRIPS - HUNTINGTON BEACH

Group		Variable - Age Group	β	(t)
Perceived Attribute Ratings		BUS1 (Safety)	1.034	3.782*
	†	BUS2 (enjoyment)	.881	3.145*
		BUS3 (delay)	1.059	4.615*
		WALK1 (Safety)	.418	1.857*
		WALK2 (effort/delay/packages)	-.300	-1.142
	†	WALK3 (enjoyment)	-.642	-3.214*
		BIKE1 (Safety)	.077	.354
	†	BIKE2 (enjoyment)	.730	2.987*
		BIKE3 (travel time/effort)	1.077	4.309*
		CAR1 (Safety)	.598	1.695*
	†	CAR2 (convenience)	.512	1.463
		CAR3 (delay/packages)	-.568	-1.790*
		BUS1 x Age > 45	-.994	-2.524*
		WALK2 x Age > 45	.311	.790
	†	BIKE2 x Age > 45	-.097	-.220
		Bike Theft	.358	2.233*
	†	Car Cost	.184	.705
		Walk Mugged	.231	1.950*
	†	Walk Skedflex	.099	.760
		Bike Insect	.499	2.318*
	†	Bike Packages	-.111	-.685
	†	Car Wlkafprk	.978	1.655*
	†	Car Pkaftshp	.425	1.568
	†	Bus Packages	-.328	-1.869*
		Bus Constant	-11.505	-3.745*
		Walk Constant	-9.603	-3.130
		Bike Constant	-12.216	-3.812*
		Walk Constant x Age > 45	-.340	-.934
		Bike Constant x Age > 45	-.255	-.659
		Bus Dist (miles)	.802	4.081*
		Bus/Bike/Car OVTT (hours)	.030	.090
		Car Dist (miles)	.813	2.374*
		Walk Time (hours)	.529	.876
		Bike IVTT (hours)	1.730	2.971*

$LnL(0) = -537.1$

$LnL(\hat{\beta}) = -270.4$

$\rho^2 = .497$

Total observations = 536
Total alternatives = 1524

* Significant at .05 level for a one-tailed test

NOTE: (See Table 4-7)

by mode split models incorporating only objective measures of mode attributes, and is consistent with the findings of the study by Kaplan et al. (14).

The preference model results for the major categories of explanatory variables are summarized in Table 4-13. One of the most significant findings we are left with in this study is that there are important differences across sites both in mode-attribute perceptions and in preferences and that any thorough analysis of non-motorized versus motorized mode choices must take regional differences into account.

Bicycle Preference

Concentrating first on general trends which appear across sites and trip purposes, we can make the following observations: An aesthetic enjoyment factor incorporating scenery enjoyment and relaxation was a significant factor for choosing bicycle as a mode in all sites and for both trip purposes. While in itself this is not a particularly surprising finding, the consistency of the result serves to demonstrate empirically that qualitative factors not traditionally included in mode-choice models influence behavior to a significant degree.

The attribute "tiring" was found to be a consistent and usually significant detriment to bicycle choice. By contrast, fear of safety and the ability to carry packages did not have a significant effect on bicycle choice in any of the sites or travel purposes. Reflecting the schedule constraints of jobs, bicycle travel time had a significant negative effect at all three sites for work travel, but an insignificant or counterintuitive effect for shopping/personal business travel. Surprisingly, fear of bicycle theft was an important consideration only for work trips in Columbus and shopping trips in Huntington Beach. At all three sites, older persons (over age 45) were consistently less likely to choose bicycle than younger persons.

Walk Preference

The explanatory variables affecting the choice of walking were very similar to those affecting bicycle choice. Aesthetic enjoyment and concerns about safety and tiring

TABLE 4-13 SUMMARY OF LOGIT COEFFICIENT RESULTS FOR VARIOUS EXPLANATORY VARIABLE DIMENSIONS

Mode Attribute Category[1]	Work Trips			Shopping/Personal Business Trips		
	Col.	Den.	HB	Col.	Den.	HB
Bike Attributes						
Safety (Danger, Injury, Unsafe)	✓	✓	✓	(C)	✓	✓
Speed/Effort (Tiring)		(✓)	(✓)	✓	(✓)	(✓)
In-vehicle Travel Time	(✓)	(✓)	(✓)	✓	X	(X)
Enjoyment (Greatout, Relax)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
Packages				✓		X
Theft	(✓)	✓	✓	✓	X	(✓)
Enjoyment (Greatout) x Age > 45	X	✓	(✓)	✓	✓	X
Age > 45 Preference Shift	(✓)	(✓)	(✓)	(✓)	(✓)	✓
Car Attributes						
Safety (Danger, Mugged, Injury)	(✓)	(C)	(✓)	✓	(✓)	(✓)
Convenience (Skedflex, Converrnd)	✓		✓	(✓)	(✓)	✓
Parking Convenience	(✓)	(✓)	✓	✓	✓	(✓)
Perceived Cost	(✓)	✓	✓	X	✓	✓
Destination Distance	✓	(✓)	✓	✓	✓	(✓)
Packages				✓	X	(X)

✓ Expected Sign

X Unexpected Sign

C Component variables yield conflicting signs

○ Significant at the .05 level for a one-tailed test (t > 1.645)

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[1] Defined in Table 4-5.

TABLE 4-13 SUMMARY OF LOGIT COEFFICIENT RESULTS FOR VARIOUS EXPLANATORY VARIABLE DIMENSIONS (Continued)

Mode Attribute Category[1]	Work Trips			Shopping/Personal Business Trips		
	Col.	Den.	HB	Col.	Den.	HB
Bus Attributes						
Safety (Danger, Injury)	✓	(✓)	(✓)	(✓)	✓	(✓)
Speed/Delay (Wait)	(✓)	(✓)	(✓)	✓	✓	(✓)
Enjoyment (Greatout, Relax)		(✓)	✓	(✓)	(✓)	(✓)
Packages				X	(✓)	(X)
Destination Distance	✓	(✓)	✓	✓	✓	(✓)
Safety x Age > 45	(✓)	✓	✓	X	✓	(X)
Walk Attributes						
Safety (Danger, Bumpy, Injury)	✓	(✓)	(✓)	X	(C)	(✓)
Enjoyment (Greatout, Relax)	(✓)	(✓)	✓	✓	(✓)	(X)
Effort (Tiring)	(✓)	(✓)	✓	(✓)	(✓)	✓
Travel Time	(✓)	(✓)	(✓)	✓	(✓)	(X)
Packages				(✓)	(✓)	✓
Age > 45 Preference Shift	(✓)	✓	(✓)	✓	✓	✓
Effort (Tiring) x Age > 45	(✓)	X	(✓)	✓	✓	X

✓ Expected Sign

X Unexpected Sign

C Component variables yield conflicting signs

◯ Significant at the .05 level for a one-tailed test (t > 1.645)

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[1] Defined in Table 4-5

all showed the significant expected effects in most of the cases. Concern about carrying packages for shopping trips also had a consistent and expected effect that was significant at two of the three sites. Similar to the finding for bicycle choice, actual travel time by walking was a significant variable at all three sites for work trips, but showed an insignificant or counter-intuitive coefficient for shopping trips at two of the sites. For older persons in Columbus and Huntington Beach, concern about tiring was an additional and significant detriment to walking to work beyond the effect of tiring for the rest of the population.

It is notable that the perceived attribute "tiring" was a consistent detriment to both bicycle and walk travel regardless of travel purpose, while travel time by these non-motorized modes was a significant variable only for work trips. Both measures can be important influences on mode choice. Clearly, travel time considerations must to some extent affect traveller behavior on any utilitarian trip. But so, too, do factors such as how tiring and unpleasant a mode is to use. There is a relationship between tiring and travel time, since by pedalling faster on bicycle or running rather than walking, a traveller can always decrease the travel time required by non-motorized modes. That few bikers are observed racing to work and few pedestrians are seen running to a store testifies to the negative effect the variable tiring has on non-motorized mode choice. In traditional approaches, travel time has been used as a proxy for exertion aspects, thus ignoring the actual differences between the two attributes. In our study, where travel time did not appear to be significant, particularly for the often short shopping/personal business trips, inclusion of the measure "tiring" proved particularly important.

Bus Preference

Turning to the estimation results vis-a-vis bus travel, aesthetic considerations turn out to be significant in the preference models for transit in shopping trips. This is particularly a reflection of the "leave-the-driving-to-us" aspect of bus travel as well as the frequent sentiment that it is easier to take the bus than to walk or ride a bike, particularly on trips of a mile or more. Waiting time and delay consideration factors, on the other hand, proved to be important deterrents to bus use, particularly for work travel in all three sites. The significance and magnitude of the parameter estimate on the time and delay factor points to the importance of a mode's ability to get the commuter to work on time. For shopping travel, time reliability proved significant in only one of the sites (Huntington Beach). Concern about the ability to carry packages on the bus was not a significant detriment to choosing bus except for Denver shopping travel.

Increasing destination distance had the general effect of increasing the probability of choosing bus relative to the other modes, although the coefficient was statistically significant only for work trips in Denver and shopping trips in Huntington Beach. As discussed earlier, the direction of this effect may be interpreted as reflecting the increasing utility of the motorized modes relative to the non-motorized modes as distances increase.

Car Preference

The estimated influence of auto attributes on mode preferences showed less consistency across sites and travel purposes than did the attributes of other modes. This may be in part due to the structure of the model as well as actual site differences. Among car-specific variables, safety generally had a significant positive effect at all sites, although the Denver work trip model showed different effects for vehicular travel safety and safety from crime. The other car attribute variables had less clear-cut patterns. Parking considerations showed significant effects in Columbus and Denver for work trips, but in Huntington Beach for shopping travel. Convenience for errands and schedule flexibility appear significant for shopping trips at two of the three sites, but were not significant at all for work trips. Concern about ease of carrying packages by car had no significant effect for shopping mode preference at any site.

The effect of destination distance on auto choice was very consistent with its effect on bus choice. As with bus choice, the probability of choosing car relative to the other (non-motorized) modes increased with greater distances, although the effect was statistically significant only for Denver work trips and Huntington Beach shopping trips.

The interpretation of these results must be viewed with caution. The structure of factors varies from one model to the next, which in part accounts for observed differences in the significance of seemingly analogous factors across sites. However, overall, the similarities in the model results are more important than the differences, as will be shown in the next section where the models are used to forecast modal demands under alternative scenarios.

Forecasting Future Mode Choice

The models of mode choice for work trips and shopping/personal business trips at each of the three sites were applied to evaluate potential demand responses to four basic strategies described in Chapter 3:

1. bicycle facility improvements
2. pedestrian facility improvements
3. land use (distance and facilities) changes
4. congestion fees applied to auto users.

An additional policy issue—that of mode choice demand changes resulting from gasoline price increases—was not investigated using the preference models because respondents were not asked to subjectively rate driving car for this scenario.[1]

The forecasting exercise involved applying the previously estimated logit model to the revised mode attribute perception ratings in order to predict first preferences for mode choice under each future scenario. These predicted preferences were

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[1]As noted previously, it was not possible to estimate a coefficient for objectively reported travel costs because of limited variation in the data (i.e., no differential parking costs and flat transit fares). A subjectively scaled variable on travel costs was used during estimation, but the resulting coefficients were mostly insignificant. Moreover, the questionnaire did not ask respondents to rescale their rating of driving costs under alternative fuel price scenarios, so in any event, predictions for this scenario were not possible.

then compared to the stated preferences in order to evaluate the extent to which the two agreed.

For each policy evaluation, the sites chosen for analysis were those that had relatively large reported shifts in modal preferences. Summaries of these analyses are presented in Table 4-14. Current or base-line modal preferences are shown also for comparison purposes. Note that the reported base-line percentages are drawn from all respondents, while only half the repondents were asked to rate and rank preferences for any given scenario.

A number of previous studies (13, 14) have found that stated intentions tend to overpredict the extent of actual mode choice shifts subsequently made. It is thus not surprising that the logit preference models predicted far smaller mode preference shifts in response to all of the stretcher scenarios than that indicated by the stated preferences examined in Chapter 3. For pedestrian facility improvements and bicycle facility improvements, the logit models do predict an increased mode share for the corresponding mode given facility improvements, but the predicted change is always dramatically less than the preference shift stated by individuals. Similarly, the models predict a shift away from car in response to an auto congestion fee, but the predicted shift is far smaller than that stated by the respondents. The land use scenario, which consists fundamentally, of decreasing travel distance and adding special paths for pedestrians and bicyclists, leads to an increase in preference for walk and bicycle travel, a decrease for car travel, and an increase of varying degrees in preference for bus.

There are several reasons for the difference between the future mode preferences predicted by the models and those stated by respondents. As mentioned above, previous studies have found that individuals generally overstate future mode choice changes when offered hypothetical situations. In addition, forces of inertia tend to reduce the extent of behavior changes even in the face of clearly superior choice alternatives. These reasons both cast some doubt on the usefulness of reported preferences under the stretcher scenarios, and suggest that the more modest mode preference changes predicted by the models may be the more reasonable estimates for the future.

TABLE 4-14 PREDICTED MODE PREFERENCE FOR ALTERNATIVE SCENARIOS

	Land Use Scenario			Bicycle Facilities Scenario	
	Work Trips (Columbus)			Work Trips (Columbus)	Shopping Trips (Denver)
	Car	Bicycle	Walk	Bicycle	Bicycle
Baseline First Preference	87.8	4.3	6.1	4.3	5.6
Predicted Preference	79.9	6.7	12.0	5.3	6.0
Stated Preference	38.2	32.8	22.5	13.9	24.0

	Congestion Fee Scenario						Walk Facilities Scenario	
	Work Trips (Hunt. Beach)			Shopping Trips (Hunt. Beach)			Work Trips (Denver)	Shopping Trips (Columbus)
	Car	Bike	Walk	Car	Bike	Walk	Walk	Walk
Baseline First Preference	89.2	3.8	3.2	90.7	3.8	4.8	6.1	5.1
Predicted Preference	80.2	13.9	3.9	83.8	8.1	4.0	7.3	6.6
Stated Preference	45.5	19.0	7.6	55.4	37.2	14.2	30.8	20.0

There are also reasons for potential error in the model predictions. In the first place, as discussed earlier, a number of previous studies have concluded that perceptions of the modes not only affect mode choice decisions, but are themselves affected by those same mode choice decisions. This behavior may be due in part to a desire by individuals to reduce cognitive dissonance, i.e., perceived inconsistencies between perceptions and already-taken actions. The models in this study assume the most common straightforward behavioral scheme in which perceptions of the modes determine preferences, which in turn largely determine actual mode choice behavior. These models thus do not recognize the existence of any feedback loop whereby perceptions (and hence, preferences) are themselves colored by already-made choice decisions. In fact, then, preference model predictions for the stretcher scenarios may be inaccurate due to potential differences between the currently reported mode perceptions responses to hypothetical scenarios and the perceptions that would be reported if these scenarios came to pass and mode choice decisions were already made.

Secondly, a related issue is the significance of the preference model coefficient estimates, which are directly related to the extent of variance in the current perceptions of mode attributes by individuals. For instance, the relatively low importance of perceived car costs may be due to a lack of variation among the population in perceptions of car expenses at present cost levels. It may be the case, however, that a larger variation in this perceived attribute among segments of the population may occur as car-related expenses rise beyond some threshold level.

Despite the possibility of some error in the preference model predictions (probably on the side of underprediction of non-motorized mode share), these predictions still yield useful insights into the impact of alternative transportation policies on mode preferences. These predictions suggest that even substantial improvements to bicycle and pedestrian facilities may result in only minor or, at best, moderate increases in the usage of bicycle and walking for work and shopping trips. A comparison of the predicted share of non-motorized use under the bicycle and pedestrian facilities scenarios, on the one hand, and the land use scenario on the other, tends to confirm the previous finding that land use compactness has the greater potential for effecting shifts to non-motorized modes (see Table 4-14, Columbus).

Summary of Findings

A summary of the major findings related to model development and subsequent forecast is given next.

1. The use of attitudinal rating techniques allows for the identification of mode attributes that cannot be easily ascertained by direct physical measurement.

2. The perception models, utilizing factor analysis, identified several common dimensions underlying perceived mode attributes. Some dimensions were common among both the motorized modes (car, bus) and the non-motorized modes (bicycle, walk). These were:

   - concerns about safety in heavy traffic
   - the ability to relax and enjoy the scenery
   - the extent of physical exertion and speed.

   Other attribute dimensions were unique to individual modes, such as:

   - for car—the extent of flexibility in route and travel time
   - for car—concerns about parking availability, cost, and access distances
   - for bus—the extent of waiting and delays

   Some variables were not highly correlated with other mode attributes. These include ease for carrying packages, perceived costs, and bicycle theft. There were minor differences in the composition of the factor dimensions between the sites, reflecting differences in perceived attribute relationships between different community size and density environments.

3. Perceived mode attribute factors contributed a large proportion of the total explanatory power of the mode preference models. A number of findings were common to all sites. Relaxation/scenery enjoyment and the extent of tiring physical exertion were both significant variables in the choice of bicycle and walk modes. Older persons showed an aversion to bicycling and walking even after controlling for other explanatory variables. In addition, the effect of tiring perceptions on the choice of walking was significantly greater for persons over age 45 than for younger persons. The bus attributes of relaxation/scenery enjoyment and wait/delay considerations both had significant effects on mode choice in most cases. For car, safety and parking considerations were important explanatory variables. Route and schedule flexibility were also important, but for shopping travel only.

4. The motorized and non-motorized modes of travel are not strictly competitive for most travel distances, as walk and bicycle are predominantly used for short distance trips, while bus and car travel were predominantly used for longer distance travel. Within the limited distance range, travel time for walking and bicycling consistently had a significant negative effect on the choice of the corresponding modes for work trips, but no significant effect for shopping/personal business travel. This is consistent with a greater concern for schedule considerations for travel to work. It was not possible to estimate mode preference coefficients of travel time and cost for the motorized modes in these settings where parking is generally freely available and bus service coverage is limited. The preference models did, however, show that the probability of choosing both car and bus rose with increasing travel distances.

