Male and female drivers: how different are they?

The University of Reading

AA Foundation for Road Safety Research

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Chapter 1 Introduction

1.1 Background

Over the last 20 years the constituents of the driving population have been changing. In particular, there are now many more women who have obtained driving licences. This radical shift in the nature of the driving population is ongoing and can be expected to continue for some time. Such changes have coincided with popular speculations concerning sex differences in driver behaviour and more recently of speculations that women are adopting a more aggressive driving style. Since the issue of potential sex differences tends to attract more heated debate than scientific observation, it is important to consider any relevant evidence.

The work presented here explored the accident involvement of men and women to determine whether the pattern of accident involvement was the same or different. In addition, the driving behaviour and attitudes of men and women was examined to determine if there were any significant differences. In the present chapter, the change in the characteristics of the driving population is outlined briefly followed by a discussion of the main aims of the project.

1.2 Characteristics of the driving population

In the last two decades the proportion of the population obtaining a full driving licence has been increasing. From Figure 1.1 it can be seen that the relative shift in the driving population is more marked for women. While the increase in the male driving population is levelling off as saturation level is approached, the situation is different for women, who are a long way from saturation and are continuing with an increase in the proportion who obtain full driving licences. In essence, as time passes, the ratio of men to women who obtain full driving licences is approaching 1:1. In 1972 there were three men to every woman with a full driving licence, whereas at present the ratio is less than two men for every woman.

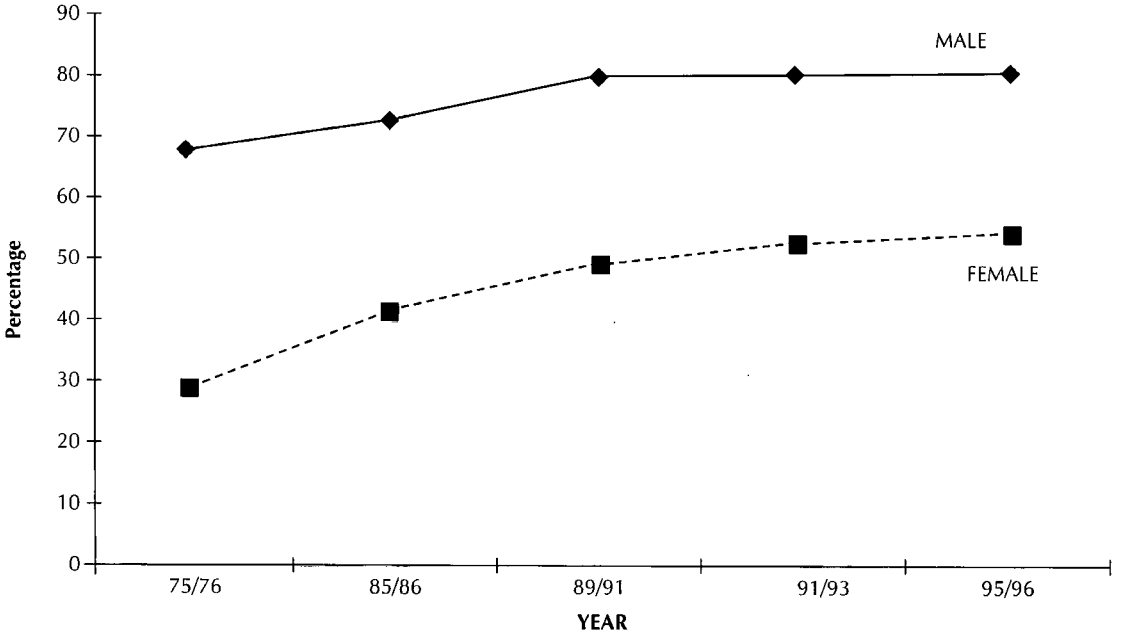


Figure 1.1 Percentage of men and women drivers with a full driving licence

The fact that there is an increasing tendency for men and women to obtain driving licences does not necessarily mean that there is an increasing tendency to use them. However, the evidence from annual mileage which is reported in the National Travel Survey (1994/1996) suggests that any differences which have previously existed between the mileage for male and female drivers is being eroded: "...the gap between mileage travelled by men and

women has slowly decreased, from an 88 per cent difference in 1973/76 to 65 per cent in 1985/86 and to 56 per cent in 94/96." (NTS 1994/96, p.10).

1.3 Study aims

Since it is clear that we have moved away from a position in which male drivers far outnumber female drivers, it is timely to consider the implications, if any, of the considerably increased numbers of women car drivers. In particular, we are concerned with implications for driver behaviour. Clearly a range of possibilities exists. For example, it is possible that, as the car usage of men and women becomes more similar, the driving style and abilities of the two sexes may be indistinguishable. Alternatively, it may be that there are intrinsic differences between men and women that will not decrease, even when their driving mileage is identical.

Although the issue of intrinsic differences between men and women is an interesting one, it is not one that is readily addressed. For example, the fact that there are differences in the mileage of men and women means that any differences in either their accident involvement or driving style might be attributed to the fact that they drive on different roads with different speed limits. Maycock, Lockwood and Lester (1991) have found that as annual mileage increases, the proportion of miles travelled on motorways increases while the proportion of miles travelled on urban roads is reduced. The fact that women, on average, drive less means that there will be a tendency for women to spend more of their time driving on urban roads than on motorways. This may then have implications for their driving style and accident involvement. In order to take some account of this in the empirical part of our investigation, when we assess the driving abilities and attitudes of men and women, we attempt to match the groups on mileage.

Our more fundamental goal was to document whether there were differences in either the pattern of their accident involvement or their driving style. To achieve this we first examined the accident statistics across the age range (including drivers aged 55 or over) to determine whether such differences in accident statistics exist. We then carried out a more intensive study of 480 drivers (age 17 to 50), focusing on key driver behaviours and attitudes that are known to be related to accident involvement. **Drivers over the age of 50 were excluded from this particular study as they are associated with a different set of issues which merit investigation in their own right.**

The main study involved the use of digitised video tests: driver **speed choice, close following, gap acceptance, overtaking and hazard perception,** and a questionnaire covering a range of factors, such as **driver experiences, sensation seeking and attitudes to alcohol and drug use.** Finally, we conducted a smaller scale observational study on the high risk group, namely young drivers: our aim here was to determine if there are differences between young men and women drivers in their everyday driving behaviour and to determine whether or not they are differentially affected by the presence of another young person in the car.

