MONASH UNIVERSITY

SPEED BEHAVIOUR AND DRIVERS' ATTITUDE TO SPEEDING

by

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Abstract:

Four studies were undertaken at rural and urban road sites aimed at relating motorists' attitudes to speed with their actual on-road speed behaviour. Those travelling at excessively fast and slow travel speeds were of particular interest. Drivers' speeds were measured at each site and target vehicles were stopped at a set of traffic lights further along the road and asked to participate in a general road safety survey. Those who agreed pulled off into an off-road parking area and were questioned about a number of driver, vehicle, trip purpose, speed attitude, and accident history factors. Significant travel speed relationships were found at all sites for driver age, number of occupants, purpose of the trip, intended speed, safe speed, accident involvement and the total number of accidents. In addition, vehicle type, age, and whether the vehicle was towing or not was related to travel speed in rural areas, while amount of weekly travel was associated with travel speed in urban areas. A surprisingly high number of motorists at all speed levels did not believe it to be dangerous to travel 30 km/h above the posted speed limits and most thought the chance of being stopped by the police for speeding at these sites to be low. Multivariate analysis was also undertaken to examine the relative importance of (and important interactions between) the variables. While these findings provided some additional useful and novel information, care needs to be taken with these results because of the relatively small amount of variance explained and hence, predictive power (other factors and interactions are clearly important for a drivers' speed decision on the road). The findings of the study point to a number of potential countermeasures against speeding and some additional research required in this area.

Key Words:
Speed, speed assessment, human factors, driver, vehicle, environment, perception, enforcement, test method

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EXECUTIVE SUMMARY

INTRODUCTION

Four studies were carried out to assess speed behaviour and drivers' attitudes to speeding on straight and curved roadways in urban and rural Victoria.

This research was aimed at describing the relationship between driver and vehicle characteristics, travel distances and times, and driver attitudes to speeding (their stated intentions to behave in a particular manner) with their actual on-road speed behaviour. The relationship between observed speed behaviour and five year accident history was also of interest.

The study was to provide new knowledge in this area as well as to identify potential countermeasures against excessive speeding.

Drivers who travelled at excessively fast and slow travel speeds (upper and lower 15% of the speed distribution) were of particular interest in this research program. The executive summary, however, emphasises the findings for excessively fast drivers only, for reasons apparent in the results.

These studies were undertaken prior to the extensive speed camera program that commenced in this state in April 1990.

METHODS

A technique was developed which involved unobtrusively measuring vehicle speeds manually at the test sites and then stopping target vehicles further down the road for interview. Selected drivers were asked a series of questions aimed at eliciting information on driver demographics, trip and vehicle data, as well as speed attitude and accident history details.

These responses were subsequently normalized and combined across similar speed zones (100 km/h in rural and 60 km/h in urban areas) and analysed in terms of their relationship with travel speed. The relative importance of, and some interactions between, the variables were also examined.

MAJOR FINDINGS

There were a number of significant findings from this research.

***DRIVER AGE* -** Younger drivers (those aged under 34 years) were more likely to exceed the speed limit and be excessively fast drivers at all locations. Older drivers (those aged 45 years or more) were more likely to be below the speed limit and to be excessively slow motorists.

***NUMBER OF OCCUPANTS* -** Vehicles with single occupants (driver only) were more likely to exceed the speed limit and be excessively fast vehicles, while those with 2 occupants were less likely to exceed the speed limit. This was consistent for urban and rural settings and for straight and curved sections of roadway. There was no significant relationship between vehicles with 3 or more occupants and travel speed.

***PURPOSE OF THE TRIP* -** Business travellers were more likely to exceed the speed limit and to be excessively fast drivers at all locations. Conversely, those travelling for recreation or domestic purposes were more likely not to exceed the speed limit. Those travelling behind schedule were more likely to exceed the speed limit and to be excessively fast motorists than all other travel schedules categories. There was a tendency for those not on any particular travel schedule to be less likely to exceed the mean traffic speed.

***TYPE OF VEHICLE* -** The type of vehicle being driven was associated with excessively slow travel speeds in rural, but not urban, areas. Those driving vans and light commercial vehicles were more likely to be very slow travellers than were passenger car drivers. There was no statistical difference in travel speed behaviour, however, between the different categories of passenger cars.

***VEHICLE AGE* -** Drivers of recent vehicles (4 years old or less) were more likely to exceed the speed limit and travel at excessively fast travel speeds than drivers of older cars in both urban and rural areas.

***TOWING A TRAILER* -** Vehicles observed not towing a trailer in rural areas were more likely to exceed the speed limit and to travel at excessively fast speeds than those towing. Again, this was not apparent in urban areas, although the numbers of vehicles towing were considerably less here.

***WEEKLY TRAVEL* -** Those who reported travelling high distances each week were more likely to exceed the speed limit and travel at excessively fast speeds in urban areas than low weekly distance travellers. There was no such finding observed in rural environments.

SPEED JUDGEMENTS – Motorists' travel speeds were highly correlated with what speed they nominated they would travel at for all locations. Most motorists correctly nominated the posted speed limit for both the rural (100 km/h) and urban (60 km/h) sites and this judgement was not related to their travel speed.

***SAFE & DANGEROUS SPEED* -** Estimates of what constituted a safe travel speed were positively correlated with observed speed and own speed estimates at all locations. There was also a significant negative correlation between travel speed and what the driver nominated as a dangerous speed at the urban sites.

***EXCESSIVELY FAST SPEED* -** A substantial number of motorists interviewed believed it was not dangerous to exceed the posted speed limit by 30 km/h at both rural and urban locations (the rates were higher for straight than curved road settings). A surprising proportion of those travelling at excessively slow speeds (up to 30%) also did not believe travelling 30 km/h above the speed limit to be dangerous.

***SPEED DETERRENCE* -** Most motorists assessed the likelihood of being stopped by the police for exceeding the speed limit by 20 km/h at these sites to be less than 50 percent. Moreover, there was no correlation between observed travel speed and the driver's assessment of the likelihood of being stopped by the police at these locations.

***ACCIDENT INVOLVEMENT* -** Those who reported having been involved in a crash (and multiple crashes) over the past 5 years were more likely to be travelling above the mean speed of the traffic and the speed limit (there were insufficient numbers to statistically test crash involvement with excessively fast and slow travel speeds). Contrary to earlier overseas findings, there was no indication of any increased crash involvement for those travelling below the mean traffic speed in these data. There were relatively small numbers of accidents reported overall in these studies.

***INJURY SEVERITY* -** There was a trend for those travelling above the mean traffic speed in all locations to report more severe injuries in previous crashes than those below. Those travelling at excessively fast speeds were more likely to report injuries requiring hospital or medical treatment, while nobody travelling at excessively slow speeds reported severe injuries.

FINDINGS WHICH WERE NOT SIGNIFICANT

There were a number of findings which were not significantly related to travel speed by themselves at any of the test sites in this research program. These included the following variables:

- sex of the driver,
- distance travelled prior to interview,
- distance still to travel,
- time since last rest stop,
- how tired the driver felt, and
- who owned the vehicle.

It was not possible to conduct a reliable analysis of travel speed for drivers not wearing their seat belts and those vehicles displaying P-Plates, given the very small numbers of observations recorded for these factors at all sites.

RELATIVE IMPORTANCE OF THE VARIABLES

Multivariate statistical analyses were undertaken to demonstrate the relative importance of (and important interactions between) the above variables for speed behaviour in rural and urban areas.

The ***rural*** analysis showed that vehicles observed exceeding the mean traffic speed and the posted speed limit were more likely (than slower speed vehicles) to have one or more of the following characteristics, in order of importance:

- not towing a trailer,
- young driver (under 34 years) with a high accident history,
- drivers reporting a high safe travel speed,
- male drivers travelling over long distances not for domestic purposes,
- vehicles with a driver only, travelling for business purposes, who drive high weekly mileages, and do not own the vehicle they drive.

Those travelling below the mean speed would be expected to have one or more of the opposite characteristics.

The ***urban*** analysis revealed that vehicles exceeding the mean traffic speed and the posted speed limit were more likely to have one or more of the following characteristics (also in order of their importance):

- a young driver (under 34 years) with a high accident history,
- drivers reporting a high safe travel speed,
- drivers in vehicles less than 5 years old,
- business travellers (not on recreation journeys) who travel high mileages each week.

There was reasonable consistency in the relative importance of the variables across the two sites, although the relationships were weaker for the urban curved arterial road in a highly residential area.

Not all of the factors found to be significantly related with travel speed were related to travel speed in the multivariate analysis. Furthermore, other factors not significant in their own right reached prominence with regression. These apparent anomalies can be explained by the relative importance of each variable and the interactions that occurred between these variables.

Care should be taken in interpreting predictive power from these analyses, given the relatively low amount of variability in travel speed explained by the variables collectively (up to 32%). Drivers' decisions about travel speed on the road are clearly multi-factorial and may also involve additional important factors not tested here.

OTHER FINDINGS

There were several other interesting findings that arose from the research.

FREE SPEEDS **-** Mean vehicle speeds measured at both the rural and urban sites were higher than the posted limit on straight sections (+5.9 km/h rural and +12.3 km/h urban) but generally lower on curved section of roadway (-7.6 km/h rural and +2.3 km/h urban). There were very few differences in mean travel speed across the different days of the week during the study period.

***SAMPLE CHARACTERISTICS* -** The sample of drivers interviewed was generally quite representative of the population of motorists using the roadway at each study site. There was a slight tendency for interviewees to be in less of a hurry at all locations, to drive smaller cars and light commercial vehicles at the rural sites, and to be older at these locations. Moreover, interview rates were higher in country areas, suggesting that these drivers had more time available (or were more approachable) than those at city locations.

***MEASUREMENT* -** The technique developed here was a particularly useful means of relating drivers' characteristics and attitudes to speed with their on-road driving behaviour. The usefulness of the accident data is somewhat limited by the small (and rather costly) amount of data available, although it is advantaged by having details on property damage crashes, not available elsewhere at this stage.

IMPLICATIONS OF THESE FINDINGS

It should be remembered that these results were based on studies undertaken before the current speed camera program began in Victoria. Hence, some of these findings may need re-testing as a consequence of this program.

The studies showed a sizable number of motorists travelling at excessive speeds at both the rural and urban locations. This practice is clearly unsafe from the accident data presented and needs to be discouraged. There are several measures available for reducing the incidence of excessive speeding.

***EDUCATION & ENFORCEMENT* -** Drivers at all speed levels, especially those likely to travel at high speeds, need to be convinced of the increased danger travelling at speeds markedly greater than the mean traffic speed, both in terms of crash involvement and greater severity of outcome.

Moreover, other research has shown that speed education or promotion effort needs to be supported by a fully integrated speed enforcement campaign if it is to be successful.

***TARGETING UNSAFE SPEED BEHAVIOUR* -** The research conducted here found a number of factors which identify drivers who should be given priority in targeting unsafe speed practices in any future campaigns against excessive speed.

***DRIVER ATTITUDE CHANGE* -** Driver attitudes towards what constituted a safe travel speed were related to speeding behaviour, although not as strongly as driver age and accident history. This is further evidence of the need for an educational campaign aimed at changing this attitude. Previous experience suggests that achieving a change in attitude may require a long-term program of measures using a multi-facet approach.

***INCREASED RISK OF SPEED DETERRENCE* -** Motorists in this study had a low perception of the probability of being detected by the police for exceeding the speed limit by 20 km/h. This needs to be increased substantially if police enforcement is to be used as a speed deterrent measure. Highly visible police enforcement effort is required to change this perception.

***SPEEDING PENALTIES* -** Current speeding penalties were not seen to be particularly severe by the motorists interviewed in this study. If speeding penalties are to act as a speed deterrent, there may be a need to increase their severity.

It should be noted, though, that other research has shown that increases in perceived detection rates are likely to be more influential than increased penalties alone.

***IN-VEHICLE SPEED CONTROL* -** Education and enforcement campaigns may not be totally successful in reducing excessive speed. Top speed limiting devices are being introduced for certain heavy vehicles to prevent excessive speeds. It may be necessary for these devices to become standard equipment on all vehicles to stop these deviant practices. They could be introduced in the first instance as a recidivist device.

In addition, technology for extending the operation of speed limiters for use in urban areas exists today, although current designs generally require substantial road infrastructure equipment and costs. These devices need further investigation and development at this time.

***PERCEPTUAL COUNTERMEASURES* -** Previous studies support the finding here that motorists' perceptions of the road and their environment have a marked influence on their speed behaviour. A number of on-road speed perception countermeasures are available for use at specific hazardous locations to change this perception and ultimately reduce travel speed. However, many of these measures still need to be evaluated.

***OTHER POSSIBILITIES* -** The data collected here suggested that consideration might also be given to lane separations to limit the interaction between fast and slow vehicles and what is an appropriate design speed for rural highways in this state.

ADDITIONAL RESEARCH REQUIRED

A number of areas requiring further research in speed behaviour and accident involvement were identified in this research program.

***ACCIDENT INVOLVEMENT* -** There was a suggestion in these data that motorists travelling below the mean traffic speed were not over-involved in accidents, and that fast driver involvement rates are of a different form and may not be as large, as has been reported previously. These findings may be a function of the small amount of data collected in this study and need to be examined further, given the lack of information currently available on the speed and accident causation relationship and the urgent need for accurate and detailed information in this area.

***LIMITING VEHICLE SPEEDS* -** There is a need for a proper review of devices for limiting vehicle speeds in urban and rural areas, including their availability, suitability and likely costs and benefits. The question of how they could be introduced into the vehicle fleet also needs to be addressed.

***BETTER SPEED DATA* -** Past research shortcomings in this area stem from the lack of available and accurate information on the speeds of vehicles involved in accidents. An on-board speed measurement device (a "black-box" recorder of lower cost than a tachograph) would be extremely helpful for better understanding this phenomenon and could be useful for ascribing culpability in road crashes. However, research and development effort is still required at this stage for developing such a device.

***FURTHER SPEED ASSESSMENT* -** Drivers' speed behaviour and attitudes to speeding need to be assessed for a number of other (additional) road and environment conditions. In particular, night-time and poor weather conditions are likely to have an influence on these judgements and need to be examined further.

***SPEED CAMERA PROGRAM* -** It might also be useful to re-test some of these findings at existing sites to assess the effect of changes in risk perception and behaviour as a result of the current speed camera program in this state.

1. INTRODUCTION

The topic of vehicle speed in driving continues to attract considerable attention in the community at large. Yet, there is very little current research underway to identify and explain the role of vehicle speed in road behaviour and traffic accidents. Moreover, despite the rhetoric that abounds about the influence of drivers' attitudes on speed behaviour, there is practically no research evidence to confirm this relationship.

In arriving at its speed management strategy for Victoria, VicRoads (Road Traffic Authority, 1987) concluded that there was a need for a review of current speed limits in this State and acknowledged the need for an extensive network of speed zones to facilitate appropriate behaviour and restore credibility between the motorist and the speed management system.

Motorist's knowledge and attitudes of what is appropriate speed behaviour are central to the success of speed zoning. VicRoads acceptance of this is reflected by their recent household surveys aimed at monitoring attitudes to speed (Road Traffic Authority, 1988). However, these projects have not attempted to relate drivers' attitudes to speed with their actual on-road speed behaviour, especially for speed deviant motorists. There is evidence which suggests that peoples stated attitudes to controversial community issues like speed behaviour may not correlate highly with their actual behaviour.

This report describes a program of research commissioned by VicRoads which assessed the relationship between speed-related attitudes and the observed speed behaviour of drivers travelling on two undivided rural highways and two undivided arterial roads in the metropolitan area.

1.1 ATTITUDES AND SPEED BEHAVIOUR

A number of recent research studies question the validity of using subjective responses to questionnaires as predictors of actual behaviour (Regan & Fazio, 1977; Ajzen & Fishbein, 1980; Fazio & Zanna, 1981). There are many external psychological factors that can influence a person's stated attitudes or intentions towards a particular behaviour, such as social pressures, competing motivations and rewards (cognitive dissonance), and so on. Moreover, many attitudes are not firmly held and can vary from moment to moment, depending upon the strength and moral conviction of the individual.

Furthermore, there is no guarantee that even having the "right attitude" or intention to behave in a particular way necessarily leads to that predictable behaviour. Moods, motivations, rewards, etc. all play a part in determining whether or not an attitude is eventually reflected in a subsequent action. In short, it is dangerous to expect that questionnaire responses alone will necessarily provide accurate information on expected or actual behaviour of motorists on the road.

An alternative approach for evaluating the relationship between attitude and behaviour involves observing behaviour unobtrusively and then questioning those individuals about their attitude to these particular behaviours. The Transportation Road and Research Laboratories in the U.K. used a variation of this approach to provide a link between drivers' drink-driving attitudes and their behaviour with some success (TRRL, 1989). With minor modification, such an approach appears most suitable for comparing motorists' attitudes to excessive speeding with their actual on-road speed behaviour.

1.2 EXCESSIVE SPEEDING & DEVIANT BEHAVIOUR

Vehicle speed is often credited as being an important cause of road accidents in this State. Yet, very little is known about the precise role of speed in road crashes (what has been reported is described in the following section). Moreover, while speed may be a contributory factor in many collisions on our roads, it is often only **one** of several factors or influences in the chain of events commonly leading to a road crash.

In the extreme, the only safe speed to travel at on our roads is 0 km/h. If there were no moving vehicles, there would not be any vehicle crashes. The fact is of course that we all depend on vehicles (bicycles, cars, trucks, buses and the like) for most of our daily needs and routines. If we want to continue living in a mobile and affluent society, we therefore must accept a trade-off between safety and mobility. We must accept some (minimum) level of road trauma for the privilege of motor travel.

The real question then becomes what level of trauma on our roads is acceptable and hence what is appropriate speed behaviour. Once the acceptable level of speed is defined on our roads, it should be possible to redefine the speed problem in terms of undesirable "excessive speed", where speeds outside this acceptable level can then be viewed as deviant behaviour and should not be tolerated.

1.3 PREVIOUS RESEARCH INTO EXCESSIVE SPEED

A number of early studies were performed in an attempt to unravel the influence of vehicle speed in road crashes. These will be reviewed briefly in the context of defining what constitutes excessive speed.

1.3.1 Speed and Crash Involvement

Several investigators have reported on the relationship between vehicle speed and accident involvement during the late 1960s and early 1970s (e.g., Solomon, 1964; Munden, 1967; Research Triangle Institute, 1970; West & Dunn, 1971; Hauer, 1971; Cumming & Croft, 1971). In general terms these investigators reported the existence of a "U-Shaped" function between crash rate and relative speed where major deviations (both slower and faster) from the average traffic speed were associated with an increase in crash risk. Excessive speed in these terms then would consist of any major variation from the mean traffic speed. Unfortunately, however, there has not been much recent work to substantiate this finding and how general it is across different types of roads, driver groups, and environments (Fildes, 1988). There is clearly an urgent need for more definitive research to identify the precise relationships between speed and crash involvement more fully.

1.3.2 Speed and Injury

A relationship is also reported in the road safety literature between the level of speed and the amount of injury sustained in a road crash. Solomon (1964), Munden (1967) and Bohlin (1967) all claimed some form of curvilinear relationship between injury and speed, where the probability of a serious injury or death was substantially greater at high impact speeds. Indeed, this relationship can be predicted from the laws of physics, where the amount of energy dissipated varies with the square of velocity.

More recently, the probability of a serious injury has further been shown to depend on the type of road vehicle involved (Campbell, 1970; Mackay, 1987), its mass or weight (Cerrelli, 1984), type of collision (Aldman, 1983), and whether the occupant or rider was wearing a seat belt (Bohlin, 1967; Evans, 1988), or a helmet (Whitaker, 1980).

In terms of injury then, excessive speed for car occupants, motorcyclists, or pedestrians is any speed that places harmful forces on the individual involved through contact with the road, its furniture, or the vehicle during a collision. Recent evidence suggests that the risk of serious injury or death can occur for some road users (eg, pedestrians) at relatively slow vehicle speeds (IRCOBI, 1975; Whitaker, 1980; Mackay, 1988). It should be stressed, though, that in this situation, excessive speed may not have caused the accident so much as contributed to the level of injury sustained from the collision (that is, as a **secondary**, rather than a **primary**, safety feature (Haddon, 1968).

1.3.3 Speed Limits & Accidents

The role of speed limits and road crashes has also attracted considerable debate over the years. A number of studies have evaluated the effects of reduced speed limits on crash involvement and injury rates (OECD, 1972; Johnston, White and Cumming, 1973; Nilsson, 1977, 1981; Johnson, 1980; Salusjarvi, 1981; Hearne, 1981; Christiansen, 1981; Lassarre & Tan, 1981). Although some of these studies may have had various methodological deficiencies, the overall conclusion from them was that there were reductions in the level of injury and the number of crashes as a consequence of lower posted speed limits. However, the reasons for these benefits were not always made clear.

More recently, there have been other reports on the consequences of **increased** speed limits in terms of subsequent injuries. The Insurance Institute for Highway Safety in the USA recently reported that the overall effect of increasing the speed limit from 55 mph (88 km/h) to 65 mph (104 km/h) on a number of rural interstate highways in a number of states was an increase in vehicle fatalities of 22%, compared to other (non-increased) rural highways (Insurance Institute for Highway Safety, 1988). More recently, this fatality trend has been confirmed and an increase in casualty crashes has also been reported in association with the increase in speed limits (Wagaenar, 1990).

1.3.4 Speed Management Strategy

The recent Speed Management Task Force in Victoria noted the difficulty in defining what is inappropriate speed behaviour (Road Traffic Authority, 1987). This report argued that exceeding the posted speed limit does not always constitute dangerous speed behaviour and suggested the need to focus on deviant speeds relative to the prevailing conditions.

They concluded that excessive speeding constituted travel speeds which were markedly greater than that of the rest of the traffic for a particular site. This is entirely consistent with the early research findings that showed an increase in accident rate and level of injury of fast travellers, although it does beg the question of higher accident involvement rate for those who travel markedly slower than the rest of the traffic.

The Task Force nominated speeds 20 to 30 km/h or more above the posted speed limit as deviant and noted that speeds in excess of 130 km/h should not be tolerated on rural highways in Victoria.

1.3.5 Excessively Fast and Slow Speed

Based on the evidence reviewed, speeds markedly in excess of the average travel speed of the traffic would seem to be a suitable definition for excessive speeding. In the present study, excessive speeders were defined as drivers in the top 15% of the free speed distribution (those above the 85th percentile).

However, the evidence further suggests that attention should also be given to those travelling considerably below the mean travel speed. Therefore, the characteristics of the slowest group of drivers were also of interest here where this group was defined as those in the lowest 15% of the free speed distribution (those below the 15th percentile).

1.4 RURAL CURVE ACCIDENTS

Casualty accidents on rural curves have been shown to be a substantial problem area in this State, especially for single vehicle accidents. Between 1983 and 1987, for instance, there were 8,937 single vehicle rural accidents reported in Victoria that involved either a fatality, a hospital admission or someone requiring medical treatment (Fildes, 1988).

Furthermore, 4,150 or 46% of these crashes occurred at or near a bend in the road. The causes for the abnormally high numbers of these accidents are not yet fully understood, although excessive speeding is often claimed to be a major factor behind many of these accidents. To date, there has been little systematic evaluation of the role of excessive speeding at road curves in either accident or driver performance studies, and practically no research into driver attitudes to speeding in these environments.

1.4.1 Speed Perception on Rural Curves

While it has not yet been firmly established, a number of authors have argued that a driver's perception of an approaching bend in the road is clearly important for its successful negotiation (Witt & Hoyos, 1976; Shinar, McDowel1 & Rockwell, 1977; Ten Brummelaar, 1983; Riemersma 1982, 1984; Fildes, 1986).

Fildes (1986) demonstrated that a driver's assessment of curvature was dependent upon the amount of deflection angle (and hence reversal curve) visible in the approach zone to the curve (see Figure 1).

Importantly, he noted that drivers systematically under-estimated the curvature of an approaching bend in the road as the deflection angle reduced below 30 deg.

In subsequent research, Fildes, Leening & Corrigan (1989) further showed that a driver's perception of safety and travel speed on rural curves was influenced by the type of road and the roadside environment in line with the earlier curvature findings. They noted the need for these findings to be compared with accident histories in similar environments.

1.5 STUDY OBJECTIVES

This program of research set out to investigate the relationship between drivers' attitudes (their stated intentions) regarding speed behaviour, their actual behaviour on the road, and accident involvement. Of particular interest were those travelling at inappropriately fast or slow travel speeds for the prevailing conditions. With this overall aim in mind, a number of additional specific objectives of the study were also of interest in this study, namely:

- to develop alternative methods to the home survey approach to elicit subjective road speed estimates,
- to evaluate the reliability and success of subjective speed estimates from roadside interviews as predictors of on-road speed behaviour,
- to identify a range of suitable countermeasures that could be introduced against excessive and unsafe speed behaviours on the road, and
- to report on the relationship between on-road speed behaviour and self-reported accident history to highlight directions for further research in this area.

Four on-road studies were subsequently conducted in the state of Victoria during 1989 and 1990 which addressed these objectives. The precise details of these studies and the subsequent results that were found are reported in the following chapters.

2. GENERAL METHOD

The four studies described in this report compared drivers' estimates of travel speed with their actual on-road travel speed to provide information linking observed with stated speed behaviour. High volume roads were selected in rural and urban areas which could accommodate unobtrusive speed measurement and selective sampling of target drivers. attitudes to speed.

2.1 SITE SELECTION

Selection criteria for the site included the need for an appropriate environment (a flat straight or curved section of road with an adequate sight distance), a normal distribution of free speeds, and a suitable location for both speed measurement and interviewing. Wherever possible, sites were also selected in known accident black-spot areas, given their dangerous nature.

The two sites chosen in each of the rural and urban settings differed in type of road alignment, roadside environment, and design speed. These sites were chosen to ensure that the results of the study would have some degree of generality in terms of road conditions and to allow for comparisons to be made between the drivers interviewed at the different sites.

2.1.1 Rural Sites

Site 1: The Hume Highway north of the township of Euroa, was chosen as the first site in this study for a number of reasons. First, the Hume is a major rural highway in this State and carries substantial volumes of cars and heavy trucks. The particular section of highway at Euroa used here is a two-lane undivided arterial with a 100 km/h speed limit (design speed in excess of 100 km/h) and is a renowned (and posted) accident zone. There are only a limited number of exit roads along this section and there were suitable roadside facilities for speed measurement. Moreover, as this section of road was in the early process of duplication, a set of temporary lights was installed North of Euroa with a control booth, ideal for this survey.

Site 2: The second rural site was located on the Calder Highway 5 km north of Woodend and was known to be an accident-prone area in Victoria. A flat rural curve of around 500 meters radius and roughly 20 degrees deflection angle in a treed environment with restricted sight distance through the curve was selected for speed measurement (design speed approximately 75 km/h). This curve was only one of many curves that exist between Kyneton and Woodend and one that had roughly 500 metres of straight road both before and after the curve itself. The posted speed limit was 100 km/h, although speeds in excess of 120 km/h were still possible through the curve.

2.1.2 Urban Sites

Site 3: The first urban site was located on Beach Road, Parkdale, between the Nepean Highway and Warrigal Road, comprising a fairly spacious seascape environment with minimum access roads and commercial activity. The posted speed limit on this straight section of 4-lane arterial highway was 60 km/h and Beach Road in this vicinity was a reputedly high-accident area. The pedestrian lights at Parkers Road with their adjacent parking area and lawns were used to pull over selected vehicles for interviewing.

Site 4: The second urban site was located on Belmore Road, Balwyn between Balwyn and Union Roads. As for Beach Road, this section was a 4-lane undivided arterial with a 60 km/h posted speed limit, although this particular site was located in a more highly residential area and the road was curved (approximately 500 metre radius). The traffic mix here comprised more residential and commuter road users than at Beach Road with fewer commercial and leisure vehicles.

2.2 FREE SPEED MEASUREMENT

Speed measurement was confined to passenger cars or derivatives, four-wheel-drive vehicles, or small passenger vans, whose travel speed reflected the driver's chosen travel speed. Thus, only those vehicles demonstrating **free speeds**, that is, a minimum of four seconds clear headway (Hoban, 1984), were included in the on-road speed sample.

To improve the possibility of an unbiased attitude response from each driver interviewed, it was imperative that the measurement of free speed was **unobtrusive** so that the speed measurement process did not alert drivers to the fact that their speed behaviour had been observed). Thus, the use of current portable electronic measuring equipment (radar guns or amphometer units) would not have been desirable, given the fact that radar detectors are used by motorists on Victorian highways and can influence travel speed (Insurance Institute for Highway Safety, 1989). Moreover, amphometer tubes (including the new generation "tape switches" steel strips) are either visible to motorists on approach or can alert them during crossing by their audible sound.

A manual free speed measurement technique was therefore developed that involved timing the passage of the vehicle between two fixed points of a known distance apart and then converting that time into travel speed. A portable laptop computer was used and suitable software was developed to compute and display vehicle speed and then log speed and various vehicle details.

A pilot study demonstrated that a distance of between 200 and 300 metres was optimal for speed measurement as this minimized measurement error and yet did not permit large speed variations (on average, there was only a 2.5% difference in the speed recorded comparing the manual technique with a hand held radar speed gun across 25 speed observations at the test site).

2.3 ATTITUDE ASSESSMENT

To match drivers' attitudes towards speed with their observed speed (without them knowing that their speed had been recorded), details on target speed vehicles were transmitted ahead and these vehicles were subsequently stopped further down the road at a set of traffic lights and the driver asked to participate in a road safety survey. The surreptitious nature of the procedure was necessary to ensure that drivers' responses were not unduly biased by their knowledge that their speeds had been observed.

To achieve the study objectives, an interview format was developed which included the following criteria:

- to provide a broad range of demographic and exposure details on drivers who were interviewed or who refused to be interviewed,
- to seek unbiased responses from those interviewed about their knowledge and attitudes to travel speed and other associated issues,
- to gain information on drivers' accident patterns over the previous 5 years (both casualty and property damage),
- not to raise any suspicion about the true nature of the survey,
- to enable comparisons to be made between these responses and previous home survey interview data.

The interview forms developed and used at the rural and urban test sites are shown in the Appendix of this report. A separate cover sheet explained that the purpose of the survey was to enable motorists to have a say about a number of current road safety issues and concerns. It also stressed (quite accurately) that the survey was being undertaken for research purposes only and that an individual’s response set would be treated in strictest confidence.

All drivers were offered a $5.00 incentive to participate in the survey and were also given a satchel of road safety literature. On average, roughly 1 in 5 of the drivers interviewed refused to accept the monetary incentive. The first page of the questionnaire was completed for all motorists who were stopped, irrespective of whether the driver agreed to participate in the surveyor not. This permitted a limited number of comparisons to be made between those who agreed to be interviewed with those who refused to assess the degree of selection bias.

2.4 ACCIDENT INVOLVEMENT

Previous accident involvement by the individuals interviewed was an important adjunct to the study as it provided a means of comparing drivers' stated attitudes to speeding with on-road speed behaviour performance for different accident history groups. It was assumed that those who had high accident histories might respond quite differently to those who had no accident history over the past 5 years. Accident histories were obtained by asking each driver whether they had had an accident during the last 5 years and to provide details of when it occurred and the degree of severity of each crash. This ensured that all types of accidents were registered (including both casualty and property damage only accidents).

It had been hoped to compare these self-reported accident data with the official accident records for the individuals involved. However, this was not attempted as it would have involved knowing who the driver was and the difficulty ensuring confidentiality. In a recent study of self-reported and official accident histories, Smith (1976) reported differences in reporting rates which suggested that the reliability of self-reported accidents was in fact better than the official records.

While it is acknowledged that self-reported accident histories may not be totally reliable it was still considered worthwhile to examine the relationship between speed and self-reported accident history, given the lack of recent data in this area.

2.5 STUDY PROCEDURE

The first study was conducted at Euroa over four days during June and August 1989. The second study was conducted at Woodend over six days in November and December of 1989, while the third and fourth studies were each conducted in the Melbourne Metropolitan area over six days during March 1990.

Testing was restricted to weekdays and sampling occurred for 8 hours on each day during off-peak daylight hours with fine weather. A total of up to eight researchers participated in each study and were divided into two teams comprising a speed measuring and an interview team. Their duties and procedures are described further below.