5. The preference models may be applied to predict preference changes in response to alternative policy strategies, using revised perception ratings for hypothetical scenarios. The preference models consistently predicted mode preference shifts that were far smaller than the dramatic preference shifts stated by the respondents in response to the described scenarios. Although there are potential sources of error in the preference model predictions, there is strong reason to believe that these predictions are more reasonable

than the respondent-stated mode preference changes. The model predictions suggest that improvements to bicycle and pedestrian facilities will, by themselves, lead to very modest increases in the respective usage of bicycle and walking for work and shopping trips.

6. The results of the mode attribute perception models, the mode preference models, and the forecasting exercises all indicate some differences in variable definitions and effects between sites and between work and shopping purposes. Nevertheless, the significant variables in the preference models and the subsequent preference predictions made all indicate a general consistency across sites and travel purpoess that support the use of these techniques for application to other geographic settings and a wider set of policy tests.

5.

COST AND BENEFITS OF INCREASING NON-MOTORIZED TRAVEL

Introduction

Forecasted travel obtained from the preference models developed in Chapter 4 indicates that--even under the very optimistic, hypothetical conditions of some of the strategies tested--only low to moderate shares of the market are captured by non-motorized modes. As an example, the "improvement of bicycle facilities" strategy, which includes provision of bicycle paths, reserved street lanes for bicycle use, improved road surfaces, installation of bicycle lock-up facilities and provision of adequate lighting on all bicycle paths and lanes, results in a predicted share of 5.3 percent of bicycle travel in the Columbus site (current bicycle share is approximately one percent). Notwithstanding the large relative increase in predicted use over current use--more than a five-fold increase--the fact remains that in absolute terms the potential for attracting a large number of users is low (a net increase of 4 percent).

Based on the above results, which are representative of the level of magnitude obtained for the other sites, the following observations can be made:

First, it appears that in order to accomplish even modest increases in the levels of walking and bicycling, a family of measures or incentives must be implemented. This is precisely what motorized traffic enjoys and takes for granted. The infrastructure for automobile travel includes not only the street and highway system, but also safe levels of lighting, ubiquitous parking facilities, and a proliferation of signs, signals and controls aimed at ensuring a safer driving environment. Access controlled freeways are, in fact, an effort to protect motorized traffic from itself by segregating its patrons, thus limiting conflicts with users of lower function roadways. Assuming a need for travel exists, it is perhaps this type of commitment to a mode that is needed to insure its acceptability and success.

Secondly, disincentives to auto use such as described in the "congestion fee" scenario, or increases in the price of fuel, will generally be motivated by needs extraneous to increasing use of non-motorized modes. Usually the goals of such actions are aimed at reducing congestion, pollution or fuel consumption (or combinations of these). As a result, it is not realistic to compare the cost of such measures (nor their benefits) with the costs and benefits of measures aimed specifically at increasing non-motorized travel. These two actions are not, in fact, mutually exclusive. Transit and non-motorized modes must fill the transportation supply gap that would be created by the constraints placed on automobile use.

Finally, the land use scenario reveals that if the motivation for travel exists in terms of opportunity and accessibility (distance), then provision of the means (facilities) to accomplish the travel will create an environment conducive to the use of non-motorized modes. Generally speaking, this implies that in built-up urban environments one must first identify those areas which fulfill the land use compactness represented in the scenario (college campuses, shopping centers, central business districts, and their residential surroundings). Once these areas are identified, then the provision of bicycle and walking facilities and support features can be investigated.

Identification of Costs and Benefits

Costs--Table 5-1 summarizes the cost components and elements associated with the provision of better walking and bicycling environments, and thus with increased use of these modes. In addition to the costs identified in this table, there are a number of direct and indirect costs, listed next, which also must be estimated in order to arrive at the total cost of providing and using the facilities or programs. It should be pointed out that, for specific trips, some of the cost items listed might not occur. Since they can occur, however, the cost elements have been included. The analyst should ascertain whether a given cost element is applicable or not to the specific project.

Indirect costs

1. Travel Time Costs

Travel time costs refer to the increased travel time generally associated with trips diverted from the automobile to the slower non-motorized modes. Hirst (33) has shown that if speeds of 10 mph for bicycles and 20 mph for auto are assumed, and if parking delays of 5 and 6 minutes, respectively, are also assumed, then bicycle travel time will exceed auto travel time for trips over one-third of a mile. Even if a bicycle speed of 15 mph is assumed, bicycle travel time will exceed auto travel time for trips over one mile. Obviously then, a time penalty should be assessed the bicycle for trips over one-third of a mile (or one mile depending on the speed assumption). At the same time, however, time penalties should be assessed on auto use for trip lengths below the limits indicated, or when congestion is such that auto speed is reduced significantly.

TABLE 5-1 MAJOR COST ELEMENTS OF FACILITIES AND PROGRAMS

Cost Component	Cost Elements	Cost
1. Planning	Personnel, planning studies	Salaries
2. Construction of facilities	Pathways/sidewalks, bike paths/lanes, landscaping, lighting, signs	ROW, Capital, O & M
3. Improvement of facilities	Intersection improvements, barrier removal, spot improvements, repairing, traffic management, grate strapping, bicycle/pedestrian actuated signals, bridges	Capital, O & M
4. Parking facilities	Bicycle lockers, racks	Capital
5. Ancillary facilities	Showers, lockers, water fountains	Capital, O & M
6. Maintenance	Equipment, personnel	Capital, salaries, O & M
7. Monetary/time Incentives	Tax credits, flexible schedule, reduction in length of work day	Time, taxes
8. Educational and Marketing Programs	Teaching personnel, TV, radio and newspapers, printing and distribution of materials	Salaries, materials
9. Regulatory and Enforcement Programs	Personnel, police training	Salaries

2. Costs of Owning and Operating Equipment

These costs are of two kinds: fixed costs (e.g., annual fraction of purchase price, license, etc.) and variable costs (operation, travel time). The variable costs are dependent on miles travelled, speed of travel and access times. (See Travel Time Costs above).

3. Reduced Transit Revenues

As seen in previous sections, the introduction of incentives to non-motorized use has the effect of diverting a number of users from the transit system. The costs associated with the loss of patronage results in a loss of revenues from the fare box and a potential loss of revenues from reduced passenger subsidy.

4. Intrusion Into Neighborhoods

Construction of facilities for walking and bicycling along neighborhoods can sometimes result in reduction of privacy, increased litter and noise, and disruption of neighborhood life. Though difficult to quantify, there are costs associated with these intrusions, not the least of which is the potential for reduction in property values.

5. Reduced Parking Capacity

If parking lanes are replaced by bicycle facilities on existing street systems, parking replacement in the immediate area might be required. The solution might be to provide off-street parking. Were this to occur, the associated costs must be taken into account.

6. Potential Health Hazards

The effects on health of bicycling (or walking) along roads with heavy vehicular traffic has been explored, but the results are at this point inconclusive (34). Should future analysis confirm health hazards, the health cost to the user of the facilities must be taken into account.

Benefits--Many of the benefits associated with increases in the mode shares of walking and bicycling occur because of the corresponding reduction in the share of motorized travel. Some benefits, however, are inherent in the activity of walking and bicycling. Benefits are identified next.

Benefits

1. Increased aesthetic enjoyment
2. Exercise/improved fitness
3. Reduced energy use
4. Reduced air pollution
5. Reduced noise levels
6. Reduced automobile costs
7. Reduced from reduced vehicular miles of travel.
8. Potential elimination of need to construct additional auto lanes.

Quantification of Costs and Benefits

Recorded below are a number of cost and benefit elements that cannot be readily converted into dollar amounts. These factors, nevertheless, are very important when trying to determine the overall cost effectiveness of the various strategies. As work is carried out on the quantification of these factors, they should be included in the calculation of the dollar amount of cost and benefits.

Increased intrusion into neighborhoods--The implementation of a path system within a residential neighborhood can cause a reduction in the privacy of those homes that are located along the path. Few people complain about having sidewalks in front of their homes (unless they are assessed for the costs). However, when the paths are located along the backyard lines, a great deal of neighborhood opposition can develop.

Planning the path system at the time of designing the subdivision or the planned unit development will help to alleviate some of the inherent problems. First, the site design can concentrate on reducing the views of backyards from the paths by manipulation of elevations. Second, the home buyers know beforehand where the paths are located. Third, added planting materials can be located between the paths and homes.

While all these steps may help reduce the negative impacts of the paths, if the residents perceive the path's location as a problem, an associated cost should be assumed to exist. Should the intrusion lead to vandalism, crime and additional litter, a cost can be established based on the property value destroyed, added insurance cost, additional police patrols required, increased maintenance costs, and reduction in property values. If these problems do not occur but, instead, the only concern of residents is related to reduced privacy, then an attempt to develop a cost estimate will be difficult.

Increased aesthetic enjoyment--This factor would be added to the positive side of the scale. Again, attempting to put a dollar cost on this aspect of bicycling or walking is so speculative that it would detract from the true value that individuals might place on this aspect of the trip making. Methods to quantify this value might include the value people place on their free or recreation time. In this way, an average value of time could be used to establish a dollar value each hour of bicycling or walking.

The fallacy in this method is that our analysis is directed at purposeful travel. The trip has to be made at some point in time and it is not recreational in nature. Thus the total value of time cannot be ascribed to the aesthetic enjoyment of the trip.

Reduced vehicular noise--While it is not a difficult problem to measure noise along a road, or to use standard formulas to estimate hypothetical noise levels given a certain volume of traffic, estimating the noise from a few vehicles is not a simple procedure. Nevertheless, a reduction in motor vehicle traffic will result in less noise. The amount of noise that is reduced is a function of the concentration of vehicles on a street, the physical characteristics of the street (i.e., grade) and the distance of the receptors from the road.

Reduced/Increased accidents--Generally, lack of reliable accident data for bicycles and pedestrians can make it difficult to ascertain the true effect of increasing shifts from motorized to non-motorized travel. However, with increased interest in the subject, it is likely that better accident reporting and record keeping will be instituted.

Potential health hazards to pedestrian/bicyclists--At present, the data on the health hazards to bicyclists/pedestrians sharing the right-of-way with motorized traffic is mixed. No serious short-term ill-effects have been found for bicyclists.

Most costs and benefits are quantifiable. The estimation procedures described next are for net costs and benefits. The assumption is that the costs and benefits accrued because of shifts from motorized to non-motorized travel, are the difference between future and current levels of use.

Before proceeding with the development of formulas for estimating costs and benefits, two factors should be determined. The first is the net reduction in auto share:

$$\text{Net Reduction In Auto Share} = \left(\text{Predicted Bike/Ped Share (percent)} - \text{Current Bike/Ped Share (percent)}\right) \times \text{Fraction from Auto}$$

In this expression, "Fraction from Auto" refers to the fraction of Bike/Ped trips that comes from auto (after discounting the fraction from transit or other mode).

The other index is the number of vehicle-miles of travel or VMT. The reduction of auto VMT is given by the following expression:

$$\text{Net Reduction In Auto VMT (vehicle-miles per year)} = \text{Number of Households} \times \text{Auto Trips per HH per year} \times \text{Net Reduction in Auto Share (fraction)} \times \text{Average Bike/Ped Distance (miles)}$$

Calculation of Benefits

$$\text{Net Energy Savings (BTU's per year)} = \text{Fuel Economy[1] (gallons per mile)} \times \text{Auto VMT Reduction (miles per year)} \times \text{BTU's per gallon}$$

Note that the above energy savings are in British Thermal Untis (BTU). Because of fuel availability problems, energy savings, in addition to energy costs, must be examined. The value of fuel saved is included in the reduction of operating costs.

$$\text{Operating Cost Reduction (dollars per year)} = \text{Auto VMT Reduction per Year (miles per year)} \times \text{Average auto Operating Cost (dollars per mile)}$$

$$\text{Reduction in Auto Accident Costs (dollars per year)} = \left\{ \text{No. of Injuries per Million VMT} \times \text{Cost per Injury} + \text{No. of Fatalities per Million VMT} \times \text{Cost per Fatality} + \text{Property Damage per Million VMT} \times \text{Cost per Occurrance} \right\} \times \text{Auto VMT Reduction (millions of VMT)}$$

$$\text{Reduced Emissions (kilogram of pollutants)} = \text{Auto Emission Rate of Pollutant (kilogram per mile)} \times \text{Auto VMT Reduction (miles)}$$

This expression provides an estimate of the amount of pollutant reduction, which by itself is of importance in evaluating the impact on air quality. To convert to dollar figures, suitable costs per kilogram of pollutant must be used.

$$\text{Increased Highway Capacity (lane-miles)} = \text{Auto VMT Reduction (miles per day)} \div \text{Hours in Peak Period (hours per day)} \div \text{Lane Capacity Per Hour (vehicles per lane-hour)}$$

Increased highway capacity is estimated for peak periods only when there are, generally, capacity deficiencies or at-capacity conditions. Thus, work trips only are appropriate.

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[1] Use fuel economy figure for the mean trip length under consideration. See reference (7).

$$\text{Reduced Cost of Building Highway Lanes (dollars per year)} = \text{Increased highway Capacity (lane-miles)} \times \text{Annual Cost of Reduction per Lane-Mile (dollars per lane-mile)} \times \text{Annual Maintenance Cost per Lane-Mile (dollars per lane-mile)}$$

$$\text{Fitness Benefits (dollars per year)} = \text{Bike/Ped. Travel Time (hour)} \times \text{No. Trips per Year} \times \text{Value of Time (dollars per hour)}$$

This formulation assumes conservatively perhaps, that fitness benefits can be measured in terms of the value people place on the time spent doing exercise, and that walking and or bicycling reduces or eliminates the need to devote additional time exercising.

Calculation of Costs

The cost elements in Table 5-1 are estimated as unit costs (Tables 5-2 through 5-5) to be multiplied by the number of units. Other direct and indirect costs are determined according to the following formulations:

$$\text{Reduction in Auto trips per Year (trips per Year)} = \text{No. of HH} \times \text{Auto Trips per HH per Year} \times \text{Net Reduction in Auto Share (fraction)}$$

$$\text{Time Cost (dollars per year)} = \text{Reduction in Auto Trips (trips per year)} \times \left[\text{Average Trip Length (miles)} \div \text{Average Bike/Ped. Speed (mph)} - \text{Average trip Length (miles)} \div \text{Average Auto Speed (mph)} \right]$$

$$\text{Bicycle Cost (dollars per year)} = \text{Annual Fixed Cost of Owning Bicycle (dollars per year)} + \text{Bicycle VMT per Year (miles per year)} \times \text{Bicycle Operating Costs (dollars per mile)}$$

$$\text{Replacement Parking Cost (dollars per year)} = \text{No. of Parking Spaces Cost (no. of spaces)} \times \text{Annualized Cost to Replace Parking Space (dollars per space)}$$

$$\text{Reduced Transit Revenue per Year (dollars per year)} = \text{Reduction in Transit Trips per year} \times \text{Transit Fare (dollars per person-trip)} + \text{Yearly Subsidy per Person (dollars per person per year)}$$

TABLE 5-2 CONSTRUCTION UNIT COSTS FOR BICYCLE FACILITIES

Facility	Description	Unit Cost
Right-of-Way	20 feet wide corridor	$10,000/acre
Bike Path	8 feet wide, full depth asphalt path	$750/100 linear feet
Intersection		
Type A	Grade separated intersection provided by use of concrete conduit, 10 feet in diameter, pumping, lighting	$100,000/intersection
Type B	Mid-block at-grade intersection use of traffic signal automatically tripped by approaching bicyclist	$40,000/intersection
Lighting	Decorative lighting to generate 0.9 foot candles along entire length of path	$1,275/light standard $450/100 feet of wire installed
Signs	Give location and direction to shopping center	$37.50 per sign
Landscaping	Seeding, mulching and shrub planting on each side of bike path, 10' grid shrubs	$26,250/acre
Bicycle Storage		
Lockers	Enclose, metal cabinets coin operated	$125
Clamp, provide own lock	Secure clamp which encloses frame and back wheel	$100

[1] Right-of-way cost are assumed to be for land prior to development (raw land costs without assessment for streets or utilities).

TABLE 5-3 MAINTENANCE UNIT COSTS FOR BICYCLE FACILITIES

Maintenance Cost Activity	Schedule	Unit Cost
Sweeping Path of Debries	Once per month, assume a speed of 5 miles an hour and 1 hour for transportation	$25/hour, 4 hours/mo 12 times/year
Landscape Maintenance including grass cutting, shrub trimming, replacing of shrubs, replacing lightbulbs, replacing signs, patching pavement	Assume grass cutting would be done 1/week for 8 months. Summer grasses will go dormant for the winter months. Shrub trimming would be done once every 6 months. The need for other repairs would be determined as part of the above mentioned maintenance work.	Mowing $250/month/year 15 acres, 8 month/year Trimming $400/acre 5 acres, 2/years Miscellaneous maintenance work $25,00/hour, 10 hours/month, 12 months/year
Pavement Repair		
Seal Coat	On the 5th and 15th year after construction	$35,00/100 linear feet
Resurfacing	10 years after construction	$250/100 linear feet
Police Protection	Two patrols per 24-hours (on bicycle)	$20/hour

TABLE 5-4 CONSTRUCTION UNIT COSTS FOR PEDESTRIAN FACILITIES

Facility	Description	Unit Cost
Right-of-Way Pedestrian Paths	Space for 6 foot ped. path and 4 foot buffers on each side	$10,000/acre[1]
Pedestrian Path	6 foot ped. path, full depth asphalt	$560/100 linear feet
Intersections	Signalized mid-block intersections with automatic accuation	$40,000
Lighting	Decorative light standards to generate 0.9 foot candles along entire length	$1,275/light standard $450/100 feet of wire wire installed
Signs	Signs indicating location of paths and directions	$37.50
Landscaping	Seeding, mulching and shrub planting on each side of paths, 10 foot grid shrubs	$26,250/acre
Bicycle Storage	Enclosed metal easements secure clamp which encloses frame and back wheel	$125/locker $100/unit

[1] Land costs are a function of the local area, stage of development and the design of the area. This price assumes that the area has yet to be developed, and therefore does not include assessments for roads and utilities.

