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2016 TTS
Data Analysis

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Executive Summary

The Transportation Tomorrow Survey (TTS) has been conducted every five years since 1986. Over the years, trip rates reported from the survey have declined, and it was observed that the recent surveys did not capture the population as well as they did back in the 1990s. Due to these deficiencies, a few changes were made in the last TTS conducted in 2016, including: introduction of multiple sample frames, extensive use of a web survey interface, and the implementation of an iterative proportional weighting process.

This document provides some comparisons among different sample frames, and the two survey modes. Since a weighting method was used in these surveys, comparisons were made at the raw data level, i.e., before expansion factors were applied. Several variables were selected for analysis: household size, advance letters, dwelling type, household income, respondent type, gender, age, employed labour force, number of trips made per person, trip start time, trip purpose, and travel mode.

Here are some findings:

- The 2016 TTS unweighted data over-represented 2-person households by 7% and under-represented households with 3 or more people. This result is reiterated for all sample types except for phone-only samples, which had a better representation of households with four or more people. The 2-person households were also oversampled by both survey methods, but online surveys had better overall representation of household size.
- Households that received the advance letter regarding the survey had higher trip rates reported than those that did not receive the letter.
- The 2016 TTS unweighted data over-represented houses but under-represented apartments. Among different sample frames, the distribution of dwelling types from address-only samples matched the data from Census.
- Comparing to the 2016 Census data, the proportion of the households in the income category of over $125,000 was under-represented before and after data weighting. The online surveys had a closer match for the proportion of households in this income category, but over-represented the middle ranges and under-represented the lower ranges. The income distribution from telephone surveys were not comparable to Census data. Among the three sample types, address-only samples had a slightly better representation of the income distribution.
- The telephone surveys from both address-only and address-and-phone samples appeared to capture households with older adults with fewer children, while the online surveys from address-only samples had a better representation of young adults.
- The trip rates of the respondents of the survey were higher than the trip rates of the proxy respondents. This is true for all sample types and both survey methods in the 2016 TTS. The trip rates of respondents from online surveys were higher than those from telephone surveys, whereas the trip rates of proxy respondents from telephone surveys were higher than those from online surveys.

- Over half of the TTS respondents were females, especially for telephone interviews. However, males are more likely than females to complete the survey online. In 2011, 72% of the web surveys were completed by males. This percentage dropped to 53% in 2016 as web surveys became more common.
- The proportion of the respondents between 18 and 35 decreased over the years since 1996 and was the lowest in the 2011 TTS. It slightly increased in the 2016 TTS, possibly due to the change in the sample frame. Consequently the proportion of this age cohort is significantly higher in online surveys than telephone surveys. Trip rates reported for this age cohort were the highest for the address-only samples. The trip rates for telephone surveys were also higher than the ones reported online except for people between 26 and 35.
- Phone-only samples had the closest proportion of employed labour force to 2016 Census data compared to the other sample types with an under-estimation of 1.6%, followed by address-only surveys with an over-estimation by 2.9%. Address-and-phone surveys had the largest discrepancies with an under-estimation of 8.7%.
- Approximately 45% of the respondents reported making exactly 2 trips on the survey day. This proportion slightly increased from 43% in 2011 to 46% in 2016. The proportion of people making less than 2 trips on the survey day has also increased over the years since 1996, whereas the proportion having more than 3 daily trips decreased. Address-only samples reported the highest proportion of 2 daily trips per day and the lowest proportion of reporting no trips. Between the two survey methods, online surveys reported a higher proportion of people who made 2 trips on survey day than telephone surveys but lower proportions in other number of trips categories.
- Online surveys reported a slightly higher average trip rate than telephone surveys before weighting (2.26 vs. 2.25), but a lower average trip rate after weighting (2.25 vs. 2.28). Surveys from address-only samples reported higher trip rates than the other sample types. This also changed slightly after data weighting. This could be due to the use of multiple variables in the weighting process.
- Online surveys reported higher trip rates than telephone surveys during morning and afternoon peak periods but significantly lower trip rates during the midday. Surveys from address-only samples also had higher trip rates during peak periods but lower trip rates during off-peak periods than address-and-phone samples. This could be the result of the under-representation of discretionary trips by online surveys.
- Online surveys did not capture as many home based non-work or non-school trips as telephone surveys. This is also reflected by the observation between address-only samples and address-and-phone samples.
- The trip rates and proportion of trips by auto driver and passenger modes decreased from 1996 to 2016 while the proportions of other modes increased. GO rail trips seemed to be over-represented in 2016 and was adjusted in the weighting process. Among the sample types, address-and-phone samples captured the highest proportion of auto drivers and auto passengers, whereas address-only samples captured more transit and active transportation modes.

From the above observations, the inclusion of address-only samples slightly improves the representation of the overall population. However, young adults between 18 and 35 were still under-represented, and other sources of data might be required to supplement this population gap. With the increasing use of an online platform, it is critical to ensure the survey interface can mimic human interaction to improve response rate and capture missing information.

Contents

1. Introduction

The 2016 TTS is the seventh cycle of the Transportation Tomorrow Survey (TTS), a household travel survey conducted every five years. The first TTS was conducted in 1986 for the Greater Toronto and Hamilton Area (GTHA). In 1991, the coverage area was extended slightly to the fringe of the GTHA. It continued to expand from 1996 to 2006. The 1996 survey area covered the Greater Toronto and Hamilton area, Cities of Barrie, Guelph, Kawartha Lakes (formerly known as Victoria County) and Peterborough, Regional Municipalities of Niagara and Waterloo, Counties of Peterborough (partial), Simcoe (partial) and Wellington (partial), and the Town of Orangeville. The 2001 survey area was expanded to include the whole of Simcoe County and City of Orillia but excluded the Regional Municipality of Waterloo. The 2006 survey area was extended to include Region of Waterloo, City of Brantford and the County of Dufferin. The County of Brant was surveyed during the training period. After 2006, the coverage remained the same for the 2011 and 2016 TTS with the County of Brant officially becoming part of the survey area.

The 2016 TTS was different from the previous TTS in many ways. First, due to the increasing use of personal cell phones instead of household landline telephones, the traditional sample frame of addresses with listed landline telephone numbers was no longer representative of the population. Therefore, a mixed sample frame consisting of address-and-phone, address-only, and phone-only samples was implemented in the 2016 TTS. Secondly, the majority of the surveys were completed online in the 2016 TTS. Although web surveys were first introduced in the 2011 TTS, only 17% of the final surveys were completed online that year. As web tools have become the standard method for surveys, including the 2016 Canada Census, 66%[1] of the surveys in the 2016 TTS were completed online. Thirdly, an iterative proportional fitting method, was used as the weighting process in the 2016 TTS. Unlike the previous cycles where the number of households collected were expanded to the Canada Census dwelling counts[2], other control variables (e.g. dwelling type, household size, age, gender, and GO rail usage by household) were also used in the weighting process. These changes were taken into account when comparisons of survey results from different cycles were made.

Based on preliminary comparisons to previous cycles, trip rates[3] collected in the 2016 TTS were lower than expected. A list of variables were selected for investigation in this report. Unweighted statistics would be the focus in this report due to the differences mentioned previously. The actual number of trip records, were not compared since the City of Hamilton was sampled at 3% whereas the remaining areas were sampled at 5% in 2016 as in previous TTS.

[1] 66% was based on unweighted observations from the 2016 TTS.

[2] In the 2011 TTS, additional adjustments were made to the expanded totals of each local municipality based on age and gender of the persons.

[3] Trip rate was defined as the total number of trips divided by total number of persons. Since TTS did not collect trips for persons under 11 years old, all person counts, unweighted or weighted, include only people over 10 years old.

2. Household Characteristics

In 2016 TTS, four types of samples were used:

(1) Address and Phone (AP) – This is the traditional sample frame that contained the listed address and landline number of each selected household.
(2) Address Only (AO) – These samples only contained addresses of the selected households. No phone numbers were included.
(3) Phone Only (P) – Phone only samples were subdivided into 3 categories: listed numbers without addresses in white pages, verified cell phone numbers, and random digit dialling of phone numbers for landline exchanges that were randomly generated from unlisted phone numbers.
(4) Volunteer (V) – There were a small portion of samples that were not included in the pre-selected list. These households contacted the call centre via phone or email and asked to be included in the survey.

Pre-interview letters were sent to selected households from the address-and-phone and address-only sample frames to provide survey background and prove the legitimacy of the survey. These households were given two methods to complete the survey. They could either complete the survey online using the unique access code included in the letter or complete the survey with a telephone interviewer by calling the toll-free number printed on the letter. For those households from the address-and-phone samples, they could also wait for a call from the survey sites if they did not complete the survey in about a week. Households from phone-only samples would only receive a call from the call centre, and no pre-interview letters were sent due to the lack of addresses.

Figure 1: Percentage of 2016 TTS Completions by Sample Type and Survey Method

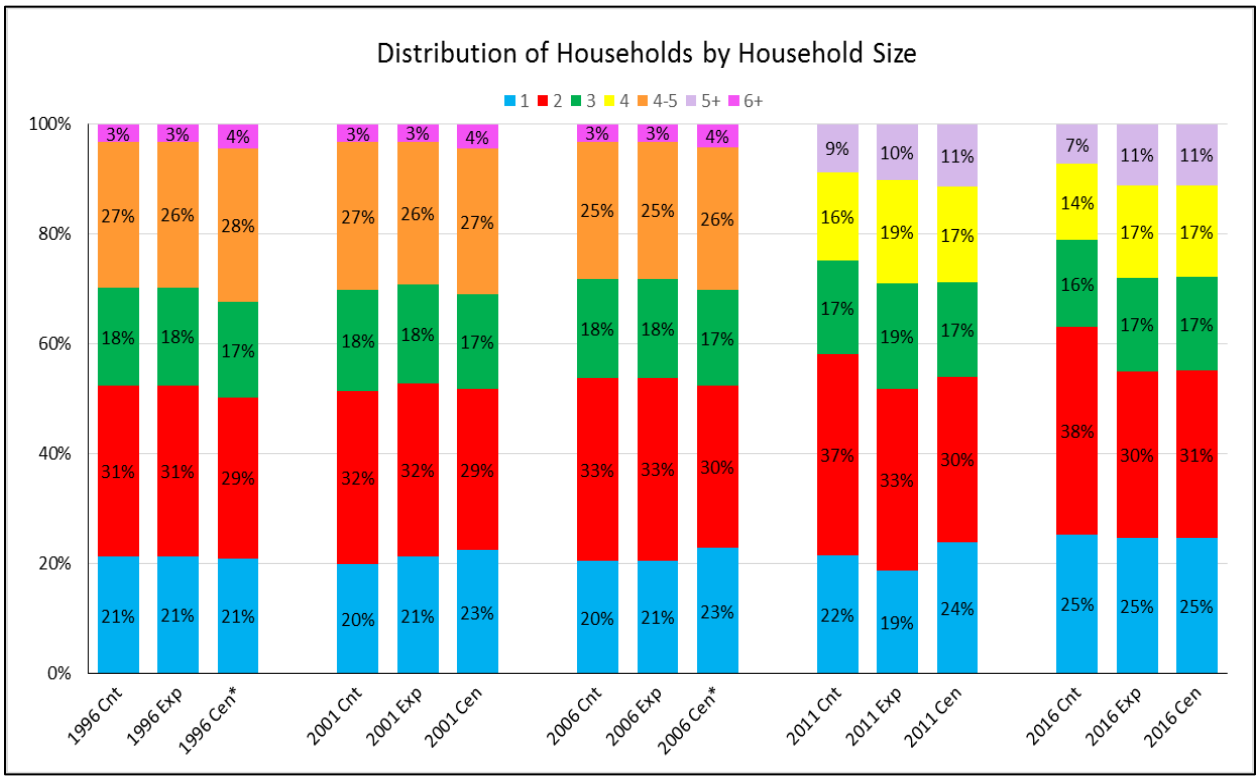
Survey Method	Sample Type				
	Address+Phone (AP)	Address-Only (AO)	Phone-Only (PO)	Volunteer (V)	Total
Phone (P)	(49,134) 30%	(7,718) 5%	(940) 1%	(55) 0%	(57,847) 36%
Online (W)	(33,326) 20%	(71,508) 44%	(16) 0%	(11) 0%	(104,861) 64%
Total	(82,460) 51%	(79,226) 49%	(956) 1%	(66) 0%	(162,708) 100%

Figure 1 shows the percentage of completions by sample type and survey method. Surveys from phone-only and volunteering samples were insignificant as they only comprised about 1% of the total completions. Surveys from phone-only samples are excluded for comparison in this report due to the low sampling rate.