2.5.1 Speed Measurement

The **speed measuring team** comprised two operators, stationed up to 3 km ahead of the interview area in an innocent looking vehicle (an old campervan) on the side of the road. Care was taken to ensure that the vehicle was positioned in such a way that it didn't cause any suspicion to passing vehicles. Both observers were seated inside the vehicle permitting them to observe free speeds and vehicle registration number plates clearly. Care was also taken to ensure that these actions were not plainly visible to passing motorists.

Using a Toshiba T1000 laptop computer with a "mouse" attachment, the first observer recorded vehicle speed by pressing the input button as the target vehicle entered the measurement zone and released it once the vehicle left the zone. The program converted the real time input into vehicle speed for a known observation distance and displayed the vehicle speed on the screen. Additional information could then be entered and that record saved on the computers' disk.

Speeds of two vehicles could be monitored simultaneously using this program. With the help of binoculars, the second observer noted the number plate of the measured vehicle and relayed it, along with a brief vehicle description, to the speed observer for data input. If the vehicle was required for interview, the number plate, the observed speed, and the vehicle description were also relayed ahead to the interview post using VHF discrete band radio transmission. Free speeds were collected continuously for as many vehicles as possible during the study periods to allow accurate free speed distributions to be determined.

2.5.2 Driver Interviews

The second team, the **interview team**, comprised up to six researchers and was stationed at a set of traffic lights further down the road. One researcher acted as message receiver and scheduler, while the others operated the traffic lights and conducted roadside interviews as required.

When a target vehicle approached, the lights were changed to red and an interviewer approached the vehicle seeking agreement to interview. Once approval was gained, the vehicle was directed to an adjacent off-road wayside stop where the interview was conducted. If a driver did not agree to be interviewed, the researcher recorded the relevant driver and vehicle details from observation while the driver was still at the lights. These details were later compared to the driver and vehicle characteristics of the interview sample in order to establish the representativeness of this sample.

Drivers who agreed to the interview were first given the instructional sheet to read while the interviewer filled out the face sheet details. A copy of the questionnaire was provided to the respondent to follow while the interviewer noted the responses on the working copy (see the Attachment). For the speed related questions, the respondents were presented with a 150 mm by 200 mm colour photograph of the section of road where their speed had been recorded and asked to answer these questions in respect of this section of the road "which they had just travelled upon".

Interviewers were initially trained in conducting these interviews and were instructed to follow the written script at all times and not to "ad-lib". Any additional comments the respondents wished to make regarding the survey were noted at the end of the questionnaire. The interview generally took between 10 and 15 minutes to complete.

2.6 INDEPENDENT VARIABLES

Observed speed was categorized into six speed categories determined from a preliminary free speed distribution at the site. Equal numbers of vehicles were sought in each category to ensure statistical reliability. The questionnaire used at the Euroa site involved a total of 38 response variables covering a broad range of items such as vehicle and personal demographics, driving exposure, trip purpose and motivation, tiredness level, speed-related attitudes, and previous accident history.

There were six speed-related attitude responses, including their knowledge of the speed limit, an estimate of their own speed and what speed they thought the rest of the traffic would travel at, what they thought was a maximum safe speed, what was the likelihood of being caught by the police for travelling 20 km/h above the speed limit in this particular location, and how dangerous they considered 130 km/h (rural) and 90 km/h (urban) was along this section of the highway. Some of these questions were taken from previous questionnaires (to enable comparisons to be made for both samples) while other questions came from other speed related surveys (Cairney & Croft, 1985; Cairney, 1986).

The questionnaire used at the Woodend site and at the two urban sites, included an additional three questions to provide additional data on drivers' perceptions of what they considered to be a dangerous speed at the test site and the level of penalties and fines which they considered to be appropriate for various speed violations. These extra questions stemmed from analysis of the first site's results and from changes introduced with a recent expansion of the home survey speed monitor.

For the drivers who refused to participate in the survey, details on the type of vehicle they were driving, the number of occupants, whether they were wearing seat belts or not, whether the vehicle was towing or displaying a P-plate, an estimate of their age and sex of the driver and purpose of the trip, and the reason they gave for refusing the interview. The data sheet used for these drivers was the first page of the interview form.

2.7 DATA ANALYSIS

The dependent variable for analysis was the frequency of respondents by travel speed for each variable level examined. The data collected from the interview and refusal samples were coded and analysed using the SPSSX statistical program.

2.7.1 Sample Representativeness -

The first stage of data analysis was to determine the representativeness of the interview sample. This was done by comparing the characteristics of the drivers and vehicles in this sample with those of the drivers who refused the interview. Chi-square (X^2) statistics were adopted as tests of significance for these comparisons.

2.7.2 Descriptive Analysis

The second stage of the data analysis involved the examination of the relationships between vehicle and driver characteristics of the drivers with the free speeds observed for these drivers at the test sites. For those variables for which information was available from both refusal and interview samples (e.g. age and sex of the driver), the data were combined for analysis. Once again, Chi-square (X^2) statistics were adopted as tests of significance for these comparisons.

Of primary interest here were the characteristics of the drivers at the two extremes of the free speed distribution: those drivers who were travelling at excessive speeds and those who were travelling at very slow speeds. As noted earlier, excessive speed in this study was defined as the highest 15% of the free speed distribution while excessively slow speed was defined as the lowest 15% of the free speed distribution. (Some early analysis of the data obtained in the present study showed that the findings of the characteristics of the excessively fast and slow speed drivers did not alter appreciably by the choice of more stringent criteria such as the highest and lowest 5% of the free speed distribution).

Where a driver or vehicle characteristic was found to be related to observed speed in the overall analysis, chi-square tests were used to determine whether the drivers in these extreme groups differed from the other drivers with respect to this variable. Pearson correlation coefficients were used as measures of statistical correlation between the responses of the drivers to the speed-related attitude questions and their travel speed.

Where appropriate, the data from the two sites with the same speed limit (rural and urban settings) were combined for statistical analysis to ensure a greater degree of generality of the findings and to provide greater numbers in the two extreme speed groups. Due to the differences in the free speed distributions, Z-score transformations needed to be performed to the individual speeds first to enable these data to be merged.

2.7.3 Multivariate Analysis

The final stage of data analysis involved the use of multivariate statistics in an attempt to highlight the degree of independence of and to rank order the variables in order of their importance in a driver's speed decision on the road. Factor analysis is a test of the independence of each of the variables and restructures the variables into particular sub- groups (interactions) that are independent of each other. Multiple regression then enables the rank ordering of variables (both original and derived factors) in terms of their share of the travel speed variance.

This type of modelling procedure is essential to provide details on the inter-relationships between variables for determining what are the key factors involved in excessive speeding. Regression analysis is particularly useful for identifying possible countermeasures against excessive speed. One needs to be careful, however, in interpreting the results of these analyses, as their usefulness is dependent upon the total variance explained by the regression equations. In particular, speed prediction is only possible when the total percentage of the variance explained is relatively high.

3. THE RURAL STUDY

As noted in the previous chapter, the two rural sites chosen differed in type of highway, road alignment, and roadside environment. The first site was a straight section of two-lane undivided inter-state highway (The Hume) at Euroa, while the second, was a two-lane undivided intra-state rural highway (The Calder) at Woodend.

At Euroa (Site 1), free speeds were measured on a 300m straight section of highway with considerable unimpeded sight distance. Observed speed was categorized into six speed categories, comprising 85 km/h or less, 86-95 km/h, 96-105 km/h, 106-115 km/h, 116-125 km/h, and 126 km/h and above. (These values were pre-determined from preliminary free speed measurements taken at the site on the first day of the study incorporating the 3rd, 15th, 50th, 80th, and 95th percentiles of the distribution).

At Woodend (Site 2), vehicle free speeds were observed from around the mid-point of the curve and continued for 100m after the curve's exit (a similar total distance of approximately 300m). Preliminary free speed measurement here revealed that the overall traffic speed was lower than at Euroa with a much tighter speed distribution. Hence, the six speed categories were reclassified into 75 km/h or less, 76-85 km/h, 86-95 km/h, 96-105 km/h, 106-115 km/h and 116 km/h and above, comprising the 5th, 23rd, 60th, 88th, and the 97th, percentile values of the preliminary free speed distribution. (The last two speed categories had to be collapsed into one when subsequent full sampling revealed a slightly negatively skewed distribution with very few values in the upper most speed category).

3.1 FREE SPEED DISTRIBUTIONS

3.1.1 The Euroa Site 1

Vehicle speeds in km/h for all free speeding vehicles were recorded continuously over the four study days. Speed measurement was essentially random, depending upon the availability of the observer and free speeding vehicles. The overall free speed distribution is shown in Figure 3.1 where the mean travel speed was 105.9 km/h with a standard deviation of 10.8 km/h. The 85th percentile value was 117 km/h and 1.5% of the vehicles were observed travelling at 130 km/h or more. There was no significant difference in travel speed by day of the study ($F(3,1293)=0.8$, $p>.05$).

3.1.2 The Woodend Site 2

The overall free speed distribution for the six study days at the Woodend site is shown in Figure 3.2. The mean travel speed here was only 92.4 km/h with a standard deviation of 9.9 km/h. The 85th percentile value was 103 km/h and, contrary to the Euroa site, there was only 1 vehicle (0.005%) observed to be travelling in excess of 130 km/h. (The 85th percentile value was 10.6 km/h above the mean travel speed and similar in form to the free speed distribution observed at Euroa).

There were differences in free speed by study day ($F(5,2034)=5.09$, $p<.001$), presumably the result of early morning rain on the very first day (when free speeds were measured but no interviewing took place).

3.2 INTERVIEW SAMPLE DETAILS

The overall interview rate for the rural study was 53% (that is, for every 100 drivers stopped at the traffic lights, 53 of them agreed to be interviewed and 47 refused). There were slight differences in the sample sizes and interview rates at the two locations.

Over 4 days at the Euroa site, 281 drivers were targeted and stopped at the temporary traffic lights of which 177 (63%) of them agreed to be interviewed. Twenty-seven percent of those interviewed refused to accept the $5.00 incentive to participate in the interview at this site. For the 6 days at Woodend, there were 329 drivers stopped at the traffic lights of which only 148 (45%) of them agreed to be interviewed. Of those interviewed, a similar 29% refused the $5.00 incentive.

There were also differences observed in interview rate by day of the week at both sites, where days in the middle tended to have higher rates than days at the start or the end of the week.

To test the representativeness of the interview sample, it was necessary to compare the breakdown of those who agreed to be interviewed with those who refused for the limited number of common variables.

At Euroa, there were no significant differences in the rate of interview across the various age groups (X^2=9.8, p>.05). However, at Woodend, young drivers (those aged 18 to 24 years) were more likely to agree to be interviewed than older drivers (X^2 =23.6, p<.001). There were no significant differences in the interview rate for the various speed groups (X^2=0.06, p>.05) or sex of the driver (X^2=0.88, p>.05) at either of the two sites.

There were, though, apparent differences in their motivations. For the refusal group, reasons for not participating included being in a hurry or late for an appointment (74%), did not want to (11 %), domestic duties prevented them from participating (5%), and other reasons (10%). By contrast, only 11% of those interviewed claimed they were in a hurry or were running late.

There was an apparent relationship between the year of manufacture of the vehicle stopped and the interview rate of the driver. With the exception of the very old vehicles, the interview rate increased proportionally with vehicle age (X^2=8.36, p<.05). This finding was consistent at both rural locations.

To facilitate further analysis of vehicle effects, the various makes and models of the vehicles stopped in the study were classified into 6 different and discrete classes. **Small cars** consisted of vehicles with 1500cc engines or less (e.g., Toyota Corolla), **compacts** comprised larger 4 cylinder models (Mitsubishi Sigma & Magna), **intermediates** were 6 cylinder "family" cars (e.g., Ford Falcon or Holden Commodore), while **large cars** comprised heavy executive models (e.g., Holden Statesman and Ford LTD). **Four-Wheel-Drive** vehicles were that special class of off-road vehicles and **light commercials** consisted of utilities, small trucks and all vans (including passenger and cargo units).

At Euroa, there were significant differences in the rate of interview across the various classes of vehicles (X^2=11.9, p<.05), where the drivers of smaller (and light commercial) vehicles were more likely to agree to be interviewed than drivers of larger vehicles. However, at Woodend, there were no differences in the rate of interview across the various classes of vehicles (X^2=1.7, p>.05).

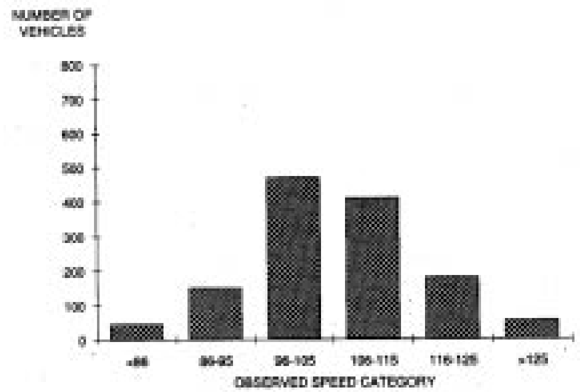


Figure 3.1 - Vehicle free speeds observed on the Hume Highway, Euroa during the study in June and August 1989

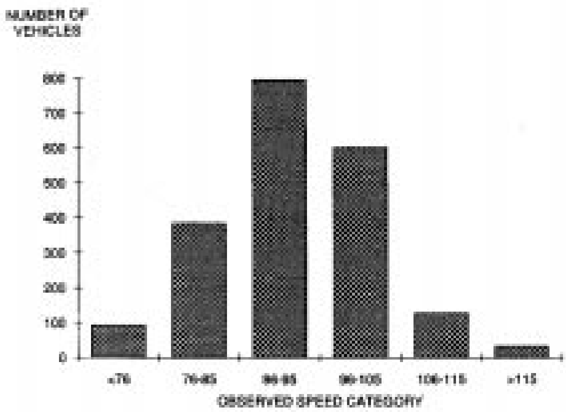


Figure 3.2 - Vehicle free speeds observed on the Calder Highway, Woodend during the study in November and December 1989

In summary then, there were some differences in the sample towards younger drivers at Woodend, drivers of small passenger vehicles and vans/commercial vehicles at Euroa, and those driving older cars at both sites. However, at both sites, those drivers who agreed to be interviewed and those who refused were essentially the same in terms of their travel speed and the sex of the driver. These relatively minor differences were not considered serious enough to substantially bias further analysis of these data in terms of defining excessively fast and slow motorists.

3.3 OVERVIEW OF THE SAMPLE VARIABLES

This section contains a description of the characteristics of the sample of drivers interviewed at both the Euroa and Woodend rural sites.

The overall ages of the drivers stopped at both locations was made up of 8% under 25 years, 64% were aged 25 to 54 years, and 28% were 55 years of age or older. There was a lower proportion of younger (under 25 years) and a higher proportion of older drivers (55 years or older) than expected on the basis of licensing rates at these rural locations. There was no difference in the percentage of young drivers at either site, although there were more older drivers 55 years and above (34% cf. 23%) and fewer 25 to 54 years (58% cf. 69%) at Euroa than Woodend.

For the combined sample, 42% of the drivers stopped were on business, 36% were recreation or holiday travellers, while 22% were performing domestic duties. While there were similar proportions of business travellers at both sites, there were slightly more drivers undertaking recreation trips (44% cf. 27%) and fewer performing domestic duties (17% cf. 28%) at Euroa.

A high proportion of the drivers stopped at these rural sites were male (overall, 79% of the sample were males compared to a 55% licensing rate for this group). This rate varied across the two sites, from 62% at Woodend to 89% at Euroa, a result that is consistent with an increase in local traffic observed at the Woodend location.

Of all the vehicles stopped, 46% had only one occupant (the driver), 36% two occupants, while 18% had 3 or more occupants. This breakdown was similar at both locations. At both sites, between 1% and 2% of vehicles displayed P-plates. A very high proportion of drivers at both sites used a seatbelt restraint (97.6% overall), while a consistent 29% of drivers interviewed did not own the vehicle they drove.

The amount of average weekly travel was roughly consistent for those interviewed at the two sites. Overall, 25% travelled less than 200 km, 33% between 200 km and 400 km each week, 17% between 400 km and 600 km, and 25% over 600 km weekly. However, there were differences in their usage patterns of the highways. At Euroa, 27% use the Hume weekly, 40% monthly, and 33% yearly or less, while the corresponding figures for Woodend were 49%, 31% and 20% respectively. Taken together, these findings further substantiate the higher proportion of local travellers observed at Woodend.

Nine percent of those interviewed at the two sites claimed to be travelling ahead of their travel schedule, 49% indicated they were travelling on-time, 11% claimed to be behind schedule, while 31% didn't care. Of all the drivers interviewed at both sites, a consistent 85% had been driving for less than one hour since they last took a break.

There were, however, large differences in the distances travelled prior to stopping and in the distances still to go to their destination at both sites. At Euroa, 67% of drivers had been travelling for more than 100 km prior to being stopped compared to only 19% at Woodend. For distance still to travel, 75% of those at Euroa still had more than 100 km to go, in contrast to the 19% of similar Woodend drivers. Clearly, the drivers stopped at Euroa were generally involved in much longer trips than were the Woodend motorists.

The distribution of type of vehicles stopped at the two sites, however, was similar. The most popular makes were Ford, Holden, Toyota, & Mitsubishi, while the more popular models included Falcon, Commodore, Corolla, and Magna. Ninety percent of the sample were cars (or derivatives), 4% were four-wheel-drives, and 6% light commercials and vans. Of the cars stopped at both sites, 16% were small cars, 24% were compact, 50% intermediate, and 10% large sizes. Recently manufactured vehicles were well represented at both sites (58% at Euroa and 32% at Woodend were less than 5 years old). Of the vehicles stopped at the two sites, a consistent 8% were towing a trailer.

Reported accident rates were similar at the two sites. Overall, 25% of the drivers reported having had at least one accident in the preceding five years, of which, three-quarters of them reported 1 accident, 20% two accidents, and 5% three or more accidents during that time period.

3.4 OBSERVED SPEED BY DRIVER & VEHICLE EFFECTS

The next phase of the analysis was to compare a number of the vehicle and driver characteristics with the free speeds observed for these respondents at the rural sites. These results were intended to provide a profile of drivers who travel at the various speed groups of interest and in what type of vehicle. The following analyses were conducted on the combined data from the two sites except for the subjective measures obtained regarding drivers' attitudes to speed and related matters (which were very much site specific).

Particular interest was in driver and vehicle characteristics for the vehicles observed travelling at **excessively fast** speeds (the top 15% of the free speed distribution) and those at **excessively slow** speeds (the bottom 15% of the free speed distribution). A number of specific hypotheses were raised concerning these particular two subsets of motorists on the road. In the analyses to follow, therefore, the effects for excessively fast and slow motorists will be emphasised.

3.4.1 Driver Effects

There was a significant relationship between driver age and observed speed for drivers interviewed in rural areas (X^2=98.71, p<.001) as shown in Figure 3.3. Young drivers were much more likely to exceed the average traffic speed (and to be excessive speeders) than were older drivers. By contrast, the likelihood of being an excessively slow driver increased proportionally with age. There was no relationship between the sex of the driver and the likelihood of exceeding the average traffic speed, or being an excessively fast or slow driver.

The number of vehicles displaying P-plates was very small (1.7%) as was the number of drivers who were observed not using a seatbelt restraint (2.4%). Hence, it was not possible to perform a statistical analysis of the relationship between these variables and free speed.

3.4.2 Number of Occupants & Exposure

There was a significant relationship between the number of occupants in the vehicle and observed travel speed (X^2=15.11, p<.05) as shown in Figure 3.4. Although not significant, there was also a trend for vehicles with single occupants to have a higher proportion of drivers in the excessive speed group and a lower proportion in the excessively slow speed group (X^2=3.8, p=.15), while the converse appeared to be true for vehicles with two occupants (X^2=5.5, p=.06). There were roughly equal proportions of high and low speeders in three or more occupant vehicles. No statistical association was evident between observed travel speed and weekly travel distance reported by the driver (X^2=6.18, P>.05) or how frequently they used the highway (X^2=3.3, p>.05).

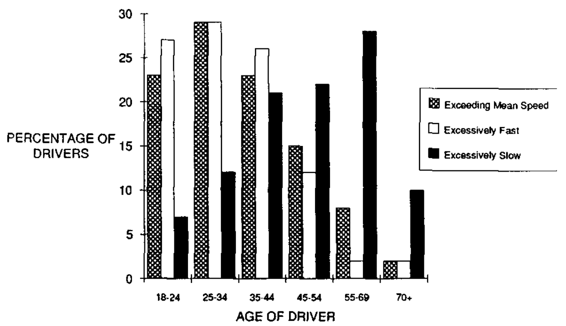


Figure 3.3 – Age group of the driver by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the two rural sites

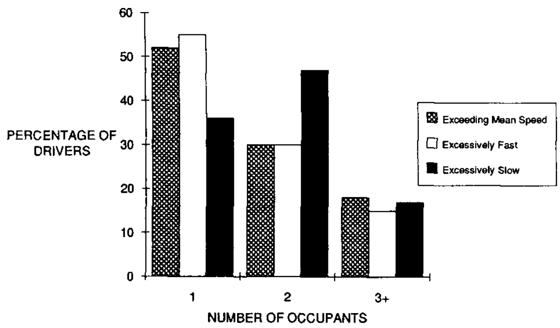


Figure 3.4 – Number of occupants by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the rural sites.

3.4.3 Vehicle Effects

There was a significant relationship between the type of vehicle and the observed travel speed (X^2=47.7, p<.001). Figure 3.5 shows that among the among the slow speed group, there was an overrepresentation of vans and light commercial vehicles and (perhaps) large passenger cars (X^2 was no reliable difference by type of vehicle for the excessively fast speed group (X^2=5.08, p>.05).

Figure 3.6 shows a significant relationship between year of manufacture of the vehicle and observed travel speed (X =35.43, p<.001). More recent vehicles (1985 to 1989) were more likely to be observed travelling at excessively fast travel speeds and all other vehicle ages more likely to be travelling at excessively slow speeds. There was also a significant relationship between travel speed and whether the vehicle was towing a trailer or not (X =104.7, p<.001). Figure 3.7 shows that vehicles towing a trailer were well over-represented amongst slower vehicles.

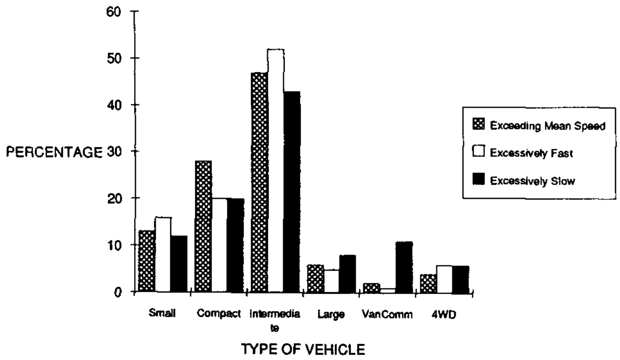


Figure 3.5 – Type of vehicle by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the rural sites

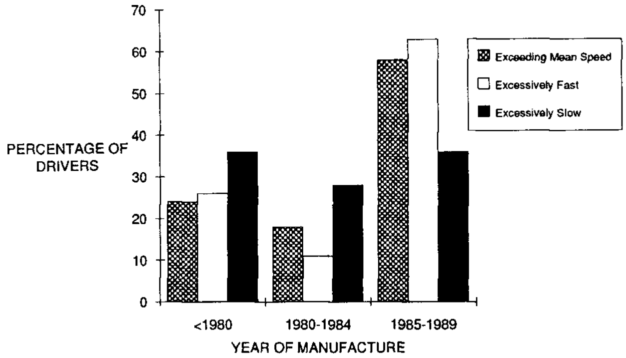


Figure 3.6 – Year of manufacture of the vehicle by the likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the rural sites

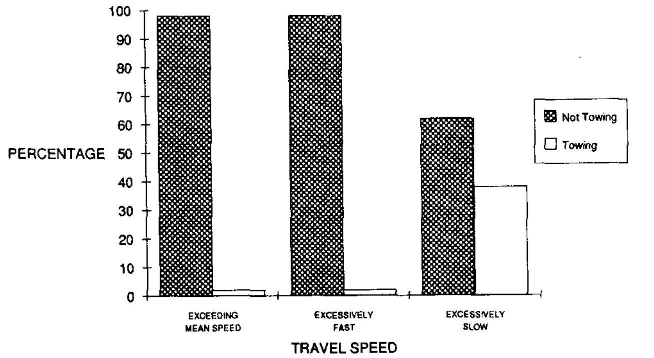


Figure 3.7 – Vehicle towing a trailer by likelihood of the driver exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the two rural sites

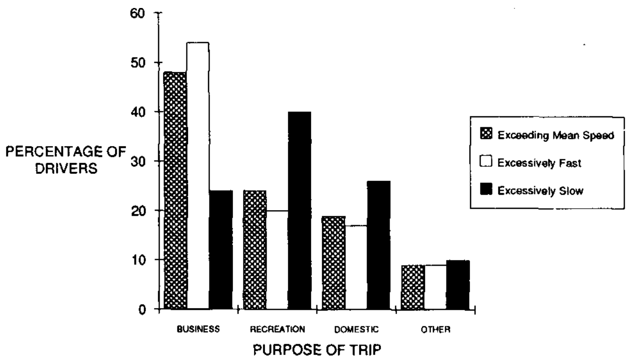


Figure 3.8 – Purpose of the trip by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the rural sites

3.4.4 Trip Purpose & Vehicle Ownership

There was a significant relationship overall between the purpose of the trip and observed speed (X^2=40.27, p<.001). Figure 3.8 shows that business travellers were more likely to be excessive speeders (X^2=10.77, p<.05), while recreation and domestic users more likely to be excessively slow vehicles (X^2=10.57, p<.05). There was no statistical relationship observed between vehicle ownership and travel speed (X^2=4.3, p>.05).

3.4.5 Journey Distance & Motivation

Drivers were asked a series of questions relating to the length of their journey, any breaks they may have had, and whether they were travelling ahead of, on time, or behind their travel schedule. There was no evidence of any statistical association between the drivers' travel speed and the distance travelled prior to the interview (X^2=14.79, p>.05), nor the distance still to travel to their destination (X^2=19.36, p>.05).

Information regarding the total distance of the journey was only available for the Woodend sample. At this site travel speed was not related to total distance travelled (X^2=22.6, p>.05).

There was no significant relationship overall between the travel schedule reported by the driver and their observed speed (X^2=17.16, p=.17). While there was also no significant association between travel speed and purpose of the trip amongst the slow speed group (X^2=4.95, p=.18), there was, however, an over-representation of drivers who reported being behind schedule amongst the excessive speeders (X^2=11.78, p<.01) which is illustrated in Figure 3.9.

The time since the last stop was not related to travel speed (X^2=4.76, p>.05). This variable will be considered further in relation to driver fatigue in the next section.

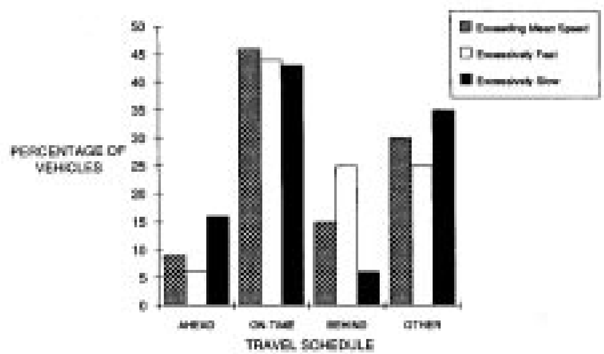


Figure 3.9 - Travel schedule by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the rural sites

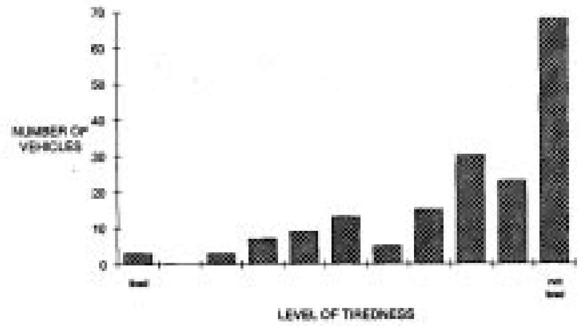


Figure 3.10 – Histogram of tiredness response at the Euroa rural site

3.4.6 Driver Fatigue

Drivers were asked to rate how tired they felt on a 10 point subjective scale. Figures 3.10 and 3.11 show that at both Euroa and Woodend most drivers reported that they did not feel tired. For ease of analysis, these subjective responses were then collapsed into tired (less than 5) and not tired (more than 5) categories and compared with observed speed. However, there was no statistical association between these levels of tiredness and travel speed (X^2=1.6, p>.05).

There was, though, a significant relationship between the level of tiredness reported by the drivers and distance travelled prior to the interview. As shown in Figure 3.12, drivers who had travelled more than 50 km prior to interview were more likely to report feeling tired than those who had travelled less than 50 km (X^2=17.7, p<.01). There was no relationship, though, between the level of tiredness and the distance still to travel (X^2=8.4, p>.05) or the time since the last stop (X^2=.02, p>.05).

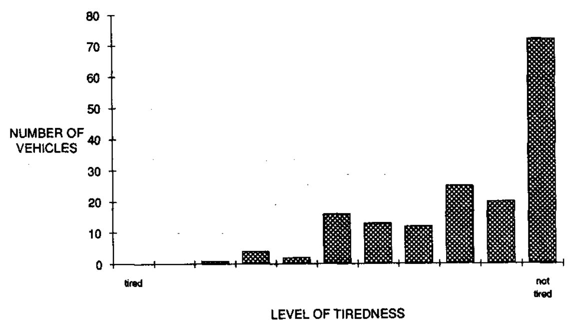


Figure 3.11 – Histogram of tiredness responses at the Woodend rural site

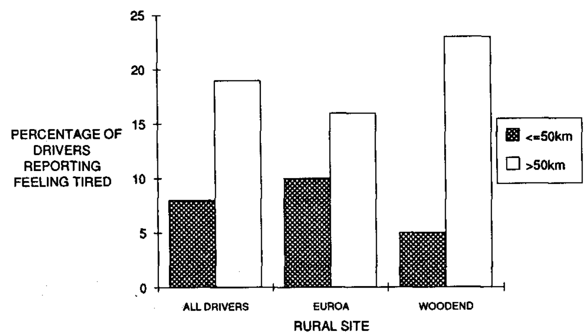


Figure 3.12 – Level of tiredness and distance travelled prior to interview at the rural sites

3.4.7 Accident Histories

The hypotheses that (1), increased accident involvement was a function of variance around the average travel speed and (2), that there was a greater likelihood of injury for high speeders was examined in these data. It should be stressed at the outset, though, that care should be taken not to over-emphasise these results, given the small amount of accident data available from this sample of motorists.

To begin with, Figure 3.13 reveals a relationship between travel speed and the drivers' accident history during the previous five years (X^2=9.18, p=.05). Those travelling at high speeds (20 km/h or more above the mean travel speed) had a history of higher accident involvement than all others. The relationship between accident involvement and travel speed around the mean is approximately linear with no particular advantage for those travelling at the average traffic speed.

In addition, the mean number of accidents reported by drivers was 0.35. For drivers in the excessive speed group, their mean number of accidents was higher (0.47) than for all others (X^2=6.2, p<.05). However, there was no significant difference in the mean number of accidents (0.31) reported by drivers in the slow speed group (X^2=0.5, p>.05). This is reflected in Figure 3.14 which shows that drivers observed travelling at excessively fast travel speeds were much more likely to have experienced 2 or more accidents over that time period than all other speed groups.