TABLE 5-5 MAINTENANCE UNIT COSTS FOR PEDESTRIAN FACILITIES

Activity	Schedule	Unit Cost
Sweeping Path of Debris	Once per month, assume a speed of 5 miles and 1 hour for transportation	$25/hour, 7.5 hours/mo. 12 times/year
Landscape Maintenance including grass cutting, shrub trimming, replacing lightbulbs, replacing signs, patching pavement.	Assume grass cutting would be done 1/week for 8 months. Summer grasses go dormant for the winter months. Shrub trimming would be done once every 6 months. The need for other repairs would be determined as part of the above mentioned maintenance work.	Mowing $250/month/acre 30 acres, 8 months/year Trimming 400/acre 8 acres/2times/year Miscellaneous maintenance work $25/hour, 20 hours/month 12 months/year
Pavement Repairs		
Seal Coat	On the 5th and 15th year after construction	8' path = $35.00/100 linear feet 6' path = $27.50/100 linear feet
Resurfacing	10 years after construction	8' path = $250/100 linear feet 6' path = $200/100 linear feet
Snow Plowing	Assumed speed of 4 miles per hour. Generally twice a month during winter months (December-March)	$6.25/mile
Police Protection	Two patrols per 24-hours (on foot or on bicycle)	$20/hour

To determine the desirability of implementation of one strategy over another, the potential demand level of each strategy must be measured against its costs and benefits. To accomplish this, the first step consists of computing the present value of costs and benefits over the analysis period. This method expresses all present and future costs and benefits as single numbers. Projects for which the present value of benefits exceeds the present value of costs can be considered economically desirable.

To perform the above analysis, three important components must be determined. The first is the analysis period or study years; once this has been established, costs and benefits must be developed for each year of the analysis period; and finally, a decision must be made on what interest rate to use to convert future dollars to present values.

The net percent value (NPV) of a project can be calculated using the following formulation:

$$\text{NPV} = \text{Present Value of Benefits} - \text{Present Value of Costs}$$

$$= \text{Annual Uniform Costs} \quad \text{Present Value Factor}$$

$$- \begin{matrix}\text{Investment}\\ \text{Costs}\end{matrix} + \left(\begin{matrix}\text{Annual}\\ \text{Uniform}\\ \text{Costs}\end{matrix} \times \begin{matrix}\text{Present}\\ \text{Value}\\ \text{Factor}\end{matrix}\right) - \begin{matrix}\text{Salvage}\\ \text{Value}\end{matrix} \times \begin{matrix}\text{Present}\\ \text{Value}\\ \text{Factor}\end{matrix}$$

Where the n is the analysis period of the project, and Present Value Factor is the factor used to convert future costs and benefits to present values. Present Value Factor is a function of the project life (n) and of the interest rate selected.

The decision on what project is more desirable can also be made using a variety of methods such as a) the benefit-cost ratio, in which the rule is that the ratio of present value of benefits to present value of costs must exceed 1.0, or b) the internal rate of return method, in which the internal rate of return (the value at which the net present value of the project equals zero) must exceed the discount rate employed; or c) the Equivalent Uniform Annual Cost Method benefits, in which equivalent uniform annual benefits must exceed costs.

It should be pointed out that, if mutually exclusive alternatives are being considered, the selection criteria must go one step further and incremental benefits and costs of each alternative over the others should be used.

Greater details about the Net Present Value Method and other methods of economic analysis may be found in many textbooks and reports (35, 36, 37, 38).

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SAMPLE SURVEY QUESTIONNAIRE

City of Austin
Founded by Congress, Republic of Texas, 1839
Municipal Building, Eighth at Colorado, P.O. Box 1088, Austin, Texas 78767 Telephone 512/477-6511

October 15, 1978

Dear Resident of Austin:

The City of Austin is cooperating in a U.S. Department of Transportation study aimed at determining what can be done to increase the level of walking and bicycling as means of travel. To accomplish this, a survey is being conducted to find out how you feel about walking and biking. The results of this survey will be helpful to those persons who are responsible for developing walking and bicycling programs and facilities.

Your neighborhood has been carefully chosen along with four other sites across the United States, and your household has been selected at random from among the residents of your area. The number of people being asked to participate is small, so your answers are very important. Please do not put your name on the questionnaire. Your responses will be kept strictly confidential.

This questionnaire is concerned with your shopping and personal business trips only. We are interested in your opinion of the transportation services available to you for shopping and personal business trips. In addition, some questions about your age, sex, and family size have been included to help us understand how your answers can be related to your community. Although the questionnaire appears long, most people find it interesting to answer the questions. We hope you do, too.

Please take time in the next day or two to answer the questions completely. Your interviewer, a representative of Winona, Inc., will pick up the completed questionnaire and will answer any questions you may have, on the following prearranged date and time:

____

If you have any questions while filling out the questionnaire, please call this toll free number: 1--800-328-2933.

Sincerely,

Carole McClellan

Carole Keeton McClellan
Mayor

CKM:cd
Enc.

WE WOULD LIKE TO ASK A FEW QUESTIONS ABOUT YOUR MOST RECENT TRIP FROM HOME FOR THE PURPOSE OF SHOPPING OR PERSONAL BUSINESS. PLEASE EXCLUDE ALL MAJOR GROCERY SHOPPING TRIPS.

1. What is the nearest intersection or street address of the place of your most recent shopping or personal business trip from home?

_______________ *(nearest intersection or street address)*　_______________ *(city)*

2. A list of specific shopping and personal business trip purposes is given below. Please check the one trip purpose that best describes your most recent shopping or personal business trip from home (exclude major grocery shopping trips). *(CHECK ONE ONLY)*

( ) Minor grocery shopping (one bag or less)
( ) clothing/shoes
( ) drugs/bookstore
( ) hardware/florist/liquor
( ) eat meal
( ) post office
( ) library/museum
( ) medical/dental
( ) other professional
( ) bank
( ) laundry/dry cleaner/shoe repair
( ) barber/beauty shop
( ) other _______________ *(please specify)*

3. Other than the above stop, did you make any additional stops on the way to and from your shopping/personal business destination? *(CHECK ONE)*

( ) none *(If you answered NONE, go to question 5.)*
( ) one
( ) two
( ) three or more

4. Did any of the additional stops between your home and your primary shopping/personal business destination require you to travel more than one mile out of the way?

( ) Yes　( ) No

5. Approximately how far was it directly from your home to your primary shopping/personal business destination (one way)?

( ) 2 blocks (¼ mile or less)
( ) 3 to 6 blocks (¼ to ½ mile)
( ) ½ to 1 mile
( ) 1 to 2 miles
( ) 2 to 4 miles
( ) 4 to 6 miles
( ) 6 to 10 miles
( ) over 10 miles

6. How many separate parcels, bags or packages were you carrying? *(CHECK ONE)*

( ) none ( ) one ( ) two ( ) three or more

7. How many persons (other than yourself) were with you on this shopping or personal business trip?

total _________ (number) Children 12 years of age and under _________ (number)

8. Where is this place where you went shopping or on personal business located?

( ) central city ( ) suburban

9. Specify the type of area where you went on your shopping/personal business trip. *(CHECK ONE)*

( ) central business district (downtown metropolitan area)
( ) regional shopping center
( ) neighborhood business district or shopping center
( ) office park/professional building
( ) college campus
( ) other _________________ *(please specify)*

10. What was the date of this most recent trip? _________________ *(month/day)*

11. At approximately what time of day did you make this trip to your shopping/personal business destination?

( ) before 7 a.m.
( ) 7 a.m. to 8 a.m.
( ) 8 a.m. to 9 a.m.
( ) 9 a.m. to 10 a.m.
( ) 10 a.m. to 2 p.m.
( ) 2 p.m. to 6 p.m.
( ) after 6 p.m.

12. How did you make the trip to this shopping/personal business destination? *(CHECK ONE)*

( ) walked all the way
( ) drove a car
( ) passenger in a car
( ) bus
( ) train, subway
( ) motorcycle
( ) bicycle
( ) moped (motorized bicycle)
( ) taxi
( ) other _________________ *(please specify)*

12a. If you used a bus or transit, how did you get to your bus or transit stop?

( ) bicycle
( ) taxi
( ) walk
( ) drove and parked
( ) passenger in a car
( ) other _________________ *(please specify)*

NOW WE WOULD LIKE YOUR OPINION OF DIFFERENT MEANS OF TRAVEL. PLEASE CONSIDER YOUR MOST RECENT SHOPPING OR PERSONAL BUSINESS TRIP WHEN COMPLETING THE FOLLOWING SECTION.

Imagine that only the following options were available to you on your most recent shopping or personal business trip: CAR (driving or riding), BUS (or transit), WALK, and BICYCLE. For the above trip, we would like to learn how you feel about each means of transportation. Please give us your opinion of each means of transportation even if you never used it.

The following pages are labeled with the means of transportation you are asked to rate. Under each label you will find a set of statements. Please read each statement and place an "X" in the space that best indicates your agreement with the statements under each means of transportation you are rating.

For example, consider the following statement for bus:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I enjoy traveling to my shopping or personal business destination by bus.	( )	( )	( )	( )	( )

If you enjoy traveling by bus, you would put an "X" in the box under agree or strongly agree, depending upon how much you enjoy travel by bus. If you do not enjoy travel by bus, you would put an "X" under disagree or strongly disagree. If you neither agree nor disagree, you would place an "X" in the center box. In the example shown here, an "X" has been placed in the box under agree, indicating this person enjoys traveling by bus.

Because we need to understand how your rating of your shopping or personal business trip varies from one means of transportation to another, we are asking that you go through the list of characteristics four times, once for each means of travel (walk, bicycle, car, and bus). Although this process might appear repetitious, we want to stress that your careful ratings of all the statements on the next four pages are especially important to the success of this survey.

Is bus service available between your home and this shopping or personal business destination?

( ) Yes

If your answer is YES, please rate the statements below concerning how you would feel about going to this destination by bus even if you didn't choose bus on your last trip.

( ) No

If your answer is NO, please go on to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Going to this destination by bus is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When shopping or on a personal business trip, it is convenient to stop and do errands when traveling by bus.	( )	( )	( )	( )	( )
3. I must schedule my trips in advance when I travel by bus to go shopping or on personal business trips.	( )	( )	( )	( )	( )
4. Traveling by bus to this shopping/personal business destination is tiring.	( )	( )	( )	( )	( )
5. Traveling by bus to my shopping/personal business destination is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When on a shopping/personal business trip with children, it is inconvenient to take the bus.	( )	( )	( )	( )	( )
7. I cannot rely on taking a bus to this destination in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry packages when I travel by bus while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9. It is uncomfortable to travel to this destination by bus because of rough or bumpy road surfaces.	( )	( )	( )	( )	( )
10. I can get to my shopping/personal business destination quickly when I travel by bus.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I travel by bus to my shopping/personal business destination.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident when I travel by bus to my shopping/personal business destination.	( )	( )	( )	( )	( )
13. It is relaxing to travel by bus to my shopping/personal business destination.	( )	( )	( )	( )	( )
14. I dislike traveling by bus to this shopping/personal bus. destination because of the many delays at intersections.	( )	( )	( )	( )	( )
15. I must walk a long distance to get to and from the bus when I go to this shopping/personal business destination.	( )	( )	( )	( )	( )
16. There is generally a long wait involved when I travel by bus to this shopping/personal business destination.	( )	( )	( )	( )	( )
17. When traveling by bus to this shopping/personal business destination I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. It is inexpensive to travel by bus to this shopping/personal business location.	( )	( )	( )	( )	( )

YOUR RATING OF WALK

Was your most recent shopping or personal business destination located less than 2 miles from your home?

( ) Yes

If your answer is YES, please rate the statements below concerning how you would feel about walking to this destination even if you did not walk there on your last trip.

( ) No

If your answer is NO, please go on to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Walking to this destination is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When shopping or on a personal business trip, it is convenient to stop and do errands when walking.	( )	( )	( )	( )	( )
3. I can pick up and go anytime I like when I walk to go shopping or on personal business trips.	( )	( )	( )	( )	( )
4. Walking to this shopping/personal business destination is tiring.	( )	( )	( )	( )	( )
5. Walking to my shopping/personal business destination is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When on a shopping/personal business trip with children, it is inconvenient to walk.	( )	( )	( )	( )	( )
7. I cannot rely on walking to this destination in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry packages when I walk while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9. It is uncomfortable to walk to this destination because of rough and bumpy walking surfaces.	( )	( )	( )	( )	( )
10. I can get to my shopping/personal business destination quickly when I walk.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident when I walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
13. It is relaxing to walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
14. I dislike walking to this shopping/personal business destination because of the many delays at intersections.	( )	( )	( )	( )	( )
15. Walking to this shopping/personal bus. destination is unsafe due to lack of pathways separated from motorized traffic.	( )	( )	( )	( )	( )
16. Walking to this shopping/personal bus. destination is dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17. When walking to this shopping/personal bus. destination, I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. Walking to this shopping/personal business destination gives healthful exercise.	( )	( )	( )	( )	( )

YOUR RATING OF CAR

When using a car, are you usually a:

( ) car driver

If you are usually a car driver, even if you did not choose auto for your last shopping or personal business trip, rate the statements below concerning how you would feel about driving on this trip.

( ) car passenger

If you are usually a car passenger, even if you did not choose auto for your last shopping or personal business trip, rate the statements below concerning how you would feel about going to this destination as a car passenger.

Please answer all questions below, even if you do not own a car.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Traveling by car to this shopping/personal business destination is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When shopping or on a personal business trip, it is convenient to stop and do errands when traveling by car.	( )	( )	( )	( )	( )
3. I can pick up and go anytime I like when I travel by car on shopping or on personal business trips.	( )	( )	( )	( )	( )
4. Traveling by car to this shopping/personal business destination is tiring.	( )	( )	( )	( )	( )
5. Traveling by car to my shopping/personal business destination is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When on a shopping/personal business trip with children, it is inconvenient to go by car.	( )	( )	( )	( )	( )
7. I cannot rely on traveling by car to this destination in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry packages when I travel by car while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9. It is uncomfortable to travel by car to this shopping/personal business destination because of rough or bumpy road surfaces.	( )	( )	( )	( )	( )
10. I can get to my shopping/personal business destination quickly when I travel by car.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I travel by car to my shopping/personal business destination.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident when I travel by car to my shopping/personal business destination.	( )	( )	( )	( )	( )
13. It is relaxing to travel by car to my shopping/personal business destination.	( )	( )	( )	( )	( )
14. I dislike traveling by car to this shopping/personal business destination because of the many delays at intersections.	( )	( )	( )	( )	( )
15. Parking the car at this destination is expensive.	( )	( )	( )	( )	( )
16. After parking the car, I must walk a long distance when I go to this shopping/personal business destination.	( )	( )	( )	( )	( )
17. I worry about the car being stolen or vandalized at this destination.	( )	( )	( )	( )	( )
18. It is inexpensive to buy and operate a car.	( )	( )	( )	( )	( )
19. Parking the car is no trouble when on this shopping/personal business trip.	( )	( )	( )	( )	( )

YOUR RATING OF BICYCLE

Was your most recent shopping or personal business destination located less than 4 miles from your home?

( ) Yes

If your answer is YES, please rate the statements below concerning <u>how you would feel about bicycling to your shopping or personal business destination,</u> even if you don't own a bicycle or didn't ride a bicycle on your last trip to this destination.

( ) No

If your answer is NO, please go to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Bicycling to this shopping/personal business destination is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When shopping or on a personal business trip, it is convenient to stop and do errands, when riding a bicycle.	( )	( )	( )	( )	( )
3. I can pick up and go anytime I like when I ride a bicycle to go shopping or on personal business trips.	( )	( )	( )	( )	( )
4. Riding a bicycle to this shopping/personal business destination is tiring.	( )	( )	( )	( )	( )
5. Riding a bicycle to my shopping/personal business destination is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When on a shopping/personal business trip with children, it is inconvenient to ride the bicycle.	( )	( )	( )	( )	( )
7. I cannot rely on riding a bicycle to this destination in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry packages when I ride a bicycle while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9. It is uncomfortable to travel to this destination by bicycle because of rough or bumpy riding surfaces.	( )	( )	( )	( )	( )
10. I can get to my shopping/personal business destination quickly, when I ride a bicycle.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I ride a bicycle to my shopping/personal business destination.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident when I ride a bicycle to my shopping/personal business destination.	( )	( )	( )	( )	( )
13. It is relaxing to ride by bicycle to my shopping/personal business destination.	( )	( )	( )	( )	( )
14. I dislike traveling by bicycle to this shopping/personal bus. destination because of many delays at intersections.	( )	( )	( )	( )	( )
15. Bicycling to this shopping/personal bus. destination is unsafe due to lack of bike paths separated from motorized traffic.	( )	( )	( )	( )	( )
16. Going by bicycle to this destination is dangerous because motorists are inconsiderate of bicyclists.	( )	( )	( )	( )	( )
17. When bicycling to this shopping/personal business destination, I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. Riding a bicycle gives healthful exercise.	( )	( )	( )	( )	( )
19. Parking, locking and unlocking my bicycle at this destination is no trouble.	( )	( )	( )	( )	( )
20. I worry about my bicycle being stolen at this shopping/personal business destination.	( )	( )	( )	( )	( )
21. It is inexpensive to buy and operate a bicycle.	( )	( )	( )	( )	( )

WE WOULD LIKE TO KNOW YOUR <u>PREFERENCES</u> FOR VARIOUS MEANS OF TRAVEL FOR SHOPPING/PERSONAL BUSINESS TRIPS.

1. Imagine that only BUS, WALK BICYCLE, and CAR (driver or passenger) were available for your most recent shopping/personal business trip. These alternatives are listed below. Please indicate your preference by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative. *(If bus service was not available for your shopping/personal business trip, please rank the three remaining alternatives.)*

   ( ) bus
   ( ) walk
   ( ) bicycle
   ( ) car (driver or passenger)

2. We would like to know how often you use each of the following means of travel for shopping/personal business trips from home. Place an X under <u>your best estimate</u> of the number of days you have used <u>each</u> means of travel during the last 30 days.