Chapter 2 The accident involvement of men and women

2.1 Introduction

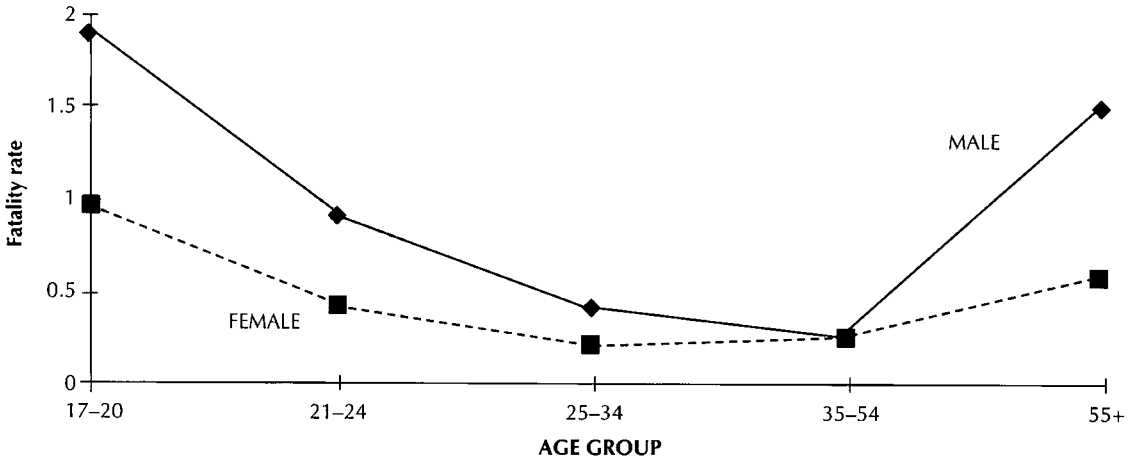
In order to examine the performance of men and women drivers, an important starting point is to consider accident involvement since this is a critical criterion of importance to society. The aim of the present chapter was first to consider the fatality risk of male and female drivers and assess whether, overall, it differed according to sex. The second aim was to **consider a range of different types of accident and determine whether there is any evidence for a differential pattern of accident involvement for men and women.** In other words, is it the case that men have a higher proportion of one type of accident and women have a higher proportion of a different type of accident or, alternatively, that men and women have the same pattern of accident involvement and any differences are quantitative? For both of these aims an important consideration was age, since it is known that this is an important factor in accident risk: any differences between men and women may be age related. The final aim of this chapter was to consider whether the pattern of accident involvement is stable across time. In other words, we have seen in Chapter 1 that many more women are obtaining driving licences. Over the last 20 years there have been many changes in the driving habits of women and these differences are embedded within significant changes in the social, psychological and work patterns within which they operate. The question then is whether the pattern of their accident involvement has changed during the same time period. The data presented in this chapter are derived from reports sent to the Department of the Environment, Transport and the Regions from Police Forces using the STATS 19 accident report form.

2.2 Fatality risk

There are various methods of examining the fatality risk of men and women. Evans (1991) has presented a number of these different analyses. The present investigation considers a relatively simple analysis of fatality risk per kilometre driven and per 100,000 licensed drivers. As can be seen from Figure 2.1, men have a higher fatality risk per kilometre driven than women.

Figure 2.1 Fatality rate/100 million km

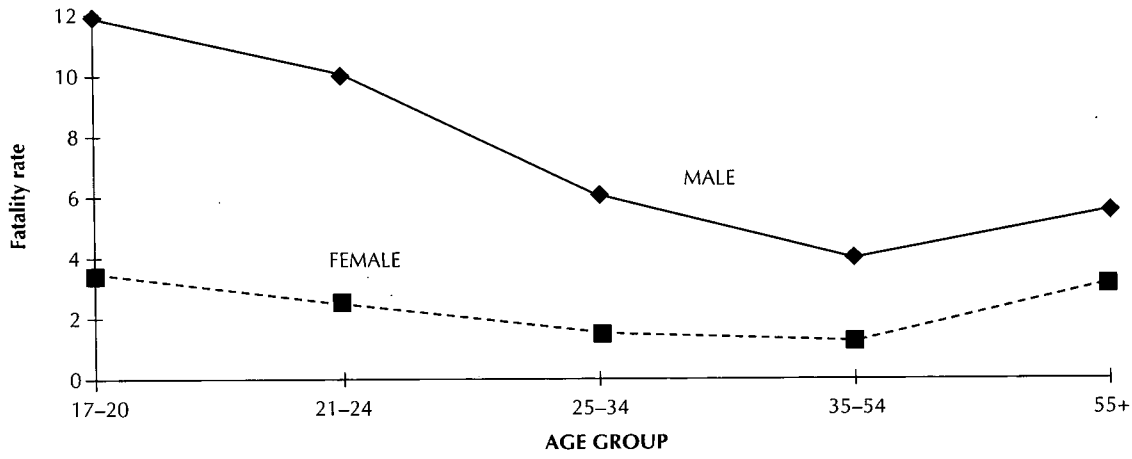
(Road Accidents Great Britain 1992)



Likewise, from Figure 2.2 it can be seen that men have a higher risk per licenced driver.

Figure 2.2
Fatality rate/100,000 licence holders

(Road Accidents Great Britain 1992)



While Maycock *et al* (1991) have pointed out that there is a technical problem in interpreting these data, namely that men and women have a different mileage and that the accident rate per mile is not constant, it should be noted that the different analyses of Evans (1991) all came to the same conclusion: that men have a higher fatality risk than women. In addition, in a sample which was matched for mileage, Maycock et al found that the accident involvement of men was greater than that of women. **Given the number of different analyses that have been carried out, it is difficult to avoid the conclusion that men have a higher fatality risk than women.**

While many surveys (McKenna, Stanier and Lewis, 1991; Sivak, Soler and Trankle, 1989) indicate that men have a higher estimate of their personal driving skills than women, the evidence would appear to indicate that, on the fairly fundamental criterion of being able to stay alive, the high opinion that men have of themselves is not well justified.

