Immobility in Urban Travel Surveys

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1 Introduction

Most reporting of urban travel surveys concentrates on the mobility characteristics of respondents, in terms of trip rates, trip purposes, mode choice etc. This paper takes a counterview of the data and considers the immobility characteristics of the respondents.

While approximately 15% of respondents report no travel on their Travel Day, the question always exists as to whether this is a true measure of immobility, or whether some of these respondents have simply reported no travel as a form of "soft refusal". This question is therefore examined by comparing the results of some recent surveys in Australia (VATS) with results obtained from a parallel Time Use Survey conducted by the ABS, which records all activities undertaken by respondents over a 24 hour period.

The overall levels of reported immobility are compared, as well as the reported immobility by demographic group and other characteristics. The reported mobility is then examined, with respect to the daily travel time and the time spent at out-of-home activities.

2 Immobility from Different Data Sources

While approximately 15% of respondents report no travel on their Travel Day, the question always exists as to whether this is a true measure of immobility, or whether some of these respondents have simply reported no travel as a form of "soft refusal". Previous research (Axhausen and Madre, 2002) has demonstrated a wide range of levels of immobility in travel surveys, from 5% up to 30%, as shown in Figure 1. Importantly, as the share of immobiles increases, the average trip rate decreases as a result of the higher number of "zeroes" in the trip rate frequency distribution.

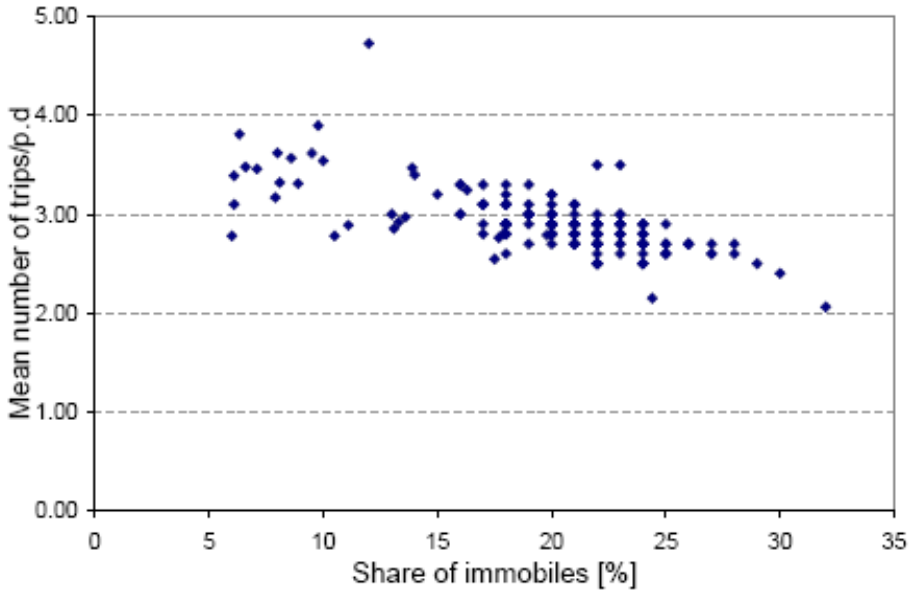


Figure 1 Share of Immobiles in a Range of Travel Surveys
(Source: Axhausen and Madre, 2002)

However, before accepting these measured levels of immobility as a true indication of the level of immobility in the population, it needs to be determined whether the measurement is affected by the way in which the survey is conducted or by the specific design of the survey instrument. In the context of the current paper, "immobility" is defined to mean not travelling on a specified travel day, and does not relate to any form of long-term immobility faced by various members of the population, whether due to lack of access to transport or other forms of social exclusion (e.g. Greco, 2007). Previous research in the area of measured immobility in surveys (Armoogum et al., 2004) has examined this issue by comparing the results from trip-based travel surveys with the results from time-use surveys, and have concluded that the trip-based survey tend to over-estimate true levels of immobility, compared to time-use surveys, but that time-use survey also miss many short trips being made because of the finite time slice used for the recording of activities.

The levels of recorded immobility in travel surveys are a function of the survey method and the survey instrument design. Allowing respondents to choose their own Travel Day on which to report their travel will significantly increase measured levels of immobility. A questionnaire design which provides an easy exit strategy for immobiles will increase the probability of respondents choosing that option as an easy way to end the survey. A face-to-face interview with the use of probing techniques will reduce recorded immobility, compared to a self-completion questionnaire with no follow-up. The use of incentives for returned questionnaires will increase the likelihood of respondents returning the forms with no trips reported, simply to be in the "prize draw". Because of all these variables, it was decided that it would be instructive to undertake an investigation of reported immobility using recent travel surveys in the Australasian context.

The first question to be addressed is whether levels of reported immobility are a function of the overall survey method used for the data recording. This question is examined by comparing the results of some recent travel surveys in Australia (VATS) with results obtained from a parallel Time Use Survey conducted by the ABS, which attempts to record all activities (including travel) undertaken by respondents over a 24 hour period..

2.1 VATS Immobility

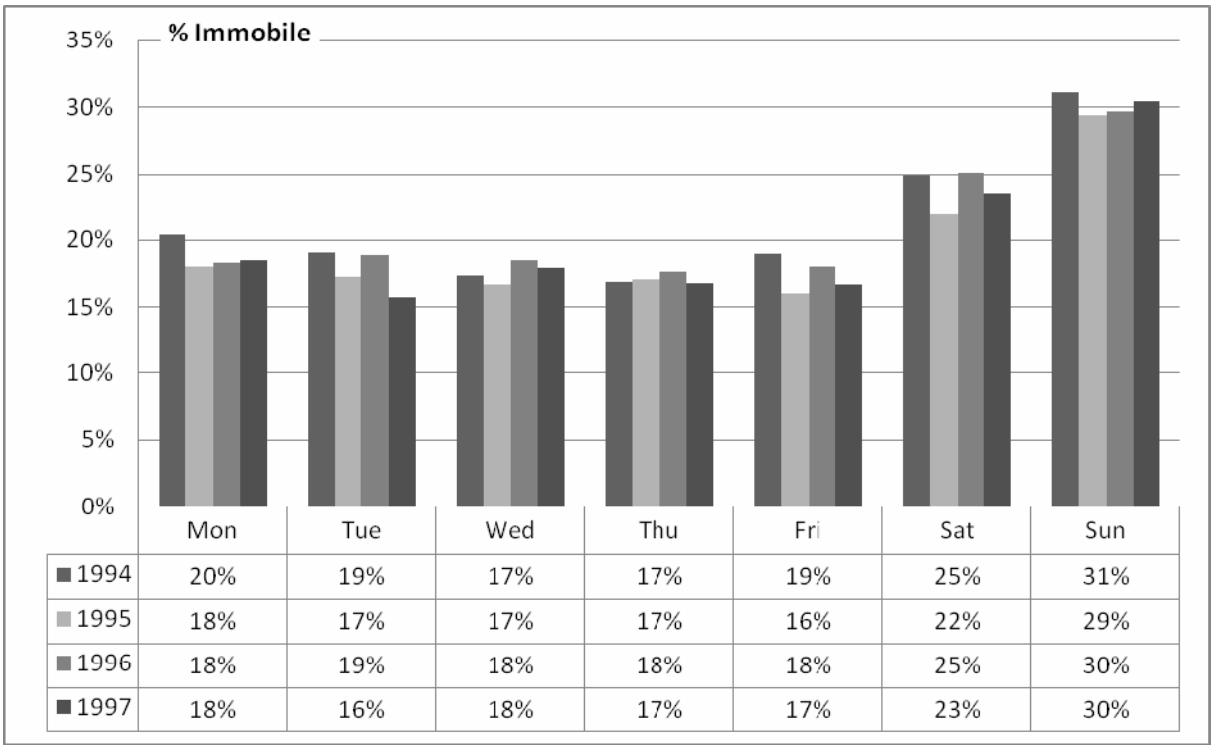
The Victorian Activity and Travel Survey (VATS) was undertaken by the Transport Research Centre from 1994 through 2002. The current study uses data from 1994 through 1997 (to synchronise with the Time-Use Survey conducted in 1997). The VATS survey used a self-completion questionnaire, seeking travel and activity details from all members of the household for one pre-specified travel day. The survey questionnaires were mailed out and mailed back. Non-respondents received up to four reminder mailings. On each reminder, the Travel Day was moved forward one week, so that it remained on the same day of the week, but was a week later with each reminder.

