1. Report No. SWUTC/05/167240-1	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Austin Commuter Survey: Findings and Recommendations		5. Report Date September 2005
		6. Performing Organization Code
7. Author(s) Chandra R. Bhat, Aruna Sivakumar, Sudeshna Sen, Jessica Guo, and Rachel Copperman		8. Performing Organization Report No. Report 167240-1
9. Performing Organization Name and Address Center for Transportation Research The University of Texas at Austin 3208 Red River, Suite 200 Austin, Texas 78705-2650		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. 167240
12. Sponsoring Agency Name and Address Southwest Region University Transportation Center Texas Transportation Institute Texas A&M University System College Station, Texas 77843-3135		13. Type of Report and Period Covered
		14. Sponsoring Agency Code
15. Supplementary Notes Supported by general revenues from the State of Texas.		

16. Abstract

The purpose of this research is to present the major findings and recommendations of a University of Texas (UT) commuter research study that (1) Examined the demographic, employment, and overall travel characteristics of Austin area commuters, and analyzing how these characteristics impact commute travel choices and perceptions, (2) Developed a framework for evaluating the effect of alternative congestion alleviation strategies on commute mode choice, and (3) Identified broad and important issues that have to be recognized when designing and analyzing a comprehensive mobility plan for Austin. The UT research study was based on a web-based survey of Austin area commuters undertaken between December 2003 and March 2004. The data from the web-based survey was weighted appropriately to be representative of the Austin area commuter population.

17. Key Words Travel time reliability, mixed logit, activity-based analysis, commute travel, mode choice.	18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161		
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 60	22. Price

Form DOT F 1700.7 (8-72)   **Reproduction of completed page authorized**

Austin Commuter Survey:

Findings and Recommendations

by

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Research Report SWUTC/05/167240-1

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September 2005

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ABSTRACT

The purpose of this research is to present the major findings and recommendations of a University of Texas (UT) commuter research study that (1) Examined the demographic, employment, and overall travel characteristics of Austin area commuters, and analyzing how these characteristics impact commute travel choices and perceptions, (2) Developed a framework for evaluating the effect of alternative congestion alleviation strategies on commute mode choice, and (3) Identified broad and important issues that have to be recognized when designing and analyzing a comprehensive mobility plan for Austin. The UT research study was based on a web-based survey of Austin area commuters undertaken between December 2003 and March 2004. The data from the web-based survey was weighted appropriately to be representative of the Austin area commuter population.

ACKNOWLEDGEMENTS

EXECUTIVE SUMMARY

Traffic trends in Austin show a longer rush hour, more congestion on the roads, and longer travel times for trips. Travel time delays and the difference in peak travel time to off-peak travel time are increasing at a greater rate in Austin than in other medium-sized cities in the country. In fact, according to the recent 2004 urban mobility report, the Austin area has the dubious distinction of having the highest level of traffic congestion among cities its size. Further, with the addition of about 25,000 new Austin area rush hour commuters each year, traffic congestion and air quality levels can be expected to only significantly worsen in the coming years unless bold, creative, coordinated, and proactive traffic congestion alleviation strategies are developed and implemented within the context of a broader vision for the economic vitality and social vibrancy of the Austin region.

To be sure, many traffic congestion alleviation measures have been proposed, and some implemented, in the past several years to address the rising concerns about mobility and accessibility problems in Austin. These have helped stem the rate of the rise in traffic congestion levels, and the associated negative mobility and air quality repercussions. However, there is a very critical need for accelerating the planning and implementation of congestion alleviation measures today. In particular, the next five years presents a crucial time window for the implementation of short-term strategies, as well as the planning and initiation of long term strategies, to ensure that the Austin traffic congestion situation does not spiral completely out of control.

The purpose of this executive summary is to present the major findings and recommendations of a University of Texas (UT) commuter research study that (1) Examined the demographic, employment, and overall travel characteristics of Austin area commuters, and analyzing how these characteristics impact commute travel choices and perceptions, (2) Developed a framework for evaluating the effect of alternative congestion alleviation strategies on commute mode choice, and (3) Identified broad and important issues that have to be recognized when designing and analyzing a comprehensive mobility plan for Austin. The UT research study was based on a web-based survey of Austin area commuters undertaken between December 2003 and March 2004. The data from the web-based survey was weighted appropriately to be representative of the Austin area commuter population.

THE "BIG PICTURE" FINDINGS

- The increasing diversity of Austin household structures (from the traditional one-worker couple/nuclear family households to two-worker couple/nuclear family households, single adult households, and single parent households) is increasing participation in nonwork activities during the commute and during the midday from work. Such chaining of nonwork activities with the commute makes it difficult to wean commuters away from driving alone to work. Overall, the commutes are getting more complex, and divorcing the examination of commute travel choices from broader nonwork activity pursuits is naïve and myopic. Informed policy actions to reduce traffic congestion should consider the broader context in which commute travel choices are made.

- A corollary to the above finding is that it is important to pursue an integrated and coordinated land-use and transportation plan to address congestion problems in Austin. For instance, a commuter rail plan should to be backed up with appropriate zoning strategies to promote the development of mixed use facilities close to the potential commuter rail stations. Such an effort would serve two purposes. The first is to foster the development of residences and offices in and around the commuter rail stations to increase transit share. The second is to facilitate the development of shopping stores, banks, post offices, and child-care facilities to obviate the need to make separate commute stops. Another complementary land-use strategy would be to facilitate eating out and personal business within walking distance of employment centers, so that a personal vehicle is not needed for such midday activity participations. This, in turn, can contribute to encouraging commuters to use non-drive alone forms of transportation during the commute.

- Addressing traffic congestion problems requires a coordinated, balanced, and multi-modal transportation plan. It is next to impossible today to resolve Austin's traffic congestion problems solely through a single transportation strategy, such as road building or tolls or commuter rail. This is because of the high share of commuters who drive alone today, and the fast growth of Austin. In fact, it is almost infeasible to even maintain today's congestion levels into the future by focusing on only one strategy. But by combining several transportation (and land-use) policy actions, there is the potential to make a tangible reduction in traffic congestion levels.

- In addition to roadway expansions and actions to reduce the share of commuters driving to work, it is important also to focus attention on modifying work arrangements as a means to alleviating traffic congestion. For instance, only 2.5% of Austin area commuters appear to telework (work from home instead of driving to their office) on any given work day. On the other hand, the hi-tech nature of jobs in Austin and the high internet penetration rate among Austin households offers ample scope for increasing the percentage of teleworkers. This is a subject for serious consideration by local transportation and work agencies. To put things in perspective, if work arrangements can be modified so that commuters, on average, work from home one day a month, the telework percentage would climb to 5%. In combination with other strategies, this can lead to a tangible reduction in traffic congestion levels.

- Commuters are not only concerned about the usual (or average) travel time, but also in the reliability of travel time when making their commute mode choice decisions. This is particularly the case for commuters with an inflexible work schedule. On average, commuters value travel time savings and improved reliability about equally. That is, everything else being equal, Austin area commuters would consider two travel modes; one with a 30 minute average travel time but which may take up to 50 minutes on certain days, and another with a 45 minute average travel time but will get the commuter to the workplace within 50 minutes every day; about equally. This finding is important in the context of considering strategies that focus on making the transportation system more reliable. For instance, a potential commuter rail transit (CRT) mode system for Austin may have a higher reliability in travel time (due to a separate right of way) compared to driving alone, even if the average travel time by CRT is higher than driving.

- Over 90% of respondents feel that their commutes are at least slightly congested; however, only 63% of respondents characterized their commute trips as being somewhat or very stressful. In particular, 37% of respondents characterized their commute as being somewhat or very enjoyable. This percentage varies by whether commuters use highways and commute distance, with highway users and long-distance commuters perceiving higher levels of congestion and stress levels relative to non-highway users and short-distance commuters, respectively. However, even within the class of highway users who commute long distances, 21% indicate that the commute is somewhat or very enjoyable (the corresponding number for non-highway, short-distance, commuters is 70%). Overall, these results indicate that several Austin area employees do enjoy the routine of traveling to their work place, perhaps because the commute is personal uninterrupted time that is increasingly difficult to find in the busy "din" of life. For example, for many employees, the commute may be the only available time to listen to music on their CD players, or to catch up on the news, or to just simply be immersed in self-thought.

SPECIFIC FINDINGS ON COMMUTER RAIL AND TOLLS

- Commuters have a more positive image of a potential commuter rail transit (CRT) mode than the current bus mode. In fact, CRT has a "travel time bonus" of about 20 minutes relative to the bus mode. That is, if all service characteristics except travel time are equal between the bus and CRT modes, an average commuter will choose the CRT mode over the bus mode even if the CRT travel time is more than the bus travel time by up to 20 minutes.

- The percentage of commuters using a potential CRT system will clearly be dependent upon the service characteristics (travel time, travel cost, reliability, and availability) of the system. Using assumptions that are not unreasonable about these service characteristics, a new CRT mode is predicted to capture 1.5% of the overall mode share if the CRT mode is available to about 10% of the commuter population. The drive alone mode share reduces by 0.7%, with the remaining 0.8% being drawn from the non-drive alone modes (shared-ride, bus, and non-motorized modes). If, however, the CRT mode is available to about 25% of the commuter population, then it is predicted to capture 4.1% of the overall mode share. The drive alone mode share reduces by 2.6% in this case, with the remaining 1.5% of the CRT share being drawn from the non-drive alone modes. The predictions illustrate the importance of CRT availability on CRT mode share, an issue discussed in the next point. It should also be noted that the numbers projected here should be used simply as an initial guideline in planning. It is important to pursue a more in-depth simulation of possible CRT service scenarios (based on the precise locations of CRT stations and the travel times, costs, and travel time reliability to be offered by a potential CRT system) to better understand the full impacts and viability of a potential CRT system for Austin.

- CRT availability to individual commuters is critical in determining the reduction in drive alone and the CRT commute mode shares. Clearly, if a commuter does not perceive CRT to be available as an alternative, CRT will not be chosen by the commuter. But within the group of individuals for whom CRT is an available alternative, we project a shift of the magnitude

of 15% from driving to CRT. Earlier studies suggest that commuter rail stations should be located within 1 mile of a person's residence and person's work place in order for commuter rail to be considered as an available alternative for the commute. Thus, the initial alignment of the CRT route and station locations should be carefully designed based on the residence and workplaces of Austin area commuters so that CRT becomes a viable alternative for as large a fraction of the population as possible. The other side of this finding is the caution that one should not expect substantial shifts in drive alone mode shares after the implementation of a "starter" rail system. The real benefits of a potential commuter rail system from a traffic congestion standpoint will likely accrue only when the proposed rail system is expanded sufficiently to serve a reasonable fraction of the commuter population.

- Tolls on highways can be expected to lead to a drop of about 2.5% in the drive alone mode share on the highways for each $1.00 toll. Also, a $1.00 toll for the use of all the major highways (Mopac, IH-35, US-183, US-360, US-71, US-290, and FM-2222) in the Austin area would lead to about a 1.5% reduction in drive alone mode share across the entire Austin metropolitan area (it is important to emphasize that we are not proposing such a blanket tolling system, but simply projecting the order of magnitude of modal shifts due to tolls). One way to frame the 1.5% reduction in drive alone share due to a $1.00 toll on all Austin highways is to compare it with the reduction in drive alone share needed each year to just maintain today's congestion levels into the future. Specifically, with about 25,000 new commuters in Austin each year, the drive alone share needs to decrease by about 5% each year if only efforts to change commute modal shares are pursued.

- The average commuter is willing to pay $12.00 for an hour of commute time savings, or about $6.00 for a 30-minute time savings, or about $3.00 for a 15-minute time savings.

OTHER FINDINGS ABOUT AUSTIN AREA COMMUTERS

- The household structures of Austin area commuters are rather diverse. In particular, the percentage of the nuclear/couple families (a male adult and a female adult with or without children) is only 46%. Further, a vast majority of these nuclear/couple family households have both adults working. In particular, only 13% of commuter households are traditional family households in which only one adult works. About 23% of all households are single person households, suggesting that the Austin commuter work force is rather young and career-oriented. Further, about 4% of the commuter families are single parent households, 13% are returning young adult households, 8% are unrelated roommate or same-sex couple households, and 10% are other kinds of households (mixtures of related and unrelated members).

- The average household income of Austin commuters is $65,700, higher than the national household average of $58,000. Perhaps due to the high income earnings as well as the hi-tech nature of jobs, a very large percentage (84%) of Austin commuters have internet access from their homes. The relatively high income of Austin area households also results in an average

motorized vehicle ownership level of 2 per household. Almost all commuter households in Austin own at least one motorized vehicle.

■ Austin area commuters are 67% white (non-Hispanic), 16% Hispanic, and 17% of other races (Asian-American, African-American, Native American, mixed race, and other). The percentage of men is 57%, while that of women is 43%. Austin commuters are a quite well educated group, with an average personal income of $44,650 (which is higher than the national average of $39,100).

■ The net result of high household incomes, high car ownership levels, diverse household structures, and increased commute/midday stop-making is high drive alone mode shares among Austin area commuters.

■ Austin area workers are primarily full-time employed, start their work between 7-9 AM and end their work between 4-6 PM, and telework rather infrequently (about 10% of commuters telework from home at least occasionally, but on any given day, only about 2.5% of commuters telework). About 42% of the workers have an inflexible work schedules in both the work arrival and departure times, 30% have a flexible work schedule in both work arrival and departure, and the remaining have flexibility at either the arrival or departure end, but not both.

■ The commute distance ranges between a quarter mile and 70 miles, and has an average of about 12.3 miles. Only 4% of the commuters live within 2 miles from work. The majority of commuters (72%) live within 15 miles from work, though a sizeable fraction of commuters (28%) live beyond 15 miles.