2.1 Household Size

According to Canada Census data, the distribution of households by household size had changed slightly from 1996 to 2016 for the area covered by TTS[4] (Figure 2). The highest proportion is 2-person households, which increased from 29% in 1996 to 31% in 2016. This is followed by single-person households, which increased from 21% to 25%. Households with 4 or more members comprised 32% of the total households in 1996 but dropped to 28% in 2016. In 1996, the TTS distribution of households by household size was reasonably consistent with Census with a slight over-sampling of 2-person households and under sampling of 4-or-more person households, both by 2%. These discrepancies had grown over the years with more severe oversampling of smaller households and under-sampling of larger households. In 2016 TTS, the overall proportion of single-person households corresponded to the Census distribution. However 2-person households were over-sampled by 7% while households of larger sizes were under-sampled. Households with 4 persons and over 5 persons were under-sampled by 3% and 4% respectively. Since household size was one of the control variables in the weighting process of the 2016 TTS, the distribution of the expanded data were brought closer to the Census'.

Figure 2: Distribution of Households by Household Size



* Household size categories from Census available for comparison were different starting in 2011.

[4] Note the TTS coverage area changed from 1996 to 2006, as discussed in the Introduction.

Figure 3: 2016 TTS Distribution of Household Size by Sample Type and Survey Method

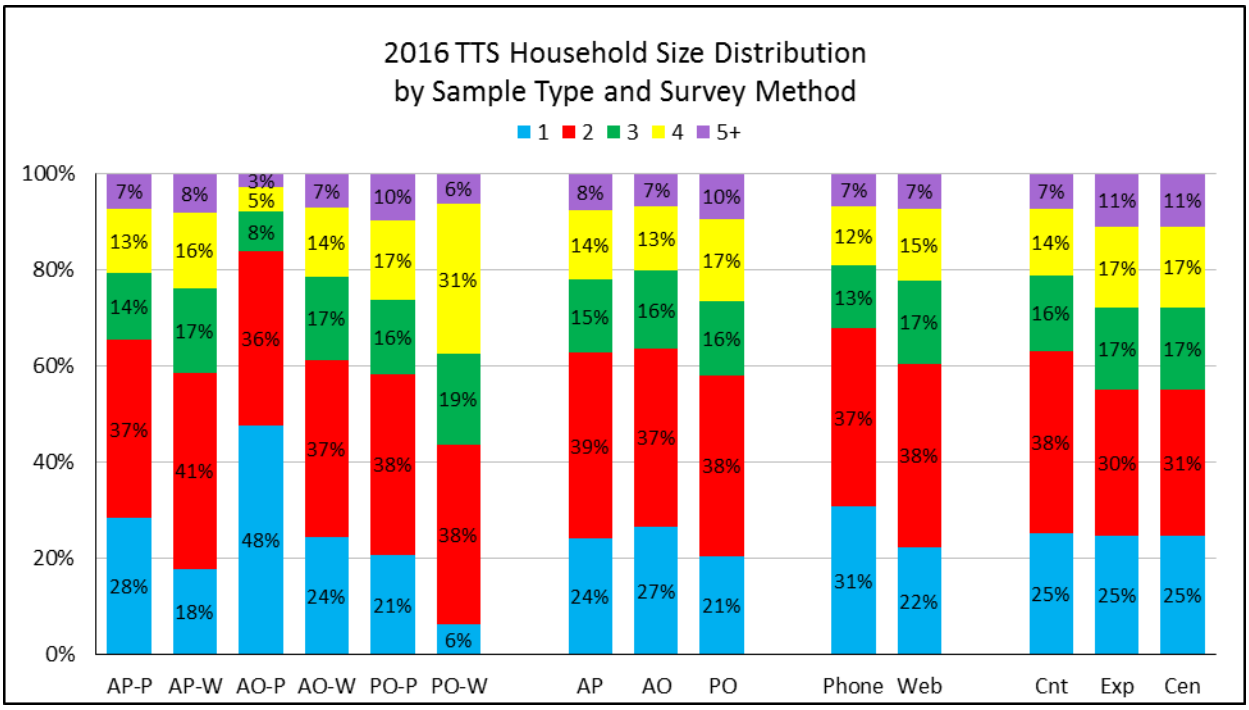


Figure 3 shows a further breakdown of the 2016 TTS household size distribution by sample type and survey method. The 2-person households were over-represented regardless of sample type and survey method. Among the three sample types, address-and-phone samples had the closest match to Census for the single-person households, whereas phone-only samples had similar proportions for the households of larger size. Between the two survey methods, online surveys had a better representation of the household sizes than the phone surveys with the 2-person households being over-represented.

It appears that the surveys from the address-only type collected by telephone interviews were the least representative of 1-person households, which were oversampled significantly. On the other hand, the online surveys from the address-only frame had the closest distribution to Census. 2-person households were oversampled from 5% to 10% depending on the sample frame and survey method. Large households with 5 or more persons were under-sampled in general with the phone surveys from the phone-only frame being the closest match. However there were only 1% of the total completed surveys in this category.

2.2 Receipt of Advance Letter

Pre-interview or advance letters were sent to the selected households from the address-and-phone and address-only sample frames to provide survey background and prove the legitimacy of the survey. The advance letters had been proven to improve survey response rate in the past cycles. Table 1 shows the proportions of the completed surveys which reported receiving the pre-interview letters in advance have increased from 1996 to 2016.

Table1: Proportion of households that received the Advance Letter (1996-2016 TTS)

Receipt of letter	Unweighted TTS					Weighted TTS				
	1996	2001	2006	2011	2016	1996	2001	2006	2011	2016
Unknown	6%	8%	1%	2%	3%	6%	8%	1%	2%	3%
No	45%	37%	47%	34%	10%	45%	38%	47%	35%	11%
Yes	49%	55%	53%	64%	87%	49%	55%	52%	63%	86%

Table 2 shows the 2016 TTS person trip rates by sample type and survey method. Surveys from address-only samples reported higher trip rates than surveys from other sample types with the ones completed by phone having the highest trip rate of 2.34 before weighting. Persons from households that reported having received the advance letter also generated higher trip rates. This proves that the use of advance letters not only improved survey response but also increased trip rates.

Table 2: 2016 TTS Trip Rates by Sample Type and Survey Method

Receipt of letter	2016 TTS Trip Rates									
	Unweighted					Weighted				
	AP-P	AP-W	AO-P	AO-W	Total	AP-P	AP-W	AO-P	AO-W	Total
No	2.06	1.99	2.33	2.12	2.08	2.12	2.07	1.90	2.10	2.11
Yes	2.27	2.21	2.34	2.32	2.28	2.31	2.23	2.32	2.31	2.29
Overall	2.23	2.20	2.34	2.29	2.25	2.27	2.22	2.32	2.27	2.26

2.3 Dwelling Type

According to the Canada Census, the distribution of households for the TTS area by dwelling type changed from 1996 to 2016 with proportions of houses[5] dropping from 63% in 1996 to 55% in 2016. On the other hand, proportions of apartments and townhouses both increased by 5% and 2% respectively. Dwelling information collected in TTS matched closely with Census in 1996, but the differences grew over the years. In 2016, houses and townhouses were oversampled by 6% and 1%, respectively, while apartments were under-sampled by 6%. The dwelling type was one of the control variables in the data weighting process; therefore, the distributions of the expanded data were comparable to Census. Figure 4 shows the comparisons of dwelling types collected by TTS with Census from 1996 to 2016.

[5] Dwelling type classifications from Census were grouped into 3 categories: house, apartment and townhouse for comparison with TTS data.

Figure 4: Proportion of Households by Dwelling Type

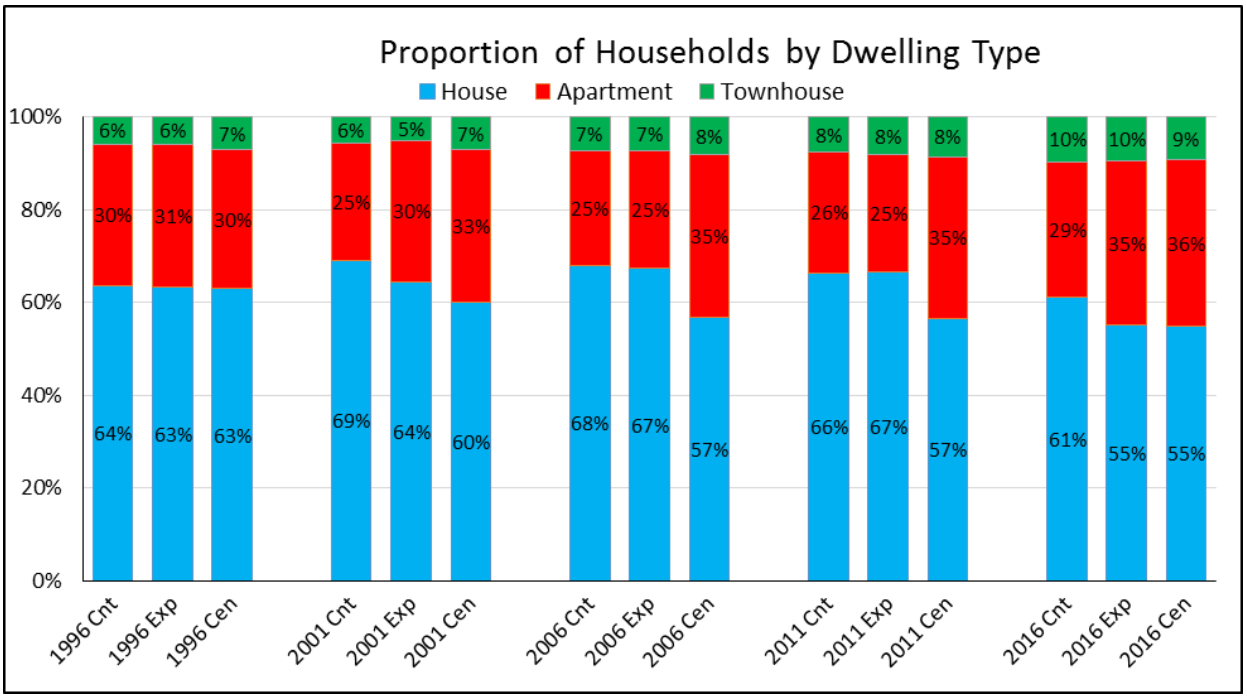
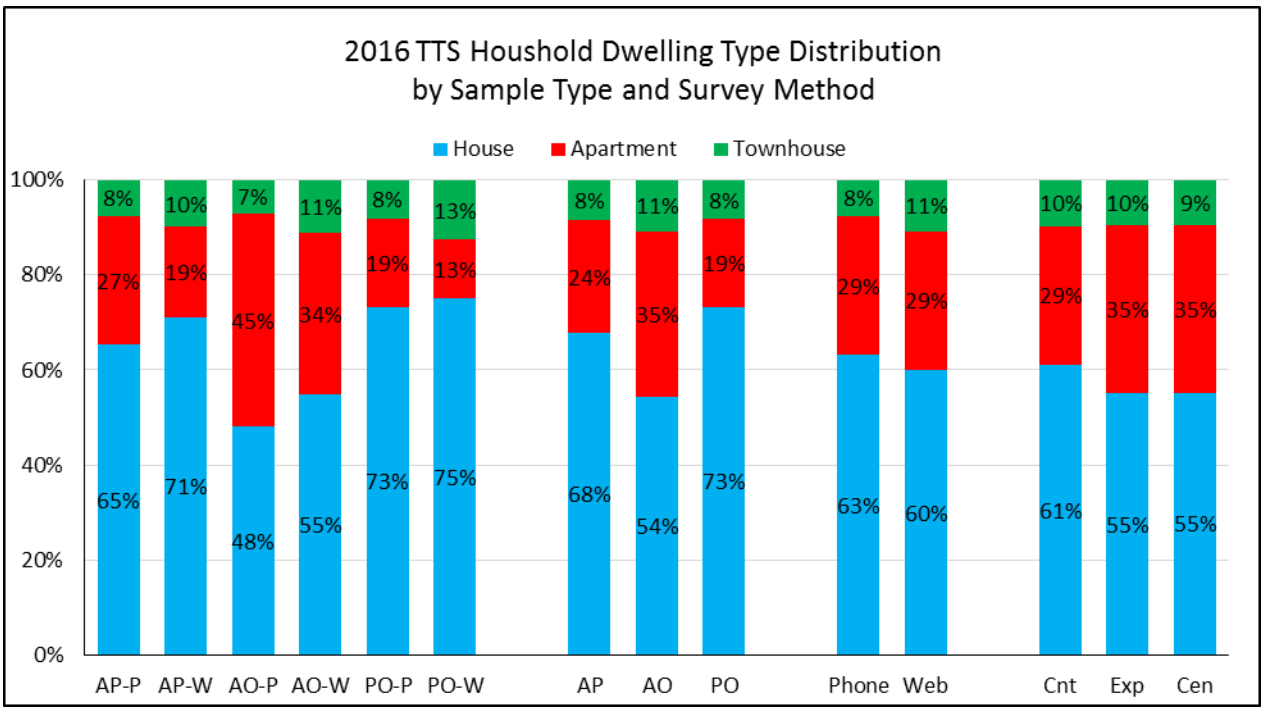


Figure 5 shows the distribution of dwelling type by different sample type and survey method from the 2016 TTS comparing with Census data. Address-only surveys had the best overall representation of the dwelling types with the ones collected online better than those by telephone. Houses were significantly oversampled while apartments were under-sampled by other sample types regardless of survey method.

