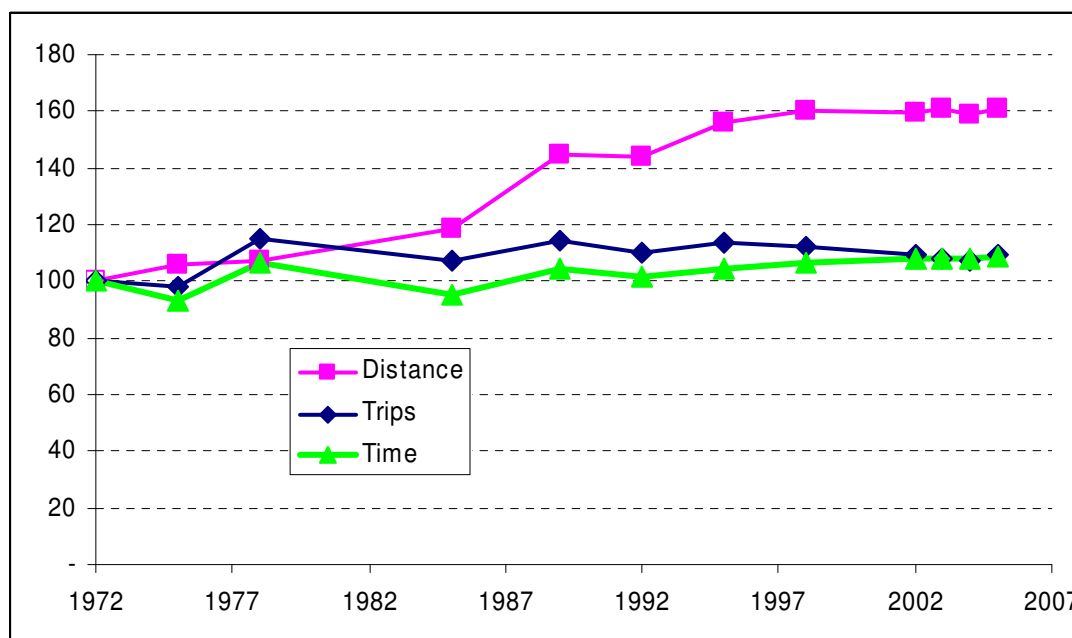


# Consistency in Daily Travel Time – An Empirical Assessment from Sydney Travel Surveys

Frank Milthorpe  
 Transport Data Centre, NSW Ministry of Transport

## 1 Introduction

A number of studies have observed remarkable consistency in total daily travel time. Goodwin (2005) provides a history of the idea of consistency of travel time and how it has been suggested that it is a fundamental property. Goodwin concludes that we have robust empirical evidence to support the idea, but limited understanding of why this is the case. Great Britain has undertaken national travel surveys for a number of years. Figure 1 shows the annual distance, trips and travel time undertaken by an individual in a year, normalised to the values for the 1972/73 survey.



Data from 1995 onwards have been weighted, causing a one-off uplift between 1992/94 and 1995/97.

**Figure 1 Annual per Person Travel Characteristics from Great Britain National Travel Surveys 1972/73 to 2005**

Source: Department for Transport (2006) Table 2.1

As can be seen in Figure 1, there has been remarkable consistency in travel time in Great Britain over many years. Hubert and Toint (2006) found that many Western European studies have also observed consistency in daily travel time, however it is on the increase in the USA. However, van Wee et al (2002) found that average travel time in the Netherlands increased by 4.9 minutes between 1979 and 1998.

Sydney has undertaken travel surveys over a number of years. This paper investigates whether the constant “daily travel time budget” phenomena can be observed for Sydney and compares the results with those found in international studies.

## 2 Some Explanations for Constant Travel Time

Goodwin (2005) and Hubert and Toint (2006) attribute Zahavi with his work in 1977 as first noticing constant travel time. Mokhtarian and Chen (2004) provide a summary of the literature written on the concept of travel time budget. A number of researchers have offered explanations for this phenomenon with van Wee et al (2002) providing a summary of some of the key theories.