	Did not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Days	More Than 20 Days
bus	( )	( )	( )	( )	( )	( )
walk	( )	( )	( )	( )	( )	( )
drive a car	( )	( )	( )	( )	( )	( )
passenger in car	( )	( )	( )	( )	( )	( )
bicycle	( )	( )	( )	( )	( )	( )
other ____________ *(specify)*	( )	( )	( )	( )	( )	( )

3. Assume that on your next shopping/personal business trip all travel conditions remained the same as present except that the price of gasoline increased to one of the price levels indicated below. For each gasoline price level, please indicate your transportation preference by placing a "1" next to the alternative you would prefer the most, a "2" next to the one you would prefer second, a "3" next to your third choice, and a "4" next to your least-preferred alternative. Please repeat for <u>each</u> of the price levels (a) through (d) below. *(If bus service is not available for your Shopping/personal business trip, please rank the three remaining alternatives.)*

(a) $1.00 Per Gallon		(b) $1.50 Per Gallon		(c) $3.00 Per Gallon		(d) $4.00 Or More Per Gallon	
walk	( )	walk	( )	walk	( )	walk	( )
bicycle	( )	bicycle	( )	bicycle	( )	bicycle	( )
bus	( )	bus	( )	bus	( )	bus	( )
car	( )	car	( )	car	( )	car	( )

WE WOULD LIKE TO KNOW MORE ABOUT THE TRANSPORTATION SERVICE AVAILABLE TO YOU. PLEASE DESCRIBE THE SERVICE FOR TRIPS FROM HOME TO THE PLACE WHERE YOU SHOP OR DO PERSONAL BUSINESS BY ANSWERING THE FOLLOWING QUESTIONS:

ANSWER IF DISTANCE FROM HOME TO SHOPPING/PERSONAL BUSINESS DESTINATION IS 4 MILES OR LESS.

1. If you were to ride your bicycle to your shopping/personal business destination, what is your best estimate of the time you would spend doing the following?

   getting the bicycle to the street _______ (minutes)

   riding the bicycle _______ (minutes)

   parking and locking up the bicycle _______ (minutes)

   walking from bicycle to destination _______ (minutes)

   TOTAL TIME FROM HOME TO DESTINATION [   ] (minutes

2. Is there a bicycle path or marked bicycle lane which you could use to bicycle on part or all of your trip from home to your shopping/personal business destination.

   ( ) bicycle path (off the street)
   ( ) bicycle lane (on the street)
   ( ) neither
   ( ) don't know

3. What portion of your total trip from home to your shopping/personal business destination is served by bicycle paths or bicycle lanes?

   ( ) none
   ( ) less than 1/4 the distance
   ( ) 1/4 to 1/2 the distance
   ( ) 1/2 to 3/4 the distance
   ( ) more than 3/4 of the distance
   ( ) don't know

ANSWER IF DISTANCE FROM HOME TO SHOPPING/PERSONAL BUSINESS DESTINATION IS 2 MILES OR LESS.

4. If you were to walk to shopping/personal business, what is your best estimate of the time it would take from the moment you left home to the moment you arrived at shopping/personal business destination?

   _______ (minutes)

5. Are there adequate sidewalks or pathways you could use to walk on your trip from home to your shopping/personal business destination?

   ( ) all or almost all the way
   ( ) part of the way
   ( ) there are none
   ( ) don't know

ANSWER IF BUS SERVICE IS AVAILABLE.

6. If you were to take the bus to your shopping/personal business destination, what is your best estimate of the time you would spend doing each of the following?

getting to the bus stop	_______	(minutes)
waiting for the bus	_______	(minutes)
riding on the bus	_______	(minutes)
walking from bus to destination	_______	(minutes)
TOTAL TIME FROM HOME TO DESTINATION	[ ]	(minutes)

7. Is it necessary to change buses to travel from your home to your shopping/personal business destination?

( ) Yes

( ) No

8. Out of ten trips, how often would you expect to have a seat on the bus all the way from home to your shopping/personal business destination?

_______ times out of ten

9. What is the one-way bus fare on your trip from home to your shopping/personal business destination?

_______ cents ( ) don't know

10. If you were to go by car to your shopping/personal business destination, what is your best estimate of the time you would spend doing each of the following?

walking to the car	_______	(minutes)
driving or riding	_______	(minutes)
parking the car	_______	(minutes)
walking from car to destination	_______	(minutes)
TOTAL TIME FROM HOME TO DESTINATION	[ ]	(minutes)

11. What is the parking cost on your trip from home to your shopping/personal business destination? *(CHECK ONE AND SPECIFY THE COST.)*

( ) no charge

( ) daily charge _______ (dollars)

( ) weekly charge _______ (dollars)

( ) monthly charge _______ (dollars)

NOW WE WOULD LIKE TO ASK SEVERAL QUESTIONS CONCERNING YOUR BICYCLING ACTIVITIES.

1. Did you ride a bicycle at least once during the past year?

( ) Yes

( ) No *(IF "NO", GO TO NEXT PAGE.)*

2. Did you ride a bicycle during the last month?

( ) Yes

( ) No *(IF "NO", GO TO NEXT PAGE.)*

3. We would like to know how often you use the bicycle for each of the following trip purposes. Place an "X" under your best estimate of the number of days you have used the bicycle for each trip purpose ("a" through "h" below) during the last 30 days.

	Did Not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Days	More Than 20 Days
a. To work	( )	( )	( )	( )	( )	( )
b. To school	( )	( )	( )	( )	( )	( )
c. For personal business	( )	( )	( )	( )	( )	( )
d. To visit friends	( )	( )	( )	( )	( )	( )
e. To go shopping	( )	( )	( )	( )	( )	( )
f. To a recreational activity	( )	( )	( )	( )	( )	( )
g. Neighborhood riding	( )	( )	( )	( )	( )	( )
h. Long distance riding (over 2 hours)	( )	( )	( )	( )	( )	( )

Is your selected shopping or personal business destination located less than 4 miles away from your home?

( ) Yes

If your answer is YES, please read below.

( ) No

If your answer is NO, please go on to page 15.

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO A NEW TRANSPORTATION IMPROVEMENT. THIS IMPROVEMENT, DESCRIBED BELOW, DOES NOT EXIST NOW. IT CONCERNS IMPROVEMENTS TO BICYCLE–RELATED FACILITIES. AFTER YOU READ THE DESCRIPTION, YOU ARE ASKED TO EXPRESS YOUR OPINIONS ABOUT <u>BICYCLING TO YOUR SHOPPING OR PERSONAL BUSINESS DESTINATION USING THE NEW FACILITIES</u>.

BICYCLE–RELATED FACILITY IMPROVEMENTS

Suppose the city introduces several improvements to bicycle-related facilities designed to increase the comfort and safety of cyclists. The improvements consist of (1) providing bicycle paths, (2) reserving street lanes for bicycle use, (3) improving road surfaces, (4) installing secure bicycle lock-up facilities in many areas, and (5) providing better lighting.

On most local streets, a yellow stripe is painted near the right-hand side of the road marking a lane reserved strictly for bicycle use. Separate bicycle paths are built adjacent to all major roadways. These bicycle paths are separated from automobile traffic by a metal guardrail or a grass median. All these paths and street lanes are smoothly paved for better riding. In addition, high-intensity lights are added along the bikeways to provide excellent visibility at night. A large number of secure bike lock-up facilities are provided and, in high activity areas, these consist of enclosed storage lockers manned by a full-time attendant. Finally, convenient locker, shower and changing facilities are made freely available.

You are now asked to express your agreement or disagreement with the following statements about <u>bicycling to your shopping or personal business destination</u> assuming the bicycle facility improvements described above are available to you on your next shopping or personal business trip. (You will note that the list of statements is the same as that used earlier. The purpose of this last rating is to find out how <u>you</u> feel about bicycle-related improvements.)

YOUR RATING OF BICYCLE WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning how you would feel about bicycling to your shopping or personal business destination using the facility improvements described on the previous page.

	Statement	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Bicycling to this shopping/personal bus. destination would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When shopping or on a personal business trip, it would be convenient to stop and do errands when riding a bicycle	( )	( )	( )	( )	( )
3.	I could pick up and go anytime I like when I ride a bicycle on shopping or on personal business trips.	( )	( )	( )	( )	( )
4.	Riding a bicycle to this shopping/personal business destination would be tiring.	( )	( )	( )	( )	( )
5.	Riding a bicycle to my shopping/personal business destination would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When on my shopping/personal business trip with children, I would find it convenient to ride the bicycle.	( )	( )	( )	( )	( )
7.	I could not rely on riding a bicycle in rainy weather.	( )	( )	( )	( )	( )
8.	I could easily carry packages when I ride a bicycle while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9.	It would be uncomfortable to travel to this destination by bicycle because of rough or bumpy riding surfaces.	( )	( )	( )	( )	( )
10.	I could get to my shopping/personal business destination quickly when I ride a bicycle.	( )	( )	( )	( )	( )
11.	I would worry about being mugged or assaulted when I ride a bicycle to my shopping/personal business destination.	( )	( )	( )	( )	( )
12.	I would worry about being injured in an accident when I ride a bicycle to my shopping/personal bus. destination.	( )	( )	( )	( )	( )
13.	It would be relaxing to ride by bicycle to my shopping/personal business destination.	( )	( )	( )	( )	( )
14.	I would dislike bicycling to this shopping/personal bus. destination because of many delays at intersections.	( )	( )	( )	( )	( )
15.	Bicycling to this shopping/personal bus. destination would be unsafe due to lack of bike paths separated from motor traffic.	( )	( )	( )	( )	( )
16.	Bicycling to this shopping/personal business destination would be dangerous because motorist are inconsiderate of bikers.	( )	( )	( )	( )	( )
17.	When bicycling to this destination, I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Riding a bicycle would give healthful exercise.	( )	( )	( )	( )	( )
19.	Parking, locking and unlocking my bicycle would be no trouble.	( )	( )	( )	( )	( )
20.	I would worry about my bicycle being stolen at this shopping/personal business destination.	( )	( )	( )	( )	( )
21.	It would be inexpensive to buy and operate a bicycle.	( )	( )	( )	( )	( )

A

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR BICYCLING. PLEASE INDICATE YOUR TRANSPORTATION PREFERENCES BELOW FOR YOUR NEXT SHOPPING OR PERSONAL BUSINESS TRIP.

1. Please indicate your preference for each of the following alternative means of travel for your next shopping or personal business trip by placing a "1" next to the alternative you prefer most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative. Please repeat the process for each statement (a) through (c) below. *(If bus service is not available between your home and your shopping or personal business destination, rank the three remaining alternatives.)*

   a. Assume the bicycle facilities are in place. Please rank the following means of travel for your next shopping or personal business trip to the same destination.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition as (a) above, except that the price of gasoline has increased to $1.50 per gallon *(please rank again)*.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the bicycle facilities are in place and the price of gasoline increased to $3.00 per gallon *(please rank again)*.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below were available for your next 10 shopping or personal business trips, how many of the 10 trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)
      (10) TOTAL TRIPS

A

LIVING NEARER TO TRAVEL DESTINATIONS

Many planners maintain that the use of automobiles has greatly increased the levels of air pollution, energy consumption, traffic congestion, and costly street and highway expenditures. It has been suggested that in order to reduce these problems, people must live nearer to their places of employment, shopping, school, and recreation.

Some communities have been designed with this compact land-use arrangement in mind. Their layout is such that most shopping and personal business trips can be accommodated within a six-block (1/2 mile) distance and most work trips are within two miles of home.

Suppose you live or moved to one such community. Suppose further that special bicycle paths and pedestrian pathways are provided so that it is possible to walk or bicycle to all shopping and personal business destinations without having to cross streets that carry heavy motor vehicle traffic; bicycle storing and lock-up facilities are provided in large numbers, free of charge, throughout the area; convenient bus service is available; and there are no special restrictions on the use of automobiles.

Now, please turn to the following pages and express how this compact land-use arrangement would affect the way you feel about using WALK, BICYCLE, BUS, or CAR for your shopping or personal business trip.

YOU HAVE JUST READ ABOUT AN ASSUMED LAND USE AND TRANSPORTATION CONDITION. IMAGINE THAT THIS CONDITION EXISTS ON YOUR NEXT SHOPPING OR PERSONAL BUSINESS TRIP.

1. Please indicate your agreement or disagreement with the following statement:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I would like to live in this type of community.	( )	( )	( )	( )	( )

2. Please indicate your preference for each of the following transportation alternatives on your shopping or personal business trip by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative, assuming the land-use arrangement described above. *(Please repeat the process for each statement (a) through (d) below.)*

   a. Assume the living conditions and special transportation facilities described on the previous page exist for your next shopping or personal business trip, and assume further that your trip is approximately 1/2 mile (6 blocks) in length. *(Please rank the following means of transportation.)*

      ( ) walk ( ) bus or transit

      ( ) bicycle ( ) car (driver or passenger)

   b. Now suppose that in addition to the conditions described in (a) above the price of gasoline increased to $1.50 per gallon. *(Please rank the following means of transportation.)*

      ( ) walk ( ) bus or transit

      ( ) bicycle ( ) car (driver or passenger)

   c. Assume the conditions described in (a) above and assume that in addition the speed limit was reduced to 15 m.p.h. in the community. *(Please rank the following means of transportation.)*

      ( ) walk ( ) bus or transit

      ( ) bicycle ( ) car (driver or passenger)

   d. Assume again conditions described in (a) above but this time assume no parking was available at your shopping or personal business destination. *(Please rank the following means or transportation.)*

      ( ) walk ( ) bus or transit

      ( ) bicycle ( ) car (driver or passenger)

YOUR RATING OF WALK WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning how you would feel about walking to your shopping or personal business destination using the facility improvements described on the previous page, even if you did not walk there on your last trip.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Walking to a shopping/personal business destination would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When shopping or on a personal business trip, it would be convenient to stop and do errands when walking.	( )	( )	( )	( )	( )
3. I could pick up and go anytime I like when I walk to go shopping or on personal business trips.	( )	( )	( )	( )	( )
4. Walking to this shopping/personal business destination would be tiring.	( )	( )	( )	( )	( )
5. Walking to my shopping/personal business destination would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When on a shopping/personal business trip with children, it would be inconvenient to walk.	( )	( )	( )	( )	( )
7. I could not rely on walking to this destination in rainy weather.	( )	( )	( )	( )	( )
8. I could easily carry packages when I walk while I am on a shopping/personal business trip.	( )	( )	( )	( )	( )
9. It would be uncomfortable to walk to this destination because of rough or bumpy walking surfaces.	( )	( )	( )	( )	( )
10. I could get to my shopping/personal business destination quickly when I walk.	( )	( )	( )	( )	( )
11. I would worry about being mugged or assaulted when I walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
12. I would worry about being injured in an accident when I walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
13. It would be relaxing to walk to my shopping/personal business destination.	( )	( )	( )	( )	( )
14. I would dislike walking to this destination because of the many delays at intersections.	( )	( )	( )	( )	( )
15. Walking to my destination would be unsafe because of the lack of pathways that are separated from motorized traffic.	( )	( )	( )	( )	( )
16. Walking to a shopping/personal business destination would be dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17. When walking to this destination I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. Walking would give healthful exercise.	( )	( )	( )	( )	( )

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR WALKING. PLEASE INDICATE YOUR PREFERENCES BELOW FOR YOUR NEXT SHOPPING OR PERSONAL BUSINESS TRIP.

1. Please indicate your preference for the following alternative means of travel for your next shopping or personal business trip by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative. Please repeat the process for each statement (a) through (c) below. *(If bus service is not available between your home and your shopping or personal business destination, rank the three remaining alternatives.)*

   a. Assume the walk facilities are in place. Please rank the following means of travel for your next shopping or personal business trip.

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition (a) above except that the price of gasoline has increased to $1.50 per gallon. *(Please rank again.)*

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the walk facilities are in place and the price of gasoline increased to $3.00 per gallon. *(Please rank.)*

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below are available for your next ten shopping or personal business trips, how many of the ten trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

   ( ) walk with improved facilities
   ( ) bicycle
   ( ) bus/transit
   ( ) car (driver or passenger)
   (10) TOTAL TRIPS

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO AN ASSUMED REGULATION CONCERNING AUTOMOBILES. AFTER YOU READ THE DESCRIPTION, YOU WILL BE ASKED TO ANSWER A FEW QUESTIONS ABOUT YOUR PREFERENCE FOR ALTERNATIVE MEANS OF TRANSPORTATION.

AUTO CONGESTION FEE

It is decided that in order to reduce congestion and lower fuel usage, a fee of $1 will be assessed to the owners of automobiles operating during the morning (7-9 a.m.) and evening (4-6 p.m.) rush hours. This means that you would be charged up to a $2.00 per day if you operate a motor vehicle during these peak travel periods. Billing would be made on a monthly basis using an automated billing process.

Please turn to the following page.

YOU HAVE JUST READ AN ASSUMED REGULATION FOR CAR USAGE. IMAGINE THAT THIS SITUATION FOR CAR USAGE EXISTS FOR YOUR NEXT SHOPPING OR PERSONAL BUSINESS TRIP.

1. Please indicate your agreement or disagreement with the following statements:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
a. I believe that a congestion fee of two dollars per day is desirable.	( )	( )	( )	( )	( )
b. It would be inexpensive to travel by car with a congestion fee of two dollars per day.	( )	( )	( )	( )	( )

2. Please indicate your preference for each of the following transportation alternatives for your next shopping or personal business trip by placing a "1" nest to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" under your least preferred alternative. Please repeat this for each of the statements (a) through (c) below. *(If bus service is not available for this shopping or personal business trip, please rank the remaining three alternatives only.)*

   a. Assume the congestion fee of $2.00 per day described on the preceding page was in effect. Please rank the following means of transportation for your next shopping or personal business trip.