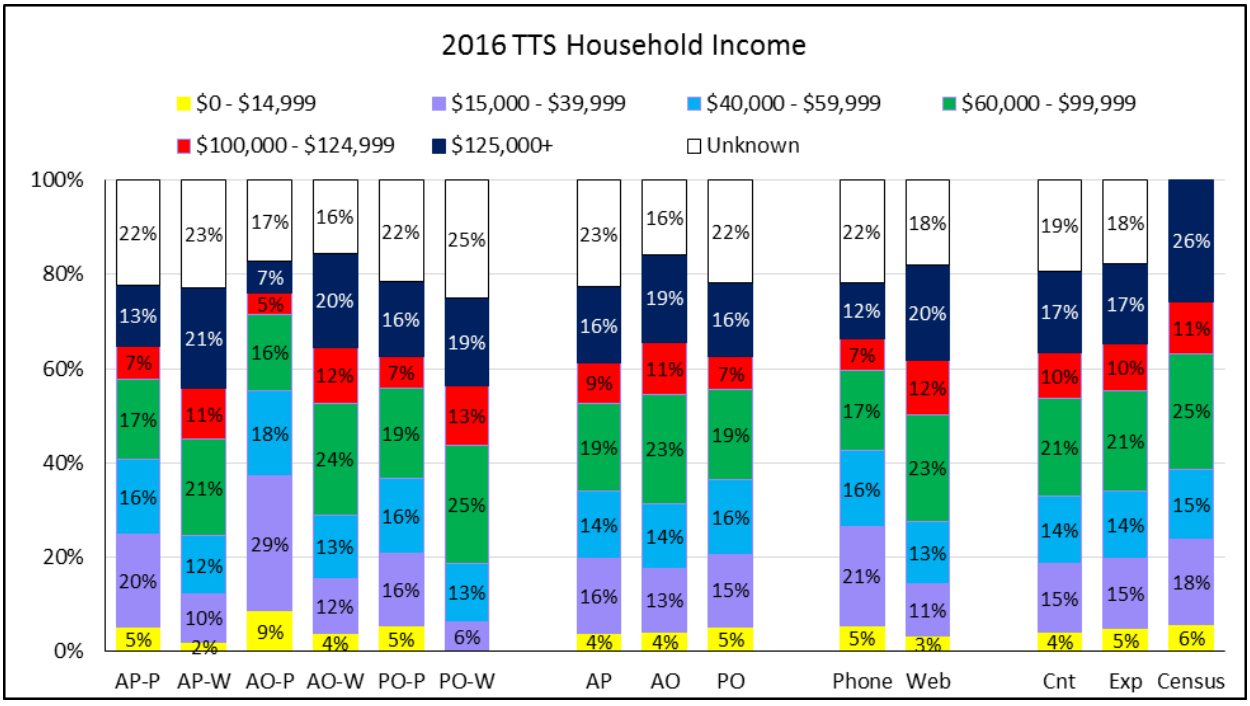
Figure 5: 2016 TTS Distribution of Household Dwelling Type by Sample Type and Survey Method



2.4 Household Income

In the 2016 TTS, the question of total household income before income tax and deductions was introduced with 6 income range categories. Approximately 19% of the surveyed households reported unknown income or declined to answer the question (see Figure 6). The households that completed the survey by telephone appeared to have a slightly higher tendency of about 4% to decline to answer the income question than those completed online as respondents might be more comfortable entering the sensitive information into the software themselves than providing that to another person over the telephone. Similarly, surveys from address-and-phone samples and phone-only samples also had higher refusal rates to this question as there were more surveys completed by telephone.

Figure 6: 2016 Household Income



After the households in the undefined income range were distributed proportionally to the other ranges, comparisons were made with Census data (see Figure 7). It appeared that the highest income category of over $125,000 was under-represented by 4% before and 5% after weighting. The remaining income categories were all slightly over-represented.

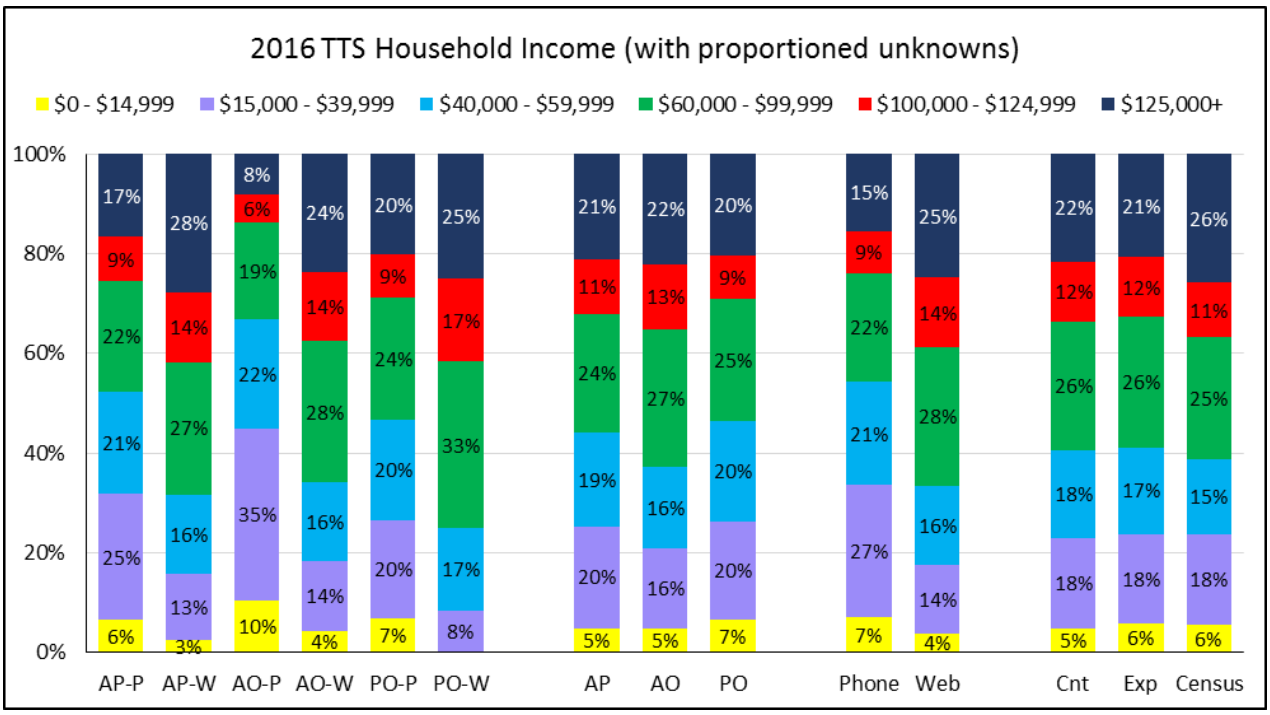
The highest income category was best represented by surveys completed online with a difference of 1%. This might be because people from higher income families are generally more tech savvy or people who are more comfortable with computers and the internet have better job opportunities. However, the categories between $40,000 and $124,999 were all over-represented, whereas the two lowest categories were under-represented. One of the possibilities is that people in the lower categories preferred not to reveal their income or did not participate in the survey. The income distribution from the surveys reported by telephone were not comparable to Census at all.

Comparing to the proportions of households by income group from Census, surveys from all sample types had a lower proportion for the category of over $125,000 but higher proportions for the other

income categories. Among the three sample types, address-only samples had a slightly better representation of the income distribution.

Among the combined sample types and survey methods, the distribution of income ranges of telephone surveys from address-and-phone samples over-sampled the lower-income households but under-sampled, the higher-income households significantly. On the contrary, surveys completed by phone from address-only samples under-sampled the higher-income households but over-sampled the lower income households.

Figure 7: Household Income excl. Unknowns



2.5 Other Household Characteristics

Figures 8 and 9 show the differences among various sample types and survey methods in other household characteristics. Comparing to other types of samples, it appeares that address-and-phone samples captured households with older adults that contain less young children[6], and hence less students. Within this sample type, 69% of the households consisted of only "adults or seniors"[7], the highest among all sample types. On the other hand, phone-only samples seem to capture more families with young children, teenagers[8], students and family members who worked at home, though the number of samples in this category was considerably smaller. The address-only sample group appeared to have properties between the other two groups with the exception that it had the highest proportion

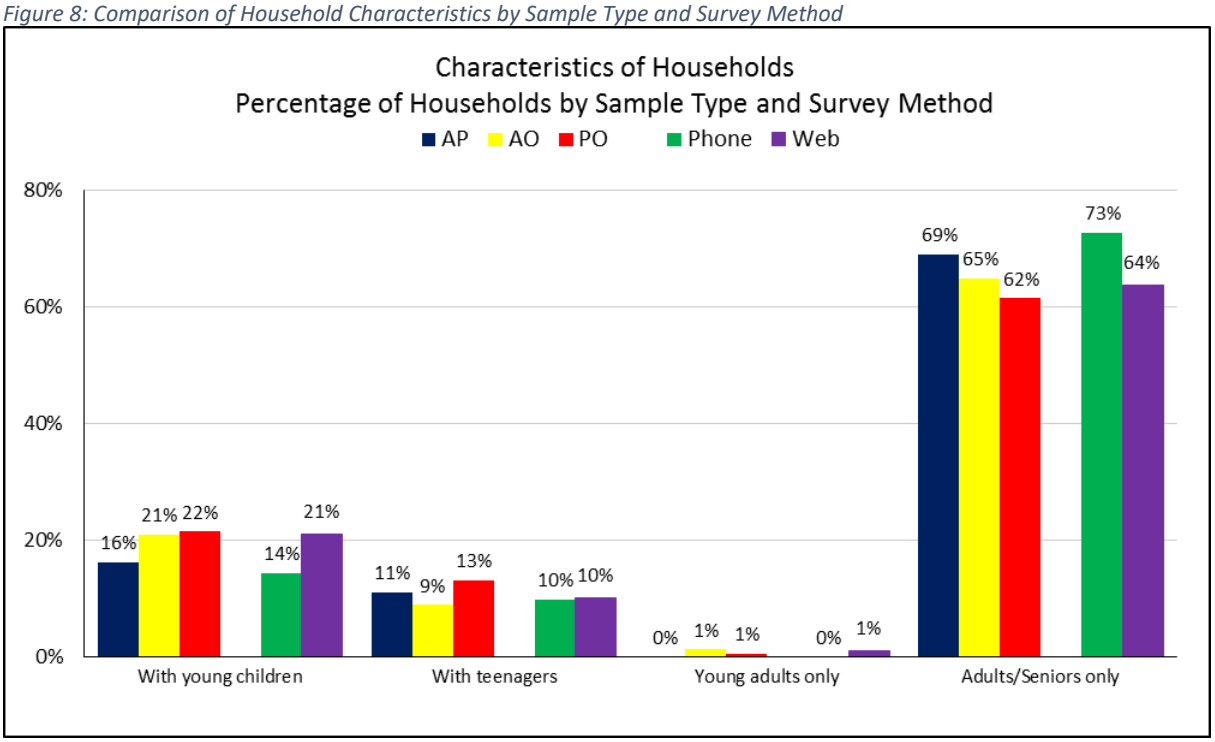
[6] Young children: Persons under 13 years old