### 2.1 Explanations for Constant Travel Time

*Reductionist explanations:* The reductionist approach explains that human behaviour is linked to physiological factors and that there is a need for a minimum level of exercise to stimulate muscles in a complex system of hormones related to the costs of travel and benefits in biological clocks.

*Reconstructive explanations:* The reconstructive approach explains human behaviour in mathematical ways based on theoretical assumptions of behaviour. This human behaviour arises from (economic) rational behaviour and can be explained as maximising utility.

*Contextualising explanations:* The contextualising approach explains human behaviour from a historic, social or geographical perspective. Evolutionary learning may explain travel time budgets.

### 2.2 Reasons to Refute Constant Travel Time

It is nearly always easier to put forward suggestions to refute the rationale of a theory than it is to support it. In the case of constant travel, this is a phenomena that is observed for the “average” of a community. It would seem plausible that constant travel time could apply to the population as a whole, (each person travels about an hour per day) and this would be consistent with the allocation of a daily time budget which “competes” with other activities such as sleep, work, eating, personal care and recreation. With only twenty four hours in the day there is only a limited proportion of the time that can be utilised on travel. This is consistent with the concept of a travel time budget. However, there is considerable variation within the population. In many larger cities people make a trade-off between the commute time to city centre and housing cost. Some people are in the workforce, whilst others are not. Prima facie there would appear to limited explanations as to why people would “trade” their “spare” travel time with each other. That is, there would appear to be no reason why the travel time of one individual would impact, either by increasing or decreasing the travel time of another person. In cities with congestion there will be some feedback, however this is the opposite effect, the more an individual travels, the greater the travel times of everyone else *ceribus paribus*. In the author’s view, as a first order approximation, travel time can be seen as a public good and its consumption by one individual does not reduce the level of consumption by others.

In large urban areas, the majority of travel is usually by private motor vehicle. However, there is a considerable proportion of people who travel by public transport. In recent years there have been increased opportunities to use the time spent travelling to also undertake other activities, for example make phone calls. With the evolution of technology, public transport users can use laptop computers for a variety of work purposes including accessing the Internet. At the other extreme, laptop computers can also be used to watch downloaded Television programs and/or DVDs. With mobile phones it is possible for people to both travel and undertake communication (whether for work or personal reasons) concurrently. With this range of options for utilising the travelling time it does not seem unreasonable to suggest that the disutility of travelling may reduce as people have more flexibility in the way they use their travelling time.

### 3 Sydney Analysis

Household Travel Surveys have been undertaken in the greater Sydney area over a number of years. These included the “traditional” one-off large scale surveys undertaken in 1971, 1981 and 1991 (Transport Study Group 1993). Since 1997 the continuous Household Travel Survey has been undertaken in Sydney. All of these surveys have collected data using the face to face survey methodology using a travel diary that the respondent uses as a memory jogger.

The Sydney travel surveys record details of each individual trip that a respondent undertakes on their survey day. This includes the time that the trip commenced, the time the trip finished, the mode of travel and the purpose of travel. Respondents to the Sydney surveys tend to round the times that journeys commence and finish to multiples of 5, 10 and 15 minutes, a finding observed in many travel surveys (Rietveld 2002). In addition to the time spent travelling between locations, in some cases (more common with public journeys) there will be time spent waiting for services.

The 1981 survey was conducted during the period from the end of July 1981 to the start of January 1982 with a mid-point of October 1981. The 1991 survey was conducted during the period from the end of September 1991 to the start of October 1992 with a mid-point of April 1992.

As at June 2007 there are nine completed waves of the continuous travel survey data available. Each wave approximates a financial year, for the example the first wave is from late June 1997 to late June 1998. To enable analysis of larger samples to be undertaken it is possible to combine multiple waves of data. Typically three waves of survey data are combined allowing more stable estimates to be obtained (NSW Department of Planning 2006). When the data from the 1999/2000, 2000/01 and 2001/02 waves are pooled the estimates are referred to as 2001 estimates with the mid-point of the survey data being December 2000. When the data from the 2003/04, 2004/05 and 2005/06 waves are pooled the estimates are referred to as 2005 estimates with the mid-point of the survey data being December 2004.