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CHAPTER 1. INTRODUCTION

1.1 The Context

The Austin area has the highest level of traffic congestion among medium-sized cities, according to the recent 2004 Urban Mobility Report∗. In particular, an average Austin area rush hour commuter spends about 50 hours annually just sitting in traffic and takes about 30% longer to get from point A to point B during the rush hour than during other times of the day. These indices of traffic congestion levels are comparable in magnitude to those of some of the largest metropolitan areas in the country, including Dallas and Houston in Texas. Further, the Austin area has had a much more dramatic increase in traffic congestion over time than other medium sized cities. Specifically, the traffic delay per rush hour traveler has risen by 250% in the past decade in Austin compared to less than 150% in other medium sized urban areas in the country. With the addition of about 25,000 new Austin area rush hour commuters each year, traffic congestion and air quality levels can be expected to only significantly worsen in the coming years unless bold, creative, coordinated, and proactive traffic congestion alleviation strategies are designed and implemented within the context of a broader vision for the economic vitality and social vibrancy of the Austin region.

> With the addition of about 25,000 new Austin area rush hour commuters each year, traffic congestion and air quality levels can be expected to only significantly worsen in the coming years unless bold, creative, coordinated, and proactive traffic congestion alleviation strategies are designed and implemented within the context of a broader vision for the economic vitality and social vibrancy of the Austin region.

To be sure, many traffic congestion alleviation measures have been proposed, and some implemented, in the past several years to address the rising concerns about mobility and accessibility problems in Austin. These have helped stem the rate of the rise in traffic congestion. However, there is a very critical need for accelerating the planning and implementation of congestion alleviation measures today, given the existing traffic situation and projected growth in Austin travel. In particular, the next five years presents a crucial time window for the implementation of short-term strategies, as well as the planning and initiation of long-term strategies, to ensure that the Austin traffic congestion situation does not spiral out of control.

The urgency of the situation may be best illustrated by providing examples of what needs to be done just to maintain today's congestion levels into the future. The 2004 Urban Mobility Report projects that 52 lane-miles of new highways and surface streets will be needed each year in Austin if the traffic congestion alleviation efforts are targeted only toward roadway capacity expansion. Alternatively, we project that the overall share of commuters driving alone should be reduced by about 5% each year if only efforts to change commute modal shares are pursued, or the percentage of commuters teleworking (*i.e.*, working from home) on any weekday should increase by 5% each year if the emphasis is only on encouraging teleworking. To put things in

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∗ The complete report is available at the Texas Transportation Institute website and can be accessed at the following address: http://tti.tamu.edu/documents/ums/mobility_report_2004.pdf

perspective, the lane-miles in Austin have increased by about 10-15 miles each year over the past several years. The drive alone mode share has shown an increase and not a decrease over the years. And the current percentage of Austin area employees teleworking on any given day is only of the order of 2.5%.

In addition to illustrating the uphill challenge to just maintain today's congestion levels, the discussion above also emphasizes the need to consider a smorgasbord of different congestion alleviation strategies rather than focus on a single strategy. In this context, there are several possible congestion reduction strategies, which may be grouped into one of three broad categories:

– **Increase supply or the vehicular carrying ability of roadways** by expanding the road network or making the road network more efficient (building new highways, adding lanes to existing highways, new overpasses, improved incident detection and response systems, better signal timing and co-ordination, and other ITS strategies fall within this category).

– **Influence vehicular traffic patterns** by reducing the percentage of commuters driving alone or the percentage of commuters using specific highways (high occupancy lanes, commuter rail and other transit improvements, pedestrian-friendly and transit-friendly urban form design, and auto-use/highway-use disincentives such as tolls, congestion pricing, and parking pricing fall within this category).

– **Change commuter travel patterns** by reducing travel or spatially/temporally shifting commuters' travel (teleworking strategies, work-staggering strategies, flexible work hours, and improved spatial balancing of jobs and housing to reduce commute distances fall in this group).

The accurate analysis of the potential effectiveness of the many possible congestion mitigation strategies, and their combinations, is critical to making informed policy decisions and capital infrastructure investments. The careful examination of commuter travel behavior, in turn, is an important prerequisite to the accurate analysis of congestion mitigation strategies, since the commute periods represent the most congested times of the weekday.

Commuter travel behavior is characterized by various choices, such as the choice of mode, the choice of the time of day to travel, and the choice of route. These choices depend on commuters' demographics (for example, age and car ownership), work characteristics (for example, work schedule and work location), and activity participation attributes (for example, whether the commuter makes a nonwork stop during the commute or not). Thus, a good understanding of commute travel requires the collection of data on the characteristics and travel choices of commuters. The analysis of such survey data provides the public and planning organizations with the necessary insights regarding commuter travel behavior to effectively address difficult policy and infrastructure investment questions.

1.2 Report Objectives and Structure

This report of the commuter characteristics and travel behavior of Austin area workers has three objectives:

(1) Examine the demographic, employment, and overall travel characteristics of Austin area commuters, and analyze how these characteristics impact commute travel choices and

perceptions. The questions to be addressed under this first objective include the following: What is the demographic profile of Austin area commuters? Are there changes happening in the demographic profile that have a bearing on commute travel choices? What kinds of work arrangements are prevalent in Austin today, and how do the work arrangements impact commute and non-commute travel? What is the current extent of teleworking and how is this related to employer type and work schedule characteristics? Do commuters participate in nonwork activities during the commute or during other times of the day? What is the nature of these nonwork activities (for example, are the nonwork activities for dropping off/picking up people, grocery shopping, or for recreation)? Is the participation in nonwork activities related to demographic attributes? What mode of transportation is used for the commute and participation in nonwork activities? How is this mode choice affected by travel time, tolls and other travel costs, reliability, demographic characteristics, and nonwork stop-making?

(2) Develop a framework for evaluating the effect of alternative congestion alleviation strategies on commute mode choice to enable policy analysts to address questions such as the following: By how much will highway road tolls shift commute mode shares? Will the introduction of a new mode, such as commuter rail, divert sufficient demand from the drive-alone mode to justify its introduction? How efficient and reliable will the new mode have to be to generate sufficient demand? How much does travel time reliability during the commute affect commute mode choice and related decisions, and is the effect of travel time reliability moderated by work characteristics, such as work schedule flexibility? Are there any differential impacts of congestion alleviation strategies on different population subgroups?

(3) Highlight the need to identify and implement a coordinated, balanced, multi-modal, and integrated land use-transportation plan to control traffic on Austin streets and highways; Emphasize the urgency to take tangible and substantial traffic congestion alleviation actions to maintain (and build upon) the economic and social vitality of the Austin region; Identify broad and important commuter-related characteristics when analyzing and designing a comprehensive mobility plan for Austin; Serve as a resource of information and findings for the public and transportation policy makers, and facilitate healthy and constructive debates regarding Austin's mobility future.

An important step in addressing the objectives identified above is to collect data on the demographics, work schedule, and activity-travel characteristics of commuters in the Austin area. This was achieved in the current study through the design of a web-based Austin Commuter Survey (ACS) that was endorsed by the CLEAN AIR Force of Central Texas and supported by NuStats Inc.

The remainder of this report is organized as follows. Chapter 2 describes the design and administration of the Austin Commuter Survey (ACS) and the data preparation process. Chapter 3 presents the household and individual characteristics of Austin area commuters. Chapter 4 describes the activity-travel characteristics of Austin area commuters. Finally, Chapter 5 summarizes the important findings and recommendations from the report.

CHAPTER 2. SURVEY DESIGN AND ADMINISTRATION

2.1 Survey Approach

The Austin Commuter Survey (ACS) was administered as a web-based survey on a website hosted by the University of Texas at Austin. There are several advantages to using such a web-based survey approach to collect activity-travel information. First, a web-based survey is relatively inexpensive to the researcher, may be easier for respondents to answer, and is environmentally friendly. Second, it has a quick turn-around time (in terms of receiving responses) and also saves considerable effort in processing, since the data is obtained directly in electronic form. Third, question branching is straightforward to implement in web-based surveys, so that only the relevant questions are presented to a respondent based on the response to earlier questions.

In the next few sections, we discuss the survey content, the survey administration procedures, and sample formation details. The survey instrument itself is available at http://www.ce.utexas.edu/commutersurvey/index.htm.

2.2 Survey Content

The web-based survey comprised several sections. The first and second sections corresponded to screening and introduction questions, respectively. The screening question was used to select only those Austin residents who traveled on one or more days of the week to a regular work place outside home in the Austin area, while the introduction questions sought general opinions about commute and non-commute travel. The third section obtained information on work-related characteristics on a typical day the individual traveled to her/his work place outside home. The fourth section elicited information regarding individuals' commute travel experience by five different modes of transportation: (1) Personally driving a motorized vehicle to work, (2) Riding as a passenger in an automobile or on a motorized two-wheeler, (3) Bus, (4) Walk, and (5) Bicycle. The fifth section sought details regarding overall commute and midday stop-making characteristics for a typical work week, as well as very detailed activity and travel information on the most recent day the individual commuted to the work place. The sixth section focused on experiments designed to obtain information on commuter travel mode preferences regarding a potential new commuter rail service in Austin. Further details of these experiments are provided in Bhat and Sardesai (2006)*. The final section collected data on individual and household demographics, presence of internet access from home, vehicle holdings by type, and the nearest cross-streets to the respondent's home and work place.

2.3 Survey Administration

The survey was administered through a web site hosted by the University of Texas at Austin, and was designed for the internet using a combination of HTML code and Java. Once the

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* The complete paper is available at www.ce.utexas.edu/prof/bhat/ABSTRACTS/Bhat_Sardesai_TRptB_rev.pdf

initial web survey design was completed, pilot surveys were undertaken. These pilot surveys provided valuable feedback and led to changes in survey instrument design, content, attribute definitions, and presentation.

After the final web survey design was completed, the UT research team recruited participants using several different mechanisms. First, the research team approached the CLEAN AIR FORCE (CAF) of Central Texas and obtained their support for the survey. The CAF then sent an e-mail message with the web link to Austin area employers who are part of the CAF's clean air partners program. The e-mail message introduced the purpose of the study and asked that the web link be distributed to employees. Second, the CAF provided a listing of about 150 e-mail addresses of commuters in the Austin region, who were sent a brief description of the survey purpose and the link to the survey. Third, information about the survey was disseminated through radio and TV media outlets to the public at large. Fourth, the Austin Chamber of Commerce included an article about the survey in its electronic newsletter, which has a wide distribution among employers in the Austin area. Fifth, color posters regarding the survey (and including the web link) were designed and printed by the University of Texas Design Center, and posted at several geographically dispersed and strategically located public places in Austin. Finally, individuals were also intercepted at public locations and handed the survey poster.

2.4 Data Preparation

The data from the completed web surveys were downloaded in ASCII format, and then imported into SPSS (a data management and statistical software program) to label and code the variables appropriately. Several steps were subsequently undertaken to obtain the final sample used in the current analysis. First, the cross-streets representing the home and work place of individuals were geo-coded by importing the cross-street information into TransCAD (a geographic information system software program) and querying TransCAD's map database to obtain the latitude and longitude coordinates. Several addresses could not be automatically geocoded in the above manner, and these were manually located on a map and translated to latitude/longitude coordinates. Second, the residential and work place locations of each respondent was overlaid on a geographic information system (GIS) layer of the Capital Area Metropolitan Planning Organization's (CAMPO's) zonal configuration, and each respondent's residential and household locations were assigned to appropriate zones. Third, the commute level-of-service attributes (costs and times by alternative travel modes) were appended to each individual's record by extracting this information from CAMPO's network skim data. Finally, several cleaning and screening steps were undertaken to ensure consistency in the records, and records with missing network level-of-service, location, or demographic information were deleted.

The final sample included 699 commuters who resided and worked within the three-county area of Hays, Williamson, and Travis counties. This sample was subsequently weighted to account for the bias introduced by the web-based nature of the survey. Specifically, the sample was weighted based on a multivariate distribution of race, income earnings, sex, household size, household type, and commute travel mode choice, using the 2000 census of population and housing survey summary file for the Austin area as the basis.

CHAPTER 3. HOUSEHOLD AND INDIVIDUAL CHARACTERISTICS

In this chapter, we describe the demographic and socio-economic characteristics of the Austin area commuters. The next section presents the household characteristics of commuters, including household size and structure, household income, housing characteristics, internet use at home, and auto-ownership. The subsequent section presents the individual characteristics of commuters, including demographic, socio-economic, and work-related attributes.