[7] Adults or Seniors Only: Persons aged 25 or over without children living at home

[8] Teenagers: Persons between 13 and 17 years old

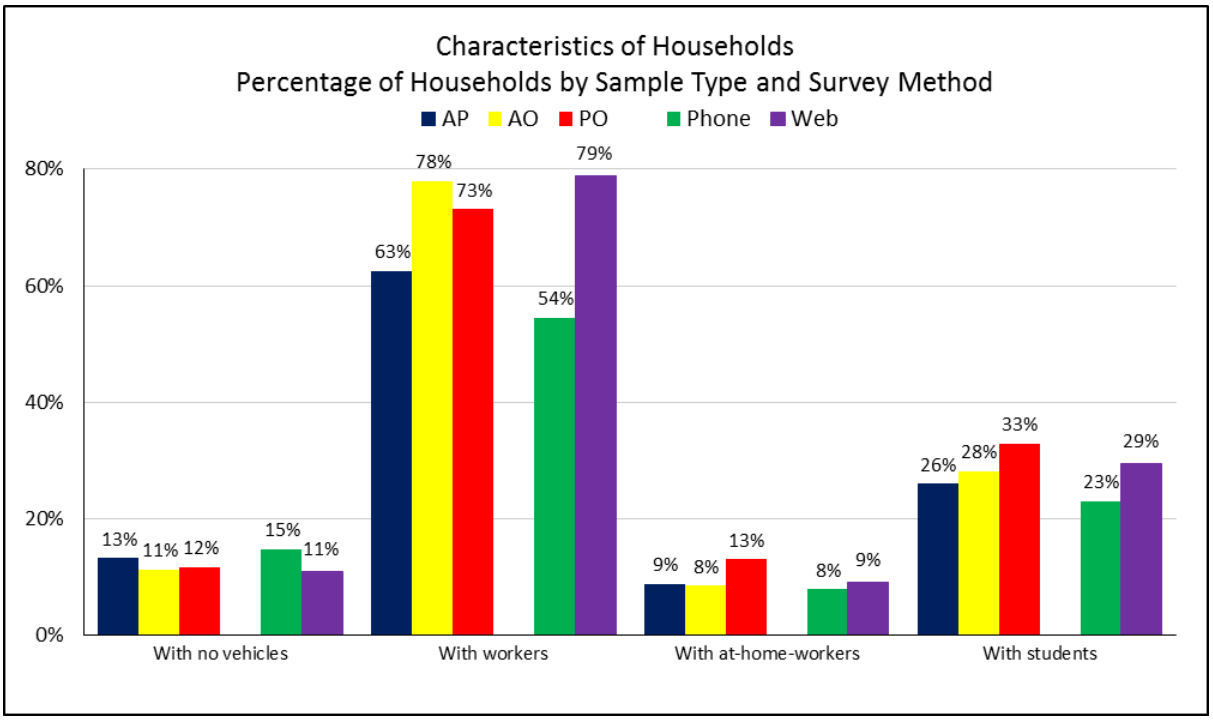
of households with full-time or part-time employees and a slightly smaller proportion of households with teenagers at 9% comparing to the other groups.

Figure 8: Comparison of Household Characteristics by Sample Type and Survey Method



Between the two survey methods, the phone surveys had characteristics comparable to those from the address-and-phone samples as predicted since two-thirds of the address-and-phone surveys were completed by telephone. Similarly, the characteristics of online surveys resembled those from the address-only sample frame, as 90% of them were completed online. Since households with young children might be more inclined to complete the survey online at their own schedule rather than spending fifteen to twenty minutes on the telephone, web surveys and hence surveys from address-only samples consisted of a higher percentage of these households.

Figure 9: Comparison of Household Characteristics by Sample Type and Survey Method (cont'd)



Figures 10 and 11 show the differences in household characteristics based on combined sample types and survey methods. For the households from the address-only samples that completed the survey by telephone, only 7% of them had young children, and 4% had teenagers at home, which were the lowest among all categories. This category also had the highest proportion of households, which consisted of only adults or seniors at 86% and the highest proportion, which had no access to a vehicle at 23%. However, there were only 41% of households with someone who was employed, only 6% with at least one member who worked from home, and 11% had students in the households, which were the lowest among all categories. Since these surveys were completed by respondents contacting the call centre, it is not surprising that these are older householders with fewer children living at home.

On the contrary, households from the same sample type but with a survey completed online had the highest proportion with young children at 23% and a slightly higher proportion of households comprised of only young adults at 2% compared to the other categories.

The composition of households were somewhat similar between the two survey methods from the address-and-phone samples, with a few exceptions. 14% of these households that completed the survey by telephone did not have access to a vehicle comparing to 7% from those completed online. For the households that completed the survey online, 72% had at least one member who was employed comparing to 56% of those completed by telephone.

Figure 10: Comparison of Household Characteristics by Combined Sample Type and Survey Method

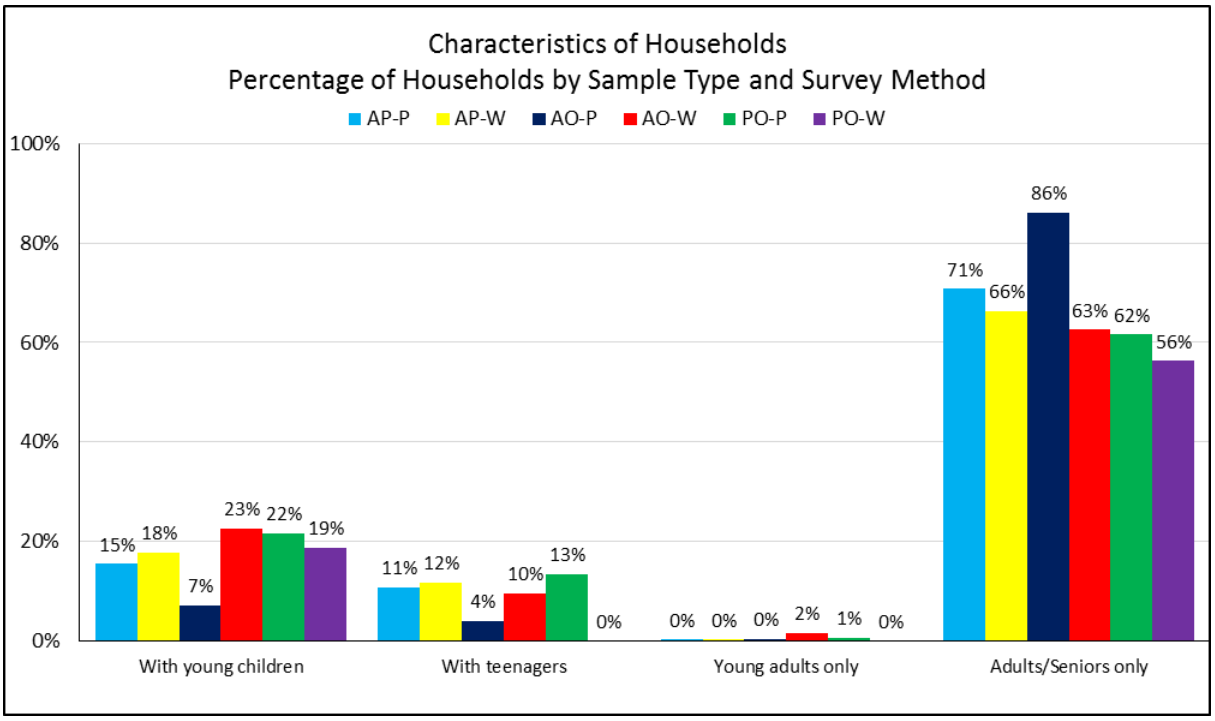
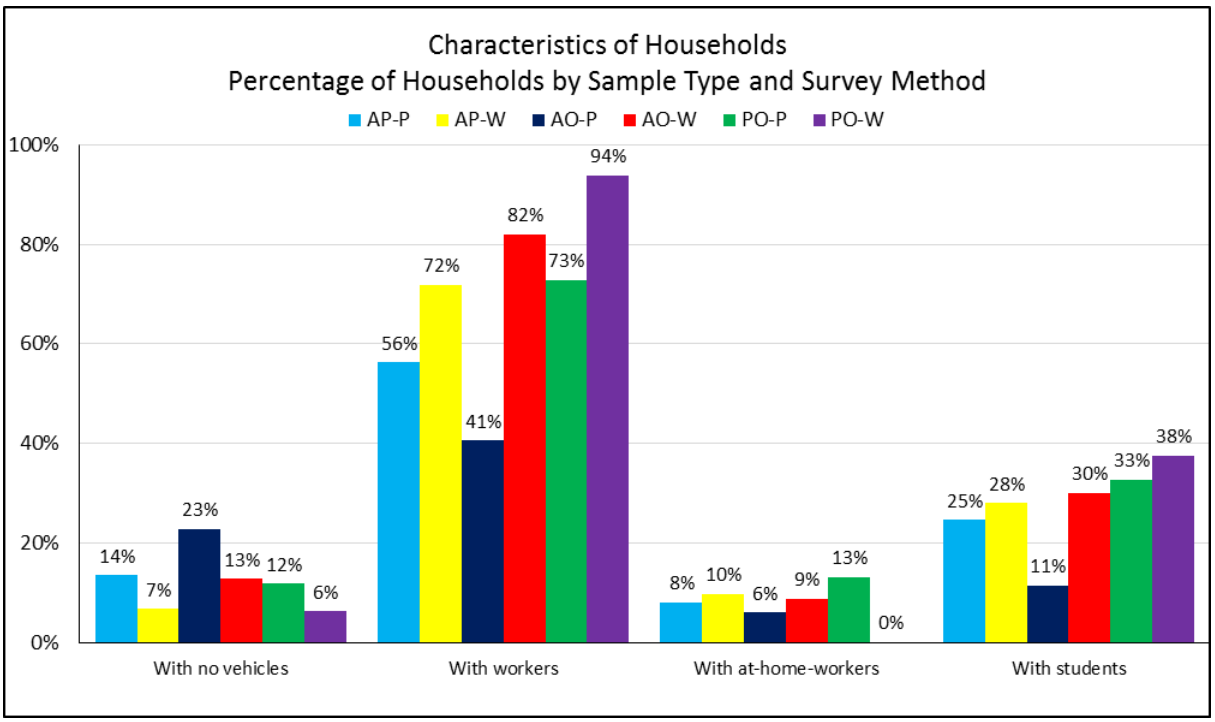


Figure 11: Comparison of Household Characteristics by Combined Sample Type and Survey Method (cont'd)



Based on the above observations, the phone surveys from the address-only samples had the highest representation of older householders, who were more likely to be retired with fewer or no children living at home. The phone surveys from the address-and-phone samples shared similar characteristics with those from the address-only samples. On the contrary, it appeared that the online surveys from address-only samples had the highest representation of households with young adults, followed by phone surveys from phone-only samples, although the proportions were insignificant.

3. Person Characteristics

This section investigates the differences in the person characteristics recorded in the surveys among different sample types and survey methods. Comparisons were made at the record level as some of these attributes are used as control variables in the weighting process where expanded totals were calculated to be compatible with the Census data.

3.1 Respondent Type

TTS is a retrospective household telephone survey in which one member of each household (respondent) reported the trips made by all members of the household. There were occasions that the respondent of the household was not aware of the movements of the other members, and follow-up calls were scheduled so that the respondent could obtain the missing information or the telephone interviewers could speak to the other members directly. In any case, the first person who started the survey would be recorded as the respondent of the household. Starting from 2011, the households were provided an option to complete the survey online in which the survey could be paused for each household member to complete their own trip information. However, only the first person who started the survey was recorded as respondent in the 2011 TTS. This was changed in 2016 where each member could be recorded as respondent. Nevertheless, there were only eight unique households in the survey which reported to have more than one respondent in the household.

