TOPIC 3
SAFETY ANALYSIS
AND POLICY (SIG)

THE TRAVEL OF CHILDREN IN PERSPECTIVE—THEIR EXPOSURE TO THE RISK OF ACCIDENT

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Abstract

The study of children in transport has been an area of relative neglect over the past decades. One of the reasons has been lack of information on their travel behaviour. This paper seeks to redress this situation by examining the travel behaviour of children, in particular the modes of travel which they use compared with their adult counterparts. It is shown that the dominant mode of transport in terms of amount of travel and time spent travelling by children is car passenger.

INTRODUCTION

The study of the travel behaviour of children has been an area of relative neglect over the past decades. In general, the analysis of behaviour of travellers or implications for planners has been carried out either from the perspective of adults (concentrating on the travel patterns of adults), or the analysis has grouped all data together, not differentiating between the travel of children and adults.

There is, however, some fairly persuasive evidence that children's perspectives in travel—both in terms of safety considerations and of their needs—are very different from that of adults. According to Briesch (1989) children's and adult's perspectives with regard to traffic safety are completely different:

> Children are not small adults. They are literal-minded and impulsive. What's more, their vision and hearing are not the same as an adult's and their judgement is different.

When looking at the percentage of travel which children do simply to accompany someone else (as high as 21% for children aged 4-10), Ampt (1983) suggested that children may well experience the taking part in activities and the travel associated with them from a perspective other than that traditionally portrayed by the adult transport planners.

One reason for this is the fact that children take part in the activity of travelling in a different context than do adults. Recent researchers have identified various "licences" given to children by their parents for independent travel (eg Hillman *et al.*, 1990, Tranter, 1994, Chen, 1994). For example, parents give their children a licence to cross main roads alone, come home from school alone, go to places other than school along, cycle on main roads, and so on.

Hillman *et al.* report that these licences have also been changing over time. Whereas once licences were freely given to walk to school with friends or even alone, these are tending to be withdrawn and children are being escorted instead (either on foot or, increasingly by car).

Using this critical finding, the latter authors have challenged the lowering of child traffic accidents in the UK between 1971 and 1990 as relating only to improvements in safety measures. They have gone on to relate the lower accident rate to the changes in these licences in the same period and contend that (Hillman *et al.*, 1990):

> The streets have not become safer; they have become ..... extremely dangerous. It is the response to this danger, by both children and their parents, that has contained the road accident death rate.

The question of children's exposure to the risk of accident is therefore critical to the argument. And while other researchers have given attention to children alone, it seems particularly useful to make a comparison between their exposure with that of their adult counterparts. This paper seeks to address this issue. Note that the paper does not look at the *actual* risk of accident, but simply at *exposure* to risk; in essence it describes the travel patterns of children compared with those of adults.

THE TRAVEL AND ACTIVITY DATA

The Victorian Activity and Travel Survey—VATS (Richardson and Ampt, 1993) is being conducted in Melbourne, Australia. It began in 1993 and will run for 5 years. It collects information on activity and travel behaviour patterns from households using a self-completion questionnaire survey technique. The VATS Survey records *all travel by all modes by all people* in responding households in the survey sample—this naturally includes children and babies. The survey covers all 365 days of the year, thus enabling seasonal and annual variations in travel and activity patterns to be observed. The response rate for the survey data presented here is just under

60% and a rigorous program of validation has ensured that the data has a high level of reliability (Ampt and Richardson, 1994).

The VATS survey collects information from about 6000 responding households per year and the data reported in this paper is from the first year of the study. Since the travel data is collected at the greatest level of disaggregation, it can be analysed either in terms of stops (where each stage of the journey is separated; eg walk to the bus, catching the bus, and walking to the destination are all separate stops) or in terms of trips (where the above example would be just one trip from origin to destination). When the trip definition is used, the following priority mode linking is used: train, tram, bus, taxi, car driver, other motorised driver, car passenger, bicycle, walk, other. This means that the mode of a "trip" will be specified as that stage highest on this priority list.

Clearly it is usually most useful when examining exposure to use the most detailed data (ie stops), though in some cases both have been given for comparison.

THE CONCEPT OF EXPOSURE TO RISK

There are essentially four ways in which the exposure to the risk of having traffic accident may be calculated. They are:

- accidents per capita
- accidents per trip
- accidents per time spent travelling, and
- accidents per distance travelled.

The first—accidents per person—does not need the data from a special travel survey, since it can be gained from accident and population statistics, both of which are usually collected on a regular basis in most countries. It gives information on what type of people actually have accidents, but does not relate this to the amount of travel they do. In terms of taking steps to reduce accidents, for example, while it may be clear that 15—25 year olds have a disproportionately high number of accidents, it is not clear whether their risk per trip, per time spent travelling or per distance travelled is actually greater or less than that of other age groups.