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   b. Assume that instead of $2.00 the congestion fee increased to $4.00 per day. *(Please rank again.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   c. Assume that in addition to the congestion fee of $2.00 per day the price of gasoline increases to $1.50 per gallon. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

WE WOULD LIKE TO ASK YOU SEVERAL IMPORTANT FACTS ABOUT YOURSELF. THESE ARE IMPORTANT IN PROJECTING YOUR VIEWS TO THE TOTAL POPULATION OF YOUR COMMUNITY. AS YOU RECALL, YOUR ANSWERS WILL NOT BE IDENTIFIED WITH YOUR NAME AND ALL RESPONSES WILL BE KEPT CONFIDENTIAL.

1. How old are you? ____________ (age)

2. What is your sex? ( ) Male ( ) Female

3. How many adults (18 or over), including yourself, are there in your household? __________

4. How many minors (under 18) are there in your household? __________

5. Do you have a valid driver's license? ( ) Yes ( ) No

6. How many licensed drivers (including yourself) are there in your household? __________

7. How many automobiles are there in your household? __________

8. Do you own a bicycle? ( ) Yes ( ) No

9. How many bicycles are there in your household? __________

10. What type of structure do you live in?
    - ( ) single family
    - ( ) duplex
    - ( ) townhouse
    - ( ) walk-up apartment (3 stories or less)
    - ( ) low-rise apartment (4 to 8 stories)
    - ( ) high-rise apartment (more than 8 stories)
    - ( ) other ______________________ *(please specify)*

11. What is your educational background? *(CHECK ONE)*
    - ( ) completed elementary school
    - ( ) some high school
    - ( ) high school graduate
    - ( ) some college or technical school
    - ( ) college or technical school graduate
    - ( ) some graduate school
    - ( ) completed graduate degree(s)

12. Please indicate your work group below:
    - ( ) work 5 or more days a week
    - ( ) work 3-4 days a week
    - ( ) work 1-2 days a week
    - ( ) presently not employed

13. What is your occupation? *(CHECK ONE)*

( ) professional-technical
( ) managerial
( ) blue collar
( ) sales worker
( ) secretarial-clerical-cashier
( ) other ______________________________
(please specify)

14. How many workers are in your household? ______________

15. Please check the category which includes your approximate family income before taxes.

( ) $5,000 and under
( ) $5,001 - $7,500
( ) $7,501 - $10,000
( ) $10,001 - $12,500
( ) $12,501 - $15,000
( ) $15,001 - $17,500
( ) $17,501 - $20,000
( ) $20,001 - $25,000
( ) $25,001 - $50,000
( ) Over $50,000

In the space below we would welcome any other comments you would like to make. Enclose additional pages if you like.

We would like to express our sincere thanks to you for completing this questionnaire.

City of Austin

Founded by Congress, Republic of Texas, 1839
Municipal Building, Eighth at Colorado, P.O. Box 1088, Austin, Texas 78767 Telephone 512/477-6511

October 15, 1978

Dear Resident of Austin:

The City of Austin is cooperating in a U.S. Department of Transportation study aimed at determining what can be done to increase the level of walking and bicycling as means of travel. To accomplish this, a survey is being conducted to find out how you feel about walking and biking. The results of this survey will be helpful to those persons who are responsible for developing walking and bicycling programs and facilities.

Your neighborhood has been carefully chosen along with four other sites across the United States, and your household has been selected at random from among the residents of your area. The number of people being asked to participate is small, so your answers are very important. Please do not put your name on the questionnaire. Your responses will be kept strictly confidential.

This questionnaire is concerned with your school trips only. We are interested in your opinion of the transportation services available to you between your home and your school. In addition, some questions about your age, sex, and family size have been included to help us understand how your answers can be related to your community. Although the questionnaire appears long, most people find it interesting to answer the questions. We hope you do, too.

Please take time in the next day or two to answer the questions completely. Your interviewer, a representative of Winona, Inc., will pick up the completed questionnaire and will answer any questions you may have, on the following prearranged date and time:

____

If you have any questions while filling out the questionnaire, please call this toll free number: 1--800-328-2933.

Sincerely,

Carole McClellan

Carole Keeton McClellan
Mayor

CKM:cd
Enc.

WE WOULD LIKE TO ASK A FEW QUESTIONS ABOUT YOUR MOST RECENT TRIP FROM HOME TO SCHOOL.

1. What is the nearest intersection or street address of the place where you go to school?

_________________________ *(nearest intersection or street address)* _________________ *(city)*

2. Approximately how far is it from your home to your school (one way)?

( ) 2 blocks or less (1/4 mile or less)
( ) 3 to 6 blocks (1/4 to 1/2 mile)
( ) 1/2 to 1 mile
( ) 1 to 2 miles
( ) 2 to 4 miles
( ) 4 to 6 miles
( ) 6 to 10 miles
( ) over 10 miles

3. What was the date of your most recent trip to school? _________________ *month/day*

4. At approximately what time of day did you make this trip to school?

( ) before 7 a.m.
( ) 7 a.m. to 8 a.m.
( ) 8 a.m. to 9 a.m.
( ) 9 a.m. to 10 a.m.
( ) 10 a.m. to 2 p.m.
( ) 2 p.m. to 6 p.m.
( ) after 6 p.m.

5. How did you make your most recent trip to school? *(CHECK ONE)*

( ) walked all the way
( ) drove a car
( ) passenger in a car
( ) bus
( ) train, subway
( ) motorcycle
( ) bicycle
( ) moped (motorized bicycle)
( ) taxi
( ) other _________________ *(please specify)*

5a. If you used bus or transit, how did you get to your bus or transit stop?

( ) bicycle
( ) taxi
( ) walked
( ) drove and parked
( ) passenger in a car
( ) other _________________ *(please specify)*

6. How many stops for errands did you make on your trip to and from school? *(CHECK ONE)*

( ) none ( ) one ( ) two ( ) three or more

7. Did anyone accompany you on this school trip? *(CHECK ONE)*

( ) I traveled alone
( ) I was with one other person
( ) I was with two other persons
( ) I was with three or more persons

NOW WE WOULD LIKE YOUR OPINION OF DIFFERENT MEANS OF TRAVEL. PLEASE CONSIDER YOUR MOST RECENT TRIP TO SCHOOL WHEN COMPLETING THE FOLLOWING SECTION.

Imagine that only the following options were available to you on your most recent school trip: CAR (driving or riding), BUS (or transit), WALK, and BICYCLE. For your travel to school we would like to learn how you feel about each means of transportation. Please give us your opinion of each means of transportation even if you never used it.

The following pages are labeled with the means of transportation you are asked to rate. Under each label you will find a set of statements. Please read each statement and place an "X" in the space that best indicates your agreement with the statements under each means of transportation you are rating.

For example, consider the following statement for bus:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I enjoy traveling to school by bus.	( )	( )	( )	( )	( )

If you enjoy traveling by bus, you would put an "X" in the box under agree or strongly agree, depending on how much you enjoy travel by bus. If you do not enjoy travel by bus, you would put an "X" under disagree or strongly disagree. If you neither agree nor disagree you would place an "X" in the center box. In the example shown here, an "X" has been placed in the box under "agree", indicating this person enjoys traveling by bus.

Because we need to understand how your rating of your trip to school varies from one means of transportation to another, we are asking that you go through the list of characteristics four times, once for each means of travel (walk, bicycle, car, and bus). Although this process might appear repetitious, we want to stress that your careful rating of all the statements on the next four pages are especially important to the success of this survey.

YOUR RATING OF BICYCLE

Is your school located less than 6 miles from your home?

( ) Yes

If your answer is YES, please rate the statements below concerning <u>how you would feel</u> about bicycling to school even if you don't own a bicycle, or didn't ride a bicycle on your last trip to school.

( ) No

If your answer is NO, please go on to the next page.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Bicycling to school is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When biking, it is convenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I can pick up and go anytime I like when I go to school by bicycle.	( )	( )	( )	( )	( )
4.	Traveling to school by bicycle is tiring.	( )	( )	( )	( )	( )
5.	Riding a bicycle to school is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When I ride the bicycle to school, I worry about being late.	( )	( )	( )	( )	( )
7.	I cannot rely on riding a bicycle to school in rainy weather.	( )	( )	( )	( )	( )
8.	I can easily carry my briefcase or other packages when I ride the bicycle to school.	( )	( )	( )	( )	( )
9.	It is uncomfortable to travel to school by bicycle because of rough and bumpy riding surfaces.	( )	( )	( )	( )	( )
10.	I can get to school quickly when I go by bicycle.	( )	( )	( )	( )	( )
11.	I worry about being mugged or assaulted when I travel to school by bicycle.	( )	( )	( )	( )	( )
12.	I worry about being injured in an accident if I ride the bicycle to school.	( )	( )	( )	( )	( )
13.	It is relaxing to travel to school by bicycle.	( )	( )	( )	( )	( )
14.	I dislike traveling to school by bicycle because of the many stops and delays at each intersection.	( )	( )	( )	( )	( )
15.	Riding the bicycle to school is unsafe because of the lack of bike paths that are separated from motorized traffic.	( )	( )	( )	( )	( )
16.	Going by bicycle to school is dangerous because motorists are inconsiderate of bicyclists.	( )	( )	( )	( )	( )
17.	When bicycling to school, I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Riding a bicycle to school gives healthful exercise.	( )	( )	( )	( )	( )
19.	Parking, locking and unlocking my bicycle at school is no trouble.	( )	( )	( )	( )	( )
20.	After parking my bicycle, I must walk a long distance when I go to school.	( )	( )	( )	( )	( )
21.	I worry about my bicycle being stolen at school.	( )	( )	( )	( )	( )
22.	It is inexpensive to buy and operate a bicycle.	( )	( )	( )	( )	( )

YOUR RATING OF BUS (or transit)

Is bus service available between your home and school?

( ) Yes

If your answer is YES, please rate the statements below concerning how you would feel about going to school by bus, even if you didn't choose bus on your last school trip.

No ( )

If your answer is NO, please go on to the next page.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Going to school by bus is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When traveling by bus, it is inconvenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I must schedule my trips in advance when I travel by bus to school.	( )	( )	( )	( )	( )
4.	Traveling by bus to school is very tiring.	( )	( )	( )	( )	( )
5.	Traveling by bus to school is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When I take the bus to school, I worry about being late.	( )	( )	( )	( )	( )
7.	I cannot rely on taking a bus to school in rainy weather.	( )	( )	( )	( )	( )
8.	I can easily carry my briefcase or other packages when I go to school by bus.	( )	( )	( )	( )	( )
9.	It is uncomfortable to travel to school by bus because of rough and bumpy road surfaces.	( )	( )	( )	( )	( )
10.	I can get to school quickly, when I take the bus.	( )	( )	( )	( )	( )
11.	I worry about being mugged or assaulted when I go to school by bus.	( )	( )	( )	( )	( )
12.	I worry about being injured in an accident if I go to school by bus.	( )	( )	( )	( )	( )
13.	It is relaxing to go to school by bus.	( )	( )	( )	( )	( )
14.	I dislike traveling to school by bus because of the many stops and delays at intersections.	( )	( )	( )	( )	( )
15.	I must walk a long distance to get to and from the bus when I go to school.	( )	( )	( )	( )	( )
16.	There is generally a long wait involved when I go to school by bus.	( )	( )	( )	( )	( )
17.	When traveling by bus to school, I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	It is inexpensive to travel by bus to school.	( )	( )	( )	( )	( )

YOUR RATING OF WALK

Is your school located less than 3 miles from your home?

( ) Yes

If your answer is YES, please rate the statements below concerning how you would feel about walking to school, even if you did not walk on your last school trip.

No ( )

If your answer is NO, please go on to the next page.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Walking to school is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When walking, it is convenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I can pick up and go anytime I like when I walk to school.	( )	( )	( )	( )	( )
4.	Walking to school is tiring.	( )	( )	( )	( )	( )
5.	Walking to school is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When I walk to school, I worry about being late.	( )	( )	( )	( )	( )
7.	I cannot rely on walking to school in rainy weather.	( )	( )	( )	( )	( )
8.	I can easily carry my briefcase or other packages when I walk to school.	( )	( )	( )	( )	( )
9.	It is uncomfortable to walk to school because of rough or bumpy walking surfaces.	( )	( )	( )	( )	( )
10.	I can get to school quickly when I walk.	( )	( )	( )	( )	( )
11.	I worry about being mugged or assaulted when I walk to school.	( )	( )	( )	( )	( )
12.	I worry about being injured in an accident if I walk to school.	( )	( )	( )	( )	( )
13.	It is relaxing to walk to school.	( )	( )	( )	( )	( )
14.	I dislike walking to school because of the many delays at intersections.	( )	( )	( )	( )	( )
15.	Walking to school is unsafe because of the lack of pathways that are separated from motorized traffic.	( )	( )	( )	( )	( )
16.	Walking to school is dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17.	When walking to school, I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Walking to school gives healthful exercise.	( )	( )	( )	( )	( )

YOUR RATING OF CAR

When using a car, are you usually a:

( ) car driver?

If you are usually a car driver, even if you did not choose auto for your last school trip, rate the statements below concerning how you would feel about driving to school.

( ) car passenger?

If you are usually a car passenger, even if you did not choose auto for your last school trip, rate the statements below concerning how you would feel about going to school as a car passenger.

Please answer all questions below, even if you do not own a car.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Traveling by car to school is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When traveling by car, it is convenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I can pick up and go anytime I like when I travel by car to school.	( )	( )	( )	( )	( )
4.	Traveling by car to school is tiring.	( )	( )	( )	( )	( )
5.	Traveling by car to school is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When I go by car to school, I worry about being late.	( )	( )	( )	( )	( )
7.	I cannot rely on traveling by car to school in rainy weather.	( )	( )	( )	( )	( )
8.	I can easily carry my briefcase or other packages when I travel by car to school.	( )	( )	( )	( )	( )
9.	It is uncomfortable to travel by car to school because of rough or bumpy road surfaces.	( )	( )	( )	( )	( )
10.	I can get to school quickly when I travel by car.	( )	( )	( )	( )	( )
11.	I worry about being mugged or assaulted when I travel by car to school.	( )	( )	( )	( )	( )
12.	I worry about being injured in an accident if I travel by car to school.	( )	( )	( )	( )	( )
13.	It is relaxing to travel to school by car.	( )	( )	( )	( )	( )
14.	I dislike traveling by car to school because of the many delays at intersections.	( )	( )	( )	( )	( )
15.	Parking the car at my school is expensive.	( )	( )	( )	( )	( )
16.	After parking the car, I must walk a long distance when I go to school.	( )	( )	( )	( )	( )
17.	I worry about the car being stolen or vandalized at school.	( )	( )	( )	( )	( )
18.	It is inexpensive to buy and operate a car.	( )	( )	( )	( )	( )
19.	Parking the car at school is no trouble.	( )	( )	( )	( )	( )

WE WOULD LIKE TO KNOW YOUR PREFERENCES FOR VARIOUS MEANS OF TRAVEL TO SCHOOL.

1. Imagine that only BUS, WALK, BICYCLE, and CAR (driver or passenger) were available for your most recent school trip. These alternatives are listed below. Please indicate your preference by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative.

(If bus service was not available for your school trip, please rank the three remaining alternatives.)

( ) bus

( ) walk

( ) bicycle

( ) car (driver or passenger)

2. We would like to know how often you use each of the following means of travel for school trips from home. Place an "X" under your best estimate of the number of days you have used each means of travel during the last 30 days.

	Oid Not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Oays	More Than 20 Oays
bus	( )	( )	( )	( )	( )	( )
walk	( )	( )	( )	( )	( )	( )
drive a car	( )	( )	( )	( )	( )	( )
passenger in a car	( )	( )	( )	( )	( )	( )
bicycle	( )	( )	( )	( )	( )	( )
other ______ *(specify)*	( )	( )	( )	( )	( )	( )

3. Assume that on your next school trip all travel conditions remained the same as present except that the price of gasoline increased to one of the price levels indicated below. For each gasoline price level, please indicate your transportation preference by placing a "1" next to the alternative you would prefer the most, a "2" next to the one you would prefer second, a "3" after your third choice, and a "4" after your least-preferred alternative. Please repeat for each of the price levels (a) through (d) below.

(If bus service is not available for your school trip, please rank the remaining three alternatives.)

(a) $1.00 Per Gallon		(b) $1.50 Per Gallon		(c) $3.00 Per Gallon		(d) $4.00 Or More Per Gallon	
walk	( )	walk	( )	walk	( )	walk	( )
bicycle	( )	bicycle	( )	bicycle	( )	bicycle	( )
bus	( )	bus	( )	bus	( )	bus	( )
car	( )	car	( )	car	( )	car	( )

WE WOULD LIKE TO KNOW MORE ABOUT THE TRANSPORTATION SERVICE AVAILABLE TO YOU. PLEASE DESCRIBE THE SERVICE FOR TRIPS FROM HOME TO SCHOOL BY ANSWERING THE FOLLOWING QUESTIONS:

ANSWER IF DISTANCE FROM HOME TO SCHOOL IS 6 MILES OR LESS.

1. If you were to ride your bicycle to school, what is your best estimate of the time you would spend doing each of the following?

   getting the bicycle to the street ______ (minutes)
   riding the bicycle ______ (minutes)
   parking and locking up the bicycle ______ (minutes)
   walking from bicycle to school ______ (minutes)
   TOTAL TIME FROM HOME TO SCHOOL [ ] (minutes)

2. Is there a bicycle path or marked bicycle lane which you could use to bicycle on part or all of your trip from home to school?

   ( ) bicycle path (off the street)
   ( ) bicycle lane (on the street)
   ( ) neither
   ( ) don't know

3. What portion of your total trip from home to school is served by bicycle paths or bicycle lanes?

   ( ) none
   ( ) less than 1/4 the distance
   ( ) 1/4 to 1/2 the distance
   ( ) 1/2 to 3/4 the distance
   ( ) more than 3/4 of the distance
   ( ) don't know

ANSWER IF DISTANCE FROM HOME TO SCHOOL IS 3 MILES OR LESS.