The overall percent immobile in each VATS survey is shown in Table 1. It can be seen to hover around the 20-21% mark in each of the years.

Table 1 % Immobile in each VATS Survey 1994-97

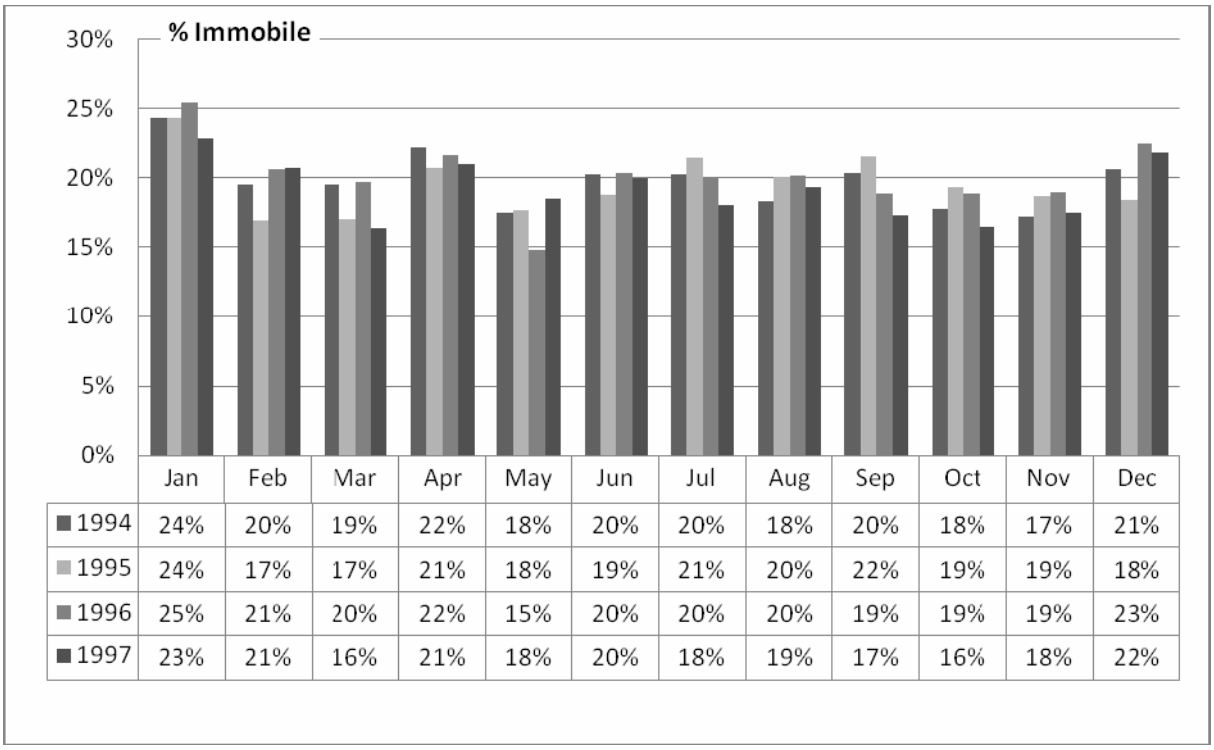
	1994	1995	1996	1997
% Immobile	21%	20%	21%	20%

While the % immobile appears to be very consistent, there are in fact some significant variations within the data that need to be accounted for before the results for VATS can be compared with other surveys. For example, VATS was conducted over seven days of the week and across all 12 months of the year. The variation in % immobile across the days of the week and the months of the year are shown in Figures 2 and 3.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1994	20%	19%	17%	17%	19%	25%	31%
1995	18%	17%	17%	17%	16%	22%	29%
1996	18%	19%	18%	18%	18%	25%	30%
1997	18%	16%	18%	17%	17%	23%	30%

Figure 2 % Immobile by Day of Week
(Source: VATS 1994-1997)

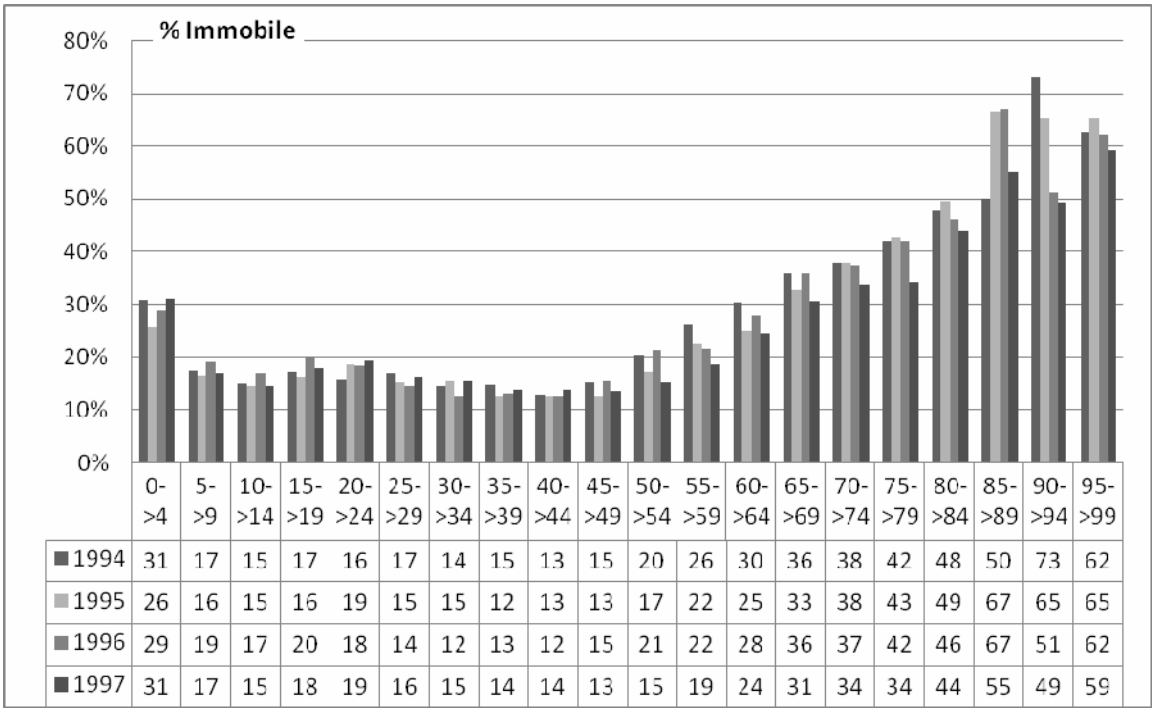


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1994	24%	20%	19%	22%	18%	20%	20%	18%	20%	18%	17%	21%
1995	24%	17%	17%	21%	18%	19%	21%	20%	22%	19%	19%	18%
1996	25%	21%	20%	22%	15%	20%	20%	20%	19%	19%	19%	23%
1997	23%	21%	16%	21%	18%	20%	18%	19%	17%	16%	18%	22%