This paper does not set out to examine this measure nor with actual accident data—rather it concentrates on the measurement of exposure to risk.

The other three measures give indications of actual risk of travelling. This paper examines two of them—the number of trips or stops that people, particularly children, make, and the time spent travelling on different modes, at different times of day by people of different gender and age.

TRAVEL PATTERNS OF CHILDREN

Number of trips and stops per person and per traveller/mobile

One way of examining exposure to risk is to ascertain whether children of different ages travel more or less in comparison to adults. In other words, are they likely to have more or less accidents simply on the grounds of travelling more or less than others?

Figure 1 gives an overall picture of travel by children relative to the rest of the population in terms of stops (all stages of travel). The continuous line is the number of stops made per person, while the dashed line represents the number of stops per person who travelled. The data shows that children up to the age of two years make many fewer stops per person than other children, but that when they do travel they make almost as many stops as the average population. This means that in children less than about 5 are more frequently immobile (ie do not travel at all) than older children, and than the population in general.

Children then travel slightly less during the first years of school (6-8 years), although by about 9 or 10 years their mobility slowly begins to rise until their mid-twenties.

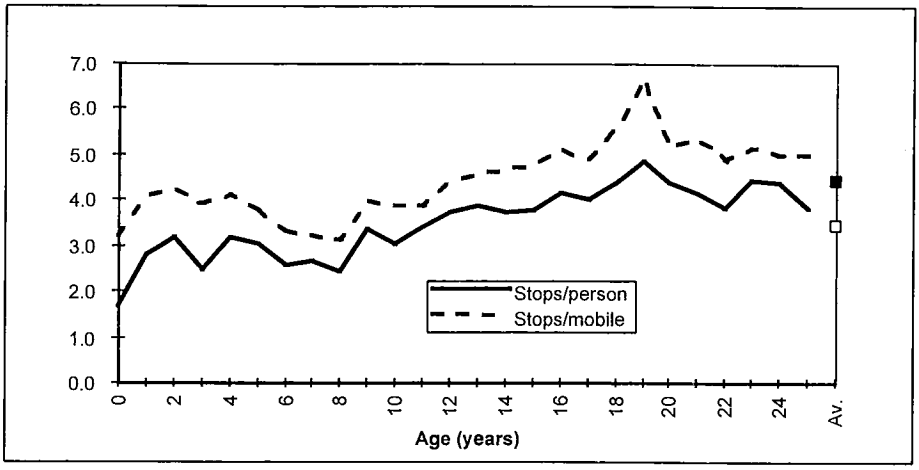

Figure 1 Stops per person and per mobile person

For comparison, Figure 2 shows the distribution of trips per person and mobile person in the same age groups. The most noticeable feature is that for children in Melboume up to the age of about 12 there is almost no difference between stops and trips. The most likely reason for this is their very low usage of public transport in this age range—an hypothesis which will be supported below. In contrast teenagers, starting at 12, peaking at about 18-19 tend to have many more stops (joumey stages) than trips suggesting much greater use of multiple modes. (most often associated with public transport travel).

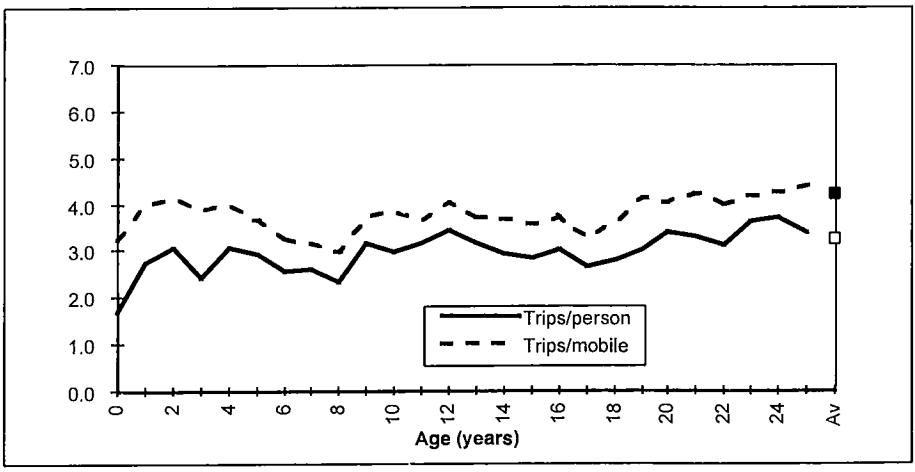

Figure 2 Trips per person and per mobile person

This leads to the conclusion that young children travel slightly less than the population at large and therefore, in terms of numbers of trips, could be considered less likely to be exposed to

accidents. Teenagers on the other hand, travel much more than the average population, with the corollary likely to be true in terms of risk.