#### 3.1 Analysis of Travel Time at Aggregate Level

To calculate the time that an individual spends travelling in a day it is simply a matter of summing the duration of each trip and adding any waiting time. These calculations have been undertaken for respondents residing in the Sydney Statistical Division surveyed on a weekday (Monday to Friday). Table 1 shows the average time spent travelling on a weekday in 1981, 1991, 2001 and 2005.

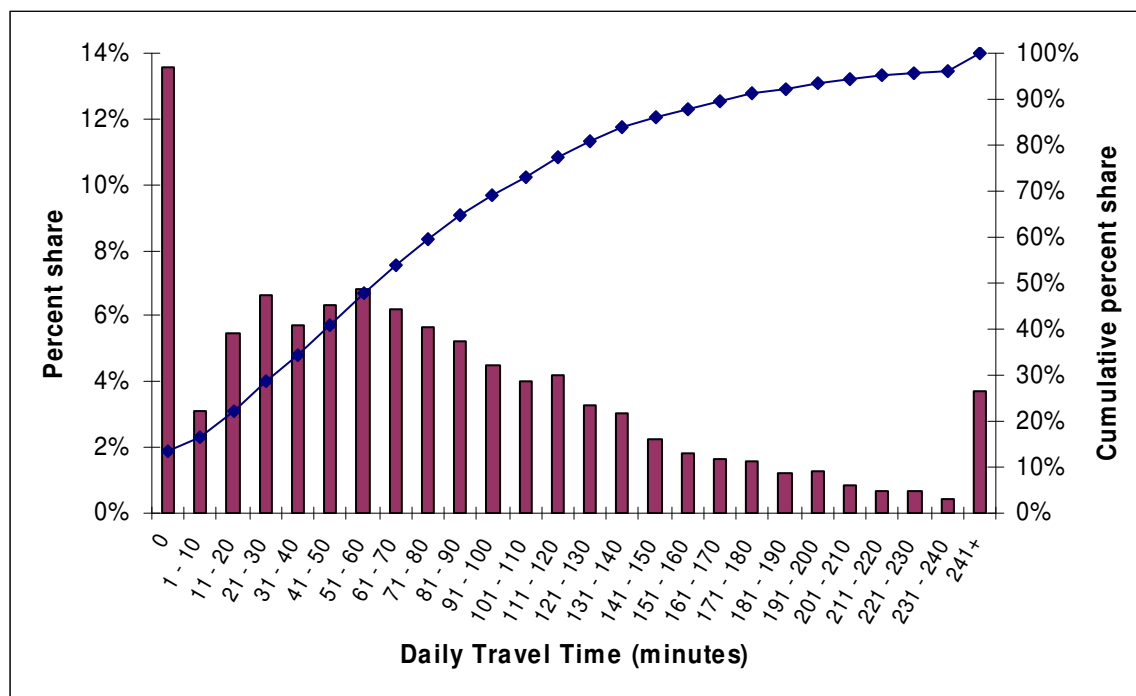
**Table 1 Average Weekday Daily Travel Time in Sydney**

	1981	1991	2001	2005
Mean	73.2	73.2	78.8	81.0
Standard Deviation	75.0	73.4	77.9	75.8
Standard Error	0.35	0.51	0.64	0.64
Number Observations	44,734	20,356	14,970	13,992

From Table 1 it can be seen that the average daily travel time in Sydney was unaltered between 1981 and 1991, however it has increased since then. The 1991 survey was undertaken during the bottom of the economic cycle and hence the estimates from this survey may have been lower than would have obtained if the survey was undertaken a

couple of years earlier or later. Also from Table 1 it can be seen that there is considerable variation in the travel times between individuals as evidenced by the large standard deviations. Figure 2 shows the percentage of people in 2005 with daily travel times in each 10 minute interval. The Figure also shows the cumulative distribution of travel times.