Figure 3 % Immobile by Month of Year
(Source: VATS 1994-1997)

It can be seen in Figure 2 that the % immobile falls very slightly over the course of the week, but then rises substantially on weekends. In Figure 3, it can be seen that the % immobile is higher during holiday periods of the year (January, April and December). In comparing VATS with other surveys, therefore, care needs to be taken to ensure that the data is collected over comparable periods of time.

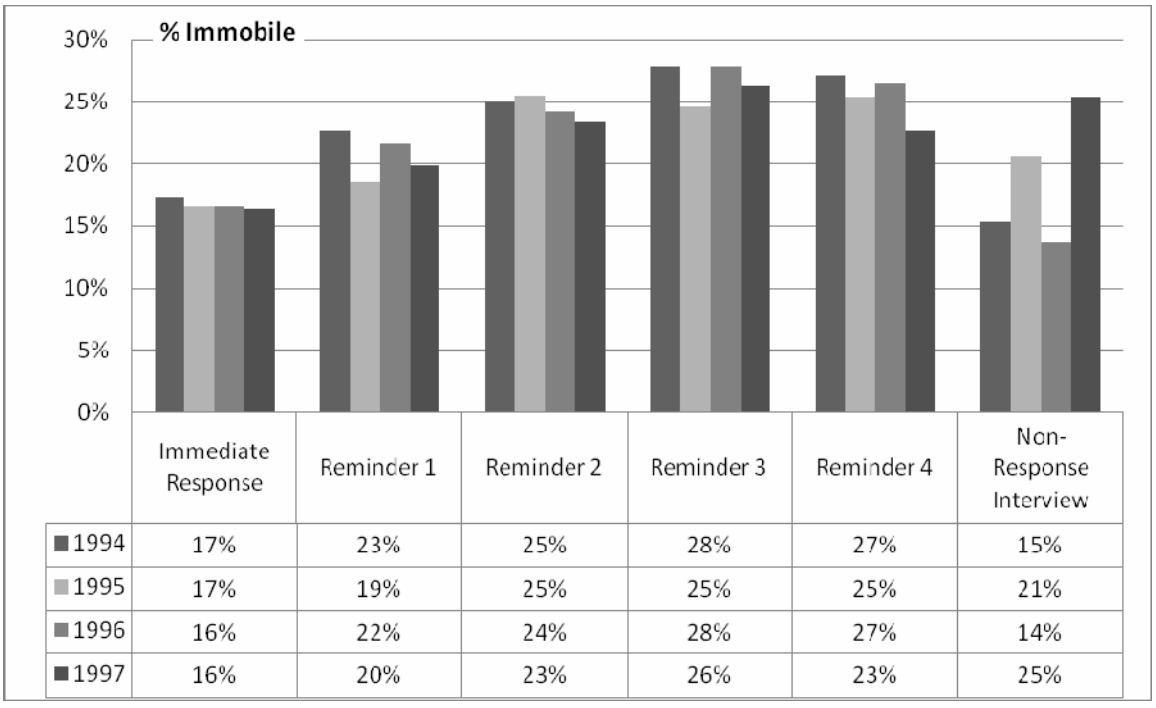
The % immobile also varies substantially by age of the respondent. As shown in Figure 4, the very young (under 5) and the older groups (above 50) show higher propensity to be immobile on their Travel Day. Comparisons with other surveys therefore need to be made for comparable age groups.



	0->4	5->9	10->14	15->19	20->24	25->29	30->34	35->39	40->44	45->49	50->54	55->59	60->64	65->69	70->74	75->79	80->84	85->89	90->94	95->99
1994	31	17	15	17	16	17	14	15	13	15	20	26	30	36	38	42	48	50	73	62
1995	26	16	15	16	19	15	15	12	13	13	17	22	25	33	38	43	49	67	65	65
1996	29	19	17	20	18	14	12	13	12	15	21	22	28	36	37	42	46	67	51	62
1997	31	17	15	18	19	16	15	14	14	13	15	19	24	31	34	34	44	55	49	59

Figure 4 % Immobile by Age of Respondent
(Source: VATS 1994-1997)

Another significant difference in the VATS data occurs as a result of the reminder regime used in that survey, as shown in Figure 5.



	Immediate Response	Reminder 1	Reminder 2	Reminder 3	Reminder 4	Non-Response Interview
1994	17%	23%	25%	28%	27%	15%
1995	17%	19%	25%	25%	25%	21%
1996	16%	22%	24%	28%	27%	14%
1997	16%	20%	23%	26%	23%	25%

Figure 5 % Immobile by Speed of Responding to Survey
(Source: VATS 1994-1997)

For those households that did not respond immediately to the survey, a reminder letter was sent asking them to complete the survey for the same day of week as the original request, but one week later. If they still did not respond, a second, third and fourth reminder was sent, each time asking them to respond for a new travel day. For those who had not responded after the fourth reminder, a sample was selected for a follow-up non-respondents survey, which was conducted by personal interview. Previous research (Richardson, 2003) has shown that the main effect of the reminder regime was to allow respondents to choose the Travel Day about which they reported their travel. With each successive reminder, respondents had another opportunity to report about a low-activity travel day in a completely truthful manner. As a result, as shown in Figure 5, the % immobile appears to increase with each reminder, from a value of about 16% for immediate respondents up to 25% for those responding to the fourth reminder. When selected in the non-respondents interview, however, the % immobile returned to an average of 16% because respondents no longer had the opportunity to select their own Travel Day.

Therefore, in comparing VATS with other survey data, consideration needs to be given to the extent to which respondents were able to choose their own day on which they reported their travel and activities.

A number of other factors should also be considered when comparing immobility from different data sources. One consideration when comparing data sources is the duration of the reporting period. The VATS surveys asked respondents to report their travel behaviour on one day only. However, most of the surveys to the left of Figure 1 above, with % immobility less than 10%, were from surveys of more than one travel day, with some of these surveys having reporting periods varying from 7 days up to 6 weeks. Clearly, the % immobile will fall as the reporting period of the survey increases, and will approach the percentage of the community who are long-term immobile (rather than just not travelling on their travel day).

A second consideration is the effort placed on recruiting low-mobility households into the survey. Some surveys allow respondents to opt out of the survey on the grounds that "they don't travel very much" and therefore would not contribute much to a travel survey. Unless special efforts are made to keep these households in the survey, the % immobile will be artificially lowered because their zero-trip day will not appear in the data set.