3.1 Household Characteristics

3.1.1 Household Size and Structure

The household size results (see Figure 1) indicate that close to 90% of the commuter households have a household size of 4 or fewer individuals. Among the 2 person households, about 72% are couple families (two individuals of the opposite sex who are either married, or unmarried but characterize their relationship to one another as a partnership), 10% are single parent families (with the son or daughter being a child less than 18 years of age), and 10% are unrelated person families or same-sex couple families (the remaining 8% are distributed across other household types). Among the 3- and 4-person households, about 60% are nuclear family households (opposite-sex couples with children, all children being less than 18 years of age), 3% are single parent families, and 25% are returning young adult families (these are families with one or both parents and one or more sons/daughters, with at least one of the sons/daughters being 18 years or older).
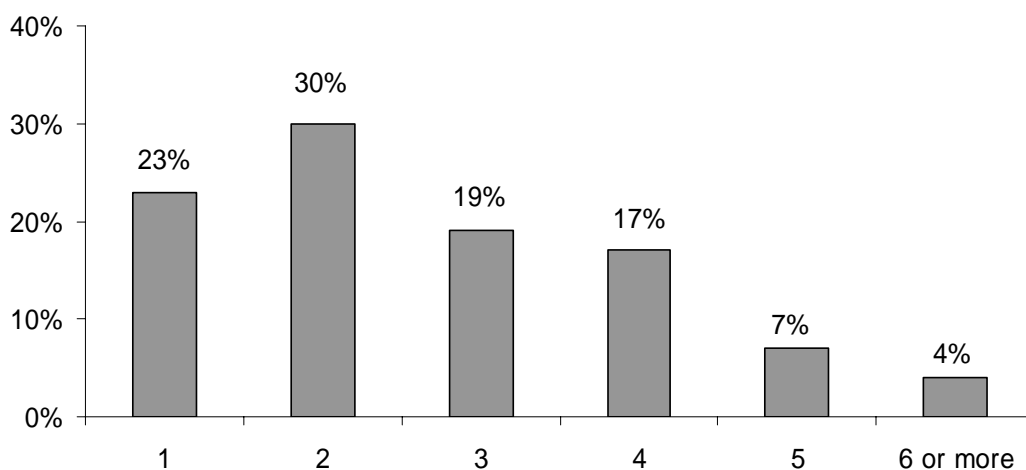

Figure 1. Distribution of household size

The distribution of family type is provided in Figure 2, which indicates that only about a quarter of all worker families are nuclear family households, with another fifth being couples. Among the nuclear family households, both adults work in 66% of households, while only one

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adult works in the remaining 34% of households. Among couple households, both adults work in 77% of the households. Overall, only 13% of all Austin area worker households are "traditional" family households (i.e., couple or nuclear families in which one adult works and the other is a homemaker). It is also significant that close to a quarter of all worker families are single person households, suggesting that the Austin commuter work force is rather young and substantially career-oriented. Further, about 4% of

> Austin family structures are getting rather diverse, and moving away from the traditional one-worker couple/nuclear family structure…. This has important implications on commute travel characteristics and traffic congestion levels.
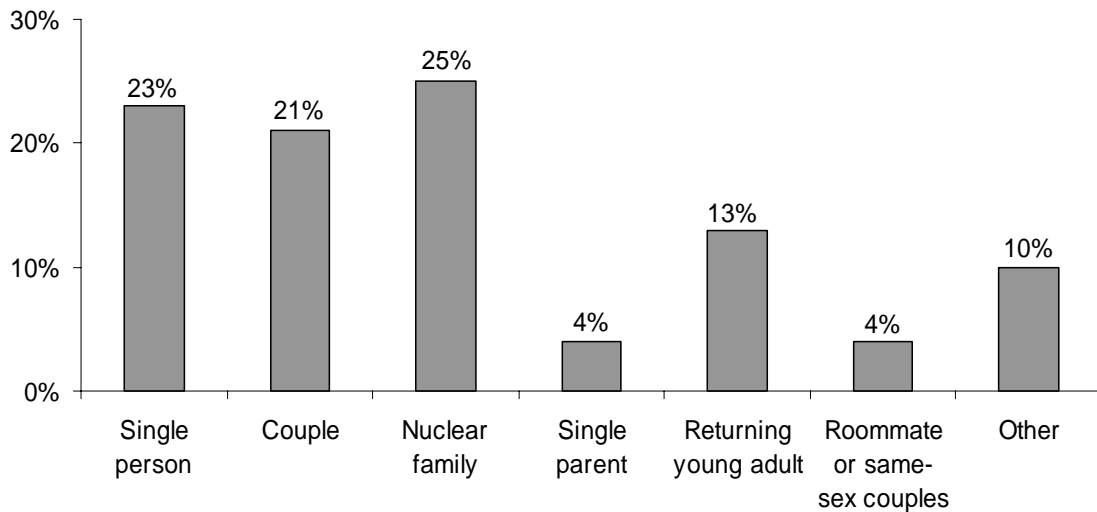
the worker families are single parent households, 13% are returning young adult households, and 10% are other kinds of households (mixtures of related and unrelated members). These statistics reinforce the fact that Austin family structures are getting rather diverse, and moving away from the traditional one-worker couple/nuclear family structure. As we discuss later, this has important implications on commute travel characteristics and traffic congestion levels.

Figure 2. Distribution of family types

3.1.2 Income

The distribution of annual household income (Figure 3) shows that 32% of the commuters have a household income of less than $35,000, while about 20% have a household income higher than $95,000. About half of the commuters have a household income in the middle range between $35,000 and $95,000. Essentially, these numbers show a wide range in income earnings of Austin area households. The average household income of the commuters is approximately $65,700, which is higher than the national average of $58,000.
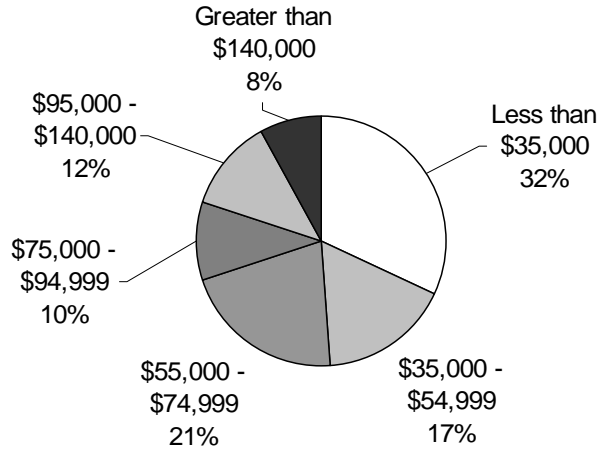
Figure 3. Distribution of household income

3.1.3 Housing Attributes and Residential Location

About two-third of the commuters own their residence, while a third rent (Figure 4(a)). As one would expect, housing tenure is very strongly impacted by household income; 94% of high income households (those earning greater than $95,000 per year) own their homes compared to 32% of low income households (those earning less than $35,000 per year) who own their homes. The home ownership percentage of the middle income household group (those earning between 35,000 and 95,000) is between those of the low and high income household groups at 76%.

As illustrated in Figure 4(b), about three-fourth of Austin area commuters live in single family residences. Again, residence type is substantially influenced by household income, with 97% of high income households living in a single family residence compared to 80% of middle income households and 51% of low income households.
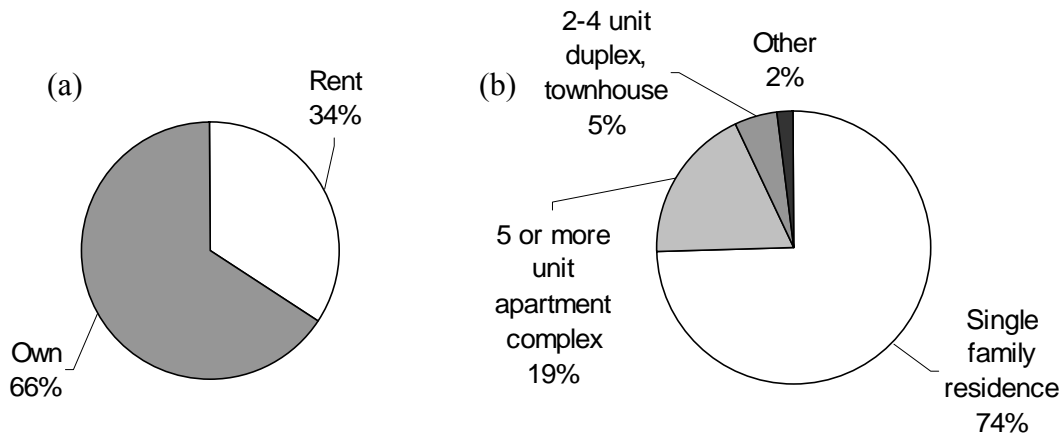

Figure 4. (a) Distribution of housing tenure type;
(b) Distribution of residence type

9

The ACS indicates the following distribution of residential location based on density of the neighborhood: (1) core CBD area – 2%, (2) CBD fringe area– 26%, urban area – 20%, suburbia – 39%, and rural area – 13%. Overall, about half of the commuters reside in high density areas (CBD and urban locations) and the other half reside in low density areas (suburban and rural locations).

3.1.4 Internet Access

A very high proportion of Austin commuters have internet access in their homes (Figure 5). The high internet penetration rate in Austin residences, in addition to the hi-tech nature of jobs in Austin, implies that teleworking (i.e., working from home on one or more days instead of traveling to the office) may be an effective traffic congestion mitigation strategy for the Austin area.
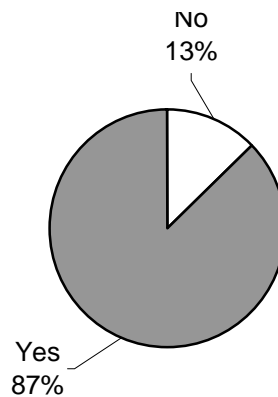

Figure 5. Internet access from residence

3.1.5 Motorized Vehicle Ownership

Motorized vehicle ownership is a powerful indicator of commute travel characteristics, since it plays an influential role in an individual's commute mode choice. For instance, the availability of a motorized vehicle for each licensed member of a household increases the likelihood of household commuters driving alone to work, and choosing to live farther away from their workplace.

The analysis of the Austin Commute Survey (ACS) indicates that almost all Austin area commuters own at least one automobile, with 65% of the population owning two or more vehicles (Figure 6). The fact that about 35% of the commuter households own only one vehicle can be attributed largely to the sizeable fraction of single adult households and low income households (less than $35,000) in the Austin commuter population. Specifically, about 92% of commuters living alone own a single motorized vehicle and represent 21% of the 35% of single vehicle households. Similarly, 72% of low income households (those earning less than $35,000) own only a single vehicle and make up 23% of the 35% of single vehicle households. Overall, 78% of single vehicle households are single person households and/or low income earning households.
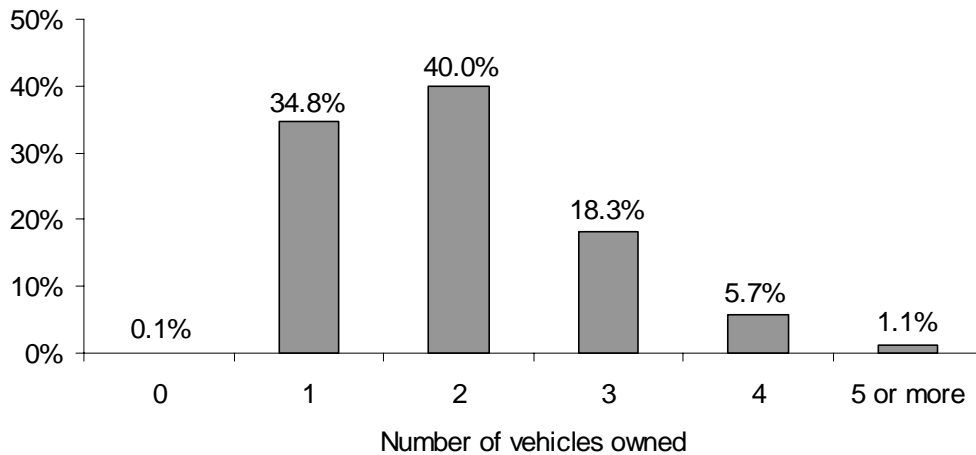
10

Figure 6. Auto-ownership of commuter households

The mean motorized vehicle ownership rate per household is almost 2, though this number varies quite substantially across population segments. For example, the mean motorized vehicle ownership rates by annual household income are as follows: low income (less than 35,000) – 1.44, medium income (35,000-94,999) – 2.13, and high income (95,000 or greater) – 2.53. Clearly, these results indicate the high motorized vehicle ownership rates for higher income households. Similarly, Table 1 shows that, in general, households residing in higher density areas own fewer motorized vehicles compared to households residing in low density areas.

Table 1. Average vehicle ownership by residence zone population density

Residence zone type	Avg. Vehicle Ownership
CBD Core	1.15
CBD Fringe	1.76
Urban	2.03
Suburban	2.15
Rural	1.99

3.1.6 Motorized Vehicle Type and Age

Both vehicle type and vehicle age are important characteristics of the vehicle fleet distribution in an area from an air quality standpoint. For instance, Environmental Protection Agency (EPA) statistics show that an average van, sports utility vehicle (SUV), or pickup truck produces twice the amount of pollutants emitted by an average passenger car. Similarly, within each vehicle type, the pollution from the tail pipe of older vehicles is significantly more than that from newer vehicles. In this section, we first examine motorized vehicle type distribution and then examine the age distribution within each vehicle type.

A relatively large percentage of vehicle types owned by commuter households in the Austin area are sedans, coupes, SUVs, and pickup trucks (see Figure 7(a)). A relatively small percentage of motorized vehicles are minivans and other vehicle types (station wagons, vans, hatchbacks, and motorized two-wheelers; these vehicle types are combined into a single aggregate category because of very small sample sizes). Figure 7(b) shows the distribution of vehicle types used for commuting. A comparison of Figure 7(a) and Figure 7(b) shows that sedans are used disproportionately more for the commute. That is, sedans constitute only 34% of the available vehicle pool, but represents 47% of the commute vehicles.
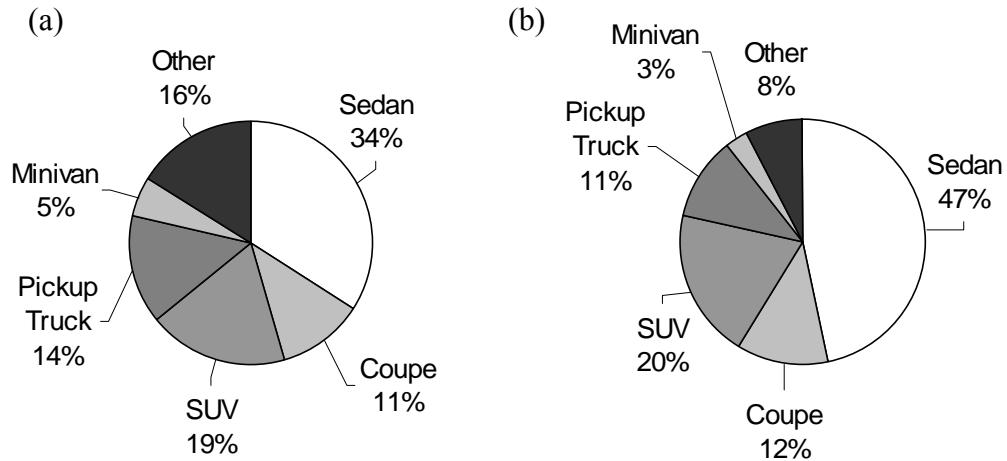

Figure 7. (a) Vehicle types owned by commuter households;
(b) Vehicle types used for commute

The average age of vehicles across all motorized vehicle types is 8.74 years. Table 2 provides the average age of vehicles within each motorized vehicle type category. This table shows that SUVs have the youngest fleets, while coupes and other vehicle types (station wagons, vans, hatchbacks, and motorized two wheelers) have older fleets.