4. If you were to walk to school, what is your best estimate of the time it would take from the moment you left home to the moment you arrived at school? ______ (minutes)

5. Are there adequate sidewalks or pathways you could use to walk on your trip from home to school?

   ( ) all or almost all the way
   ( ) part of the way
   ( ) there are none
   ( ) don't know

ANSWER IF BUS SERVICE IS AVAILABLE.

6. If you were to take the <u>bus</u> to school, what is your <u>best estimate</u> of the time you would spend doing each of the following?

getting to the bus stop	______	(minutes)
waiting for the bus	______	(minutes)
riding on the bus	______	(minutes)
walking from bus to school	______	(minutes)
TOTAL TIME FROM HOME TO SCHOOL	[ ]	(minutes)

7. Is it necessary to change buses to travel from your home to school?

( ) Yes

( ) No

8. Out of ten trips, how often would you expect to have a seat on the <u>bus</u> all the way from home to school?

______ times out of ten

9. What is the one-way bus fare on your trip from home to school?

______ cents ( ) don't know

10. If you were to go by car to school, what is your <u>best estimate</u> of the time you would spend doing each of the following?

walking to the car	______	(minutes)
driving or riding	______	(minutes)
parking the car	______	(minutes)
walking from car to school	______	(minutes)
TOTAL TIME FROM HOME TO SCHOOL	[ ]	(minutes)

11. What is the parking cost on your trip from home to school? *(CHECK ONE AND SPECIFY THE COST.)*

( ) no charge		
( ) daily charge	______	(dollars)
( ) weekly charge	______	(dollars)
( ) monthly charge	______	(dollars)

NOW WE WOULD LIKE TO ASK SEVERAL QUESTIONS CONCERNING YOUR BICYCLING ACTIVITIES.

1. Did you ride a bicycle at least once during the past year?

   ( ) Yes

   ( ) No *(IF "NO", GO TO NEXT PAGE.)*

2. Did you ride a bicycle during the last 30 days?

   ( ) Yes

   ( ) No *(IF "NO", GO TO NEXT PAGE.)*

3. We would like to know how often you use the bicycle for each of the following trip purposes. Place an "X" under your best estimate of the number of days you have used the bicycle for each trip purpose ("a" through "h" below) during the last 30 days.

	Did Not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Days	More Than 20 Days
a. To work	( )	( )	( )	( )	( )	( )
b. To school	( )	( )	( )	( )	( )	( )
c. For personal business	( )	( )	( )	( )	( )	( )
d. To visit friends	( )	( )	( )	( )	( )	( )
e. To go shopping	( )	( )	( )	( )	( )	( )
f. To a recreational activity	( )	( )	( )	( )	( )	( )
g. Neighborhood riding	( )	( )	( )	( )	( )	( )
h. Long distance riding (over 2 hours)	( )	( )	( )	( )	( )	( )

Is your school located less than 6 miles away from your home?

( ) Yes | No ( )

If your answer is YES, please read below.

If your answer is NO, please go to page 14.

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO A NEW TRANSPORTATION IMPROVEMENT. THIS IMPROVEMENT, DESCRIBED BELOW, DOES NOT EXIST NOW. IT CONCERNS IMPROVEMENTS TO BICYCLE–RELATED FACILITIES. AFTER YOU READ THE DESCRIPTION, YOU ARE ASKED TO EXPRESS YOUR OPINIONS ABOUT BICYCLING TO SCHOOL USING THE NEW FACILITIES.

BICYCLE–RELATED FACILITY IMPROVEMENTS

Suppose the city introduces several improvements to bicycle-related facilities designed to increase the comfort and safety of cyclists. The improvements consist of (1) providing bicycle paths, (2) reserving street lanes for bicycle use, (3) improving road surfaces, (4) installing secure bicycle lock-up facilities in many areas, and (5) providing better lighting.

On most local streets, a yellow stripe is painted near the right-hand side of the road, marking a lane reserved strictly for bicycle use. Separate bicycle paths are built adjacent to all major roadways. These bicycle paths are separated from automobile traffic by a metal guardrail or a grass median. All these paths and street lanes are smoothly paved for better ride. In addition, high-intensity lights are added along the bikeways to provide excellent visibility at night. A large number of secure bike lock-up facilities are provided and, throughout the school area, these consist of enclosed free storage lockers manned by a full-time attendant. Finally, convenient locker, shower and changing facilities are made available.

You are now asked to express your agreement or disagreement with the following statements about bicycling to school, assuming the bicycle facility improvements, described above, are available to you on your next trip to school. (You will note that the list of statements is the same as that used earlier. The purpose of this last rating is to find out how you feel about the bicycle-related improvements.)

YOUR RATING OF BICYCLE WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning how you would feel about bicycling to school using the facility improvements described on the previous page.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Bicycling to school would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When biking, it would be convenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I could pick up and go anytime I like when I go to school by bicycle.	( )	( )	( )	( )	( )
4.	Traveling to school by bicycle would be tiring.	( )	( )	( )	( )	( )
5.	Riding a bicycle to school would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	If I rode the bicycle to school, I would worry about being late.	( )	( )	( )	( )	( )
7.	I could not rely on riding a bicycle to school in rainy weather.	( )	( )	( )	( )	( )
8.	I could easily carry my briefcase or other packages when I ride the bicycle to school.	( )	( )	( )	( )	( )
9.	It would be uncomfortable to travel to school by bicycle because of rough and bumpy surfaces.	( )	( )	( )	( )	( )
10.	I could get to school quickly when I go by bicycle.	( )	( )	( )	( )	( )
11.	I would worry about being mugged or assaulted when I travel to school by bicycle.	( )	( )	( )	( )	( )
12.	I would worry about being injured in an accident if I ride the bicycle to school.	( )	( )	( )	( )	( )
13.	It would be relaxing to travel to school by bicycle.	( )	( )	( )	( )	( )
14.	I would dislike traveling to school by bicycle because of the many stops and delays at intersections.	( )	( )	( )	( )	( )
15.	Riding the bicycle to school would be unsafe because of the lack of bike paths that are separated from motorized traffic.	( )	( )	( )	( )	( )
16.	Going by bicycle to school would be dangerous because motorists are inconsiderate of bicyclists.	( )	( )	( )	( )	( )
17.	When bicycling to school, I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Riding a bicycle to school would give healthful exercise.	( )	( )	( )	( )	( )
19.	Parking, locking and unlocking my bicycle at school would be no trouble.	( )	( )	( )	( )	( )
20.	After parking my bicycle, I would have to walk a long distance when I go to school.	( )	( )	( )	( )	( )
21.	I would worry about my bicycle being stolen at school.	( )	( )	( )	( )	( )
22.	It would be inexpensive to buy and operate a bicycle.	( )	( )	( )	( )	( )

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR BICYCLING. PLEASE INDICATE YOUR TRANSPORTATION PREFERENCES BELOW FOR YOUR NEXT SCHOOL TRIP.

1. Please indicate your preference for the following alternative means of travel for your next trip to school by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative. Please repeat the process for each statement, (a) though (c) below. *(If bus service is not available between your home and your school, rank the three remaining alternatives only.)*

   a. Assume the bicycle facilities are in place. Please rank the following means of travel for your next trip to school.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition as (a) above, except that the price of gasoline has increased to $1.50 per gallon. *(Please rank again.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the bicycle facilities are in place and the price of gasoline increased to $3.00 per gallon. *(Please rank.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below were available for your next 10 trips to school, how many of the 10 trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)
      (10) TOTAL TRIPS

LIVING NEARER TO TRAVEL DESTINATIONS

Many planners maintain that the use of automobiles has greatly increased the levels of air pollution, energy consumption, traffic congestion, and costly street and highway expenditures. It has been suggested that in order to reduce these problems, people must live nearer to their places of employment, shopping, school, and recreation.

Some communities have been designed with this compact land-use arrangement in mind. Their layout is such that most shopping and personal business trips can be accommodated within a six-block (1/2 mile) distance and most work and school trips are within two miles.

Suppose you live or moved to one such community. Suppose further that special bicycle paths and pedestrian pathways are provided so that it is possible to walk or bicycle to school without having to cross streets that carry heavy motor vehicle traffic; bicycle storing and lock-up facilities are provided in large numbers, free of charge, throughout the area; convenient bus service is available and there are no special restrictions on the use of automobiles.

Now, please turn to the following pages and express how this compact land-use arrangement would affect the way you feel about WALK, BICYCLE, BUS, or CAR for your school trip.

YOU HAVE JUST READ ABOUT AN ASSUMED LAND–USE AND TRANSPORTATION CONDITION. IMAGINE THAT THIS CONDITION EXISTS ON YOUR NEXT SCHOOL TRIP.

1. Please indicate your agreement or disagreement with the following statement:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I would like to live in this type of community.					

2. Please indicate your preference for each of the following transportation alternatives on your next trip to school, by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative, assuming the land-use arrangement described above. Please repeat the process for each statement (a) through (d) below.

a. Assume the living conditions and special transportation facilities described on the previous page exist for your next trip to school, and assume further that your trip to school is approximately one mile away. *(Please rank the following means of transportation.)*

( ) walk
( ) bicycle
( ) bus or transit
( ) car (driver or passenger)

b. Now suppose that in addition to the conditions described in (a) above that the price of gasoline increased to $1.50 per gallon. *(Please rank again.)*

( ) walk
( ) bicycle
( ) bus or transit
( ) car (driver or passenger)

c. Assume the conditions described in (a) above and assume that in addition the speed limit is reduced to 15 mph in the community. *(Please rank.)*

( ) walk
( ) bicycle
( ) bus or transit
( ) car (driver or passenger)

d. Assume again the conditions described in (a) above, but this time assume no parking was available at your school. *(Please rank.)*

( ) walk
( ) bicycle
( ) bus or transit
( ) car (driver or passenger)

YOUR RATING OF WALK WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning how you would feel about walking to school using the facility improvements described on the previous page, even if you did not walk on your last trip to school.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Walking to school would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When walking, it would be convenient to stop and do errands on my way to and from school.	( )	( )	( )	( )	( )
3.	I could pick up and go anytime I like when I walk to school.	( )	( )	( )	( )	( )
4.	Walking to school would be tiring.	( )	( )	( )	( )	( )
5.	Walking to school would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	If I walked to school, I would not worry about being late.	( )	( )	( )	( )	( )
7.	I could not rely on walking to school in rainy weather.	( )	( )	( )	( )	( )
8.	I could easily carry my briefcase or other packages when I walk to school.	( )	( )	( )	( )	( )
9.	It would be uncomfortable to walk to school because of rough or bumpy walking surfaces.	( )	( )	( )	( )	( )
10.	I could get to school quickly when I walk.	( )	( )	( )	( )	( )
11.	I would worry about being mugged or assaulted when I walk to school.	( )	( )	( )	( )	( )
12.	I would worry about being injured in an accident if I walk to school.	( )	( )	( )	( )	( )
13.	It would be relaxing to walk to school.	( )	( )	( )	( )	( )
14.	I would dislike walking to school because of the many delays at intersections.	( )	( )	( )	( )	( )
15.	Walking to school would be unsafe because of the lack of pathways that are separated from motorized traffic.	( )	( )	( )	( )	( )
16.	Walking to school would be dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17.	When walking to school, I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Walking to school would give healthful exercise.	( )	( )	( )	( )	( )

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR WALKING. PLEASE INDICATE YOUR TRANSPORTATION PREFERENCES BELOW FOR YOUR NEXT SCHOOL TRIP.

1. Please indicate your preference for each of the following alternative means of travel for your next trip to school by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative. Repeat the process for each statement (a) through (c) below.

   (If bus service is not available between your home and school, rank the three remaining alternatives only.)

   a. Assume the walk facilities are in place. Please rank the following means of travel for your next trip to school.

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition as (a) above, except that the price of gasoline has increased to $1.50 per gallon. *(Please rank again.)*

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the walk facilities are in place and the price of gasoline increased to $3.00 per gallon. *(Please rank.)*

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below were available for your next 10 trips to school, how many of the 10 trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

      ( ) walk with improved facilities
      ( ) bicycle
      ( ) bus/transit
      ( ) car (driver or passenger)
      (10) TOTAL TRIPS

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO AN ASSUMED REGULATION CONCERNING AUTOMOBILES. AFTER YOU READ THE DESCRIPTION, YOU WILL BE ASKED TO ANSWER A FEW QUESTIONS ABOUT YOUR PREFERENCE FOR ALTERNATIVE MEANS OF TRANSPORTATION.

AUTO CONGESTION FEE

It is decided that in order to reduce congestion and lower fuel usage, a fee of $1.00 will be charged to the owners of automobiles operating during the morning (7-9 a.m.) and evening (4-6 p.m.) rush hours. This means that you would be charged up to $2.00 per day if you operate a motor vehicle during these peak travel periods. Billing would be made on a monthly basis using an automated billing process.

PLEASE TURN TO THE FOLLOWING PAGE.

YOU HAVE JUST READ AN ASSUMED FEE ON AUTO USAGE. IMAGINE THAT THIS SITUATION EXISTS FOR YOUR NEXT SCHOOL TRIP.

1. Please indicate your agreement or disagreement with the following statements:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
a. I believe that a congestion fee of two dollars per day is desirable.	( )	( )	( )	( )	( )
b. It would be inexpensive to travel by car with a congestion fee of two dollars per day.	( )	( )	( )	( )	( )

2. Please indicate your preference for each of the following transportation alternatives for your next trip to school by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative. Please repeat this for each of the statements (a) through (c) below. *(If bus service is not available for your school trip, please rank the three remaining alternatives only.)*

   a. Assume the congestion fee of $2.00 per day, described on the preceding page, was in effect. Please rank the following means of transportation for your next trip to school.

      ( ) walk

      ( ) bicycle

      ( ) bus/transit

      ( ) car (driver or passenger)

   b. Assume that instead of $2.00, the congestion fee increased to $4.00 per day. *(Please rank again.)*

      ( ) walk

      ( ) bicycle

      ( ) bus/transit

      ( ) car (driver or passenger

   c. Assume that in addition to the congestion fee of $2.00 per day, the price of gasoline increases to $1.50 per gallon. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus/transit

      ( ) car (driver or passenger)

WE WOULD LIKE TO ASK YOU SEVERAL IMPORTANT FACTS ABOUT YOURSELF. THESE ARE IMPORTANT IN PROJECTING YOUR VIEWS TO THE POPULATION OF YOUR COMMUNITY. AS YOU RECALL, YOUR ANSWERS WILL NOT BE IDENTIFIED WITH YOUR NAME AND ALL RESPONSES WILL BE KEPT CONFIDENTIAL.

1. How old are you? ________ (age)

2. What is your sex? ( ) Male ( ) Female

3. How many adults (18 or over), including yourself, are there in your household? ________

4. How many minors (under 18) are there in your household? ________

5. Do you have a valid driver's license? ( ) Yes ( ) No

6. How many licensed drivers (including yourself) are there in your household? ________

7. How many automobiles are there in your household? ________

8. Do you own a bicycle? ( ) Yes ( ) No

9. How many bicycles are there in your household? ________

10. What type of structure do you live in?

   ( ) single family
   ( ) duplex
   ( ) townhouse
   ( ) walk-up apartment (3 stories or less)
   ( ) low-rise apartment (4 to 8 stories)
   ( ) high-rise apartment (more than 8 stories)
   ( ) other ________ *(please specify)*

11. What is your educational background? *(CHECK ONE)*

   ( ) completed elementary school
   ( ) some high school
   ( ) high school graduate
   ( ) some college or technical school
   ( ) college or technical school graduate
   ( ) some graduate school
   ( ) completed graduate degree(s)

12. How many workers are in your household? ________

13. Please check the category which includes your approximate family income before taxes.

   ( ) $5,000 and under
   ( ) $5,001 - $7,500
   ( ) $7,501 - $10,000
   ( ) $10,001 - $12,500
   ( ) $12,501 - $15,000
   ( ) $15,001 - $17,500
   ( ) $17,501 - $20,000
   ( ) $20,001 - $25,000
   ( ) $25,001 - $50,000
   ( ) Over $50,000

In the space below we would welcome any other comments you would like to make. Enclose additional pages if you like.

____

____

____

____

We would like to express our sincere thanks to you for completing this questionnaire.

CITY OF PHILADELPHIA

PHILADELPHIA CITY PLANNING COMMISSION
13th Floor City Hall Annex
S. E. Cor., Juniper & Filbert St., Philadelphia, Pa 19107
MU 6-1776

WILLIAM L RAFSKY, Chairman

JOHN C MITKUS, Executive Director
G. CRAIG SCHELTER, Deputy Executive Director

October 15, 1978

Dear Resident of Society Hill and of Rittenhouse:

The City of Philadelphia is cooperating in a U. S. Department of Transportation study aimed at determining what can be done to increase the level of walking and bicycling as means of travel. To accomplish this, a survey is being conducted to find out how <u>you</u> feel about walking and biking. The results of this survey will be helpful to those persons who are responsible for developing walking and bicycling programs and facilities.

Your neighborhood has been carefully chosen along with four other sites across the United States, and your household has been selected at random from among the residents of your area. The number of people being asked to participate is small, so your answers are <u>very important</u>. Please do not put your name on the questionnaire. Your responses will be kept strictly confidential.

This questionnaire is concerned with your <u>work trips only</u>. We are interested in your opinion of the transportation services available to you between your home and your place of work. In addition, some questions about your age, sex, and family size have been included to help us understand how your answers can be related to your community. Although the questionnaire appears long, most people find it interesting to answer the questions. We hope you do, too.

Please take time in the next day or two to answer the questions completely. Your interviewer, a representative of Winona, Inc., will pick up the completed questionnaire and will answer any questions you may have, on the following prearranged date and time:

____

If you have any questions while filling out the questionnaire, please call this toll free number: 1--800--328-2933.

Sincerely,

John C. Mitkus
Executive Director

JCM:sm
Enc.

WE WOULD LIKE TO ASK A FEW QUESTIONS ABOUT YOUR MOST RECENT TRIP FROM HOME TO WORK.