A third consideration is how respondents who are out of the survey study area on the Travel Day are treated. Some surveys treat these respondents as Sample Loss and simply remove them from the sample. However, if the sample data is to be expanded to Census counts of total households in the area, then they should be included as households who made no trips on the Travel Day in the Study Area. If this is not done, then the % immobile will be artificially lowered and the average trip rate will be artificially increased when the sample data are expanded to population totals.

Finally, one needs to consider the effect of incentives. Axhausen and Madre (2003) claim that the use of incentives should reduce the measured % immobile (because of reduced soft refusals) because "the gift places a stronger social obligation of full reporting on the recipient". While this may be true for a well-designed up-front, unconditional incentive, many surveys use the promise of a gift as an incentive to complete the survey, and this can prove to be totally counter-productive. In a pilot survey for the recent Perth and Regions Travel Survey (PARTS), a prize draw was used as an incentive for those respondents who completed and returned the questionnaire. The incentive was successful in improving the response rate, but analysis of the travel data showed a % immobile of about 30%, compared to an expected value of around 15%. Follow-up interviewing with respondents revealed that many "respondents" were using the questionnaire as a lottery ticket to enter the prize draw, and the easiest way to "complete" the survey was simply to report that they had not travelled. Not surprisingly, the incentive was dropped from the main survey.

2.2 ABS Time Use Survey Immobility

The 1997 Australian Time Use Survey (TUS) was conducted by the Australian Bureau of Statistics and examined how people allocate time to different kinds of activities (ABS, 1998). The survey was conducted at four time intervals during 1997 in order to balance seasonal influences which affect patterns in the way people use their time. Since time use may vary according to the day of the week and particularly between weekdays and weekends, all days of the week were surveyed in equal proportions, in a 13-day period in each of the four seasons of the year, with school and public holidays represented in approximately the same proportion as they occurred during the year. Diaries were completed on two pre-specified days for each respondent, and placement of diaries was made no earlier than three days before the first specified day.

The survey covered residents of private dwellings in urban and rural areas across all States and Territories of Australia. All households within selected dwellings were included in the survey and all persons aged 15 years or older were in scope. Usual residents of selected private dwellings were included in the survey if they were staying at, or had stayed at, the selected dwelling for any part of that quarter's enumeration period. Usual residents who were absent from the dwelling for the whole collection fortnight were excluded. Over 4,500 households (8,600 people) were included in the sample.

Trained ABS interviewers collected information from an adult member of the household about all persons aged 15 years or more in the household. A diary was then left for each of these persons to record their activities over two specified days. The diary was designed to collect information on a respondent's activities, their nature, timing and duration. Instructions and two completed sample pages at the beginning of the diary gave respondents an idea of the type of information and level of detail required. The diary was divided into two separate days, with fixed intervals of five-minutes covering 24 hours from 12 midnight. Five columns with question headings organised responses into main and simultaneous activities, for whom the activity was done, who else was there and where the activity took place. Diaries were collected by the interviewer on a return visit.

The diaries required an intensive editing process. The processing task involved sorting the reported activities into “episodes”, editing where necessary and recording episodes into a database using a tailored computer program. An episode contains the following elements:

- start and finish time;
- main activity;
- simultaneous activity;
- person or group 'for whom' the activity is done;
- location;
- mode of transport for travel items;
- technology/communication code where relevant;
- who was with the respondent; and
- the age and health details of any household people present.

From this database on episodes, records were extracted to describe the travel patterns of respondents on their specified recording days.

While a previous study in Melbourne (Ironmonger and Norman, 2006) has compared VATS and the TUS, the emphasis in that study was on the amount and type of travel undertaken, and not the counterview considered in this paper of the proportion of people not travelling.

From this TUS data, estimates of immobility were calculated. The overall % immobile in TUS1997 was 12.5% (where each of the two days recorded for each respondent were considered as separate entities; i.e. the 12.5% immobility was based on each day of data and was not a measure of the proportion that did not travel across both their reported days). The immobility level was slightly different on the two days, with the first day having an immobility rate of 12.0%, while the second day had an immobility rate of 13.1%.

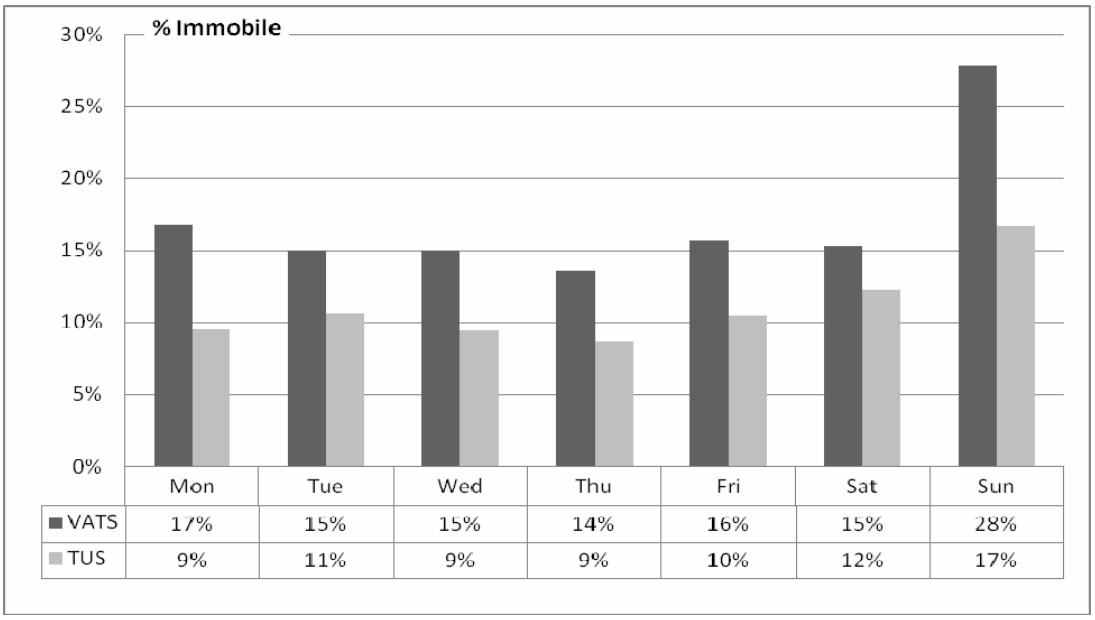
Since the TUS was conducted across all of Australia, the results had to be considered by region type (since VATS was only conducted in Melbourne). In capital cities and major urban areas, the % immobile in TUS was only 11%, while it was 12.5% in regional cities and 18.2% in rural areas. Note that in the following analyses, it is assumed that the Melbourne immobility rate in the TUS is the same as the Australia-wide capital city immobility rate.

2.3 Comparison of VATS and ABS Time Use Survey Immobility

In attempting to compare immobility rates from the VATS and TUS data, both data sets need to be modified to establish a comparable sample base. For example, the TUS data contains diaries only from those over 15, and hence the VATS data needs to be censored to exclude those under 15. On the other hand, VATS is only from the Melbourne metropolitan area, and hence the TUS data has to be constrained to capital city data only (as the best approximation to Melbourne-only). In addition, because of the effect of the reminder (and the self-selection of the Travel Day in VATS), only the data from the Immediate Responses will be used in this comparison. Since the VATS 1994-97 data showed no major trends over time in Section 2.1, the average across all four years of data is used in the following comparison.