Table 2. Average age of vehicles by vehicle type

Vehicle type	Avg. Age of Vehicles
Sedan	8.72
Coupe	11.42
SUV	6.78
Pickup Truck	8.07
Minivan	8.75
Other	10.03

3.2 Individual Characteristics

3.2.1 Demographic Characteristics

About 43% of the commuters in Austin are female, while 57% are male, indicating a higher representation of males in the commuter population (Figure 8). White, non-Hispanic, individuals comprise 67% of the commuter population, while Hispanics form the largest minority group at nearly 16% (Figure 9). The number of commuters in each of several other racial groups (for example, African Americans, Asian Americans, Native Americans, and mixed race individuals) is too low to present individual percentages. Consequently, these other racial groups are combined into a single "other race" category.
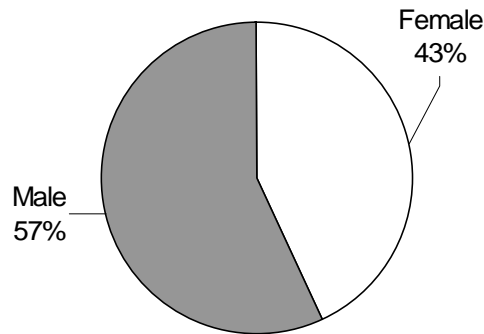

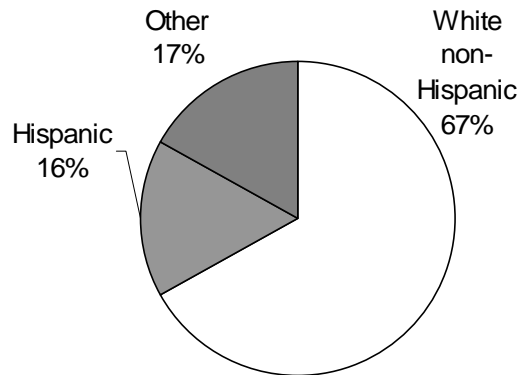**Figure 8. Gender composition of the commute population**

Figure 9. Racial composition of the commute population

About 30% of the commuters are less than 29 years, and more than 80% of the commuters are less than 49 years of age (Figure 10). The average age of Austin area commuters is 38 years. These statistics reveal the young nature of the Austin work force, reinforcing the perception of Austin being a "Mecca for young, dynamic, individuals with creative minds". In part due to the youthfulness of the workforce, 43% of the commuters in the survey sample are unmarried (Figure 11). However, the unmarried group includes those that cohabitate with a partner.

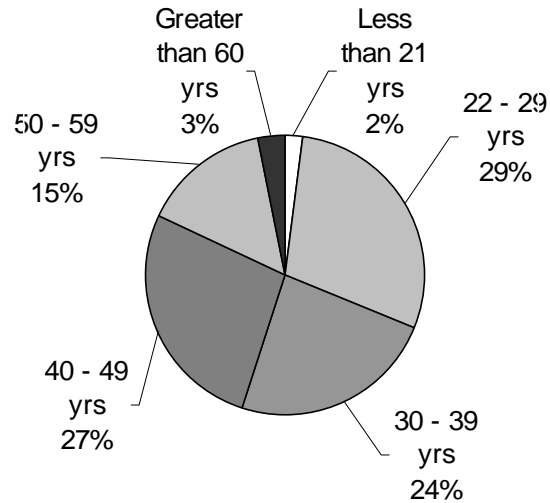> Austin is a "Mecca for young, dynamic, individuals with creative minds".

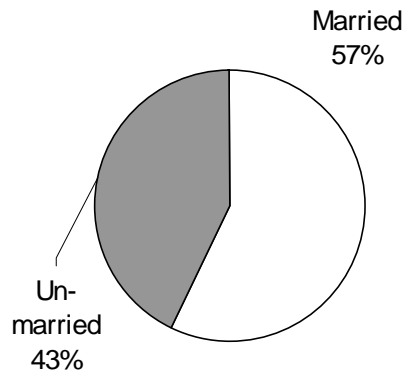**Figure 10. Age distribution of commuters**

Figure 11. Marital status of commuters

3.2.2 Socio-Economic Characteristics

The workforce in Austin is quite well educated, as indicated in Figure 12. About 83% of the commuters have completed at least an undergraduate degree. More than a quarter of the commuters have graduate degrees, i.e. Masters or Ph.D.
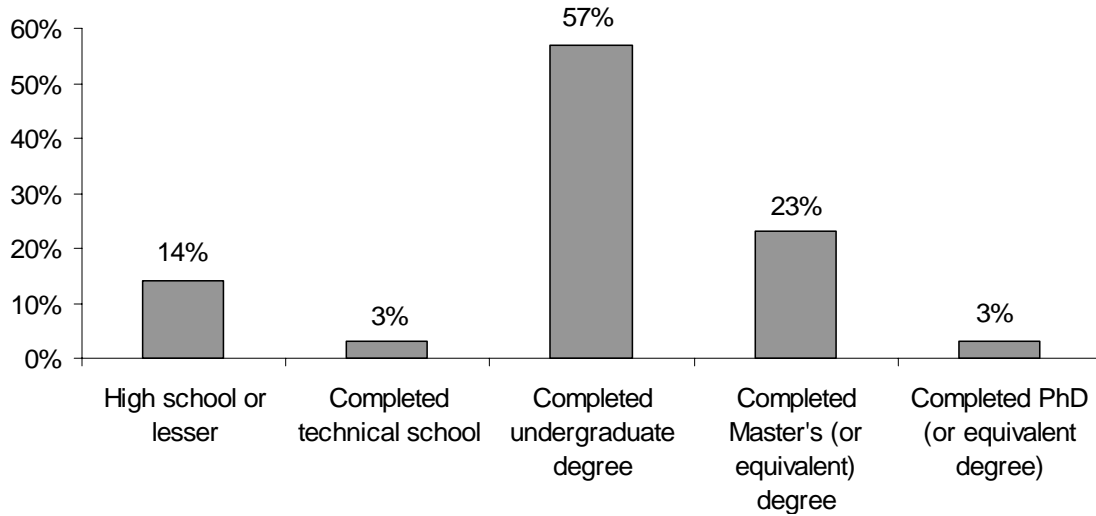
Figure 12. Distribution of highest level of education

The ACS data also suggests that, due to the high education levels and the hi-tech orientation of jobs, Austin area workers are quite well-paid with an average personal income of $44,650 (the national average is $39,100). However, there is also a very wide range in personal income (see Figure 13), with as many as 44% of the commuters earning an annual income of less than $35,000. On the other hand, about 7% of the commuters earn more than $95,000, with more than half of these workers earning more than $120,000 per year. Almost half of the Austin workforce earns between $35,000 and $95,000 per year.

> Austin area workers are quite well-paid with an average personal income of $44,650 (the national average is $39,100).
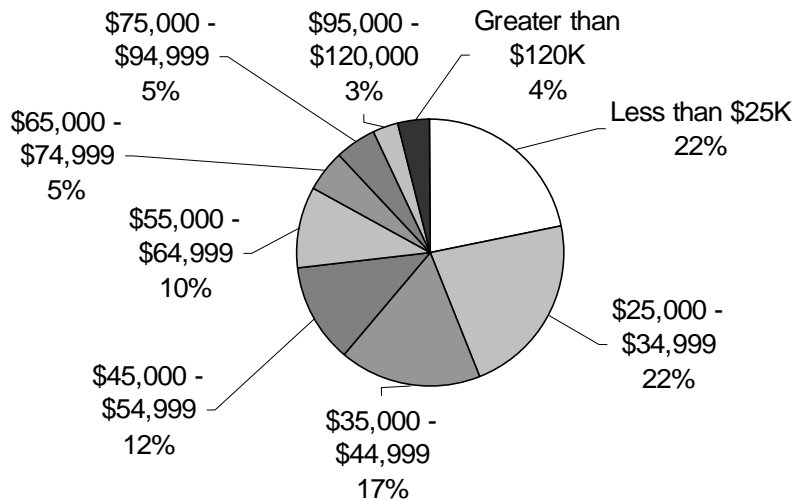

Figure 13. Distribution of personal income

3.2.3 Work Characteristics

3.2.3.1 General Employment Characteristics

       The ACS data reveals that a large fraction (85%) of Austin area employees work full-time (Figure 14). Further, the classification of employees by employer type (see Figure 15) shows that a third of all Austin area workers are employed by a private, for-profit, company.
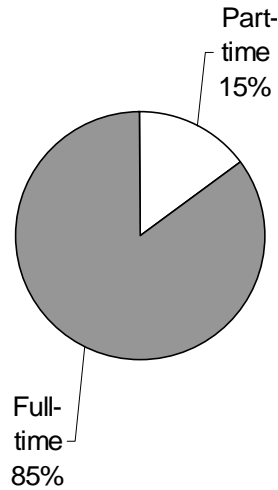

Figure 14. Employment status
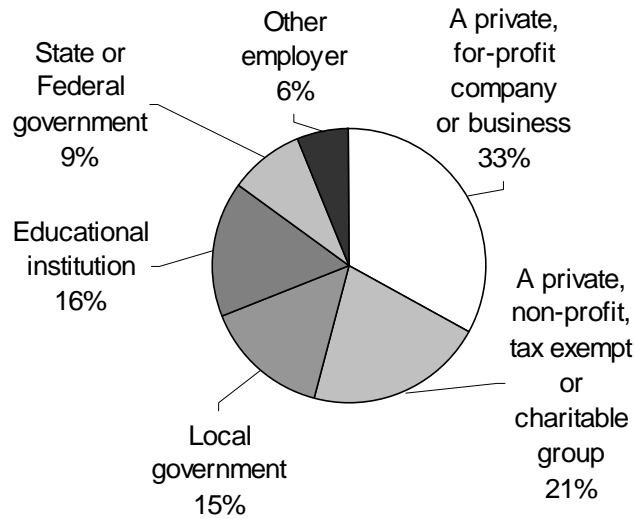

Figure 15. Distribution of employer type

       Figure 16 provides information regarding the distribution of duration of employment in Austin. The figure shows that 36% of the commuters have been working in Austin less than 5 years, an indication of the high rate of influx of individuals into the Austin work force from the rest of the country, particularly among the younger age groups.
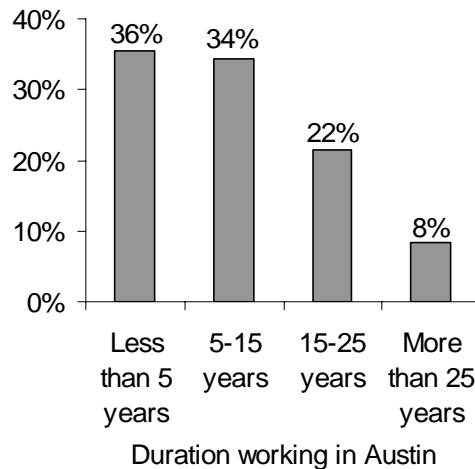
Figure 16. Length of time working in Austin

3.2.3.2 Work Arrangement Characteristics

In this section, we discuss work schedules (usual timing of work start and work end), work flexibility, and the extent of teleworking.

The work start time distribution of commuters is shown in Figure 17. As expected, the vast majority (about 88%) of the commuters starts work between 7-9AM, and about two-thirds begin their work day between 8-9 AM. It is also interesting to note, however, that close to 10% of commuters begin work after 9AM. A close examination of these "late work-start" commuters reveals that close to 56% of them are part-time workers, compared to only 11% of "regular work-start" workers (i.e., those who begin work at or before 9 AM) who are part-time workers.

The usual work end time distribution of commuters is presented in Figure 18. The figure shows that about 82% of commuters end their work day between 4-6 pm, with 5-6 pm being the peak hour for ending work. Overall, more than three-quarters (76.5% to be precise) of Austin area workers have the traditional work schedule of starting work between 7-9 AM and ending work between 4-6 PM. Of these traditional work schedule commuters, 8% indicate that they are part-time employed. Of the non-traditional work schedule commuters, 35% indicate that they are part-time employed. Clearly, there is a tie between work schedules and part-time/full-time employment.
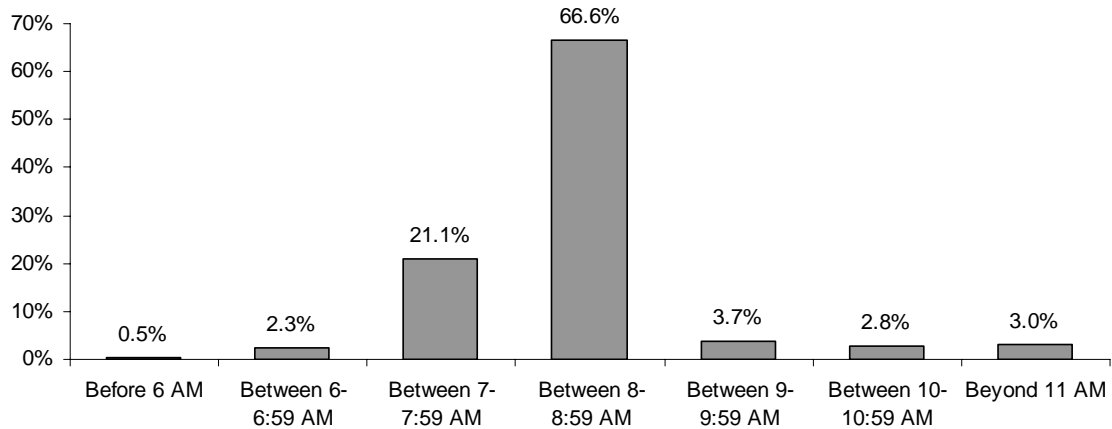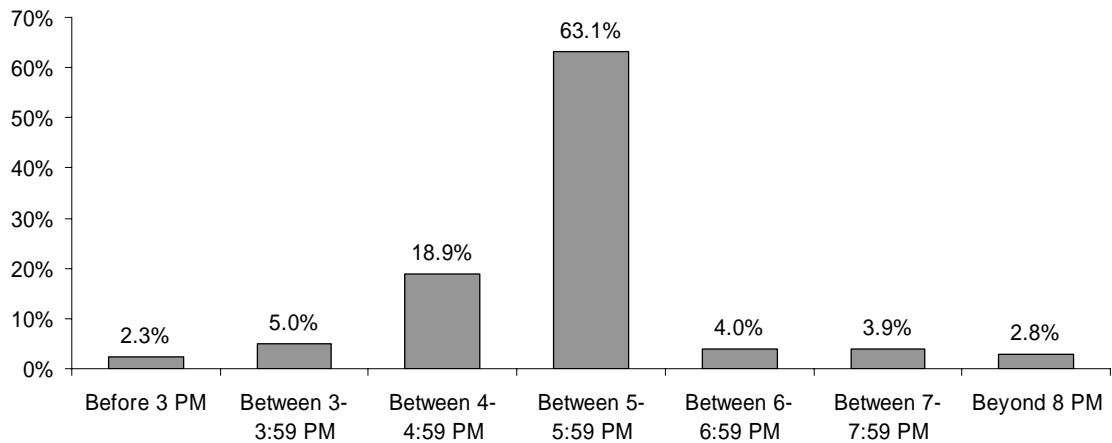
Figure 17. Work start time distribution