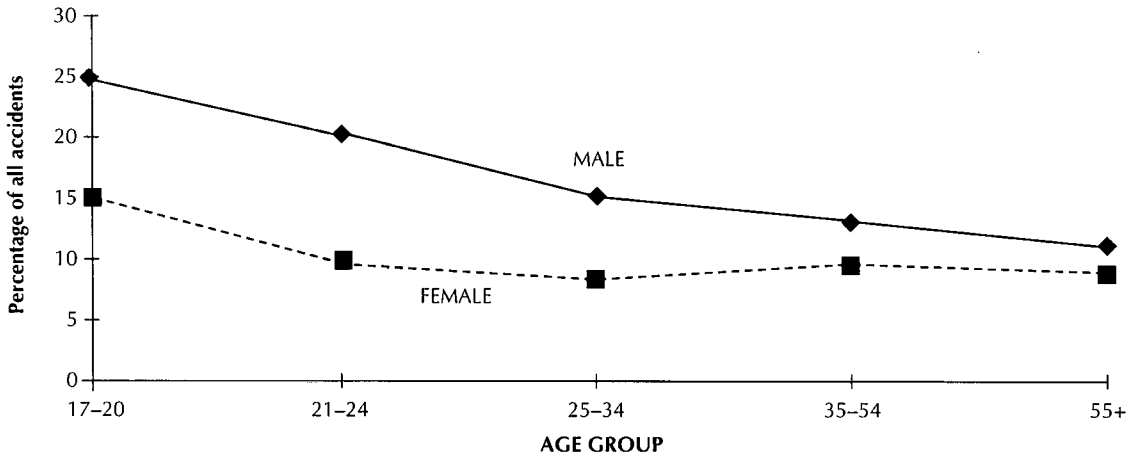
2.3 The pattern of accident involvement of men and women

Given that men have a higher fatality risk than women, a question that follows is whether men and women drivers are involved in the same types of accidents but men are involved in more, or alternatively, that the type of accident involvement for men and women is different. In an attempt to answer this question, we have combined the accident classification outlined in STATS 20 with the data in STATS 19. Given that the frequency of fatalities is relatively small in comparison to overall accident involvement, and that we wished to disaggregate the data by both age and gender, the present analyses were carried out on the complete dataset from STATS 19 and not just the fatalities. This involved examination of the distribution of accident trends and a comparison of trends for male and female drivers. **The accidents considered here are those involving bends, overtaking, driving in darkness and right and left turns.**

2.3.1 Accidents on bends

One reason for examining accidents on bends is that it is thought that this type of accident is often linked to a behavioural factor, namely speed choice. From the results presented in Figure 2.3 a number of features merit comment.

Figure 2.3 Involvement in bend accidents as a function of age and sex

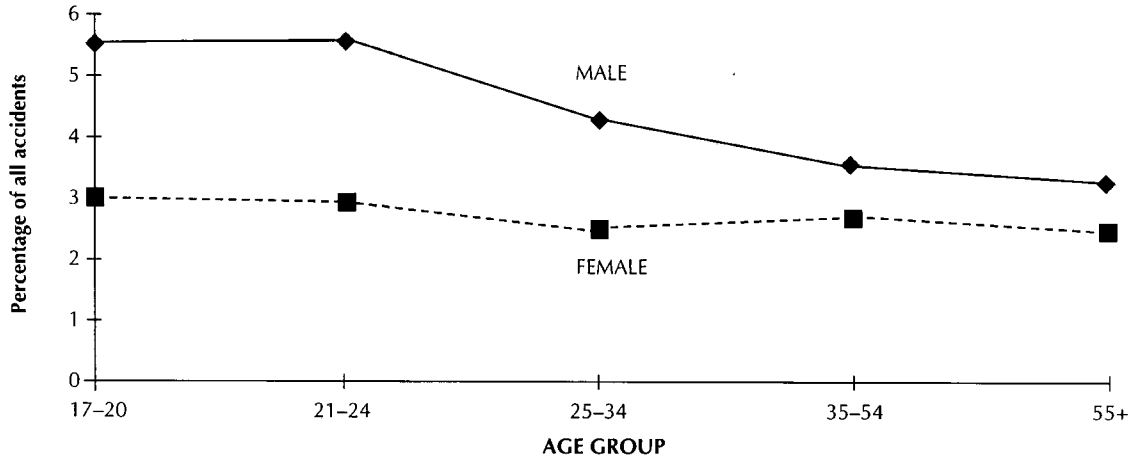


First it is clear that men have a higher proportion of their accidents on bends. Second, this difference between men and women diminishes as age increases. In other words, while this difference between men and women is substantial for the young group, it is small for the older group. It is also worth commenting on the change across age for men and women. For both men and women, the proportion of accidents on bends is highest for those who are youngest and least for those who are oldest. This decrease in the proportion of bend accidents from youngest to oldest is more dramatic among men.

2.3.2 Overtaking accidents

Given the change in speed required for most overtaking manoeuvres, and also that this increase often takes place on top of a considerable existing level of speed, this type of manoeuvre can be associated with accidents where the forces involved are substantial. This, of course, is particularly true when the accident involves an oncoming vehicle.

Figure 2.4 Overtaking accidents as a function of age and sex



It is clear from Figure 2.4 that males have a higher proportion of their accidents when overtaking is the key manoeuvre. It is also clear that the difference between men and women diminishes as age increases. As with bend accidents, while the sex difference is clearly present for the young group, it is relatively small for the oldest age group. While the proportion of overtaking accidents that women are involved in is relatively constant across age group, for men there appears to be a small reduction in the proportion of their overtaking accidents. It is perhaps worth noting that although the absolute magnitude (less than 6 percent of all accidents) and relative magnitudes (less than 3 percent change between the sexes) are small, the fact that overtaking accidents can involve collisions that involve considerable forces may mean that they are, nevertheless, worth considering.

2.3.3 Accidents during the hours of darkness

Perhaps the most striking feature of Figure 2.5 is the magnitude of young male involvement in accidents during the hours of darkness. Almost 50 percent of accidents involving young males occur during this period.