Travel by mode

Having reviewed overall travel, it is interesting to observe the way in which children choose or use different modes of travel vis-a-vis teenagers and adults. Figure 3 shows the distribution of modes used when stops per person who travelled (mobile) are examined.

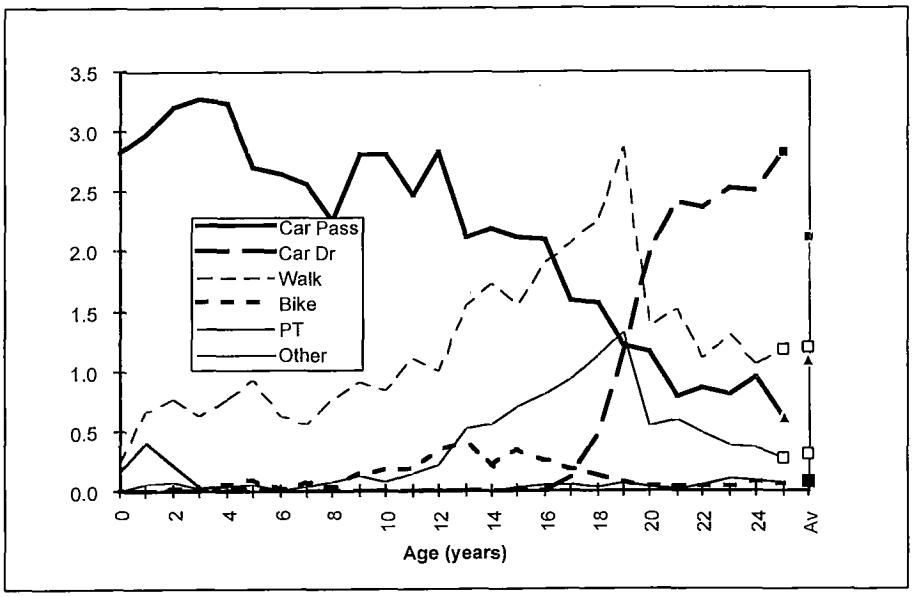

Figure 3 Mode used by stops per mobile

Figure 4 presents this same data in an aggregated form to the mode split for children in each age group.

Both figures highlight the marked dominance of car passenger as the most important mode for children up to their early teenage years. There appears to be a slight decline in travel overall as the children enter primary school at about 5-7, but after that time the amount of walking they do increases fairly significantly. While the data presented here does not show it, another analysis of Melbourne travel (Chen, 1994) suggests that this could be associated with the children's being permitted to make more unaccompanied walk trips at this time in life.

By the time the children reach about 13 years old public transport travel is increasing in parallel with walking. However, both travel by public transport and walking drop dramatically at the age of 18 when car driver's licences can be obtained. The highest rate of car driving is for the large group of people who are 25 years of age and over.

One of the most important implications of the data reported here is the dominance of car passenger travel by children in their early years, accounting for about 70% of all their travel. While this drops to about 63% for travel to school, car passenger still remains by far the most dominant of all modes. In Melbourne this finding has already influenced changes in the safety education in primary schools. Up until this time, the preparation of literature and courses relating to safety in travelling to school had always operated on the rule of thumb that about 90% of all children

walked to primary school. This has now been changed to ensure that safety education focuses on behaviour related to boarding and alighting from cars, rather than only on walking.

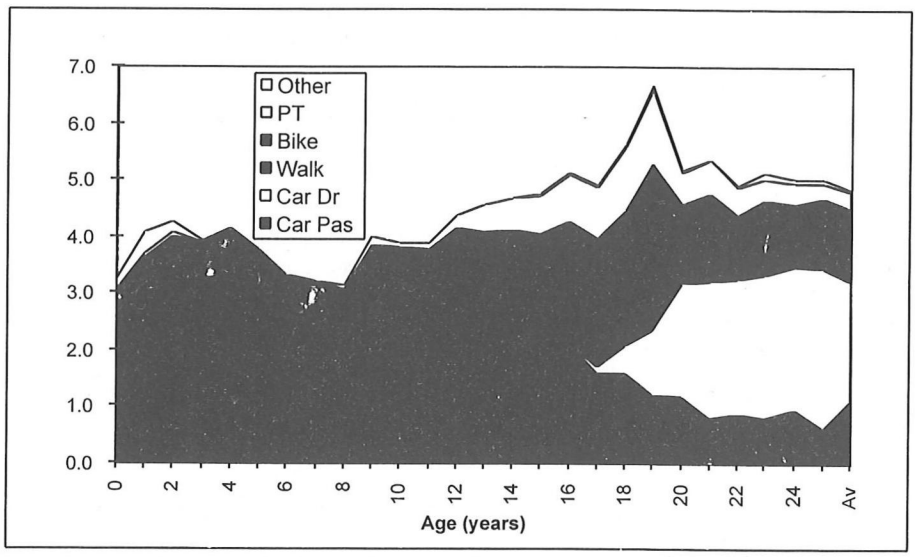

Figure 4 Mode used by stops per mobile—aggregated

Given the importance of school travel, Table 1 is designed to show the degree to which children travel alone, both to school and other activities.