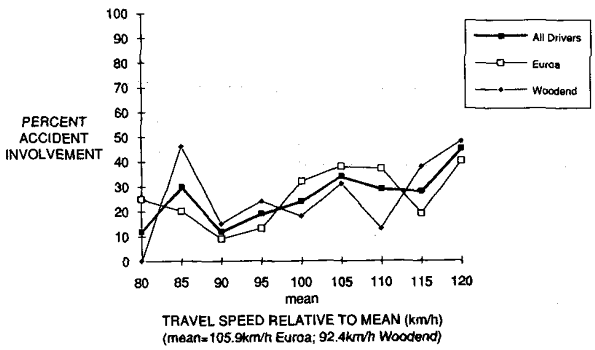


Figure 3.13 – Accident involvement by observed speed relative to the mean traffic speed at the rural sites

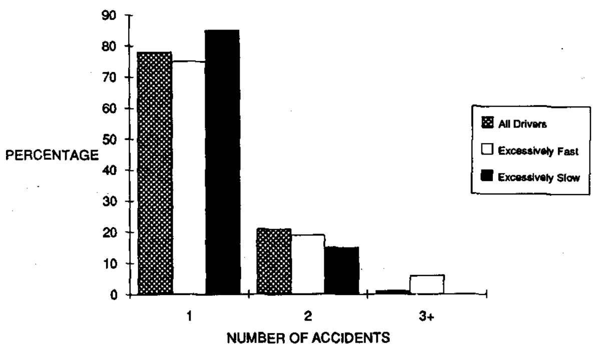


Figure 3.14 – Percentage of drivers by the number of accidents reported overall and those travelling at excessively fast or slow speeds

This difference, though, may have been, at least in part, a function of the higher proportion of drivers in the excessive speed group who reported accident involvement (there were fewer accidents observed in general amongst slow travellers, as seen in Figure 3.13). Figure 3.15 further shows the breakdown of reported accidents by injury severity for all drivers as well as for the excessively fast and slow travellers. Of the 117 total accidents reported at the two sites, 87% did not result in injury, (property damage crashes only), 8% resulted in injuries which required medical treatment only, and 5% resulted in hospitalisation.

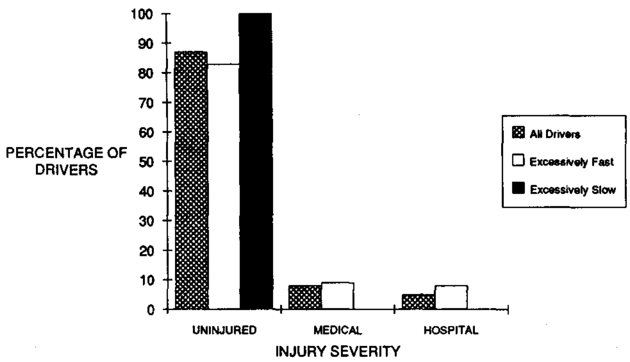


Figure 3.15 – Injury severity for all self-reported accidents and for those travelling at excessively fast and slow speeds

Seventeen percent of the accidents reported by those travelling at excessive speeds resulted in injury requiring medical or hospital treatment. By contrast, none of the accidents reported by the excessively slow speed group resulted in injury. Again, this needs to be tempered by the low numbers of injury crashes and the lower propensity for accidents amongst the excessively slow speed group.

3.5 ATTITUDES TO SPEED

The next stage of the data analysis was aimed at examining drivers' attitudes to speed, speed enforcement, and danger on straight and curved sections of rural highway (Questions 12 through to 17 on the questionnaire). The analysis of this data is reported for each site separately because of the differences in the road conditions and speed distributions at the two sites. For both sites, Pearson correlation coefficients were used as principle measures of statistical association here. Tables 3.1 and 3.2 show the Pearson correlation coefficients for the speed and attitude responses at Euroa and Woodend.

Table 3.1 Correlation coefficient matrix of attitude responses at Euroa site during the rural speed study

	Observed speed	Own speed	Others speed	Safe speed	Speed limit	Danger 130 km/h	Police
Observed speed	1.00	.495 * (.000)	.226 * (.001)	.254 * (.000)	.039 (.307)	-.260 * (.000)	.070 (.180)
Own speed		1.00	.309 * (.000)	.672 * (.000)	.342 (.498)	-.379 (.000)	.085 (.135)
Others speed			1.00	.268 * (.000)	.207 * (.003)	-.187 * (.007)	-.034 (.344)
Safe speed				1.00	.292 * (.000)	-.419 * (.000)	.060 (.211)
Speed limit					1.00	-.083 (.140)	-.106 (.083)
Danger 130 km/h						1.00	-.012 (.440)
Police							1.00

Table 3.2 Correlation coefficient matrix of attitude responses at Woodend site during the rural speed study

	Observed speed	Own speed	Others speed	Safe speed	Danger speed	Speed limit	Danger 130 km/h	Police
Observed speed	1.00	.457 * (.000)	.119 (.071)	.283 * (.000)	-.055 (.249)	.047 (.284)	-.055 (.251)	.144 * (.038)
Own speed		1.00	.402 * (.000)	.758 * (.000)	-.059 (.234)	.618 * (.498)	-.336 * (.000)	.019 (.409)
Others speed			1.00	.446 * (.000)	-.056 (.247)	.421 * (.000)	-.227 * (.002)	-.116 (.076)
Safe speed				1.00	-.058 (2.36)	.536 * (.000)	-.400 * (.000)	-.082 (.157)
Dangerous speed					1.00	-.064 (.216)	-.044 (.295)	-.087 (.087)
Speed limit						1.00	-.229 * (.002)	-.071 (.192)
Danger 130 km/h							1.00	-.106 (.096)
Police								1.00

3.5.1 Speed Limit

EUROA: Figure 3.17 shows the drivers' estimates of what the posted speed was along the Hume Highway at the section of road where their speeds were measured. Eighty-three percent of drivers correctly identified the 100 km/h limit, 10% nominated the limit to be 110 km/h (the speed limit assigned to some highway standard freeways at that time in Victoria), while 7% claimed the speed limit was 90 km/h or less. No drivers nominated the speed limit to be greater than 110 km/h. Table 3.1 further demonstrates that there was no significant correlation between drivers estimates of the speed limit and their observed travel speed (r=0.04, p>.05).

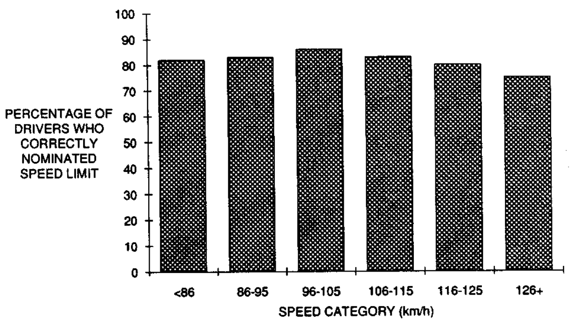


Figure 3.17 – Drivers' estimates of the posted speed limit at the Euroa site

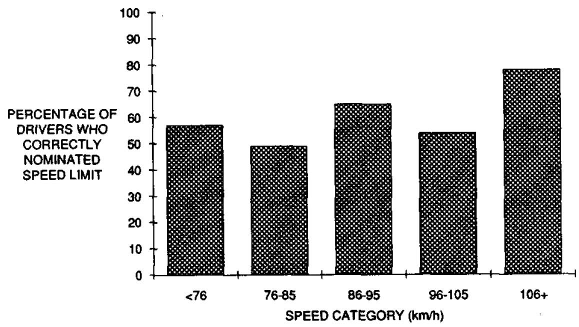


Figure 3.18 – Drivers' estimates of the posted speed limit at the Woodend site

WOODEND: Figure 3.18 shows the drivers' estimates of what the posted speed was along this section of the Calder Highway. By contrast with the previous finding, only 60% of drivers at this site could correctly identify the 100 km/h limit, 31% nominated the limit to be between 75 and 90 km/h, and none of the drivers thought the limit to be over 100 km/h.

As shown in Table 3.2, though, there was again no correlation between the estimate of speed limit and observed travel speed (r=.047, p>.05).

It is conceivable that the difference in accurately nominating what the posted speed limit was between the two sites was a reflection of the curved nature of the Calder Highway site and perhaps its particular setting close to the township of Woodend.

3.5.2 Own & Others Travel Speed

Drivers at both sites were also asked to nominate what speed they would travel at and what the rest of the traffic would travel at along these sections of highway.

The high correlation between driver estimates of their own and others travel speed at Euroa (r=0.310, p<.001) and Woodend (r=.402, p<.001) confirms that these two were effectively measuring the same judgement. Hence, further interest in these variables will be confined to driver estimates of their own travel speed only.

EUROA: Table 3.1 reported a strong positive correlation between observed speed at Euroa and the speed that drivers' claimed they would travel at for this site (r=.495, p<.001). Figure 3.19 shows that excessively slow drivers were more likely to nominate a slow travel speed, and fast speeders, a fast travel speed. When estimating their own travel speeds, the drivers observed driving at faster speeds were less accurate (or less honest) than the slower drivers. However, when estimating the speed of other drivers the responses of the fast drivers more closely represented their own travel speeds.

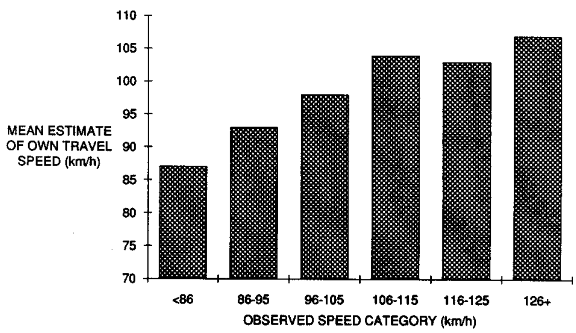


Figure 3.19 – Relationship between observed speed and the drivers' estimates of their own travel speed at the Euroa rural site

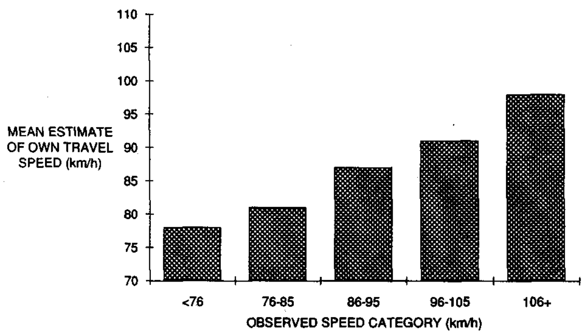


Figure 3.20 – Relationship between observed speed and the drivers' estimates of their own travel speed at the Woodend rural site

WOODEND: There was also a significant correlation in Table 3.2 between the observed travel speed of the drivers and estimates of their own travel speed at Woodend (r=0.46, p=<.001). Figure 3.20 confirms the previous Euroa finding where slow drivers were more likely to nominate a slow speed than were the faster drivers. However, the relationship between the observed speed and the estimate of the speed of the rest of the traffic was not as strong here as for Euroa and only significant at the 7 percent level (r=0.12, p=.07). For this environment, the slow drivers (below 76 km/h) conversely nominated much higher travel speeds than their own and speeds closer to the posted speed limit. This would seem to be a function of the particular characteristics of the drivers at this site.

3.5.3 A Safe Travel Speed

EUROA: Drivers' estimates of what they believed was a safe travel speed at this site were significantly related to their observed speed (r=.254, p<.001) as well as the speed they nominated as their travel speed (r=.672, p<.001). Figure 3.21 shows that slow travellers were more inclined to nominate travel speeds at, or below, the speed limit as being safe while fast travellers more frequently nominated speeds above the speed limit as safe.

Slightly more than half of the very slow motorists at Euroa (less than 86 km/h) believed that 100 km/h was a safe travel speed, even though they choose to travel at least 15 km/h below it. While many of those travelling 15 km/h or more above the speed limit believed that it was safe to do so, roughly one-half of them still maintained that a safe speed here was 100 km/h or less.

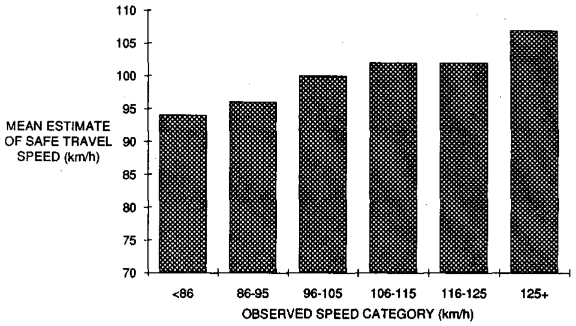


Figure 3.21 – Relationship between observed speed and the drivers' estimates of a safe travel speed at the Euroa rural site

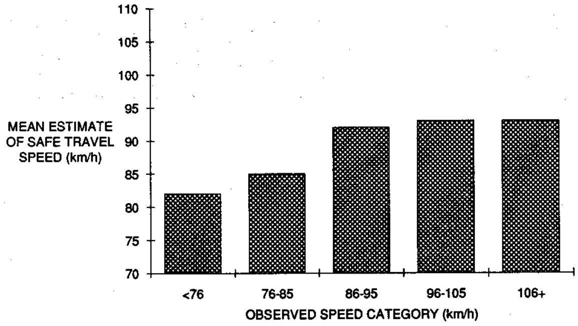


Figure 3.22 – Relationship between observed speed and the drivers' estimates of a safe travel speed at the Woodend rural site

WOODEND: As for Euroa, the correlations between safe speed and observed speed (r=.283, p<.001) and safe speed and own speed (r=.758, p<.001) were again highly significant at Woodend. Again, the slow travellers were more inclined to nominate travel speeds at, or below, the speed limit as being safe, while fast travellers more frequently nominated speeds above the speed limit as safe (see Figure 3.22).

Furthermore, the trend that a substantial proportion of very slow motorists believe it safe to travel at (18%) or above (12%) the speed limit (and contrary to their own behaviour) was also repeated at this site.

3.5.4 A Dangerous Travel Speed

WOODEND: Drivers were asked to nominate what they considered to be a dangerous travel speed at the Woodend site only. As shown in Table 3.2, there was no relationship between these estimates and the observed speed of the drivers on this section of the Calder Highway (r=-.055, p>.05) or any other variable. This indicates that drivers' speed decisions were insensitive to judgements of what they believe was a dangerous speed at this site.

3.5.5 How Dangerous 130 km/h?

EUROA: Table 3.1 shows that there were significant negative correlations between the drivers' perception of how dangerous it is to travel at 130 km/h and his or her observed speed (r=-.260, p<.001), and estimates of own speed (r=-.379, p<.001), others speed (r=-.187, p<.007), and a safe speed (r=-.419, p<.001). The relationship between how dangerous 130 km/h is and drivers travel speed is shown in Figure 3.23. (This judgement involved a subjective assessment on a 10 point scale, varying from 0 = not dangerous at all to 10 = extremely dangerous). With the exception of the very slow speeders, drivers' judgements of danger were higher for those travelling slower and progressively became less dangerous as travel speed increased.

There was a high proportion of motorists (28% overall) who responded that 130 km/h was not dangerous (5 or less on the scale). This included drivers in all speed categories, most notably 35% of the very slow group who responded in this way, suggesting an abnormal misperception on their part of the danger of travelling at these speeds or some confusion with the response scale for this group. (Excessively slow drivers tended to be older motorists who may have misinterpreted the safe and dangerous ends of the scale).

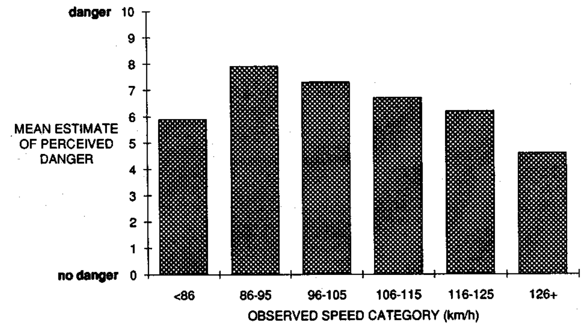


Figure 3.23 - Relationship between observed speed and the drivers' estimate of the danger of travelling at/h at the Euroa rural site

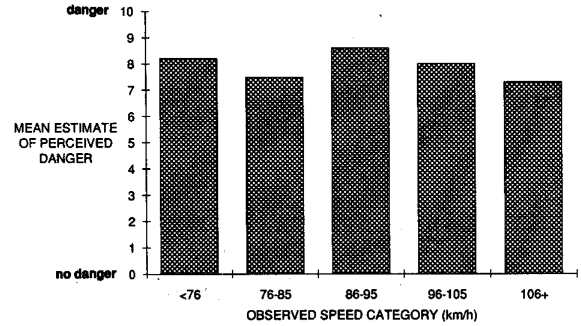


Figure 3.24 - Relationship between observed speed and the drivers. estimate of the danger of travelling at/h at the Woodend rural site

WOODEND: In contrast to the Euroa findings, there was no significant correlation observed between observed travel speed and the perceived danger of travelling at 130 km/h at this site (r=-.055, p=.251), as shown in Figure 3.24. While not significant, nevertheless, the trend towards fast travellers having a lower perception of danger was similar to the Euroa finding for those travelling above 85 km/h. The relatively high (and consistent) danger response at this site is presumably a function of the lower overall speeds and consequently, the greater proportion of motorists travelling below 85 km/h. It should be noted, though, there were significant negative correlations between how dangerous it is to travel at 130 km/h with estimates of own speed (r=-.336, p<.001), others speed (r=-.227, p=.002), safe speed (r=-.400, p<.001), and the speed limit (r=-.229, p=.002) at this site.

3.5.6 Likelihood of Police Stoppage

EUROA: Overall, 58% of the respondents believed it was unlikely that they would be stopped by the police for driving 20 km/h over the speed limit at the test site. Moreover, Figure 3.25 shows that there was no statistical relationship between perceived likelihood of being stopped by the police and travel speed (r=0.07, p<.05).

WOODEND: Overall, 81% of the respondents believed it was unlikely that a motorist would be stopped by the police for driving 20 km/h over the speed limit at this Calder Highway site.

Contrary to Euroa, though, there was a significant association here between observed travel speed and the perceived likelihood of being stopped by the police (r=0.14, p<.05). As shown in Figure 3.26, drivers who travelled at higher speeds were more likely to believe that apprehension by the police was possible compared to those who travelled at lower speeds. However, even for this group, the majority of drivers (75%) believed the likelihood of being stopped for speeding at this site was less than 50%.

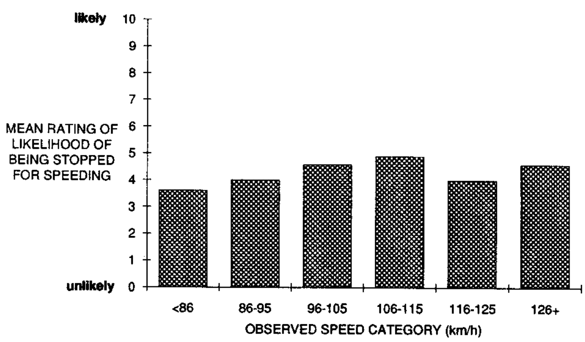


Figure 3.25 - Observed speed and drivers' estimates of the likelihood of being stopped by the police for travelling 20 km/h over the posted speed limit at Euroa

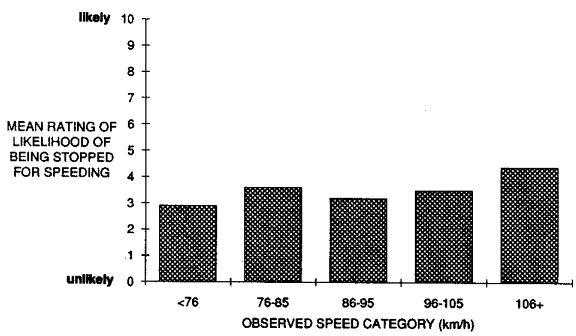


Figure 3.26 - Observed speed and drivers' estimates of the likelihood of being stopped by the police for travelling 20 km/h over the posted speed limit at Woodend

3.6 PENALTIES & FINES

Motorists on the Calder Highway were also questioned about the level of penalty which they considered appropriate for exceeding the speed limit by 10, 20 and 30 km/h at the Woodend site. As shown in Figure 3.27, there was a positive association between the level of speed of an offender above the speed limit and the level of severity recommended for the penalty.

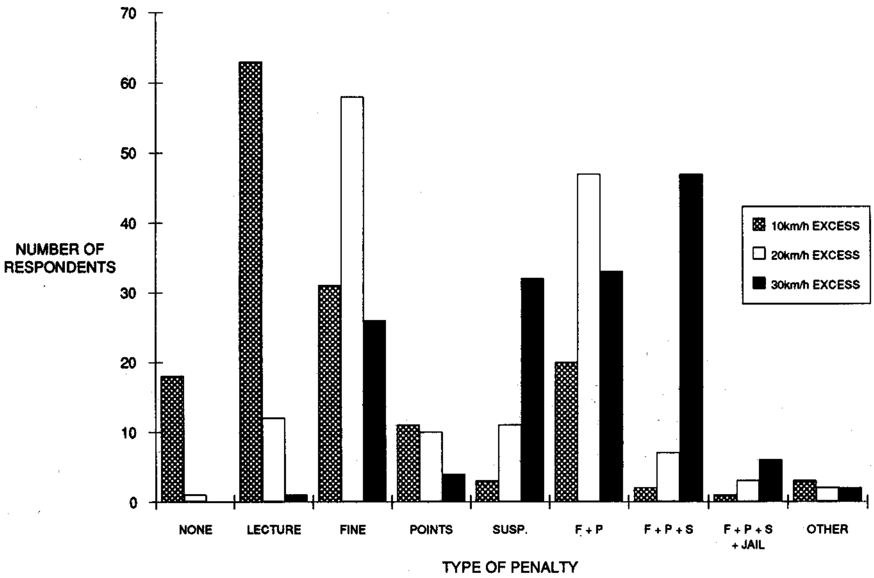


Figure 3.27 - Type of penalty (by level of severity) nominated by drivers for a range of speeding violations at the Woodend rural site

In particular, respondents stressed increasing fines and loss of demerit points as speeding violations increased from 10 to 20 km/h while license suspensions were nominated for those travelling 30 km/h over the speed limit.

The various levels of penalty were reclassified into 3 groups of penalty severity; ***minor*** penalties consisted of a lecture or a fine, ***intermediate*** penalties comprised a fine and/or a loss of demerit points, while ***severe*** penalties included loss of license and jail sentences. Figures 3.28 to 3.30 show the relationship between level of penalty severity and observed travel speed for each of the three levels of speed violation.

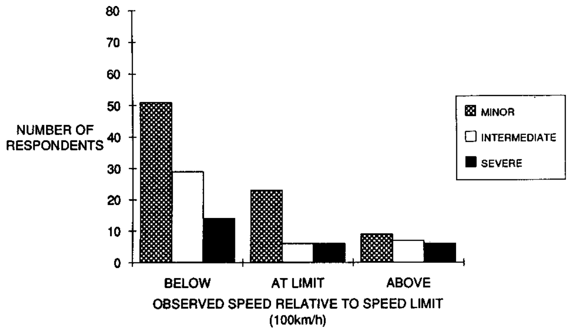


Figure 3.28 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 10 km/h at the Woodend test site

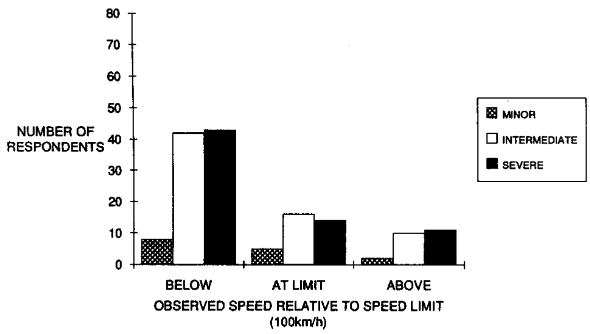


Figure 3.29 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 20 km/h at the Woodend test site

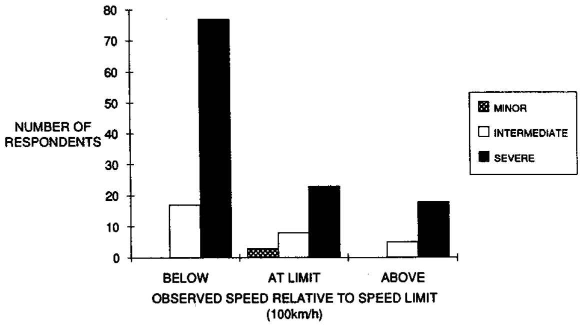


Figure 3.30 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 30 km/h at the Woodend test site

There appeared to be an interaction between these factors: those travelling below the speed limit appear to be more generous (in favour of less severe penalties) than those travelling above the speed limit for the lower violation levels; responses were similar for a 20 km/h excess; while slow travellers appeared to be more harsh in nominating penalties for exceeding the speed limit by 30 km/h than their fast counterparts. However, this relationship was not statistically significant at the 5% level for any of the three speeding violations (for 10 km/h excess, X^2 =6.5, p=.59; for 20 km/h excess, X^2 =6.3, p=.61; for 30 km/h excess, X^2 = 13.4, p=.10).

The level of fine varied depending upon the magnitude of speeding. For a 10 km/h excess, motorists thought an average penalty of $66 was appropriate (peaks of $50 and $100 were observed). For a 10 km/h excess, the average fine stipulated was $166 with peaks of $50, $100, and $200, while for a 30 km/h excess, an average fine of $320 was nominated with peaks of $150, $200 and $500.

The level of fine recommended by the motorists (classified as less than $100, greater than, or equal to $100) was not related to travel speed for either 10 km/h (X^2=1.01, p=.298), 20 km/h (X^2 = 2.5, p=.110), or 30 km/h (X^2=0.96, p=.298) violations.

3.7 RELATIVE IMPORTANCE OF THE VARIABLES

A regression analysis was performed to test the relative importance of each of the measured variables in determining a driver’s speed. This final analysis was considered necessary to rank the significant variables in their order of importance to determine possible countermeasures against excessive speeding.

However, a factor analysis was first conducted on the combined data from the two rural sites to test the independence of the independent variables. A principal components analysis was used to extract the factors and the varimax method was used for orthogonal rotation of the factors. All of the variables relating to driver and vehicle characteristics were included in the analysis as was the drivers' estimates of a safe travel speed.

Two tests of legitimacy of the use of factor analysis were initially conducted on these data as recommended by Norusis (1985). The Bartlett test of sphericity (Value=2165.2, p<.001) and the Kaiser-Meyer-Olkin measure of sampling adequacy (0.37). The former result was in order, while the latter low value confirmed the inclusion of many 0-1 variables in the analysis (e.g. PUR1, CL1, SEX). These variables could not be excluded from the factor analysis, however, as there was ***apriori*** evidence to suggest that they were as important with regard to observed travel speed.

Table 3.3 shows variables which had a high factor loading score for the seven main factors identified in the analysis. [Factor loadings less than 0.3 have been omitted from the table]. The criteria used for deciding which variables to include in the regression analysis was based on an evaluation of how meaningful the factor was in terms of the characteristics of the sample and the amount of total variance which could be explained by the factor. On this basis it was decided to include the first three factors (RURAL1 to RURAL3) in the regression analysis.

Table 3.3 Rotated factor matrix from factor analysis conducted on the combined rural site data

VARIABLE	RURAL1	RURAL2	RURAL3	RURAL4	RURAL5	RURAL6	RURAL7
BUSINESS	+.81						
RECREATION	-.73		+.45				
No. OCCUP	-.69						
MILEAGE	+.53						
OWNER	+.40					+.34	
AGE		+.91					
EXPERIENCE		+.90					
ACCIDENT		+.57					
DOMESTIC			-.73				
POST-DISTANCE			+.68				
PRE-DISTANCE			+.67				
SEX OF THE DRIVER			-.49				
COMPACT CAR				-.87			
INTER. CAR				+.75			-.50
Z SAFE SPEED							
LARGE CAR					-.82		
YEAR OF MANUFACTURE					+.54		
SMALL VAN						-.86	
TOWING					+.30	+.47	
SMALL CAR							+.94
%Variation	14.0	11.1	9.6	8.0	7.1	6.2	5.6

As shown in Table 3.3, some of these variables were strongly correlated, suggesting that there were groups of drivers for which these variables naturally go together. For instance, RURAL1 representing business travellers who travelled large distances each week, drove a vehicle they did not own, and carried few passengers. RURAL2 comprised older (or more experienced) drivers with low accident rates. The third factor, RURAL3, represented male drivers undertaking long trips for recreational or holiday purposes. Collectively, these three factors explained approximately 35 percent of the total variance. For the regression analysis, the three factors extracted from the factor analysis (RURAL1 to RURAL3) were included as were other variables which did not have high factor loadings for these factors. A multiple linear regression equation was then computed using stepwise selection of these variables. The final regression equation relating these variables to observed speed for the combined samples at the two rural sites is shown in Table 3.4. All independent variables were included in the factor analysis. Where factors were not continuous variables (i.e., purpose of the trip) each level of that factor was assigned a binary choice and included as a separate factor, such as BUSINESS, SMALL CAR, TOWING, etc. This procedure is recommended by SPSS Inc. (1982) when analysing these variables using SPSS-X.

Table 3.4 Summary of Multiple Regression Analysis for Rural Sites

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
TOWING	1.2810	.1941	.3180	6.6	.0000
RURAL2	-.2771	.0502	-.2761	-5.5	.0000
Z_SAFE	.1661	.0499	.1673	3.3	.0010
RURAL3	.1416	.0480	.1415	2.9	.0034
RURAL1	.0917	.0485	.0916	1.9	.0594
CONSTANT	-2.4598	.3784		-6.5	.0000

NB: TOWING is whether the vehicle was towing a trailer or not, and Z_SAFE is the normalized safe speed estimate.

This model suggests that exceeding the mean travel speed was associated with vehicles that were not towing, had younger (inexperienced) drivers who reported high accident histories, drivers who considered high speeds to be safe, male drivers travelling long distances for other than domestic purposes, and single occupant business travellers who do not own their own vehicle and travel over large weekly distances.

The adjusted R^2 the model could explain 26% of the variance in the observed travel speeds. Similar results were obtained for equations in which the individual variables were used (rather than the factors extracted in the factor analysis).

The large amount of unexplained variance and large standard error of the dependent variable (0.86, i.e. almost 1 standard deviation) indicates that the model shown in Equation 1 is not a powerful predictor of driver travel speeds. In other words, there were many other factors that also contributed to a drivers travel speed on the road (albeit in a lesser role to the factors identified above).

3.7.1 Individual Sites

A multiple linear regression equation was also calculated for each of the individual sites, using the factors extracted from the combined sample to further explain the role of different site characteristics in travel speed. The multiple regression summary table for the Euroa site is shown in Table 3.5.

Table 3.5 Summary of Multiple Regression Analysis at Euroa

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
RURAL2	.3332	.0610	-.3495	-5.5	.0000
TOWING	1.0948	.2354	.3029	4.7	.0000
RURAL3	.2362	.0749	2050	3.2	.0019
Y.O.M.	.0275	.0129	.1414	2.1	.0340
CONSTANT	-4.4293	1.0783		4.1	.0001

NB: TOWING is whether the vehicle was towing a trailer or not, and Y.O.M. is the year of manufacture of the vehicle.

The Euroa model suggests that fast travel speed on this section of the Hume Highway was associated with vehicles not towing a trailer, younger (less experienced) drivers, those with a high accident rate, male drivers travelling a long distance for recreational purposes, and recently manufactured vehicles.

The major difference here with the overall model (apart from the different weights assigned to the variables) was the exclusion of the variables RURAL1 (single occupant business travellers) and Z_SAFE and the inclusion of Y.O.M. The adjusted R^2 value for this model is 0.32, with a standard error of 0.82, meaning that this model explains 32% of the variance in travel speeds observed at the Euroa rural site.

The similar regression equation obtained from the data collected at the Woodend site is shown in Table 3.6.

Table 3.6 Summary Of Multiple Regression Analysis At Woodend

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
TOWING	1.5322	3371	.3226	4.5	.0000
RURAL2	-.2509	.0855	-.2302	-2.9	.0039
Z_SAFE	.2012	.0796	.2015	2.5	.0126
RURAL1	.1752	.0763	.1711	2.3	.0232
VANS	-.6748	.3013	-.1599	-2.2	.0266
CONSTANT	-2.9809	.6639		4.5	.0000

NB: TOWING is whether the vehicle was towing a trailer or not, Z_SAFE is the normalized safe speed estimate, while VANS refers to drivers travelling in forward control passenger vans.

This model shows that fast travel speeds on this section of the Calder Highway were associated with vehicles not towing trailers, younger (inexperienced) drivers who reported high accident histories over the past five years, those who considered high speeds to be safe, and those driving passenger cars and/or four-wheel-drives (not vans). At Woodend, the major differences with the overall model was the exclusion of the RURAL3 (distance travelled and sex of the driver) and the inclusion of VANS (small passenger vans). This finding was consistent with lower travel distances observed at this site and an increase in local domestic traffic. The adjusted R^2 value for this model is 0.26, with a standard error of 0.86, showing that this model explains 26% of the variance in travel speeds observed at the site.