Figure 18. Work end time distribution

Work schedule flexibility is measured for the purpose of this analysis as the ease with which the respondent can arrive at work 15-30 minutes late (for arrival time flexibility) and the ease with which the respondent can depart from work 15-30 minutes early (for departure time flexibility). Respondents were asked to rate this ease on a five point scale from "easy" at one extreme (=1) to "difficult" at the other extreme (=5). Those who provided a rating of '1' or '2' are considered to have a flexible work arrival time/departure time, while those who provided a rating of '3" or higher are considered to have an inflexible work arrival time/departure time. Figure 19(a) shows that 47% of Austin area commuters have flexible arrival times, while Figure 19(b) indicates that a slightly smaller percentage of 41% have flexible departure times. A cross-tabulation of arrival and departure time flexibility shows that only about 30% of Austin workers have flexibility in both arrival and departure time, while 42% have inflexible work schedules in both arrival and departure time. The remaining 28% have flexibility at either the arrival end or the departure end, but not both.
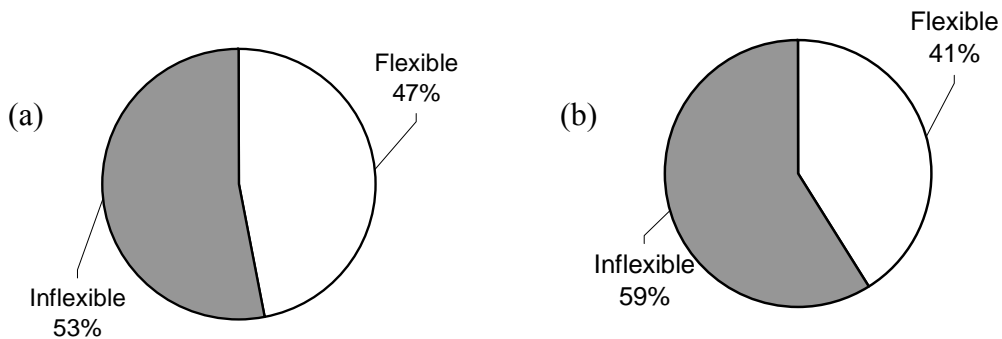
Figure 19. (a) Work start time flexibility;
(b) Work end time flexibility

About 11% of the commuter population teleworks from home at least occasionally. This percentage varies by part-time versus full-time employment, employer type, and work flexibility (see Figure 20). In particular, part-time employers, employees in education institutions, and employees with greater flexibility in work schedule are more likely to telework compared to full-time employees, employees in non-educational institutions, and employees with lesser flexibility in work schedule, respectively. Within the group of

> With the rather high penetration of the internet in Austin residences, and the hi-tech nature of many jobs in Austin, it would appear that there is scope for increasing the percentage of teleworkers. This is a subject for serious consideration by local transportation and work agencies.

telecommuters, about half telework less than once a week, while the other half telework once a week or more often (Figure 21). Overall, the results indicate a very low amount of teleworking in Austin. In fact, one can compute the percentage of person days of telework relative to the total person days of work. This comes out to be a mere 2.5%. That is, on a typical work day, only 2.5% of workers telework. Clearly, increasing the percentage of teleworking individuals can contribute substantially to alleviating traffic congestion. With the rather high penetration of the internet in Austin residences, and the hi-tech nature of many jobs in Austin, it would appear that there is scope for increasing the percentage of teleworkers. This is a subject for serious consideration by local transportation and work agencies.
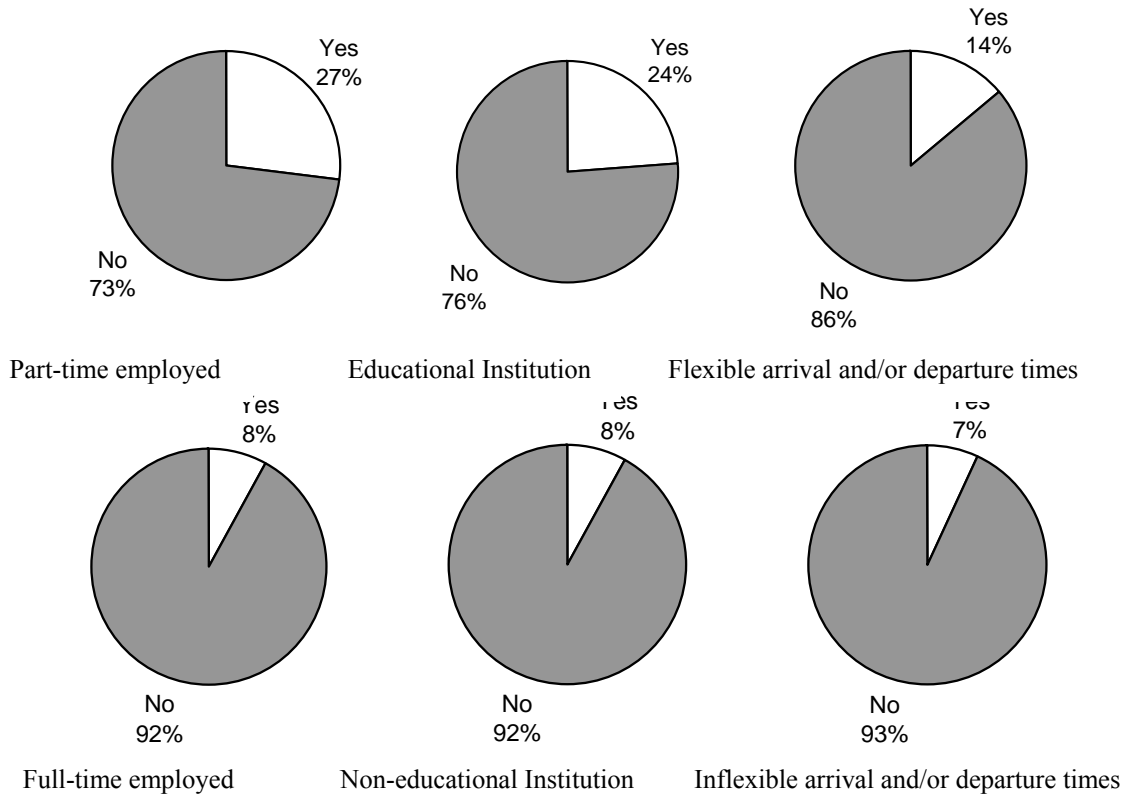
Figure 20. Teleworking percentage by (a) Employment status, (b) Employer type, and (c) Flexibility of arrival and departure times
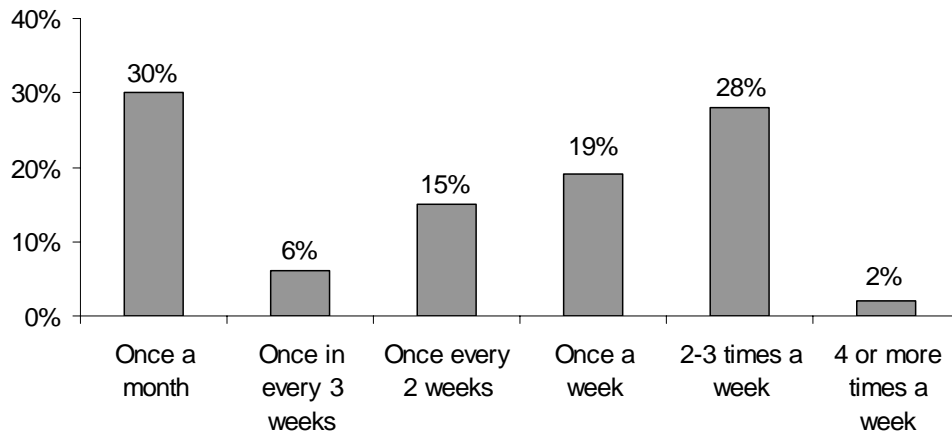

Figure 21. Frequency of teleworking

CHAPTER 4. COMMUTE TRAVEL CHARACTERISTICS

The ACS captures several commute-related and other travel characteristics of Austin area residents, including general weekly travel pattern attributes as well as detailed travel pattern characteristics on the most recent work day of respondents. The next section presents information on travel perceptions, following by commute distance statistics and stop-making characteristics. The chapter concludes by discussing commute mode use and the temporal characteristics of the commute.

4.1 Travel Perceptions

The survey data indicates that 55% of the commuters perceive traffic conditions to be very congested or extremely congested during their commute (Figure 22). Only about 8% of respondents felt that their commute was not at all congested. Interestingly, even though over 90% of respondents feel that their commutes are at least slightly congested, only 63% of respondents characterized their commute trips as being somewhat or very stressful (Figure 23). In particular, 37% of respondents characterized their commute as being somewhat or very

> …several Austin area employees do value the routine of traveling to their work place, perhaps because the commute is personal uninterrupted time that is increasingly difficult to find in the busy "din" of life.

enjoyable. This indicates that several Austin area employees do value the routine of traveling to their work place, perhaps because the commute is personal uninterrupted time that is increasingly difficult to find in the busy "din" of life. For example, for many employees, the commute may be the only available time to listen to music on their CD players, or to catch up on the news, or to just simply indulge in self-thought.
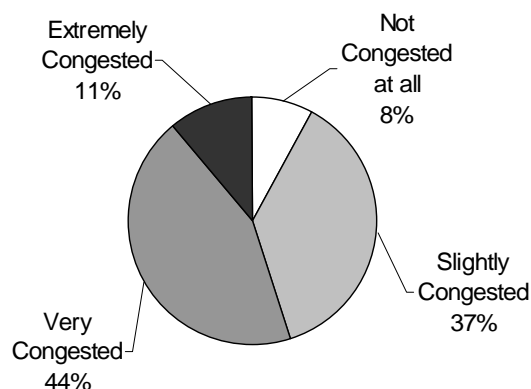

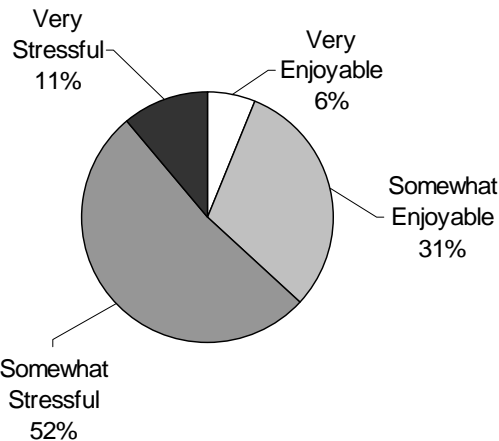**Figure 22. Perception of level of congestion during commute**

Figure 23. Characterization of the commute trip

Commute travel perceptions are influenced by commute distance and highway use, as can be observed from Figures 24 and 25. Clearly, commuters who travel longer distances and who use Austin highways (Mopac, IH-35, US-183, US-360, US-71, US-290, and FM-2222) perceive higher levels of traffic congestion and characterize their commuting experience as more stressful compared to commuters who travel shorter distances and do not use highways, respectively (these results can be observed by comparing the pie-charts horizontally to discern the effect of commute distance and comparing the pie-charts vertically to discern the effect of highway use). The influence of commute distance suggests that land-use mixing strategies of housing with offices to create better jobs-housing balance have the potential to reduce congestion levels as well as stress levels during the commute. The impact of highway use on congestion and stress perceptions emphasize the heavy commute traffic on these roadways (almost 60% of Austin commuters use one or more of the Austin highways listed above).