Table 3: TTS Trip Rates 1996-2016

Unweighted Trip Rates														
Respondent	Survey Year					Changes				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
Yes	2.82	2.91	2.78	2.67	2.58	3%	-4%	-4%	-3%	2.51	2.65	2.47	2.49	2.63
No (Proxy)	2.23	2.29	2.24	2.14	1.97	2%	-2%	-4%	-8%	1.98	1.96	2.07	2.03	1.95
Total	2.49	2.55	2.47	2.37	2.25	3%	-3%	-4%	-5%	2.22	2.29	2.24	2.25	2.26
Weighted Trip Rates														
Respondent	Survey Year					Changes				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
Yes	2.81	2.88	2.77	2.73	2.63	3%	-4%	-1%	-4%	2.59	2.66	2.53	2.56	2.66
No (Proxy)	2.23	2.28	2.24	2.17	1.98	2%	-2%	-3%	-9%	2.02	1.94	2.12	2.06	1.95
Total	2.48	2.54	2.47	2.40	2.26	2%	-3%	-3%	-6%	2.25	2.27	2.28	2.28	2.25

Table 3 shows the TTS trip rates by respondent type from 1996 to 2016, and by sample type and survey method for the 2016 TTS, before and after data expansion. Trip rates increased from 1996 to 2001 but started to decline since 2001 for both respondents and proxy respondents of the surveys. Respondents consistently reported to have made more trips than non-respondents in every TTS. There was a significant decrease of 8% in trip rates for proxy respondents from 2011 to 2016, although only a 3% decrease was observed for respondents. Trip rates slightly decreased for all categories after the weighting process.

Trip rates of respondents were 0.14 percentage point higher for surveys collected online than by telephone, whereas trip rates of proxy respondents were 0.08 percentage point higher for telephone surveys than web surveys. Among the three sample types, surveys from address-only sample reported the highest trip rates for respondents, but lowest for proxy respondents. The trip rates for proxy respondents collected from 2016 online surveys were less than 2.0, which suggested the respondents did not take advantage of the web tool to pause the survey and ask for complete information from other members of their households.

3.2 Gender

Table 4 shows the proportion of TTS respondents by gender. It has been observed that there were more females than males who responded to the TTS surveys in general. The differences were approximately 12% from 1996 to 2006. This difference was slightly changed in 2011 when online surveys were introduced. Among the online surveys, 72% of the respondents were male and only 28% were female which brought the overall responses to be 49% completed by females and 51% by males. In 2016 TTS, the proportion of online surveys completed by females had increased to 47%. Among the telephone surveys, females continued to be the majority of the respondents.

Table 4: Proportion of Respondents by Gender 1996-2016

Respondent Gender	Survey Year								
	1996	2001	2006	2011	2011 Ph	2011 Web	2016	2016 Ph	2016 Web
Female	56%	56%	56%	49%	53%	28%	51%	59%	47%
Male	44%	44%	44%	51%	47%	72%	49%	41%	53%

3.3 Age

Table 5 shows the proportion of the TTS population by age cohort. The proportions of the population in the age groups 18-25 and 26-35 had decreased over the years since 1996 and reached the lowest in the 2011 TTS. They had slightly increased in the 2016 TTS possibly due to the change in sample frame as the proportions were higher for address-only and phone-only surveys. Similarly, proportions of population in these age groups are significantly higher from online surveys than telephone surveys. This is not unexpected as persons in these age groups are more tech-savvy in general and comfortable with computers and the internet.

Table 5: Proportion of Unweighted TTS Population by Age Cohort 1996-2016

Age Group	Survey Year					2016 Sample Type			2016 Survey Method		2016
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web	Census
(0-10)	15%	14%	13%	12%	11%	9%	12%	12%	9%	11%	12%
(11-17)	9%	10%	10%	8%	7%	8%	6%	9%	7%	7%	8%
(18-25)	10%	9%	8%	7%	7%	7%	7%	8%	6%	7%	11%
(26-35)	18%	15%	12%	9%	11%	6%	16%	8%	6%	14%	13%
(36-45)	17%	18%	16%	13%	13%	11%	15%	14%	10%	14%	13%
(46-55)	12%	14%	15%	17%	15%	16%	15%	16%	14%	16%	15%
(56-65)	8%	9%	11%	15%	16%	17%	14%	15%	16%	15%	13%
(66-75)	6%	7%	8%	10%	12%	15%	9%	11%	16%	10%	8%
(76-85)	3%	4%	5%	6%	6%	9%	4%	6%	11%	4%	5%
(86-98)	1%	1%	1%	2%	2%	3%	1%	1%	4%	1%	2%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Under-representation of the population between 18 and 35 was observed since 2006 TTS. One explanation is that the survey sample frame was based on listed landline telephone, which has been slowly replaced by cellular phones, especially in the younger households. As an experiment, address-only and phone-only samples were introduced in the 2016 TTS so that households without landline telephones would still be included in the survey.

Figure 12: 2016 Population Distribution by Sample Type and Survey Method

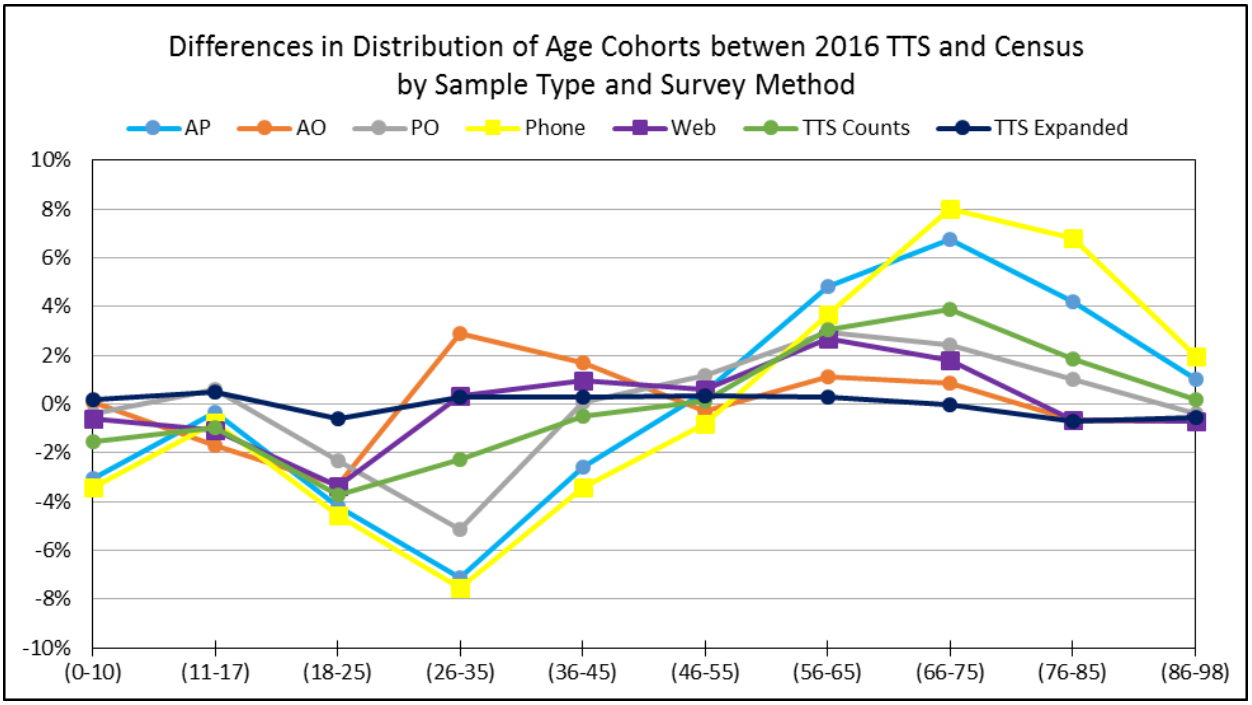


Figure 12 shows the age distribution by age group, sample types, and survey methods comparing to the 2016 Census data. Surveys from address-and-phone samples and those reported online had very similar

age distribution patterns and were least representative of the population, especially for age groups 26 to 35 (-7% and -8%) and 66 to 75 (+7% and +8%). Surveys from phone-only samples also had a similar pattern but with fewer differences from Census. Address-only samples, on the other hand, had much closer distribution to Census particularly for the age groups over 46 years old. The only exception was the over-representation of the age group of 26 to 35 by 3%. The overall web surveys were most comparable to Census data for the age groups between 26 and 55 but were slightly higher than Census for the groups between 56 and 75.

It appears that the population in the age group between 46 and 55 was well represented regardless of the sample type and survey method. However, the age group between 18 and 25 was under-represented by all sample types and survey methods.

Table 6 displays the number of persons in each age cohort after expansion, comparing to Census. Although the age of the population was one of the control factors in the 2016 TTS weighting process, age groups 76-85 and 86-98 were highly under-represented. This is because the TTS sample frame did not include collective institutions such as old age homes, and therefore special adjustments were made. Age groups 18-25 were also under-represented even after adjustment in the weighting process.

Table 6: 2016 TTS Age Cohorts Comparison with Census

Age	(0-10)	(11-17)	(18-25)	(26-35)	(36-45)	(46-55)	(56-65)	(66-75)	(76-85)	(86-98)
Census	1,084,315	731,795	969,635	1,213,995	1,209,220	1,360,050	1,125,845	741,935	405,320	158,530
TTS	1,077,017	761,655	897,729	1,212,831	1,207,431	1,362,056	1,125,103	722,446	333,969	107,127
%Diff	-0.7%	4.1%	-7.4%	-0.1%	-0.1%	0.1%	-0.1%	-2.6%	-17.6%	-32.4%

Similar to the observations based on respondent type, TTS Trip rates declined for all age groups since 2001, as shown in Table 7. As it was expected, people over 75 years old consistently had lower trip rates than other age groups. Since the population between 18 and 25 was under-reported by TTS, for those who were captured in the survey, some of their trips were not reported and hence their low trip rates. The average trip rate for this age group from the 2016 TTS was less than 2.0.

Table 7: Trip Rates by Age Cohort

Unweighted Trip Rates														
Age	Survey Year					Change				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
11-17	2.49	2.53	2.54	2.52	2.39	2%	0%	-1%	-5%	2.45	2.31	2.61	2.49	2.34
18-25	2.47	2.49	2.34	2.09	1.94	1%	-6%	-11%	-7%	1.94	1.94	1.89	1.99	1.91
26-35	2.66	2.64	2.50	2.41	2.30	-1%	-6%	-4%	-4%	2.16	2.36	2.06	2.21	2.32
36-45	2.92	3.00	2.94	2.83	2.72	3%	-2%	-4%	-4%	2.79	2.67	2.65	2.82	2.69
46-55	2.63	2.80	2.80	2.72	2.55	6%	0%	-3%	-6%	2.59	2.50	2.65	2.63	2.51
56-65	2.12	2.30	2.38	2.33	2.22	9%	3%	-2%	-5%	2.24	2.20	2.13	2.28	2.19
66-75	1.73	1.86	1.86	2.04	2.00	8%	0%	10%	-2%	1.99	2.02	1.98	2.12	1.91
76-85	1.25	1.43	1.44	1.63	1.62	15%	1%	13%	0%	1.62	1.63	1.44	1.76	1.43
86+	0.60	0.80	0.88	1.01	1.05	32%	10%	15%	5%	1.04	1.08	0.82	1.17	0.85
Total	2.49	2.55	2.47	2.37	2.25	3%	-3%	-4%	-5%	2.22	2.29	2.24	2.25	2.26

Weighted Trip Rates														
Age	Survey Year					Change				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
11-17	2.48	2.53	2.54	2.53	2.37	2%	0%	0%	-6%	2.44	2.28	2.67	2.47	2.31
18-25	2.47	2.49	2.34	2.08	1.92	1%	-6%	-11%	-8%	1.92	1.92	1.95	1.97	1.90
26-35	2.65	2.63	2.49	2.38	2.28	-1%	-5%	-5%	-4%	2.14	2.34	1.99	2.19	2.30
36-45	2.91	2.98	2.94	2.83	2.72	2%	-2%	-4%	-4%	2.80	2.65	2.67	2.83	2.67
46-55	2.63	2.78	2.80	2.73	2.54	6%	1%	-2%	-7%	2.60	2.48	2.64	2.63	2.50
56-65	2.11	2.30	2.37	2.33	2.19	9%	3%	-1%	-6%	2.23	2.13	2.20	2.27	2.14
66-75	1.72	1.86	1.85	2.03	1.92	8%	-1%	10%	-5%	1.92	1.93	1.82	2.04	1.82
76-85	1.24	1.43	1.43	1.59	1.51	15%	0%	11%	-5%	1.52	1.49	1.36	1.66	1.29
86+	0.61	0.81	0.87	0.97	0.99	33%	8%	12%	2%	0.98	1.02	0.89	1.12	0.78
Total	2.48	2.54	2.47	2.40	2.26	2%	-3%	-3%	-6%	2.25	2.27	2.28	2.28	2.25