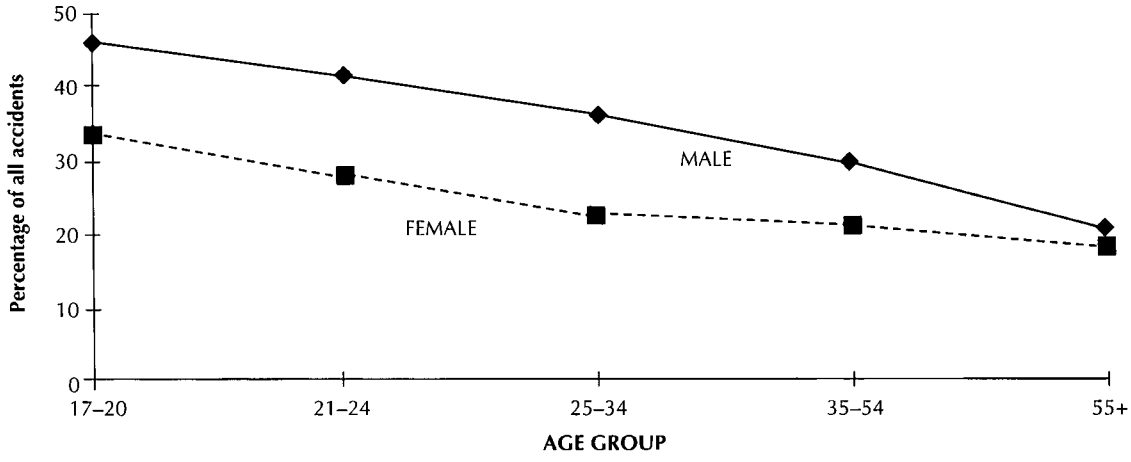


Figure 2.5 Accidents during the hours of darkness as a function of age and sex

There is a clear sex difference indicating that a far higher proportion of male accidents occur during darkness. There is also some evidence that the sex difference decreases across age group although this decrease is most apparent in the oldest age group. For both men and women across age group, there is a marked decrease in the proportion of accidents occurring during the hours of darkness.

2.3.4 Right turn accidents

Figure 2.6 indicates that women have a higher proportion of their accidents when the manoeuvre involved is a right turn. This sex difference is apparent across all the age groups though it may be smaller in the oldest age group.

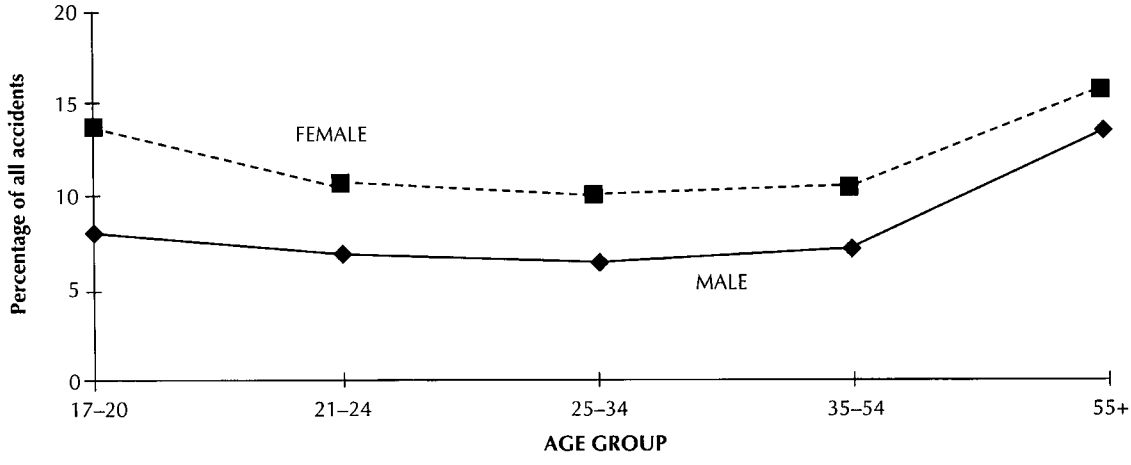


Figure 2.6 Right turn accidents as a function of age and sex

Men and women show a different trend of involvement in this type of accident, across age groups. For men, the proportion of right turn accidents is relatively constant prior to the increase in the older group. By contrast, for women, there is an initial decrease in the proportion of right turn accidents across age, prior to an increase for older drivers. The final point worthy of comment is that, for both men and women, there is a marked increase in the proportion of right turn accident involvement for the older groups.

2.3.5 Left turn accidents

To provide an additional evaluation of accident involvement at junctions, an analysis of left turn accidents was carried out. Figure 2.7 indicates the results.