Table 1 Primary school children's independent travel

	Walk Only		Car Passenger		Bus		Bike	Public transport & walk	
School	School	All Weekday Travel	School	All Weekday Travel	School	All Weekday Travel	All Weekday Travel	School	All Weekday Travel
Independent of family	57%	23%			16%	71%	67%	50%	94%
*Accompanied by non-householder**			*8%*	*9%*					
Accompanied by primary school age sibling	30%	23%			84%	29%			
Accompanied by older sibling or parent	13%	54%	92%	91%			33%	50%	6%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mode Share	27%	25%	63%	70%	7%	2%	2%	3%	1%

* This can only be measured in the VATS survey when children travel as a car passenger in a non-household vehicle.

Clearly not only do primary school children most often travel as car passengers in which case they are automatically with an adult, but almost all of their other travel is accompanied by someone else—either a parent, a sibling, or someone outside the household. Another noteworthy factor is the lack of travel to primary school by bus (7%) and bicycle (none). The reason for this is not clear from the data, although Hillman *et al.* (1990) would argue that this is an effect of lack of safety. In

the Melbourne context it is likely to be a response to perceived risks in both traffic and personal safety.

The implications for safety education suggest that for many transport modes, attention needs to focus as much on the person doing the accompanying as on the child. Furthermore travel alone by the non-motorised modes of walk and bicycle apparently starts in late primary school. This means that past experience and role models before that time are likely to have a great effect on the behaviour exhibited by children at that time. Similarly it suggests that the optimal timing for education in non-motorised travel behaviour may be in late primary school rather than earlier.

Time spent travelling

As identified earlier, another measure of exposure to risk is the time spent travelling. Figure 5 shows the total time spent travelling by each mode of transport. Note that it includes waiting time as a separate travel activity. In many respects the time spent travelling closely replicates the number of stops people make by each of the modes (Figure 3) with the longest time as children being spent as a car passenger. It is interesting to note, however, that as the child gets older (between about 8 and 10 years) the time spent travelling does not decrease as rapidly as the number of car passenger stops. This indicates that as the child reaches this age, car passenger travel is actually taking longer—possibly because their field of activities is getting geographically larger.

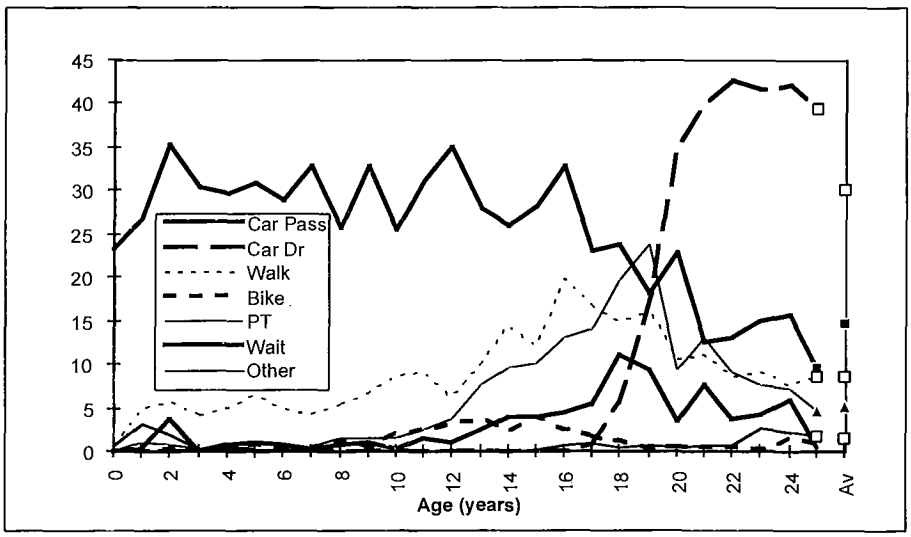

Figure 5 Average daily time spent travelling by each mode

When the child is very young—in fact up to the age of about 7 or 8, no modes except walking are used for longer than 5 minutes a day—and walk trips longer than 5 minutes are very rare. Other than car passenger, the one mode which children spend a consistent amount of time with is walking. In fact, the second longest amount of time is spent walking up until the late teens when, for a while, public transport takes over. After the age of 19 by far the most travel time is spent driving a car.