1. What is the nearest interest intersection or street address of the place where you work?

_______________________________ *(nearest intersection or street address)*   _______________ *(city)*

2. Where is the place where you work located:

( ) central city

( ) suburban

3. Specify the type of area where your work place is located. *(CHECK ONE)*

( ) central business district (downtown of metropolitan area)

( ) neighborhood business district or shopping center

( ) regional shopping center

( ) industrial district

( ) office park/professional building

( ) college campus or school

( ) other _______________ *(please specify)*

4. Approximately how far is it from your home to your work place (one way)?

( ) 2 blocks or less (¼ mile or less)

( ) 3 to 6 blocks (¼ to ½ mile)

( ) ½ to 1 mile

( ) 1 to 2 miles

( ) 2 to 4 miles

( ) 4 to 6 miles

( ) 6 to 10 miles

( ) over 10 miles

5. What was the date of your most recent trip to work?

_______________ *month/day*

6. At approximately what time of day did you make this trip to work?

( ) before 7 a.m.
( ) 7 a.m. to 8 a.m.
( ) 8 a.m. to 9 a.m.
( ) 9 a.m. to 10 a.m.
( ) 10 a.m. to 2 p.m.
( ) 2 p.m. to 6 p.m.
( ) after 6 p.m.

7. How did you make your <u>most recent trip</u> to work? *(CHECK ONE)*

( ) walked all the way
( ) drove a car
( ) passenger in a car
( ) bus
( ) train or subway
( ) motorcycle
( ) bicycle
( ) moped (motorized bicycle)
( ) taxi
( ) other ______________________ *(please specify)*

7a. If you answered bus, train or subway above, how did you get to your bus or transit stop?

( ) bicycle
( ) taxi
( ) walked
( ) drove and parked
( ) passenger in a car
( ) other ______________________ *(please specify)*

8. Between the time you left home to go to work and the time you returned home, did you make any side trips that required you to travel more than <u>one mile</u> out of your way?

( ) yes
( ) no

9. Did anyone accompany you on your last work trip: *(CHECK ONE)*

( ) I traveled alone
( ) I was with one other person
( ) I was with two other persons
( ) I was with three or more persons

NOW WE WOULD LIKE YOUR OPINION OF DIFFERENT MEANS OF TRAVEL. PLEASE CONSIDER YOUR MOST RECENT TRIP TO WORK WHEN COMPLETING THE FOLLOWING SECTION.

Imagine that only the following options were available to you on your most recent work trip: CAR (driving or riding), BUS (or transit), WALK, and BICYCLE. For your travel to work we would like to learn how you feel about each means of transportation. Please give us your opinion of each means of transportation even if you never use it.

The following pages are labeled with the means of transportation you are asked to rate. Under each label you will find a set of statements. Please read each statement and place an "X" in the space that best indicates your agreement with the statements under each means of transportation you are rating.

For example, consider the following statement for bus:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I enjoy traveling to work by bus.	( )	( )	( )	( )	( )

If you enjoy traveling by bus, you would put an "X" in the box under agree or strongly agree, depending on how much you enjoy travel by bus. If you do not enjoy travel by bus, you would put an "X" under disagree or strongly disagree. If you neither agree nor disagree you would place an "X" in the center box. In the example shown here, an "X" has been placed in the box under "agree", indicating this person enjoys traveling by bus.

Because we need to understand how your rating of your trip to work varies from one means of transportation to another, we are asking that you go through the list of characteristics four times, once for each means of travel (walk, bicycle, car, and bus). Although this process might appear repetitious, we want to stress that your careful rating of all the statements on the next four pages are especially important to the success of this survey.

YOUR RATING OF WALK

Is your work place located less than 3 miles from your home?

( ) yes

If your answer is YES, please rate the statements below concerning how you would feel about walking to work even if you did not walk on your last work trip.

( ) no

If your answer is NO, please go on to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Walking to work is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When walking, it is convenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3. I can pick up and go anytime I like when I walk to work.	( )	( )	( )	( )	( )
4. Walking to work is tiring.	( )	( )	( )	( )	( )
5. Walking to work is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When I walk to work I worry about being late.	( )	( )	( )	( )	( )
7. I cannot rely on walking to work in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry my briefcase or other packages when I walk to work.	( )	( )	( )	( )	( )
9. It is uncomfortable to walk to work because of rough or bumpy walking surfaces.	( )	( )	( )	( )	( )
10. I can get to work quickly when I walk.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I walk to work.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident if I walk to work.	( )	( )	( )	( )	( )
13. It is relaxing to walk to work.	( )	( )	( )	( )	( )
14. I dislike walking to work because of the many delays at intersections.	( )	( )	( )	( )	( )
15. Walking to work is unsafe because of the lack of pathways that are separated from motorized traffic.	( )	( )	( )	( )	( )
16. Walking to work is dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17. When walking to work I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. Walking to work gives healthful exercise.	( )	( )	( )	( )	( )

YOUR RATING OF CAR

When using a car, are you usually a:

( ) car driver?

( ) car passenger?

If you are usually a car driver, even if you did not choose auto for your last work trip, rate the statements below concerning how you would feel about driving to work.

If you are usually a car passenger, even if you did not choose auto for your last work trip, rate the statements below concerning how you would feel about going to work as a car passenger.

Please answer all questions below, even if you do not own a car.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Traveling by car to work is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When traveling by car, it is convenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3.	I can pick up and go anytime I like when I travel by car to work.	( )	( )	( )	( )	( )
4.	Traveling by car to work is tiring.	( )	( )	( )	( )	( )
5.	Traveling by car to work is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	When I go by car to work I worry about being late.	( )	( )	( )	( )	( )
7.	I cannot rely on traveling by car to work in rainy weather.	( )	( )	( )	( )	( )
8.	I can easily carry my briefcase or other packages when I travel by car to work.	( )	( )	( )	( )	( )
9.	It is uncomfortable to travel by car to work because of rough or bumpy road surfaces.	( )	( )	( )	( )	( )
10.	I can get to work quickly when I travel by car.	( )	( )	( )	( )	( )
11.	I worry about being mugged or assaulted when I travel by car to work.	( )	( )	( )	( )	( )
12.	I worry about being injured in an accident if I travel by car to work.	( )	( )	( )	( )	( )
13.	It is relaxing to travel by car to work.	( )	( )	( )	( )	( )
14.	I dislike traveling by car to work because of the many delays at intersections.	( )	( )	( )	( )	( )
15.	Parking the car at my place of work is expensive.	( )	( )	( )	( )	( )
16.	After parking the car, I must walk a long distance when I go to work.	( )	( )	( )	( )	( )
17.	I worry about the car being stolen or vandalized at work.	( )	( )	( )	( )	( )
18.	It is inexpensive to buy and operate a car.	( )	( )	( )	( )	( )
19.	Parking the car at work is no trouble.	( )	( )	( )	( )	( )

YOUR RATING OF BICYCLE

Is your work place located less than 6 miles from your home?

( ) Yes

If your answer is YES, please rate the statements below concerning how you would feel about bicycling to work even if you don't own a bicycle, or didn't ride a bicycle on your last trip to work.

( ) No

If your answer is NO, please go on to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Bicycling to work is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When biking, it is convenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3. I can pick up and go anytime I like when I go to work by bicycle.	( )	( )	( )	( )	( )
4. Traveling to work by bicycle is tiring.	( )	( )	( )	( )	( )
5. Riding a bicycle to work is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When I ride the bicycle to work I worry about being late.	( )	( )	( )	( )	( )
7. I cannot rely on riding a bicycle to work in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry my briefcase or other packages when I ride the bicycle to work.	( )	( )	( )	( )	( )
9. It is uncomfortable to travel to work by bicycle because of rough and bumpy riding surfaces.	( )	( )	( )	( )	( )
10. I can get to work quickly when I go by bicycle.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I travel to work by bicycle.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident if I ride the bicycle to work.	( )	( )	( )	( )	( )
13. It is relaxing to travel to work by bicycle.	( )	( )	( )	( )	( )
14. I dislike traveling to work by bicycle because of the many stops and delays at intersections.	( )	( )	( )	( )	( )
15. Riding the bicycle to work is unsafe because of the lack of bike paths that are separated from motorized traffic.	( )	( )	( )	( )	( )
16. Going by bicycle to work is dangerous because motorists are inconsiderate of bicyclists.	( )	( )	( )	( )	( )
17. When bicycling to work I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. Riding a bicycle to work gives healthful exercise.	( )	( )	( )	( )	( )
19. Parking, locking and unlocking my bicycle at work is no trouble.	( )	( )	( )	( )	( )
20. After parking my bicycle I must walk a long distance when I go to work.	( )	( )	( )	( )	( )
21. I worry about my bicycle being stolen at work.	( )	( )	( )	( )	( )
22. It is inexpensive to buy and operate a bicycle.	( )	( )	( )	( )	( )

YOUR RATING OF BUS (or transit)

Is bus service available between your home and work place?

( ) yes

If your answer is YES, please rate the statements below concerning how you would feel about going to work by bus even if you didn't choose bus on your last work trip.

( ) no

If your answer is NO, please go on to the next page.

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1. Going to work by bus is pleasant because I can enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2. When traveling by bus, it is inconvenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3. I must schedule my trips in advance when I travel by bus to work.	( )	( )	( )	( )	( )
4. Traveling by bus to work is very tiring.	( )	( )	( )	( )	( )
5. Traveling by bus to work is dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6. When I take the bus to work I worry about being late.	( )	( )	( )	( )	( )
7. I cannot rely on taking a bus to work in rainy weather.	( )	( )	( )	( )	( )
8. I can easily carry my briefcase or other packages when I go to work by bus.	( )	( )	( )	( )	( )
9. It is uncomfortable to travel to work by bus because of rough and bumpy road surfaces.	( )	( )	( )	( )	( )
10. I can get to work quickly when I take the bus.	( )	( )	( )	( )	( )
11. I worry about being mugged or assaulted when I go to work by bus.	( )	( )	( )	( )	( )
12. I worry about being injured in an accident if I go to work by bus.	( )	( )	( )	( )	( )
13. It is relaxing to go to work by bus.	( )	( )	( )	( )	( )
14. I dislike traveling to work by bus because of the many stops and delays at intersections.	( )	( )	( )	( )	( )
15. I must walk a long distance to get to and from the bus when I go to work.	( )	( )	( )	( )	( )
16. There is generally a long wait involved when I go to work by bus.	( )	( )	( )	( )	( )
17. When traveling by bus to work I worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18. It is inexpensive to travel by bus to work.	( )	( )	( )	( )	( )

WE WOULD LIKE TO KNOW YOUR PREFERENCES FOR VARIOUS MEANS OF TRAVEL TO WORK.

1. Imagine that only BUS, WALK, BICYCLE, and CAR (driver or passenger) were available for your most recent work trip. These alternatives are listed below. Please indicate your preference by placing a "1" next to the alternative you prefer the most, a "2" next to your second most-preferred alternative, a "3" next to your third most-preferred alternative, and a "4" next to your least-preferred alternative.

(If bus service was not available for your work trip, please rank the three remaining alternatives.)

( ) bus
( ) walk
( ) bicycle
( ) car (driver or passenger)

2. We would like to know how often you use each of the following means of travel for work trips from home. Place an "X" under your best estimate of the number of days you have used each means of travel during the last 30 days.

	Did Not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Days	More Than 20 Days
bus	( )	( )	( )	( )	( )	( )
walk	( )	( )	( )	( )	( )	( )
drive a car	( )	( )	( )	( )	( )	( )
passenger in a car	( )	( )	( )	( )	( )	( )
bicycle	( )	( )	( )	( )	( )	( )
other ________ *(specify)*	( )	( )	( )	( )	( )	( )

3. Assume that on your next work trip all travel conditions remained the same as present except that the price of gasoline increased to one of the price levels indicated below. For each gasoline price level, please indicate your transportation preference by placing a "1" next to the alternative you would prefer the most, a "2" next to the one you would prefer second, a "3" next to your third choice, and a "4" next to your least-preferred alternative. Please repeat for each of the price levels (a) through (d) below.

(If bus service is not available for your work trip, please rank the three remaining alternatives.)

(a) $1.00 Per Gallon		(b) $1.50 Per Gallon		(c) $3.00 Per Gallon		(d) $4.00 Or More Per Gallon	
walk	( )	walk	( )	walk	( )	walk	( )
bicycle	( )	bicycle	( )	bicycle	( )	bicycle	( )
bus	( )	bus	( )	bus	( )	bus	( )
car	( )	car	( )	car	( )	car	( )

WE WOULD LIKE TO KNOW MORE ABOUT THE TRANSPORTATION SERVICE AVAILABLE TO YOU. PLEASE DESCRIBE THE SERVICE FOR TRIPS FROM HOME TO THE PLACE WHERE YOU WORK BY ANSWERING THE FOLLOWING QUESTIONS:

ANSWER IF DISTANCE FROM HOME TO WORK IS 6 MILES OR LESS.

1. If you were to ride your bicycle to work, what is your best estimate of the time you would spend doing each of the following?

   getting the bicycle to the street _______ (minutes)

   riding the bicycle _______ (minutes)

   parking and locking up the bicycle _______ (minutes)

   walking from bicycle to school _______ (minutes)

   TOTAL TIME FROM HOME TO WORK [ ] (minutes)

2. Is there a bicycle path or marked bicycle lane which you could use to bicycle on part or all of your trip from home to work?

   ( ) bicycle path (off the street)
   ( ) bicycle lane (on the street)
   ( ) neither
   ( ) don't know

3. What portion of your total trip from home to work is served by bicycle paths or bicycle lanes?

   ( ) none
   ( ) less than 1/4 the distance
   ( ) 1/4 to 1/2 the distance
   ( ) 1/2 to 3/4 the distance
   ( ) more than 3/4 of the distance
   ( ) don't know

ANSWER IF DISTANCE FROM HOME TO WORK IS 3 MILES OR LESS.

4. If you were to walk to work, what is your best estimate of the time it would take from the moment you left home to the moment you arrived at work? _______ (minutes)

5. Are there adequate sidewalks or pathways you could use to walk on your trip from home to work?

   ( ) all or almost all the way
   ( ) part of the way
   ( ) there are none
   ( ) don't know

ANSWER IF BUS SERVICE IS AVAILABLE.

6. If you were to take the bus to work, what is your best estimate of the time you would spend doing each of the following?

getting to the bus stop	______	(minutes)
waiting for the bus	______	(minutes)
riding on the bus	______	(minutes)
walking from bus to work	______	(minutes)
TOTAL TIME FROM HOME TO WORK	[ ]	(minutes)

7. Is it necessary to change buses to travel from your home to work?

( ) Yes

( ) No

8. Out of ten trips, how often would you expect to have a seat on the bus all the way from home to work?

______ times out of ten

9. What is the one-way bus fare on your trip from home to work?

______ cents ( ) don't know

10. If you were to go by car to work, what is your best estimate of the time you would spend doing each of the following?

walking to the car	______	(minutes)
driving or riding	______	(minutes)
parking the car	______	(minutes)
walking from car to work	______	(minutes)
TOTAL TIME FROM HOME TO WORK	[ ]	(minutes)

11. What is the parking cost on your trip from home to work? *(CHECK ONE AND SPECIFY THE COST.)*

( ) no charge		
( ) daily charge	______	(dollars)
( ) weekly charge	______	(dollars)
( ) monthly charge	______	(dollars)

NOW WE WOULD LIKE TO ASK SEVERAL QUESTIONS CONCERNING YOUR BICYCLING ACTIVITIES.

1. Did you ride a bicycle at least once during the past year?

   ( ) Yes

   ( ) No *(IF "NO", GO TO THE NEXT PAGE.)*

2. Did you ride a bicycle during the last 30 days?

   ( ) Yes

   ( ) No *(IF "NO", GO TO NEXT PAGE.)*

3. We would like to know how often you use the bicycle for each of the following trip purposes. Place an "X" under your best estimate of the number of days you have used the bicycle for each trip purpose ("a" through "h") during the last 30 days.

	Did Not Use	1-5 Days	6-10 Days	11-15 Days	16-20 Days	More Than 20 Days
a. To work	( )	( )	( )	( )	( )	( )
b. To school	( )	( )	( )	( )	( )	( )
c. For personal business	( )	( )	( )	( )	( )	( )
d. To visit friends	( )	( )	( )	( )	( )	( )
e. To go shopping	( )	( )	( )	( )	( )	( )
f. To a recreational activity	( )	( )	( )	( )	( )	( )
g. Neighborhood riding	( )	( )	( )	( )	( )	( )
h. Long distance riding (over 2 hours)	( )	( )	( )	( )	( )	( )

Is your work place located less than 6 miles away from your home?

( ) Yes

If your answer is YES, please read below.

( ) No

If your answer is NO, please go on to page 16.

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO A NEW TRANSPORTATION IMPROVEMENT. THIS IMPROVEMENT, DESCRIBED BELOW, DOES NOT EXIST NOW. IT CONCERNS IMPROVEMENTS TO BICYCLE–RELATED FACILITIES. AFTER YOU READ THE DESCRIPTION, YOU ARE ASKED TO EXPRESS YOUR OPINIONS ABOUT <u>BICYCLING TO WORK USING THE NEW FACILITIES</u>.

BICYCLE–RELATED FACILITY IMPROVEMENTS

Suppose the city introduces several improvements to bicycle-related facilities designed to increase the comfort and safety of cyclists. The improvements consist of (1) providing bicycle paths, (2) reserving street lanes for bicycle use, (3) improving road surfaces, (4) installing secure bicycle lock-up facilities in many areas, and (5) providing better lighting.

On most local streets, a yellow stripe is painted near the right hand side of the road, marking a lane reserved strictly for bicycle use. Separate bicycle paths are built adjacent to all major roadways. These bicycle paths are separated from automobile traffic by a metal guardrail or a grass median. All these paths and street lanes are smoothly paved for a better ride. In addition, high intensity lights are added along the bikeways to provide excellent visibility at night. A large number of secure bike lock-up facilities are provided and, in high employment centers, these consist of enclosed free storage lockers manned by a full-time attendant. Finally, convenient locker, shower and changing facilities are made available.