(a) Highways not used
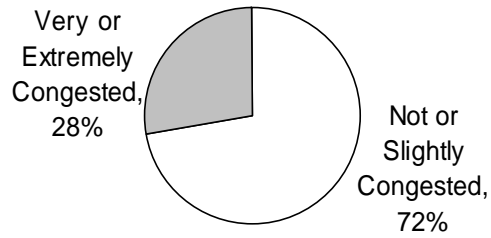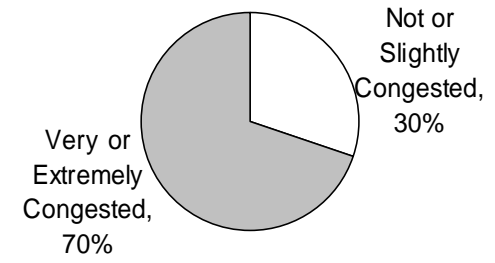
Very or Extremely Congested, 28%

Not or Slightly Congested, 72%

Short Commute (≤ 7 miles)

Very or Extremely Congested, 40%

Not or Slightly Congested, 60%

Medium Commute (7.01-15 miles)

Not or Slightly Congested, 30%

Very or Extremely Congested, 70%

Long Commute (> 15 miles)

(b) Highways used

Very or Extremely Congested, 49%

Not or Slightly Congested, 51%

Short Commute (≤ 7 miles)

Not or Slightly Congested, 34%

Very or Extremely Congested, 66%

Medium Commute (7.01-15 miles)

Not or Slightly Congested, 22%

Very or Extremely Congested, 78%
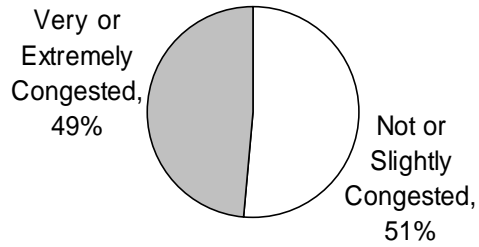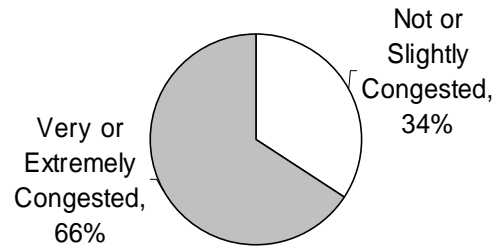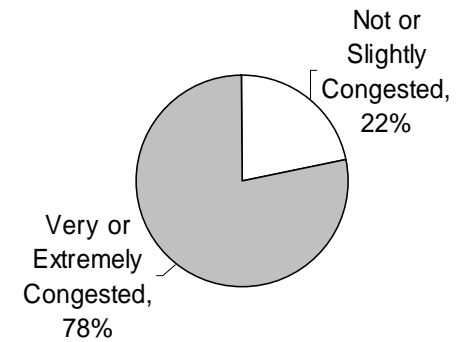
Long Commute (> 15 miles)
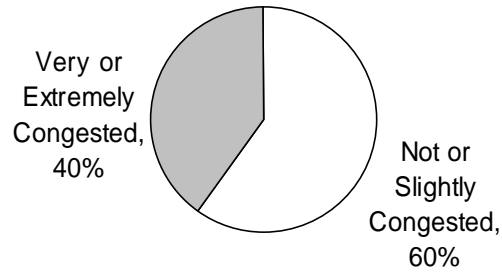
Figure 24. Perception of level of congestion by commute distance

(a) Highways not used
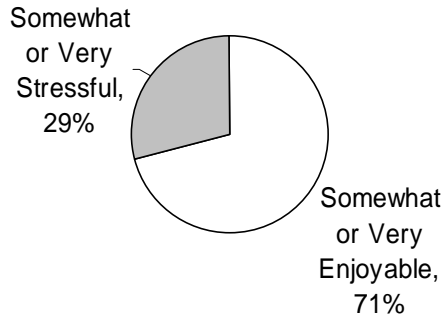
Somewhat
or Very
Stressful,
29%
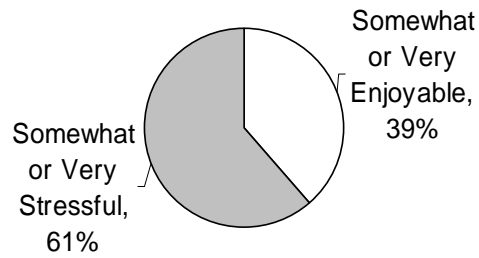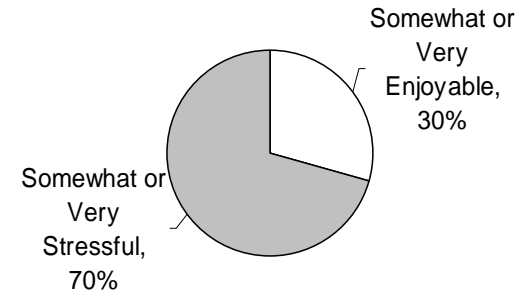
Somewhat
or Very
Enjoyable,
71%

Short Commute (≤ 7 miles)

Somewhat
or Very
Enjoyable,
39%

Somewhat
or Very
Stressful,
61%

Medium Commute (7-15 miles)

Somewhat or
Very
Enjoyable,
30%

Somewhat or
Very
Stressful,
70%

Long Commute (≥ 15 miles)

(b) Highways used

Somewhat
or Very
Enjoyable,
35%

Somewhat
or Very
Stressful,
65%

Short Commute (≤ 7 miles)

Somewhat
or Very
Enjoyable,
27%

Somewhat
or Very
Stressful,
73%

Medium Commute (7-15 miles)

Somewhat
or Very
Enjoyable,
21%

Somewhat
or Very
Stressful,
79%
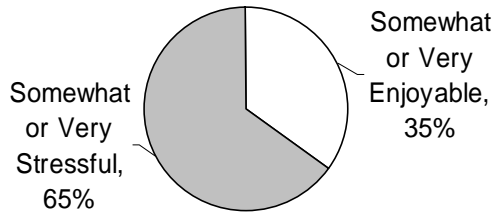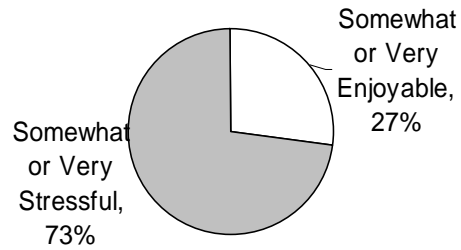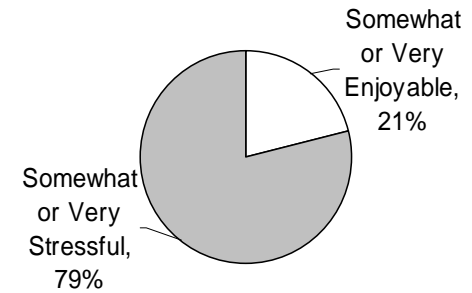
Long Commute (≥ 15 miles)

Figure 25. Characterization of commute trip by commute duration

Interestingly, we did not find any substantial differences in perception of congestion and stress levels by the sex of the commuter or the area type of residence/work place of the commuter.

Unlike the commute where respondents indicated clearly that the traffic conditions are congested, a very large percentage of the respondents indicated that it was "very easy" or "easy" to travel to nonwork activities (such as grocery shopping, recreation, *etc.*) around their residential neighborhoods (Figure 26).
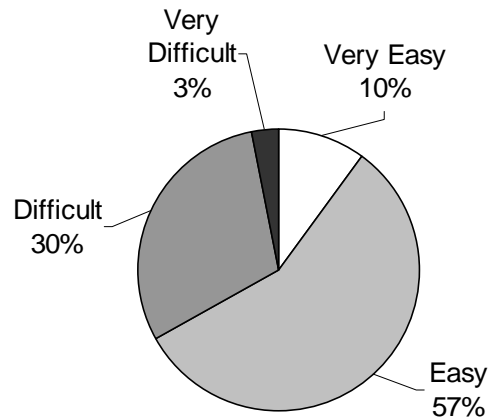
Figure 26. Ease of travel to nonwork activities around home

4.2 Commute Distance

The direct home-to-work distance, a result of work and residential location choice decisions, is another important commute travel characteristic. According to the ACS data, the commute distance ranges between a quarter mile and 70 miles, and has an average of about 12.3 miles. Only 4% of the commuters live within 2 miles from work. The majority of commuters (72%) live within 15 miles from work, though a sizeable fraction of commuters (28%) live beyond 15 miles (Figure 27). Interestingly, there were no statistically significant differences in commute distance by sex of the commuter and commuter income.
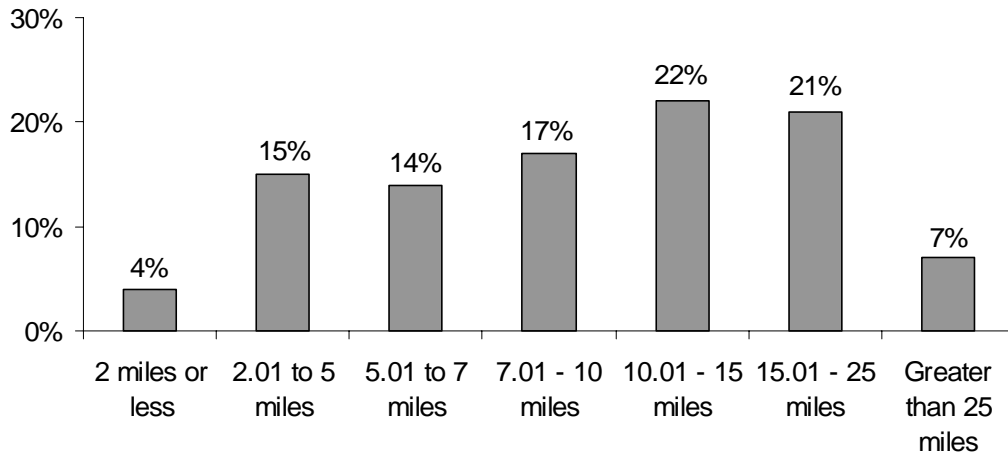
Figure 27. Distribution of commute distance

4.3 Do Commuters Make Nonwork Stops?

Another factor that plays a very important role in commute travel-related choices is stop-making behavior. Very often an individual's choice of commute mode or route will be dictated by the activity stops s/he has to make en route or during midday from work. In this section, we discuss commute and midday stop-making both at a weekly level as well as on the most recent work day.

4.3.1 Stop-Making at a Weekly Level

Figures 28(a) and 28(b) show weekly stop-making propensities during the morning and evening commute trips, and Figures 29(a) and 29(b) show the propensities to make nonwork stops and return home during the midday from work. The first set of figures indicates that 49% of commuters make a morning commute stop on one or more days of the week, while a much higher percentage of 83% of commuters make an evening commute stop on one or more days of the week. The second set of figures show that about 57% of commuters make midday nonwork stops from work on one or more days of the workweek, while 20% return home on one or more days during the midday. Overall, the figures clearly indicate the high level of commute stop-making and midday stop-making. Specifically, as summarized in Figures 30(a) and 30(b), about 85% of commuters make one or more nonwork stops during the commute in the course of their work week, and over 60% of commuters make a nonwork stop or return home from work during the midday on at least one of their work days.

> About 85% of commuters make one or more nonwork stops during the commute in the course of their work week, and over 60% of commuters make a nonwork stop or return home from work during the midday on at least one of their work days… This has an important impact on commute mode choice.

(a) During the morning commute   (b) During the evening commute
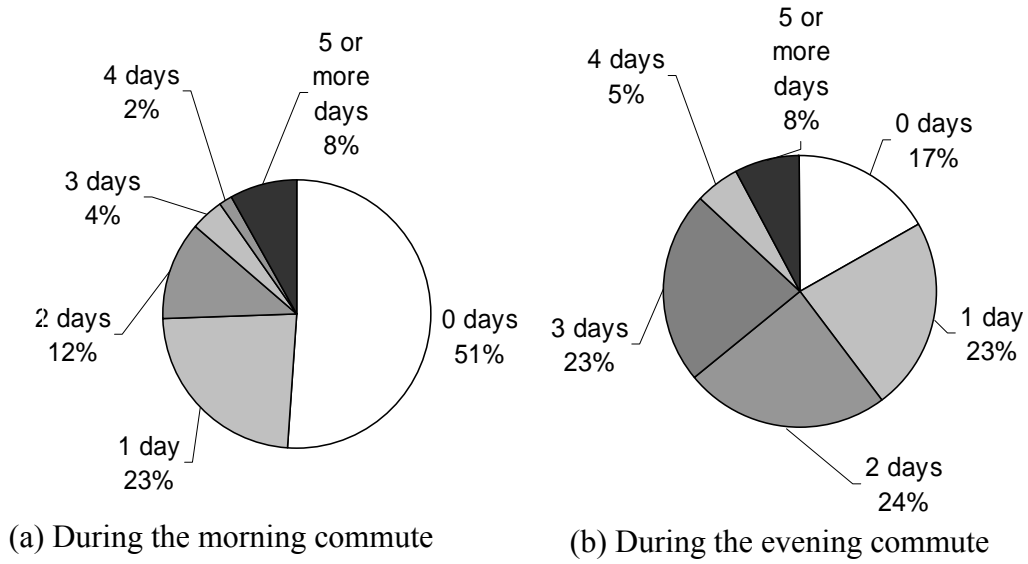
Figure 28. Distribution of weekly commute stop-making

(a) Non-home stops   (b) Return home stops
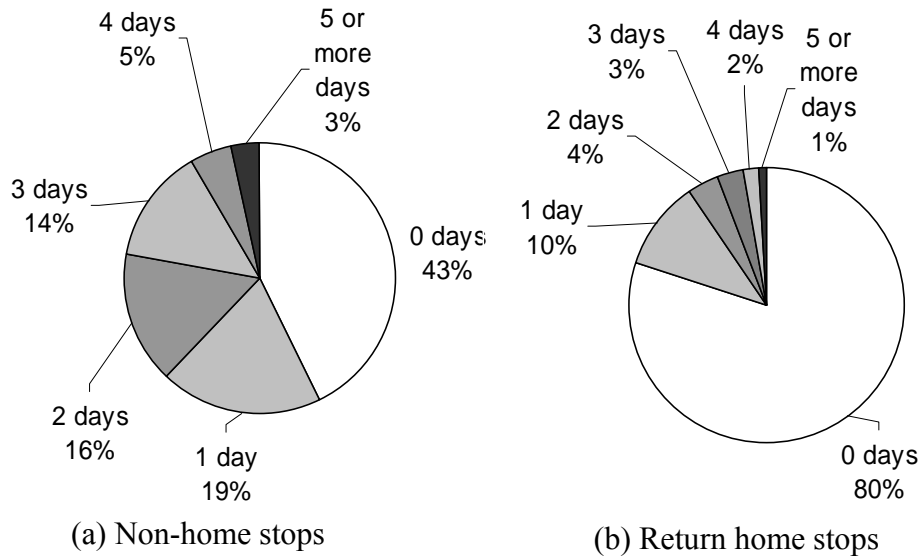
Figure 29. Distribution of weekly midday stop-making
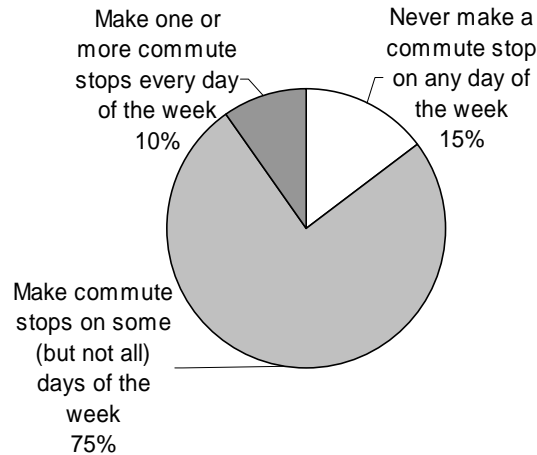
(a) Commute stop-making
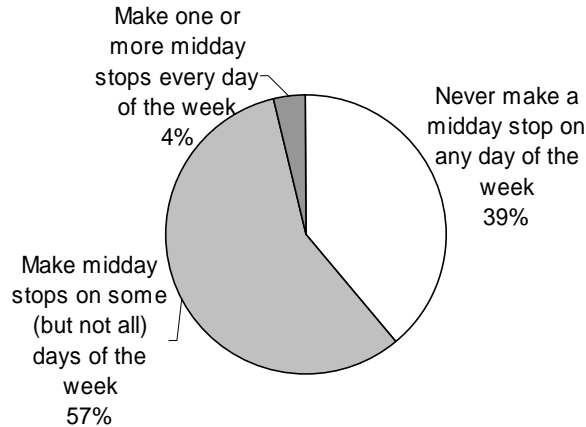
(b) Midday stop-making

Figure 30. Degree of stop-making during the week

The tendency to make commute stops during the week is closely related to the sex of the commuter and the household type. Specifically, only 10% of women never make a commute stop on any day of the week compared to 18% of men who never make a commute stop. Further, only 8% of commuters in two-worker couple/nuclear family households never make a commute stop on any day of the week compared to 14% of commuters in one-worker nuclear/couple family households. Also, 26% of single parent households make commute stops every day of the week compared to only 9% of non-single parent households who make commute stops every day. There are also significant differences in midday stop-making based on the household structure of the commuter, though not based on the sex of the commuter. For example, 48% of commuters in one-worker couple/nuclear families do not make any midday stops on any day of the week, compared to 37% of commuters from two-worker couple/nuclear households, 32% of commuters who live alone, and 27% of commuters who are single parents.