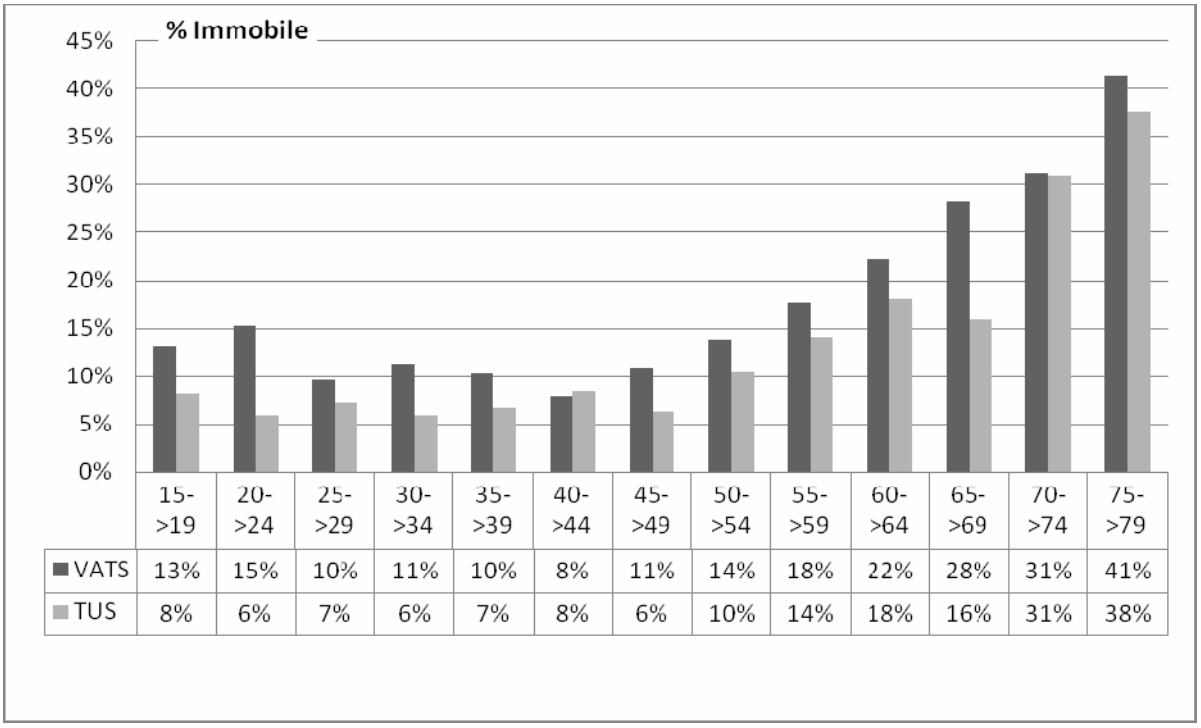
With these modifications of both data sets, the VATS data has 17% immobiles compared to 11% immobile in the TUS data. These overall results are similar to those reported by Armoogum et al. (2004) for France and Belgium, where they found 17% for the travel survey and 8% for the time use survey in France, and 22% and 14%, respectively, in Belgium. It therefore appears to be a common finding that TUS give lower levels of immobility than travel surveys.

To investigate why TUS give lower levels of immobility than travel surveys, consider the levels of immobility as a function of a range of variables. Figures 6 through 10 show % immobile from VATS and TUS as a function of day of week, age of respondent, gender of respondent, activity status of respondent and number of persons in the respondent's household. It can be seen that, with few exceptions, the two data sets show similar variations, but with the VATS data typically having about 50% greater immobility than the TUS data. Thus, immobility rates are higher on weekends, especially Sunday; older people have higher immobility rates; females are more immobile; those out of the workforce have higher immobility than those in the workforce; while person from larger households tend to have lower immobility than those from smaller households. It appears, however, that there is no particular segment that has a particularly different level of immobility in the two data sets.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
VATS	17%	15%	15%	14%	16%	15%	28%
TUS	9%	11%	9%	9%	10%	12%	17%

Figure 6 % Immobile by Day of Week
(Sources: VATS 1994-1997 and TUS 1997)



	15->19	20->24	25->29	30->34	35->39	40->44	45->49	50->54	55->59	60->64	65->69	70->74	75->79
VATS	13%	15%	10%	11%	10%	8%	11%	14%	18%	22%	28%	31%	41%
TUS	8%	6%	7%	6%	7%	8%	6%	10%	14%	18%	16%	31%	38%

Figure 7 % Immobile by Age of Respondent
(Sources: VATS 1994-1997 and TUS 1997)

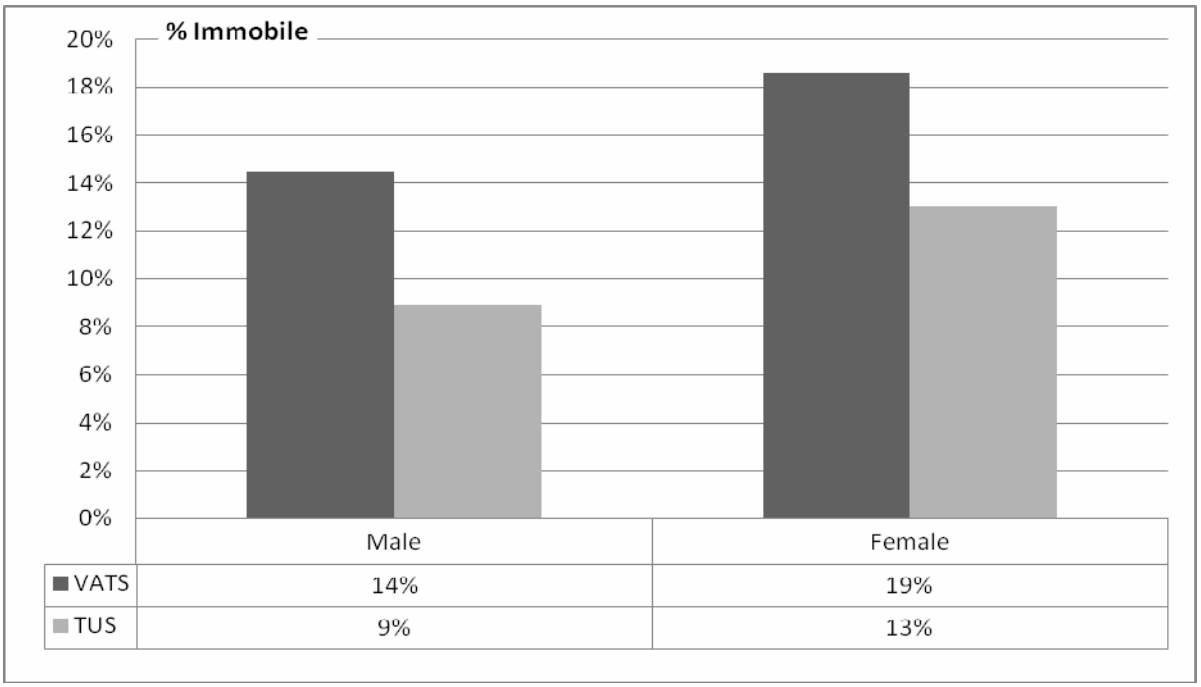


Figure 8 **% Immobile by Gender of Respondent**
(Sources: VATS 1994-1997 and TUS 1997)