### 3.2 Variation of Travel Time between Individuals



**Figure 2 Daily Travel Time for 2005**

From Figure 2 it can be seen that nearly 4% of people have daily travel time greater than four hours. At the other extreme, nearly 14% of people reported that they undertook zero trips in the day. This wide range of values is expected given that the standard deviation is approximately the same as the mean. To help understand whether the increase observed in mean travel time is because all people are travelling for slightly longer, or if the mean is increasing because of an increase of “excessive” travel by a few is distorting the results, more detailed analysis was undertaken for each of the surveys. These results are shown graphically in Figure 3.

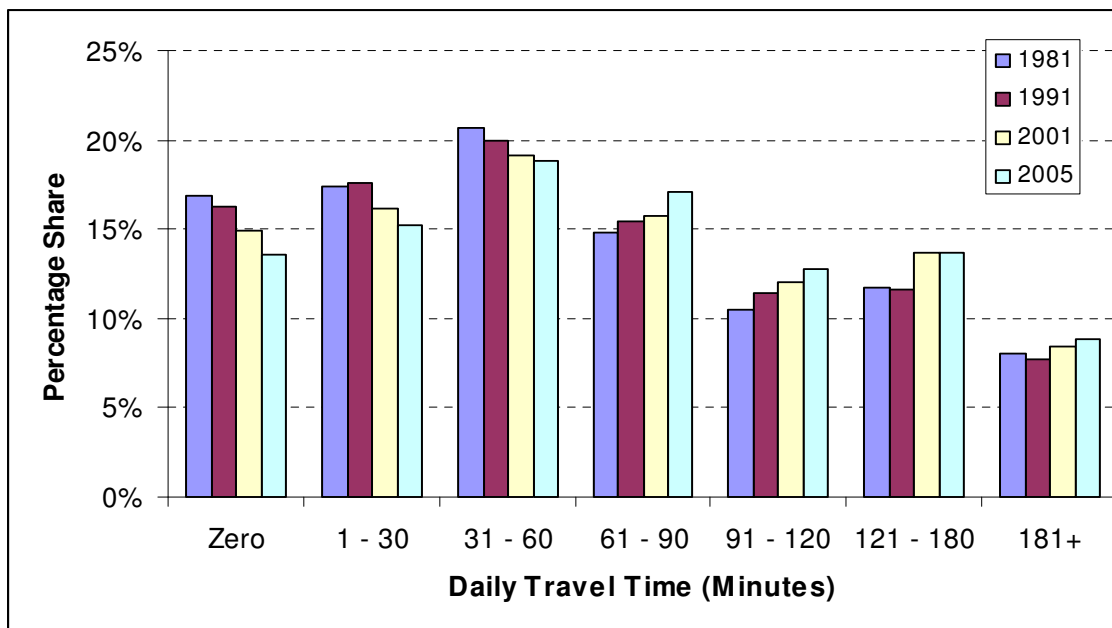


Figure 3 Travel Time Bands for 1981, 1991, 2001 & 2005

From Figure 3 it can be seen that there is a decrease in the number of people who did not travel (zero trippers) over time. This trend in Sydney is in contrast to the results in Denmark where Christensen (2004) observed an increase in the number of zero-trippers. It can also be seen from Figure 3 that over time there has been a consistent decrease in the proportion of people spending less than one hour per travelling, whilst there has been an increase in the number of people spending more than an hour per day travelling. Figure 4 shows the cumulative travel times for the four years.

