Auto Passenger Travel
and
Auto Occupancy in the GTA

1996 Results and Recent Trends

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1. Introduction

Auto use continued its rapid growth in the GTA from 1986 to 1996 as recorded by the Transportation Tomorrow Survey (TTS) program. The overall volume of auto passenger trips has been increasing at a faster rate than the auto trips themselves. At the same time, the number of transit trips has continued to decline, which begs the question whether some of the growth in auto passenger travel has occurred at the expense of the transit mode.

Transportation decision-makers and planners need information that will provide a better understanding of recent trends in auto and auto passenger trips for the transportation system improvements that are being planned and are being implemented in the coming years by the provincial and municipal governments.

We need to understand the nature of the changes that are behind the increased use of the auto mode and the growth in auto passenger trips. For example, do these changes result from evolving demographic characteristics of the users, such as aging of the population? Do they result from the urban growth patterns and lifestyle changes that occur with the suburbanization of the population? Or, are they the result of people switching away from their traditional choice of transportation mode (such as a switch from transit to auto)? Finally, are these changes likely to continue into the future?

This review is intended to provide an initial overview of the subject, and it is based primarily on the results of the TTS surveys. The following versions of the TTS database were used for the analysis: 1996 TTS vers 2.1, 1991 TTS vers 4.1, and 1986 TTS vers 3.1.

The overview begins with a look at the overall growth of GTA travel and of auto passenger trips in particular. The characteristics of auto passengers are compared with the user attributes of the other modes. The effect of age, trip purpose, gender, driver's licence, and location in the GTA are explored. Some of the graphics and travel trend analyses documented in the report by Amer Shalaby have been included in this report by permission of the author, in order to have the benefit of this earlier work. The final section of the report briefly reviews auto occupancy trends in the GTA based on the Cordon Count Program and estimates derived from the TTS surveys. Comparisons are made with auto occupancy trends in Ottawa, Vancouver, and urban areas of the United States using results and analysis from the National Personal Transportation Survey in the United States.

1.1 Growth in GTA Travel and Auto Passenger Trips

The auto passenger and auto driver modes have seen an increased market share over the 10-year survey period, while local transit and "other" have seen slight declines (Figure 1). Trip-making by auto passengers grew at a faster rate than the trips by auto drivers.

The total number of person trips made by residents of the GTA on a typical weekday grew from 8.2 million in 1986 to 10.1 million in 1996 (Figure 2). This increase of 1.9 million trips per day over the 10-year period represents a growth of 23%, with most of the growth occurring in the 1986 to 1991 period.

The increased GTA trip-making was driven by auto use which grew by 1.7 million daily trips over 10 years, a growth of 29% over the 6 million daily auto trips of 1986. Of that total, auto passenger trips grew by 420,000 trips. This represents a 36% increase over the 1986 activity level while the growth in auto driver trips represented only a 27% increase over the 1986 daily auto driver trips.

While daily transit trips declined by 3.1% (40,000 trips) over the 10-year period, the growth in ridership on the GO Rail system was almost sufficient to provide an equivalent offset in daily trips.

By 1991 the auto passenger market share had overtaken the local transit market share (in terms of total daily trips handled) to become the second busiest mode, next to auto driver. By 1996, there were 1.6 million auto passenger trips per day, compared with 1.3 million daily trips by transit.

2. Characteristics of Auto Passenger Travel in 1996 Relative to Travel by Other Modes

Given the rapid growth in the use of the auto for GTA travel, it is of interest to know more about the auto passenger market, its characteristics, and why it has realized such an increase in market share.

2.1 Growth in Auto Passenger Trip-Making

Trip purpose has been a key influencing factor in auto passenger trip growth as shown in Figure 3. Home-based discretionary (HBD) and home-based school trips (HBS) have grown significantly. Discretionary trips grew rapidly during the first 5 years, while school trips grew steadily over the entire 10-year period.

2.2 Factors Influencing Choice of Auto Passenger Mode

Other market factors are also important determinants in the choice of the auto passenger mode as summarized in Figure 4. These include location in the GTA (related to the availability of good transit service as an alternative),

gender and whether the individual has a driver's licence, and trip purpose. Women are more than twice as likely to choose to travel as an auto passenger than men, especially if they do not have a driver's licence. The factors shown in Figure 4 will be explored in further detail in this report.

2.3 Choice of Auto Passenger Mode by Location in the GTA

In 1996, the auto passenger market share was 15.7% of total daily trips and there was not much variation from Region to Region. (Figure 5). The highest passenger market share was for Hamilton-Wentworth at 18%, while the lowest share was for Toronto at 15%. This lower market share for Toronto is, however, offset by Toronto's higher local transit mode split of 22%.

2.4 Location of Auto Passenger Trip Growth in the GTA

Auto passenger trip growth did not occur uniformly from 1986 to 1996 in all areas of the GTA as shown in the following table:

Table 2.4.1: Growth in Auto Passenger Trips by Region

	1986 Daily Auto Passengers	1986 to 1991 Auto Passenger Increase	1991 to 1996 Auto Passenger Increase	1986 to 1996 Auto Passenger Total Increase
Toronto	531,000	138,000	-	138,000
Durham	111,000	35,000	11,000	46,000
York	100,000	51,500	46,000	98,000
Peel	175,000	75,000	23,000	98,000
Halton	93,000	2,500	24,000	26,000
Ham-Went	157,000	300	17,000	17,000
TOTAL	1,167,000	302,000	121,000	423,000
INCREASE		(+26%)	(+8%)	(+36%)

One third of the total auto passenger trip growth occurred within Toronto. It took place during the first 5-year period and then changed very little during the subsequent 5 years. This may have coincided with the recession and the decline in employment in Toronto, which occurred after 1991. York and Peel Regions accounted for almost half of the total growth, followed by Durham Region. The number of daily auto passenger trips in York Region doubled from 1986 to 1996.

Overall, auto passenger activity grew by 26% in the first 5 years and then an additional 8% in the subsequent 5-year period.

2.5 Mode Preference by Time of Day and Trip Purpose

One of the best ways to appreciate the importance of trip purpose as a factor in the choice of mode is to examine the trip peaking profiles by time of day. The pattern of mode choice by trip start time is shown in Figure 6 for 1996 trips. All modes experience peak loads in the morning and evening periods. Transit accommodates very pronounced peak loads. While the auto passenger traffic experiences some peaking, its p.m. peak is distinctly different from the other modes. The auto passenger evening peak is quite flat and spread out over a period of 7 hours from approximately 2:30 p.m. to 9:30 p.m. One might expect the auto passenger peaking to be similar to that of the auto driver, since the passenger rides with the driver. However, the passenger activity has a very broad peak that occurs about 2 hours after the auto driver peak has been reached. This reflects a change in auto occupancy that is higher in the evening, after normal working hours.

The GTA traffic patterns that are created by the four different trip purposes are shown in Figure 7. Home-based discretionary trips immediately stand out with a distinctly different peaking profile. This profile shows a relatively steady level of activity throughout the day followed by a broad evening peak with nearly twice the number of discretionary trips at the peak relative to the mid-day period. There is a strong correspondence between the overall HBD profile and the auto passenger profile seen in Figure 6. Work and school trips have a much higher degree of peaking than the HBD trips.

Figures 8 and 9 show how the auto mode accommodates trips of different purposes over the day. Half of the trips handled by the auto passenger mode (Figure 8) are home-based discretionary (HBD) and these have a strong peak just after 6 o'clock. The trip purpose mix handled by the auto driver mode (Figure 9) also shows a strong share of HBD trips (42% of the total). But the auto driver mode handles nearly twice as many work trips as the auto passenger mode (39% HBW vs. 21% HBW respectively).

People making home-based discretionary trips in the GTA overwhelmingly favour the automobile. 90% of HBD trips are accommodated by the auto and only 9% by transit. Transit, on the other hand, is a more popular mode for work or school-related trips which occur almost entirely during peak periods (Figure 10). Transit accommodates only a small share of the discretionary trips. It does not attract much of the evening peak in discretionary travel (compared with auto passenger discretionary trips in Figure 8), which may be a reflection of the reduced level of transit service that generally occurs in the evening periods.

2.6 Demographics and Social Factors

2.6.1 Effect of Age on Total GTA Trips by Mode

Age has a strong influence on the choice and frequency of use of travel modes (Figure 11). Auto driver trip-making in the GTA is dominant

for people over 20 years of age. A peak in auto driving activity occurs for residents between 36 and 40 years of age. Of particular interest, however, is a comparison between auto passenger and transit trip-making by age. The auto passenger mode dominates the transit mode for total trip-making except for the 16- to 35-years age bracket. Also of interest is the faster relative rate of decline of transit use with age. Auto passenger trips decline more slowly with age and show a slight resurgence early in the retirement years, beyond age 60.

2.6.2 Aging of the Population

The aging of the population (Figure 12) is a key factor behind increased auto use and declining transit use over time. As the baby boom ages and the peak approaches age 40, there are more people at a higher auto driver trip generation rate (Figure 13), and this results in more auto driver trips being made in the GTA.

The population has decreased in numbers for the younger age cohorts (ages 11 to 30), the age group that has the strongest generation rate for transit trips (Figure 15). But it has increased in the subsequent years which generally have higher trip rates for both auto drivers and passengers (Figures 13 and 14). The population increase is most noteworthy for ages 31 to 50 (working years) and for ages 65 to 90 (retirement years).

2.6.3 Modal Trip Rates by Age

The combination of population aging and increase in trip rates has generated the large absolute increases in GTA auto trips over the 1986 to 1991 period (as seen in Figure 2).

For auto passengers (Figure 14), trip rates have grown noticeably for two groups, the 11 to 25 group and for persons of age 60 and above. This reflects greater use of auto for transporting school children and an increased preference by seniors to choose to be an auto passenger. The trip rate distribution for auto passengers is remarkably flat above age 20. Surprisingly, auto passenger travel activity does not decline with advancing age, a pattern followed by the other modes.

Transit trip rates (Figure 15) are highest for the 16 to 20 age cohort and then decrease steadily with age. In the 1986 to 1996 period, transit trip rates have dropped for all age cohorts. The reductions in the transit trip rate are most pronounced for ages 50 to 90. It was within this group that we saw significant auto passenger trip rate increases from 1986 to 1996.

2.6.4 Growth in GTA Auto Passenger Trips by Age

Figure 16 shows where the growth in auto passenger trips has occurred by age, as a result of population growth, aging, and increased preference for the auto passenger mode (some of which is due to the increased suburbanization of the population). The most pronounced growth occurred for young people under 20. But there were also major increases in auto passenger trips by residents of ages 31 to 55 (working years) and by seniors of age 61 and above.

2.6.5 Trip Purpose Trends by Mode

The trip purpose distribution for auto passengers (Figure 17) underwent the biggest change, not in the proportion of discretionary trips which remained close to 52% but in the proportions of school and work trips. Home-based work trips declined from 26% in 1986 to 21% in 1996, while home-based school trips increased from 9% to 15% over the same period. The discretionary and school-related travel markets have been growing the fastest in the GTA over the 10-year period.

The high growth in discretionary trips was also significant for the auto driver mode. Auto drivers in 1986 made as many home-based discretionary trips (40%) as home-based work trips (40%), but the share of HBD trips increased to 43% in 1996 while the work trips dropped to a 38% share in 1996.

Among the other modes, most noticeable is the declining proportion of work trips by local transit in a market where the total number of GTA transit trips has declined over the 10-year period.

2.6.6 Modal Trip Rates by Age

The next three figures show the observed trip rate trends by trip purpose. School trips (Figure 18) have recorded significant increases in trip making rates for travellers up to age 25. But these trip rate increases are, however, largely offset by a population decline in these same cohorts. The school trip rate pattern also appears to have been accommodated into the first 3 cohorts of the auto passenger trip rate pattern seen earlier (Figure 14)

Home-based work (HBW) activity (Figure 19) increases quickly around age 20 and then declines after age 50. The 10-year trends indicate that HBW trip-making activity rates have been declining both at the leading edge of the HBW profile and at the trailing edge as well (above age 50). This may reflect the increased difficulty for young people to enter the labour force, and the effect of earlier retirements. It may also reflect the recession which came into effect in the early 90's, and the difficulty of achieving full employment recovery in Toronto.

The age profile of home-based discretionary trip rates (Figure 20) has two peaks. Trip rates rose over the 10-year period for cohorts above age 40, with the strongest increases in discretionary trip-making rates above age 60. Once again, this pattern with the two peaks seems to be reflected in the trip rate distribution of the auto passengers (Figure 14).

2.6.7 Modal Trip-Making by Gender, Driver's Licence and Age

Just over two-thirds of the auto passenger trips made in 1996 were by females (68%) while only 43% of the auto driver trips were made by females (Figure 21). 59% of the daily transit trips were by women. A comparison with the 1986 results shows that the proportion of auto passenger and transit trips by females has not changed, but the proportion of auto driver trips made by women has increased slightly from 40 % in 1986.

2.6.8 Modal Split and Trip Rates by Gender, Driver's Licence and Age,

Figure 22 shows the number of auto passenger trips made the 1996 (in terms of gender and possession of a driver's licence by age). Auto passenger trip-making is dominated by people with a driver's licence, and above age 30, women with a licence make about twice as many trips as men with a licence.

Further information about mode choice by gender is presented in Figure 23. For males with a driver's licence, being an auto driver is overwhelmingly the mode of preference, with a mode share approaching 90% beyond age 30. For this group, transit is preferred to being an auto passenger up to age 55. Auto passenger and transit are almost insignificant modes for males with a driver's licence.

For females with a driver's licence (Figure 24), the auto driver mode is not as dominant, and the auto passenger mode share increases to a peak of about 30% at age 70. The auto passenger mode is preferred to transit above age 25 and the preference gap widens with increasing age. But auto passenger and transit are nonetheless viable modes for this group.

Figure 25 and 26 shows some striking differences in the way unlicenced males and females choose their mode of travel. Males without a driver's licence prefer transit to auto passenger 60% to 25%. Beyond age 50 the preference for auto passenger increases while the preference for transit decreases.

Females without a driver's licence are almost equally likely to choose auto passenger or transit at about the 45% level. But there is a well-defined mode preference by age. Transit is the preferred mode from age 16 to 55, and beyond age 50, auto passenger is the preferred mode. Females without a driver's licence appear to switch preference from transit

to the auto mode as their age progresses. It is also interesting to note that above age 20, the choice of the auto passenger mode increases steadily with age.

Survey results would suggest that as age increases, females with a drivers' licence switch their preference from auto driver to auto passenger, and females without a drivers' licence switch their preference from transit to auto passenger.