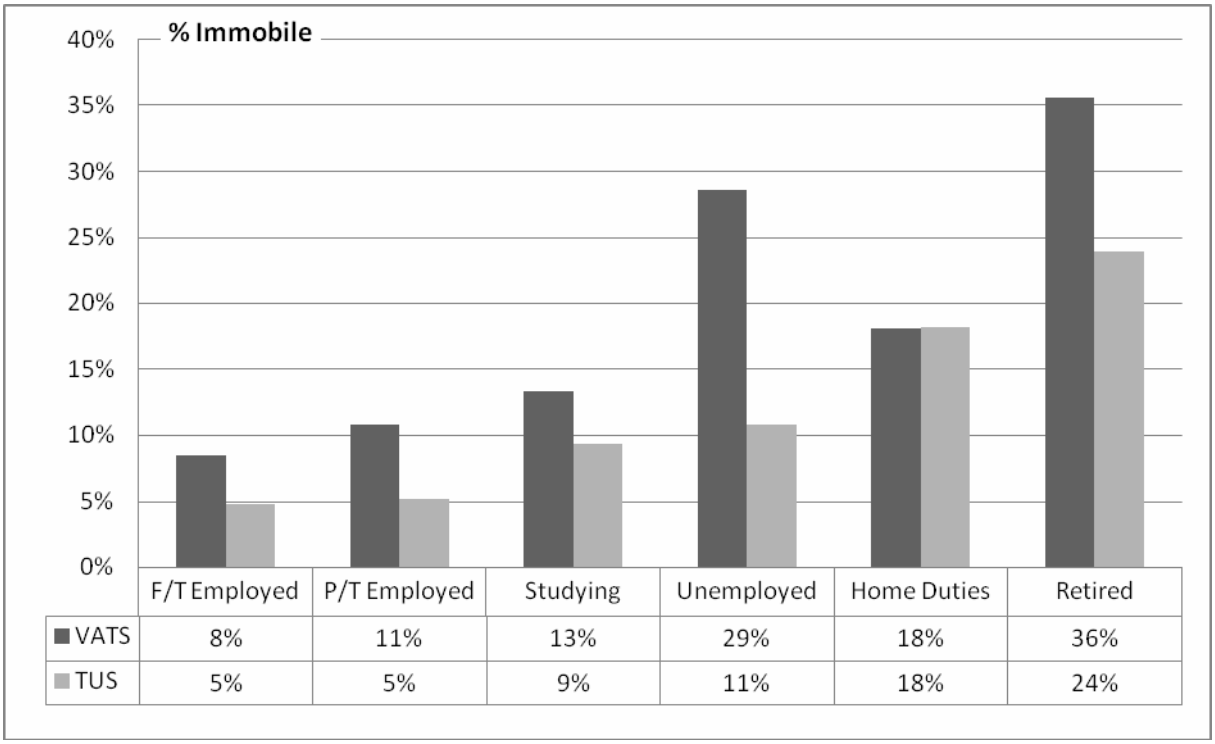
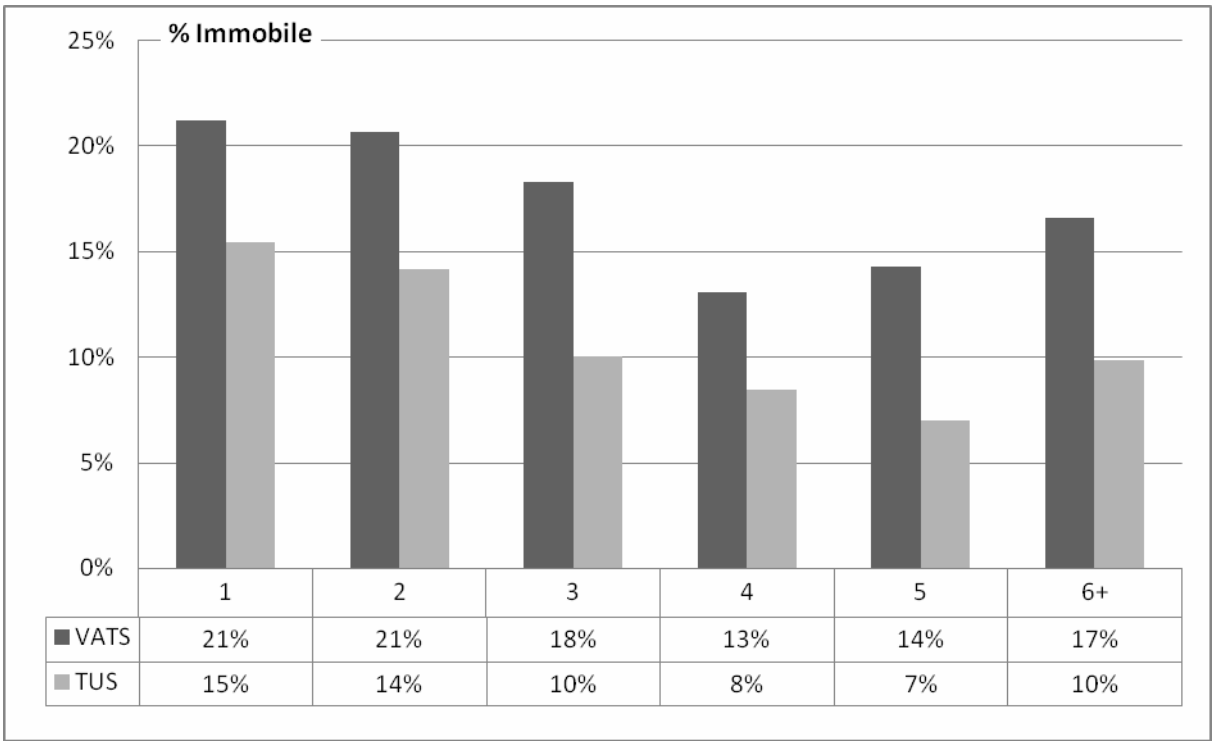


Figure 9 **% Immobile by Activity Status of Respondent**
(Sources: VATS 1994-1997 and TUS 1997)