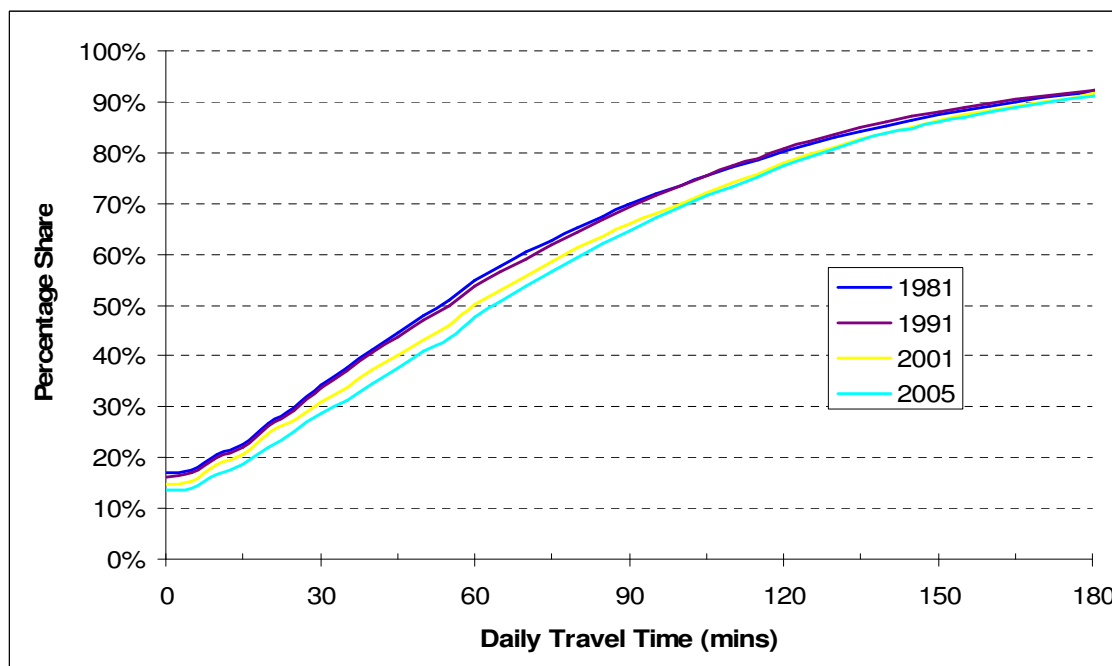


Figure 4 Cumulative Travel Times for 1981, 1991, 2001 & 2005

From Figure 4 it can be seen that a decreasing percentage of people are travelling for a given travel time. Within this Figure, a lower percentage share for a given travel time indicates that more people are travelling for a longer duration. For example, in 1981 55% of the population had a daily travel time of an hour or less. Therefore, 45% of the population had a daily travel time of more than one hour. By 2005, only 48% of the population had a daily travel time of one hour or less, with 52% of the population having a daily travel time of more than one hour. From Table 1 the 1981 and 1991 mean travel times are the same and not surprisingly, the cumulative travel distributions for these two years in Figure 4 are very similar.

As shown in Figure 2 there is considerable variation in the daily travel times between individuals. However, this analysis has not looked at the demographic characteristics of the population and what trends / differences exist between different groups of the population. Figure 5a shows the average daily travel time for different age groups of males, whilst Figure 5b shows the same information for females.