Figure 27 clearly summarizes the gender preferences for urban travel modes, and how those preferences change with age. Figure 27c shows that female auto passenger trip rates are much higher than those of males across all ages. The difference increases with age to about age 65 where the female trip rate is more than 3 times that of the male. This is in sharp contrast with the auto driver mode (Figure 27a) where males have higher trip rates than females, and above age 55 male drivers make more than twice the daily trips of female drivers.

The transit trip rate distributions for females and males have a similar shape (Figure 27b), but the female transit trip rate is higher than the male's by a nearly constant amount of 0.15 trips/person. In comparing Figures 27b and 27c, a strong gender preference is demonstrated by females for both the auto passenger and transit modes.

2.7 Mode Choice Trends by Location in the GTA

The effect of GTA location on choice of passenger mode is shown in Figure 28. As you move outward from PD1 in central Toronto to the 905 belt, the shift from a transit to an auto-dominated market is evident. For PD1-based trips, the GO Rail market increased from 4.3% in 1986 to 6.1% in 1996. The other noticeable change in transportation market share is an observable shift from transit to auto use within Toronto and even for PD1-based trips. As the market share for local transit decreases from 1986 to 1996, the share for the auto passenger mode increases.

2.8 Trends in Auto Passenger Trip Length

In 1996 the median trip length of auto passenger trips was 3.8 kilometres (in straight line or Euclidean distance measure) as shown in Figure 29.

While many of the auto passenger trips are very short (slightly shorter than auto driver and local transit trips – see the cumulative distribution in Figure 30), about 5% of the trips are longer than 30 kilometres.

Auto passenger and local transit trips have decreased slightly in length over the 10-year period (Figure 29). Auto driver and Go Rail trips, on the other hand, have increased in length.

Changes in the trip purpose mix have influenced these trends. HBD trips have been getting shorter while HBW, HBS, and NHB trips have been increasing in length (Figure 31).

The following table compares trip length by trip purpose for the major modes:

Table 2.8.1: 1996 Median Trip Length by Trip Purpose (straight line distance in kilometres)

	HBW	HBS	HBD	NHB
Auto Passenger	7.55	2.98	4.58	4.60
Auto Driver	11.05	9.44	3.90	5.82
Local Transit	8.30	4.72	4.95	5.45

2.9 Auto Passenger Trip-Making Trends by Time of Day

Approximately half of the daily GTA travel occurs during six hours of peak period travel (Figure 32). But travel is spreading into the off-peak period with most of the growth occurring in the mid-day period from 9:00 a.m. to 3:00 p.m. Modal market shares are changing with this shift.

2.9.1 Trip Start Times and Mode Split

Figure 33 shows that during the mid-day period, the auto passenger market share has been increasing while the transit market share has declined. Surprisingly, it is during the two peak periods that transit is losing much of its market share to the auto passenger mode. The auto passenger mode is handling more peak period and mid day travel, while the proportion of auto passenger activity during the evening period has declined slightly.

2.9.2 Growth in Auto Passenger Trips in the A.M. Peak Period

A.M. peak period auto passenger trips have grown significantly from 1986 to 1996 (Figure 34). In fact, the rate of growth in the A.M. peak period trips (4.3%) exceeded the rate of growth in daily auto passenger trips (3.1%). As shown, home-based school trips were the fastest growing component. Fortunately these trips are the shortest in length of the four purposes examined, and take place primarily on the local street system. HBD trips, the other high growth component, are likewise relatively short in length.

3. Auto Occupancy Trends in Comparison with Other Urban Areas

3.1 Auto Occupancy Trends in the GTA Based on Cordon Counts

The Cordon Count Program by Regional Municipalities in the GTA has captured time series trends of vehicle and person trip movements across a grid of screenlines in the GTA. A complete accounting of the auto occupancy trends is available in other reports, but some of the results are summarized here to give an appreciation of the overall trends that have been observed in the GTA.

Like most urban areas, the GTA has been experiencing reductions in auto occupancy particularly during peak periods. Between 1985 and 1995 the auto occupancy inbound across the Metro (Toronto) Boundary Cordon during the a.m. peak period declined from 1.21 persons per vehicle to 1.16 persons per vehicle. Across the Suburban Cordon (the intermediate ring which includes a section of Highway 401), the occupancy decreased from 1.22 to 1.18 over the same period. At the Central Area Cordon (which circles the CBD), the auto occupancy dropped from 1.28 to 1.23 over the 10-year period. In all cases the rate of decline was approximately 4% in 10 years.

Further details are given in the following table:

Table 3.1.1: Summary of Metro Cordon Counts: Vehicle Occupancy in A.M. Peak Period (Inbound Direction)

	Metro Boundary Cordon	Suburban Cordon	Central Area Cordon
1975	1.24	1.27	1.33
1981	1.22	1.22	1.30
1985	1.21	1.22	1.28
1991	1.20	1.22	1.26
1995	1.16	1.18	1.23
% Single Occupant Vehicle			
1975	80.1	77.4	72.3
1985	81.7	80.7	75.7
1995	85.9	83.8	79.0

York Region, as an example of one of the outer regions of the GTA, has also seen significant declines in car occupancy levels. For example, the daily occupancies on five screenlines (North Metro, South York, York Simcoe, Highway 404, and Highway 400) have declined by about 3.2% from 1991 to 1995 or the equivalent of 8% over 10 years.

3.2 Estimating Auto Occupancy in the GTA from TTS Data

Data from the Transportation Tomorrow Survey can be used to calculate an index of auto occupancy. It is an index because it is estimated, based on the relative number of auto passenger and auto driver trips rather than being an actual observation. The TTS does not actually record occupancy by identifying when travellers are sharing the same vehicle for a trip. Furthermore, no information was collected for children under the age of 11 (very likely to be auto passengers). Attempts to deduce shared trips after the fact is difficult because shared trips may not even have a common trip purpose.

The auto occupancy index (trip-based) is estimated by adding passenger and driver trips, and dividing by the number of driver trips. A second index (distance-based) can be estimated in the same way using the total distance travelled by drivers and passengers. The distance-based index gives a lower weighting to the shorter trips and better represents an average occupancy that would be observed on GTA roads. The two indices can be calculated for any time period and the values for peak and off-peak periods are shown in the following table:

Table 3.2.1: GTA Occupancy Index, Trip and Distance-Based

	Occupancy Index (Trip-Based)			Occupancy Index (Distance-Based)		
	1986	**1991**	**1996**	**1986**	**1991**	**1996**
A.M. Peak[1]	1.17	1.18	1.21	1.14	1.14	1.14
P.M. Peak[2]	1.20	1.20	1.23	1.18	1.17	1.18
Off Peak[3]	1.27	1.27	1.28	1.25	1.25	1.23
TOTAL	1.23	1.24	1.25	1.20	1.20	1.19

Occupancy Index (Trip-Based) = $\frac{\text{Driver Trips + Passenger Trips}}{\text{Driver Trips}}$

Occupancy Index (Distance-Based) = $\frac{\text{Driver Distance + Passenger Distance}}{\text{Driver Distance}}$

(1) 6:00 – 8:59 a.m.
(2) 3:00 – 5:59 p.m.
(3) All other hours

Because daily auto passenger trips have increased at a faster rate than auto driver trips, the trip-based index shows a slight occupancy increase from 1986 to 1996 from 1.23 to 1.25.
The distance-weighted occupancy for the day, however, is seen to decline slightly from 1986 to 1996, which is more in keeping with the observed trends.

The auto occupancy index can also be calculated for each of the trip purposes, and the results are as follows:

Table 3.2.2: Auto Occupancy Index by Trip Purpose

	Trip-Based	Distance-Based
Home-Based Work	1.14	1.11
Home-Based School	2.52	1.64
Home-Based Discretionary	1.31	1.35
Non-Home Based	1.18	1.15
Overall Average	1.25	1.19

As indicated, the occupancies were found to be lowest for work trips and highest for school trips.

3.3 Comparison with Occupancy Trends in Vancouver and Ottawa

3.3.1 Experience with Auto Occupancy in Vancouver

Vancouver's screenline program makes use of the natural barriers created by such features as the north and south arms of the Fraser River and the Burrard Inlet just north of the Vancouver CBD. The screenline data can be used to make up 3 basic rings for comparison purposes. The innermost ring is the Vancouver "CBD". The intermediate ring is comprised of Burrard Inlet, Boundary Road and the North Arm, while the outermost ring can be made up from sections of the North Road and the South/Main Arm.

A comparison of 1996 and 1985 occupancies for the a.m. and p.m. peak hours (combined inbound and outbound directions) is as follows:

Table 3.3.1: Vancouver Occupancy Trends

	A.M. Peak Hour		
Location	**1985**	**1996**	**% Change**
CBD	1.25	1.19	-5%
Burrard Inlet	1.20	1.13	-6%
Boundary Road	1.20	1.18	-1%
North Arm	1.22	1.19	-2%
North Road	1.21	1.14	-5%
South/Main Arm	1.18	1.14	-3%

	P.M. Peak Hour		
Location	**1985**	**1996**	**% Change**
CBD	1.33	1.26	-5%
Burrard Inlet	1.26	1.18	-6%
Boundary Road	1.26	1.23	-3%
North Arm	1.31	1.27	-3%
North Road	1.29	1.22	-6%
South/Main Arm	1.30	1.22	-6%

The average vehicle occupancy for both the morning and afternoon rush hour periods has declined at all screenlines. The greatest reductions were for the CBD and for the outermost ring. At these locations occupancy typically dropped by approximately 5 to 6 % over the 11-year period.

3.3.2 Auto Occupancy History in Ottawa

Ottawa has a regular program which has tracked vehicle occupancy every two or three years over the past 25 years.

Results are given for two cordons: C1, which surrounds Greater Ottawa, and C3 for the Central Business District.

Table 3.3.2: Ottawa Occupancy Trends

Greater Ottawa – C1		
	Inbound, A.M. Peak Hour	**Outbound, P.M. Peak Hour**
71	1.62	1.72
76	1.48	1.54
81	1.38	1.46
86	1.32	1.45
91	1.29	1.32
96	1.27	1.30

CBD – C3		
	Inbound, A.M. Peak Hour	**Outbound, P.M. Peak Hour**
71	1.66	1.68
76	1.43	1.56
81	1.43	1.53
86	1.41	1.48
91	1.38	1.49
96	1.32	1.44

The overall average rate of decline of auto occupancy is about 5.5% in 10 years.

In summary, the comparison of the histories of the GTA, Vancouver, and Ottawa suggest very similar patterns and rates of decline in auto occupancies.

An interpretation of the impact of a 5% reduction in the peak hour auto occupancy is that it is equivalent to a 5% increase in the peak hour demand, in order to accommodate the same number of person trips.

3.4 Trends in Automobile Occupancy in the United States: The Nationwide Personal Transportation Survey

One of the few sources of information on auto occupancy trends in North America is the Nationwide Personal Transportation Survey conducted over a 25-year period in the United States. It was initiated in 1969 and has been repeated in 1977, 1983, 1990 and 1995 under the sponsorship of the Federal Highway Administration of the U.S. Department of Transportation. The scope of the survey includes both urban and intercity activity, but the urban data can be extracted.

An examination of auto use trends in U.S. cities is of interest because of many similarities in the patterns of urban growth and the socioeconomic factors which are shaping cities and urban transportation activity. Furthermore, the availability of data from the NPTS survey series has resulted in a significant program of transportation research on a range of topics including transit and automobile use and auto occupancy.

Users of the data need to be aware of changes that took place in the survey methodology and survey design when comparing results from different years. For example, beginning in 1990 the survey was done by telephone, while the earlier surveys were conducted by home interview.

The NPTS program recorded the rapid growth in personal mobility and increased use of the private automobile that has been seen in the United States. For example, in the period from 1983 to 1990, the population grew by 4%, the person miles of travel (PMT) grew by 19% and the vehicle miles of travel (VMT), grew by 42%. A number of influences contributed to VMT growth including declining auto occupancy, which accounted for about 6% of the growth in VMT, over the 7-year period.

The following are some of the key findings about vehicle occupancy from the NPTS, primarily for the 1983 to 1990 period:

1) Average vehicle occupancy continues to decline over time. This decline has occurred for virtually all trip purposes. Based on the 1990 NPTS, occupancy is highest for vacation/pleasure driving trips (2.22) and other social/recreational trips (1.93), and least for work trips (1.12). Overall average occupancy changed from 1.55 (1983) to 1.51 (1990). Work trip occupancy went from 1.18 to 1.12 over the same period (a reduction of 5% in 7 years). Work and vacation trips had the greatest percentage decrease in auto occupancy over time of all the trip purposes.

2) Vehicle occupancy increases with trip length. Occupancies increase for trips that exceed about 20 miles in length. But the actual distance breakpoint depends on trip purpose.

3) Availability of rail/subway transit in the urban area results in lower occupancies. Large urban areas with rail service had lower average occupancy rates in 1990. (For example, the cities which had more than 1 million people and were without rail transit services had an occupancy of 1.13. Comparable cities with rail transit had an occupancy of 1.10 in 1990.) The market characteristics of auto passengers are similar to those of transit users. Some people who would otherwise be candidates for ridesharing may find rail transit to be a more efficient and effective alternative.

4) The family unit is a key factor in ridesharing. There is a tendency for ridesharing to be done by members of the same household. For example, 62.1 % of the persons in the average two-person carpool in 1990 were from the same family. For the average four-person carpool, 51.5 % of the occupants were from the same household. Only in carpools of five or more persons were carpoolers more often from different households.

5) Average vehicle occupancy is directly related to household size. In 1990, the one-person household had an average occupancy rate of 1.04 persons per

vehicle while a household of 5 or more persons had a 1.14 average trip occupancy rate.

6) Average vehicle occupancy is inversely related to number of vehicles available. Households with zero or one vehicle (1.24 and 1.26 vehicle occupancies respectively, in 1990) demonstrated a greater propensity for ridesharing than households of four and five vehicles (with 1.14 and 1.07 vehicle occupancies respectively).

One factor affecting occupancy trends in the U.S. is vehicle operating cost and the price of automotive fuels. These have both remained low in real terms for many years. There is limited economic incentive for vehicle occupancy to increase while operating costs remain low.

Occupancy is one measure of transportation efficiency, and user costs can be reduced by increasing the number of passengers riding in a vehicle. The fact that trips are getting longer over time and that vehicle occupancy tends to increase with increasing length of trips helps to improve both the energy efficiency and the cost of travel over longer distances.

There is an ongoing debate in the United States about whether saturation has been reached in the personal use of the private automobile. The NPTS is providing supporting information for that debate, including information on auto occupancy.

4. Summary

Auto passenger travel has grown significantly in the GTA over the 10-year period spanned by the TTS. In 1996, 1.59 million trips were taken daily as an auto passenger, compared with 1.17 million daily trips in 1986, a growth of 36% or 420,000 trips.