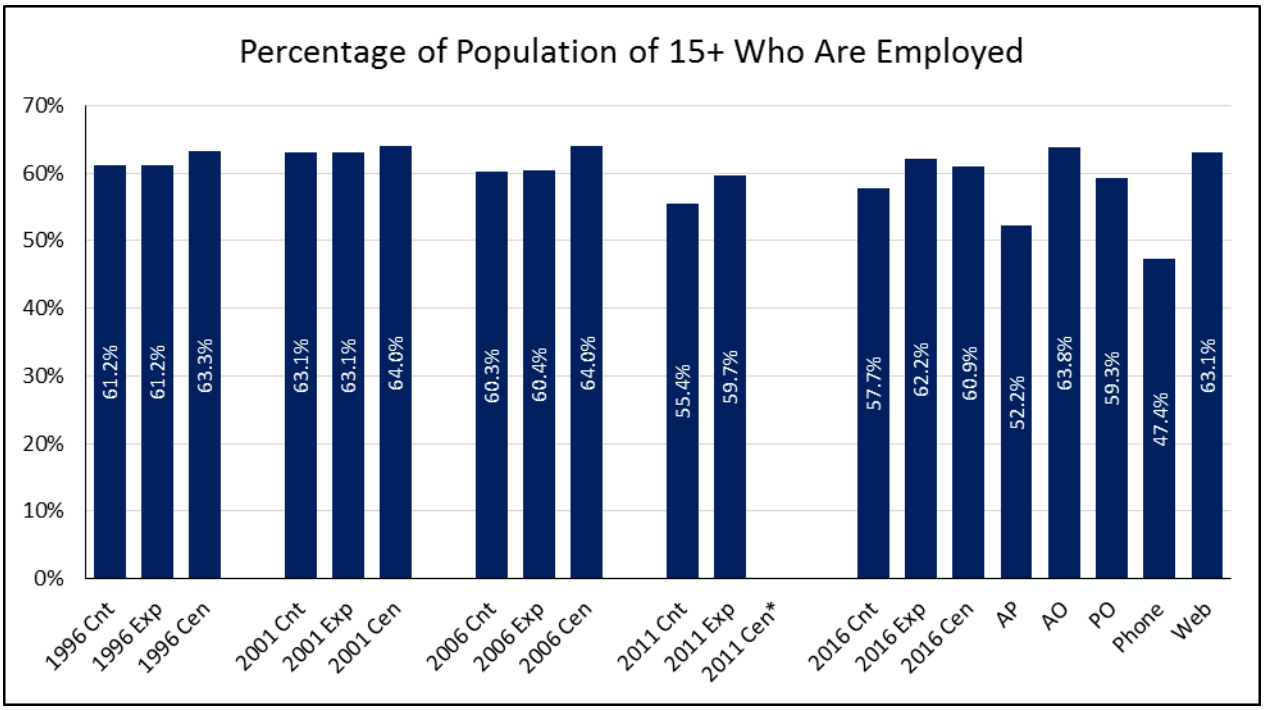
Between the two survey methods, trip rates were lower for all age groups collected online than by telephone interviews with the exception of the age group 26 to 35, which was 5% higher for online surveys. The trip rates for this age group had the biggest decline of 7% among all age groups from 2011 to 2016. The trip rates for this age group also dropped 11% from 2006 to 2011. This result confirmed the challenge to capture young adults in travel surveys.

3.4 Employed Labour Force

The percentage of people over 14 years old (i.e. 15+) who were employed full-time or part-time from the TTS data were compared with the employed labour force data from the Canada Census in Figure 13. Based on Census data, the employed labour force proportion stayed relatively steady at 63% to 64% from 1996 to 2006 and dropped to 61% in 2016. This was slightly under-represented by the TTS data by 1% to 2% from 1996 to 2006 and around 3% in 2016.

Comparing the three sample types, surveys from phone-only samples had the closest proportion to Census with an underestimation of 1.6%. Surveys from address-only samples over-estimated the employed labour force by 2.9% while address-and-phone samples under-estimated by 8.7%. This is also reflected by the significant underestimation of 13.5% in phone surveys and a slight overestimation of 2.2% in online surveys. One possible explanation is that people who were employed were likely to be unavailable when the interviewers called but responded online at their own schedule.

Figure 13: Proportion of Population over 15 Years Old who are employed 1996-2016



* In Canada Census, questions related to employed labour force were part of the mandatory long-form questionnaire sent to 25% of Canadian households, except in 2011 when the long-form questionnaire was replaced by a voluntary National Household Survey (NHS). Due to the low response rate to NHS, information for some geographic areas is suppressed and cannot be used for comparison.

3.5 Number of Trips made by Each Person

As shown in Table 8, from 1996 to 2001, there were slight increases in the proportion of people who made over two trips on survey day, but the proportions decreased since 2001. Between 2011 and 2016, the proportions of people who made three to four trips per day decreased by 1.5% and over five trips by 1.8%. This is consistent with the overall declining trip rates observed in TTS (see Table 9).

Almost 50% of the population from address-only samples reported making exactly two trips on survey day, which was the highest among the three sample types. However, surveys from this sample type also had the lowest proportion for three or more trips per day. Between the two survey methods, telephone surveys reported a higher percentage of people with three or more trips than online surveys. This observation is reversed after data weighting.

Table 8: Proportions of TTS Persons by Number of Trips Made

Unweighted Proportions of Persons by Trips Made														
# of Trips	Survey Year					Changes				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
0	19.1%	17.9%	20.1%	22.5%	22.5%	-1.2%	2.2%	2.4%	0.0%	24.2%	20.7%	23.0%	25.3%	24.7%
1	1.1%	1.1%	1.1%	1.2%	1.4%	0.0%	0.0%	0.1%	0.2%	1.4%	1.5%	1.4%	1.3%	1.3%
2	45.7%	45.5%	44.3%	43.2%	46.4%	-0.2%	-1.1%	-1.1%	3.2%	44.8%	48.1%	45.1%	40.0%	42.7%
3-4	22.8%	23.5%	22.7%	22.0%	20.5%	0.7%	-0.8%	-0.7%	-1.5%	20.4%	20.5%	21.4%	23.3%	21.7%
5+	11.3%	12.0%	11.7%	11.0%	9.2%	0.7%	-0.3%	-0.6%	-1.8%	9.1%	9.3%	9.1%	10.0%	9.6%
Weighted Proportions of Persons by Trips Made														
# of Trips	Survey Year					Changes				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
0	19.2%	18.0%	20.2%	20.9%	21.4%	-1.2%	2.1%	0.7%	0.5%	22.6%	20.3%	21.5%	22.3%	23.0%
1	1.1%	1.1%	1.1%	1.2%	1.4%	0.0%	0.0%	0.1%	0.2%	1.3%	1.4%	1.2%	0.8%	1.2%
2	45.7%	45.5%	44.4%	44.9%	48.1%	-0.2%	-1.1%	0.5%	3.2%	46.8%	49.4%	46.9%	48.3%	44.8%
3-4	22.8%	23.4%	22.7%	22.1%	20.1%	0.7%	-0.8%	-0.6%	-2.0%	20.3%	20.0%	21.4%	18.4%	21.5%
5+	11.3%	11.9%	11.6%	10.9%	9.0%	0.6%	-0.3%	-0.7%	-1.9%	9.1%	8.9%	9.0%	10.1%	9.4%

Table 9: Overall TTS Trip Rates for Persons Aged 11 and over

	Survey Year					Change				2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	96-01	01-06	06-11	11-16	AP	AO	PO	Phone	Web
Unweighted	2.49	2.55	2.47	2.37	2.25	3%	-3%	-4%	-5%	2.22	2.29	2.24	2.25	2.26
Weighted	2.48	2.54	2.47	2.40	2.26	2%	-3%	-3%	-6%	2.25	2.27	2.28	2.28	2.25

As noticed in other variables, the trip rates decreased since 2001. Before the 2016 data were expanded, the trip rates collected from address-only samples had the highest trip rate of 2.29 among the three sample types (see Table 9), and online surveys also had slightly higher trip rate than telephone surveys. However after data expansion, trip rates were raised for address-and-phone and phone-only samples but lowered for address-only samples. Similarly trip rates for surveys collect by telephone interview also increased after data weighting. This is due to the weighting process that used multiple control variables which subsequently adjusted the number of trips.

4. Trip Characteristics

4.1 Start Time of Trip

Table 10 shows the TTS trip rates by trip start time from 2001 to 2016 and the trip rates for different sample types and survey methods in the 2016 TTS. There were significant decreases from 2011 to 2016 for the two time periods between 7 pm and 4 am (13% and 19%). Similar decreases were observed in those time periods from 2001 to 2006. During these periods, trips were mostly of a discretionary nature, so it appeared trips unrelated to work or school decreased or were underestimated.

Online surveys reported higher trip rates than telephone surveys during morning and afternoon peak periods but significantly lower trip rates during midday. Therefore, it appeared that online surveys under-represented discretionary trips. Surveys from address-only samples resembled the pattern of

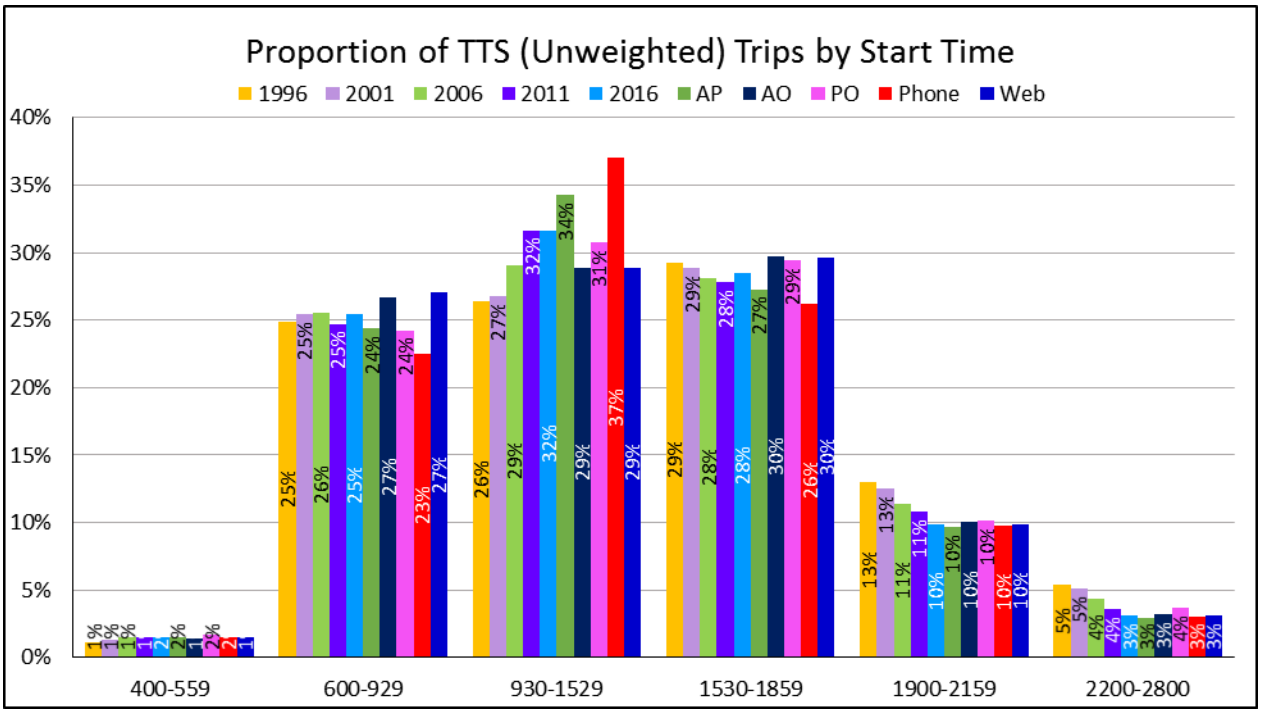
online surveys in that they had higher trip rates during peak periods but lower trip rates during off-peak periods than address-and-phone samples.