### 3.3 Analysis of Travel Times by Gender and Age

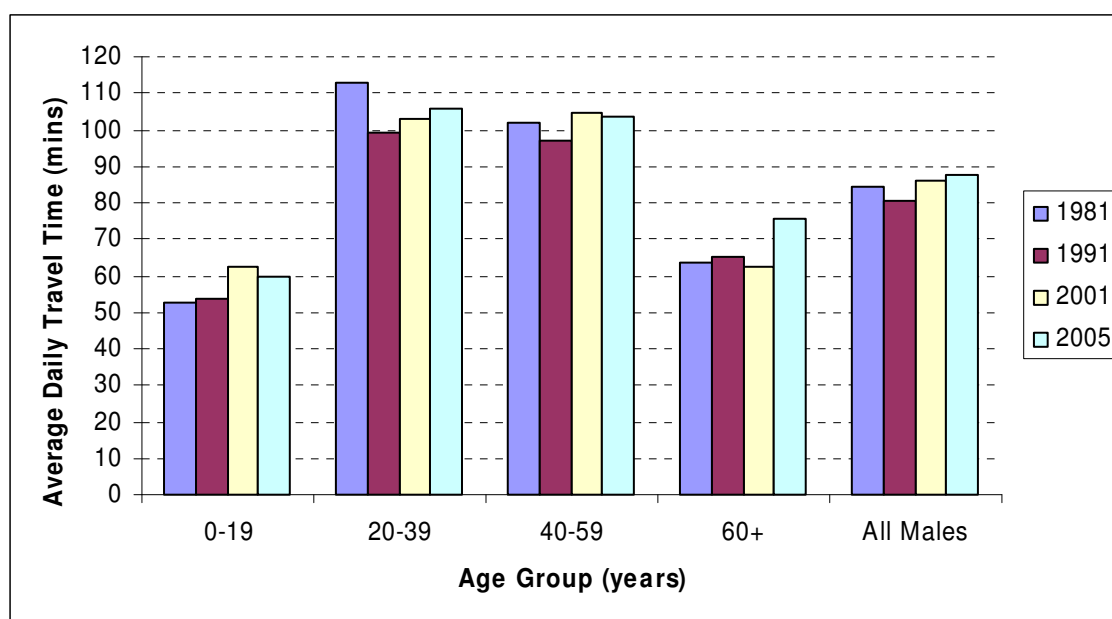
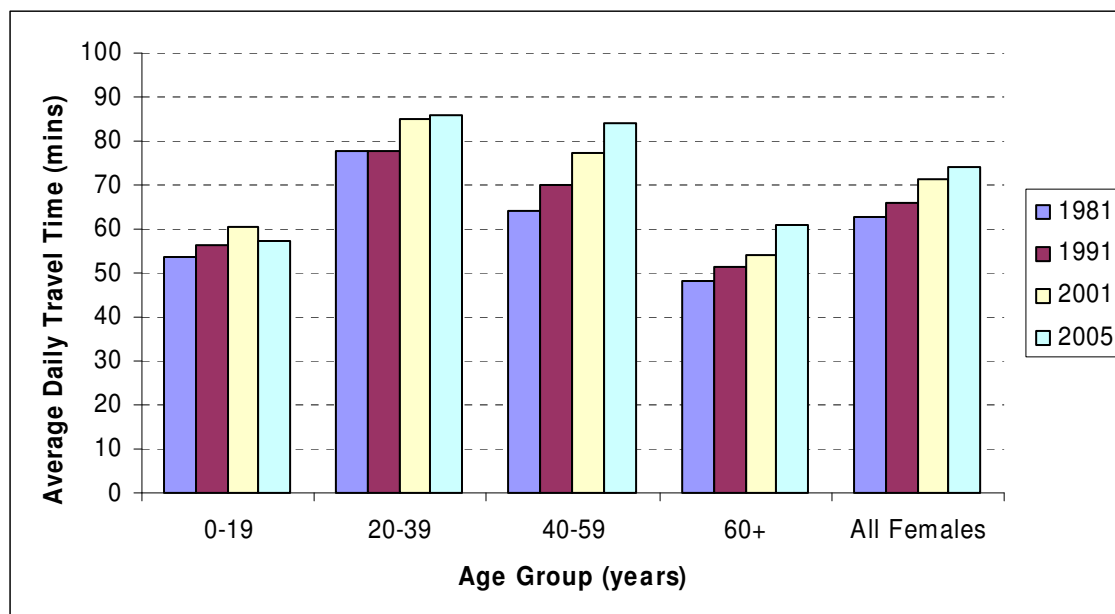


Figure 5a Male Average Daily Travel Times for 1981, 1991, 2001 & 2005 by Age Group



**Figure 5b Female Average Daily Travel Times for 1981, 1991, 2001 & 2005 by Age Group**

From Figures 5a and 5b it can be seen that the females have lower average daily travel times than males. However, the increase in travel times has been much greater for females. During the period 1981 to 2005, average daily male travel times have increased by 3.7 minutes whilst the corresponding increase for females is 11.6 minutes. There are distinct differences in the trends in the different age groups.

In the under twenty age groups in 1981 and 1991 the average travel times for females were slightly higher than for males. However, for 2001 and the 2005 this had been reversed with males having slightly higher average travel times than females. For the under twenty age group the differences in travel times between the genders in each year was quite small with the largest difference being 2.7 minutes in 1991.

In the twenty to under forty age group, males travelled on average for 35 minutes longer than for females in 1981. By 2005, this difference had reduced to just under 20 minutes. This apparent significant reduction arises from the high value of 113 minutes travel time for males in 1981 compared with only 99 minutes in 1991. For the period 1991 to 2005 the difference between the travel times for males and females range from 21 minutes to 18 minutes. This suggests a relatively consistent difference in the travel times between males and females during this period. During this period there has been a gradual increase in both the male and female travel times since 1991.