Overall, the auto share of daily trip-making has grown to 78% in 1996 from 75% in 1986.

The number of daily auto passenger trips in the GTA now exceeds the number of local transit trips (1.59 million vs. 1.25 million daily transit trips in 1996). The auto passenger mode has assumed increased significance in GTA transportation. The implications of this growth should be further reviewed by planners and policy-makers with a view to assessing the impacts of these trends, and also to identify any opportunities that may be associated with this growing market.

The following have been identified as important factors in the growth of the auto passenger trips:

1) Suburban growth

280,000 (or 2/3) of the new auto passenger trips were generated in the 905 region. This is also where 80% of the GTA population

growth occurred, and it is an area that is not favoured with as high a level of transit service as Toronto.
The remaining growth of 140,000 auto passenger trips took place within Toronto from 1986 to 1991.

2) Increase in discretionary travel and school-related activity

Home-based discretionary trips increased by 200,000 daily trips in the 1986 to 1991 period, and home-based school trips increased by 125,000 trips over the entire 10-year period. The high growth in discretionary trips, many of which take place during offpeak periods, favours the auto mode because of the reduced transit service levels during the offpeak periods.

3) Growth in children taking auto passenger trips

The age cohorts with the highest 10-year growth in auto passenger trips (190,000 trips in total) were the two cohorts of ages 11 to 15 and 16 to 20 (a 67% increase in daily trips). Because the TTS survey purposely excludes children of age 10 and younger, the overall growth in auto passenger trips for children may be understated. The growth in this particular market may reflect the growing concern of parents for the security of their children with the result that more children are driven to school and to other activities.

4) Aging of the population and the preference of seniors for auto travel

There has been a disproportionate increase (55%) in the seniors population (65 and above). This group also has higher 1996 trip rates for both auto passenger and auto driver activity and reduced trip rates for transit trips. The net result is a 91% increase in auto passenger trip-making by seniors from 1986 to 1996.

5) Gender effects

While the proportion of women with driver's licences has increased, the proportion of auto passenger trips made by women (68%) did not change from 1986 to 1996. The proportion of driver trips by women did, however, increase from 40 to 43%.

6) A.M. peak period growth

Peak period auto passenger trips have grown at an even faster rate (4.3% per year) than the daily passenger trips (3.1% per year) over the 10 years of the survey. This is because of the very high growth

of school trips that occurred during the peak period. It is not expected that this rate of growth will be sustained in the coming years. Fortunately the impact of the school trip growth is minimized because the trips are shorter in length, and they take place primarily on the local street system close to home.

Auto passenger trips are, on the average, shorter in length (median distance, 3.8 km) than trips by auto drivers and transit passengers (5.4 and 5.3 km respectively). With the growth in home-based school and discretionary trips, the average trip length of auto passenger trips has been getting slightly shorter over time.

The Greater Toronto Area, like most of the metropolitan areas in North America, has experienced a steady decline in auto occupancy, particularly during peak periods. For example, the occupancy in the a.m. peak period, inbound across the Metro Toronto Boundary declined from 1.21 to 1.16, a reduction of about 4% over 10 years. The proportion of single occupant vehicles has increased from 82% of the vehicles in 1985 to 86% in 1995, thereby reducing the average occupancy.

The significance of a 4% reduction in auto occupancy in the GTA is that it is equivalent to an increase of about 250,000 vehicle trips per day and 25,000 vehicle trips in the peak hour. This represents close to one year's growth across the entire road system.

Comparisons were made with peak hour figures for both Vancouver, and Ottawa. Occupancy reductions for those cities were about 4.5% and 5.5% respectively over 10 years.

Perhaps the most extensive analysis of auto occupancy trends in North America has been done as part of the National Personal Transportation Survey in the United States. Work trip occupancy declined by about 7% in 10 years. The NPTS identified relationships between auto occupancy and household size, number of vehicles in the household, length of trip, and the availability of rail/subway transit in the urban area. The survey also confirmed that ridesharing occurred most often among members of the same family.

With growing congestion in the GTA, and increasing attention being given to such issues as global warming and the targets set at the Kyoto conference, it will be even more critical for us to understand and monitor the growth in auto travel in the Greater Toronto Area and the trends in auto occupancy.

FIGURES

Figure 1. Growth in Market Share by Mode
(Daily Trips by GTA Residents)

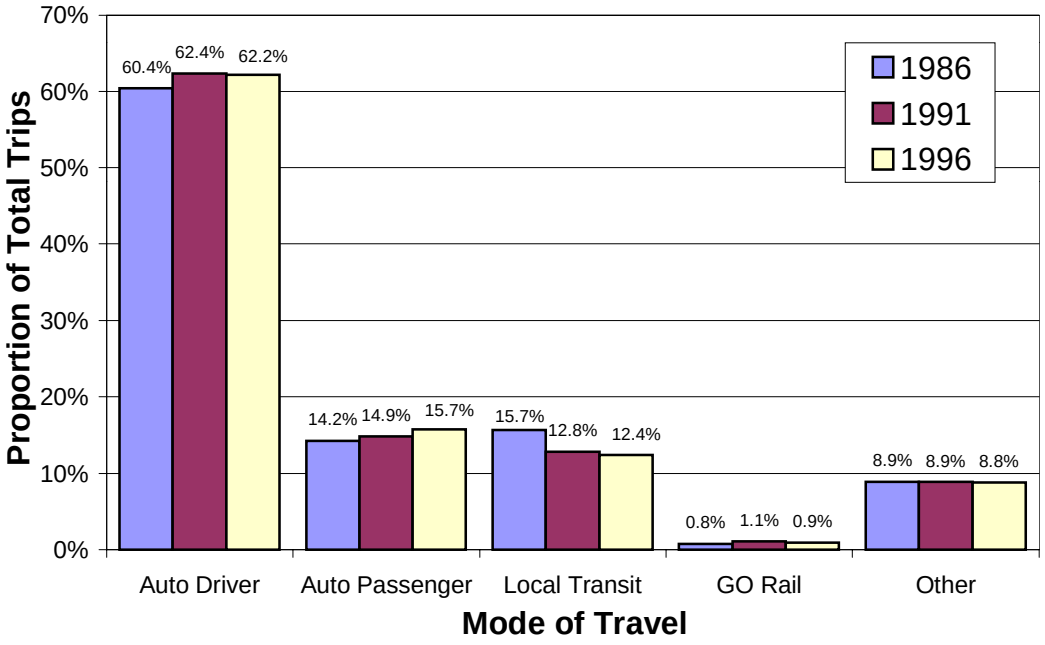


Figure 2. Growth in Daily Trips in the GTA by Mode

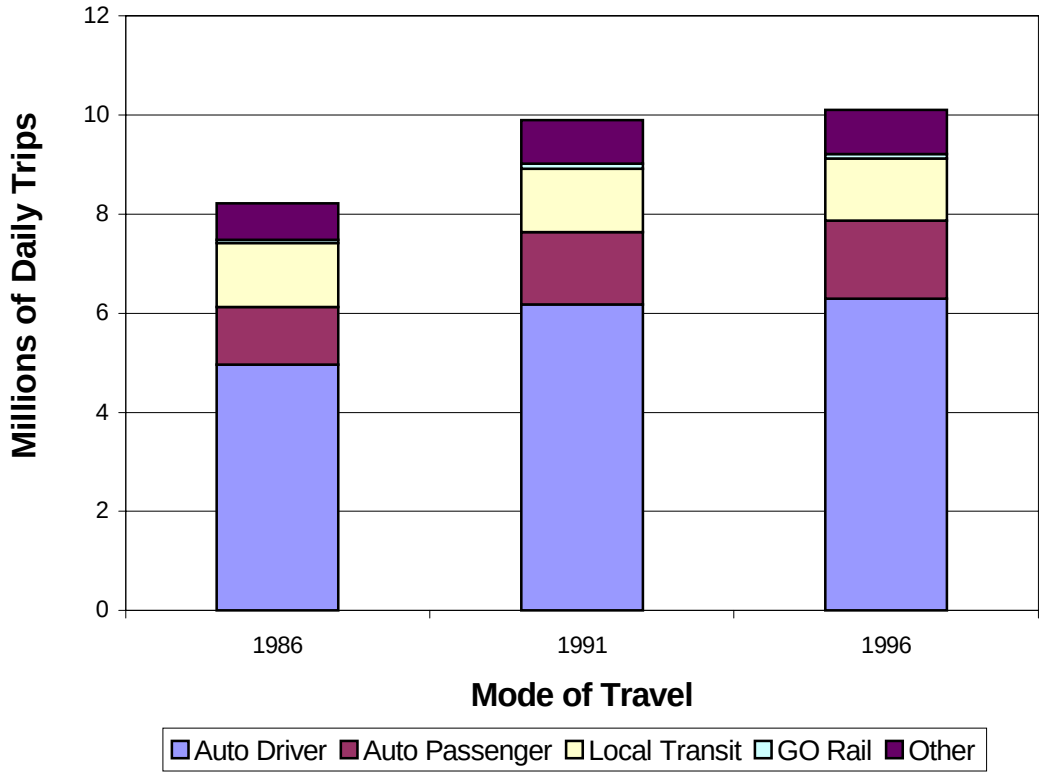


Figure 3. Growth in Daily GTA Auto Passenger Trips by Purpose

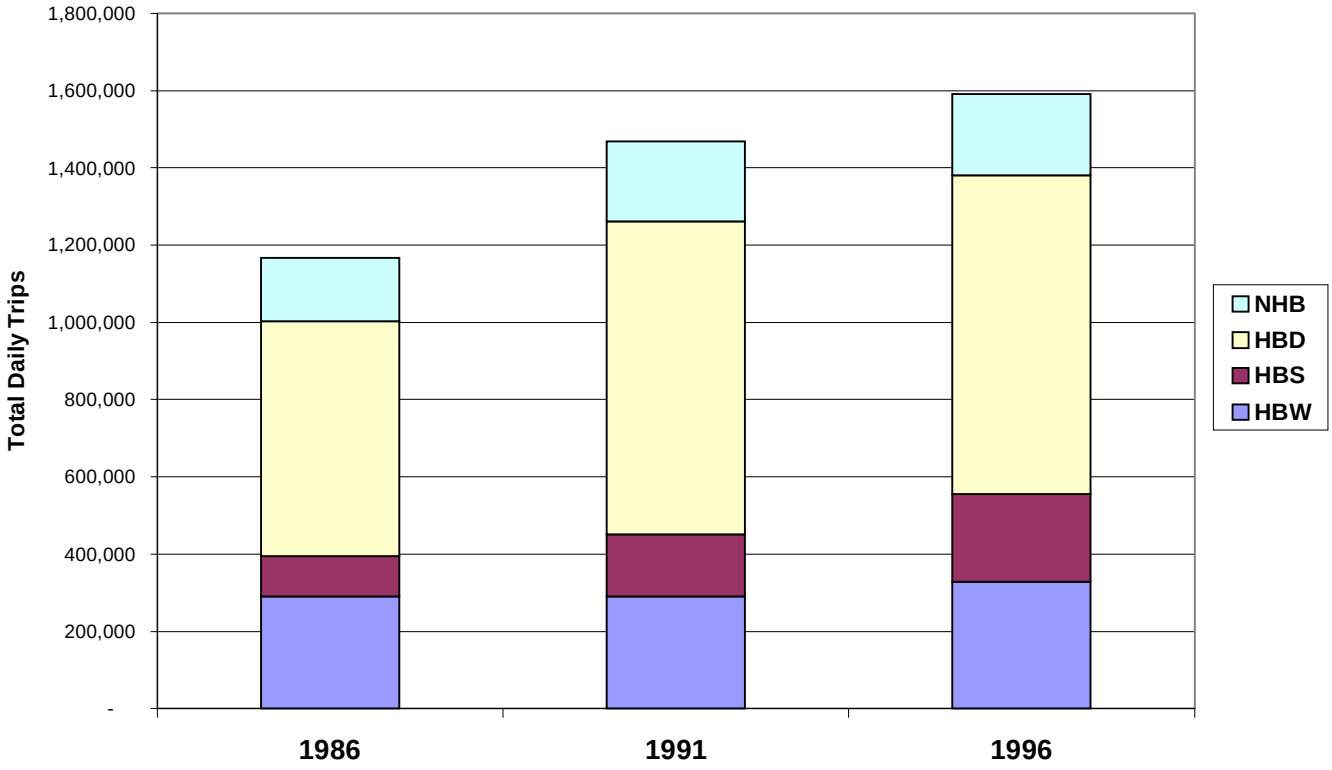


Figure 4. Factors Affecting the Choice of Auto Passenger Mode for Daily GTA Trips (1996)