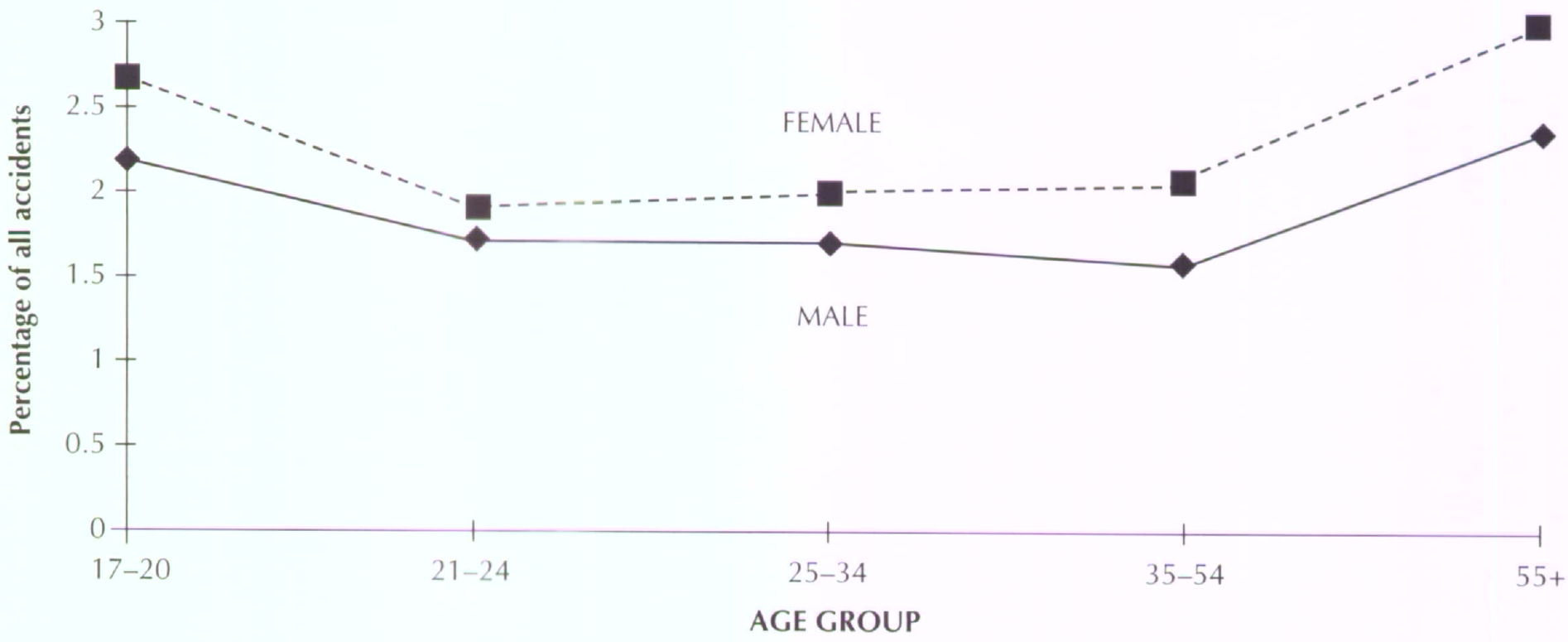


Figure 2.7
Left turn accidents as a function of age and sex

Although the absolute and relative magnitudes are small, the trends are similar to those for right turn accidents. Women have a higher proportion of their accidents when making left turns. There is a small decrease in the proportion of left turn accidents from age group 17–20 to 21–24 for both men and women. There is also a small increase in the proportion of left turn accidents for the older group which applies to both men and women.

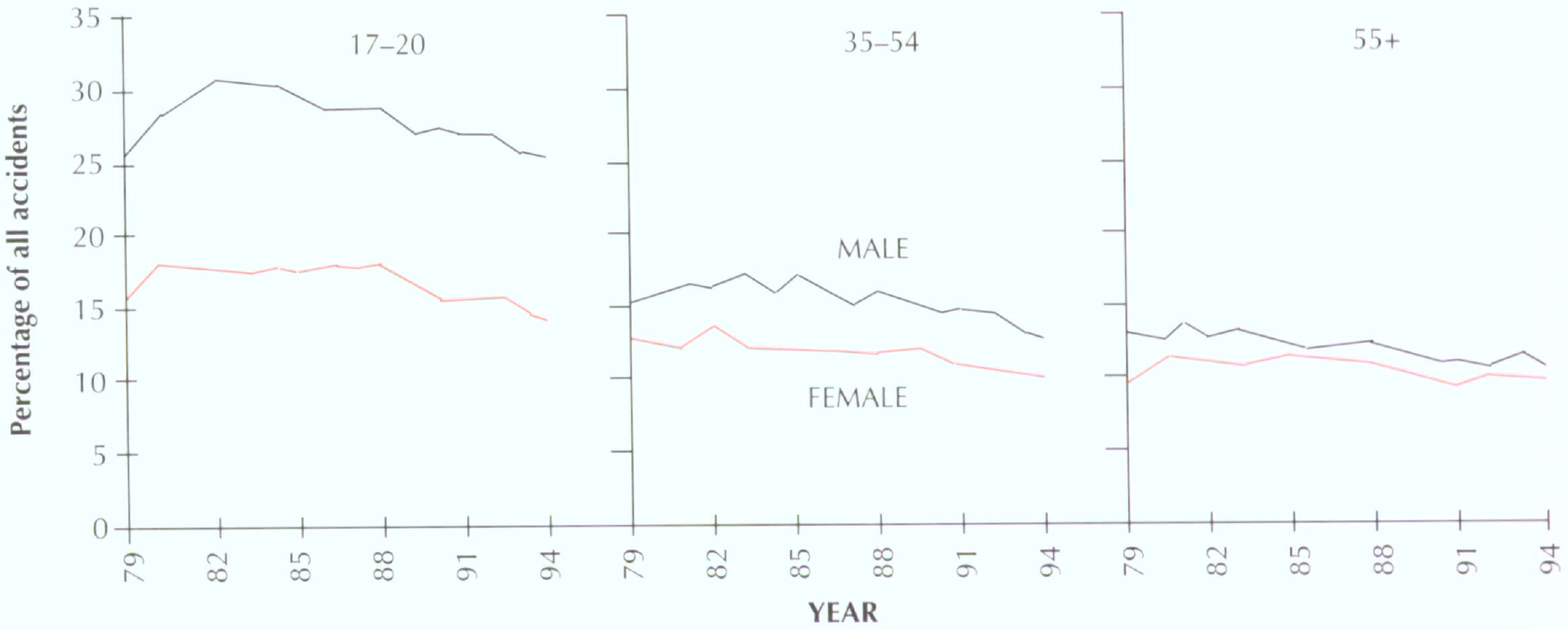
2.4 The pattern of accident involvement across time

We have seen that there are clear differences in the pattern of accident involvement for men and women. In this section the aim was to consider whether the sex differences observed are stable over time. Given that there has been such a dramatic change in the proportion of women who have obtained full driving licences, it is worth considering whether any sex and age differences that have been observed are stable over time. It is, of course, possible, given the large changes in the proportion of the population of women who now have driving licences, combined with the change in their mileage, that the pattern of accident involvement has changed. In order to address this issue, we plotted the trends across the years 1979–1995 – the period for which data are available. Since it is possible that any change in the pattern of accident involvement may be related to a particular age group, we present the data for three age bands: 17–20, 35–54, and ≥55. We examined the historical trend in the accident pattern for each of the accident types that have previously been considered.