In the forty to under sixty age group, males travelled on average for 37 minutes longer than for females in 1981. By 2005, this difference had again reduced to just under 20 minutes. For all years for males the travel time is relatively stable within the range 97 to 105 minutes. Meanwhile, the travel times for females have increased from 64 minutes in 1981 to 84 minutes in 2005 in upward trend, which is easy to observe in Figure 5b.

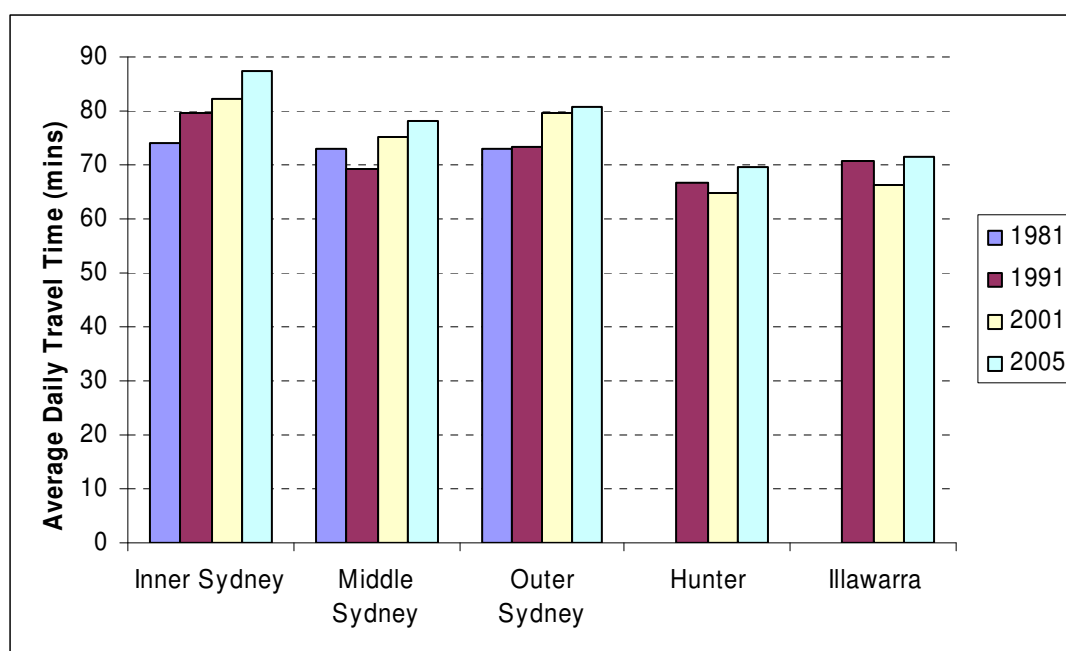
In the over sixty year age group there is an increase in travel times for both genders. The difference in travel times between the genders has remained relatively consistent at around 15 minutes.

Overall, the travel times for females are increasing much more quickly than for males, with the travel times increasing most in the older age groups.

### 3.4 Analysis of Travel Times by Geographic Area

The Sydney travel surveys include details of the location of the household. To assist with understanding the geographic variations, the location of the household has been classified into five broad geographic regions, Inner Sydney, Middle Sydney, Outer Sydney, Hunter and Illawarra regions. The Inner Sydney region is generally up to approximately 10kms from the CBD. The Middle Sydney region is generally from 10 – 25 kms from the CBD, with the Outer Sydney region the remainder of Sydney Statistical Division.

The 1981 survey did not include residents of the Hunter and Illawarra and hence their results have not been included in the analysis presented elsewhere in this paper.



**Figure 6 Average Daily Travel Times for 1981, 1991, 2001 & 2005 by Region**

From Figure 6 it can be seen that there are differences in the daily times between regions. The Hunter and Illawarra regions consistently have lower average travel times than the Sydney regions. This consistent variation would support the view that there is no requirement for consistent travel times for the whole population.