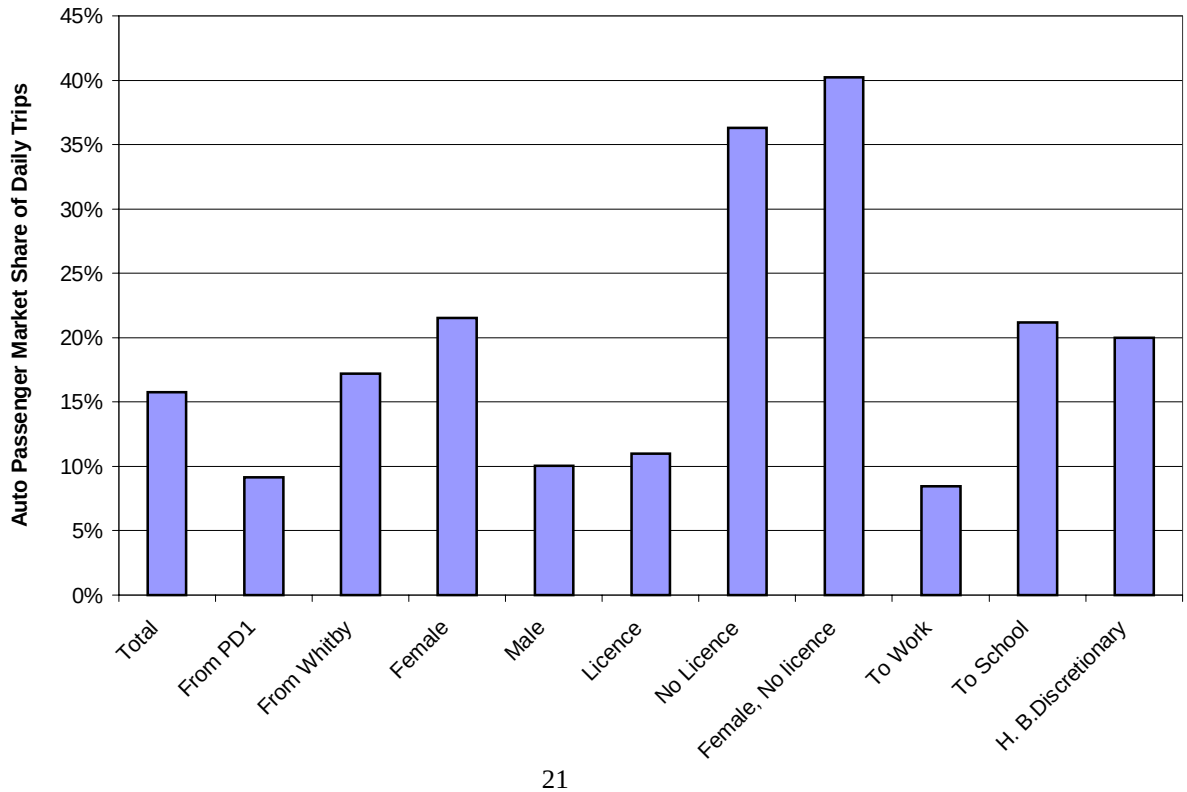


Figure 5. Mode Choice by Region for 1996 Trips

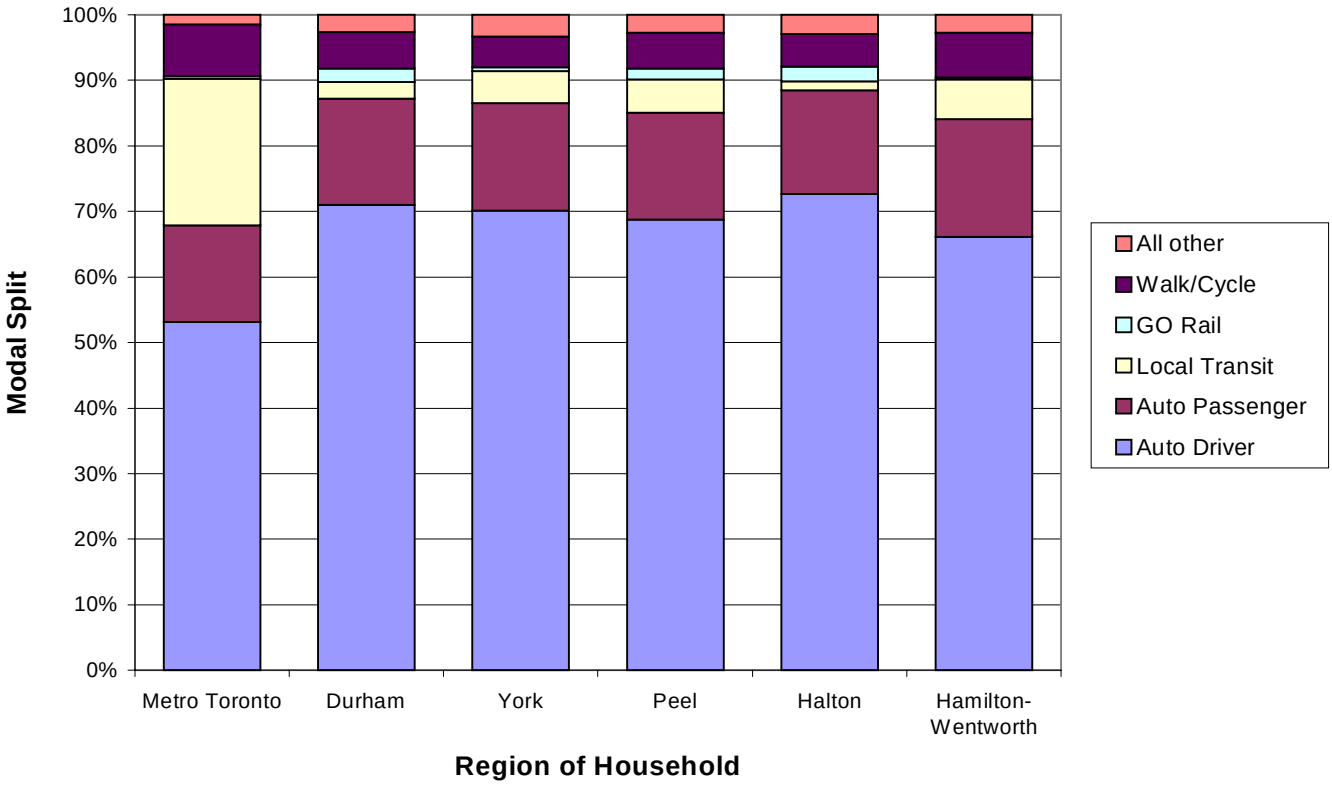


Figure 6. Peaking of GTA Trips by Mode (1996)

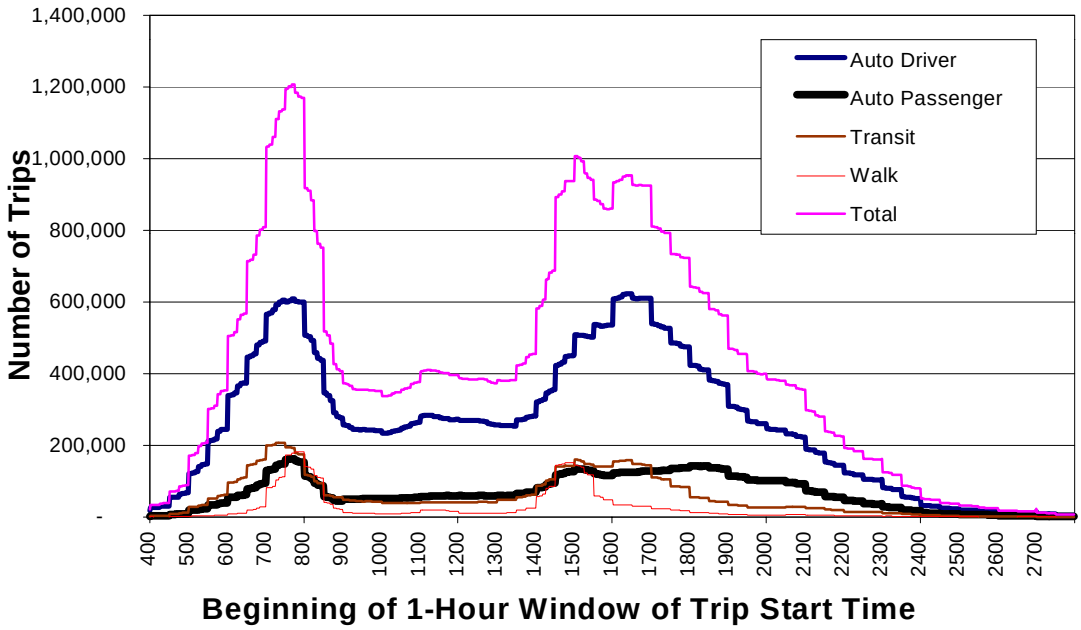


Figure 7. Peaking of GTA Trips by Purpose (1996)

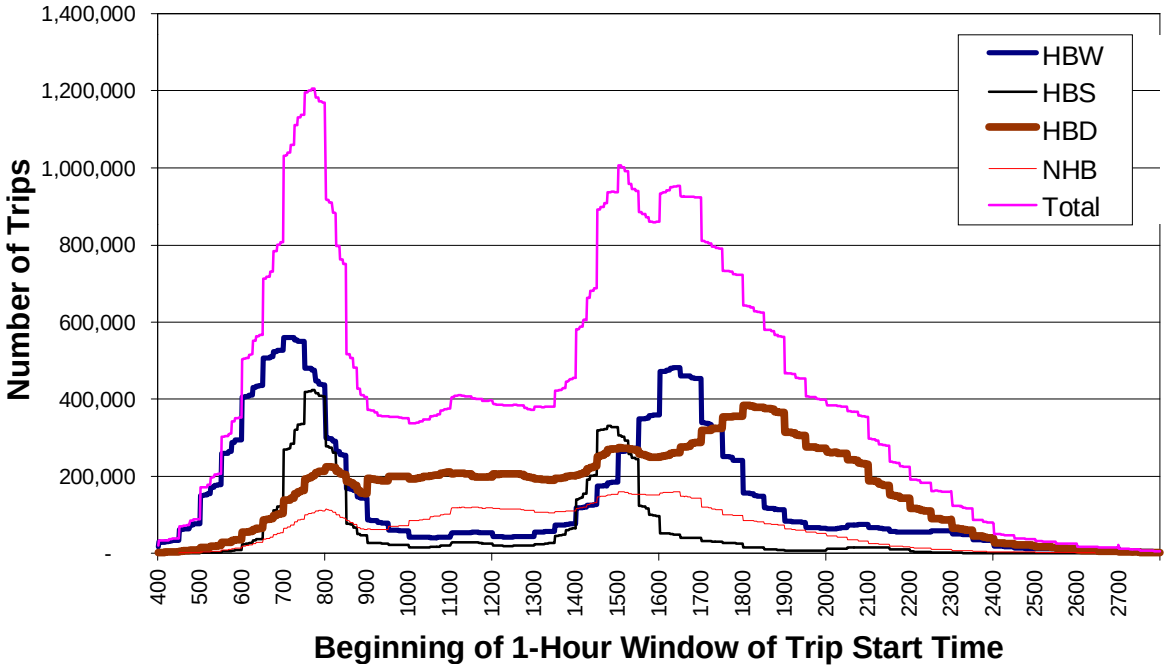


Figure 8. Peaking of GTA Auto Passenger Trips by Purpose (1996)

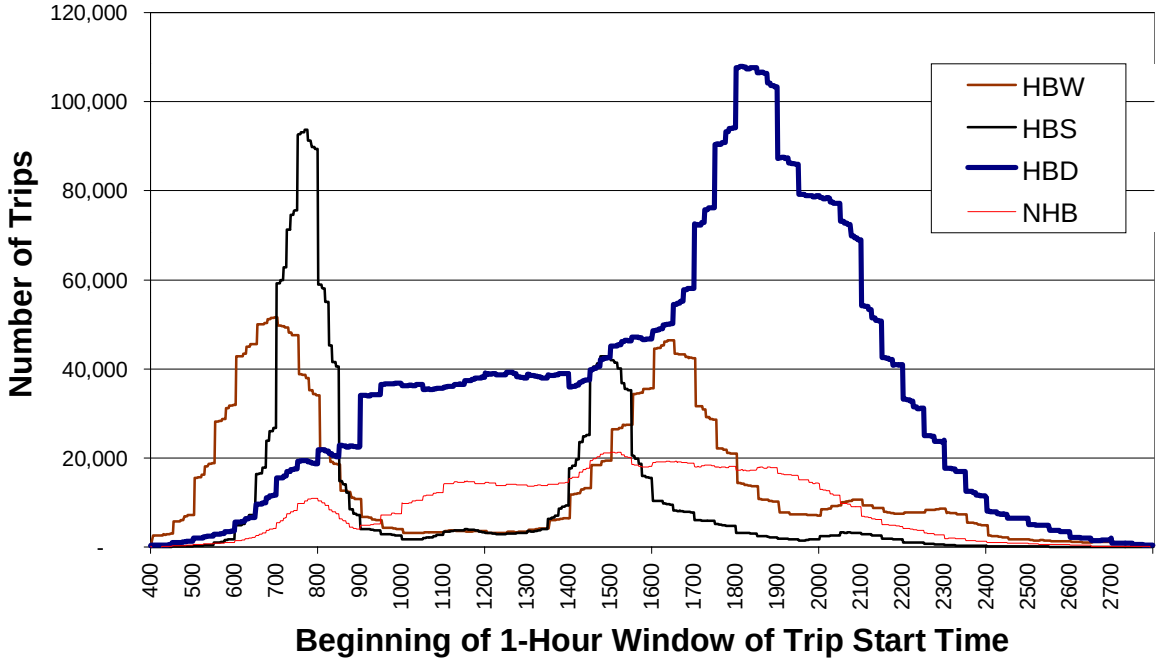


Figure 9. Peaking of GTA Auto Driver Trips by Purpose (1996)

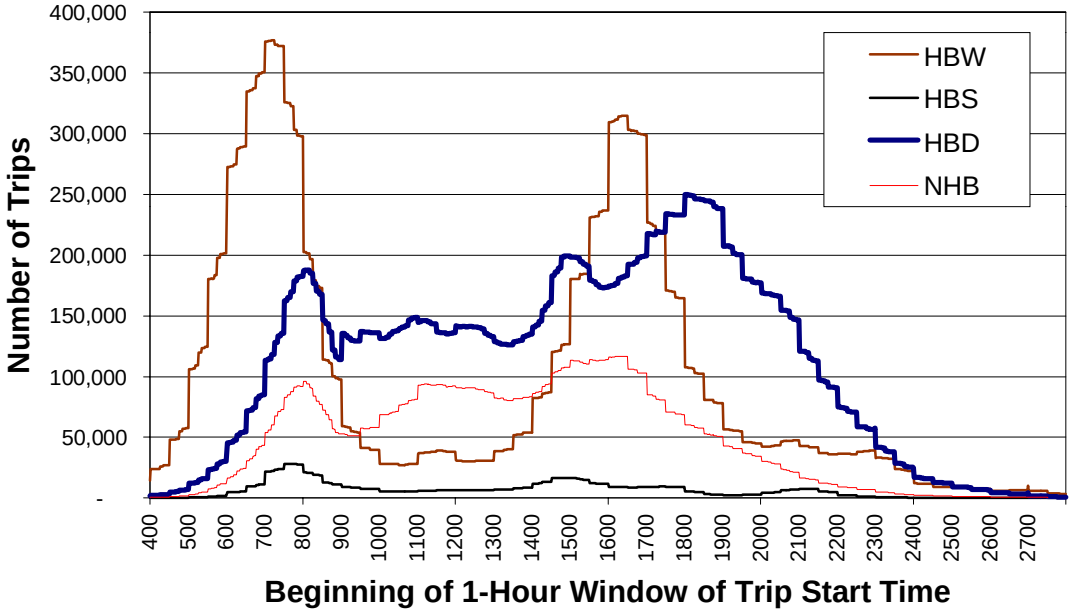


Figure 10. Peaking of Transit Trips by Purpose (1996)