4. DISCUSSION OF THE RURAL RESULTS

4.1 FREE SPEED DISTRIBUTIONS

The results obtained at Euroa demonstrated that motorists, on average, travelled about 5 km/h above the posted speed limit along this section of the Hume Highway at the time of the survey. Moreover, this was approximately 5 km/h faster than figures observed for similar highways in other parts of Victoria around this time period (VicRoads, 1989). It was, however, less than the design speed value for that site. This difference may be a "carry-over" effect in speed at the Euroa site from the preceding freeway (vehicle speeds at Euroa were observed on an undivided section of highway posted at 100 km/h and 6 km after they had exited from a long section of (the then) 110 km/h posted divided freeway.

Travel speeds observed at the Woodend site were substantially less than at Euroa (the mean travel speed was 13.5 km/h lower at Woodend than at Euroa) and approximately 8 km/h less than that recorded at other sites on the Calder Highway (Fildes, Fletcher & Corrigan, 1987). This appears to be a function of their specific road conditions at this site, namely a 500m curved tree-lined intra-state highway with restricted sight distance. Interestingly, mean travel speed at Woodend was in fact greater than the design speed for that curve (92.4 km/h c.f. 75 km/h).

4.2 OVERVIEW OF THE SAMPLE

Of the 610 drivers stopped at both sites in the rural study, more than half of them (53%) agreed to be interviewed. Moreover, there were no substantial differences in refusal rates by speed category, although there were minor differences by study day. This is reassuring and seems safe to assume that any bias is equally reflected in all speed category responses.

The majority of the drivers approached for interview during the study were males (72% at the Woodend site and 89% at the Euroa site). This is much higher than that expected on the basis of licensing rates alone where 55% percent of drivers are males. Such a finding suggests that it is predominantly men who drive in rural areas [this has been reported elsewhere cf. Fildes, Fletcher & Corrigan, 1987; Fildes, Leening & Corrigan, 1989; Ove Arup, 1990]. There were substantially more women drivers encountered at the Woodend site than at the Euroa site, probably because of the apparent increase in local traffic at this site.

The age distribution of the drivers stopped at the two sites was quite similar with fewer younger drivers than would be expected from licensing rates (these figures suggest that drivers aged over 55 years were over-represented while those under 25 years were under-represented at these rural sites). This is reassuring as it suggests that the associations found between age and travel speed was not simply a function of a bias in the sample ages.

The accident histories reported by the drivers were also quite similar in both sample groups with approximately 25% of the drivers having reported being involved in at least one accident in the past five years. Of the accidents reported by the drivers 87% involved property damage only. This is roughly in accord with other published figures (Sanderson and Hoque, 1987).

4.3 SAMPLE REPRESENTATIVENESS

The interview rate was relatively high in both samples, with the rate being slightly higher at Euroa (63 percent) than at Woodend (45 percent). The overall interview rate was much higher than that expected from other survey research and probably indicates that drivers travelling in rural areas may be less pressed for time than city drivers and, hence, more receptive to participating in these surveys.

For both of the test sites the two sample populations (those who refused to be interviewed compared to those who agreed) were similar in terms of their travel speeds, and sex of the driver. However, the type of vehicle driven had some influence on the likelihood of interview in this study. For both surveys, the interview rate increased with vehicle age (those drivers who drove older cars were more likely to agree to be interviewed).

At Euroa, too, drivers who drove small passenger vehicles and commercial vehicles were also more likely to agree to be interviewed, and contrary to that found at Woodend. At Euroa the interview rate was not related to the age of the driver. However, young drivers were more likely to agree to be interviewed than the older drivers at Woodend.

Finally, there was evidence in both experiments that the interview sample was biased towards those drivers who were not in a hurry or running late for an appointment. It is difficult to see how this could be improved using this methodology and hence, must be an inherent flaw with this approach. Alternative methods such as follow-up questionnaires, however, would not necessarily guarantee a less biased sample and may well introduce additional biases of their own (e.g., responses at a time markedly different to when their speeds were observed).

4.4 DRIVER & VEHICLE CHARACTERISTICS ON TRAVEL SPEED

The effects of driver and vehicle characteristics on travel speed were of particular interest in this study. Table 4.1 summarizes the results obtained overall, and for excessively fast and slow travellers, for the combined data from both rural sites.

Table 4.1 Summary of the effects of the independent variables on travel speed for the combined data at the rural sites

VARIABLE	OVERALL	FAST	SLOW
Driver age	sig.	<34 yrs	>55 yrs
Driver sex	n.s.	n.s.	n.s.
P-Plates		insufficient numbers	
Seat belts		insufficient numbers	
No. occupants	sig.	single *	two *
Purpose of trip	sig.	business	rec/dom
Travel schedule	n.s.	behind	n.s.
Vehicle type	sig.	n.s.	vans/L.cars
YOM vehicle	sig.	<5 yrs	>5 yrs
Towing a trailer	sig.	not towing	towing
Vehicle ownership	n.s.	n.s.	n.s.
Accident involvement	sig.	more crashes	less crashes
Number accidents	sig.	2 or more	n.s.
Injury severity	trend	more severe	no severe
Weekly travel	n.s.	n.s.	n.s.
Prior distance	n.s.	n.s.	n.s.
Post distance	n.s.	n.s.	n.s.
Time of last stop	n.s.	n.s.	n.s.
Tiredness	n.s.	n.s.	n.s.

sig = significant p<.05
n.s. = not significant p<.05
* approaching significance

4.4.1 Driver & Occupant Characteristics

There were a number of driver and occupant characteristics which were statistically related to the observed travel speed of the drivers at the two rural sites. Driver age (and amount of driving experience) was a function of travel speed where younger drivers (those aged less than 25 to 34 years) were more likely to be excessive speeders, while those aged over 45 years were more likely to be excessively slow motorists.

The sex of the driver was not associated with travel speed (nor with excessively fast or slow travel speeds). While there was a bias towards male drivers in this study, there were still sufficient numbers of female drivers for an effect to be obvious if one was there.

The number of occupants in the vehicle was associated with travel speed. Single occupant vehicles (driver only) were more likely to be excessive speeders, while those with 2 occupants were more likely to be excessively slow vehicles. There was no association between travel speed and whether the vehicle had 3 or more occupants. It would be expected that this finding would be highly correlated with the age of the driver and the purpose of the trip.

There were insufficient numbers of vehicles displaying P-Plates and unbelted drivers to test these effects thoroughly here.

In short, what these results show is that young (inexperienced) drivers and/or those alone in their vehicles are likely to be excessive speeders on rural highways in Victoria. These effects were consistent at both sites, even though there were fewer younger drivers observed than would be expected from driving license statistics. The relative strength of these effects to other variables tested will be discussed further on.

4.4.2 Vehicle Characteristics

There were significant associations observed between travel speed and the age of the vehicle, whether it was towing a trailer or not, and to a lesser degree, the type of vehicle.

At both sites, excessively fast travel speeds were associated with recently manufactured vehicles and vehicles which were not towing a trailer. By contrast, the very slow motorists were driving older vehicles and/or those which were towing a trailer. There was a hint that motorists in vans and large passenger cars were also more likely to be excessively slow travellers, although this finding could be compounded by driver age and trip purpose.

The finding that towing a trailer was associated with slower travel speeds is not too surprising, given the penalty of extra load and perceived loss of stability generally associated with towing a trailer at relatively high speeds.

4.4.3 Travel & Tiredness Effects

There were robust findings observed between travel speed and purpose of the trip and the drivers' travel schedule. Those travelling on business or running behind their travel schedule were more likely to be excessive speeders, while those on holidays or carrying out domestic duties were more likely to be excessively slow motorists. Again, it is conceivable that the effects of these variables would also be highly correlated with other factors, such as driver and vehicle age, number of occupants, and so on.

There were, however, very few statistical associations between travel speed and either distance travelled or level of tiredness. This may have been a function of the particular locations and the time of day of the study. While Euroa was a reasonable distance from both Melbourne and Albury (between 1 and 2 hours travel in either direction), these were not particularly long distances on high grade highways and rural freeways. Moreover, very few drivers reported feeling tired during the daylight hours of the study. It would be useful to examine these findings further in more remote locations, on lower grade highways, and at night.

4.4.4 Accident Histories

There was a statistical relationship between observed speed and the reported accident involvement rate for the drivers at the two sites. Those travelling at excessively fast speeds were more likely to report previous accident involvement (and multiple accident involvement) than those travelling at slower speeds.

Moreover, there was also a significant association between level of injury and travel speed. Excessive speeders were likely to report medical and hospital treatment for their injuries from these crashes, while none of those travelling at excessively slow speeds reported injuries requiring medical or hospital treatment. These results have similarities with previously reported findings between travel speed, accident involvement, and injury severity and need to be fully discussed.

CRASH INVOLVEMENT: Solomon (1964), Munden (1967), Research Triangle Institute (1970), and others have reported increased accident involvement rates for excessive speeders in rural environments, consistent with the findings observed here. This is reassuring as it confirms the likelihood of increased accident involvement with high variance from the mean traffic speed. However, these earlier reports also noted increased crash involvement for those travelling at speeds markedly lower than the mean rural traffic speed (the U-shaped variance hypothesis around the mean travel speed). No such finding was observed in this study for slow travellers. In fact, the results here suggest that the relationship between travel speed and crash involvement is a simple linear function, where accident involvement is likely to be lower for those travelling below the mean traffic speed, and higher for those travelling above.

This difference is most striking and needs to be put in context. First, the results obtained here were from self-reported accident involvement, compared to comparisons with official statistics in the other studies. It may well be that these findings have a degree of under-reporting which may not be consistent across the various speed groups (excessively slow vehicles tended to be driven by older people who may have greater difficulty recalling their previous accident histories). However, official statistics, too, are subject to under-reporting (e.g., Bull and Roberts, 1973; McGuire 1973; Shinar et al, 1983 to mention only a few) and are particularly vulnerable to under-reporting of property damage only crashes. Indeed, Smith (1977) concluded that self-reported crashes are often more reliable than the official records.

Second, the numbers of crashes recorded here were small compared to the earlier reports which is of some concern. However, the finding for slow vehicle drivers to report fewer accidents was not even close to significance and there was no sign of any trend in the expected direction either.

Finally, the earlier reports examined the speed and accident involvement relationship over a much larger range of speeds than those used in this study (most of the marked upward increase in accident risk in the work of Solomon and others occurred 20 to 25 km/h above and below the speed limit). As there were very few observations in these extreme speed categories in this study, it was not possible to test self-reported accident involvement rates over a larger range than plus or minus 20 km/h.

Given the apparent importance placed on the U-shaped relationship between speed variance and accident causation in the literature and the consequences for countermeasure development, it is imperative that these apparent differences be examined further using a much larger database and comparing self-reported accident involvement with official accident statistics.

It should also be noted that at both sites, there was evidence of a significant correlation between accident involvement and the age of the driver, where younger drivers were more likely to have been involved in an accident than older drivers. This also questions the usefulness of looking for a single functional relationship between speed and accident involvement in countermeasure development, rather than targeting particular groups of motorists who have been shown to be accident involved.

CRASH CONSEQUENCE: Excessively fast drivers were more likely to have reported sustaining an injury requiring medical treatment or hospitalisation than were those of the slow drivers. This finding is consistent with previous reports by Solomon (1964), Munden (1967) and others, and is also consistent with that expected from the physical relationship between speed and impact severity (force equals mass by velocity squared). Clearly, those travelling at excessively fast travel speeds are placing themselves more at risk of inflicting a severe injury to themselves and other occupants in their vehicle (and other road users as well) in the event they are involved in a collision.

SUMMARY: The results obtained here suggest that travelling at excessive speeds above the mean traffic speed in rural environments has disbenefits, both in terms of higher accident involvement and greater injury severity. By contrast, those travelling at slower speeds appear to be less likely to be involved in crashes and to sustain severe injuries. There was no suggestion of a U-shaped functional relationship between travel speed and variance around the mean traffic speed as earlier reported. The findings for the very slow and fast motorists in particular need to be examined further using a larger data set.

4.5 ATTITUDES TO SPEED

Driver attitudes are commonly associated with travel speed in rural and urban environments. This study sought to examine these relationships further, although it was not possible to combine the individual site data, given differences in the mean travel speeds at both sites and differences in interpreting the questions inherent with the particular site characteristics.

4.5.1 Knowledge of Posted Speed Limits

At both test sites, the majority of drivers interviewed were able to correctly nominate the posted speed limit. In addition, their observed speed was not significantly related to their estimate of the speed limit. This result indicates that the drivers' travel speed was not a function of an inappropriate understanding of what the speed limit was, but rather that travellers on these sections of highway do not place much store in the speed limit in choosing their travel speeds. This will be examined further in the following sections.

4.5.2 Own, Others & Safe Travel Speed

At both sites, it was found that drivers' judgements of their own, others and safe travel speed were all highly correlated. These three measures were used by Cairney & Croft (1985) and Cairney (1986) in earlier speed perception research to minimize the possibility of socially acceptable responses. The results from this study, however, show that the three measures produced essentially the same pattern of responses. Subsequent analysis, therefore, only focused on drivers' estimates of their own and safe travel speeds (previous evidence suggested that in some circumstances, drivers may choose to travel slower than what they perceive is safe (Fildes et al, 1987; 1989).

Drivers at both sites were accurate at estimating their own traffic speed. The responses of slow drivers were particularly accurate, compared to excessive speed responses which were more varied. This may be, in part, a function of social forces at work, where many of those who choose to travel above the speed limit would not openly admit to it, as well as the possibility that drivers of newer vehicles (many of whom were travelling at fast speeds) may be less able to judge their own travel speeds than drivers of older vehicles.

There was also a significant relationship between the observed speed and the drivers' estimates of a safe travel speed at both rural sites. Drivers who travelled at fast speeds were more likely to nominate higher speeds as being safe than those who travelled at slower speeds.

However, slightly more than half of the excessively slow motorists at Euroa (less than 86 km/h) maintained that 100 km/h was still a safe travel speed, even though they choose to travel at least 15 km/h below it. Similarly, 20% of the very slow motorists at Woodend (less than 75 km/h) believed that 100 km/h or over was a safe travel speed, even though they choose to travel at least 25 km/h below it. The reason why these motorists are deliberately choosing to travel well below the mean traffic speed is not clear, although some of them were driving old cars and/or pulling caravans which might help to explain this anomaly.

In addition at Euroa, half of those travelling 15 km/h or more above the speed limit responded that 100 km/h or even less constituted a safe operating speed. The question remains why these people choose to travel at these fast speeds if they don't believe it safe to do so. Quite possibly, they may be simply expressing a conservative answer, not uncommon in these interview situations. Alternatively, they may not have been aware of what speed they were travelling at, or felt that they were a special case (that is, they are more able to drive at these speeds than the rest of the population). Clearly, any campaign aimed at reducing excessive speeds needs to emphasize the increased likelihood of being involved in a road crash at high speeds and that all motorists who choose to travel at these speeds are equally vulnerable.

4.5.3 What Is a Dangerous Travel Speed?

Only the drivers at the Woodend site were asked what constituted a dangerous speed. This was included in the second study to see whether there were differences between drivers' perceptions of safe and danger. Clearly, there were, as judgements of danger were not correlated with observed speed (although they were negatively correlated with safe speed estimates). Many of the drivers reported some difficulty in answering this question and appeared to be uncertain with regard to its meaning. It appears that drivers have a clearer understanding of "what is safe" than "what is dangerous" on the road when it comes to speed behaviour. This is an interesting finding which might be worth following up in any future research in this area.

However, drivers did not have any difficulty responding to the question "how dangerous is it to travel at 130 km/h on this section of highway?”. At Euroa, drivers travelling at fast speeds were more likely to describe 130 km/h as not dangerous than were slower drivers. At Woodend, though, there was no relationship between travel speed and the drivers' perceptions of how dangerous it is to drive at 130 km/h at that site. The reason for this discrepancy is most likely site differences. The site at Euroa was a straight section of road with good sight distance, while the Woodend site was a tree-lined curved section of road with limited sight distance. Mean travel speeds reflected these differences and, contrary to that observed at Euroa, there were very few motorists travelling above 130 km/h at Woodend. In other words, it was not really possible to compare the responses to this question across both sites.

Of some concern was the high proportion of motorists at Euroa who responded that 130 km/h was not dangerous (and to a lesser degree at Woodend as well). There was a percentage of drivers in all speed categories including the very slow group (a surprising 35% at Euroa) who responded in this way to this question. The earlier discussion on the accident history results for excessive speeders showed the fallacy of this belief in terms of their increased risk of both accident involvement and severe injury. Hence, there is an immediate need to stress on all drivers the risk they take in travelling at these very high speeds on rural highways. A high proportion (40%) of those travelling over 125 km/h at Euroa responded 'dangerous' to this question, too. While a few of them would have been travelling less than 130 km/h, most were not. Some of these people may have simply been expressing a socially accepted response to this question, while others may have the belief that "it can’t happen to me". Either way, it is yet another demonstration of the fallacy of the risk associated with excessive speeding.

4.5.4 Likelihood of Being Stopped by the Police

The majority of the drivers at both sites thought it unlikely to be stopped by the police for exceeding the speed limit by 20 km/h. A higher proportion of drivers at Woodend (81%) considered it unlikely that a driver would be stopped by police than at Euroa (58%). At both of the test sites there was no relationship found between the observed travel speed of the drivers and the perceived likelihood of being stopped by the police. These findings suggest that if police surveillance is to be used as a general deterrent against excessive speed, the perceived likelihood of being detected by the police travelling above the speed limit in these rural areas needs to be enhanced at these two road sites, and most particularly at the Woodend site. Given the similarity of the response across all speed groups, this perceptual change needs to be aimed at all motorists.

The intensive use of speed cameras in Victoria which commenced after these data were collected was expected to have changed this result recently. It would be useful to re-test this finding at one or two of these sites again to assess the area-wide detection effect of the speed camera program.

4.5.5 Penalties and Fines

The questions concerning penalties and fines for speeding violations were addressed to the Woodend drivers only. The responses of these drivers stressed increasing fines and loss of demerit points as speeding violations increased form 10 to 20 km/h and license suspensions for those travelling 30 km/h over the speed limit. No relationship was found, though, between the observed speed of the vehicle and the level of penalty or magnitude of fine suggested by the driver.

In general terms, the level of severity of the penalty for speeding closely approximated current practice. While this is not too surprising, it does show, nevertheless, that current levels of penalties for speeding were not threatening to motorists in an environment where the perceived risk of detection was low. This suggests, therefore, that an increase in the magnitude and severity of the offense might act as an increased deterrent against speeding. However, other evidence suggests that penalties alone are not likely to be a sufficient deterrent in their own right, and that any increase in penalty needs to be associated with an increased in the perceived risk of detection as well.

4.6 RELATIVE IMPORTANCE OF THE VARIABLES

A number of statistical associations were found between the independent variables tested here and observed travel speed. However, a number of these variables seem to be inter-related and it was not possible to gauge the relative importance of each of these variables in determining travel speed on the road. Given the need to prioritize these factors for determining possible countermeasures against excessive speeding, a factor and multiple regression analysis was performed on these data.

The overall results show that excessive speeding on these rural roads was associated with vehicles that were not towing a trailer, with younger (inexperienced) drivers who reported high accident histories, drivers who considered high speeds to be safe, male drivers travelling long distances for business, and single occupant business travellers who do not own their own vehicle and travel large weekly distances. Conversely, slow travellers were more likely to be towing a trailer, to be older drivers, driving older vehicles they own, travelling on holidays or on domestic duties, or people who consider it unsafe to travel at high speeds. The order of these variables in the regression equation relates to the order of importance attached to each factor.

There were minor differences in importance of the variables at both sites suggesting slight differences for different road settings. At Euroa, for instance, excessive travel speeds were less associated with single occupant business travellers but more related to recent vehicles, while at Woodend, distance travelled and sex of the driver was less important in determining travel speed but the type of vehicle became more of an issue (vans were related to excessive slow travellers). As noted earlier, these findings were consistent with lower travel distances and an increase in local domestic traffic at the Woodend site.

It should be pointed out that each of the models proposed were only able to explain between 26% and 32% of the total variance of the responses. In addition, there were large standard errors in the transformed speed scores at most sites (up to almost 1 standard deviation). This suggests that each of the 3 models reported here were not powerful predictors of driver travel speeds. In other words, there were many other factors that also contributed to a drivers travel speed on the road (albeit in a lesser role to the factors identified above).

This should not be taken to mean that these models are unimportant, but rather, indicate that an individual driver's travel speed is a complex multi-factorial decision. The variables identified by the model will permit a number of possible countermeasures, against excessively fast (and slow) travel speeds on rural highways. This will be discussed further in the final chapter of this report. However, it needs to be acknowledged that any effect on reducing excessive travel speeds will likely be in proportion to the amount of variance explained by the model. One should be careful, therefore, not to use these models as a predictor of speed behaviour on the road.

5. THE URBAN STUDY

As in the rural study, the two urban sites chosen similarly differed in terms of their road alignment and roadside environment. The first site (site 3) at Beach Road, Parkdale was a straight section of 4-lane straight undivided arterial road with a seaside setting, a60 km/h speed limit, and between 1 and 2 km sight distance. This road had been shown to be particularly susceptible to excessive speeding from previous studies (cf. Sanderson and Corrigan, 1986; Fildes, Fletcher and Corrigan, 1987).

The second urban site (site 4) was at Belmore Road, Balwyn and consisted of a 500m curved section of 4-lane undivided arterial road in a residential setting which also had a posted speed limit of 60 km/h but only minimal sight distance (approximately 350m from the start of the speed measurement zone).

A small pilot study was initially undertaken at each site to determine the approximate speed profile for these 60 km/h zones. At Beach Road, these data showed a mean speed of 71 km/h with a standard deviation of 9.1 km/h. On the basis of these results, the 6 speed categories at this site comprising 60 km/h or less, 61-65 km/h, 66-70 km/h, 71-75 km/h, 76-80 km/h, and greater than 80 km/h. At Belmore Road, the pilot study revealed a mean speed of 67.1 km/h with a 7.5 km/h standard deviation, from which these 6 speed categories were derived, namely 50 km/h or less, 51-55 km/h, 56-60 km/h, 61-65 km/h, 66- 70 and greater than 70 km/h.

The procedure used in the urban studies was essentially the same as that used for the rural studies. Pedestrian lights were again used to stop the target motorists and the questionnaire developed for Woodend was adapted for use in urban settings. As the urban sites involved 4-lane arterials, speed measurement was permitted in either travel lane (but identified separately on the database). To minimize the possibility of loss through vehicles turning off, the distance between speed measurement and the point of interview was reduced to 750m.

5.1 FREE SPEED DISTRIBUTIONS

5.1.1 Beach Road Site

The free speed distribution observed at Beach Road over the 6 study days is shown in Figure 5.1. The mean travel speed was 72.3 km/h with a standard deviation of 10.2 km/h and the 96th percentile value was 90 km/h. Only 9% of the drivers were observed travelling at or below the speed limit (60 km/h). There was a difference in the speed between the two lanes, with vehicles in the outside lane (curb side of the road) travelling slower than those in the inside lane (70.2 km/h and 80.5 km/h respectively).

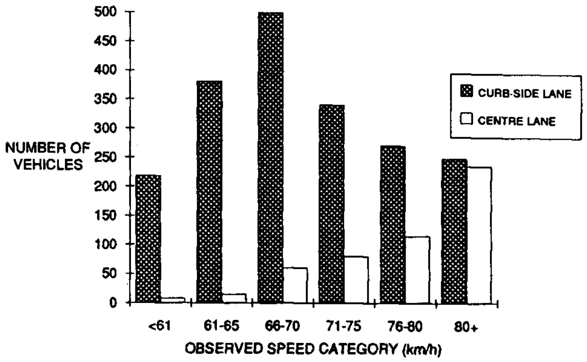


Figure 5.1 - Vehicle free speeds observed at Beach Road, Parkdale during the urban study in March 1990

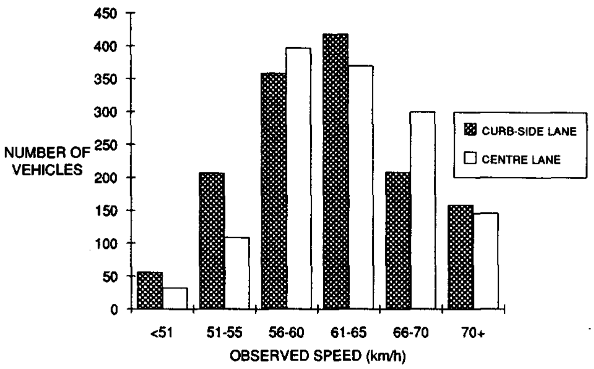


Figure 5.2 - Vehicle free speeds observed at Belmore Road, Balwyn during the urban study In March 1990

5.1.2 Belmore Road Site

The free speed distribution at Belmore Road for the 6 study days is shown in Figure 5.2. The mean travel speed at this site was 62.3 km/h with a standard deviation of 6.8 km/h while the 96th percentile value was 74 km/h. Forty percent of the drivers were travelling at or below the 60 km/h speed limit.

As in the Beach Road study, there was a difference in the speed distributions across the two lanes (albeit much less striking here) with vehicles on the curb side of the road travelling slower than those in the inside lane (mean = 61.7 km/h and 62.8 km/h respectively). The travel speeds observed at this site were considerably lower than those observed at Beach Road. This was most likely a function of the curved setting and possibly the residential environment.

5.2 INTERVIEW SAMPLE DETAILS

The overall interview rate for the urban study was 31%. This is much lower than the interview rate observed in rural areas. Moreover, there were slight differences in the sample sizes and interview rates at the two locations.

Over 6 days at the Beach Road site, 584 drivers were targeted and stopped at the temporary traffic lights of which 206 (35%) of them agreed to be interviewed. Seventeen percent of those interviewed refused to accept the $5.00 incentive. For the 6 days at the Belmore Road location, there were 665 drivers stopped at the traffic lights of which only 176 (26%) agreed to be interviewed. Of these, 19% refused the $5.00 incentive. There were also differences observed in interview rate by day of the week at both sites, where (as in the rural study) days in the middle tended to have higher rates than days at the start or the end of the week at both sites, where (as in the rural study) days in the middle tended to have higher rates than days at the start or the end of the week.

To test the representativeness of the urban interview sample, comparisons of those who agreed to be interviewed with those who refused were made for the limited number of items collected on both groups. Combined data were used for the analyses when there were no individual site differences.

There were no significant differences in the interview rate for the various speed groups (X^2=0.65, p>.05) or sex of the driver (X^2 =1.76, p>.05) overall, or at either site. There were, however, differences in their motivations; for the refusal group, 75% claimed to be in a hurry or late for an appointment, while for those interviewed, only 11% claimed they were in a hurry or were running late.

There was also a difference in the interview rate depending on the driver's age. Those in the younger age groups (less than 34 years) and those in the older age groups (over 70 years) were more likely to agree to be interviewed than were drivers aged between 35 and 44 years (X^2 =27.5, p<.01). There were no differences, though, between the two sites. There was also no relationship between the interview rate and the year of manufacture (X^2=1.94, p>.05) or the class of the vehicle (X^2 = 7.74, p>.05) overall or at either site.

IN CONCLUSION: While there was a slight overrepresentation of younger and older drivers, and those who were not in a hurry, the two populations (those who refused to be interviewed and those who agreed) were essentially the same in terms of their travel speed, the sex of the driver, the class of the vehicle and the year of manufacture of the vehicle. These differences are similar to those observed at the rural sites and, as previously, would not be expected to have any significant influence on the results of the urban study.

5.3 OVERVIEW OF THE SAMPLE VARIABLES

The following is a brief description of the characteristics of the drivers stopped at the Beach and Belmore Road sites. First, the age distribution of the drivers stopped at the two sites were similar. The distribution by age group consisted of 8% under 25 years, 70% aged 25 to 54 years, and 22% were aged 55 years or older. This is similar to the age distribution of drivers stopped at the rural sites.

The majority of the urban drivers stopped were male (overall, 64% of the sample were males compared to a 55% licensing rate for this group). This represents a substantially higher proportion of females than that observed for the rural study (36% cf. 21%). Sixty nine percent of all vehicles stopped were occupied only by the driver, 24% had two occupants, while 7% had 3 or more occupants. This also represents a much higher proportion of single-occupant vehicles than that found in the rural sample.

Only 1.3% of vehicles were displaying P-Plates. Almost all of the drivers stopped at the urban sites were using a seatbelt (99.4%), a finding consistent with the high rate of seatbelt use observed in the previous speed studies. Twenty one percent of the drivers interviewed did not own the vehicle they drove. The amount of weekly travel reported across the sample comprised 64% less than or equal to 400 km and 36% greater than 400 km and was consistent for both sites. Overall, 75% of the drivers interviewed at the two sites used the road weekly or more frequently, 16% used it monthly and 9% used it yearly or less often. More drivers used Belmore Road weekly or more often than did those interviewed at Beach Road.

The distribution of vehicle types stopped at the two sites was very similar. The most popular makes were Ford, Holden, Toyota, & Mitsubishi, while the more popular models included Falcon, Commodore, Corolla, and Magna. Ninety one percent of the sample were cars (or derivatives), 2% were four-wheel-drives, and 7 percent light commercials and vans. Of the cars stopped, 24% were minis, 28% were compacts, 33% were intermediates, and 6% were large models. Overall, there were more small and compact and fewer intermediate-sized vehicles than in the rural sample.

Recently manufactured vehicles were well represented at both sites, as was found in the rural studies (approximately half the urban vehicles were less than five years old). Of the vehicles stopped at the two sites only 1% were towing a trailer of some kind which is considerably less than at the rural sites.

The purpose of the trip overall consisted of 49% business, 21% recreation or holiday, and 30% domestic duties. At Beach Road there were more drivers undertaking trips for recreational purposes and fewer for domestic duties or business purposes than at Belmore Road. Nine percent of those interviewed at the two sites claimed to be travelling ahead of their travel schedule, 37% indicated they were travelling on-time, 11% admitted to being behind schedule, while 43% did not care.

Of all the drivers stopped for interview, 80% had travelled for less than 30 minutes since they last took a break from driving and 67% of them had travelled less than 15 km of their journey prior to being stopped.

Moreover, 73% of drivers had 15 km or less to travel to their destination. Sixty nine percent of the drivers were travelling a total distance of 35 km or less. As expected these travel distances were much shorter than those observed at the two rural sites. Furthermore, Belmore Road drivers were generally undertaking shorter trips than those stopped at Beach Road. As in both the previous studies, most of the drivers at the two sites (90%) claimed not to be feeling tired when they were interviewed.

The reported accident rate was similar at the two sites, although much higher than that reported by the drivers at the rural sites. Overall, 34% of the drivers reported having at least one accident in the preceding five years. Of the 122 drivers who reported accident involvement, 72% reported one, 23% reported two crashes, while 5% reported three or more crashes during that time period.

5.4 VEHICLE & DRIVER EFFECTS ON OBSERVED SPEED

The next phase of the analysis was to compare a number of the vehicle and driver characteristics with the free speeds observed for these respondents at the urban sites. These results were intended to provide a profile of drivers who travel at the various speed groups of interest and in what type of vehicle.

Once again, the main interest here was with the vehicle and driver characteristics for the vehicles observed travelling at excessively fast and slow travel speeds (the highest and lowest 15% of the free speed distribution). Except for the subjective measures obtained regarding drivers' attitudes to speed and related matters, the following analyses were conducted on the combined data from the two sites.

5.4.1 Driver Effects

There was a significant relationship between driver age and observed speed (X^2 =144.1, p<.001). Figure 5.3 shows that among the excessive speed group there was an over-representation of young drivers (aged less than 34 years) with relatively few older drivers (X^2 =52.0, p<.001), while the slow speed group consisted mostly of the older drivers aged 55 years or over) with very few young drivers (X^2 =79.22, p<.001). The sex of the driver was again not related to travel speed in the urban environments (X^2 =5.14, p>.05).

Once more, the number of vehicles displaying P-Plates was very small (1.3%) as was the number of drivers who were observed not using a seatbelt restraint (0.4%), hence, no statistical analysis was attempted of any relationship with observed speed.