2.4.1 Accidents on bends

One particular reason for considering the historical trends in accident involvement on bends concerns the potential significance of speed choice in this type of accident. While there are many anecdotal speculations that there is now more aggressive driving among women and that this is reflected by their faster speeds, there is relatively little evidence to support this point. If it is accepted that speed choice is an important factor in bend accidents, then more aggressive speed choice by women would exhibit itself by an increase in the proportion of bend accidents for female drivers and possibly a decrease in any sex difference over time.

Figure 2.8
Bend accidents: year on year trends



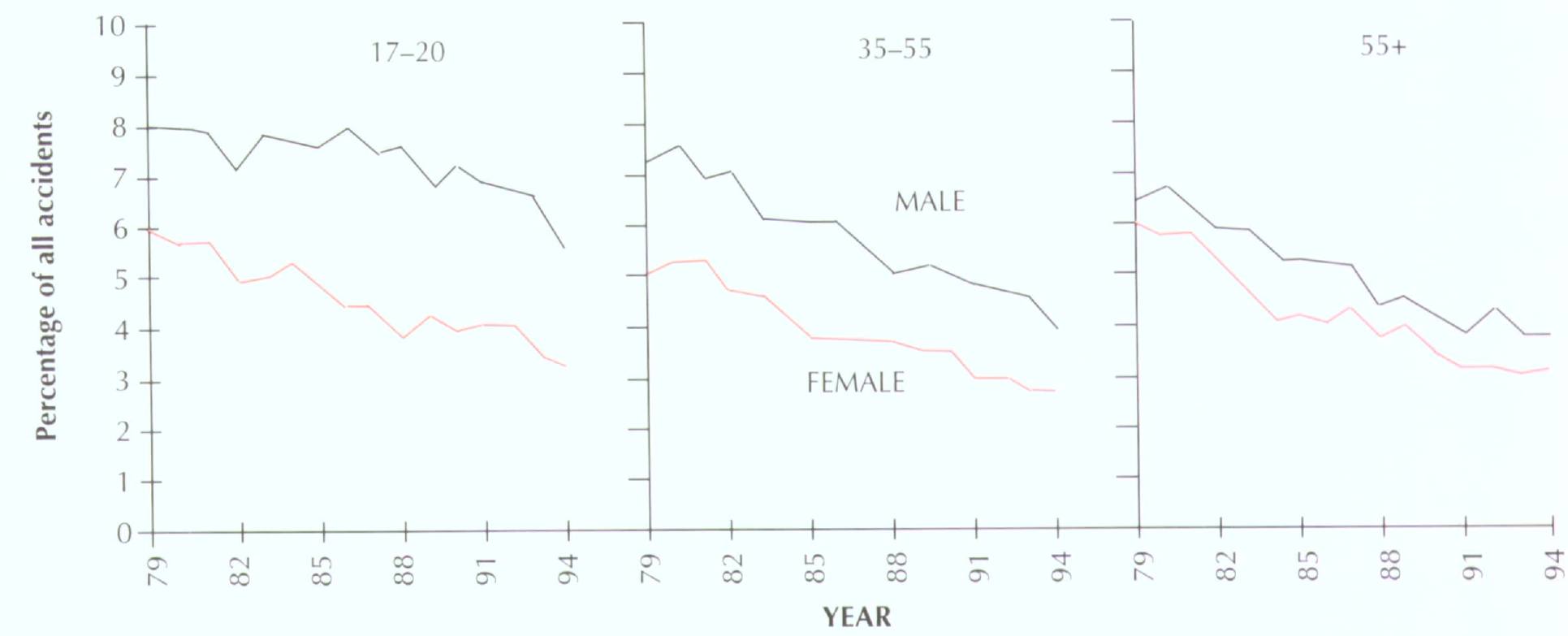
While there appear to be trends across years for a decreasing proportion of accidents on bends, this is true for both men and women, thus leaving the sex difference relatively constant. This is the case for each of the three age groups. There is certainly no evidence of an increase in the proportion of bend accidents for women, nor a decrease in the sex difference over the last 15 years. **Men have a higher proportion of their accidents on bends than women and this is true for all three age groups and for every year examined. The sex difference decreases across age group and this is true for every year examined.** The decrease in the sex difference across age group is largely due to a change in the proportion of bend accidents for men. In other words while the proportion of bend accidents does decrease for women across age group the decrease is more dramatic for men.

Overall, while there is a trend for a decrease in the proportion of bend accidents, the magnitude of the sex difference does not diminish across time.

2.4.2 Overtaking accidents

As noted earlier, since overtaking accidents often involve both significant changes in speed and very considerable forces, they merit attention. Figure 2.9 plots the trend in overtaking accidents across years.

Figure 2.9
Overtaking accidents: year on year trends



The first point worth noting is the historical trend in overtaking accidents. For each of the three age groups there is a clear decrease in the proportion of overtaking accidents over years. Since overtaking can be a particularly dangerous manoeuvre, it interesting to note that, not only is there no evidence of an increase in accidents involving this manoeuvre, there is unambiguous evidence of a decrease. Whether this decrease is due to factors such

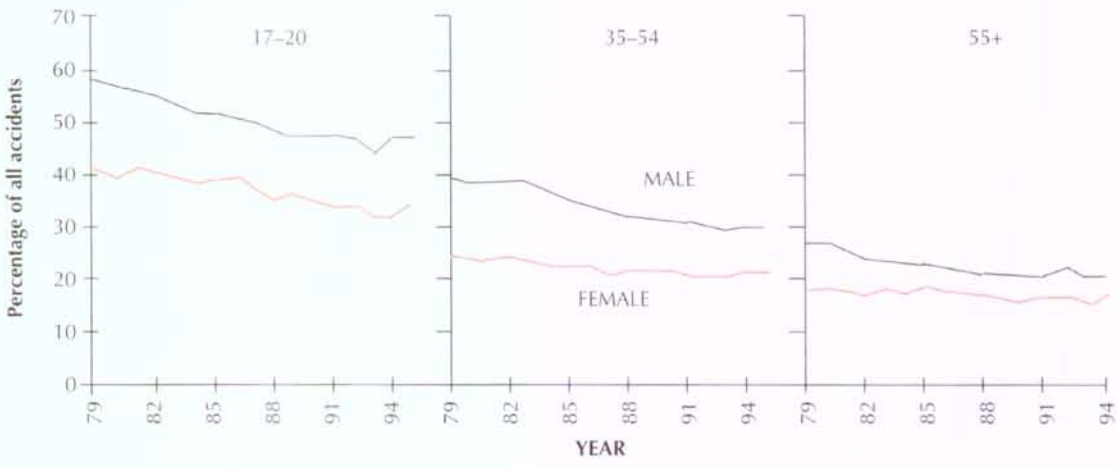
as a reduction in the opportunity to overtake due to traffic congestion or to engineering measures is difficult to determine. Interestingly, the decrease is relatively constant for men and women, hence **men still have a higher proportion of their accidents during overtaking; this is true for all three age groups and for every year examined. It is clear that the sex difference decreases across age group and that this pattern is replicated over the time period.** There is little evidence that the sex difference is decreasing across years. Across age group, there is a small decrease in the proportion of overtaking accidents – this is more evident for men than for women. For men, the proportion of overtaking accidents decreases across years from one age group to the next. For women the pattern is less consistent.