Table 10: TTS Trip Rates for Persons Aged 11+ by Time Period

Unweighted Trip Rates													
	Survey Year				Changes			2016 Sample Type			2016 Survey Method		
Start Time	2001	2006	2011	2016	01-06	06-11	11-16	AP	AO	PO	Phone	Web	Web/Phone
400-559	0.03	0.04	0.04	0.03	12%	-3%	-4%	0.03	0.03	0.04	0.03	0.03	-3%
600-929	0.65	0.63	0.59	0.57	-3%	-7%	-2%	0.54	0.61	0.54	0.51	0.61	20%
930-1529	0.68	0.72	0.75	0.71	5%	5%	-5%	0.76	0.66	0.69	0.83	0.65	-22%
1530-1859	0.74	0.69	0.66	0.64	-6%	-5%	-3%	0.60	0.68	0.66	0.59	0.67	14%
1900-2159	0.32	0.28	0.26	0.22	-12%	-9%	-13%	0.21	0.23	0.23	0.22	0.22	2%
2200-2800	0.13	0.11	0.09	0.07	-18%	-21%	-19%	0.06	0.07	0.08	0.07	0.07	5%
Total	2.55	2.47	2.37	2.25	-3%	-4%	-5%	2.22	2.29	2.24	2.25	2.26	0%
Weighted Trip Rates													
	Survey Year				Changes			2016 Sample Type			2016 Survey Method		
Start Time	2001	2006	2011	2016	01-06	06-11	11-16	AP	AO	PO	Phone	Web	Web/Phone
400-559	0.03	0.04	0.04	0.04	10%	1%	1%	0.04	0.04	0.05	0.04	0.04	-8%
600-929	0.64	0.63	0.62	0.61	-2%	-2%	-2%	0.59	0.63	0.58	0.56	0.63	12%
930-1529	0.68	0.71	0.70	0.66	5%	-2%	-7%	0.70	0.61	0.66	0.75	0.61	-20%
1530-1859	0.73	0.69	0.68	0.65	-6%	-2%	-4%	0.63	0.68	0.67	0.61	0.67	9%
1900-2159	0.32	0.28	0.27	0.23	-11%	-5%	-14%	0.23	0.23	0.24	0.23	0.23	-1%
2200-2800	0.13	0.11	0.09	0.08	-17%	-14%	-18%	0.07	0.08	0.08	0.08	0.08	3%
Total	2.54	2.47	2.40	2.26	-3%	-3%	-6%	2.25	2.27	2.28	2.28	2.25	-1%

Figure 14 shows the proportions of the TTS unweighted trips by start time period from 1996 to 2016. The proportion for trips collected between 4 am, and 6 am stayed consistently stable over the years. For the morning peak period, there were slight fluctuations in the proportions around 25%. The proportion of mid-day trips increased over the years but stayed the same since 2011. Similar to the morning peak period, the proportion of trips made during the afternoon peak period was steady at around 28%. However, the proportion of trips made in the evening and during the night slightly decreased from 1996 to 2016. Since TTS is a retrospective survey which relies on the one member to complete the survey for the rest of the household, it has been observed that the survey tends to under-represent discretionary trips, which are mostly made during midday or in the evening. Therefore extra efforts were made in the training of the telephone interviewers and the preparation of the web interface to correct this problem. It appeared that the TTS had improved in capturing the midday trips but is still missing the trips made in the evening and late hours.

Figure 14: Proportion of Unweighted TTS Trips by Time Period



Between the two survey methods, telephone surveys reported lower proportions of trips in the peak periods but significantly higher proportion in the mid-day than online surveys. Since telephone surveys primarily came from address-and-phone samples, they shared the same trip distributions. It shows that more effort should be spent in the web design in order to capture the discretionary trips made by proxy respondents during non-peak periods. Table 11 displays the proportion of trips by start time in table format.

Table 11: Proportion of Unweighted TTS Trips by Time Period

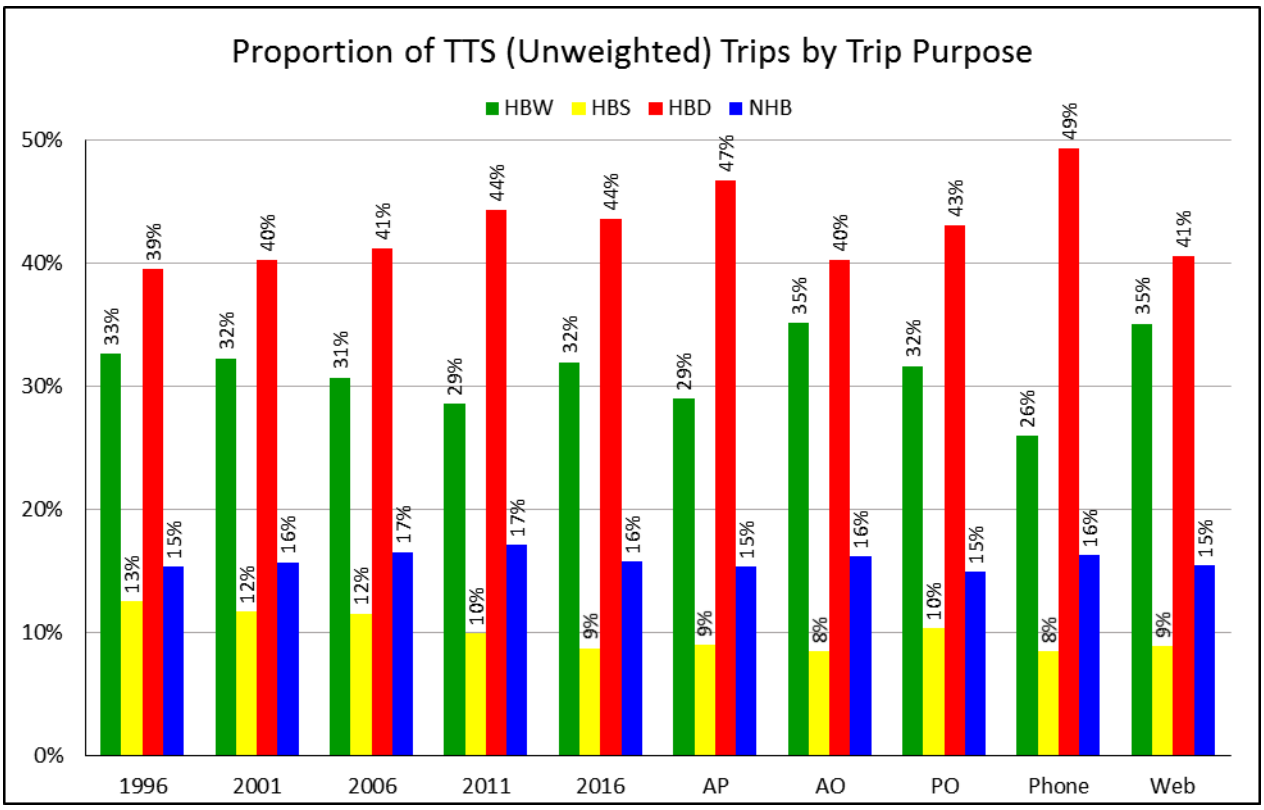
The proportion of Unweighted Trips by Start Time										
Start Time	Survey Year					2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
400-559	1.1%	1.3%	1.5%	1.5%	1.5%	1.6%	1.4%	1.7%	1.5%	1.5%
600-929	24.9%	25.4%	25.6%	24.7%	25.5%	24.4%	26.7%	24.3%	22.5%	27.0%
930-1529	26.4%	26.8%	29.1%	31.6%	31.6%	34.2%	28.9%	30.8%	37.0%	28.9%
1530-1859	29.2%	28.9%	28.1%	27.8%	28.5%	27.3%	29.7%	29.4%	26.2%	29.6%
1900-2159	13.0%	12.5%	11.4%	10.8%	9.8%	9.7%	10.0%	10.2%	9.7%	9.9%
2200-2800	5.4%	5.1%	4.4%	3.6%	3.1%	2.9%	3.3%	3.7%	3.0%	3.1%

4.2 Trip Purpose

The trip purpose attribute in the TTS datasets is defined by the purposes at the origin and destination of a trip combined. There are four categorizes: home-based-work (HBW, i.e. home to work or work to home), home-based-school (HBS, i.e. home to school or school to home), home-based-discretionary (HBD, i.e. home to non-work/school or vice versa), and non-home-based (NHB, i.e., neither end of the

trip is home). Figure 15 displays the proportion of TTS trips by trip purpose from 1996 to 2016 and broken down by sample type and survey method for 2016. Home-based-discretionary trips comprised the highest proportion among all four categories and increased from 39% in 1996 to 44% in 2016. The proportion of home-based-work trips decreased from 33% in 1996 to 29% in 2011 but climbed back to 32% in 2016. Non-home-based trips were consistent over the years between 15% and 17%. The proportion of home-based-school trips had gradually decreased since 1996, which repeated the observation that young adults, especially those who were attending universities or colleges and living away from home during the conduct of the survey, were under-represented.

Figure 15: Proportion of Unweighted TTS Trips by Trip Purpose



Among the three sample types, surveys from address-only samples had the highest proportion of home-base-work trips but the lowest home-based-discretionary trips. Online surveys also had similar results with considerably higher home-based-work trips but lower home-based-discretionary trips. It appears that online surveys did not capture non-work or non-school trips as well as telephone surveys.

4.3 Destination Trip Purpose

As seen in table 13 and table 14 there were gradual declines in overall trip rates from 2001 to 2016. Trip rates for all trip purposes declined from 2011 to 2016, with the exception of daycare trips and first trips to work. The daycare trip rate, in fact, increased 38% from 2006 to 2011 and 56% from 2011 to 2016. In 2016, it was four times higher from online surveys than phone surveys, which could be the result of an instruction included in the web interface that used daycare trips specifically to demonstrate the

definition of a trip. Since 64% of the surveys were completed online, this also affected the total trip rate for this purpose category.

Table 12: TTS Trip Rates by Destination Purpose (1996-2016)

Unweighted Trip Rates by Destination Purpose												
Destination Purpose	Survey Year					2016 Sample Type				2016 Survey Method		
	1996	2001	2006	2011	2016	Adr+Ph	Adr-Only	Ph-Only	Vol*	Phone	Web	Web/Ph
Home	1.05	1.07	1.03	0.98	0.95	0.94	0.96	0.95	0.88	0.94	0.95	1%
Work	0.45	0.46	0.43	0.39	0.41	0.36	0.47	0.40	0.35	0.33	0.46	39%
Sub Work	0.08	0.08	0.07	0.06	0.05	0.05	0.06	0.05	0.06	0.04	0.06	30%
School	0.16	0.16	0.15	0.13	0.11	0.11	0.11	0.13	0.17	0.10	0.11	7%
Sub School	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-17%
Daycare	0.01	0.01	0.01	0.02	0.03	0.02	0.04	0.01	0.02	0.01	0.04	347%
Facilitate	0.13	0.16	0.17	0.17	0.14	0.15	0.13	0.14	0.16	0.15	0.14	-7%
Market/Shop	0.21	0.21	0.23	0.25	0.23	0.24	0.22	0.21	0.16	0.27	0.21	-21%
Other	0.38	0.38	0.37	0.37	0.33	0.36	0.31	0.36	0.47	0.41	0.30	-27%
Total	2.49	2.55	2.47	2.37	2.25	2.22	2.29	2.24	2.27	2.25	2.26	0%
Weighted Trip Rates by Destination Purpose												
Destination Purpose	Survey Year					2016 Sample Type				2016 Survey Method		
	1996	2001	2006	2011	2016	Adr+Ph	Adr-Only	Ph-Only	Vol*	Phone	Web	Web/Ph
Home	1.05	1.07	1.03	1.00	0.96	0.96	0.96	0.97	0.92	0.96	0.96	-1%
Work	0.45	0.46	0.43	0.42	0.44	0.40	0.48	0.42	0.40	0.37	0.47	29%
Sub Work	0.08	0.08	0.07	0.06	0.05	0.05	0.06	0.05	0.04	0.05	0.06	21%
School	0.16	0.16	0.15	0.15	0.14	0.14	0.13	0.16	0.19	0.14	0.13	-5%
Sub School	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	-28%
Daycare	0.01	0.01	0.01	0.02	0.03	0.02	0.04	0.01	0.01	0.01	0.04	294%
Facilitate	0.13	0.16	0.17	0.18	0.15	0.16	0.13	0.15	0.19	0.16	0.14	-13%
Market/Shop	0.21	0.21	0.22	0.22	0.20	0.20	0.19	0.19	0.13	0.23	0.19	-18%
Other	0.38	0.38	0.37	0.35	0.30	0.32	0.28	0.31	0.42	0.36	0.27	-26%
Total	2.48	2.54	2.47	2.40	2.26	2.25	2.27	2.28	2.29	2.28	2.25	-1%

Trip rates for subsequent school trips had the most significant decrease of 32% from 2006 to 2011 and 47% from 2011 to 2016, which might be due to the combination of under-representation of post-secondary students in the last two TTS and discretionary trips. Trip rates for school per students in Table 15 also show the same results as the rates gradually reduced between 2006 and 2016.