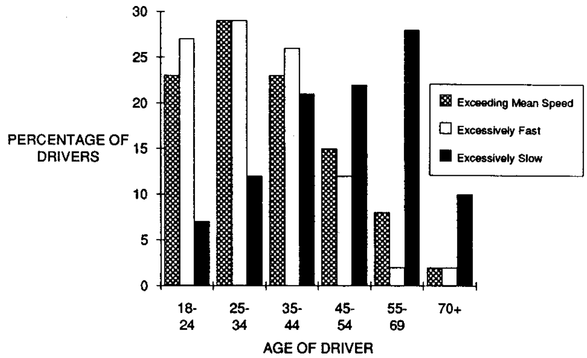


Figure 5.3 - Age group of the driver by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow travel speeds at the two urban sites

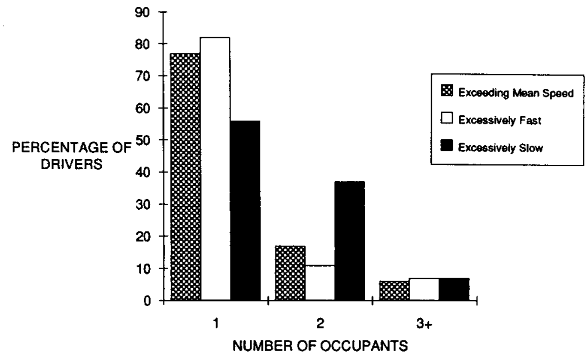


Figure 5.4 - Number of occupants by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the urban sites

5.4.2 Number of Occupants & Exposure

There was a significant relationship between number of occupants and travel speed (X^2=49.0, p<.001). Single occupant vehicles were more likely to be observed travelling at high travel speeds than were vehicles with two or more occupants. As shown in Figure 5.4, there was again an over-representation of single occupants among excessive speeders (X^2=20.1, p<.001) and two occupants in the excessively slow group (X^2=21.6, p<.001).

Contrary to the result found in the rural environments, there was a significant association observed here between weekly travel distance reported by the driver and travel speed (X^2=14.6, p<.05). As shown in Figure 5.5, drivers who reported travelling longer distances were observed travelling at higher speeds than the drivers who travelled shorter distances. Moreover, drivers who travelled longer distances were over-represented in the excessively fast speed group (X^2=5.0, p<.05), while those travelling short distances, in the excessively slow speed group (X^2=8.9, p<.01). There was no significant relationship observed between frequency of use of the road and observed travel speed (X^2 =19.2, p>.05).

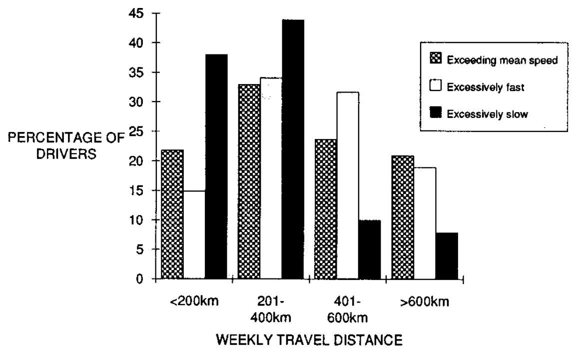


Figure 5.5 - Weekly travel distance by likelihood of the driver exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the two urban sites

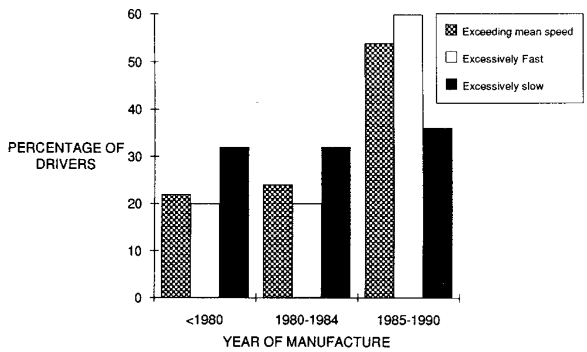


Figure 5.6 - Year of manufacture of the vehicle by the likelihood of exceeding the mean speed, or travelling at excessively fast or slow speeds at the urban sites

5.4.3 Vehicle Effects

Similar to the rural findings, there was a significant association observed between travel speed and the year of manufacture of the vehicle in urban settings (X^2=11.2, p<.05), as shown in Figure 5.6. However, type of vehicle did <u>not</u> have a significant influence on travel speed in this environment (X^2=7.7, p>.05). As only 1.1% of the vehicles were towing a trailer of some sort in urban areas, the numbers were really too small for a reliable statistical analysis of the relationship between this variable and observed speed.

5.4.4 Trip Purpose & Vehicle Ownership

There was a significant relationship between the purpose of the trip and observed speed (X^2=28.2, p<.001). As shown in Figure 5.7, there was an over-representation of business travellers in the excessive speed group with relatively few drivers undertaking domestic duties or travelling for recreational purposes (X^2 =6.45, p<.05). In contrast, the slow speed group consisted primarily of those travelling for domestic or recreational purposes with few business travellers (X^2 = 8.4, p<.05). There was no relationship observed between vehicle ownership and travel speed (X^2=4.7, p>.05), as found for drivers at rural sites.

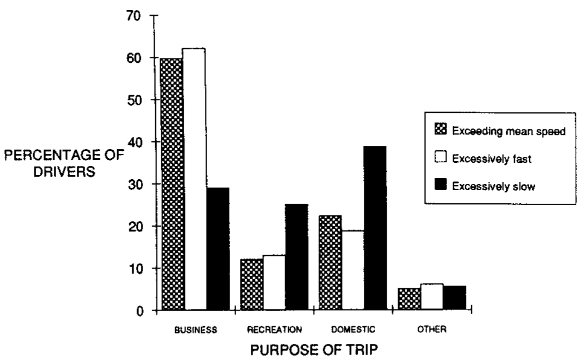


Figure 5.7 - Purpose of the trip by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the urban sites

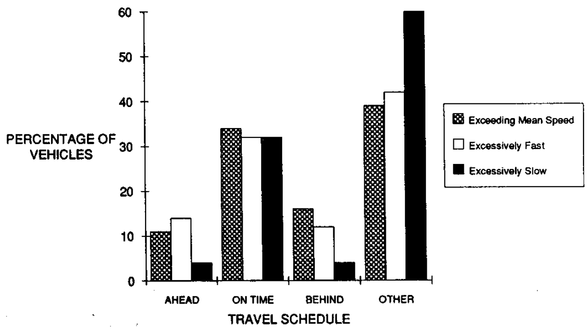


Figure 5.8 - Travel schedule by likelihood of exceeding the mean travel speed, or travelling at excessively fast or slow speeds at the urban sites

5.4.5 Journey Distance & Motivation

The findings between travel speed and the distance travelled prior to the interview (X^2=3.19, p>.05), the distance still to travel to their destination (X^2=10.89, p>.05), or the total distance travelled (X^2=4.09, p>.05) were not significant again in the urban environment.

However, there was a significant relationship between the travel schedule reported by the driver and observed speed (X^2=23.01, p<.05). Figure 5.8 shows fast travellers tended to be over-represented as "behind schedule", while excessively slow drivers tended to be over-represented in the “not travelling according to any set schedule” (X^2=8.61, p<.05). The time since the last stop was not related to travel speed (X^2=5.07, p>.05).

5.4.6 Driver Fatigue

Drivers were asked to rate how tired they felt on a 10 point subjective scale. Figures 5.9 and 5.10 show that at both the Beach and Belmore Road sites, the majority of drivers reported that they did not feel tired. These subjective responses were subsequently collapsed into **tired** (less than 5) and **not tired** (more than 5) categories and compared with observed speed. The results showed that the level of tiredness reported by the driver did not significantly influence travel speed (X^2 =3.1, p>.05).

Moreover, there was no statistical relationship either between the level of tiredness and the distance travelled prior to the interview (X^2=0.23, p>.05), the distance still to travel (X^2=1.4, p>.05), the total distance travelled (X^2=0.86, p>.05) or the time since the last stop (X^2=3.7, p>.05).

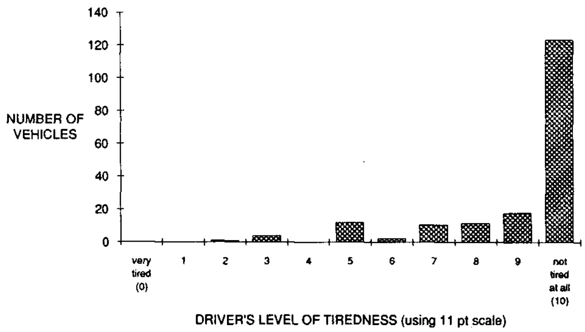


Figure 5.9 - Histogram of tiredness responses at the Beach Road urban site

Figure 5.10 - Histogram of tiredness responses at the Belmore Road urban site

5.4.7 Accident Histories

As with the rural results, the data collected here enabled an examination of the relationship between travel speed, accident involvement, and injury severity. As noted before, care should be taken not to place too much emphasis on these results, given the relatively small amount of accident data available.

There was a significant relationship between observed speed and accident involvement over the previous five years (X^2=15.9, p<.01). As shown in Figure 5.11, excessively fast drivers were more likely to have had an accident than were all other drivers (X^2=5.01, p<.05). Only 29% of these motorists reported not having had an accident in the last five years. This contrasts with the slow speed group who were under-involved in accidents (X^2=7.29, p<.01) with 63% of these drivers reporting no accidents during the past five years.

The relationship between previous accident involvement and travel speed relative to the mean speed in this study was roughly linear for the range of speeds observed (+/- 25 km/h around the mean speed), with no particular advantage for those travelling at the average traffic speed, compared to those at slower speeds.

The mean number of accidents reported by all drivers was 0.46. The difference in the number of accidents reported by drivers in the two extreme speed groups was most striking. The mean number of accidents reported by excessively fast drivers was 0.84, compared to only 0.14 for the slow speed group. This represents a reported accident rate 6 times higher for drivers in the excessively fast speed group than those in the excessively slow speed group.

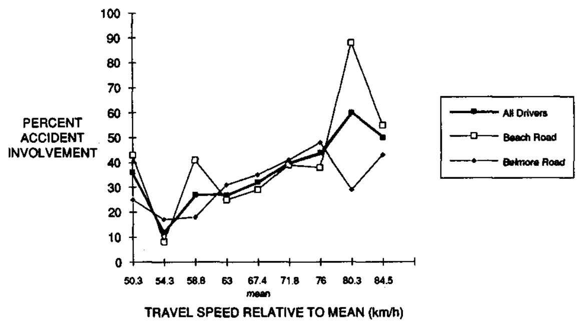


Figure 5.11 – Accident involvement by observed speed relative to the mean traffic speed at the urban sites

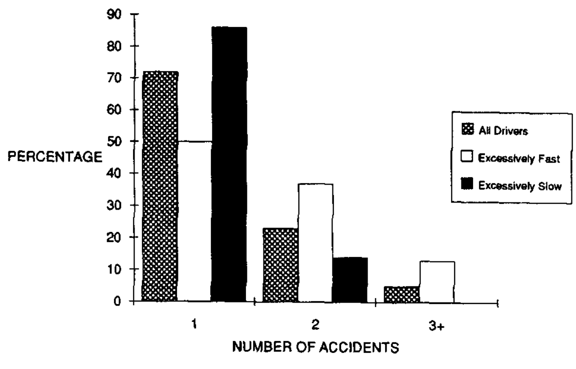


Figure 5.12 - Number of self-reported accidents for all drivers and for those travelling at excessively fast or slow speeds in the urban study

This is further illustrated by the fact that excessive speeders were over-represented amongst drivers who reported 3 or more crashes over the past 5 years (X^2=13.2, p<.01), while excessively slow travellers were under-represented (X^2=13.7, p<.01). As shown in Figure 5.12, drivers observed travelling at excessively fast travel speeds were much more likely to report having had 3 or more accidents over that time period than those travelling at all other speeds. There were no instances of 3 or more crashes observed amongst the excessively slow group.

Figure 5.13 further shows the breakdown of reported accidents by injury severity for all drivers as well as for the excessively fast and slow travellers.

Of the 117 total accidents reported at the two urban sites, 87% did not result in injury, (property damage crashes only), 8% resulted in injuries which required medical treatment only, and 5% resulted in hospitalisation. For the excessive speeders, 17% resulted in injury requiring medical or hospital treatment. However, none of the accidents reported by the excessively slow speed group involved injury.

Again, this finding needs to be tempered by the low numbers of injury crashes reported and the lower propensity for accidents amongst the excessively slow speed group.

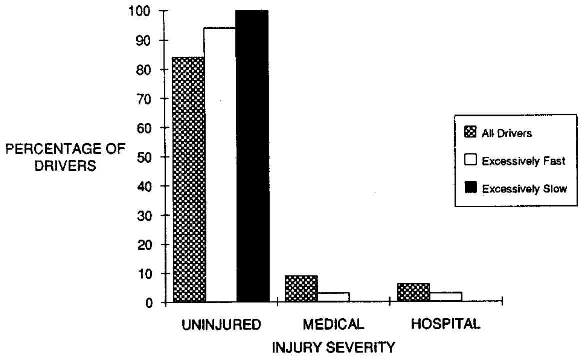


Figure 5.13 - Injury severity for all self-reported accidents and for those travelling at excessively fast and slow speeds in the urban study

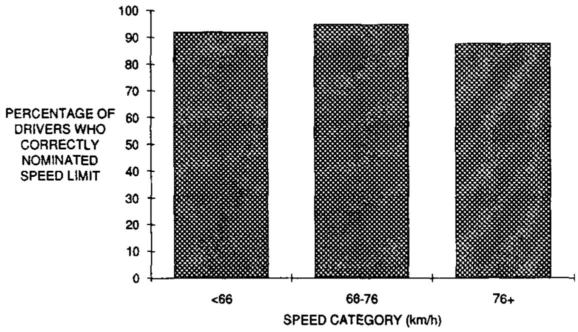


Figure 5.14 – Drivers' estimates of the posted speed limit at Beach Road

5.5 ATTITUDES TO SPEED

Drivers' attitudes to speed, speed enforcement, police presence and danger at the two urban arterial road sites were examined next. As with the rural attitude analysis, these data could not be combined into a single database because of marked differences in the road conditions and speeds observed at the two sites, hence they will be reported separately.

Pearson correlation coefficients were performed once more between the observed speed and the drivers' responses to the various attitude questions at the two sites are shown in Tables 5.1 (Beach Road) and 5.2 (Belmore Road).

Table 5.1 Correlation coefficient matrix of attitude responses at the Beach Road site during the urban speed study

	Observed speed	Own speed	Others speed	Safe speed	Danger speed	Speed limit	Danger limit	Police 90 km/h
Observed speed	1.00	.520 * (.000)	.300 * (.000)	.348 * (.000)	.376 * (.000)	.119 (.061)	-.346 * (.000)	.118 (.064)
Own speed		1.00	.420 * (.000)	.731 * (.000)	.539 * (.000)	.352 * (.000)	-.477 * (.000)	.040 (.298)
Others speed			1.00	.392 * (.000)	.305 * (.000)	.303 * (.000)	-.290 * (.000)	-.079 (.140)
Safe speed				1.00	.536 * (.000)	.310 * (.000)	-.479 * (.000)	.085 (.123)
Dangerous speed					1.00	.205 * (.002)	-.523 * (.000)	.006 (.469)
Speed limit						1.00	-.198 * (.003)	.114 (.060)
Danger 90 km/h							1.00	.036 (.311)
Police								1.00

* significant at p=.05 or less

Table 5.2 Correlation coefficient matrix of attitude responses at the Belmore Road site during the urban speed study

	Observed speed	Own speed	Others speed	Safe speed	Danger speed	Speed limit	Danger limit	Police 90 km/h
Observed speed	1.00	.121 * (.045)	.138 * (.034)	.338 * (.000)	.192 * (.006)	.077 (.155)	-.083 (.137)	-.071 (.175)
Own speed		1.00	-.007 (.465)	.063 (.202)	.011 (.445)	-.000 (.498)	.055 (.235)	.007 (.466)
Others speed			1.00	.433 * (.000)	.306 * (.000)	-.060 (.216)	-.317 * (.000)	-.094 (.109)
Safe speed				1.00	.444 * (.000)	.197 * (.004)	-.437 * (.000)	.006 (.467)
Dangerous speed					1.00	.101 (.090)	-.407 * (.000)	-.008 (.459)
Speed limit						1.00	-.063 (.202)	.005 (.472)
Danger 90 km/h							1.00	.097 (.100)
Police								1.00

* significant at p=.05 or less

5.5.1 Speed Limit

BEACH ROAD Figure 5.14 shows the drivers' estimates of what the posted speed was along this section of road where their speeds had been measured. Almost all of the drivers correctly nominated the speed limit as 60 km/h and no one thought the speed limit was greater than 80 km/h. Moreover, there was no correlation between the speed limit estimate and the drivers' observed travel speed (r=0.119, p>.05).

BELMORE ROAD Figure 5.15 shows the drivers' estimates of what the posted speed was along Belmore Road where their speeds were measured. Ninety four percent of drivers correctly identified the 60 km/h limit, and again, nobody identified the limit as being over 80 km/h. There was also no correlation between the estimate of the speed limit and travel speed at this site (r=.077, p>.05). These results are in general accord with each other and the previous findings from the rural studies.

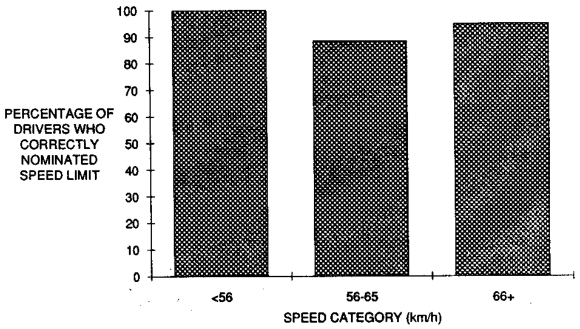


Figure 5.15 – Drivers' estimates of the posted speed limit at Belmore Road

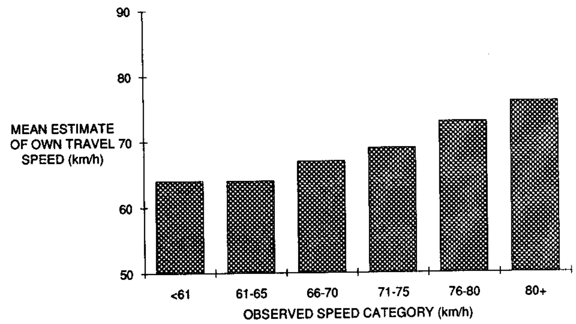


Figure 5.16 - Relationship between observed speed and the drivers' estimates of their own travel speed at Beach Road

5.5.2 Own & Others Travel Speed

Estimates were again highly correlated between own, others, and safe travel speed at the Beach Road site, similar to that reported for the rural study. Thus, only the results for own and safe speed responses will be reported for Beach Road for reasons previously expressed. However, the estimates at Belmore Road were generally less correlated and own speed estimates were not correlated with any other judgement. Thus, it was deemed necessary to report both the own and others results at this site.

BEACH ROAD Observed travel speed of the drivers was related to estimates of their own travel speed at Beach Road (r=0.520, p<.001). Figure 5.16 shows that fast drivers were more likely to nominate a fast travel speed, while slow motorists more frequently estimated a slow travel speed. As previously reported at the rural sites, those driving at faster speeds were less accurate at predicting their own travel speed (or less honest) than the slower drivers. However, when estimating the speed of other drivers the responses of the fast drivers were more closely related to their own travel speeds.

BELMORE ROAD There was a significant relationship between the observed travel speed of the drivers and their estimates of their own travel speed (r=0.121, p=<.05). Figure 5.17 shows that slow drivers more likely nominated a slow travel speed for themselves while fast travellers, a faster travel speed. The finding for drivers' estimates of others' travel speeds were similar to judgements of their own travel speeds (r=0.138, p=.034), although not as consistent in form. The reason for the reduction in sensitivity to these judgements at this one particular urban site is unclear but conceivably would be a function of the different traffic mix, road alignment, and/or residential character of the area.

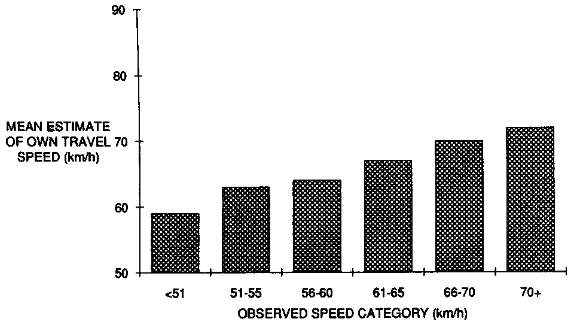


Figure 5.17 – Relationship between observed speed and the drivers' estimates of their own travel speed at Belmore Road

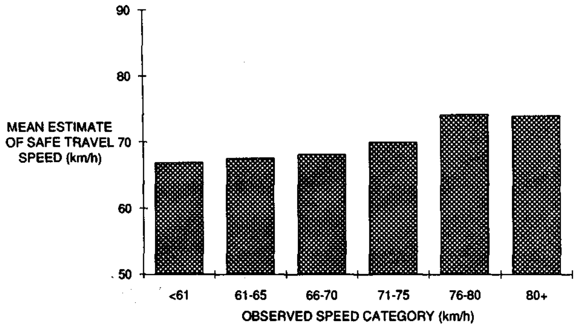


Figure 5.18 - Relationship between observed speed and the drivers' estimates of a safe travel speed at the Beach Road site

5.5.3 A Safe Travel Speed

BEACH ROAD As shown in Figure 5.18, drivers' estimates of a safe travel speed were correlated with their observed travel speed at Beach Road (r=0.348, p<.001). Slow travellers were more likely to nominate slow travel speeds as being safe, while excessively fast travellers more frequently nominated speeds above the speed limit as being safe at this site.

BELMORE ROAD There was also a significant correlation between safe speed estimate and travel speed at the Belmore Road site too (r=0.338, p<.001). As shown in Figure 5.19, those travelling at fast travel speeds were more likely to nominate a fast speed as safe, in contrast to those travelling at slow speeds who more frequently nominated the opposite.

The findings observed between drivers' estimates of safe travel speed and their own travel speed at these urban sites are quite similar to what was reported earlier for the rural sites.

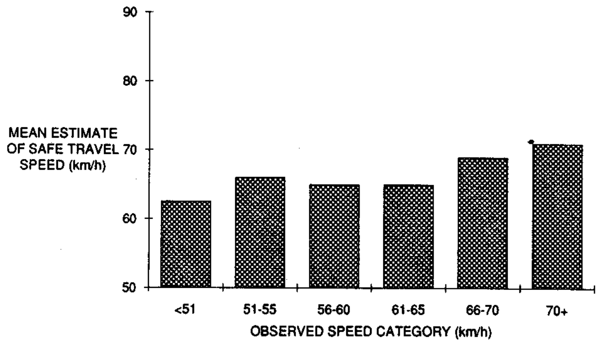


Figure 5.19 - Relationship between observed speed and the drivers' estimates of a safe travel speed at the Belmore Road site

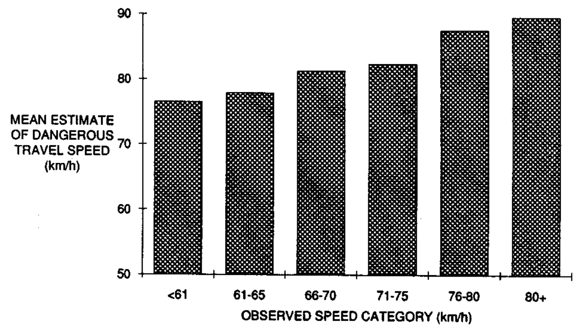


Figure 5.20 - Relationship between observed speed and the drivers' estimates of a dangerous travel speed at the Beach Road site

5.5.4 A Dangerous Travel Speed

BEACH ROAD As shown in Figure 5.20 there was a significant correlation between the drivers' estimates of what constituted a dangerous travel speed and their observed speed on this section of urban road (r=0.376, p<.001). Slow drivers generally nominated a lower speed as being dangerous than those who had been observed travelling at faster speeds.

BELMORE ROAD As shown in Figure 5.21 there was a significant correlation between the estimates of what was a dangerous speed and drivers' observed speed at this site too (r=0.192, p<.01). As noted at Beach Road, slow drivers generally nominated relatively lower travel speeds as being dangerous, compared to drivers who had been observed travelling at faster speeds.

The urban findings of the relationship between what drivers' considered to be a dangerous speed to travel at and their observed speed on the road were different to those reported from data collected at Woodend. It is not clear why this is so but may be a function of differences in the absolute level of speed between the urban and rural road sites or perceived differences in safety between these two separate environments.

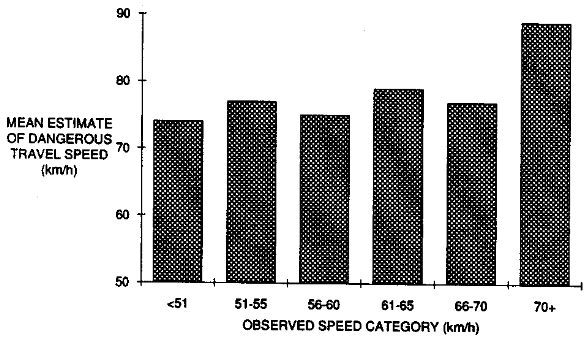


Figure 5.21 - Relationship between observed speed and the drivers' estimates of a dangerous travel speed at the Belmore Road site

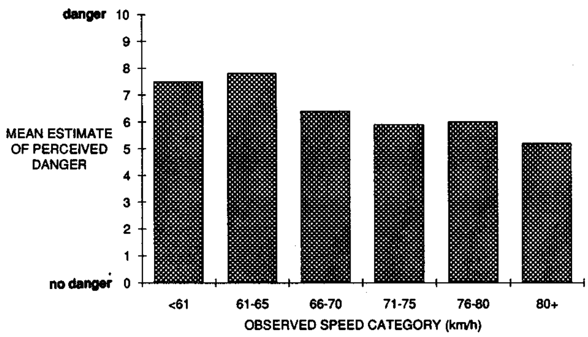


Figure 5.22 - Relationship between observed speed and the drivers' estimates of the danger travelling at/h at the Beach Road site

5.5.5 How Dangerous is 90 km/h?

BEACH ROAD A significant correlation was found between the perceived danger of travelling at 90 km/h and drivers' travel speed at this site (r=-0.346, p<.001). Figure 5.22 shows that those travelling at high speeds were generally more conservative in their estimates of how dangerous this action was, compared to those travelling at slower speeds. It should be noted that the mean travel speed at Beach Road was 18 km/h below the 90 km/h threshold and that 4% of the free speed distribution was in excess of 90 km/h.

BELMORE ROAD By contrast, though, there was no statistical relationship observed between travel speed and the perceived danger of travelling at 90 km/h at Belmore Road (r=-0.083, p>.05), as shown in Figure 5.23. Drivers of all speeds responded roughly equally in terms of how dangerous it was to travel at 90 km/h at this site. It is worth noting that there was a larger difference in speed between the mean traffic speed and 90 km/h at this site (28 km/h) and that there were practically no drivers observed travelling in excess of this upper value at the Belmore Road site.

It is worth noting that there was a larger difference in speed between the mean traffic speed and 90 km/h at this site (28 km/h) and that there were practically no drivers observed travelling in excess of this upper value at the Belmore Road site.

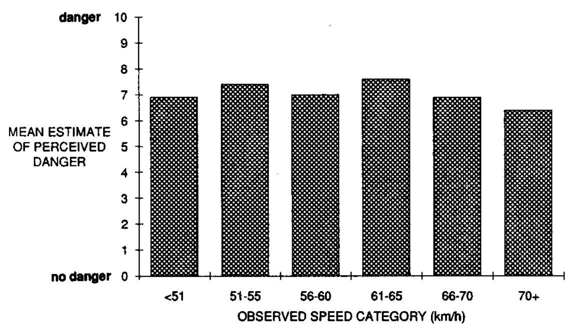


Figure 5.23 - Relationship between observed speed and the drivers' estimates of danger travelling at 90 km/h at the Belmore Road site

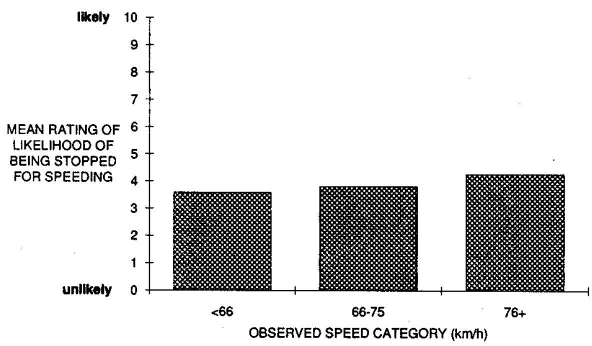


Figure 5.24 - Relationship between observed speed and the drivers' estimates of the likelihood of being stopped by the police for travelling 20 km/h over the posted speed limit at the Beach Road site

5.5.6 Likelihood of Police Stoppage

Estimates of the likelihood of being stopped by the police at both of these sites for travelling 20 km/h over the speed limit were analysed next. Seventy eight percent of drivers interviewed at both sites considered this to be less than a 50% chance.

BEACH ROAD As shown in Figure 5.24, there was no reliable association between the perceived likelihood of being stopped by the police and observed speed (r=0.118, p>.05). While there was a hint of a slight trend for the faster drivers to have a higher likelihood of apprehension by police than the slower drivers, this was far from being significant at the 5 percent level.

BELMORE ROAD In addition, there was no association between the observed travel speed and the perceived likelihood of being stopped by the police at this site either (r=-0.07, p>.05), as shown in Figure 5.25.

These two results agree with the findings reported at the rural sites and confirm that this variable does not have a great influence on travel speed in either rural or urban settings.

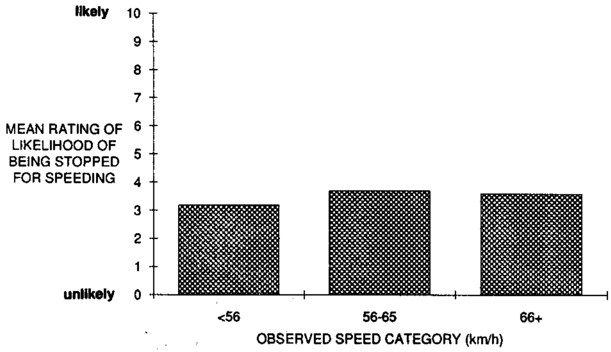


Figure 5.25 - Relationship between observed speed and the drivers' estimates of the likelihood of being stopped by the police for travelling 20 km/h over the posted speed limit at the Belmore Road site

5.6 PENALTIES & FINES

Motorists at both these sites were questioned about the level of penalty and fine which they considered appropriate for exceeding the speed limit by 10, 20 and 30 km/h at these urban test sites.

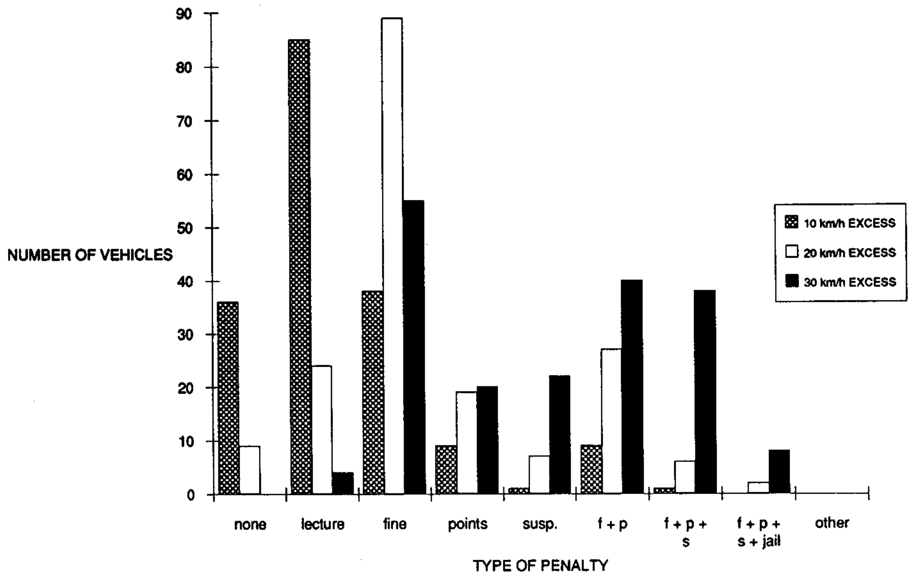


Figure 5.26 - Type of penalty (by level of severity) nominated by drivers for a range of speeding violations at the Beach Road site

BEACH ROAD As shown in Figure 5.26, the severity of the penalty nominated by the drivers increased with the magnitude of the speeding offense. Motorists' responses stressed increasing fines and loss of demerit points as speeding violations increased from 10 to 20 km/h and included license suspensions as a suitable penalty for those travelling 30 km/h over the speed limit. This pattern is similar to that observed for the drivers interviewed in rural environments and is similar to the existing level and structure of penalties in force for speeding in Victoria.