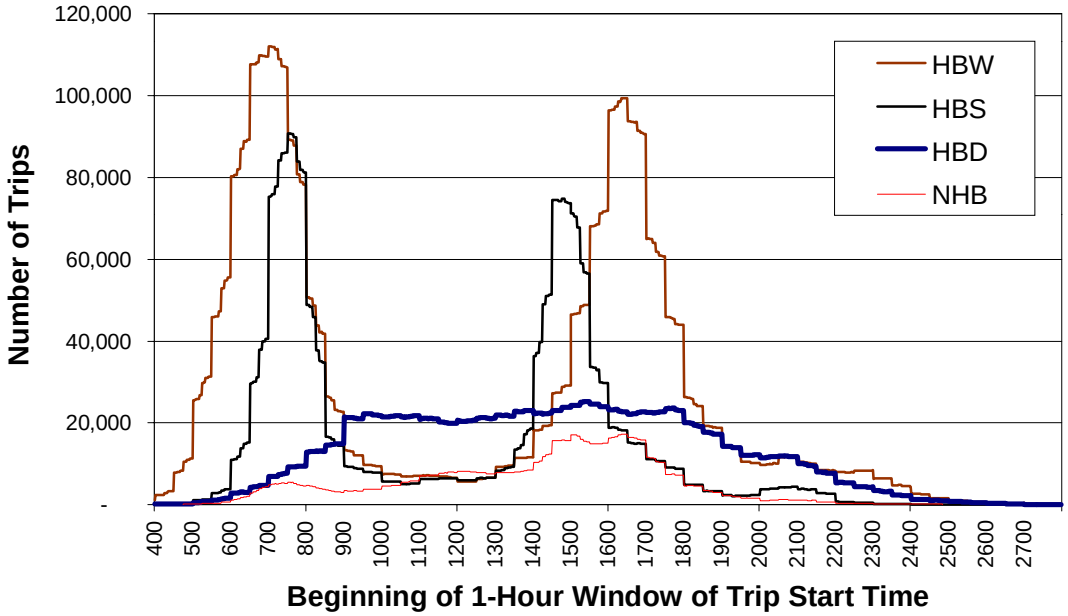


Figure 11. 1996 Daily Trips in the GTA by Mode and Age

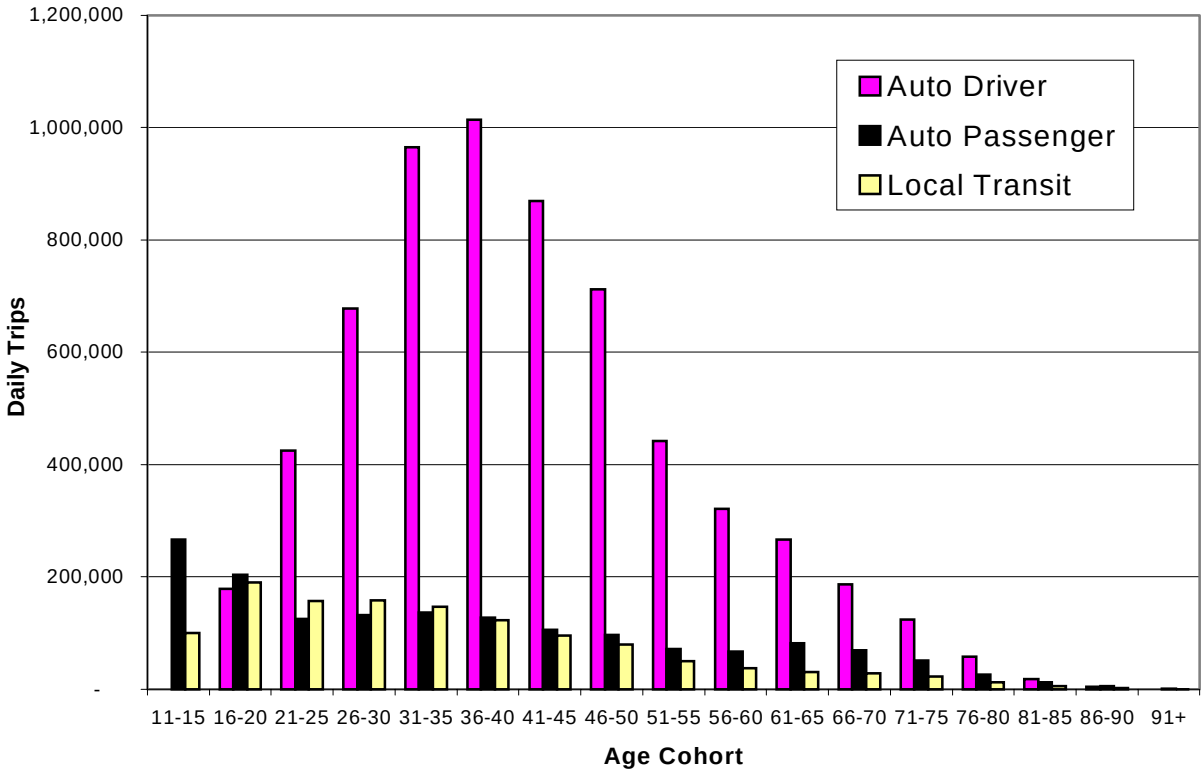
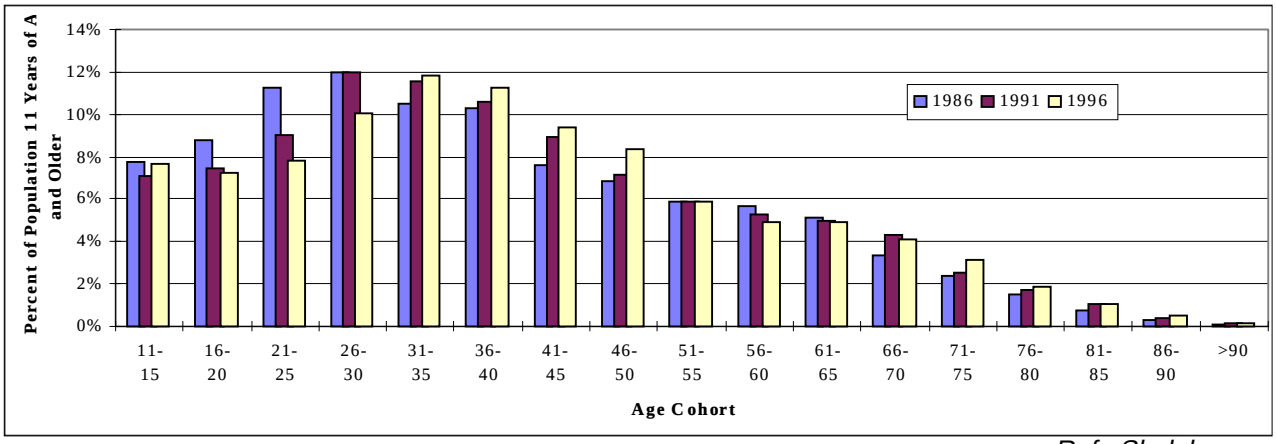


Figure 12. Changing Age Distribution in the GTA



Ref.: Shalaby

Figure 13. Auto Driver Trip Making Rate by Age

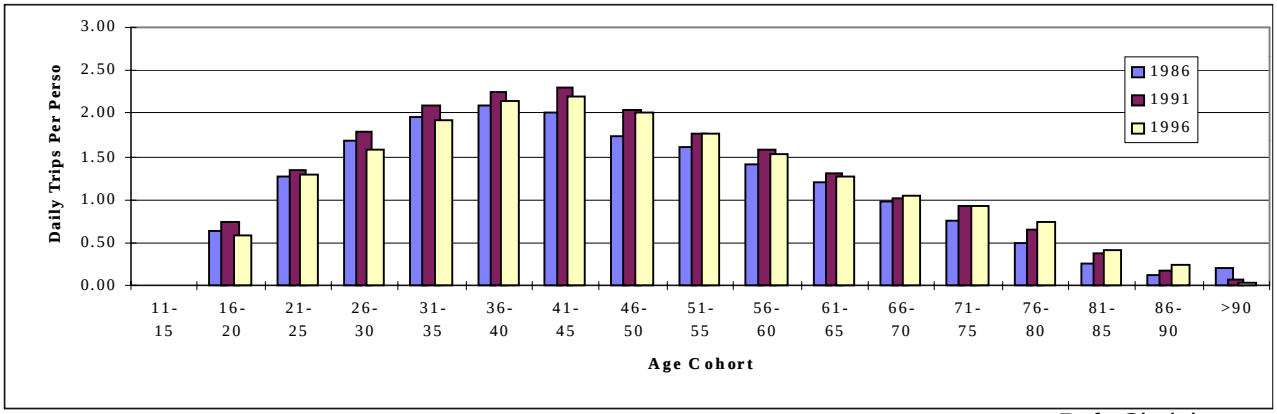


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Figure 14. Auto Passenger Trip Making Rate by Age

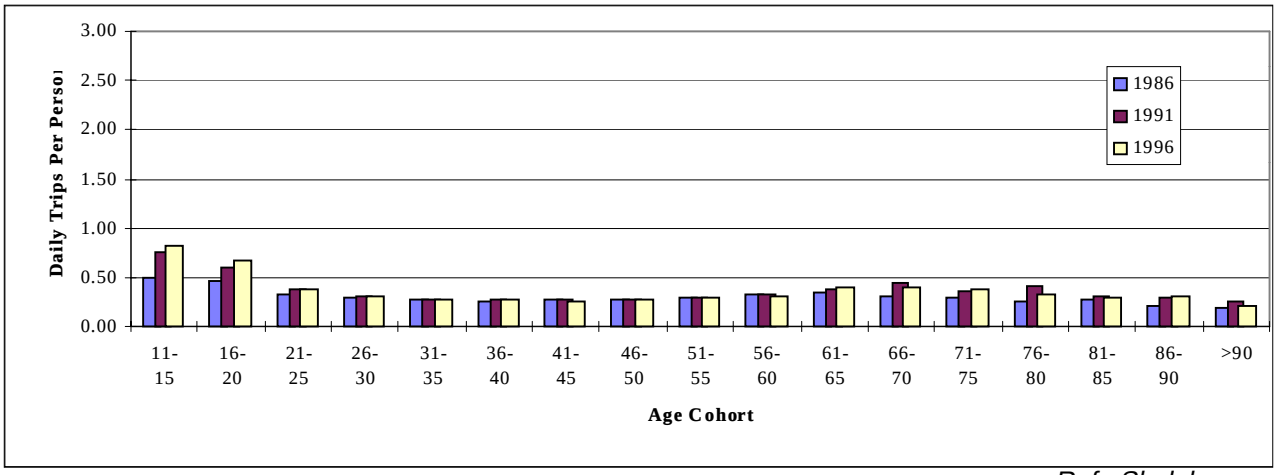

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Figure 15. Local Transit Trip Making Rate by Age

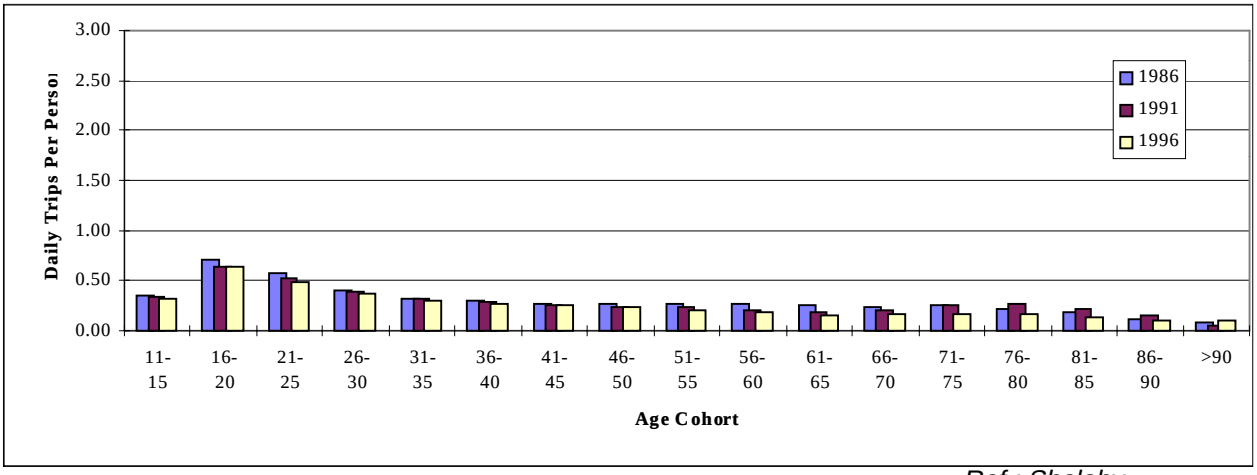

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Figure 16. Growth in Daily Auto Passenger Trips in the GTA by Age 1986 to 1996