In the overall, the increasing diversity of Austin household structures (from the traditional one-worker couple/nuclear family households to two-worker couple/nuclear family households, single adult households, and single parent households) is having the result of increasing commute and midday stop-making, perhaps because of schedule/time constraints and the resulting need to use time efficiently. The increased commute/midday stop-making, in turn, has an impact on commute mode choice (as discussed in the next section).

4.3.2 Stop-Making at a Daily Level

The activity-travel pattern data on the most recent commute day provides information to examine detailed daily nonwork stop-making behavior characteristics. Table 3 presents the number of nonwork stops made during each of five time periods of the commute day. This table clearly indicates a "loading" of nonwork stops toward the midday and later periods of the day. For example, 88.4% of commuters do not make a nonwork activity stop during their morning commute, compared to only 70% who do not make a nonwork stop during the evening commute. The low nonwork activity participation rate in the morning periods is an intuitive result because of work start time constraints.

Table 3. Distribution of number of activity stops

No. of Activity Stops	Percentage of each number of stops during:				
	Before Morning Commute	Morning Commute	Midday	Evening Commute	After Evening Commute
0	93.6	88.4	72.9	70.0	81.2
1	5.4	10.6	11.3	15.8	6.0
2	0.4	1.0	10.2	9.6	3.2
3	0.0	0.0	3.7	2.5	3.2
4	0.6	0.0	1.5	0.6	2.4
≥5	0.0	0.0	0.4	1.5	4.0

Table 4 presents the percentage of individuals making one or more stops of each activity purpose during each period. The most frequent reason to make a stop before or during the morning commute is for dropping off children. The stops made during the midday period are mostly for eating out, personal business, and work-related business. A small fraction of the commuters also participate in grocery/non-grocery shopping and social (visiting friends or relatives) activities during the midday. The most frequent purpose for stops during the evening commute are grocery and non-grocery shopping, pick-up/drop-off, personal business, and recreation. Finally, commuters participate mostly in eating out, shopping or social/recreational purposes after the evening commute.

Table 4. Distribution of stop-making by purpose and time period

Activity type	Percentage of individuals making one or more stops of each type in each period				
	Before Morning	During Morning	Midday	During Evening	After Evening
Go out to eat	0.0	0.0	17.5	3.0	7.2
Conduct personal business	1.7	2.9	14.3	9.3	5.7
Go shopping (groceries)	0.0	0.3	2.3	14.9	10.6
Go shopping (other items)	0.0	0.0	3.7	8.4	10.3
Conduct work related to business	1.1	3.6	11.0	0.0	0.1
Drop-off/pick-up my children	4.4	6.4	0.9	7.4	0.0
Drop-off/pick-up adults in my household	0.0	0.0	0.0	1.0	1.9
Other drop-off/pick-up	1.1	0.0	0.0	1.4	0.0
Visit friends/family	0.0	0.0	1.3	2.3	7.4
Undertake recreational activities	0.0	0.0	0.0	5.0	10.6
Just wanted to travel	0.0	0.0	0.0	0.6	0.0

4.4 Which Mode of Transportation do Commuters Use for Their Travel?

The survey provides information on mode usage both over a week as well as the most recent day commuted. For the purpose of characterizing mode usage, individuals who personally drive to work and make a stop during the commute for dropping/picking up children are classified as "driving alone". This is based on the notion that such individuals are unlikely to share a ride with others or use other modes because of the responsibility of transporting children. Further, these individuals drive alone for part of the commute, and the children are dependent on an adult for transportation (i.e., children cannot choose a travel mode on their own). On the other hand, if an individual personally drives to work with other household or non-household adults, the individual is classified as sharing a ride. Additionally, all individuals riding as a passenger are classified as sharing a ride.

The distribution of mode use over the week is provided in Figure 31. The results clearly indicate that a vast majority of commuters drive alone all days of the week (note that some of these commuters may be dropping/picking up children on all or some days of the week). Further, about 85% of all commuters use the same mode over the entire week (the first five categories in the figure correspond to single mode use throughout the week). Among the combination mode use categories, the most common one is driving on some days and using transit on other days (6.9%).
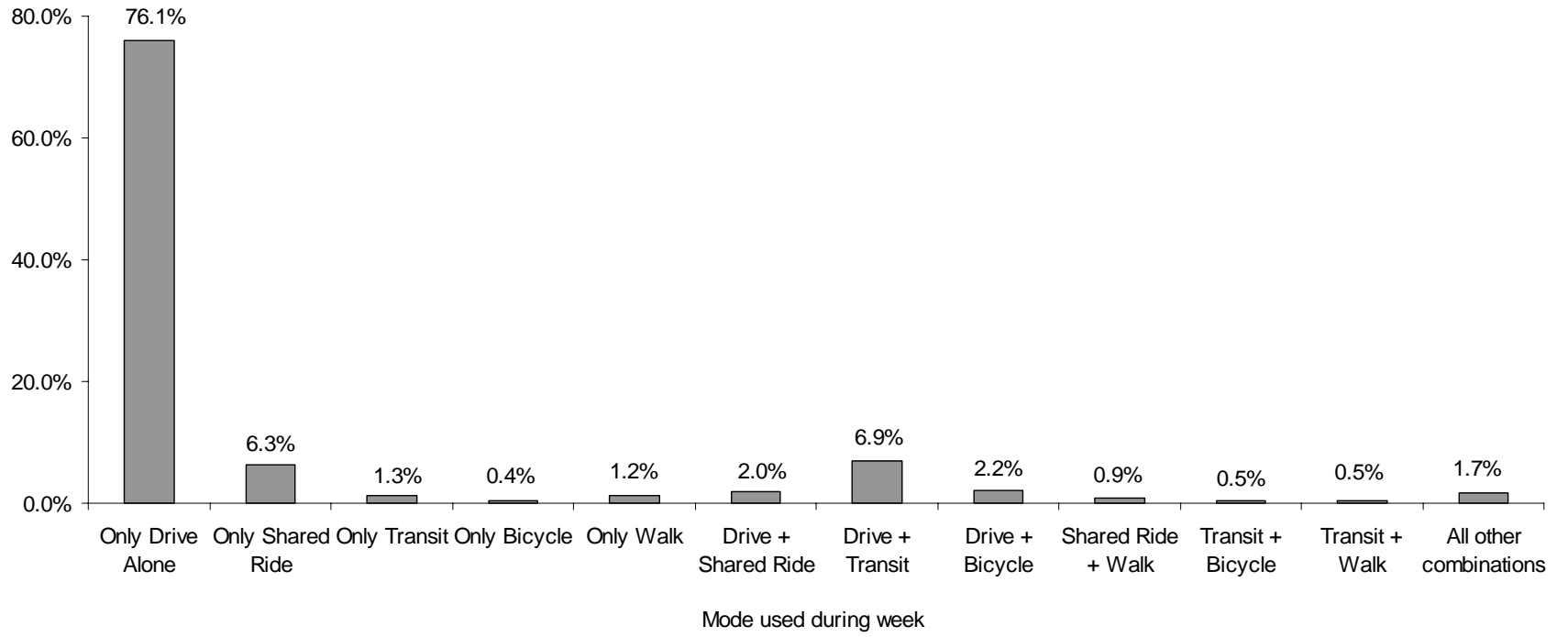
Figure 31. Distribution of mode use over the week

The mode splits for the most recent day commuted is provided in Figure 32. As expected, a majority of commuters (84.6%) drive alone to work. The reader will note that this includes commuters who drop-off/pick-up their child during one or both the commute legs. Such commuters constitute 7.7% of the population (within this group of commuters who drop off/pick up children during the commute, 53% have a drop off/pick off during both commute legs and the remaining 47% have a drop off/pick up on only one leg). The "other" category in Figure 32 includes individuals who used different modes for the home-to-work and work-to-home commutes. Overall, the results show that the mode used for the two legs of the commute are almost always the same; that is, there is little mode mixing within the day.
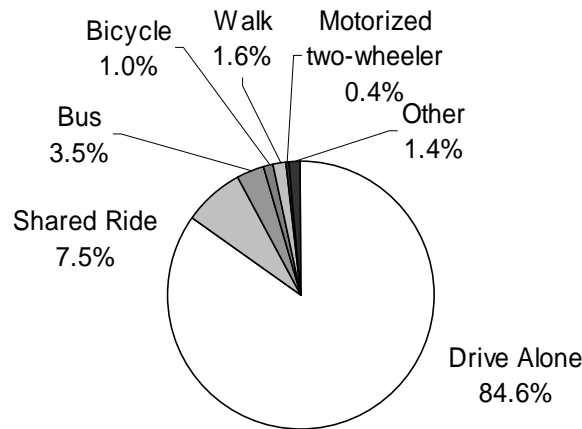
Figure 32. Commute mode choice on most recent work day

The mode choice of commuters varies considerably by such commuter-associated factors as household socio-economics (for example, number of vehicles owned by household, number of individuals who hold a license to drive a motorized vehicle, and household income), individual income, work place employment density, level of service (travel time, cost, and reliability) offered by the alternative travel modes, weekly commute and midday stop-making characteristics, and land-use design attributes. A comprehensive and rigorous analysis of the impact of these factors has been undertaken in Bhat and Sardesai (2006). Here, we will descriptively examine the effect of weekly stop-making on the mode choice for the most recent day of commuting, and summarize the important results from Bhat and Sardesai (see the full paper at www.ce.utexas.edu/prof/bhat/ABSTRACTS/Bhat_Sardesai_TRptB_rev.pdf).

Table 5 show the mode splits for each of the following two commuter segments: (1) commuters who do not make commute stops on any day of the week, and (2) commuters who make commute stops on one or more days of the week. The percentages in the table add up to 100 for each column. The results very clearly indicate the important impact of weekly commute stop-making on commute mode choice.

Commuters who make commute stops on one or more days of the week are very likely to drive alone on each day of the week because of the convenience and flexibility offered by driving. Consequently, it is rather difficult to "wean" stop-making commuters from driving alone.

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In particular, 69.5% of commuters who never make a commute stop drive alone, compared to 87% of commuters who make a commute stop on one or more days of the week. The percentages of the bus and non-motorized modes (walk and bicycle) are correspondingly higher for commuters who do not make commute stops compared to those who do. The overall implication is clear. Commuters who make commute stops on one or more days of the week are very likely to drive alone on each day of the week because of the convenience and flexibility offered by driving. Consequently, it is rather difficult to "wean" stop-making commuters from driving alone.

Table 5. Mode split by weekly commute stop making propensity

	Never make a commute stop on any day of the week	Make one or more commute stops on one or more days of the week	Total
Drive Alone	69.5%	87.0%	84.6%
Shared Ride	6.9%	7.5%	7.5%
Bus	9.8%	2.5%	3.5%
Bicycle	2.0%	0.8%	1.0%
Walk	8.8%	0.5%	1.6%
Motorized two-wheeler	2.0%	0.2%	0.4%
Other	1.0%	1.5%	1.4%

Table 6 shows the mode splits segmented by individuals who do not make midday stops and those who do. Again, the impact of making midday stops is apparent. Individuals who make midday stops on any day of the week are more likely to drive alone during their commute and less likely to use the shared-ride and non-motorized modes than individuals who do not make midday stops. This can be attributed to the need for a personal vehicle to pursue midday stops. For instance, if there is no convenient food place near a person's work building, the individual may have to drive to lunch. This, in turn, has the effect of constraining the individual to drive to work. A policy implication is that mixed land use development strategies (such as having post-offices, restaurants, and banks around employment centers) have the potential to facilitate mode switching away from driving alone.

Table 6. Mode split by mid-day stop-making propensity

	Never make a mid-day stop on any day of the week	Make one or more mid-day stops on one or more days of the week	Total
Drive Alone	80.7%	87.2%	84.6%
Shared Ride (with workers)	11.9%	4.7%	7.5%
Bus	1.6%	4.7%	3.5%
Walk	3.3%	0.7%	1.6%
Bicycle	1.1%	0.7%	1.0%
Motorized two-wheeler	0.7%	0.1%	0.4%
Other	0.7%	1.9%	1.4%

Other important results from Bhat and Sardesai (2006) regarding travel mode choice are as follows:

- The ability of auto-use disincentive actions (such as tolls, parking pricing, or peak period pricing) and high occupancy vehicle-use incentives (such as high occupancy vehicle lanes or a new commuter rail mode) to shift commuters away from driving to car/van-pooling and transit modes will be overestimated if the impact of commute and midday stop-making on commute mode choice is ignored.