The level of fine nominated by the drivers also varied depending upon the magnitude of speeding offense at Beach Road. For a 10 km/h violation, motorists thought an average penalty of $64 was appropriate (fines of $50 and $100 were most commonly nominated). For a 20 km/h violation, the average fine stipulated was $89 with fines of $50, $100 and $150 most common, while for a 30 km/h violation, the average fine nominated by the drivers was $165 with peaks of $50, $100 and $200.

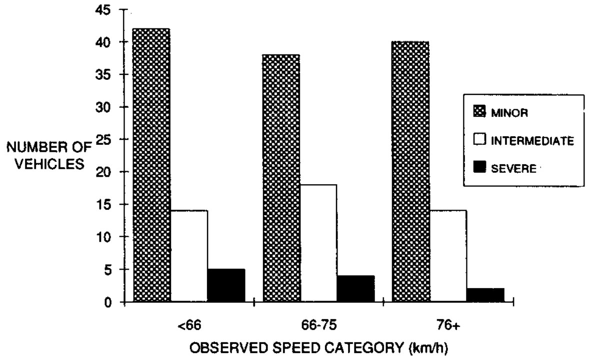


Figure 5.27 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 10 km/h at the Beach Road site

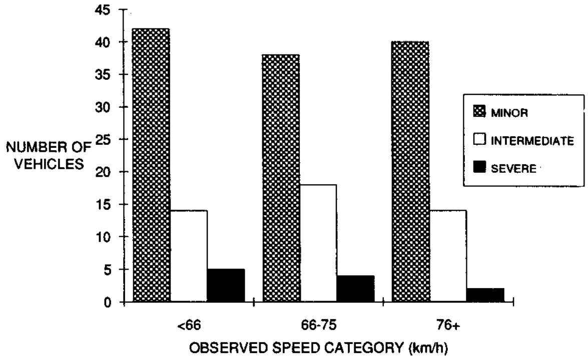


Figure 5.28 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 20 km/h at the Beach Road site

Figures 5.27 to 5.29 illustrate the relationship between the observed speed and the drivers' responses regarding the severity of penalty for driving at 10 km/h (X^2=1.97, p>.05) or 30 km/h (X^2=5.08, p>.05) over the speed limit. However, drivers' travel speed was associated with level of fine for 20 km/h speed violations (X^2=10.46, p<.05). There was no statistical association between observed speed and the magnitude of the fine nominated for 10 km/h (X^2=0.85, p>.05), 20 km/h (X^2=3.02, p>.05) or 30 km/h (X^2=0.26, p>.05) speeding offenses at this site.

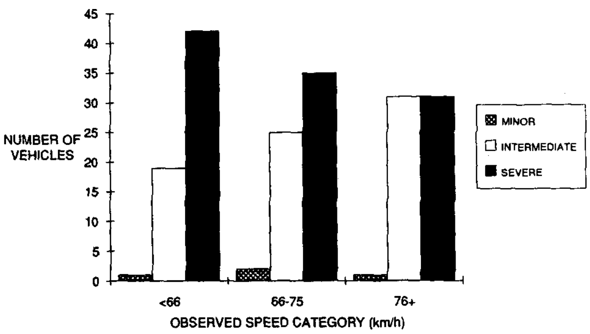


Figure 5.29 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 30 km/h at the Beach Road site

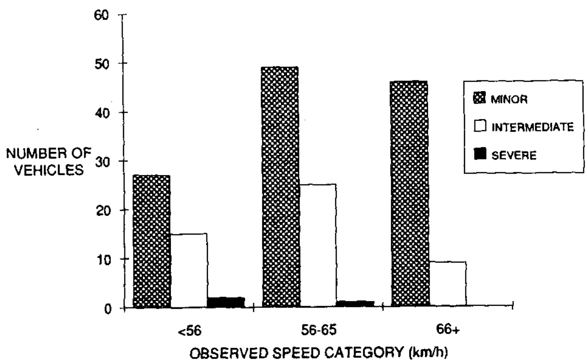


Figure 5.31 - Observed speed by drivers' estimates of penalty for exceeding the speed limit by 10 km/h at the Belmore Road site

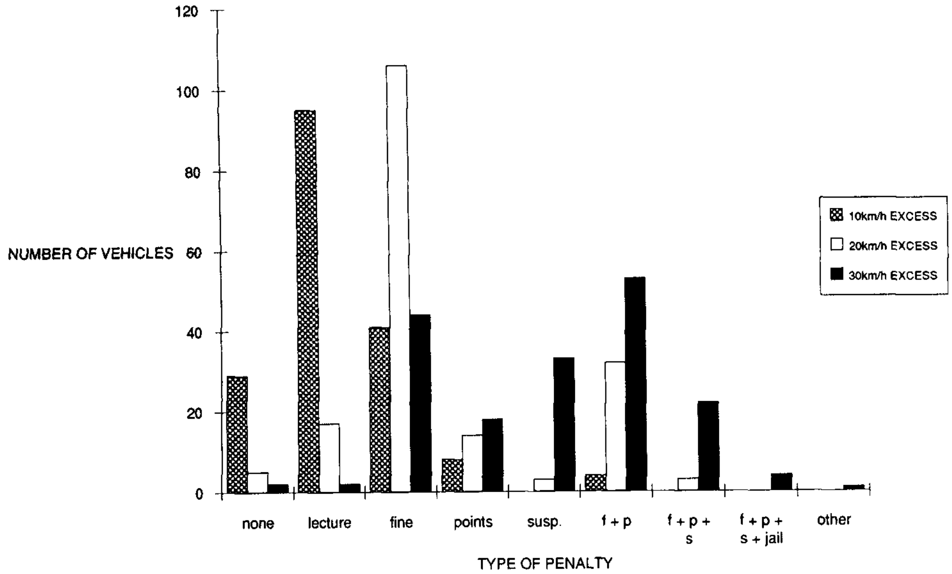


Figure 5.30 - Type of penalty (by level of severity) nominated by drivers for a range of speeding violations at the Belmore Road site

BELMORE ROAD The pattern of results obtained at this site were similar to those obtained at Beach Road. Figure 5.30 shows that the severity of the penalty nominated by the drivers increased with the magnitude of the speeding offense. Motorists' responses again stressed increasing fines and loss of demerit points as speeding violations increased from 10 to 20 km/h and included license suspensions for violations in excess of 30 km/h.

The level of fine nominated by the drivers also varied depending upon the magnitude of speeding offense. For a 10 km/h violation, motorists thought an average penalty of $55 was appropriate (fines of $50 and $100 were most commonly nominated). For a 20 km/h violation, the average fine stipulated was $87 with fines of $50, $100 and $150 most common, while for a 30 km/h violation, the average fine nominated by the drivers was $147 with peaks of $50, $100 and $200.

There was no significant relationship between the observed speed and the drivers' responses regarding the severity of penalty for driving at 10 km/h (X^2=9.08, p>.05), 20 km/h (X^2=0.61, p>.05) or 30 km/h (X^2=5.23, p>.05) above the speed limit at the Belmore Road site (shown in Figures 5.31 to 5.33). There was also no reliable association found between observed speed and the magnitude of the fine nominated for 10 km/h (X^2=0.27, p>.05), 20 km/h (X^2=5.05, p<.05) or 30 km/h (X^2=0.27. p>.05) at this site.

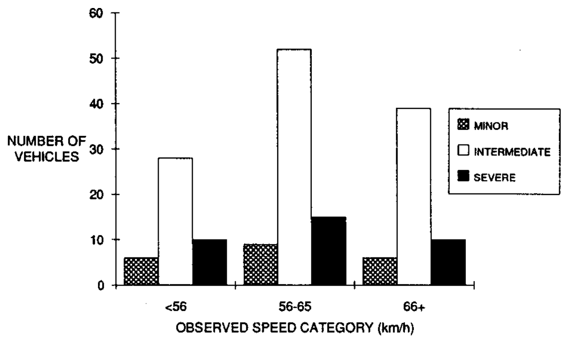


Figure 5.32 – Observed speed by drivers' estimates of penalty for exceeding the speed limit by 20 km/h at the Belmore Road site

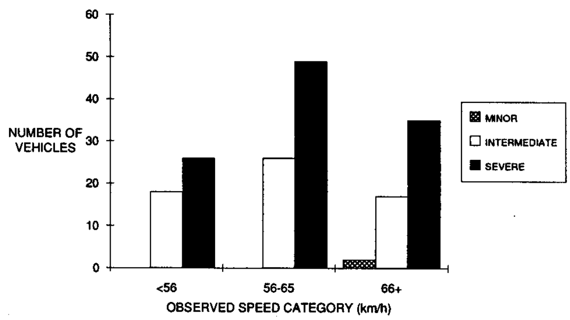


Figure 5.33 – Observed by drivers' estimates of penalty for exceeding the speed limit by 30 km/h at the Belmore Road site

5.7 RELATIVE IMPORTANCE OF THE VARIABLES

A regression analysis was again attempted here to rank the relative importance of each of the significant variables in drivers' speed behaviour in urban areas. The approach was similar to that previously carried out on the rural speed data. A factor analysis was conducted initially on the combined data from the two urban sites to test the independence of the independent variables. A principal components analysis was then used to extract the factors and the varimax method again provided orthogonal rotation of the factors. For reasons previously described, all of the variables relating to driver and vehicle characteristics were included in the analysis as was the drivers' estimates of a safe travel speed.

The Bartlett test of sphericity for the factor analysis was 2142, p<.001, indicating that a factor analysis was appropriate on these data. The Kaiser-Meyer-Olkin measure of sampling adequacy for this analysis was relatively low (0.35). As was the case for the factor analysis on the rural site data, this was due to the large number of 0-1 variables in the analysis (e.g. PUR1, CL1, SEX). These variables were not excluded from the factor analysis as there was ***a priori*** evidence to suggest that some of these variables were important with regard to their relationship to observed travel speed.

Table 5.3 Rotated factor matrix from factor analysis conducted on the combined urban site data

VARIABLE	URB1	URB2	URB3	URB4	URB5	URB6	URB7	URB8	URB9
PRE-DIST.	+.70								
POST-DIST.	+.66								
DOMESTIC	-.63					-.56			
SEX	-.51				+.50				
EXPERIENCE		+.93							
AGE		+.92							
ACCIDENT		+.51							
RECREATION	+.34		-.79						
BUSINESS	+.34		+.75			+.37			
MILEAGE			+.47						
COMPACT CAR				+.88					
INTER. CAR				+.73	-.52				
SMALL CAR					+.91				
OCCUPANT No.						+.65			
Z SAFE						+.63		-.15	
YEAR OF MANUFACTURE							+.83		
OWNER			+.32				+.57		
LARGE CAR								-.86	
POSTSTOP								+.40	
SMALL VAN									+.92
%Variation	15.3	11.6	7.9	7.4	7.2	6.0	5.8	5.2	5.0

All independent variables were included in the factor analysis. Where factors were not continuous variables (i.e., purpose of the trip) each level of that factor was assigned a binary choice and included as a separate factor, such as BUSINESS, SMALL CAR, etc. This procedure is recommended by SPSS Inc. (1982) when analysing these variables using SPSS-X.

Table 5.3 shows variables which had a high factor loading score for the nine factors identified in the urban analysis. Factor loadings less than 0.3 have been omitted from the table. The criteria used for deciding which variables to include in the regression analysis was based on an evaluation of how meaningful the factor was in terms of the characteristics of the sample and the amount of total variance which could be explained by the factor. On this basis it was decided to include the first three factors (URBAN1, URBAN2, and URBAN3) in the regression analysis.

As shown in Table 5.3, URBAN1 is a factor which represented male drivers undertaking long distance trips for recreation or business purposes. URBAN2 is a factor representing younger (less experienced) drivers with high accident rates, while URBAN3 represented drivers with high weekly mileage, driving vehicles they do not own, and travelling for business purposes. Collectively, these three factors explained approximately 35% of the total variance.

The three urban factors (URBAN1, URBAN2 and URBAN3) were included in the regression analysis along with other variables which did not have high factor loadings for these factors. A multiple linear regression equation was then computed using stepwise selection of these variables. The summary table of the multiple regression analysis which relates these variables to the transformed Z-SPEED dependent variable for the combined urban sample is shown in Table 5.4.

Table 5.4 Summary of multiple regression analysis for urban sites

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
URBAN2	-.3959	.0536	-.4004	-7.4	.0000
Z_SAFE	.1664	.0543	.1677	3.1	.0024
Y.O.M.	.0265	.0085	.1619	3.1	.0021
URBAN3	.1455	.0506	.1472	2.9	.0044
CONSTANT	-2.1361	.7073		-3.0	.0028

NB: Z_SAFE is the normalized safe speed estimate, while Y.O.M. is the year of manufacture of the vehicle.

This suggests that excessive speeding on urban roads was associated with younger (under 34 years) less experienced high accident record drivers, with relatively high safe speed perceptions, who travel high weekly mileages, on business (not recreation), and driving recently manufactured vehicles.

Excessively slow motorists, on the other hand, in these environments are more likely to be older (45 years and above) more experienced drivers who have had fewer accidents over the past 5 years, drive older vehicles, and who consider a safe travel speed to be relatively low.

The adjusted R^2 value for this set of variables was 0.27, suggesting that only 27% of the variance in the observed travel speeds could be explained. Similar results were obtained for equations in which the individual variables were used (rather than the factors extracted in the factor analysis).

The large amount of unexplained variance and large standard error of the Z_SPEED estimates (0.85, approaching 1 standard deviation) indicates that the regression analysis finding is not a powerful predictor of driver travel speeds in urban areas. In other words, there were many other factors (and combinations of factors) that also contributed to a drivers travel speed on the road, albeit in a lesser role to the factors identified above.

5.7.1 Individual Sites

A multiple linear regression equation was also calculated for each of the individual sites, using the factors extracted from the combined sample to further explain the role of different site characteristics in urban travel speed. The regression analysis summary table for the Beach Road site is shown in Table 5.5.

Table 5.5 Summary of multiple regression analysis for Beach Road site

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
URBAN2	-.4602	.0783	-.4536	-5.9	.0000
URBAN3	.1792	.0639	.2024	2.8	.0058
Z_SAFE	.1701	.0806	.1650	2.1	.0366
Y.O.M.	.0328	.0125	.1893	2.6	.0097
CONSTANT	-2.5880	1.0333	-2.5		.0135

NB: Z_SAFE is the normalized safe speed estimate, while Y.O.M. is the year of manufacture of the vehicle.

The Beach Road analysis utilized the same variable combinations as reported for the combined data (albeit at slightly different regression co-efficients). In short, there was essentially no difference in terms of the order of importance of the variables at Beach Road over that previously described in Table 3.4.

The adjusted R^2 value was 0.33, with a standard error of 0.84, demonstrating that the Beach Road analysis could explain a slightly higher 33% of the variance in urban travel speeds.

The similar regression equation obtained from the data collected at the Belmore Road site is shown in Table 5.6.

Table 5.6 Summary of multiple regression analysis for Belmore Road site

VARIABLE	B	STD.ERR_B	BETA	T	Sig.T
URBAN2	-.3252	.0735	-.3375	-4.4	.0000
Z_SAFE	.1890	.0729	.1976	2.6	.0105
CONSTANT	.0225	.0698		0.3	.7476

NB: Z_SAFE is the normalized safe speed estimate.

With an adjusted R^2 value of 0.18, the analysis at Belmore Road, Balwyn was a very weak predictor of travel speeds and could only define excessive speeders as younger (under 34 years) less experienced high accident record drivers, with relatively high safe speed perceptions.

6. DISCUSSION OF THE URBAN RESULTS

6.1 FREE SPEED DISTRIBUTIONS

The results obtained at Beach Road, Parkdale indicated that the average speed of motorists at this site was about 12 km/h above the 60 km/h posted speed limit. Moreover, only 9% of drivers were observed travelling below the speed limit and 4% were travelling above 90 km/h at this location.

By contrast, at the Belmore Road site, the mean travel speed was only 2.3 km/h above the 60 km/h posted speed limit (that is, 10 km/h lower than at the Beach Road site) with 40% of motorists at or below the posted speed limit and none observed travelling above 90 km/h.

The absolute values of travel speed were noticeably different between the rural and urban studies, as expected from differences in the environments and posted speed limits. However, there were consistent differences in the pattern of results between these two environments. First, straight roads were associated with higher travel speeds than curved roads for both rural and urban settings. This is consistent with previous findings (cf., Fildes et al, 1987; 1989) confirming the influence of speed perception in determining travel speed.

Second, the fact that there were practically no motorists observed travelling at speeds greater than 30 km/h at either curved site demonstrates the ceiling effect that the design speed of curved roads places on travel speeds on the road.

6.2 SAMPLE REPRESENTATIVENESS

The interview rate was relatively low in both samples, compared to the rural study equivalents. At Beach Road, the rate was slightly higher than at Belmore Road (34% cf., 26%) but overall, was only 50% the rate observed in the rural studies. This is further evidence of the fact that drivers travelling in rural areas seem to be less pressed for time than city drivers and, hence, more receptive to participating in these surveys.

For both of the test sites the two sample populations (those who refused to be interviewed compared to those who agreed) were essentially the same in terms of their travel speeds, and sex of the driver, the type of vehicle and the year of manufacture. However, there was evidence of some bias in the interview sample towards younger (less than 34 years) and old drivers (70 years and over), and also towards those drivers who were not in a hurry or running late for an appointment.

This small difference was unlikely to have had a marked effect on the results obtained from those interviewed at the urban sites.

6.3 OVERVIEW OF THE SAMPLE

Of all the drivers who were stopped during the study the majority (64% of them) were males. This was slightly higher than expected on the basis of licensing rates alone and a result previously reported in metropolitan driver surveys (Rogerson & Keall, 1990). However, it should be noted that there were more female drivers encountered at these urban sites than that observed at the rural sites (36% cf. 21%).

The age distribution of the drivers stopped at the two urban sites was similar to those of the rural drivers, with fewer younger drivers and more older drivers than that expected from licensing rates. This may well be a function of the sites chosen and the time of day and week (Beach Road, Parkdale in particular, is well frequented by retired persons travelling to and from the Peninsula during these periods).

The accident histories were similar at both sites where roughly one-third of the drivers reported being involved in at least one accident in the past five years. This represents a much higher accident rate than was reported by drivers in the rural areas (33% cf. 25% overall). Of all the accidents reported by the drivers, 84%

involved property damage only. This is similar to that found in the rural studies and with other published figures for metropolitan crashes (Sanderson and Hoque, 1987).

6.4 DRIVER & VEHICLE CHARACTERISTICS ON TRAVEL SPEED

Table 6.1 summarizes the effects of the independent variables on travel speed for the combined urban data.

Table 6.1 Summary of the effects of the independent variables on travel speed for the combined data at the urban sites

VARIABLE	OVERALL	FAST	SLOW
Driver age	sig.	<34 yrs	>55 yrs
Driver sex	n.s.	n.s.	n.s.
P-Plates		insufficient numbers	
Seat belts		insufficient numbers	
No. occupants	sig.	single	two
Purpose of trip	sig.	business	rec/dom
Travel schedule	sig.	behind	don't care
Vehicle type	n.s.	n.s.	n.s.
YOM vehicle	sig.	<5 yrs	>5 yrs
Towing a trailer		insufficient numbers	
Vehicle ownership	n.s.	n.s.	n.s.
Accident involvement	sig.	more crashes	less crashes
Number accidents	sig.	2 or more	n.s.
Injury severity	trend	more severe	no severe
Weekly travel	sig.	long	short
Prior distance	n.s.	n.s.	n.s.
Post distance	n.s.	n.s.	n.s.
Time of last stop	n.s.	n.s.	n.s.
Tiredness	n.s.	n.s.	n.s.

sig. = significant p<.05
n.s. = not significant p <.05

6.4.1 Driver & Occupant Characteristics

There were a number of driver and vehicle characteristics which were related to the observed travel speed of the drivers at the two urban sites. The age of the driver, the number of occupants, and the purpose of the trip was again found to be significantly associated with observed speed. Those aged 34 years or less, vehicles with single occupants, and those travelling on business were more likely to exceed the mean traffic speed and to be excessive speeders, while those aged over 55 years, vehicles with 2 occupants, and those undertaking recreation or domestic trips were more likely not to exceed the mean traffic speed and to be excessively slow motorists in urban areas. These findings were very similar to those reported earlier for the rural study.

Travel schedule and weekly mileage, however, were significant and different findings in the urban studies. Those who were behind schedule were again more likely to be excessive speeders but excessively slow urban travellers were more likely not to be on any particular travel schedule. Moreover, those who travelled large weekly distances were more likely to be excessive speeders, and those who drove infrequently each week, excessively slow travellers in these urban areas.

There were no significant differences in the travel speeds observed between males and females, or frequent use of the road for the drivers stopped at the two urban sites. Moreover, those displaying P-Plates and those not wearing seat belts could not be examined in detail because of insignificant numbers.

6.4.2 Vehicle Characteristics

As in the rural results, travel speed was related to age of the vehicle at these urban sites, but not to vehicle type. The ratio of recent cars was slightly higher in urban than rural areas (46% cf. 37% less than 5 years old) and there were relatively similar proportions of the various vehicle types. It would appear that discrepancies in travel speed between the various types of vehicles is greater in rural than .in urban areas, probably a function of the overall reduction in travel speed in urban areas and the relative ease for the slower vehicle types to keep up with the rest of the traffic.

As found earlier in the rural studies, vehicle ownership was again not related to travel speed in these urban studies. This tends to suggest that the fact that a driver does not own the vehicle he drives has very little effect on his or her propensity to speed. Of course, this may be somewhat confounded by any effects of vehicle age but nevertheless indicate that excessive speeding is simply not the result of lack of responsibility through non-ownership.

6.4.3 Travel & Tiredness Effects

It was also found that the observed speed of the drivers at the two sites was not related to the distance travelled prior to, or after, the interview, the time since the last stop, or the level of driver fatigue at these urban sites. This finding, too, is consistent with the results obtained at the rural sites.

Travel distances were generally much shorter in rural areas so it's not too surprising that a null result was obtained here. It was argued previously that fatigue was not evident in the rural studies because of the time of day of testing. As similar test periods were also adopted in urban areas, these results are perfectly consistent. As noted in the discussion of the rural results, it would be interesting to test these findings further for different times of the day and days of the week.

6.4.4 Accident Histories

There was a significant relationship between observed speed and the reported accident involvement rate for the drivers at the two urban sites. Those observed to be excessive speeders were more likely to report having been involved in an accident during the last 5 years than other motorists. Moreover, excessive speeders were more likely to report multiple accident involvement and more severe injuries than slower travellers.

These results were remarkably consistent with those obtained at the rural sites and there was again evidence of a roughly linear relationship between speed around the mean traffic speed and accident involvement. Most of the earlier overseas reports on the relationship between travel speed and accident involvement were based on data collected on rural highways involving relatively high speeds. There was no particular a priori reason to expect similar findings in urban areas, although Solomon's curve is often generalized to include the total road network in discussions of the role of speed in accident causation.

The findings from this limited study give some support to the notion that the relationship between travel speed (relative to the average traffic speed) is similar on both rural and urban arterials. However, as pointed out in discussing the results of the rural studies, the relationships observed in these studies only support the likely association between excessively fast speeding and an increased crash involvement rate. There was no evidence observed here for increased accident involvement rates for those travelling at what was defined as excessively slow speeds (the lowest 15% of the free speed distribution observed at both the rural and urban sites).

Once more, this finding needs to be examined further using a much larger database of motorists' speeds and crash histories (including a larger range of speed levels) and self-reported and official crash statistics.

It would also be desirable, to attempt to relate speeds with crash involvement in the same area on the same day to minimize the effect of any changes in speed behaviour (the method used here and elsewhere assumes that motorists speeds and accident patterns are typical of his or her normal travel patterns). However, this would be difficult in this State alone, given the relatively low daily crash rates and the current police accident reporting system (insufficient numbers of daily casualty crashes). Nevertheless, a larger database might allow the 5-year accident history period to be reduced substantially, thereby minimizing the possibility of changes in behaviour between the time of observed speed and accident records.

The results also confirmed the different outcomes observed between slow and fast motorists involved in crashes in the rural studies. The excessive speed group were more likely to report accidents resulting in injury requiring medical or hospital treatment than were the slow speed drivers. This finding is consistent with reports from other speed studies in the literature and is consistent with basic physics on the relationship between speed and energy dissipation.

At both urban sites, there was evidence of a significant correlation between accident involvement and the age of the driver. Younger drivers were more likely to have been involved in an accident than were older drivers. This finding concurs with the results obtained at the two rural sites and raises doubts about whether it is useful for countermeasure development to pursue the form of the relationship between speed and accident involvement or rather, focus attention on particular individuals or groups of individuals who are particularly at risk. This will be discussed further in the next chapter.

6.5 ATTITUDES TO SPEED

At both sites, it was found that the observed speed of the drivers was related to estimates of their own travel speed, the speed of other drivers, and what they believed was a safe and dangerous travel speed. Drivers who were observed travelling at high speeds gave higher estimates for all of these questions than did the slower drivers. Furthermore, there were many significant correlations between these speed estimates, suggesting that many of these judgements were somewhat similar.

6.5.1 Knowledge of the Speed Limit

At both test sites, the observed speed of the drivers was not related to their estimate of the speed limit. This result indicates that the majority of travellers interviewed knew what the correct speed limit was on these sections of roads but chose to travel at whatever speed they felt was appropriate. As in rural areas, knowledge of the speed limits appeared to have little influence on travel speed on the road.

6.5.2 Own & Others Travel Speed

Once again, there was a high correlation between driver's estimates of their own speed with their observed travel speed at these urban sites. This is further confirmation of the efficacy of this measure to elicit speed responses in a non-threatening environment. However, there were particular speed group differences that need to be emphasized.

As was found at the rural sites, most excessively fast motorists at the Beach and Belmore Road sites were observed travelling at speeds higher than their estimates of their own travel speed. Once again, this may be explained in terms of social influences, where many of those travel above the speed limit would not openly admit to it. This is supported by their estimates of travel speed for other drivers at both sites, where speeders were more likely to nominate higher speeds for other motorists than themselves.

Furthermore, slow travellers tended to over-state their proposed travel speed, relative to that observed. This may be a function of their inattention or lack of knowledge about what speed they travel at.

Taken together, these two results (high speeders under-estimating and slow travellers, over-estimating travel speed) might suggest that a majority of motorists tend to nominate travel speeds close to the speed limit when asked this question. It should be pointed out, though, that there was a significant correlation observed between observed speed and estimate of own speed, therefore suggesting that motorists on the whole were quite accurate (and honest) when making this judgement.

It was assumed that asking motorists to nominate the travel speeds of others would more clearly reflect their own actions by removing the pressure of having to reveal their own deviant behaviour. Indeed, this seems to be so for the high speeders in urban areas, although the findings were not as clear-cut in the urban studies as those observed in the rural data. Most of the slow travellers indicated that the rest of the traffic would generally travel at around the average travel speed recorded at the two sites and certainly much faster than what they had been observed travelling at. This finding was also obtained at the two rural sites. Thus, slow drivers appear to be really responding to the speeds of others, rather than themselves, in contrast to the faster drivers. Interestingly, very few of the slow motorists at either the rural or urban sites suggested that other motorists would travel at their speeds.

6.5.3 Safe & Dangerous Travel Speeds

Again, a correlation was observed between motorists' estimates of their own speed and what constituted a safe travel speed at the Beach Road site. This was similar to the finding at both rural sites, confirming that these motorists believe that their nominated travel speeds are also safe. At Belmore Road, however, no correlation was found between estimates of safe and own travel speed. This is a little surprising and may be a function of the specific characteristics at this site or of this group of motorists. Importantly, though, the correlation between observed speed and the drivers' estimates of safe speed were significant at both urban locations, confirming that these motorists at least travel at speeds they believe are safe.

In general, excessive speeders more likely nominated a higher travel speed as safe than did slower travellers. This might reveal differences in perceptions of safety between these motorists, or simply reflect justification of their own (illegal) behaviour. Some of the excessively fast drivers estimated safe travel speeds less than the speeds they were observed travelling at, and nominated their own travel speed as dangerous. This raises the question of why these people were travelling at such high speeds. Were they simply expressing a conservative answer, or were they not aware of what speed they were travelling at.

Some drivers expressed opinions that they felt that they were a special case (they were more able to travel safely at high speeds than the rest of the population). The accident data suggests that this is clearly not so and such an opinion needs to be changed.

The vast majority of slow drivers at both sites, however, nominated a safe travel speed to be greater than the speed they were observed travelling at. Either, their understanding of their own travel speed behaviour was quite inaccurate or they simply chose to travel below what they thought was safe. While this anomaly seems difficult to understand, the accident data shows a safety benefit for motorists adopting such a strategy and, hence, worthy of support. (A possible campaign using this concept might be to encourage motorists to estimate what they think is a safe speed to travel at on a particular section of road, then choose a speed for themselves X km/h below that).

Safe and dangerous travel speed judgements were highly correlated in these two urban studies, contrary to the findings observed at Woodend. As there were no procedural changes introduced between these studies, it would appear to be easier (and perhaps more meaningful) to estimate what is a dangerous speed in these low speed restricted areas than in high speed zones.

6.5.4 Danger Travelling at 90 km/h

Legislation exists in Victoria aimed at severely punishing drivers caught travelling in excess of 30 km/h over the speed limit anywhere in the State. Nevertheless, a surprising 30% of the motorists interviewed at these urban sites did not consider 90 km/h in a 60 km/h zone to be dangerous.

At Beach Road there was a significant negative correlation between perceived danger of travelling at 90 km/h and travel speed. However, at Belmore Road, no such relationship was found between these judgements and the observed speed of the drivers. The difference in the results obtained at the two sites is probably due to the different road conditions. It is likely that a travel speed of 90 km/h is relatively more dangerous on the curved section of Belmore Road than at the straight Beach Road site. Indeed, there was a higher proportion of drivers at Belmore Road who considered this speed to be dangerous than those observed at Beach Road.

A significant number of drivers travelling at excessive speeds at the two sites indicated that they considered 90 km/h to be dangerous. While some of them would have been travelling slightly less than 90 km/h, most were not, illustrating a proportion of motorists who are aware of the danger of travelling at excessive speeds but still choose to travel at these speeds. As noted earlier, subjects may have been expressing the socially accepted response to this question or that the "it can't happen to me" maxim was operating here. Either way, these motorists are clearly at higher risk of accident involvement and injury and need to be discouraged from travelling at such speeds. It should be pointed out, though, that these people are likely to be the most difficult to persuade to the dangers of travelling at excessive speeds and strong measures may be required to affect a change in attitude amongst these people.

6.5.5 Likelihood of a Police Stoppage

The majority of the drivers at both sites thought it unlikely to be stopped by the police for exceeding the speed limit by 20 km/h. This was not related to their observed travel speed or to any judgements of how dangerous it was to travel 30 km/h above the speed limit. These findings were similar to those obtained at the rural sites and highlight a need for greater police surveillance as a general deterrent against excessive speed. Given the similarity of the response across all speed groups, this perception needs to be aimed at all motorists.

The current speed camera program in Victoria is likely to have some influence on motorists' perceptions of the likelihood of being detected for speeding. The data collected here would be most useful for evaluating the effectiveness of this program in terms of changed perceptions or attitudes to motorists resulting from the speed camera program in both urban and rural areas.