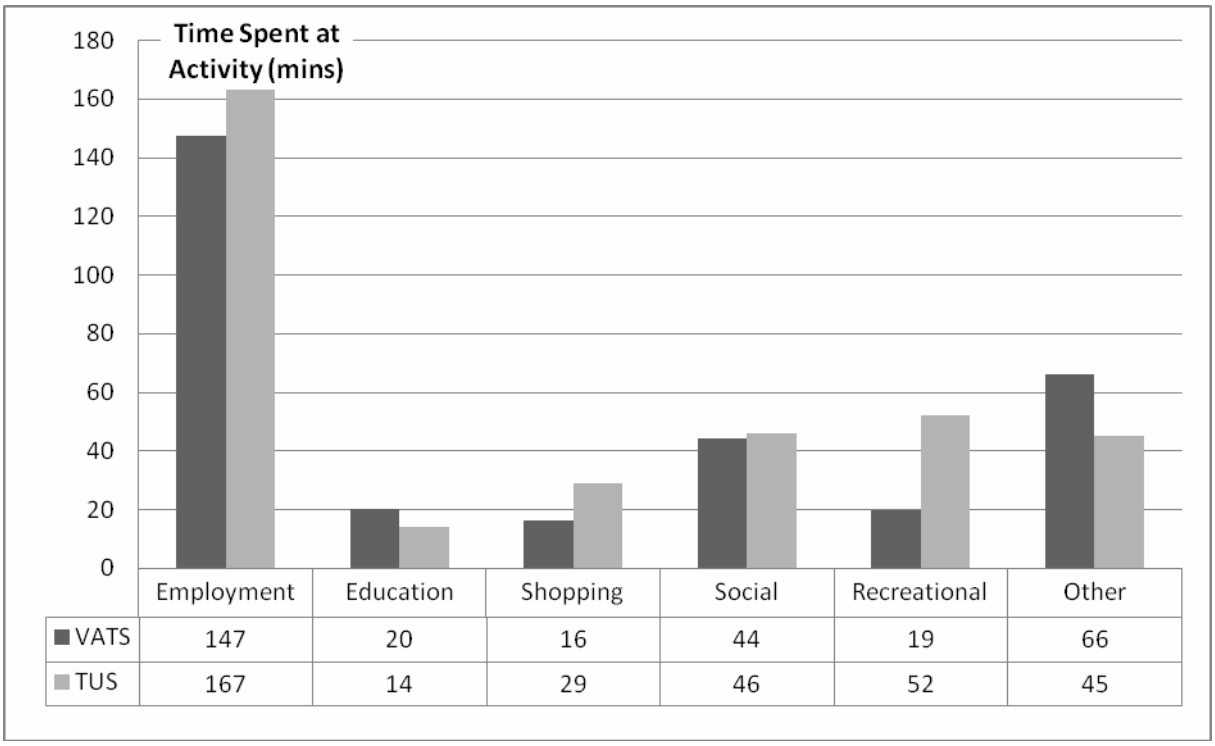
	1	2	3	4	5	6+
VATS	21%	21%	18%	13%	14%	17%
TUS	15%	14%	10%	8%	7%	10%

Figure 10 % Immobile by Household Size
(Sources: VATS 1994-1997 and TUS 1997)

If the immobility levels in VATS are 50% higher than in TUS, the question remains as to what type of trips and out-of-home activities are potentially missing from the data. To examine this issue, the travel and out-of-home activities from the TUS are compared with the comparable data from VATS. It is not possible to make strict comparisons because the TUS data pertains to all Capital Cities and not just Melbourne, and the definition of activity purposes is not exactly the same in both surveys. Nonetheless, such a comparison may prove to be informative in determining whether the higher levels of immobility measured in VATS have a significant effect on the travel and activity patterns measured in the survey.

The measure of travel used in these comparisons is the time spent travelling. This is necessary since the TUS only measures time, and not distance, involved in travel (and activities). It has also proved to be a more reliable measure of travel activity. Overall, those aged 15 and above who responded in the first wave to VATS spent an average of 71 minutes per day involved in travel, while the same age cohort in the TUS spent an average of 80 minutes per day travelling. Thus, while VATS had a 50% higher immobility rate, it only has a 9% deficit in terms of average daily travel time. It would appear that if some people in the VATS survey are taking the easy way out by saying they don't travel at all on the Travel Day, then they must only have been light travellers since the omissions of their travel does not significantly affect the average daily travel time.

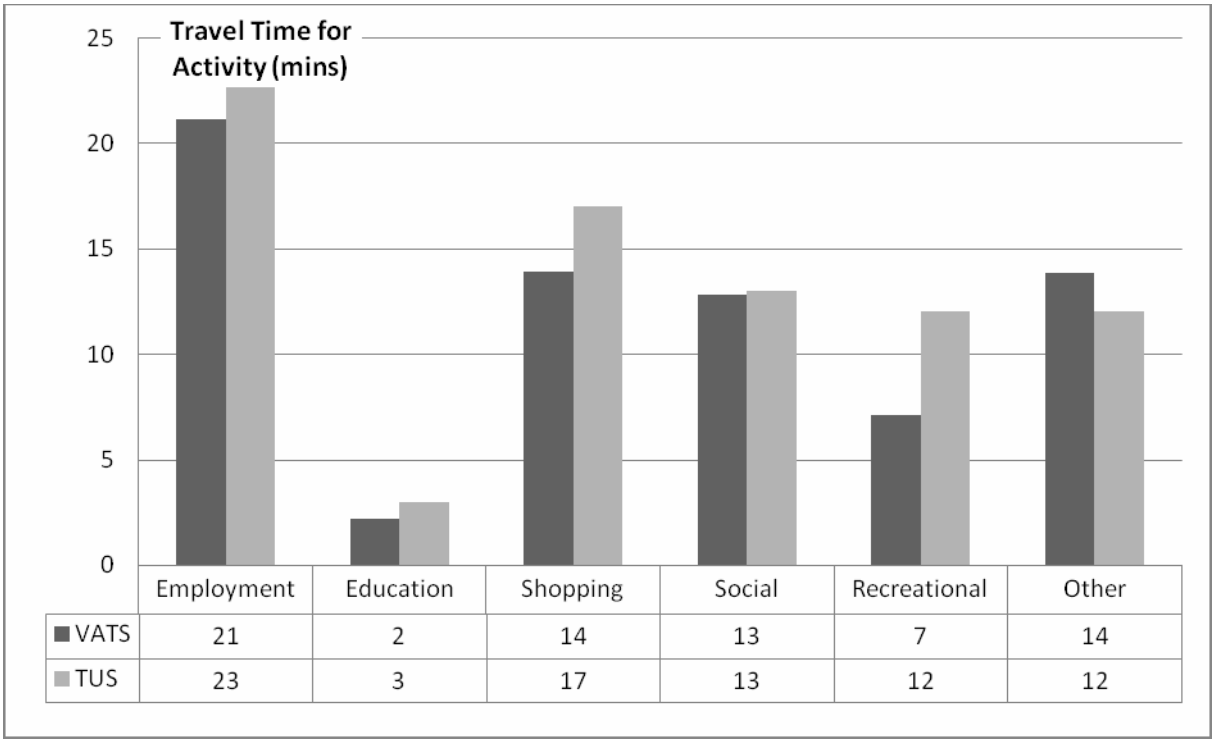
If VATS respondents are failing to tell us about their travel, they must also be failing to tell us about their out-of-home activities. While they are 9 minutes short in travel time (compared to the TUS), they are 39 minutes short in out-of-home activities (314 minutes in VATS, compared to 353 minutes in TUS), resulting in an 11% deficit in time spent on out-of-home activities. Once again the activities that might not be reported are those that are shorter in duration. The distribution of out-of-home activity time is shown in Figure 11. It can be seen that the VATS and TUS data accord fairly well, with the exception of Recreational activities, where the TUS appears to have substantially more of these activities. However, this is mainly due to definitional issues between the two surveys, where, for example, the TUS records talking on the phone (away from home) as a recreational activity.