You are now asked to express your agreement or disagreement with the following statements about <u>bicycling to work</u>, assuming the bicycle facility improvements described above are available to you on your next work trip. (You will note that the list of statements is the same as that used earlier. The purpose of this last rating is to find out how <u>you</u> feel about the bicycle-related improvements.)

YOUR RATING OF BICYCLE WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning how you would feel about *<u>bicycling</u>* *to work using the facility improvements described on your previous page.*

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongl Disagre
1.	Bicycling to work would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When biking, it would be convenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3.	I could pick up and go anytime I like when I go to work by bicycle.	( )	( )	( )	( )	( )
4.	Traveling to work by bicycle would be tiring.	( )	( )	( )	( )	( )
5.	Riding a bicycle to work would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	If I rode the bicycle to work, I would worry about being late.	( )	( )	( )	( )	( )
7.	I could not rely on riding a bicycle to work in rainy weather.	( )	( )	( )	( )	( )
8.	I could easily carry my briefcase or other packages when I ride the bicycle to work.	( )	( )	( )	( )	( )
9.	It would be uncomfortable to travel to work by bicycle because of rough and bumpy surfaces.	( )	( )	( )	( )	( )
10.	I could get to work quickly when I go by bicycle.	( )	( )	( )	( )	( )
11.	I would worry about being mugged or assaulted when I travel to work by bicycle.	( )	( )	( )	( )	( )
12.	I would worry about being injured in an accident if I ride the bicycle to work.	( )	( )	( )	( )	( )
13.	It would be relaxing to travel to work by bicycle.	( )	( )	( )	( )	( )
14.	I would dislike traveling to work by bicycle because of the many stops and delays at intersections.	( )	( )	( )	( )	( )
15.	Riding the bicycle to work would be unsafe because of lack of bike paths that are separated from motor traffic.	( )	( )	( )	( )	( )
16.	Going by bicycle to work would be dangerous because motorists are inconsiderate of bicyclists.	( )	( )	( )	( )	( )
17.	When bicycling to work I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Riding a bicycle to work would give healthful exercise.	( )	( )	( )	( )	( )
19.	Parking, locking and unlocking my bicycle at work would be no trouble.	( )	( )	( )	( )	( )
20.	After parking my bicycle I would have to walk a long distance when I go to work.	( )	( )	( )	( )	( )
21.	I would worry about my bicycle being stolen at work.	( )	( )	( )	( )	( )
22.	It would be inexpensive to buy and operate a bicycle	( )	( )	( )	( )	( )

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR BICYCLING. PLEASE INDICATE YOUR TRANSPORTATION PREFERENCES BELOW FOR YOUR NEXT WORK TRIP.

---

1. Please indicate your preference for the following alternative means of travel for your next trip to work by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative. Repeat the process for each statement (a) through (c) below.

   (If bus service is not available between your home and your place of work, rank the three remaining alternatives only.)

   a. Assume the bicycle facilities are in place. please rank the following means of travel for your next trip to work.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition as (a) above except that the price of gasoline has increased to $ 1.50 per gallon. *(Please rank again.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the bicycle facilities are in place and the price of gasoline increased to $3.00 per gallon. *(Please rank.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below were available for your next ten trips to work, how many of the ten trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

   ( ) bicycle with improved facilities
   ( ) walk
   ( ) bus/transit
   ( ) car (driver or passenger)
   (10) TOTAL TRIPS

A

LIVING NEARER TO TRAVEL DESTINATIONS

Many planners maintain that the use of automobiles has greatly increased the levels of air pollution, energy consumption, traffic congestion and costly street and highway expenditures. It has been suggested that in order to reduce these problems people must live nearer to their places of employment, shopping, school and recreation.

Some communities have been designed with this compact land-use arrangement in mind. Their layout is such that most shopping and personal business trips can be accommodated within a six block (½ mile) distance, and most work trips are within two miles of home.

Suppose you live or moved to one such community. Suppose further that special bicycle paths and pedestrian pathways are provided so that it is possible to walk or bicycle to work without having to cross streets that carry heavy motor vehicle traffic; bicycle storing and lock-up facilities are provided in large numbers, free of charge, throughout the area; convenient bus service is available to work places: there are no special restrictions on the use of automobiles.

Now, please turn to the following pages and express how this compact land-use arrangement would affect the way you feel about using WALK, BICYCLE, BUS or CAR for your work trip.

YOU HAVE JUST READ ABOUT AN ASSUMED LAND USE AND TRANSPORTATION CONDITION. IMAGINE THAT THIS CONDITION EXISTS ON YOUR NEXT WORK TRIP.

1. Please indicate your agreement or disagreement with the following statement:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
I would like to live in this type of community.					

2. Please indicate your preference for <u>each</u> of the following transportation alternatives on your next trip to work, by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative, <u>assuming the land-use arrangement described</u> above. Please repeat the process for each statement (a) through (d) below.

   a. Assume the living conditions and special transportation facilities described on the previous page exist for your next trip to work, and assume further that your trip to work is approximately one mile away. *(Please rank the following means of transportation.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   b. Now suppose that in addition to the conditions described in (a) above, the price of gasoline increased to $1.50 per gallon. *(Please rank again.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   c. Assume the conditions described in (a) above and assume that in addition, the speed limit was reduced to 15 mph in the community. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   d. Assume again the conditions described in (a) above but this time, assume no parking was available at your work place. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

Is your work place located less than 3 miles from your home?

( ) Yes No ( )

If your answer is YES, please read below. *If your answer is NO, please go on to page 15.*

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO A NEW TRANSPORTATION IMPROVEMENT. THIS IMPROVEMENT, DESCRIBED BELOW, DOES NOT EXIST NOW. IT CONCERNS IMPROVEMENTS TO PEDESTRIAN-RELATED FACILITIES. AFTER YOU READ THE DESCRIPTION, YOU ARE ASKED TO EXPRESS YOUR OPINIONS ABOUT WALKING TO WORK USING THE NEW FACILITIES.

PEDESTRIAN-RELATED FACILITY IMPROVEMENTS

Suppose the city introduces several improvements to pedestrian-related facilities designed to increase the comfort and safety of pedestrians. The improvements consist of (1) providing pedestrian pathways, (2) improving sidewalks, (3) providing better lighting, and (4) making traffic signals more pedestrian-oriented.

Separate pedestrian ways or walkways are built adjacent to all major roadways. These pathways are separated from automobile traffic by trees or grass medians. At all busy street crossings, pedestrians will be able to change traffic lights in their favor. All existing sidewalks are repaired to make walking easier. High intensity lights are added along the pathways to provide excellent visibility at night. Finally, the walkways are enhanced by the presence of water fountains, shade trees, benches and pedestrian-oriented stands with flowers, newspapers and refreshments.

You are now asked to express your agreement or disagreement with the following statements about walking to work, assuming the facility improvements described above are available to you on your next trip to work. (You will note that the list of statements is the same as that used earlier. The purpose of this last rating is to find out how you feel about the pedestrian-related improvements.)

YOUR RATING OF WALK WITH FACILITY IMPROVEMENTS

Please rate the statements below concerning <u>how you would feel</u> about <u>walking</u> to work using the facility improvements described on the previous page, even if you did not walk on your last trip to work.

		Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
1.	Walking to work would be pleasant because I could enjoy the scenery and surroundings.	( )	( )	( )	( )	( )
2.	When walking, it would be convenient to stop and do errands on my way to and from work.	( )	( )	( )	( )	( )
3.	I could pick up and go anytime I like when I walk to work.	( )	( )	( )	( )	( )
4.	Walking to work would be tiring.	( )	( )	( )	( )	( )
5.	Walking to work would be dangerous because of the heavy traffic.	( )	( )	( )	( )	( )
6.	If I walked to work I would worry about being late.	( )	( )	( )	( )	( )
7.	I could not rely on walking to work in rainy weather.	( )	( )	( )	( )	( )
8.	I could easily carry my briefcase or other packages when I walk to work.	( )	( )	( )	( )	( )
9.	It would be uncomfortable to walk to work because of rough or bumpy walking surfaces.	( )	( )	( )	( )	( )
10.	I could get to work quickly when I walk.	( )	( )	( )	( )	( )
11.	I would worry about being mugged or assaulted when I walk to work.	( )	( )	( )	( )	( )
12.	I would worry about being injured in an accident if I walk to work.	( )	( )	( )	( )	( )
13.	It would be relaxing to walk to work.	( )	( )	( )	( )	( )
14.	I would dislike walking to work because of the many delays at intersections.	( )	( )	( )	( )	( )
15.	Walking to work would be unsafe because of the lack of pathways that are separated from motorized traffic.	( )	( )	( )	( )	( )
16.	Walking to work would be dangerous because motorists are inconsiderate of pedestrians.	( )	( )	( )	( )	( )
17.	When walking to work I would worry about perspiring or soiling my clothes.	( )	( )	( )	( )	( )
18.	Walking to work would give healthful exercise.	( )	( )	( )	( )	( )

YOU HAVE JUST RATED TRANSPORTATION IMPROVEMENTS FOR BICYCLING. PLEASE INDICATE YOUR TRANSPORTATION PREFERENCES BELOW FOR YOUR NEXT WORK TRIP.

1. Please indicate your preference for the following alternative means of travel for your next trip to work by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative. Repeat the process for each statement (a) through (c) below.

   (If bus service is not available between your home and your place of work, rank the three remaining alternatives only.)

   a. Assume the bicycle facilities are in place. please rank the following means of travel for your next trip to work.

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   b. Now assume the same condition as (a) above except that the price of gasoline has increased to $ 1.50 per gallon. *(Please rank again.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

   c. Suppose that the bicycle facilities are in place and the price of gasoline increased to $3.00 per gallon. *(Please rank.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)

2. If only the alternatives listed below were available for your next ten trips to work, how many of the ten trips would you make using each alternative? *(Write the number of trips in the box next to each alternative.)*

      ( ) bicycle with improved facilities
      ( ) walk
      ( ) bus/transit
      ( ) car (driver or passenger)
      (10) TOTAL TRIPS

NOW WE WOULD LIKE TO LEARN YOUR REACTIONS TO AN ASSUMED REGULATION CONCERNING AUTOMOBILES. AFTER YOU READ THE DESCRIPTION, YOU WILL BE ASKED TO ANSWER A FEW QUESTIONS ABOUT YOUR PREFERENCE FOR ALTERNATIVE MEANS OF TRANSPORTATION.

AUTO CONGESTION FEE

It is decided that in order to reduce congestion and lower fuel usage, a fee of $1.00 will be assessed to the owners of automobiles operating during the morning (7-9 a.m.) and evening (4-6 p.m.) rush hours. This means that you would be charged up to $2.00 per day if you operate a motor vehicle during these peak travel periods. Billing would be made on a monthly basis using an automated billing process.

PLEASE TURN TO THE FOLLOWING PAGE.

YOU HAVE JUST READ AN ASSUMED FEE ON AUTO USAGE. IMAGINE THAT THIS SITUATION EXISTS FOR YOUR NEXT WORK TRIP.

1. Please indicate your agreement or disagreement with the following statements:

	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
a. I believe that a congestion fee of two dollars per day is desirable.					
b. It would be inexpensive to travel by car with a congestion fee of two dollars per day.					

2. Please indicate your preference for <u>each</u> of the following transportation alternatives for your next trip to work by placing a "1" next to the alternative you prefer the most, a "2" next to your second most preferred alternative, a "3" next to your third most preferred alternative, and a "4" next to your least preferred alternative. Please repeat this for <u>each</u> of the statements (a) through (d) below. *(If bus service is <u>not</u> available for your work trip, please rank the three remaining alternatives below.)*

   a. Assume the congestion fee of $2.00 per day described on the preceding page was in effect. Please rank the following means of transportation for your next trip to work.

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   b. Assume that instead of $2.00, the congestion fee increased to $4.00 per day. *(Please rank again.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   c. Assume that in addition to the congestion fee of $2.00 per day the price of gasoline increases to $1.50 per gallon. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

   d. Assume that the congestion fee of $2.00 per day was in effect, and assume further that your employer allowed you to arrive before 7:00 a.m. and leave before 4:00 p.m., or to arrive after 9:00 a.m. and leave after 6:00 p.m. *(Please rank.)*

      ( ) walk

      ( ) bicycle

      ( ) bus or transit

      ( ) car (driver or passenger)

B

WE WOULD LIKE TO ASK YOU SEVERAL IMPORTANT FACTS ABOUT YOURSELF. THESE ARE IMPORTANT IN PROJECTING YOUR VIEWS TO THE TOTAL POPULATION OF YOUR COMMUNITY. YOUR ANSWERS WILL NOT BE IDENTIFIED WITH YOUR NAME AND ALL RESPONSES WILL BE KEPT CONFIDENTIAL.

---

1. How old are you? ____________ (age)

2. What is your sex? ( ) Male ( ) Female

3. How many adults (18 or over) including yourself are there in your household? ____________

4. How many minors (under 18) are there in your household? ____________

5. Do you have a valid driver's license? ( ) Yes ( ) No

6. How many licensed drivers (including yourself) are there in your household? ____________

7. How many automobiles are there in your household? ____________

8. Do you own a bicycle? ( ) Yes ( ) No

9. How many bicycles are there in your household? ____________

10. What type of structure do you live in?

    ( ) single family
    ( ) duplex
    ( ) townhouse
    ( ) walk-up apartment (3 stories or less)
    ( ) low rise apartment (4 to 8 stories)
    ( ) high rise apartment (more than 8 stories)
    ( ) other ____________ *(please specify)*

11. What is your educational background? *(CHECK ONE)*

    ( ) completed elementary school
    ( ) some high school
    ( ) high school graduate
    ( ) some college or technical school
    ( ) college or technical school graduate
    ( ) some graduate school
    ( ) completed graduate degree(s)

12. Please indicate your work group below:

    ( ) work 5 or more days a week
    ( ) work 3-4 days a week
    ( ) work 1-2 days a week
    ( ) presently unemployed

13. What is your occupation? *(CHECK ONE)*.

    ( ) professional-technical
    ( ) managerial
    ( ) blue collar
    ( ) sales worker
    ( ) secretarial-clerical-cashier
    ( ) other ____________ *(please specify)*

14. Does your job require you to dress up? *(CHECK ONE)*

( ) usually ( ) sometimes ( ) not usually

15. How many workers including yourself are in your household? ____________________

16. Please check the category which includes your approximate family income before taxes.

( ) $5,000 and under	( ) $15,001 - $17,500
( ) $5,001 - $7,500	( ) $17,501 - $20,000
( ) $7,501 - $10,000	( ) $20,001 - $25,000
( ) $10,001 - $12,500	( ) $25,001 - $50,000
( ) $12,501 - $15,000	( ) Over $50,000

In the space below we would welcome any other comments you would like to make. Enclose additional pages if you like.

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Feasibility
incentives
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Form DOT F 17
FORMERLY FORM D

We would like to express our sincere thanks to you for completing this questionnaire.

*U.S. GOVERNMENT PRINTING OFFICE: 1981-0-728-477/1851

FEDERALLY COORDINATED PROGRAM (FCP) OF HIGHWAY RESEARCH AND DEVELOPMENT

The Offices of Research and Development (R&D) of the Federal Highway Administration (FHWA) are responsible for a broad program of staff and contract research and development and a Federal-aid program, conducted by or through the State highway transportation agencies, that includes the Highway Planning and Research (HP&R) program and the National Cooperative Highway Research Program (NCHRP) managed by the Transportation Research Board. The FCP is a carefully selected group of projects that uses research and development resources to obtain timely solutions to urgent national highway engineering problems.*

The diagonal double stripe on the cover of this report represents a highway and is color-coded to identify the FCP category that the report falls under. A red stripe is used for category 1, dark blue for category 2, light blue for category 3, brown for category 4, gray for category 5, green for categories 6 and 7, and an orange stripe identifies category 0.

FCP Category Descriptions

1. Improved Highway Design and Operation for Safety

Safety R&D addresses problems associated with the responsibilities of the FHWA under the Highway Safety Act and includes investigation of appropriate design standards, roadside hardware, signing, and physical and scientific data for the formulation of improved safety regulations.

2. Reduction of Traffic Congestion, and Improved Operational Efficiency

Traffic R&D is concerned with increasing the operational efficiency of existing highways by advancing technology, by improving designs for existing as well as new facilities, and by balancing the demand-capacity relationship through traffic management techniques such as bus and carpool preferential treatment, motorist information, and rerouting of traffic.

3. Environmental Considerations in Highway Design, Location, Construction, and Operation

Environmental R&D is directed toward identifying and evaluating highway elements that affect the quality of the human environment. The goals are reduction of adverse highway and traffic impacts, and protection and enhancement of the environment.

4. Improved Materials Utilization and Durability

Materials R&D is concerned with expanding the knowledge and technology of materials properties, using available natural materials, improving structural foundation materials, recycling highway materials, converting industrial wastes into useful highway products, developing extender or substitute materials for those in short supply, and developing more rapid and reliable testing procedures. The goals are lower highway construction costs and extended maintenance-free operation.

5. Improved Design to Reduce Costs, Extend Life Expectancy, and Insure Structural Safety

Structural R&D is concerned with furthering the latest technological advances in structural and hydraulic designs, fabrication processes, and construction techniques to provide safe, efficient highways at reasonable costs.

6. Improved Technology for Highway Construction

This category is concerned with the research, development, and implementation of highway construction technology to increase productivity, reduce energy consumption, conserve dwindling resources, and reduce costs while improving the quality and methods of construction.

7. Improved Technology for Highway Maintenance

This category addresses problems in preserving the Nation's highways and includes activities in physical maintenance, traffic services, management, and equipment. The goal is to maximize operational efficiency and safety to the traveling public while conserving resources.

0. Other New Studies

This category, not included in the seven-volume official statement of the FCP, is concerned with HP&R and NCHRP studies not specifically related to FCP projects. These studies involve R&D support of other FHWA program office research.

* The complete seven-volume official statement of the FCP is available from the National Technical Information Service, Springfield, Va. 22161. Single copies of the introductory volume are available without charge from Program Analysis (HRD-3), Offices of Research and Development, Federal Highway Administration, Washington, D.C. 20590.

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