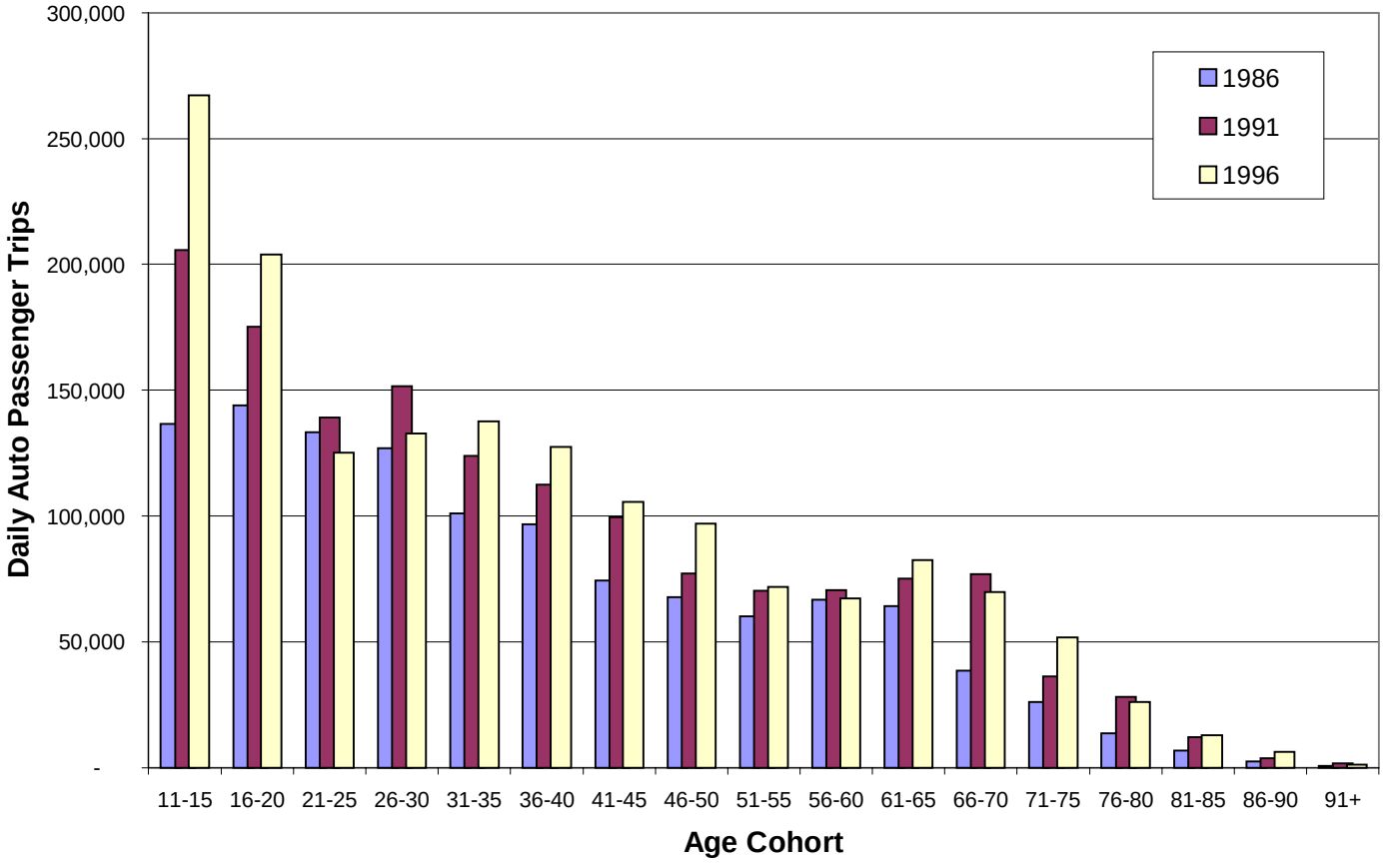

Figure 17. Trends of Trip Purpose by Mode

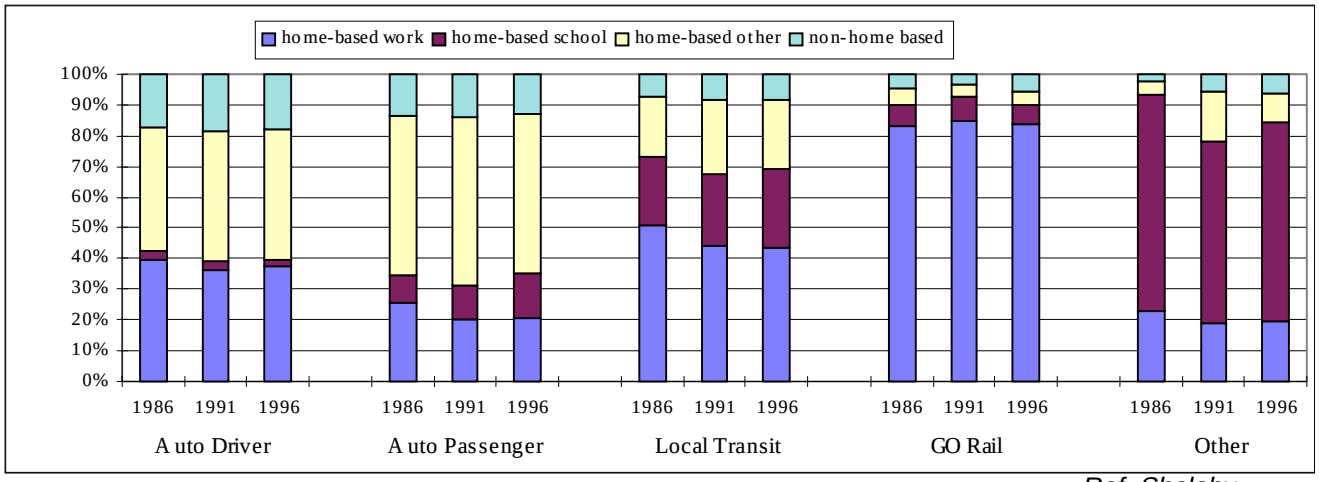

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Figure 18. Home-Based School Trip Rate by Age

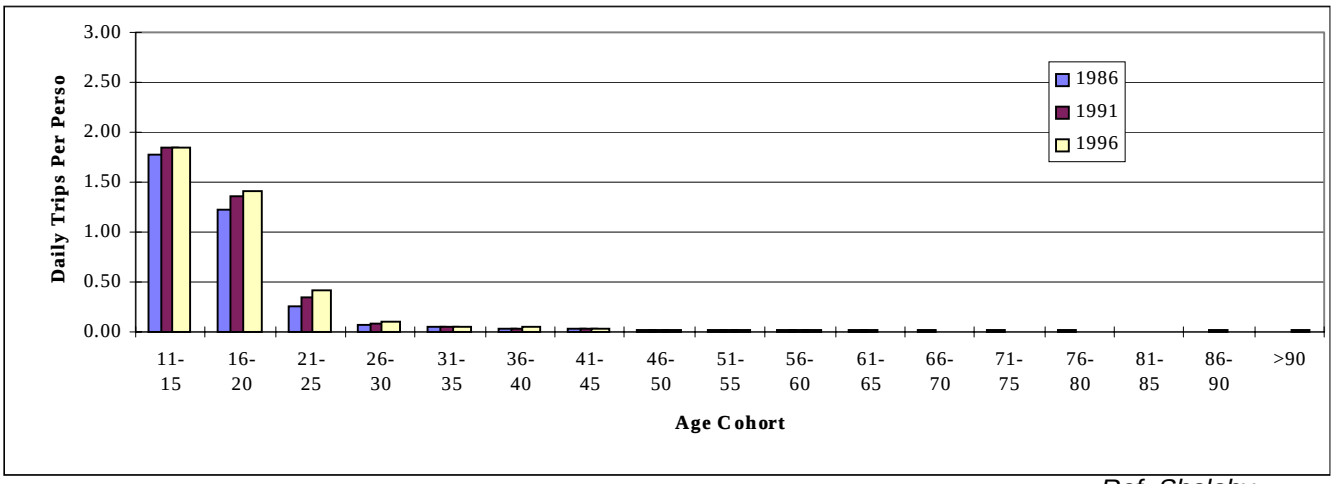

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Figure 19. Home-Based Work Trip Rate by Age

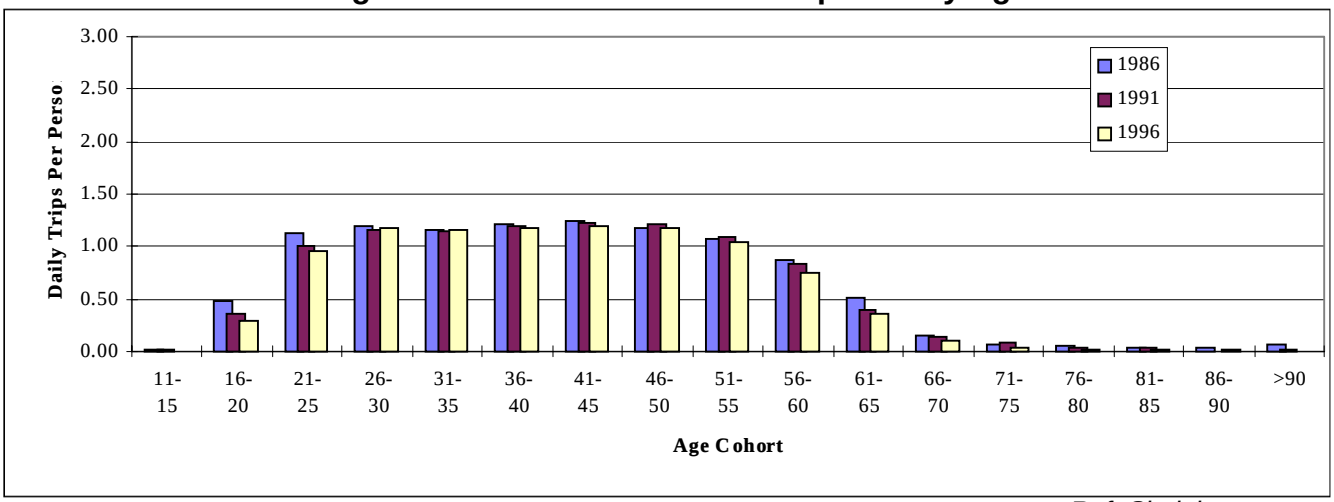

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Figure 20. Home-Based Discretionary Trip Rate by Age

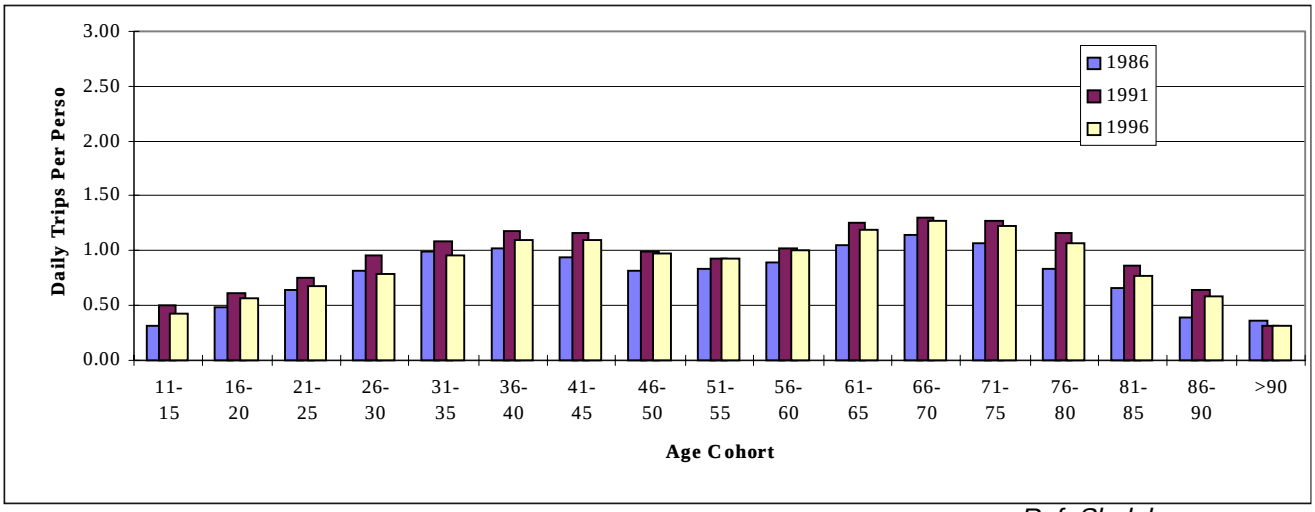

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Figure 21. Gender Proportion for Each Mode (1996)

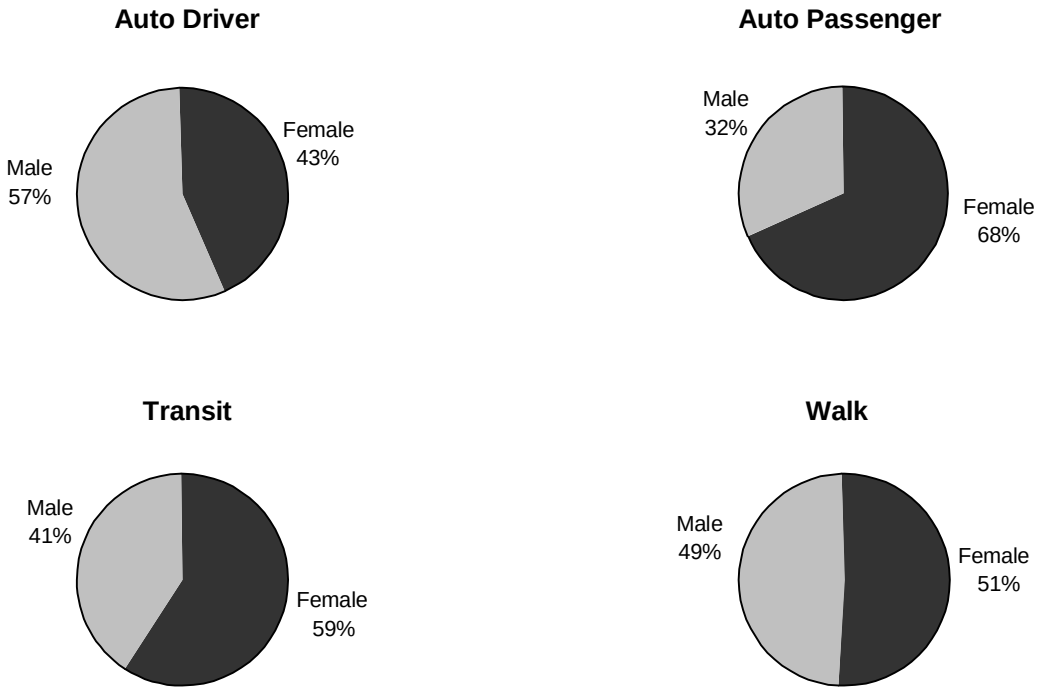


Figure 22. Auto Passenger Trips by Age, Gender and Driver's Licence (1996)

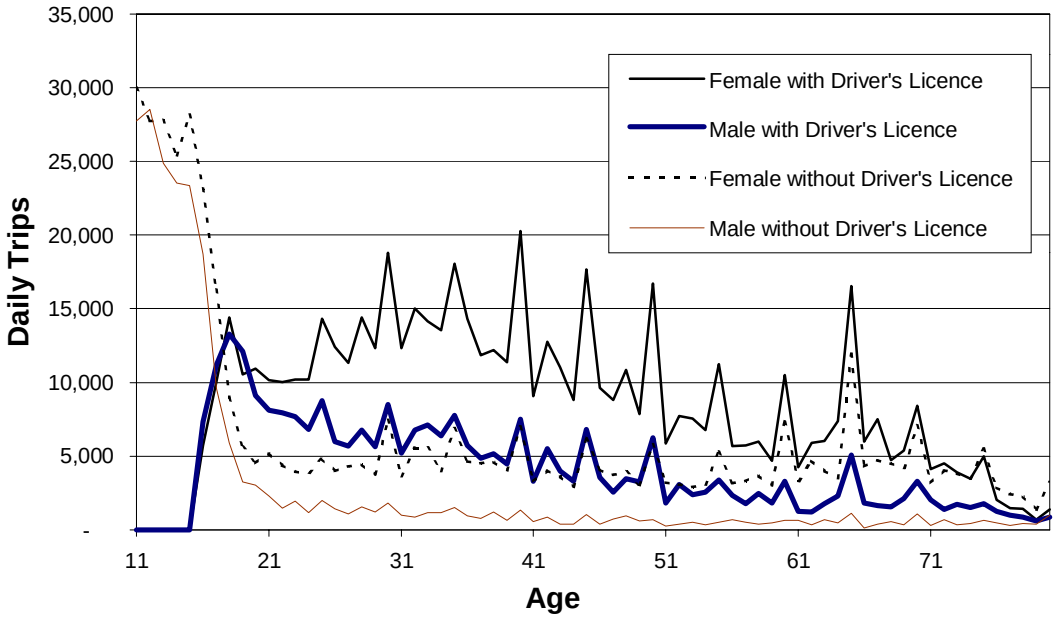


Figure 23. Mode Split for Males with Driver's Licence (1996)