Figure 6 makes it obvious that the time spent travelling stays relatively constant at between 40 and 45 minutes per day until a child is about 10. After that time it rises rapidly until almost doubles at about 80 minutes per day between the ages of 19 and 24. It is interesting to note that shortly before

the age of being able to obtain a driver's licence, time spent travelling has already increased, though mostly due to walking and public transport travel.

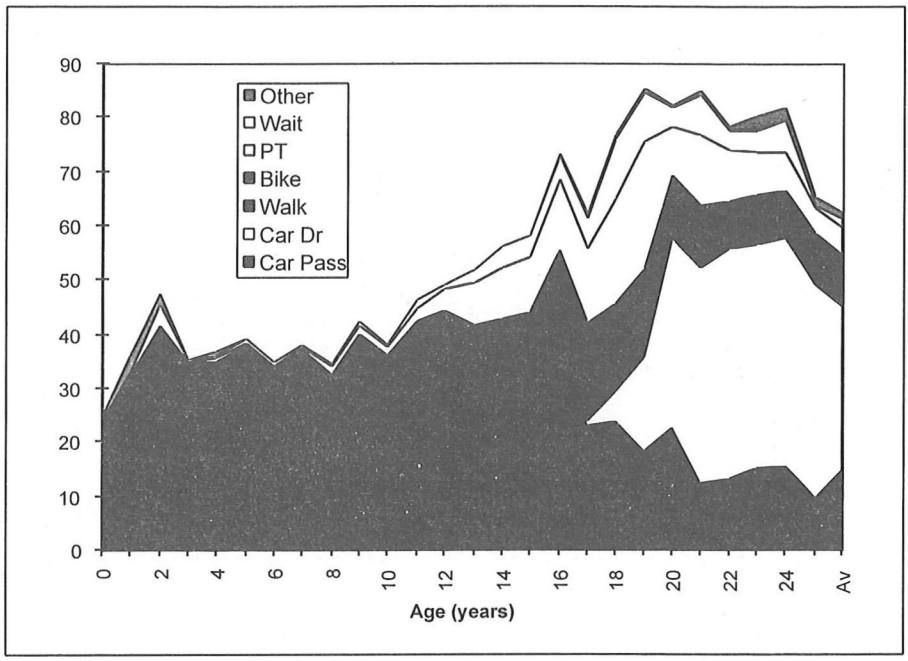

Figure 6 Average daily time spent travelling by each mode—aggregated

The fact that the licence to drive a car also gives a licence to spend greater time travelling is likely to mean that these people are travelling over a much wider part of Melbourne and Victoria and that the geographic region in which they are exposed to risk is also widening.

Time spent riding a bicycle corresponds closely with the ages when children make most bicycle stops—between the ages of about 10 and 15. For the city as a whole, bicycle riding never exceeds more than about 5 minutes per day which means that—in terms of time at risk—cyclists are much less exposed than walkers. This is also likely to mean that bicycle travel is very close to home and is currently not used extensively for recreational travel relative to other transport modes.

Gender differences in children's travel

Having looked in general at the differences in exposure related to the amount and duration of travel, it is interesting to look at three other possible effects on exposure to the risk of accident. They are gender, and the time of day and day of week on which travel takes place.

In terms of number of stops made, there is very little difference between males and females until the late teens (17 to 19 years) when males tend to travel slightly less. At this time they have not yet begun the large increase due to car driver travel and at the same time females of that age continue to travel as car passengers at a higher rate than males.

The time spent travelling by males and females is shown in Figures 7 to 10. Figures 7 and 8 show the differences in time spent using each mode. Car passenger remains fairly constant for male children from birth until about 16 years at around 30 minutes per day. In contrast, female children always travel slightly longer as car passengers and between 10 and 12 it rises to nearly 40 minutes per day.

On the other hand teenage girls walk longer (around 20 minutes) while teenage boys always remain in the 10—15 minute range. Boys ride bicycles more often than girls, but also for longer, particularly between the ages of 12 and 16.

Time spent travelling as a car driver is particularly significant for males in their early twenties when about 50 minutes per day is the average.