6.5.6 Penalties & Fines

The responses of the drivers at both urban sites stressed increasing fines and loss of demerit points as speeding violations increased from 10 to 20 km/h and license suspensions for those travelling 30 km/h over the speed limit. No relationship was found, though, between the observed speed of the drivers and the level of penalty or magnitude of fine suggested by the drivers. These findings are similar to those obtained at the rural sites.

The data collected on the amount of the fine by speed violation, again, closely reflects current levels of fines for 10 and 20 km/h violations, but tends to under-estimate the level of fine for 30 km/h violations and above.

6.6 RELATIVE IMPORTANCE OF THE VARIABLES

A number of statistical associations were found between the independent variables and observed travel speed in urban areas. As with the rural study analysis, though, several of these factors appeared to be inter-related and there was no indication of the relative importance of each of these variables in determining travel speed on urban roads. Hence, multivariate analysis was again performed on these data, using factor analysis and multiple regression techniques.

Factor analysis on the combined urban database revealed three important independent derived factors, namely Urban1, Urban2, and Urban3. The first of these consisted of male drivers undertaking long distance trips for recreation or business purposes.

Urban2 comprised young inexperienced drivers with high accident records, while Urban3 involved drivers with high weekly mileage, driving vehicles they do not own, and travelling for business purposes. Even though the factor loadings and order of these derived factors were slightly different, the prime factors in urban areas were remarkably similar to those derived in the rural environment.

The subsequent multiple regression analysis showed that exceeding the mean traffic speed on the road was associated with younger drivers (under 34 years) with high accident records, relatively high safe speed perceptions, who travel high weekly mileages, on business (not recreation), and drive recently manufactured vehicles. Those travelling below the speed limit were likely to be older (45 years and above) more experienced drivers with fewer accidents in recent years, driving older vehicles, and who consider a safe travel speed to be relatively low.

There were differences in which variables were important and their order of importance at both urban sites. At Beach Road, the variables and order of importance was essentially the same as that derived for the combined data set. At Belmore Road, though, exceeding the mean travel speed was associated with young (inexperienced) high accident record drivers with relatively high perceptions of what constitutes a safe speed. The year of manufacture of the vehicle and the trip purpose was of less consequence at this site.

Once more, it should be pointed out that between 18% and 33% of the total variance of the responses could be explained by this analysis. In particular, the Belmore Road analysis only accounted for less than one-fifth of the total variance, and none of the other factors, by itself, was able to enter the regression equation. Thus, this suggests that speed behaviour at this site is a very complex and involved interplay of many factors (each one of which is not especially important) and care should be taken in interpretation of these findings.

The Beach Road results, though, were more clear cut and useful for the development of a number of countermeasures against excessively fast (and slow) travel speeds on urban arterials. This will be discussed further in the final chapter of this report. However, it needs to be acknowledged that any effect on reducing excessive travel speeds will again likely be in proportion to the amount of variance explained by the urban analysis.

7. GENERAL DISCUSSION AND RECOMMENDATIONS

This program of research set out to investigate the relationship between drivers' attitudes (their stated intentions) regarding speed behaviour, their actual behaviour on the road, and accident involvement. Of particular interest were those travelling at inappropriately fast or slow travel speeds for the prevailing conditions.

A number of additional specific objectives were also of interest in this study. These included the development of on-road sampling methods of driver attitudes, the assessment of the success of subjective speed estimates from roadside interviews as predictors of on-road speed behaviour, examination of the relationship between speed estimates, performance and accident histories, the identification of a range of suitable countermeasures to reduce unsafe speed behaviours on the road, and highlight directions for further research or developments in this area.

Four on-road studies were subsequently conducted during 1989 and 1990 which addressed these objectives. This final chapter is intended to draw together these findings from the urban and rural speed studies to identify common and important attributes about those exceeding the speed limit and those who drive at excessively fast and slow travel speeds.

7.1 SPEED RELATED DRIVER & VEHICLE FACTORS

A number of the driver and vehicle related factors that were tested proved to be significantly associated with travel speed. In some instances, these associations were consistent for both rural and urban environments; in others, significance was found in either one or the other setting. It is worth briefly reviewing which factors were significantly related to travel speed and how general their effects were across sites and environments.

DRIVER AGE - The age (and driving experience) of the driver was significantly associated with driving speed at all survey sites. Drivers under the age of 34 years were more likely to be excessive speeders, while those aged 55 years or older were much more likely to be excessively slow travellers. This finding was consistent in both urban and rural settings, as well as for both straight and curved roads.

THE NUMBER OF OCCUPANTS - The number of occupants in the vehicle was also related to travel speed in these studies. Vehicles with single occupants (the driver) were likely to be excessively fast and those with two occupants, excessively slow. There was no association with travel speed for vehicles with 3 or more occupants. This effect was also consistent across the different environments and road types. It was pointed out, though, that this finding is somewhat compounded by the age of the driver, the purpose of the trip, and the age of manufacture of the vehicle.

PURPOSE OF THE TRIP - The purpose of the trip indicated by the drivers was also significantly related to their travel speed at all sites. Those travelling for business were more likely to be excessive speeders while domestic travellers were more likely to be excessively slow motorists. Those travelling for recreation could be either fast or slow, depending upon other factors such as their age and test site. Again, there was an apparent inter-relationship between purpose of the trip and year of manufacture of the vehicle.

TRAVEL SCHEDULE - Travel schedule was also associated with travel speeds at most sites. Drivers travelling behind schedule were more likely to be excessively fast travellers, while those claiming not to be on any particular travel schedule were more likely excessively slow motorists. This effect did not appear to be as strong as others listed above and was not consistent across sites, although this was (at least in part) a function of the interview process as many motorists travelling "behind schedule" claimed not to have time to be interviewed.

VEHICLE YEAR - The year of manufacture of the vehicle was associated with travel speed in rural and urban areas. Those driving recent vehicles (less than 5 years old) were much more likely to be excessive speeders than those in older vehicles. This effect was consistent for both straight and curved roads. Again, this factor is also likely to be correlated with purpose of the trip and number of occupants (many recent vehicles observed had only one occupant who was a business traveller).

TOWING A TRAILER - This variable had a strong influence at both rural sites, although there were insufficient cases to test it thoroughly at the urban sites. Those pulling a trailer of some kind were much more likely to be excessively slow travellers, while vehicles not towing, more likely to be excessive speeders.

VEHICLE TYPE - The type of vehicle was somewhat related to travel speed, depending on the environment. Those travelling in vans and light commercial vehicles were more likely to be excessively slow travellers in rural settings, while there was no such association in urban areas. The type of passenger car did not appear to be significantly associated with travel speed at any test site.

WEEKLY TRAVEL - The amount of weekly travel was associated with travel speed in urban areas, although not so in rural settings. Those travelling high mileages were more likely to be excessively fast travellers while those with short weekly mileages, excessively slow travellers. Weekly travel patterns did tend to be higher in rural than urban areas which would probably help explain the lack of a rural effect for this variable.

7.2 FACTORS NOT ASSOCIATED WITH SPEEDING

A few of the driver and vehicle factors were not associated with travel speed and two variables could not be tested due to insufficient numbers. These are discussed here.

SEX OF THE DRIVER - The sex of the driver was not significantly associated with travel speed in any of the 4 studies undertaken in this research. In addition, there was no reliable effect between the driver's sex and either excessively fast or slow travel. While there was a bias towards male drivers in all 4 studies, there were still sufficient numbers of female drivers to test this effect thoroughly. Clearly, the propensity to speed was not a function of whether you are a male or a female driver in any of the settings that were tested.

VEHICLE OWNERSHIP - Ownership of the vehicle, too, was not a significant factor in a driver's travel speed or propensity to travel at excessive speeds. This was in spite of the fact that between 19 and 30 percent of the drivers interviewed did not own the vehicle they drove. This suggests that there was little evidence of irresponsibility on the part of the driver who did not own the vehicle they drove in terms of their speed behaviour on these roads.

VARIABLES NOT TESTED - Because of the minimal numbers of P-Plates on vehicles and unbelted drivers (roughly 1 to 2 percent of the sample in each case), it was not possible to test the effects of these factors on travel speed at any of the study sites.

7.3 DRIVER ATTITUDES TO SPEEDING

A major component of this research was aimed at understanding the role of attitudes towards speeding in a driver's on-road speed behaviour. A number of attitude responses (stated intentions to behave in a particular manner) were included in the questionnaire to examine this influence. Several interesting effects were reported in both rural and urban environments.

7.3.1 Drivers' Judgements of Speed

Previous research by Cairney and Croft (1985) and Cairney (1986) suggested that it would be prudent to ask questions regarding an individual driver's speed behaviour in a number of ways (what would you travel at, what would others travel at, and what do you consider is a safe and a dangerous travel speed at a nominated section of highway). In fact, the results of this study show that drivers are generally fairly honest about nominating their own travel speeds when they are not threatened with punishment.

There were high correlations generally between these measures, suggesting that they were essentially measuring the same behavioural axiom. Moreover, the differences observed in these judgements could be explained by subtle differences in the way these questions were interpreted. Hence, the discussion tended to focus on only drivers' judgements of their own travel speed at each road setting.

The results at both the rural and urban sites demonstrated that drivers nominated travel speed were significantly correlated with their actual travel speed. Those who travelled at excessively fast speeds generally nominated a higher travel speed, while those who travelled at excessively slow speeds more likely nominated a slow travel speed. There were one or two interesting aspects with these findings that need further elaboration.

First, slow drivers were generally more honest (or accurate) than faster drivers in nominating their travel speed. This result was not too surprising, given the illegal nature and penalties that exist for such behaviour. As fast travellers speeds were better correlated with others travel speed, it is worth retaining this alternative question in any future speed attitude assessments aimed at those travelling above the speed limit.

Second, slower travellers were more likely to nominate faster travel speeds for the rest of the traffic than what they chose to travel at for both observed speed and nominated travel speed. This suggests that their travel speed behaviour may be subject to other factors than those tested here.

7.3.2 Safe & Dangerous Speed

Drivers were asked to nominate what was a safe and a dangerous travel speed and how safe they believed it was to travel at 30 km/h above the posted speed limit at the test sites. In general, judgements of a safe speed were highly correlated with their own travel speed which confirms the interrelationships between these factors noted above.

However, drivers had more difficulty nominating a dangerous travel speed and these judgements were not correlated with travel speed in rural areas. This suggests that such an open-ended question is not particularly meaningful in this context. Better to rephrase it in terms of judgements of danger for particular speed behaviours (e.g., how dangerous is it to travel at 10, 20, 30, or 40 km/h above the posted or mean traffic speed).

In examining the responses to drivers' judgements of how safe it was to travel 30 km/h above the posted speed limit, an alarming percentage of all speed group drivers (including up to 30% of those travelling at excessively slow speeds) did not believe this was unsafe for either of the urban or rural roads that were tested. This finding is not supported by the accident data and such beliefs need to be discouraged.

7.3.3 Speed Deterrence

The final attitude question related to assessments of the risk of being caught travelling 20 km/h above the speed limit at the test sites.

The data showed that for both environments, the perceived risk of being stopped by the police for exceeding the speed limit by the majority of motorists was less than 50 percent. Moreover, this judgement was not related to their travel speed at any test site, suggesting that speed enforcement was not a significant influence on drivers' travel speeds in this study.

There appears to be an urgent need for an increase in the perceived risk of detection for speeding if enforcement is to be a major countermeasure against excessive speeding in both urban and rural environments.

7.4 FATIGUE, TRAVEL DISTANCE & SPEEDING

There was practically no evidence found that suggested that the level of driver tiredness, the time since the driver last took a break from driving, the distance travelled prior to interview, or the distance still to travel had any marked influence on travel speed in any of these rural or urban studies.

It was argued that this finding was probably a function of the time of day and the day of the week of the tests. (All studies were conducted on week days between 9.00 am and 4.30 pm when there is less chance for fatigue to be a major influence (Lisper et al, 1979).

Hence, it would be more interesting to test the effects of fatigue and travel distance on observed speed more thoroughly during "high fatigue" times on the road (e.g., late at night or early in the morning).

7.5 ACCIDENT HISTORIES & SPEEDING

As noted in both the rural and urban discussions, there was a statistical relationship observed between travel speed and the reported accident involvement rate of drivers at each of the sites. Those travelling at excessively fast speeds were more likely to report previous accident involvement (and multiple accident involvement) than those travelling at slower speeds. This was consistent for both 60 km/h and 100 km/h speed zones.

Furthermore, there was also a significant association between level of injury and travel speed at the four sites. Excessive speeders were likely to report medical and hospital treatment for their injuries sustained from these crashes, while none of those travelling at excessively slow speeds reported injuries requiring medical or hospital treatment. These results have implications for previously reported findings in this area.

7.5.1 Accident Involvement

Previous research by Solomon (1964), Munden (1967), Research Triangle Institute (1970), and others suggested an increased accident involvement rates for excessive speeders in rural environments, consistent with the findings observed here. However, the rate of accident involvement in this study was less than that found in the earlier overseas reports.

Collectively, then, these results support this claim of increased accident involvement with high variance above the mean traffic speed. Moreover, the results from this study suggest that this finding also generalizes to urban areas as well, which has not been previously reported.

The overseas reports also claimed an increased crash involvement for those travelling at speeds markedly lower than the mean rural traffic speed (the U-shaped variance hypothesis around the mean travel speed). No such finding was observed in this study for slow travellers. In fact, the results reported here suggested that the relationship between travel speed and crash involvement is a simple linear or slightly curvilinear function, where accident involvement is likely to be higher for those travelling above the mean traffic speed, lower for those travelling below, and no particular accident involvement advantage for mean speed travellers. (For ease of interpretation, the accident functions obtained in this experiment for both rural and urban settings have been re-plotted on top of Solomon's Curve in Figure 7.1) This difference is most striking and needs to be put in context.

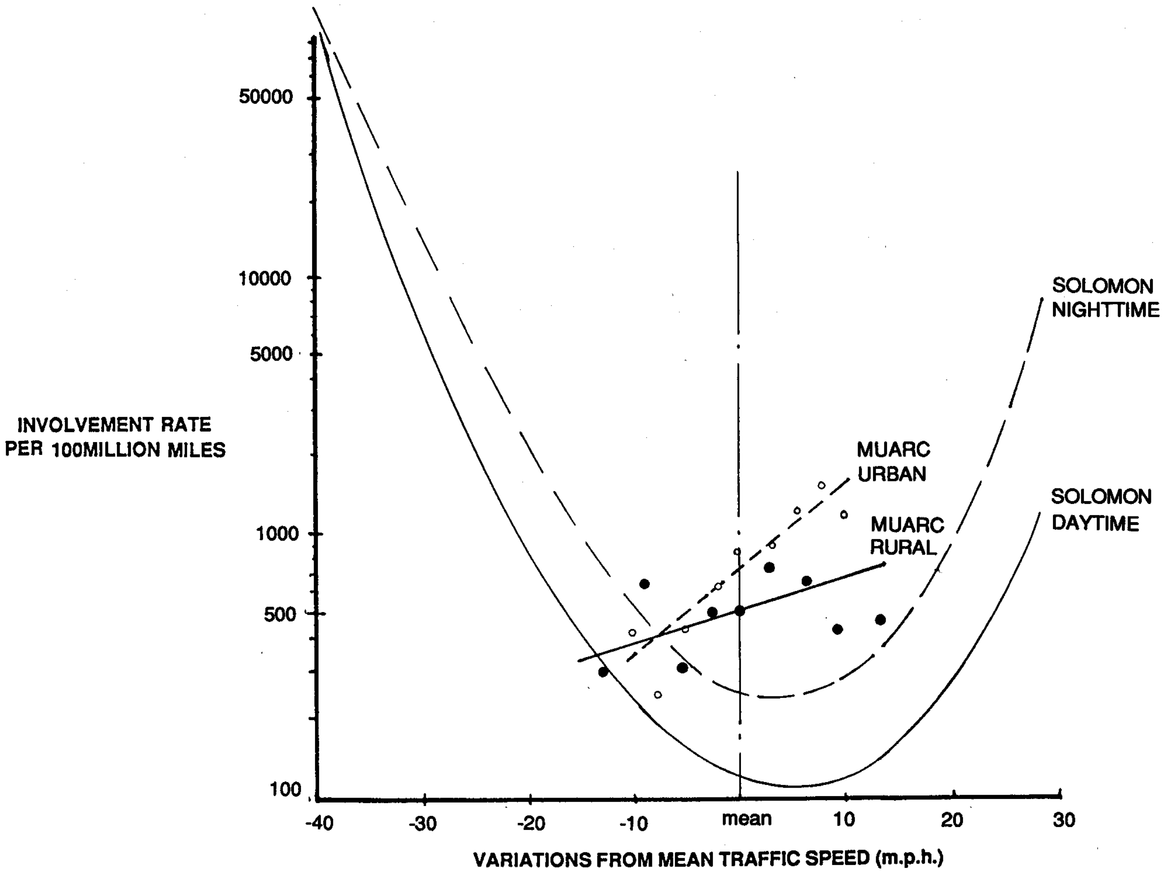


Figure 7.1 - Involvement rate by variation from the mean traffic speed - Solomon's (1964) curve versus findings from the rural and urban sites.

First, the results obtained here were from self reported accident involvement, compared to comparisons with official statistics in the other studies. It may well be that these findings have a degree of under-reporting which may not be consistent across the various speed groups (excessively slow vehicles tended to be driven by older people who may have greater difficulty recalling their previous accident histories).

However, official statistics, too, are subject to underreporting (e.g., Bull and Roberts, 1973; McGuire, 1973; Shinar et al, 1983 to mention only a few) and are particularly vulnerable to under-reporting of property damage only crashes. Indeed, Smith (1977) concluded that self-reported crashes are often more reliable than the official records.

Second, the numbers of crashes recorded here were small compared to the earlier reports which is of some concern. However, the finding for slow vehicle drivers to report fewer accidents was not even close to significance at any site and there was no sign of any trend in the expected direction either.

Finally, the earlier reports examined the speed and accident involvement relationship over a much larger range of speeds than those used in this study (most of the marked upward increase in accident risk in the work of Solomon and others occurred 20 to 25 km/h above and below the 100 km/h speed limit). As there were very few observations in these extreme speed categories in this study, it was not possible to test self-reported accident involvement rates over a larger range than plus or minus 20 km/h in rural areas.

Nevertheless, this divergence is most interesting and is extremely important in terms of specifying speed countermeasures and other speed management issues. It is imperative, therefore, that these apparent differences be examined further using a much larger database and comparing self-reported accident involvement with official accident statistics.

It should also be noted that at both sites, there was evidence of a significant correlation between accident involvement and the age of the driver, where younger drivers were more likely to have been involved in an accident than older drivers. This also questions the usefulness of a simple functional relationship between speed and accident involvement in countermeasure development, rather than targeting particular groups of motorists who have been shown to be accident involved.

7.5.2 Injury Consequences

Excessively fast drivers at both the urban and rural sites were more likely to have reported sustaining an injury requiring medical treatment or hospitalisation than were slow drivers. This finding is consistent with previous reports by Solomon (1964), Munden (1967) and others, and is also consistent with that expected from the physical relationship between speed and impact severity (force equals mass by velocity squared). Clearly, those travelling at excessively fast travel speeds are placing themselves more at risk of inflicting a severe injury to themselves and other occupants in their vehicle (and other road users as well) in the event they are involved in a collision.

7.5.3 Final Comment

The results obtained here suggest that travelling at excessive speeds above the mean traffic speed in both rural and urban environments has disbenefits, both in terms of higher accident involvement and greater injury severity. By contrast, those travelling at slower speeds appear to be less likely to have been involved in crashes and to sustain severe injuries. There was no suggestion of a U-shaped functional relationship between previous accident involvement and variance around the mean traffic speed as earlier reported. However, the findings for the slower motorists in particular need to be examined further using a larger data set.

7.6 RELATIVE IMPORTANCE OF THE VARIABLES

While a number of the variables were shown to be statistically related to travel speed, it was not possible to rank the relative importance of each of these factors without further analysis. Hence, a factor analysis and multiple regression was undertaken to permit such a comparison to be made. This was deemed necessary to facilitate prioritizing possible countermeasures against excessive speeding.

7.6.1 Speeding in Rural Areas

Drivers in rural areas who were observed travelling above the mean traffic speed (and the speed limit) were likely to have *one* or *more* of the following characteristics:

- not towing a trailer,
- young (inexperienced) driver (under 34 years) with a high accident history,
- high perception of what constitutes a safe travel speed,
- males travelling over long distances for other than domestic journeys, and
- single occupant business travellers who drive high weekly mileages and do not own the vehicle they drive.

Conversely, those travelling at excessively slow speeds (the lower 15% of the free speed distribution) would be expected to have one or more of the opposite characteristics.

There was reasonable consistency in the relative importance of the variables across the two rural sites. (Year of manufacture of the vehicle was more important and safe speed judgement less important at Euroa, while vans and light commercial vehicles were also critical factors at Woodend).

7.6.2 Speeding In Urban Areas

Motorists speeding in urban areas are likely to have *one* or *more* of the following driver and/or vehicle characteristics:

- young (inexperienced) driver (under 34 years) with a high accident history,
- high perception of what constitutes a safe travel speed,
- drivers in vehicles less than 5 years old, and
- business travellers (not on recreation journeys) who drive high weekly mileages.

Conversely, those travelling at speeds below the mean traffic speed (and in some cases the speed limit) on straight road urban arterial roadways would be expected to have one or more of the opposite characteristics.

The findings for the straight road urban site were very similar to findings for the overall analysis. However, there was a general lack of statistical association with the findings for the curved arterial site at Belmore Road. This reveals the relative difficulty in nominating what were the critical factors in a driver' speed choice at this location.

7.6.3 Anomalies & Limitations

Not all of the factors found to be significantly correlated with travel speed in their own right were correlated with travel speed in the multivariate analysis. Conversely, there were variables found to be significant in the regression equation (normally in conjunction with other variables) that were not significant by themselves. These apparent anomalies need to be viewed in relation to the multivariate procedure used here.

These findings occur because of the factor analysis procedure and the process of *"variable rotation"*. That is, factor analysis is sensitive to interrelationships between variables and sets out to create new variables consisting of components of existing variables which are completely orthogonal (i.e., uncorrelated). In short, it is possible for a variable such as sex of the driver to assume a more important role in conjunction with other factors following this process than it does on its own.

The fact that other significant variables failed to rate a mention in multivariate analysis is also a function of the cut off value applied in the procedure (for reasons of ease of interpretation) which in effect is a statement of their lack of overall importance to speed behaviour. While they may be related to a driver's speed decision, they are clearly less important than the variables identified in the regression model.

Perhaps the greatest limitation with the procedure undertaken here was the relatively small amount of variance explained by both the rural and urban multivariate analysis (up to 35% maximum). There are two points worth making about this result.

First, it suggests that the variables examined here (including both their number and their interactions allowed to enter the regression equation) is only a limited subset of the variables involved in a driver's decision about travel speed. In short, what influences travel speed on the road is clearly a complex arrangement of many factors and interactions between these factors. Moreover, it is highly likely that there are also other variables beyond those tested here that play a part in speed behaviour on the road.

Secondly, with such a small amount of the variance explained by the models, it is dangerous to suggest that these findings can be used as a predictor of travel speed. It should be pointed out, however, that this has never been the intent of this analysis; it was undertaken purely as a procedure for establishing the relative importance of the variables of prime interest. In this context, it is still legitimate to claim that the variables identified by the model would be of priority in any future campaign aimed at reducing excessive speed (relative to the rest of the variables tested). Given the shortage of objective speed information in this area, these results, therefore, are most useful for countermeasure development.

7.7 SUCCESS WITH THE TECHNIQUE

A pleasing aspect of the study reported here was the overwhelming success of the technique developed here to elicit detailed information on the characteristics of drivers using rural and urban roadways in Victoria, their travel speeds, and reasons why they choose to travel at these speeds. This technique was developed here to link driver behaviour with attitude assessment and is a relatively new approach to knowledge in this area.

Moreover, while it was developed specifically for explaining speed behaviour, it also has potential to be used to examine a wide range of other unsafe road user behaviours, such as inappropriate overtaking, tailgating, red light running, and unsafe turning. It could also be used in specific "black-spot" locations to help explain conflicts and accident problems.

There were one or two problems or limitations with the study that need to be highlighted. First, the lack of data in the extreme speed categories is of some concern, given the likely importance placed on these categories for speed management and the intent to sample evenly across at speed categories in the study design. While these categories were given highest priority when targeting motorists for interview, the relative fewer numbers of them on the road made it time consuming just to collect the numbers obtained here. It would be a more costly exercise to collect equal numbers in every category, but necessary if statistical reliability is, paramount.

Second, these findings were derived from only two rural and two urban sites in this State. While these are important sites in terms of traffic movements and accidents, and provide some information about driver behaviour under different road conditions, it does, nevertheless, restrict the ability to generalize these findings.

Moreover, the study was conducted on only three days of the week (mid-week), and during daylight hours with dry weather conditions. Clearly, a range of different road types, alignments, traffic mix, study periods and weather conditions would be ultimately desirable for a full explanation of speed behaviour.

7.8 IMPLICATIONS FOR SPEED MANAGEMENT

The results of this study have a number of implications for speed management in Victoria (and the rest of Australia as well). A number of potential countermeasures against excessive speeding, which were associated with high accident involvement, were suggested from these findings and are discussed below.

It should be pointed out that some of these measures may need further development and substantiation in terms of their likely costs and benefits. In addition, they may need to be introduced on a trial basis and property evaluated. These issues go far beyond the intent or scope of this project.

7.8.1 Education & Enforcement

The most immediate application of these research findings is in relation to education and enforcement of safe speed practices on these roads, and a number of measures in this area seem possible. However, it should be stressed that education by itself is not likely to be totally sufficient in this area. As pointed out by Elliott (1989), road safety promotional programs work best in conjunction with a fully integrated campaign including other measures such as legislative, enforcement, news, change-agents.

PERCEIVED RISK OF DETECTION - The low perceived risk of detection for travelling 20 km/h above the speed limit is disturbing in these data, and suggests that police enforcement efforts at the time these studies were conducted was not a sufficient speed deterrence to these motorists.

The current speed camera program in Victoria was introduced after these studies were completed. This program is intended to increase the perceived risk of detection for speeding in this State and hopefully will have a positive long-term benefits here.

Leggett (1988) demonstrated recently that the perceived risk of detection for speeding could be increased by police maintaining a high visual presence on state highways. Hence, there may also be merit in police maintaining a higher visible presence on these roads as an excessive speed countermeasure.

EXCESSIVE SPEEDERS - The findings from these studies further showed that a sizable number of motorists using the Hume highway and Beach Road at Parkdale were travelling 30 km/h or more above the posted speed limit. In addition, a sizable proportion of motorists were found exceeding the mean and posted speed limits at the two curved road sites. Given the relationship observed here between excessive speeding, accident involvement, and injury severity, it is clear that this practice is unsafe.

An education and enforcement campaign needs to emphasise the increased risk of being involved in a crash and serious injuries for those travelling at excessively fast travel speeds. Current penalties for this behaviour may not be severe enough and motorists need to be convinced of the risks involved for such behaviour on the road.

A similar approach to that adopted against drink driving would seem appropriate here, emphasizing a "Borkenstein" type speed and risk curve for crash involvement and injury severity. Naturally, further effort is required to develop the former but, as noted later on in the section on further research still required, the use of high-technology enforcement devices may provide the means for collecting sufficient data to generate such curves in Victoria.

There was no evidence that slow travellers were over-involved in road crashes and they certainly derive injury benefits when involved in road crashes. Thus, there appears to be no accident benefit in attempting to raise these motorists' speeds to the mean speed level as suggested by the Solomon curve. In fact, the evidence here is of a disbenefit, both in terms of more crashes and a higher risk of injury, for such a program, although the effects of slow travellers on other drivers was not measured in this study.

THE ROLE OF DRIVER ATTITUDES - In general terms, there was some evidence that driver attitudes to speed were associated with their on-road speed behaviour. Those observed to be travelling at excessive speeds predicted that they would travel at similar speeds and generally believed it to be safe to do. As noted above, there is good reason to discourage such an opinion.

However, it should be pointed out a drivers' perception of what is a safe speed was an important variable in both the rural and urban speed models, it was less important to the drivers age, accident history and whether they were towing a trailer or not. Previous attempts to change drivers' behaviour through attitude change have not always been successful. Hence, while efforts need to be directed towards changing people's beliefs about what is and is not safe speed behaviour, other measures are also called for to ensure reductions in excessive speeding.

EXCESSIVE SPEED TARGET GROUPS - The results obtained from the two rural sites highlight a number of specific groups of motorists that need to be targeted to reduce excessive speed. These include drivers under 35 years of age (and under 25 in particular), those driving recent model cars, and those travelling on business.

There is evidence that the characteristics of drivers who travel at excessive speed at the four sites was slightly different. For instance, at Euroa and Parkdale, there was a high preponderance of single occupant business travellers driving recent vehicles. Hence, speed reduction in these areas needs to focus on these particular target groups for maximum effectiveness.

There was no evidence that tiredness and taking breaks influenced travel speed. However, there is considerable evidence that this is a desirable road safety measure anyway and ought to be encouraged.

There may be grounds for speed targeting those who have a high previous involvement in accidents, too, but further research is still warranted to support this.

ADDITIONAL SPEEDING PENALTIES - As noted earlier, most motorists responses to what constituted a suitable penalty for speed violations of 10 to 30 km/h were roughly in line with what current penalties were for these offenses, suggesting that current penalties were not viewed as particularly severe by these drivers.

A major change in community attitudes to drink driving was associated with heavier penalties and increased enforcement directed against those who ignored the law. There may be a case, therefore, for considering the need for increased penalties against excessive speeders to bring about a major change in community attitudes to speeding.

However, it must be stressed that there is other evidence that suggests that increases in perceived detection rates are more likely to be successful as an excessive speed countermeasure than increased penalties alone.

7.8.2 In-Vehicle Speed Measures

It is unlikely that these education and enforcement measures will be totally sufficient in eliminating excessive speeding in rural and urban areas. Hence, other possible countermeasures need to be examined and developed to reduce excessive speeding in the longer-term. Some possible additional measures that could be considered are outlined below. It should be noted, though, that many of these interventions still require research and development to ensure their likely effectiveness.

TOP SPEED LIMITERS FOR ALL VEHICLES - If all attempts to reduce excessive speeding ultimately do not have a large impact, it may be necessary to develop and implement devices to limit the top speed of all vehicles using roads in this State (or country). So long as car companies continue to manufacture and sell vehicles capable of travelling in excess of 150 km/h (and in some cases well over 200 km/h), it seems there will always be motorists willing to travel at excessively fast speeds.

Devices are currently available in tachograph technology for limiting the top speed of trucks without reducing acceleration capacity. While these measures tend to be relatively expensive, it would not take very much to develop a more simple device to limit the top speed of all passenger cars. In the first instance, such a device could be introduced as a recidivist device for those who continue to speed, ultimately to become a standard safety feature in all vehicles.

URBAN SPEED MONITORS - As well as top speed limiters, an urban speed monitor has also been proposed by others based on it being a speed violation detection device and, hence, a deterrent against speeding (refer Howie (1989) for a full discussion of these devices and their modes of operation). In a simpler form, it could also provide "negative" feedback information to the driver on speeding excursions in similar ways to fuel economy meters, or even cut-off power to those wanting to accelerate when already travelling above the speed limit.

These measures would require a fairly substantial and costly road infrastructure to convey to the monitor what the speed limit was on a particular road, as well as detailed circuitry for feedback and/or penalty. In addition, questions of reductions in civil liberties need to addressed with these devices. Nevertheless, they are an engineering option to reducing excessive speeding in urban areas, although clearly, further research effort would be required to develop a suitable measure at this time.

7.8.3 On-Road Speed Measures

PERCEPTUAL COUNTERMEASURES - There was a slight suggestion in these data that the road and the surrounding environment was influencing travel speeds by changing motorists' perceptions. A range of possible treatments against excessive speeding was outlined by Fildes et al (1989) for systematic evaluation. In addition, there are likely to be other novel perceptual manipulations that could be useful here, although it should be stressed that these treatments may only have a marginal effect or only work in specific road and roadside locations.