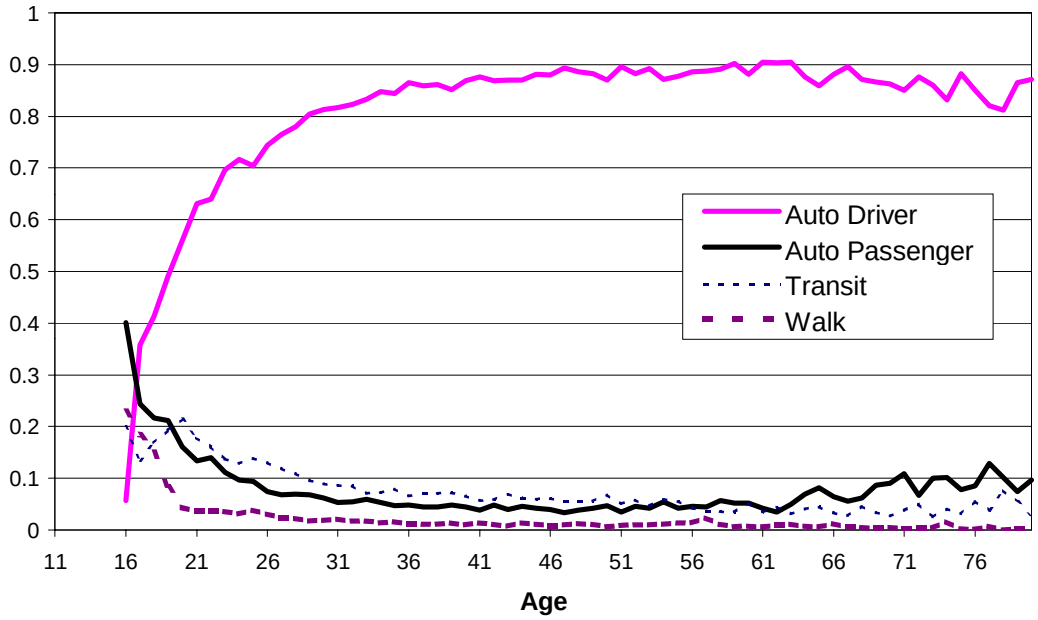


Figure 24. Mode Split for Females with Driver's Licence (1996)

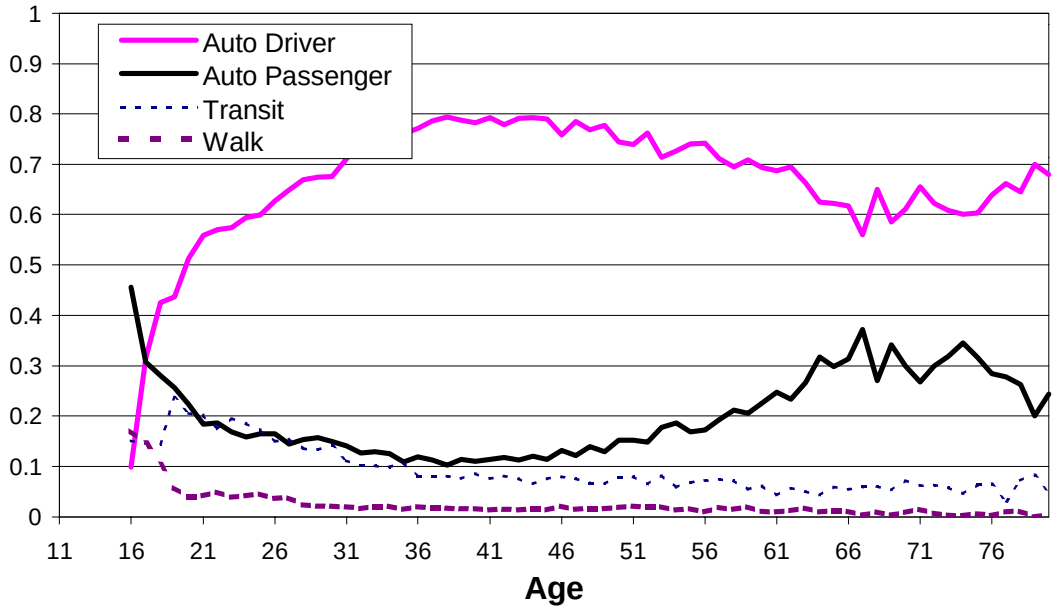


Figure 25. Mode Split for Males without Driver's Licence (1996)

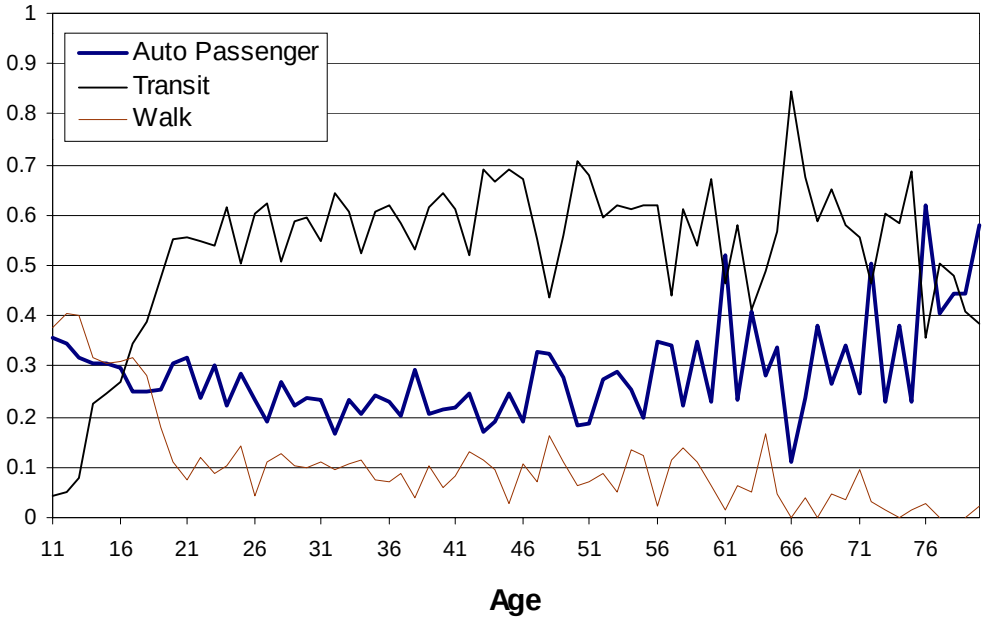


Figure 26. Mode Split for Females without Driver's Licence (1996)

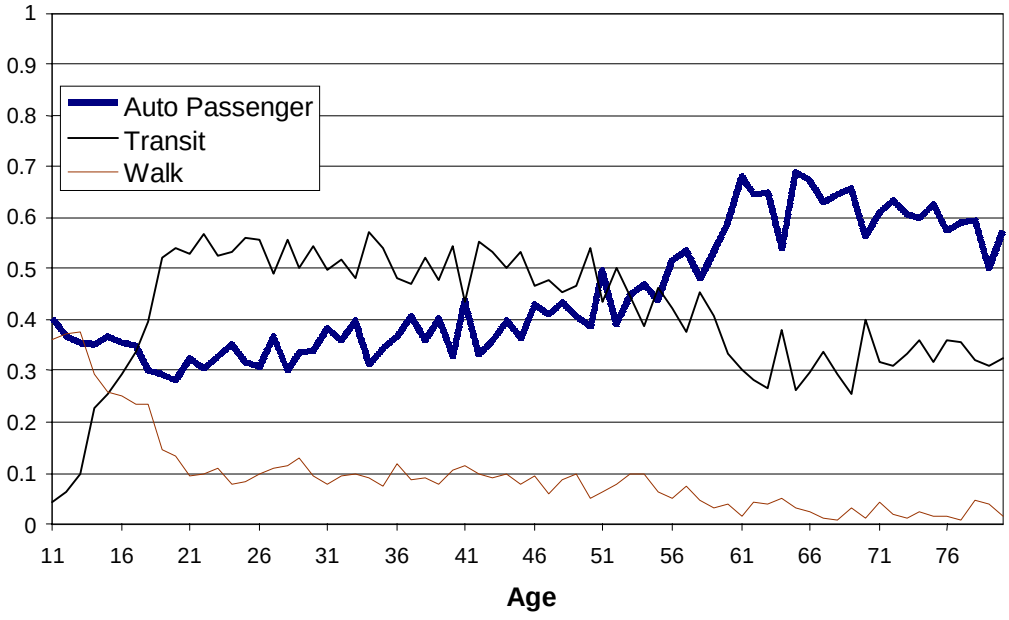
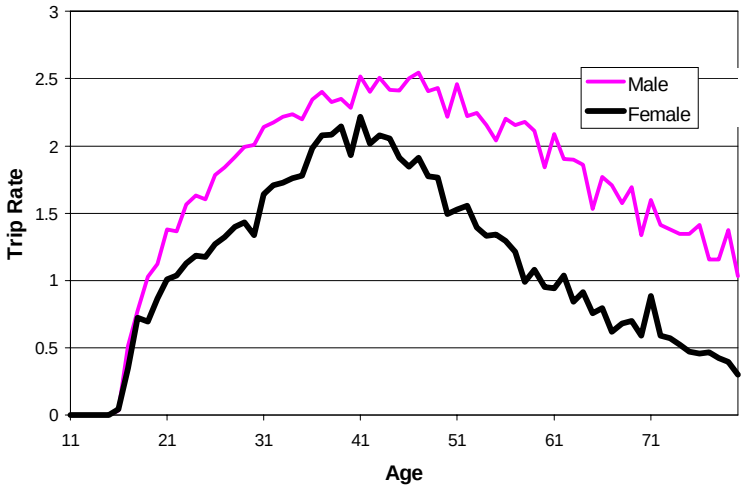
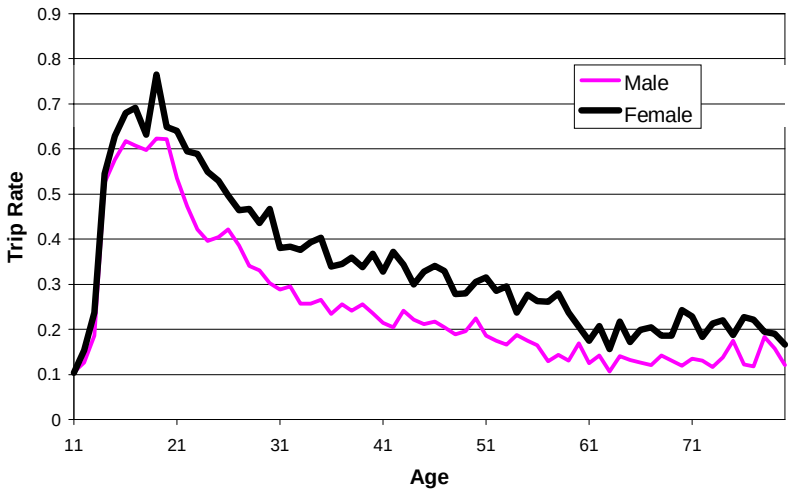


Figure 27. Daily Trip Rates by Mode and Gender (1996)