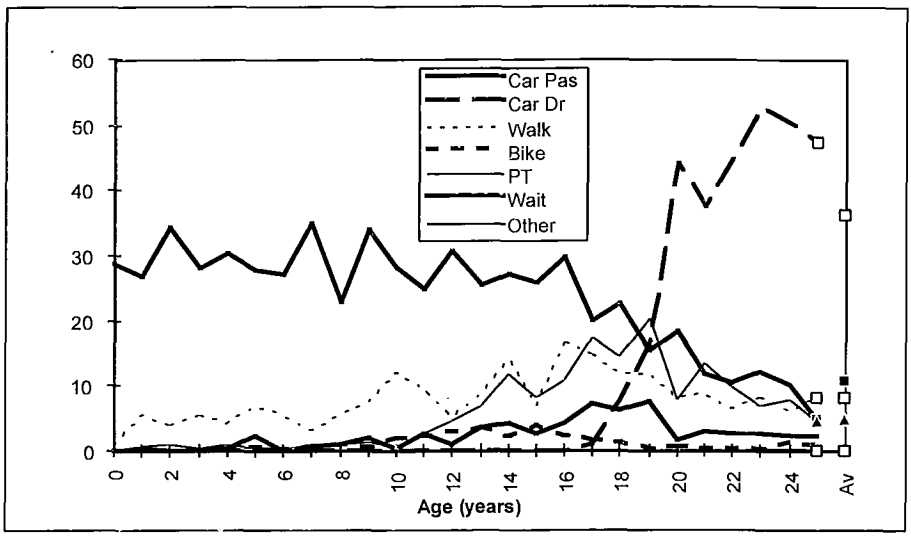

Figure 7 Daily time spent travelling on each mode by males

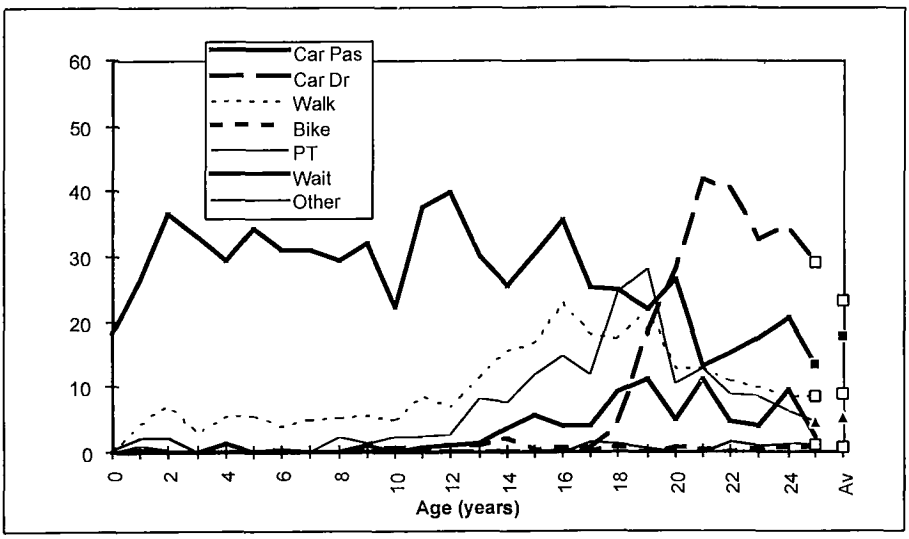

Figure 8 Daily time spent travelling on each mode by females

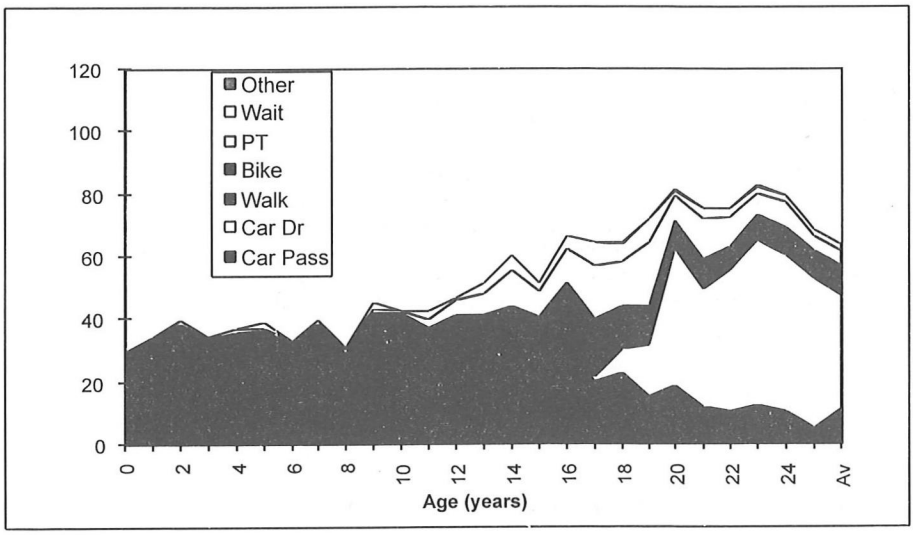

Figure 9 Daily time spent travelling on each mode by males—aggregated

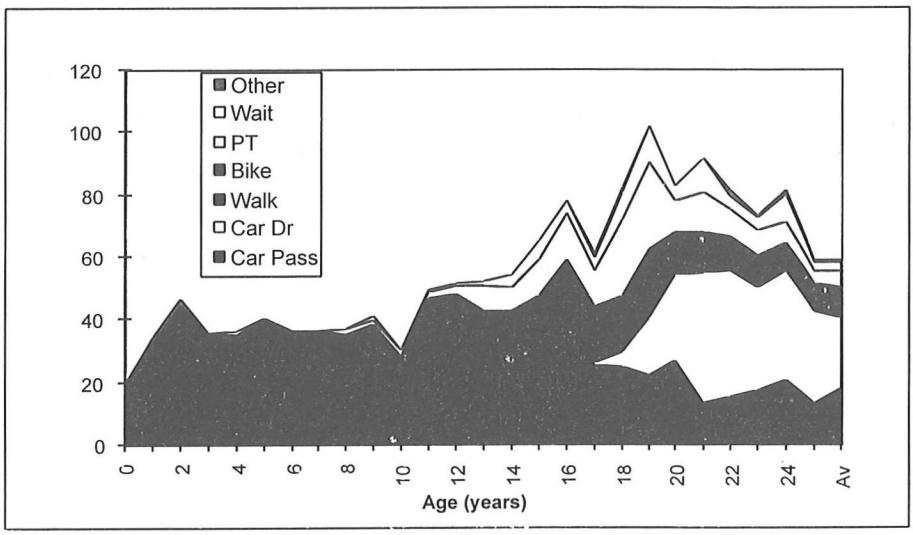

Figure 10 Daily time spent travelling on each mode by females—aggregated

Figures 9 and 10 present the same results in a different way, aggregating travel for each mode. The most obvious difference portrayed here is the overall much greater time spent travelling by females than males in the teenage years. This is most noticeable after 12 years of age, and most particularly between about 16 and 24. Table 2 makes this very clear.

Table 2 Average time spent travelling by gender (minutes)

	0—12 years	13—16 years	17—24 years	Population Average
Male	38	57	74	64
Female	38	62	81	58

On average males and females spend the same amount of time travelling up until the age of 12 years. Females spend longer than males between 13 and 16 years, but between 17 and 24 they travel nearly 10 minutes a day longer than males. After that time their travel time decreases so that after the age of 25 they actually travel less than males. This appears to result almost entirely from the large proportion of females using the slower mode of public transport in their late teenage years. Males, on the other hand, spend significantly longer in cars as the driver during this time.