LANE SEPARATIONS - Assuming that the basic crash problem with speed variance lies in mixing slow and fast vehicles and the associated human error, stressors, and motivations this can cause, it may be necessary to re-consider mandatory lane separations between slow and fast vehicles on multi-lane rural highways in this State. In particular, consideration might also be given to means of separating vehicles of extremely different sizes and weights (e.g. trucks and cars).

ROAD ALIGNMENT STANDARDS - Current alignment standards for divided rural highways assume a design speed of 130 km/h. With automobile developments emphasizing comfort, quietness, and smoothness of ride, it's not too surprising that motorists in recent vehicles have a tendency towards excessive speeds. While controversial, there may be a need in the long-term to reconsider what constitutes an acceptable design speed, bearing in mind the total safety benefits of this decision.

7.9 FUTURE SPEED RESEARCH

There were a number of areas identified as needing further research and development identified in this research program.

7.9.1 Speed and Accident Involvement

Given the overwhelming importance of clearly understanding the relationship between travel speed and accident involvement, this requires further examination. The recent Road Safety Researchers' conference in Woodend (November 1989) assessed the need for this research to be of prime importance in assigning priorities for future research in this country (VicRoads, 1990).

With the advent of high-technology measures of speed recording and driver identification (such as speed cameras and on-road video recorders), it would be possible to compare vast numbers of cases of speeding motorists with previous accident involvement histories to test the relationship between excessive speeding and accident involvement more thoroughly and over a larger range of values than was possible here.

Of interest, though, was the lack of any increased accident involvement for those travelling at excessively slow speeds, as predicted from Solomon's U-Shape curve. As current speed camera enforcement techniques ignore those travelling at speeds below the posted speed limit, this source of data would not be totally sufficient to test this effect. Alternative methods need to be derived to test the U-Shape hypothesis thoroughly.

7.9.2 Other Driving Conditions

Different driving conditions are likely to have a substantial effect on the speed behaviour and attitudes towards speeding of motorists. In particular, there is a need to consider what effect night-time and bad weather has. Conceivably, the effects of driver fatigue are likely to be more pronounced under degraded visual and physical conditions.

A number of potentially interesting and/or non-significant findings from this study warrant further investigation. These include the effects of inexperienced drivers on P-Plates, and those not wearing seat belts, assuming sufficient numbers can be found (e.g., at different times of the day and week).

Moreover, the effects of journey distance were not adequately explained here and fatigue effects needs elaboration upon. It would also be worthwhile exploring the findings of perceived danger more fully for a range of different travel speeds (including very fast and slow speeds).

7.9.3 In-Vehicle Speed Control

The top speed limiting device is one of the more promising measures for the future in speed control. There can be little objection to such a device, especially as it need not interfere with a vehicle's performance below that speed.

These devices are currently in the process of becoming mandatory equipment for certain heavy vehicles and their accident benefits and any associated problems can be assessed for this fleet once they have been introduced. This will enable the technology to be fully developed and safety benefits evaluated as a lead in to consideration of similar devices for all vehicles on the road. There is a need for additional research in this area in future.

As noted earlier, an urban speed monitor has also been proposed as a speed violation detection device and, hence, a deterrent against speeding. The design of these devices is still very much in its infancy and still need to be fully developed, both in terms of technology and level of operation. In addition, the degree and sophistication of road infrastructure required to support these in-vehicle devices and their likely community acceptance also need to be addressed.

7.9.4 A "Black-Box" Speed Recorder

One of the major obstacles to understanding fully the ramifications of the role of speed in accidents has been the lack of accurate comprehensive speed data in crash records. Without exception, crash speed information is derived retrospectively from site inspections, police or eye-witness accounts, or even from reports from those involved in the crash. There is no means currently available for collecting accurate speed information at the time of the collision.

A relatively simple in-vehicle device could be developed which measures the speed of the vehicle on impact (delta-V). While some vehicle speed is lost prior to the moment of impact through skidding and braking, this could be estimated in many cases. In any event, these devices would provide infinitely more accurate data on speed prior to collision than retrospective accounts.

They need not be too complicated; technology is already available to do this in a single plane which could be expanded to cover all three dimensions. Indeed, while details are scant at this time, it is believed that such a device is currently being worked on in Sweden as a joint venture between Folksam Insurance and Volvo.

As well as providing more accurate information on impact speed of vehicles involved in crashes, these devices would also be helpful to accident investigators when assigning crash culpability.

REFERENCES

AJZEN I. & FISHBEIN M. (1980). *Understanding Attitudes And Predicting Social Behaviour*, Prentice-Hall: Englewood Cliffs, New Jersey.

ALDMAN B. (1983). Synthesis report of the EEC biomechanics programme, Paper presented at the Commission of European Communities seminar on the Biomechanics of Impacts in Road Accidents, 2123 March 1983.

ARMOUR M. (1986). The effects of police presence on urban driving speeds, *J. Transportation Engineers*, 56(2), 40-45.

BOHLIN N.I. (1967). A statistical analysis of 28,000 accident cases with emphasis; on occupant restraint value, *Eleventh Strapp Car Crash Conference*, Anaheim, California.

CAIRNEY P. (1986). *The influence of cues from the road and the roadside environment on estimates of operating speed and speed limits*, Australian Road Research Board Research Report, ARR 143.

CAIRNEY P. & CROFT P.G. (1985). *A pilot study of driver's judgements about speed limits, safe speed and average speeds*, Australian Road Research Board, Internal Report AIR 394-9.

CAMPBELL B.J. (1970). *Driver injury in automobile accidents involving certain car models*, Report HSRC-TR18, University of North Carolina Highway Safety Research Centre. Chapel Hill, N.C.

CERRELLI E.C. (1984). *Risk of fatal injury in vehicles of different size*, Report DOT HS 806-653, National Highway Traffic Safety Administration, US Department of Transportation, Washington DC.

CHRISTIANSEN J. (1981). The effects of general speed limits on driving speeds and accidents in Denmark, Proceedings of the International Symposium on the Effects of Speed Limits on Traffic Accidents & Fuel Consumption, Organisation for Economic Co-operation and Development, Ireland.

COWLEY J.E. (1980). *A review of rural speed limits in Australia*, Report CR20, Federal Office of Road Safety, Department of Transport, Canberra.

CUMMING, R.W. AND CROFT, P.G. (1971). *A review of speed control in relation to road safety*, Australian Department of Transport, Canberra, Australia.

DENTON G.G. (1973). *The influence of visual pattern on perceived speed at Newbridge MB Midlothian*, Laboratory Report LR531, Transport and Road Research Laboratory, Crowthorne, England.

ELLIOTT B.J. (1981). Attitudes to exceeding the speed limits, Report to the Road Traffic Authority of Victoria, Melbourne.

ELLIOTT B.J. (1989). *Effective road safety campaigns: A practical handbook*, Report CR80, Federal Office of Road Safety , Canberra.

EVANS L. (1988). *Restraint effectiveness, occupant ejection from cars, and fatality reductions*, Report GMR-6398, General Motors Research Laboratories, Warren, Michigan.

FAZIO R.H. & ZANNA M.P. (1981). Direct-experience and attitude-behaviour consistency, *Advances in Experimental Social Psychology*, 14, 161-202.

FILDES, B.N. (1986). The perception of road curves, Unpublished Ph.D. Dissertation, Monash University, Australia.

FILDES, B.N. (1988). Excessive speed - an unsafe driving action, Paper presented at the Colloquium on Driver Behaviour, a joint initiative by the Australian Psychological Society and the Victoria Police, 6 December 1988 National Science Centre, Melbourne, Australia.

FILDES, B.N., FLETCHER, M.R. & CORRIGAN, J. McM. (1987). *Speed Perception 1: Driver's judgements of safety and travel speed on urban & rural straight roads*, Report CR54, Federal Office of Road Safety, Department of Transport and Communications, Canberra.

FILDES, B.N., LEENING, A.C. & CORRIGAN, J. McM. (1989). *Speed Perception 2: Driver's judgements of safety and travel speed on rural curved roads and at night*, Report CR60, Federal Office of Road Safety, Department of Transport and Communications, Canberra, (in press).

HADDON W.R.,Jnr. (1968). The changing approach to the epidemiology, prevention, and amelioration of trauma: The transition to approaches etiologically rather than descriptively based, *American J. Public Health*, 58, 1431-1438.

HAUER, E. (1971) . Accidents, overtaking and speed control, *Accident Analysis & Prevention*, 3(1), 1-14.

HAUER E., AHLIN F.J. & BOWSER J.S. (1982). Speed enforcement and speed choice, *Accident Analysis & Prevention*, 14(4), 267-278.

HAWORTH N.L., TRIGGS T.J. & GREY E.M. (1988). *Driver fatigue: concepts, measurement and crash countermeasures,* Report CR72, Federal Office of Road Safety, Department of Transport and Communications, Canberra, Australia.

HEARNE R. (1981). Car & truck speeds related to road traffic accidents on the Irish National road system, Proceedings of the International Symposium on the Effects of Speed Limits on Traffic Accidents & Fuel Consumption, Organisation for Economic Co- operation and Development, Ireland.

HOBAN C. (1984). Bunching on two-lane rural roads, in Gipps P. (ed), *Traffic Flow Theory*, ESSO Monash Traffic Course Handbook, 93-114.

HOWIE D. (1989). Advanced technology and road safety, Report for-the Road Traffic Authority and the Transport Accident Commission, Monash University Accident Research Centre, Melboume.

INTERNATIONAL RESEARCH COMMITTEE ON THE BIOKINETICS OF IMPACT (IRCOBI 1975). Biomechanics of serious injury , Proceedings of the Second International IRCOBI Conference, Birmingham, 9-11 September 1975.

INSURANCE INSTITUTE FOR HIGHWAY SAFETY (IIHS 1988). 65mph is taking its toll, *Status Report*, 23(8), August 13, 1988.

INSURANCE INSTITUTE FOR HIGHWAY SAFETY (IIHS 1989). Research confirms that radar detectors do influence speed, *Status Report*, 24(6), 2-3.

JOHNSON P. (1980). The effectiveness of the 55mph National speed limit as a life saving benefit, National Highway Traffic Safety Administration, US Department of Transport, Washington DC.

JOHNSTON I.R., WHITE G.R. & CUMMING R.W. (1973). The role of optical expansion patterns in locomotor control, *American J. Psychology*, 86, 311.

LASSARRE S. & TAN S.H. (1981). Evaluation of the effects of speed limits and the energy crisis on the frequency & severity of accidents on rural roads, Proceedings of the International Symposium on the Effects of Speed Limits on Traffic Accidents & Fuel Consumption, Organisation for Economic Co-operation and Development, Ireland.

LEGGETT L.M.W. (1988). The effect on accident occurrence of long- term, low-intensity police enforcement, *Proceedings of the 14th Australian Road Research Board Conference*, 14(4), 92-104.

LISPER H-O., ERIKSSON B., FAGERSTROM K-O. & LINDHOLM J. (1979). Diurnal variation in subsidiary reaction time in long-term driving task, *Accident Analysis & Prevention*, 11, 1-5.

MACKAY M. (1987). Kinematics of Vehicle Crashes, *Adv. Trauma*, 2, 21-42.

MACKAY M. (1988). Vehicle Occupant Protection, Internal Report on discussions with Dr. Murray Mackay during recent visit to Monash University Accident Research Centre, Melbourne, June 1988.

McMENOMY L.R. (1984). Deterrence & detection, Proceedings of the National Road Safety Symposium, Canberra, 29-31 October 1984.

MOSTYN B.J. & SHEPPARD D. (1980). A national survey of driver's attitudes and knowledge about speed limits, Supplementary Report 548, Transport & Road Research Laboratories, Crowthorne, England.

MUNDEN J.W. (1967). The relation between a driver's speed and his accident rate, Laboratory Report LR88, Road Research Laboratory, Crowthorne, England.

NILSSON G. (1977). The effects of speed limits on traffic accidents in Sweden, Proceedings of the International Symposium on the Effects of Speed Limits on Traffic Accidents & Fuel Consumption, Organisation for Economic Co-operation and Development, Ireland.

O'NEILL B. (1987). Speeding on the increase: More motorists exceeding 65mph now than 5- 7 months ago, News Release, Insurance Institute for Highway Safety, Washington DC.

O'NEILL B. (1988). Federal report conclusion: Deaths up 20 percent on highways where speed limits raised to 65mph, News Release, Insurance Institute for Highway Safety, Washington DC.

ORGANISATION FOR ECONOMIC CO-OPERATION & DEVELOPMENT (OECD 1972). *Speed Limits Outside Built-Up Areas Paris*: OECD.

OVE ARUP (1990). 1989 rural town restraint use survey, Report GR/90-4, VIC; ROADS Research and Investigations, Australia.

PAXUS (1989). New Passenger Vehicle Registrations December 1980 to December 1988, Australia.

REGAN D.T. & FAZIO R. (1977). On the consistency between attitudes and behaviour: look to the method of attitude formation, *Journal of Experimental Social Psychology*, 13, 28-45.

RESEARCH TRIANGLE INSTITUTE (1970). Speed & accidents, Report of the National Highway Safety Bureau, Durham, North Carolina.

RIEMERSMA, J.B.L. (1982). Perception and control of deviations from a straight course; a field experiment, Report 12F 1982 C-20, Institute of Perception TNO, Soesterberg, the Netherlands.

RIEMERSMA, J.B.L. (1984). The perception of speed during car driving, Report IZF 1984 C-11, Institute of Perception TNO, Soesterberg, the Netherlands.

ROAD TRAFFIC AUTHORITY (1987). A speed management strategy for Victoria, Report to the Board of the Road Traffic Authority of Victoria, March 1987, Australia.

ROAD TRAFFIC AUTHORITY (1988). Monitor of driver attitude to speed, Research Proposal issued by the Road Traffic Authority of Victoria, 16 December 1988, Australia.

ROGERSON P. & KEALL M. (1990). The Melbourne on-road exposure surveys: 1984, 1985, 1986 and 1988, Report GR/90-5, VicRoads Research and Investigations, Australia.

SANDERSON, J.T. & HOQUE, M.M. (1987) Insurance claims and road user safety, Traffic and Safety Department, Royal Automobile Club of Victoria.

SALUSJARVI M. (1981). Speed limits and Traffic accidents, Proceedings of the International Symposium on the Effects of Speed Limits on Traffic Accidents & Fuel Consumption, Organisation for Economic Co-operation and Development, Ireland.

SHINAR, D., McDOWELL, E.D. & ROCKWELL, T.H. (1977). Eye movements in curve negotiation, *Human Factors*, 19, 63- 71.

SHINAR D. & STIEBELJ. (1986). The effectiveness of stationary versus moving police vehicles on compliance with the speed limit, *Human Factors*, 28(3), 365-371.

SOLOMON D. (1964). Accidents on main rural highways related to speed, driver and vehicle, US Department of Commerce, Bureau of Public Roads, Washington, DC.

TEN BRUMMELAAR, T. (1983). The reversal point in the perspective road picture, *Australian Road Research*, 13, 123-127.

VicRoads (1989). Traffic parameters: Road service information, VicRoads, Melbourne.

WEBSTER K. & SCHNERRING F. (1986). 40km/h speed limit trials in Sydney, Research Note RN6/86, Traffic Authority of New South Wales, Sydney.

WEST, L.B. AND DUNN, J.W. (1971). Accidents, speed deviation and speed limits, *Traffic Engineering*, 41(10), 17-50.

WHITAKER J. (1980). A survey of motorcycle accidents, Laboratory Report LR913, Transport & Road Research Laboratory, Crowthorne, England.

WITT, H. AND HOYOS, C.G. (1976) Advanced information on the road: a simulation study of Road the effects of road markings, *Human Factors*, 18, 521-532.

ATTACHMENT 1

MONASH UNIVERSITY
ACCIDENT RESEARCH CENTRE

DRIVER QUESTIONNAIRE – EUROA

MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE
DRIVER QUESTIONNAIRE - EUROA

SCHEDULER:

TIME: ....REG. NO.: ....

VEHICLE DESCRIPTION: ....

INCENTIVE: $ ☐ none ☐

VEHICLE DETAILS:

MAKE/MODEL: ....
(e.g. Ford Falcon)

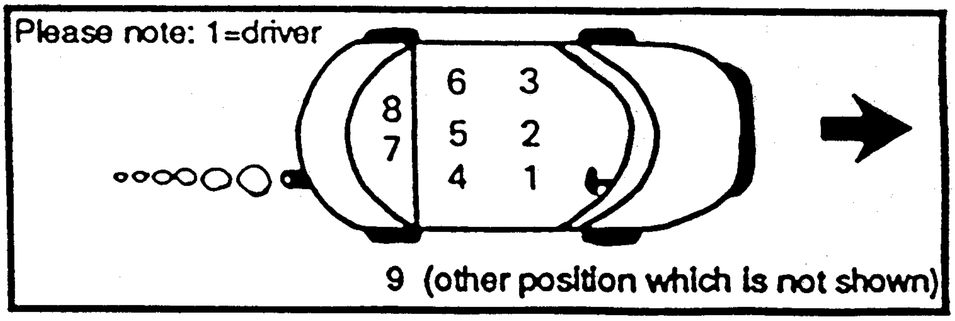
BODY TYPE: ....YEAR: ....
(e.g. sedan, wagon)

TOWING A TRAILER/CARAVAN: yes ☐ no ☐

P-PLATES DISPLAYED: yes ☐ no ☐ unsure ☐

NO. OF OCCUP.: .....

O = restrained occupant X = unrestrained occupant



REFUSAL DETAILS:

AGE/SEX: __ __ (refer to CARD)

ESTIMATE PURPOSE OF TRIP:

business	recreation/ holiday	domestic duties	unsure
☐	☐	☐	☐

REASON FOR REFUSAL:

IT IS IMPORTANT TO US THAT YOU ANSWER EACH QUESTION AS ACCURATELY AND HONESTLY AS POSSIBLE AND TAKE AS MUCH TIME AS YOU NEED TO ANSWER EACH QUESTION.

1. ARE YOU THE OWNER OF THIS VEHICLE? yes ☐ no ☐

2. ROUGHLY HOW MANY KILOMETRES DO YOU NORMALLY DRIVE EACH WEEK?

less than 200 ☐ 201-400 ☐ 401-600 ☐ more than 600 ☐

3. HOW MANY YEARS HAVE YOU BEEN DRIVING FOR?.....YRS

4. IS THE PURPOSE OF THIS TRIP FOR:

business ☐ recreation/holiday ☐ domestic duties ☐ other ☐

5. WHERE DID YOU START YOUR TRIP TODAY?..............

6. WHERE ARE YOU HEADING FOR TONIGHT?................

7. HOW LONG HAVE YOU BEEN DRIVING SINCE YOUR LAST BREAK?
DURATION:........HRS

8. HOW TIRED DO YOU FEEL?

VERY TIRED — NOT AT ALL TIRED

0 1 2 3 4 5 6 7 8 9 10

9. WHEN DO YOU HOPE TO ARRIVE AT YOUR DESTINATION?

TIME:............. don't care ☐

10. ARE YOU TRAVELLING?

ahead of schedule ☐ on time ☐ behind schedule ☐ other ☐

11. HOW OFTEN DO YOU TRAVEL ALONG THIS SECTION OF THE HUME HIGHWAY?

daily ☐ weekly ☐ monthly ☐ yearly ☐ less than yearly ☐ first time ☐

SHOW PHOTO OF ROAD

I AM GOING TO ASK YOU SOME QUESTIONS ABOUT THIS SECTION OF HIGHWAY WHICH YOU HAVE JUST TRAVELLED ALONG. PLEASE GIVE HONEST ANSWERS, KEEPING IN MIND THAT THE SURVEY IS FOR RESEARCH ONLY. YOUR ANSWERS WILL BE TREATED IN STRICT CONFIDENCE AND WILL NOT BE SHOWN TO THE POLICE.

12. WHAT DO YOU THINK IS THE SPEED LIMIT ON THIS ROAD? ....KM/H

13. REGARDLESS OF THE SPEED LIMIT, WHAT SPEED WOULD YOU TRAVEL AT ALONG THIS ROAD?................KM/H

14. WHAT DO YOU THINK IS A SAFE SPEED TO TRAVEL AT ON THIS ROAD?..........................KM/H

15. WHAT SPEED DO YOU THINK MOST OF THE TRAFFIC WOULD TRAVEL AT ON THIS ROAD?......................KM/H

16. PLEASE CONSIDER THE FOLLOWING SITUATION.

    A PERSON IS DRIVING ON THE ROAD SHOWN IN THE PHOTOGRAPH ON A SATURDAY AFTERNOON. THEY ARE DRIVING ABOUT 20 KM/H OVER THE SPEED LIMIT BUT ARE OTHERWISE WITHIN THE LAW. WHAT DO YOU THINK IS THE LIKELIHOOD THAT THEY WILL BE STOPPED BY THE POLICE?

NO CHANCE — CERTAIN

0 1 2 3 4 5 6 7 8 9 10

17. A PERSON IS DRIVING ON THE ROAD SHOWN IN THE PHOTOGRAPH. IT IS A FINE AFTERNOON AND THE TRAFFIC IS LIGHT. THEY ARE DRIVING AT 130 KM/H BUT ARE OTHERWISE WITHIN THE LAW. HOW DANGEROUS IS THIS BEHAVIOUR?

NOT DANGEROUS AT ALL — EXTREMELY DANGEROUS

0 1 2 3 4 5 6 7 8 9 10

IN THE LAST PART OF THE SURVEY WE WANT TO OBTAIN COMPREHENSIVE DETAILS ON THE NUMBER AND TYPE OF ACCIDENTS THAT PEOPLE ARE HAVING ON THE ROAD. WE STRESS AGAIN THAT THIS INFORMATION WILL BE TREATED IN STRICT CONFIDENCE.

18. HAVE YOU BEEN INVOLVED AS A DRIVER IN ANY ROAD ACCIDENT (SERIOUS OR MINOR) IN THE LAST 5 YEARS?

no ☐ yes ☐ HOW MANY?.......

19. COULD YOU GIVE ME A ROUGH IDEA OF WHEN EACH ACCIDENT HAPPENED AND HOW SERIOUSLY YOU WERE INJURED? *(Spell out the categories)*

(tick appropriate boxes)

DATE OF ACCIDENT	HOSPITALISED	MEDICAL TREATMENT ONLY	UNINJURED (PROPERTY DAMAGE ONLY)

SHOW CARD

20. COULD YOU PLEASE TELL ME WHICH AGE/SEX GROUP NUMBER APPLIES TO YOU? GROUP __ __

Attachment 1

AGE / SEX

	MALES		FEMALES
18 - 20 years	01	or	02
21 - 24 years	03	or	04
25 - 34 years	05	or	06
35 - 44 years	07	or	08
45 - 54 years	09	or	10
55 - 69 years	11	or	12
70 years or more	13	or	14
	MALES		FEMALES

Attachment 1

IF WE NEED ADDITIONAL INFORMATION FOR OUR STUDY, WOULD YOU BE PREPARED TO PARTICIPATE FURTHER?

yes ☐ no ☐

COULD YOU PROVIDE US WITH YOUR NAME AND ADDRESS SO THAT WE COULD WRITE TO YOU AT A LATER DATE?

NAME:...

ADDRESS:......................................

...........................POSTCODE:.............

THANK YOU FOR PARTICIPATING AND DRIVE SAFELY

COMMENTS:

ATTACHMENT 2

MONASH UNIVERSITY
ACCIDENT RESEARCH CENTRE

DRIVER QUESTIONNAIRE – BELMORE ROAD

MONASH UNIVERSITY ACCIDENT RESEARCH CENTRE
DRIVER QUESTIONNAIRE - BELMORE ROAD

SCHEDULER:

TIME: ....REG. NO.: ....

VEHICLE DESCRIPTION: ....

INCENTIVE: $ ☐ none ☐

VEHICLE DETAILS:

MAKE/MODEL: ....
(e.g. Ford Falcon)

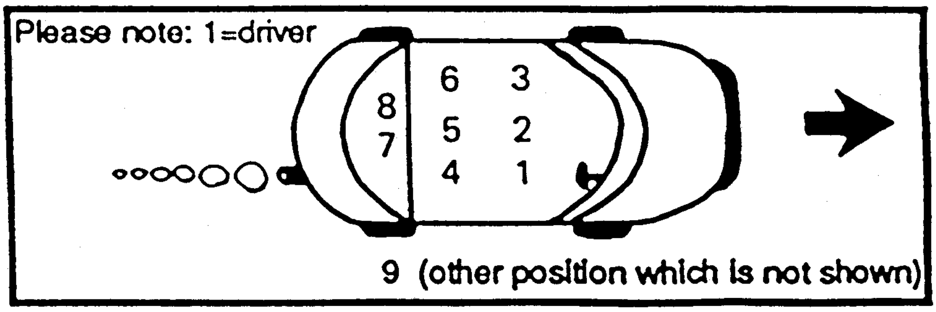
BODY TYPE: ....YEAR: ....
(e.g. sedan, wagon)

TOWING A TRAILER/CARAVAN: yes ☐ no ☐

P-PLATES DISPLAYED: yes ☐ no ☐ unsure ☐

NO. OF OCCUP.: .....

○ = restrained occupant X = unrestrained occupant



REFUSAL DETAILS:

AGE/SEX: __ __ (refer to CARD)

ESTIMATE PURPOSE OF TRIP:

business	recreation/ holiday	domestic duties	unsure
☐	☐	☐	☐

REASON FOR REFUSAL:

IT IS IMPORTANT TO US THAT YOU ANSWER EACH QUESTION AS ACCURATELY AND HONESTLY AS POSSIBLE AND TAKE AS MUCH TIME AS YOU NEED TO ANSWER EACH QUESTION.

1. ARE YOU THE OWNER OF THIS VEHICLE? yes ☐ no ☐

2. ROUGHLY HOW MANY KILOMETRES DO YOU NORMALLY DRIVE EACH WEEK?

less than 200 ☐ 201-400 ☐ 401-600 ☐ more than 600 ☐

3. HOW MANY YEARS HAVE YOU BEEN DRIVING FOR?.....YRS

4. IS THE PURPOSE OF THIS TRIP FOR:

business ☐ recreation/holiday ☐ domestic duties ☐ other ☐

5. WHERE DID YOU START YOUR TRIP?...................

6. WHERE WILL THIS TRIP END?.........................

7. HOW LONG HAVE YOU BEEN DRIVING SINCE YOUR LAST BREAK? DURATION:........HRS

8. HOW TIRED DO YOU FEEL?

VERY TIRED — NOT AT ALL TIRED

0 1 2 3 4 5 6 7 8 9 10

9. WHEN DO YOU HOPE TO ARRIVE AT YOUR DESTINATION?

TIME:............. don't care ☐

10. ARE YOU TRAVELLING?

ahead of schedule ☐ on time ☐ behind schedule ☐ other ☐

11. HOW OFTEN DO YOU TRAVEL ALONG THIS SECTION OF THE BELMORE ROAD?

daily ☐ weekly ☐ monthly ☐ yearly ☐ less than yearly ☐ first time ☐

SHOW PHOTO OF ROAD

I AM GOING TO ASK YOU SOME QUESTIONS ABOUT THIS SECTION OF ROAD WHICH YOU HAVE JUST TRAVELLED ALONG. PLEASE GIVE HONEST ANSWERS, KEEPING IN MIND THAT THE SURVEY IS FOR RESEARCH ONLY. YOUR ANSWERS WILL BE TREATED IN STRICT CONFIDENCE AND WILL NOT BE SHOWN TO THE POLICE.

12. WHAT DO YOU THINK IS THE SPEED LIMIT ON THIS ROAD? ....KM/H

13. REGARDLESS OF THE SPEED LIMIT, WHAT SPEED WOULD YOU TRAVEL AT ALONG THIS ROAD?................KM/H

14. WHAT DO YOU THINK IS A SAFE SPEED TO TRAVEL AT ON THIS ROAD?..........................KM/H

15. WHAT SPEED WOULD BE DANGEROUS ON THIS ROAD?..........KM/H

16. WHAT SPEED DO YOU THINK MOST OF THE TRAFFIC WOULD TRAVEL AT ON THIS ROAD?.....................KM/H

17. PLEASE CONSIDER THE FOLLOWING SITUATION.

    A PERSON IS DRIVING ON THE ROAD SHOWN IN THE PHOTOGRAPH ON A SATURDAY AFTERNOON. THEY ARE DRIVING ABOUT 20 KM/H OVER THE SPEED LIMIT BUT ARE OTHERWISE WITHIN THE LAW. WHAT DO YOU THINK IS THE LIKELIHOOD THAT THEY WILL BE STOPPED BY THE POLICE?

NO CHANCE — CERTAIN

0 1 2 3 4 5 6 7 8 9 10

18. A PERSON IS DRIVING ON THE ROAD SHOWN IN THE PHOTOGRAPH. IT IS A FINE AFTERNOON AND THE TRAFFIC IS LIGHT. THEY ARE DRIVING AT 85 KM/H BUT ARE OTHERWISE WITHIN THE LAW. HOW DANGEROUS IS THIS BEHAVIOUR?

NOT DANGEROUS AT ALL — EXTREMELY DANGEROUS

0 1 2 3 4 5 6 7 8 9 10

19. LOOKING AT TABLE 1, WHAT DO YOU THINK IS AN APPROPRIATE PENALTY (IF ANY) FOR DRIVING ON THIS SECTION OF ROAD AT:
FINE

A 10 KM/H OVER THE SPEED LIMIT........ ☐ $......

B. 20 KM/H OVER THE SPEED LIMIT........ ☐ $......

C. 30 KM/H OVER THE SPEED LIMIT........ ☐ $......

NOTE: IF THEY MENTION FINE, *RECORD HOW MUCH FOR EACH SPEED*

IN THE LAST PART OF THE SURVEY WE WANT TO OBTAIN COMPREHENSIVE DETAILS ON THE NUMBER AND TYPE OF ACCIDENTS THAT PEOPLE ARE HAVING ON THE ROAD. WE STRESS AGAIN THAT THIS INFORMATION WILL BE TREATED IN STRICT CONFIDENCE.

20. HAVE YOU BEEN INVOLVED AS A DRIVER IN ANY ROAD ACCIDENT (SERIOUS OR MINOR) IN THE LAST 5 YEARS?

no ☐ yes ☐ HOW MANY?.......

21. COULD YOU GIVE ME A ROUGH IDEA OF WHEN EACH ACCIDENT HAPPENED AND HOW SERIOUSLY YOU WERE INJURED?
(Spell out the categories)

(tick appropriate boxes)

DATE OF ACCIDENT	HOSPITALISED	MEDICAL TREATMENT ONLY	UNINJURED (PROPERTY DAMAGE ONLY)

SHOW TABLE 2

22. COULD YOU PLEASE TELL ME WHICH AGE/SEX GROUP NUMBER APPLIES TO YOU? GROUP __ __

23. IF WE NEED ADDITIONAL INFORMATION FOR OUR STUDY, WOULD YOU BE PREPARED TO PARTICIPATE FURTHER?

yes ☐ no ☐

COULD YOU PROVIDE US WITH YOUR NAME AND ADDRESS SO THAT WE COULD WRITE TO YOU AT A LATER DATE?

NAME:...

ADDRESS:..

..........................POSTCODE:.............

24. WHAT SORT OF DRIVING DO YOU THINK CONSTITUTES SPEEDING?
PROBE FOR FULL EXPLANATION.

OTHER COMMENTS:

THANK YOU FOR PARTICIPATING AND DRIVE SAFELY

Attachment 2

TABLE 1

1.	NO PENALTY	01
2.	REPRIMAND FROM POLICE	02
3.	FINE	03
4.	LOSS OF POINTS (FOR LICENCE)	04
5.	SUSPENSION OF LICENCE	05
6.	FINE, AND LOSS OF POINTS	06
7.	FINE, LOSS OF POINTS AND LICENCE SUSPENSION	07
8.	FINE, LOSS OF POINTS, LICENCE SUSPENSION AND JAIL TERM	08
9.	OTHER (SPECIFY)	09
10.	DON'T KNOW	10

TABLE 2

AGE / SEX

	MALES		FEMALES
18 - 20 years	01	or	02
21 - 24 years	03	or	04
25 - 34 years	05	or	06
35 - 44 years	07	or	08
45 - 54 years	09	or	10
55 - 69 years	11	or	12
70 years or more	13	or	14
	MALES		FEMALES