	Employment	Education	Shopping	Social	Recreational	Other
VATS	147	20	16	44	19	66
TUS	167	14	29	46	52	45

Figure 11 Average Time spent at Out-of-Home Activities
(Sources: VATS 1994-1997 and TUS 1997)

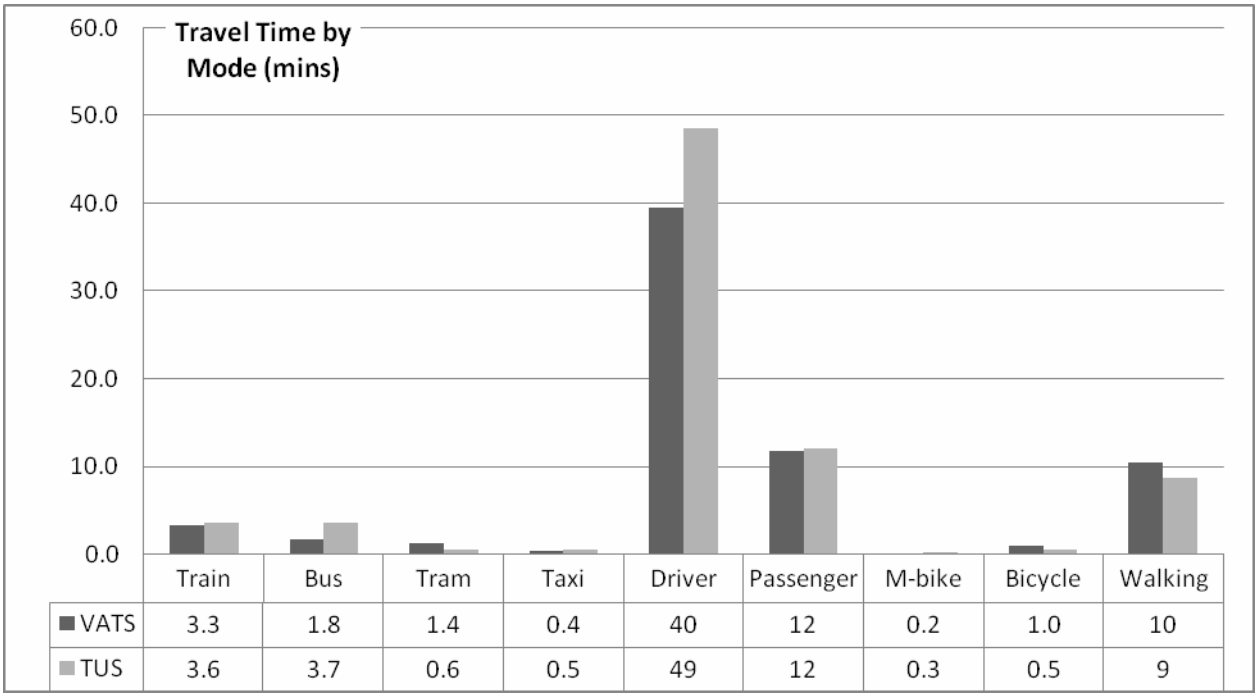
The travel time spent getting to and from these activities is shown in Figure 12. Once again, there is fairly good agreement between the two surveys, with the exception of travel time getting to and from recreational activities.



	Employment	Education	Shopping	Social	Recreational	Other
VATS	21	2	14	13	7	14
TUS	23	3	17	13	12	12

Figure 12 Average Travel Time associated with Out-of-Home Activities
(Sources: VATS 1994-1997 and TUS 1997)

Finally, the travel time spent on various modes of transport is shown in Figure 13. Allowing for the fact that Melbourne has more tram use and less bus use than other capital cities, the overall percent use of public transport is fairly close, as are all the other modes except for car driver, which appears to be under-represented in VATS.



	Train	Bus	Tram	Taxi	Driver	Passenger	M-bike	Bicycle	Walking
VATS	3.3	1.8	1.4	0.4	40	12	0.2	1.0	10
TUS	3.6	3.7	0.6	0.5	49	12	0.3	0.5	9

Figure 13 Average Travel Time by Mode of Transport
(Sources: VATS 1994-1997 and TUS 1997)

The above comparisons show that while the % immobility rate in VATS is significantly higher than in TUS (suggesting that some people are using the "did not travel" option as a form of soft refusal), the effect on daily travel time and out-of-home activity time is less pronounced, because the travel and activities that are not being reported are shorter in average duration than the travel and activities that are being reported. These "soft refusals" might therefore not be having a major effect on reported travel patterns.

3 Conclusions

This paper has examined the reported level of immobility (i.e. a respondent not reporting any travel on their Travel Day) in a typical household travel survey (VATS) and in the ABS Time Use Survey. The overall levels of reported immobility have been compared, as well as the reported immobility by demographic group and other characteristics. The reported mobility was then examined, with respect to the daily travel time and the time spent at out-of-home activities.

For comparable demographic groups (aged 15 and over) these comparisons show that the % immobility rate in VATS is significantly higher (17%) than in TUS (11%), suggesting that some people are using the "did not travel" option as a form of soft refusal to the travel survey. While the magnitude of the immobility rate is different in the two surveys, there are similar patterns with respect to demographics and other variables. For example, immobility is higher on weekends (particularly Sundays), it is higher for people aged over 50, higher for females, higher for those out of the workforce and higher for people in smaller households.

The effect of these "soft refusals" on daily travel time and out-of-home activity time is less pronounced, because the travel and activities that are not being reported are shorter in average duration than the travel and activities that are being reported. Average daily travel

time (for those over 15) in VATS is 71 minutes, compared to 80 minutes in the TUS, while the average time spent at out-of-home activities in VATS is 314 minutes, compared to 353 minutes in the TUS. These "soft refusals" might therefore not be having a major effect on reported travel patterns.

This study, like those of Ironmonger and Norman (2006), Richardson et al. (2005a) and Richardson et al. (2005b), has demonstrated the value of using multiple datasets to examine the same issue. Using different methodologies to collect similar data minimises the impact of any specific methodological bias in any of the data collection methods, and often casts new light on a familiar problem.

The analysis highlighted the impact of some survey design features on reported mobility and immobility. For example, the use of the repeated reminders in VATS was useful in improving the overall response rate, but had the unintended effect of increasing the reported immobility and decreasing the reported mobility. It also indicated some design changes that might prove useful in discouraging the reporting of "no travel" as an easy way to end the survey. For example, since VATS, also surveys designed by TUTI have including questions after the "no travel" question to identify the reason for not travelling on the Travel Day and to find out when that person last travelled. This has resulted in a reduction in the reported immobility.

The study has also shown the importance of using different measures of mobility when interpreting travel survey data. Traditional analyses use trip rates as measures of mobility, but this can give very different results compared to using travel time or travel distance as measures of amounts of travel.

Finally, the topic of "immobility" is assuming increased importance as the planning process focuses more on the sustainability and social inclusion of transport systems. In the former situation, one is attempting to reduce overall travel for environmental reasons, while in the latter situation one is attempting to ensure that those in the community who truly are disadvantaged are given every opportunity to travel to economic and social activities in order to minimise their social exclusion. In both cases, however, one needs to ensure that true levels of immobility are being measured, and not artificially depressed levels of reported immobility.

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