Once again, the data on gender has important implications for exposure analysis. Young males and females take part in about the same number of travel activities, but females use of public transport as teenagers means that they spend much longer travelling. Females also consistently spend more time walking than their male counterparts.

Time of day differences in children's travel

Figure 11 compares trips per person during daytime and evening hours. Daytime trips are defined as those which begin at 7am or after and arrive at or before 6pm. The remainder are classed as evening trips. The distinction is a coarse attempt at looking at travel during daylight and night-time hours since almost all of it was collected between December and May, 1993.

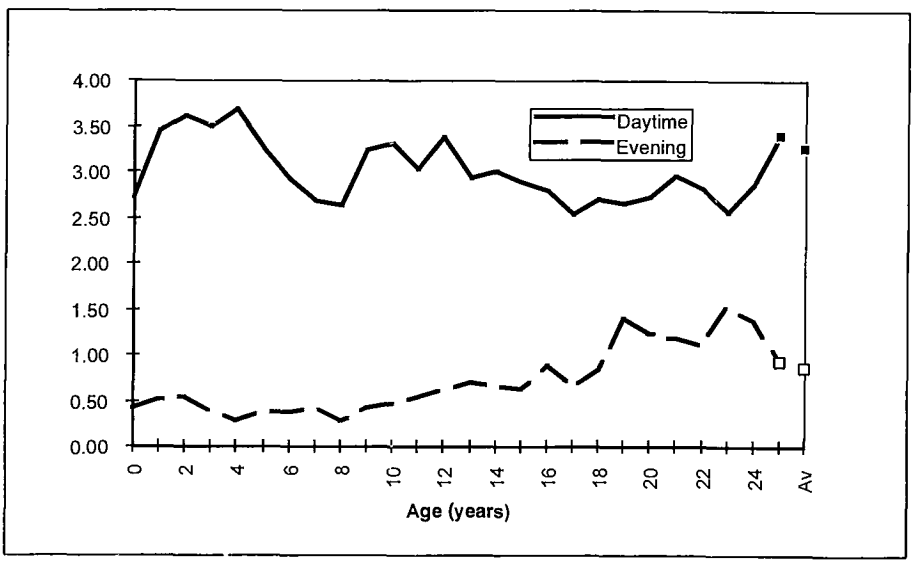

Figure 11 Time of day of travel

The population overall makes about twice as many trips in daylight hours as at night. The differential is, however, much greater for children, meaning that their exposure to night time travel risks is considerably less than adult's. Teenagers from the age of 16 onwards make an increasing number of night-time journeys, at the same time reducing somewhat the day time travel vis-a-vis their younger counterparts.