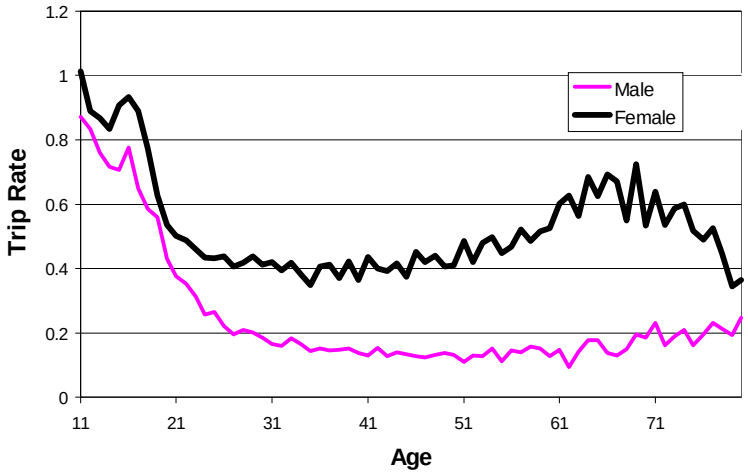
(a) Auto Driver Trip Rate Distribution



(b) Transit Trip Rate Distribution



(c) Auto Passenger Trip Rate Distribution



(d) Walk Trip Rate Distribution

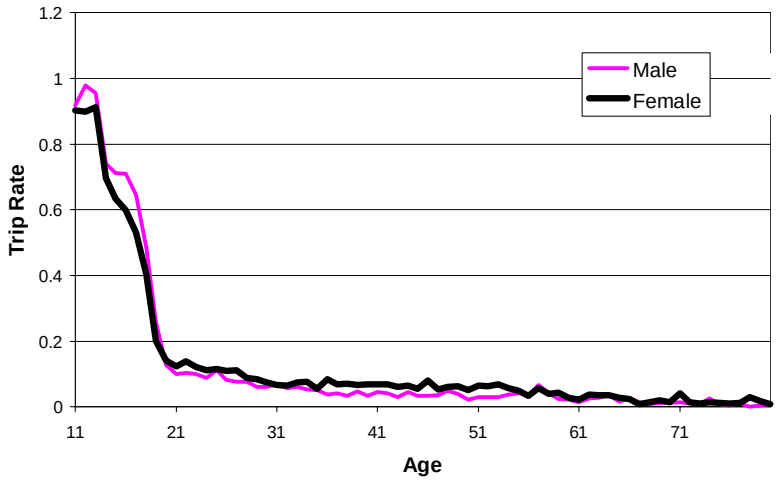
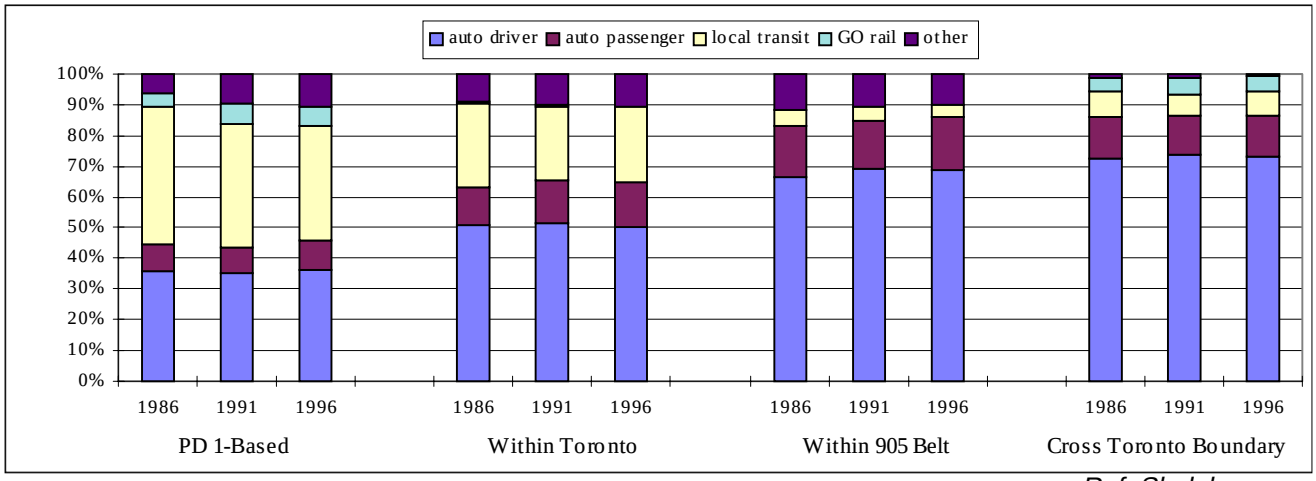
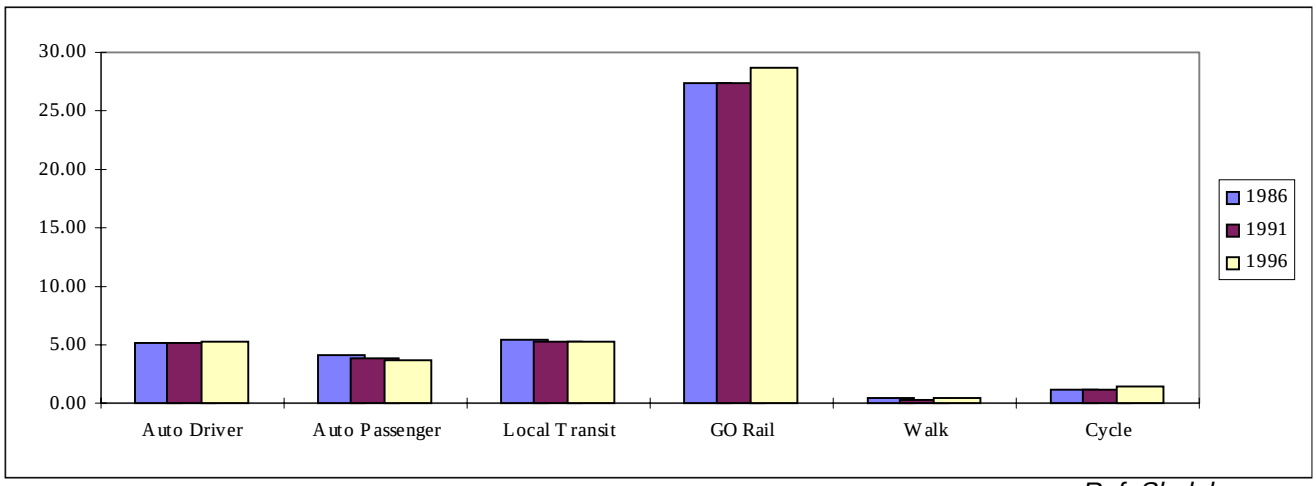


Figure 28. Mode Split of GTA Daily Trips by Spatial Market



Ref. Shalaby

Figure 29. Trends in Median Trip Length by Mode



Ref. Shalaby

Figure 30. 1996 Trip Length Distribution by Mode in the GTA (Cumulative)

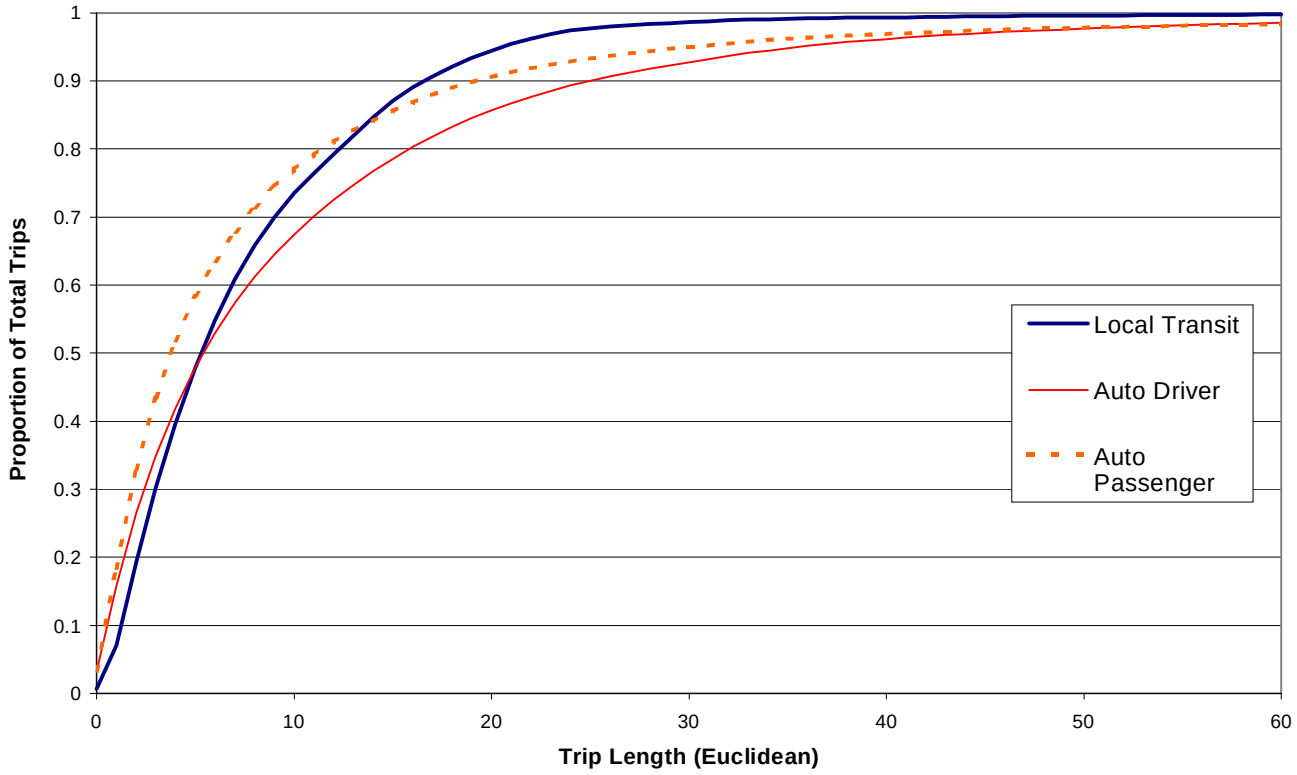
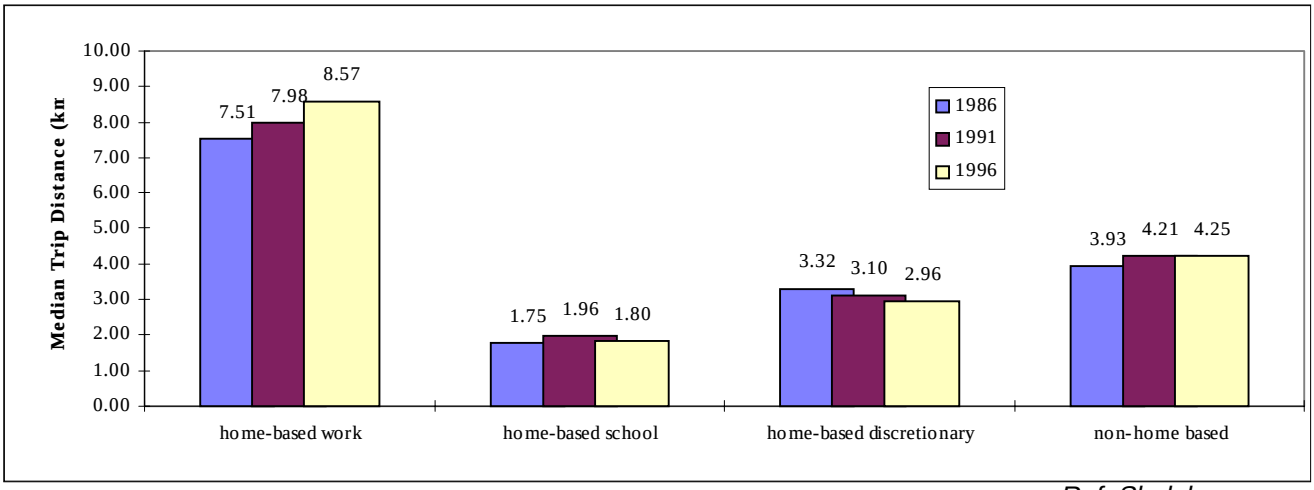


Figure 31. Trends in Median Trip Length by Trip Purpose



Ref. Shalaby

Figure 32. Distribution of Trip Start Times

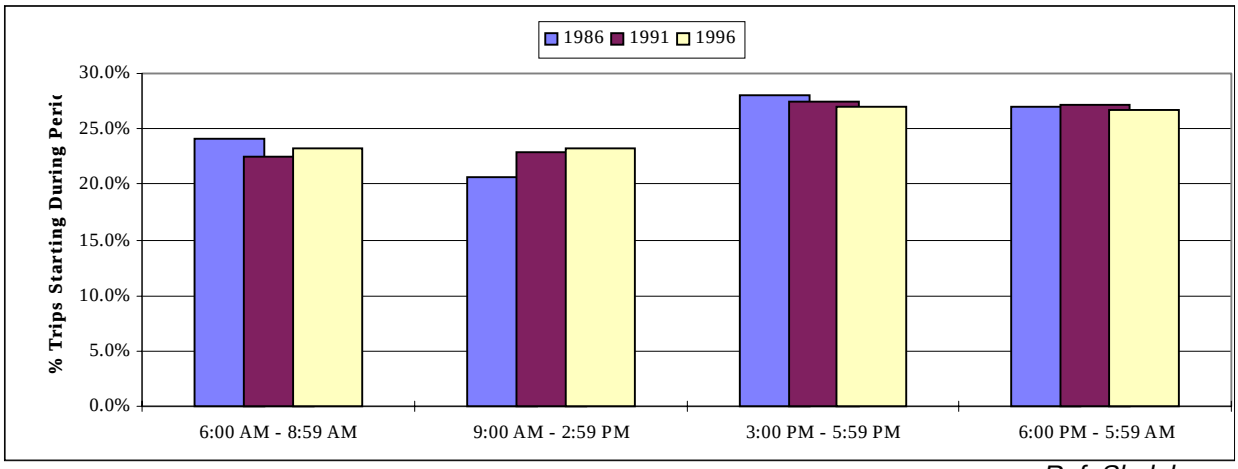


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Figure 33. Mode Split of GTA Daily Trips by Time of Day

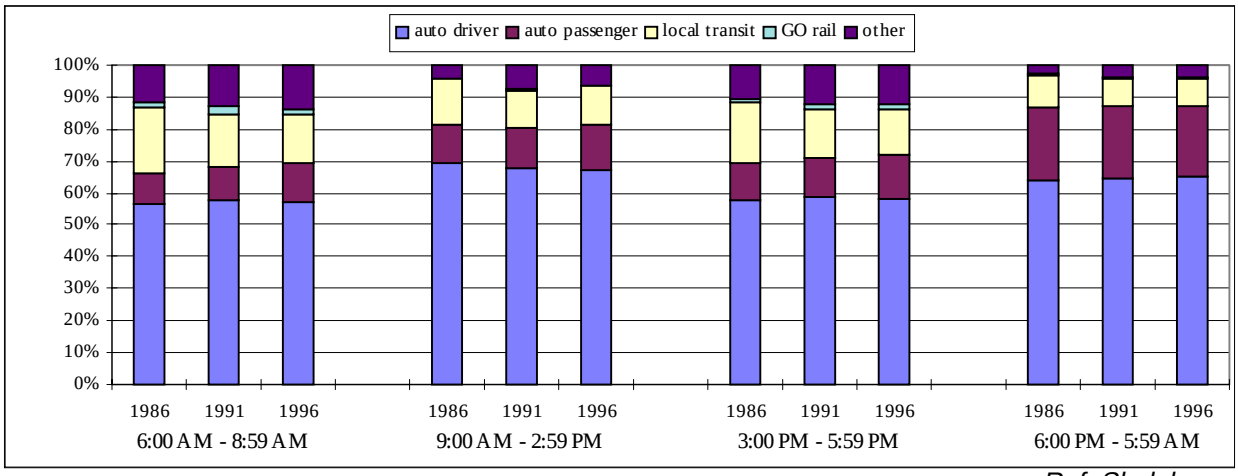

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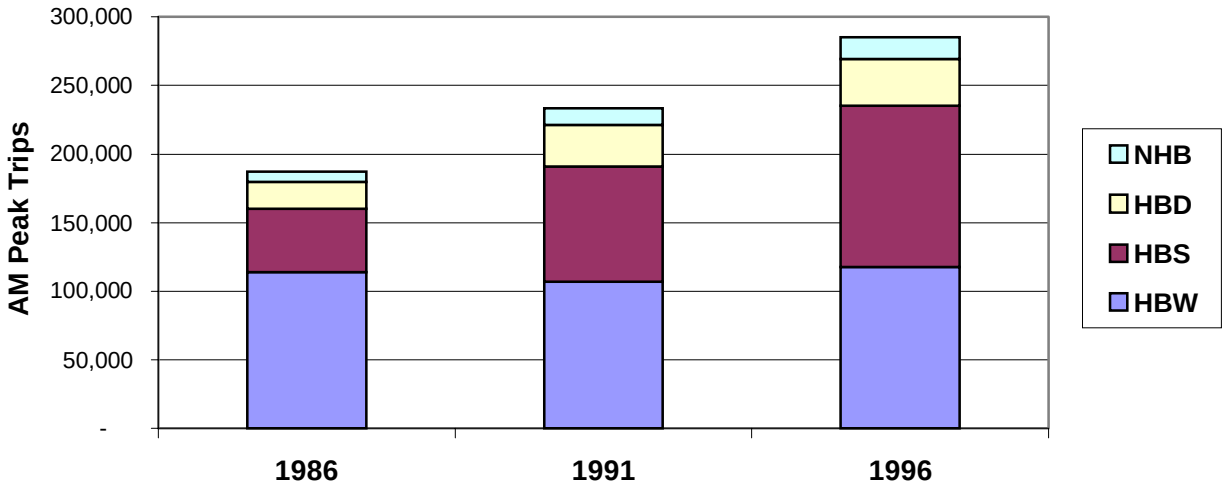
Figure 34. Growth in the GTA Auto Passenger Trips by Purpose AM Peak



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