Overall, despite the decrease in the proportion of overtaking accidents over the years the sex difference remains remarkably stable.

2.4.3 Accidents during the hours of darkness

Figure 2.10 presents the historical trend for the proportion of accidents which occur during the hours of darkness. Across years there appears to be a decrease in the proportion of accidents which occur during darkness although this is more evident for men than women.

Figure 2.10 Accidents during the hours of darkness: year on year trends



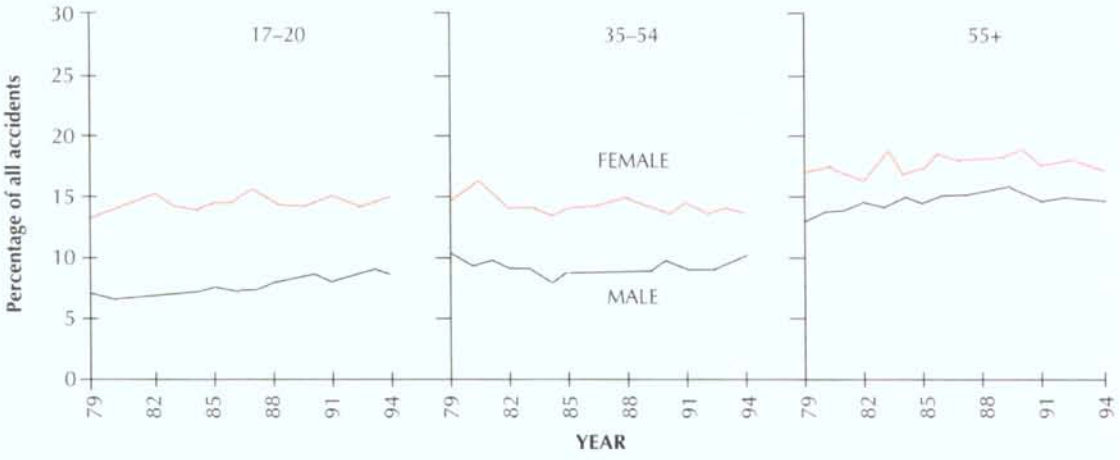
For every year examined men have a higher proportion of their accidents during the hours of darkness. If there is a decrease in the sex difference across years, it is less evident for the youngest group than for the two older groups. There is a marked decline in the proportion of darkness accidents across age group – this is true for both men and women and occurs for every year examined. The sex difference is smaller for the older age group than for the other two age groups.

Overall, the sex difference in the proportion of accidents in the dark remains robust across time though there may be a diminution of this difference in the older groups. For the younger (high accident) age group there is little evidence of a decrease in the sex difference across years.

2.4.4 Right turn accidents

The historical trend in right turn accidents is illustrated in Figure 2.11 and indicates a relatively stable picture. For both men and women, and for each of the three age groups, the proportion of right turn accidents changes little over the years.

Figure 2.11
Right turn accidents: year on year trends



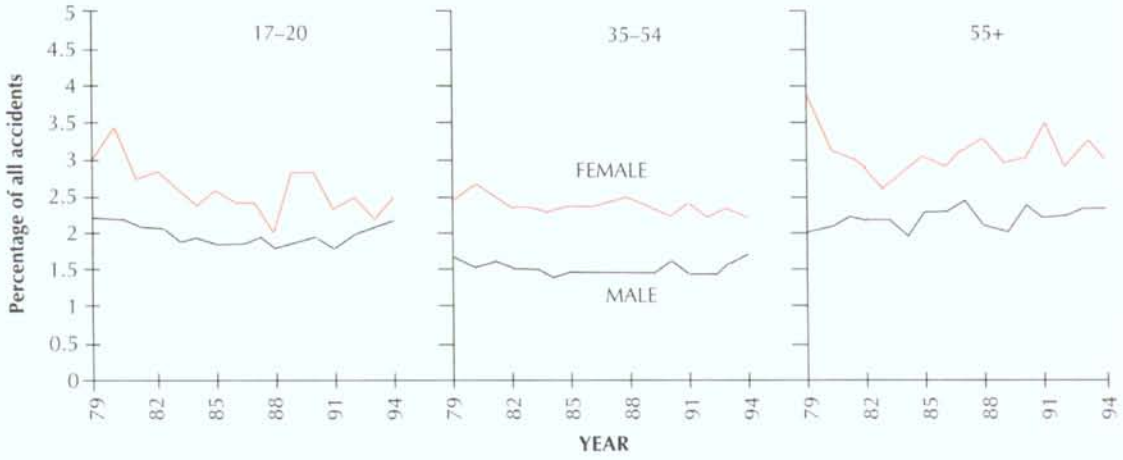
Women have a higher proportion of right turn accidents and this is true for every year examined. Across age group, the pattern of accident involvement is different for men and women. The increase in the proportion of right turn accidents for the older drivers is present for both sexes and is evident for every year examined.

Overall, the sex difference in the proportion of right turn accidents remains remarkably constant over the years.

2.4.5 Left turn accidents

Although the proportion of left turn accidents is relatively small for both men and women, it can be seen from Figure 2.12 that the sex difference is clear.