Table 13: Changes in Trip Rates by Destination Purpose (1996-2016)

Changes in Trip Rates								
Destination Purpose	Unweighted				Weighted			
	96-01	01-06	06-11	11-16	96-01	01-06	06-11	11-16
Home	2%	-4%	-4%	-4%	2%	-4%	-3%	-4%
Work	2%	-7%	-10%	6%	2%	-7%	-3%	5%
Sub Work	0%	-8%	-14%	-18%	1%	-9%	-14%	-16%
School	-4%	-4%	-17%	-16%	-4%	-3%	-2%	-9%
Sub School	-19%	18%	-32%	-47%	-18%	20%	-20%	-40%
Daycare	-9%	3%	38%	56%	-9%	4%	62%	40%
Facilitate	24%	3%	3%	-19%	22%	5%	6%	-17%
Market/Shop	2%	6%	10%	-7%	2%	5%	0%	-11%
Other	1%	-2%	-1%	-9%	2%	-4%	-7%	-13%
Total	3%	-3%	-4%	-5%	2%	-3%	-3%	-6%

Table 14: TTS Trip Rates for School per Student

TTS Unweighted School Trip Rates for Students									
Survey Year					2016 Sample Type			2016 Survey Method	
1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
0.58	0.59	0.60	0.58	0.54	0.57	0.52	0.54	0.57	0.53
TTS Weighted School Trip Rates for Students									
Survey Year					2016 Sample Type			2016 Survey Method	
1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
0.58	0.59	0.60	0.59	0.56	0.58	0.53	0.59	0.59	0.54

Although the trip rates for first work trips had slightly increased by 6% from 2011 to 2016, subsequent work trips dropped by 18%. This could also be a result of the under-representation of non-peak trips due to proxy respondents. Table 16 displays the trip rates for work by employees, which also shows a steady decline from 1996 to 2016.

Table 15: TTS Trip Rates for Work per Employee

TTS Unweighted Work Trip Rates for Employees									
Survey Year					2016 Sample Type			2016 Survey Method	
1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
0.93	0.92	0.89	0.86	0.84	0.82	0.86	0.79	0.82	0.85
TTS Weighted Work Trip Rates for Employees									
Survey Year					2016 Sample Type			2016 Survey Method	
1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
0.93	0.92	0.89	0.85	0.83	0.82	0.84	0.79	0.81	0.84

Trip rates for facilitating trips slightly increased from 1996 to 2011 but dropped 19% from 2011 to 2016. This implies that some respondents failed to report the trips to pick up or drop off other household members in the 2016 TTS.

4.4 Primary Travel Mode

Table 17 shows the trip rates for each travel mode reported by TTS from 1996 to 2016, and by sample type and survey method for 2016 TTS. Table 18 shows the changes between survey years. As expected, auto driver mode had the highest trip rates in all years, followed by auto passenger mode. The trip rates for these two modes constantly declined since 2001 while the other modes also declined from 2001 to 2011 but increased between 2011 and 2016. Cycling mode had the highest increase of 55% in 2016. The combined mode taxi passengers and paid rideshare had the second highest increase of 53% though the actual number was relatively small. This was followed by GO rail which had an increase of 46% before weighting. After initial expansion, adjustments were made to weightings using GO rail corridor counts provided by Metrolinx, which brought the trip rates down from 0.04 to 0.03.

Between the two survey methods, phone surveys reported higher trip rates for auto driver and auto passenger while online surveys reported higher rates for the other travel modes. The major difference was cycling trips where the trip rate reported online was twice of that reported by telephone. This could be a result of the slightly better representation of the 18 to 35 age group. Similar results were reflected in the sample types as 60% of the surveys from address-and-phone sample were completed by telephone, and 90% of the address-only samples were completed online.

Table 16: TTS Trip Rates by Travel Mode (1996-2016)

TTS Unweighted Trip Rates by Travel Mode											
Travel Mode	Survey Year					2016 Sample Type			2016 Survey Method		
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web	Web/Ph
Auto Driver	1.60	1.67	1.61	1.57	1.47	1.50	1.44	1.47	1.51	1.45	-4%
Auto Passenger	0.41	0.40	0.40	0.39	0.30	0.34	0.27	0.33	0.37	0.27	-27%
GO Rail	0.02	0.02	0.02	0.03	0.04	0.04	0.04	0.03	0.03	0.05	69%
Local Transit	0.25	0.24	0.23	0.21	0.22	0.17	0.27	0.19	0.18	0.24	32%
Cycle	0.02	0.02	0.01	0.02	0.03	0.02	0.04	0.03	0.02	0.04	127%
Walk	0.14	0.13	0.13	0.10	0.13	0.10	0.17	0.13	0.09	0.16	74%
Taxi passenger & Paid rideshare	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	32%
Other	0.05	0.05	0.06	0.05	0.04	0.05	0.04	0.05	0.04	0.04	-11%
All Transit	0.27	0.27	0.25	0.24	0.26	0.21	0.32	0.22	0.21	0.28	37%
Total	2.49	2.55	2.47	2.37	2.25	2.22	2.29	2.24	2.25	2.26	0%
TTS Weighted Trip Rates by Travel Mode											
Travel Mode	Survey Year					2016 Sample Type			2016 Survey Method		
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web	Web/Ph
Auto Driver	1.59	1.66	1.60	1.55	1.44	1.48	1.40	1.42	1.48	1.42	-4%
Auto Passenger	0.40	0.40	0.40	0.39	0.30	0.34	0.26	0.35	0.37	0.27	-27%
GO Rail	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.03	62%
Local Transit	0.25	0.24	0.23	0.24	0.25	0.20	0.30	0.24	0.22	0.27	23%
Cycle	0.02	0.02	0.01	0.02	0.03	0.02	0.04	0.02	0.02	0.04	113%
Walk	0.14	0.13	0.13	0.11	0.15	0.12	0.18	0.15	0.11	0.17	50%
Taxi passenger & Paid rideshare	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	41%
Other	0.05	0.06	0.06	0.05	0.05	0.06	0.04	0.07	0.06	0.05	-22%
All Transit	0.27	0.26	0.25	0.27	0.28	0.22	0.33	0.26	0.24	0.30	26%
Total	2.48	2.54	2.47	2.40	2.26	2.25	2.27	2.28	2.28	2.25	-1%

Table 17: Changes in TTS Trip Rates (1996-2016)

Changes in Trip Rates								
Travel Mode	Unweighted				Weighted			
	96-01	01-06	06-11	11-16	96-01	01-06	06-11	11-16
Auto Driver	5%	-4%	-3%	-6%	4%	-4%	-3%	-7%
Auto Passenger	0%	0%	-3%	-22%	-1%	0%	-3%	-23%
GO Rail	33%	-1%	16%	46%	36%	-1%	30%	-10%
Local Transit	-2%	-7%	-6%	3%	-4%	-4%	6%	4%
Cycle	-3%	-16%	31%	55%	-3%	-15%	41%	51%
Walk	-6%	-2%	-20%	27%	-4%	-1%	-13%	30%
Taxi passenger & Paid rideshare	6%	-6%	-13%	53%	8%	-7%	-16%	56%
Other	3%	7%	-16%	-12%	7%	-1%	-9%	0%
All Transit	0%	-6%	-4%	8%	-2%	-4%	8%	2%
Total	3%	-3%	-4%	-5%	2%	-3%	-3%	-6%

Table 19 shows the distribution of travel modes of the TTS Trips from 1996 to 2016, broken down by sample type and survey method for the 2016 TTS. Similar to trip rates, the proportion of auto driver and passenger trips decreased from 1996. Between 2011 and 2016, the proportions of all non-auto trips increased with walk trips having the highest increase of 1.5%, followed by local transit. There was an increase in the proportion of GO rail trips of 0.6% before expansion, which became a slight decrease afterward since GO rail usage was one of the control variables in the weighting process.

Table 18: Proportion of TTS Trips by Travel Mode (1996-2016)

Proportion of TTS Unweighted Trips by Primary Travel Mode										
Travel Mode	Survey Year					2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
Auto Driver	64.1%	65.4%	65.1%	65.9%	65.3%	67.6%	62.9%	65.5%	67.1%	64.4%
Auto Passenger	16.3%	15.8%	16.3%	16.4%	13.5%	15.3%	11.6%	14.9%	16.5%	12.0%
GO Rail	0.7%	0.9%	0.9%	1.1%	1.7%	1.6%	1.9%	1.4%	1.2%	2.0%
Local Transit	10.0%	9.5%	9.2%	9.0%	9.7%	7.6%	12.0%	8.4%	8.0%	10.6%
Cycle	0.7%	0.7%	0.6%	0.8%	1.3%	0.8%	1.9%	1.2%	0.7%	1.6%
Walk	5.7%	5.2%	5.3%	4.4%	5.9%	4.5%	7.3%	5.6%	4.0%	6.9%
Taxi passenger & Paid rideshare	0.4%	0.4%	0.4%	0.4%	0.6%	0.5%	0.8%	0.5%	0.5%	0.7%
Other	2.1%	2.1%	2.3%	2.0%	1.8%	2.1%	1.6%	2.4%	2.0%	1.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Proportion of TTS Weighted Trips by Primary Mode										
Travel Mode	Survey Year					2016 Sample Type			2016 Survey Method	
	1996	2001	2006	2011	2016	AP	AO	PO	Phone	Web
Auto Driver	64.1%	65.3%	64.9%	64.3%	63.7%	65.7%	61.7%	62.2%	64.8%	63.1%
Auto Passenger	16.3%	15.8%	16.3%	16.2%	13.2%	15.1%	11.4%	15.5%	16.1%	11.8%
GO Rail	0.7%	0.9%	1.0%	1.3%	1.2%	1.2%	1.3%	1.0%	0.9%	1.4%
Local Transit	10.1%	9.4%	9.3%	10.1%	11.1%	8.8%	13.3%	10.5%	9.6%	11.9%
Cycle	0.7%	0.7%	0.6%	0.9%	1.4%	0.9%	1.9%	0.9%	0.8%	1.7%
Walk	5.6%	5.2%	5.3%	4.7%	6.6%	5.3%	7.8%	6.4%	4.9%	7.4%
Taxi passenger & Paid rideshare	0.4%	0.4%	0.4%	0.4%	0.6%	0.4%	0.8%	0.3%	0.5%	0.7%
Other	2.1%	2.2%	2.2%	2.1%	2.2%	2.6%	1.9%	3.2%	2.6%	2.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Among the sample types, address-and-phone samples captured the highest proportion of auto driver and passengers whereas address-only samples captured more transit and active transportation modes. This is possibly due to the demographic differences between the households in the two sample frames.

5. Conclusion

Based on the above comparisons, it is found that the addition of address-only samples to the traditional address-and-phone samples provided a better representation of the population in the survey area. Surveys from various sample types and survey methods carry different demographic and travel characteristics. In order to capture complete and accurate travel patterns of the population, more effort should be made in the training of the telephone interviewers and the design of the web interface so to improve survey response and avoid missing information.