Given that children's major form of travel is by car passenger it would seem that their independent risk of travel during darkness is much lower than that of teenagers and adults.

Day of week differences in travel

Finally, Figure 12 gives a comparison of travel made on weekdays and weekends. It shows some significant differences in weekday and weekend travel between children and adults.

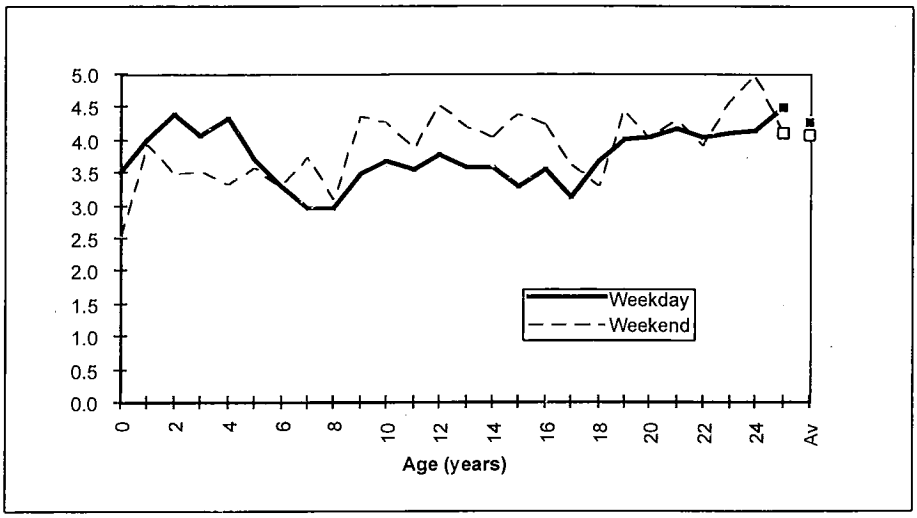

Figure 12 Trips per mobile person per day on weekends and weekdays

Up until the age of 6 years children who travel make more trips on weekdays than on weekends. Then, as primary school age is reached the weekend travel per person becomes greater and essentially stays that way until 17 or 18 years when for some years it is similar. In the early twenties those people who travel make more trips on weekends, but for people 25 years of age and older, weekdays again become the most important time for travel.

This finding has particular significance for children's exposure to the risk of accident, and hence on the focus of safety programs. Clearly, children are travelling more, and therefore are implicitly more exposed to risk on weekends than on weekdays and further research in this area would be warranted.

SUMMARY AND CONCLUSIONS

The following points are a summary of the findings of this paper.

- Children travel overall slightly less than teenagers and adults, but slightly fewer children travel at all, meaning that the rate of travel per mobile child is similar to adults.
- The dominant mode among children is car passenger (about 70% of all travel) with walking gaining some significance between the ages of 12 and 20. Public transport replaces car passenger to some extent in the teenage years, but after about 18, car driver is the most common mode.
- Children up to the end of primary school are almost always accompanied in their travel—either by an adult or sibling.

- Although children travel slightly less than teenagers and adults, they spend a great deal less time travelling, suggesting that they usually make very short trips. There is a great increase in time spent travelling in teenage years, peaking in the early twenties.
- Male and female children travel about the same amount, but females spend a lot longer travelling in their teenage years, until they are "caught up" by males in their early twenties. This is due to the large amount of public transport travel by females and longer car driver journeys by males in these respective periods.
- Children travel very little at night.
- Children travel more on weekends than weekdays which is the reverse of their adult counterparts.

The implications of these findings are manifold:

- The fact that children are almost always accompanied suggests that for many transport modes, attention needs to focus as much on the person doing the accompanying as on the child.
- Furthermore, the fact that children make very few independent trips until high school age means that their experience is essentially passive until that time—both in terms of mode choice and in actual "travel-wise" behaviour. In terms of exposure to risk, this means that education in late primary school (ie at the commencement of independent travel) may need to focus on both issues—what is involved in mode choice in terms of safety, and how does one behave safely when using a given mode.
- In particular, the dominance of public transport travel by female teenagers and time spent travelling by 20+ year males as car drivers would seem to warrant special attention in terms of education and safety programs.

  The low usage by children of the non-motorised modes of bicycle and walking means that they have had very little exposure to independent travel before their early teens.
- Since children do not travel very often at night—even when accompanied by someone else—the advent of a large amount of night travel by teenagers is made without having observed their parent's or others behaviour in these situation. Safety programs could specifically target this aspect of education.
- Attention needs to focus on the day of week on which children travel since more trips per child are made on weekends than on weekdays which is the reverse of their parent's behaviour.

ACKNOWLEDGMENT

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