- Commuters are not only concerned about the usual (or average) travel time, but also in the reliability of travel time when making their commute mode choice decisions. This is particularly the case for commuters with an inflexible work schedule. On average, commuters value travel time savings and improved reliability about equally. That is, everything else being equal, Austin area commuters would consider two travel modes; one with a 30 minute average travel time but which may take up to 50 minutes on certain days, and another with a 45 minute average travel time but will get the commuter to the workplace within 50 minutes every day; about equally. This finding is important in the context of evaluating strategies that focus on making the transportation system more reliable. For instance, a potential commuter rail transit (CRT) mode system for Austin may have a higher reliability in travel time (due to a separate right of way) compared to driving alone, even if the average travel time by CRT is higher than driving.

- The average commuter is willing to pay $12.00 for an hour of commute time savings, or about $6.00 for a 30-minute time savings, or about $3.00 for a 15-minute time savings.

- Commuters have a more positive image of a potential commuter rail transit (CRT) mode than the current bus mode. In fact, CRT has a "travel time bonus" of about 20 minutes relative to the bus mode. That is, if all service characteristics except travel time are equal between the bus and CRT modes, an average commuter will choose the CRT mode over the bus mode even if the CRT travel time is more than the bus travel time by up to 20 minutes.

- The presence of a grocery store around potential CRT stations acts as an impetus for CRT mode-use, among those individuals who pursue one or more commute stops during the week. However, the presence of a child care center around CRT stations does not provide any stimulation for CRT mode-use, even among commuters who make a child care pick-up/drop-off stop during the commute. The absence of the effect of a child care center around CRT stations on CRT mode choice may suggest that parents do not consider CRT stations to be appropriate locations, from a safety and noise standpoint, for child care centers.

- The percentage of commuters using a potential CRT system will clearly be dependent upon the service characteristics (travel time, travel cost, reliability, and availability) of the system. Using assumptions that are not unreasonable about these service characteristics, a new CRT mode is predicted to capture 4.1% of the overall mode share. The drive alone mode share reduces by 2.6%, with the remaining 1.5% of the CRT share being drawn from the shared-ride, bus, and non-motorized modes. As expected, the CRT mode is likely to draw more proportionate share from the non-drive alone modes than the drive alone mode. However, the numbers projected here should be used simply as an initial guideline in planning. It is important to pursue a more in-depth simulation of possible CRT service scenarios (based on the precise locations of CRT stations and the travel times, costs, and travel time reliability to be offered by a potential CRT system) to better understand the full impacts and viability of a potential CRT system for Austin.

- CRT availability to individual commuters is critical in determining the reduction in drive alone and the CRT commute mode shares. Clearly, if a commuter does not perceive CRT to be available as an alternative, CRT will not be chosen by the commuter. But within the group of individuals for whom CRT is an available alternative, we project a shift of the magnitude of 15% from driving to CRT. Earlier studies suggest that commuter rail stations should be located within 1 mile of a person's residence and person's work place in order for commuter rail to be considered as an available alternative for the commute. Thus, the initial alignment of the CRT route and station locations should be carefully designed based on the residence and workplaces of Austin area commuters so that CRT becomes a viable alternative for as large a fraction of the population as possible. The other side of this finding is the caution that one should not expect substantial shifts in drive alone mode shares after the implementation of a "starter" rail system. The real benefits of a potential commuter rail system from a traffic congestion standpoint will likely accrue only when the proposed rail system is expanded sufficiently to serve a reasonable fraction of the commuter population.

- Tolls on highways can be expected to lead to a drop of about 2.5% in the drive alone mode share on the highways for each $1.00 toll. Also, a $1.00 toll for the use of all the major highways (Mopac, IH-35, US-183, US-360, US-71, US-290, and FM-2222) in the Austin area would lead to about a 1.5% reduction in drive alone mode share across the entire Austin

metropolitan area (it is important to emphasize that we are not proposing such a blanket tolling system, but simply projecting the order of magnitude of modal shifts due to tolls).

4.5 How Long Do Commuters Travel?

The average home-to-work commute duration is 27 minutes, and the average work-to-home commute duration is 30 minutes. As one would expect, the commute duration is a function of mode used. The average durations across commuters for each of the driving alone, shared-ride, and bicycle groups are very close to the average durations just discussed. However, the duration for commuters using transit is about 43 minutes in each direction, while the duration for commuters who walk to their work place is about 17 minutes in each direction.

4.6 When Do Commuters Travel?

Figures 33 and 34 show the distribution of the time of the morning and evening commutes of Austin area employees, respectively. Figure 33 shows that more than three-fourths of Austin area employees undertake their morning commute between 6-9 AM (i.e., they start their commute and end their commute between 6-9 AM). Similarly, almost three-fourths of Austin commuters pursue their evening commute between 4-7 pm (i.e., they start and complete their evening commute between 4-7 pm).
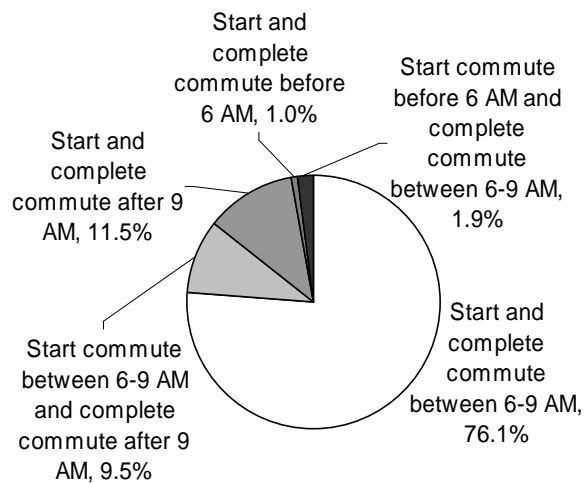

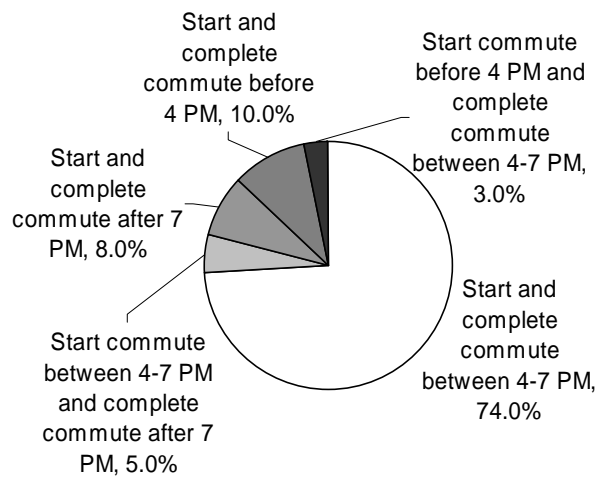
Figure 33. Distribution of the time of the morning commute

Figure 34. Distribution of the time of the evening commute

CHAPTER 5. CONCLUSIONS AND POLICY IMPLICATIONS

Traffic trends in Austin show a longer rush hour, more congestion on the roads, and longer travel times for trips. Travel time delays and the difference in peak travel time to off-peak travel time are increasing at a greater rate in Austin than in other medium-sized cities in the country. In fact, according to the recent 2004 urban mobility report, the Austin area has the dubious distinction of having the highest level of traffic congestion among cities its size.

The objectives of the current effort were to (1) Examine the demographic, employment, and overall travel characteristics of Austin area commuters, and analyze how these characteristics impact commute travel choices and perceptions, (2) Develop a framework for evaluating the effect of alternative congestion alleviation strategies on commute mode choice, and (3) Identify broad and important issues that have to be recognized when designing and analyzing a comprehensive mobility plan for Austin. Toward this end, a web-based survey of Austin area commuters was undertaken between December 2003 and March 2004. The data from the web-based survey was weighted appropriately to be representative of the Austin area commuter population.

Important findings from our analysis include the following:

1. The household structures of Austin area commuters are rather diverse. In particular, the percentage of the nuclear/couple families (a male adult and a female adult with or without children) is only 46%. Further, a vast majority of these nuclear/couple family households have both adults working. In particular, only 13% of commuter households are traditional family households in which only one adult works. About 23% of all households are single person households, suggesting that the Austin commuter work force is rather young and career-oriented. Further, about 4% of the commuter families are single parent households, 13% are returning young adult households, 8% are un-related roommate or same-sex couple households and 10% are other kinds of households (mixtures of related and unrelated members).

2. The average household income of Austin commuters is $65,700, higher than the national household average of $58,000. Perhaps due to the high income earnings as well as the hi-tech nature of jobs, a very large percentage (84%) of Austin commuters have internet access from their homes. The relatively high income of Austin area households also results in an average motorized vehicle ownership level of 2 per household. Almost all households in Austin own at least one motorized vehicle.

3. Austin area commuters are 67% white (non-Hispanic), 16% Hispanic, and 17% of other races (Asian-American, African-American, Native American, mixed, and other). The percentage of men is 57%, while that of women is 43%. Austin commuters are a quite well-educated group, with an average personal income of $44,650 (which is higher than the national average of $39,100).

4. Austin area workers are primarily full-time employed, start their work between 7-9 AM and end their work between 4-6 PM, and telework rather infrequently (about 10% of commuters telework from home at least occasionally, but on any given day, only about 2.5% of commuters telework). About 42% of the workers have an inflexible work schedules in both the work arrival and departure times, 30% have a flexible work schedule in both work arrival

and departure, and the remaining have flexibility at either the arrival or departure end, but not both.

5. Over 90% of respondents feel that their commutes are at least slightly congested; however, only 63% of respondents characterized their commute trips as being somewhat or very stressful. In particular, 37% of respondents characterized their commute as being somewhat or very enjoyable. This percentage varies by whether commuters use highways and commute distance, with highway users and long-distance commuters perceiving higher levels of congestion and stress levels relative to non-highway users and short-distance commuters, respectively. However, even within the class of highway users who commute long distances, 21% indicate that the commute is somewhat or very enjoyable (the corresponding number for non-highway, short-distance, commuters is 70%). Overall, these results indicate that several Austin area employees do enjoy the routine of traveling to their work place, perhaps because the commute is personal uninterrupted time that is increasingly difficult to find in the busy "din" of life. For example, for many employees, the commute may be the only available time to listen to music on their CD players, or to catch up on the news, or to just simply be immersed in self-thought.

6. The commute distance ranges between a quarter mile and 70 miles, and has an average of about 12.3 miles. Only 4% of the commuters live within 2 miles from work. The majority of commuters (72%) live within 15 miles from work, though a sizeable fraction of commuters (28%) live beyond 15 miles.

7. The increasing diversity of Austin household structures from the traditional one-worker couple/nuclear family households to two-worker couple/nuclear family households, single adult households, and single parent households is having the result of increasing commute and midday stop-making, perhaps because of schedule/time constraints and the resulting need to use time efficiently.

8. Commuters are much more likely to make nonwork stops during the evening commute rather than the morning commute. The most common stop purposes during the evening commute are for picking up children, shopping, personal business, and recreational activities, while the most common stop purposes during the morning commute are for dropping off children, personal business, and work-related business. As expected, the most common midday stop purposes are for eating, personal business, and work-related business.

9. The net result of high household incomes, high car ownership levels, diverse household structures, and increased commute/midday stop-making is high drive alone mode shares among Austin area commuters. The high drive alone mode share may be reduced by such transportation policy actions as a new commuter rail mode, tolls on highways, and exclusive high-occupancy vehicle lanes. However, our analysis indicates that any of these measures, in isolation, will have a limited impact on weaning commuters from their cars. For instance, a new commuter rail mode or a toll of $1.00 on Austin highways may draw only about 2.5% of commuters away from their cars (with about 25,000 new commuters in Austin each year, the drive alone share needs to decrease by about 5% each year if today's congestion levels are to be maintained, let alone improved). But by combining several transportation policy actions, there is the potential to make a tangible reduction in drive alone mode share. Further, our analysis emphasizes the need to pursue an integrated and coordinated land-use and transportation planning strategy. For example, a commuter rail plan should to be backed up

with appropriate zoning strategies to promote the development of mixed use facilities close to the commuter rail stations. Such an effort would serve two purposes. The first is to foster the development of residences and offices in and around the commuter rail stations to increase transit share. The second is to facilitate the development of shopping stores, banks, post offices, and child care facilities to obviate the need to make separate commute stops (note that the most common commute stops are for personal business, child care, and shopping). Another complementary land-use strategy would be to facilitate eating out and personal business within walking distance of employment centers, so that a personal vehicle is not needed for such midday activity participations. This, in turn, can contribute to shifting away from driving during the commute.

10. Commuters are not only concerned about the usual (or average) travel time, but also in the reliability of travel time when making their commute mode choice decisions. This is particularly the case for commuters with an inflexible work schedule. On average, commuters value travel time savings and improved reliability about equally. That is, everything else being equal, Austin area commuters would consider two travel modes; one with a 30 minute average travel time but which may take up to 50 minutes on certain days, and another with a 45 minute average travel time but will get the commuter to the workplace within 50 minutes every day; about equally. This finding is important in the context of evaluating strategies that focus on making the transportation system more reliable. For instance, a potential

> Commuters are not only concerned about the usual (or average) travel time, but also in the reliability of travel time when making their commute mode choice decisions.

commuter rail transit (CRT) mode system for Austin may have a higher reliability in travel time (due to a separate right of way) compared to driving alone, even if the average travel time by CRT is higher than driving.

11. Overall, for any mode to compete with the auto modes it will have to be safe, reliable, inexpensive, extensive in coverage, well-connected to schools and in close proximity to sources of shopping, recreation, food and child-care.

REFERENCES

Bhat, C.R., and R. Sardesai (2006). The Impact of Stop-Making and Travel Time Reliability on Commute Mode Choice. In press, *Transportation Research Part B*.

Schrank, D., and T. Lomax (2004). The 2004 Urban Mobility Report. Texas Transportation Institute, The Texas A&M University System, September.