Somewhat surprising from Figure 6 is the highest average daily travel times in the Sydney region are for those people living in the Inner areas. Whilst these residents may have the highest travel times, their average travel speeds are lower than for the other regions of Sydney. Interestingly the residents of the outer region since 1991 have consistently had slightly higher travel times than those of the middle region.

The average daily travel times for the Illawarra have consistently been slightly higher than for the Hunter, albeit the differences in 2001 and 2005 have only been 1.5 minutes. If there was some fundamental “law” of travel time it would be expected that the travel times for all of these regions would be the same.

## 4 Conclusions

Analysis of the Sydney travel surveys have shown that there has been an increase in the average daily travel times in the period 1981 to 2005. This result is consistent with findings from North America and some European countries and in contrast to the findings in Great Britain.

Whilst the analysis and reporting of mean travel time is a convenient measure to summarise the aggregate travel behaviour of many individuals it masks the considerable variation between individuals. We also suspect that there is considerable variation in the travel times of an individual on a day to day basis, however as the Sydney travel surveys are only for a single day it is not possible to obtain data from this source to investigate this hypothesis. From the analysis undertaken there is variation in the daily travel times between genders and age-groups. Also, there is variation between residents of different geographic regions.

Given the considerable changes that have occurred over the 1981 to 2005, it is perhaps remarkable that the average daily times have not increased by more. The analysis undertaken of travel in Sydney supports the broad concept of comparable travel time, however the evidence does not support the concept of constant travel time as a fundamental principle of travel behaviour in Sydney.

## References

- Christensen, L (2004) Possible Explanations for an Increasing Share of No-Trip Respondents, paper presented at The Seventh International Conference on Travel Survey Methods, Costa Rica, 1-6 August available from [www.dtf.dtu.dk/upload/df/engelsk/engelsk/2005/working%20papers/paper0405.pdf](http://www.dtf.dtu.dk/upload/df/engelsk/engelsk/2005/working%20papers/paper0405.pdf)
- Department for Transport (2006) Transport Statistics Bulletin: National Travel Survey: 2005 available from [www.dft.gov.uk/pgr/statistics/datatablespublications/personal/mainresults/nts2005/](http://www.dft.gov.uk/pgr/statistics/datatablespublications/personal/mainresults/nts2005/)
- Goodwin, P (2005) The Remarkable Consistency of Travel Time *Local Transport Today*, page 17, LTT432 8 December
- Hubert, J and Toint, P L (2006) From average travel time budgets to daily travel time distributions: an appraisal of two conjectures by Kölbl and Helbing and some consequences, *Transportation Research Board 2006 Annual Meeting CD-ROM*
- Mokhtarian, P. L. and Chen, C (2004) "TTB or not TTB, that is the question: a review and analysis of the empirical literature on travel time (and money) budgets" *Transportation Research Part A-Policy and Practice*. 38 (9-10), pp. 643-675. Postprint available free at: [repositories.cdlib.org/postprints/38](http://repositories.cdlib.org/postprints/38)
- NSW Department of Planning (2006) *2004 Household Travel Survey Summary Report 2006 Release* available from [www.transport.nsw.gov.au/tdc/documents/hts-2004-2006-release.pdf](http://www.transport.nsw.gov.au/tdc/documents/hts-2004-2006-release.pdf)
- Rietveld, P (2002) Rounding of Arrival and Departure Times in Travel Surveys: An Interpretation in terms of Scheduled Activities, *Journal of Transport and Statistics*, Vol 5 N 1, pp. 77-88 available from [www.bts.gov/publications/journal\\_of\\_transportation\\_and\\_statistics/volume\\_05\\_number\\_01/](http://www.bts.gov/publications/journal_of_transportation_and_statistics/volume_05_number_01/)
- Transport Study Group (1993) Home *Interview Survey Methodology and Data Directory* Report 93/8, TSG

van Wee, B, Reitveld, P and Meurs, H (2002) *A constant travel time budget? In search for explanations for an increase in average travel time* Research Memorandum 2002-31: Faculty of Economic Sciences, Business Administration and Econometrics, Free University of Amsterdam available from [ideas.repec.org/p/dgr/vuarem/2002-31.html](http://ideas.repec.org/p/dgr/vuarem/2002-31.html)