Figure 2.12
Left turn accidents: year on year trends



Women have a higher proportion of left turn accidents – this is true for all three age groups and for every year examined. Across age group the pattern is more clear cut for men than for women. There is an initial decrease in the proportion of left turn accidents for men, prior to the increase for the older group. For women, the increase for the older age group, when compared to the middle aged group, is the clear result.

Overall, there is no indication that the sex difference is changing over the years.

2.5 Summary

- **It is clear that the fatality risk for males is higher than that for women.** In addition, the pattern of accident involvement for men and women is different. **Males have a higher proportion of their accidents on bends, while overtaking and in the hours of darkness. By contrast women have a higher proportion of their accidents at junctions.**
- **Perhaps the most striking feature of the analyses of the pattern of accident involvement across years is the remarkable stability of the sex difference across years.** Despite the fact that there has been a massive shift in the population of women drivers there is little evidence that the sex difference in the pattern of accident involvement is changing over the years.
- **For four out of five of the accident types the sex difference was smaller for the older age group.** The only exception was left turn accidents for which there was little evidence of any decrease in the magnitude of the sex difference for the older age group.

Chapter 3 The empirical study of men and women drivers

3.1 Introduction

In Chapter 2 the sex difference in fatality risk was considered and the differential pattern of accident involvement was examined in some detail. It is clear that the pattern of accident involvement for men and women is different: men having a higher proportion of bend and overtaking accidents as well as accidents during the hours of darkness. Women, by contrast, have a higher proportion of their accidents at junctions. It is impressive that these sex differences have remained remarkably constant across a time period in which the proportion of women drivers increased massively. The fact that these sex differences do remain stable despite such large changes in driver characteristics suggests that it would be worthwhile examining the behaviour and attitudes of men and women drivers. The present chapter briefly outlines how we investigated potential differences between the sexes **for drivers up to 50 years of age.** The investigation focused on key driver behaviours that are known to be related to accident involvement. These are **speed choice, close following, violations, hazard perception and overtaking.**

3.1.1 Speed

Even if the same number and type of driving errors were committed at both low and high speeds, the importance of speed choice would remain because of the link between speed choice and accident severity (Joksch, 1993). There is now convincing evidence that driver speed is implicated in accident involvement. Using an observational study Wasielewski (1984) found a significant correlation between accidents and speed. Two other methodologies support this conclusion, one using an instrumented vehicle (Wilson and Greensmith 1983) and the other using self-report (French, West, Elander and Wilding, in press). In addition, the significant role of speed is indicated by the change in fatality rates which occurred when some rural Interstate speed limits in the US were increased from 55mph to 65mph. Baum, Lund and Wells (1989) found a 15% increase in fatalities, even though the average speed of drivers only went up by about 3mph.

3.1.2 Close following

Using an observational method Evans and Wasielewski (1983) have found that those individuals with more accidents adopt shorter headways than those with no accidents. Harvey, Jenkins and Sumner (1975) found that following too closely was the most frequent driving error observed – this was true whether it was assessed through an observational study or through in-vehicle direct assessment of the driver.

3.1.3 Violations

There is a long history to the establishment of a relationship between traffic violations and accident involvement (See Little (1966) for an examination of the early literature). By simply examining drivers' records it has been possible to show that there is a relationship between the traffic violation record and the accident record. Peck and Kuan (1983) present a more recent demonstration of this relationship and Parker, Reason, Manstead, and Stradling (1993) have recently found a relationship between self-reported traffic violations and accidents.

3.1.4 Hazard perception

Using visual simulation techniques it has been shown that those drivers who are relatively slow to detect hazards on the road are more involved in accidents (Pelz and Krupat 1974; Quimby, Maycock, Carter, Dixon and Wall 1986). More recently McKenna and Crick

(1994) have simplified the method and demonstrated that it is possible to train drivers on hazard perception.

3.1.5 Overtaking

Wilson and Greensmith (1983) have found that those who most frequently engaged in overtaking were more involved in accidents.

3.1.6 Supplementary measures

Given the importance of accidents at junctions, we included a measure of gap acceptance. In addition, we included a whole range of measures that assessed drug and alcohol use, attitudes to driving, and preparedness to drive for long periods without a break.

3.2 The driver sample

The drivers were recruited from a variety of sources. A total of 480 drivers were tested in the generation of the database used in the main project. A volunteer database collected during a previous project at the University of Reading was used initially and this, together with a snowball effect (where participants recruited their own colleagues and friends) provided access to the first one hundred or so participants. Many of the other participants were recruited via a Reading charity (Children's Aid Direct) which asked its sponsors to take part and donate any moneys received to the charity. This gave access to several national companies from whom many of the remaining participants were recruited. In-house company magazines were also used for recruitment purposes. Other sources included two RAF camps and several schools and sixth form colleges. A small proportion of the youngest age group was made up of university students. In order to reduce the number of extraneous variables an attempt was made to select, where possible, the same number of men and women from each of the sources. Payment was made, either to individuals or as a donation to the charity, as an inducement for drivers to take part. In the observational study (see section 3.5) a total of 1390 observations were made (each observation corresponding to a vehicle driven by a young driver). As the observations taken in this field study were passive, obviously no recruiting was necessary.

3.3 The primary dataset (main study)

The aim of the project was to compare driving behaviour between gender and across three age groups: 17–20, 21–29 and 30–50. Participants were assigned to one of a set of six subgroups, depending on their age and gender. In the primary dataset 80 drivers were recruited for each cell. Demographic and driver experience details are given below in Table 3.1. Two measures of driving experience were used: average mileage during the last three years and number of years driving since passing the test.

Table 3.1 Demographic and mileage information for the primary dataset (standard deviation in brackets)

(Appendix: demographics questionnaire (dem1, dem2))

	MALES			FEMALES		
Age group	**17–20**	**21–29**	**30–50**	**17–20**	**21–29**	**30–50**
N	80	80	80	80	80	80
Mean age	18.1 (0.95)	25.4 (2.37)	38.2 (5.74)	18.3 (0.95)	25.8 (2.49)	37.5 (6.01)
Mean mileage	5,971	11,996	15,251	3,964	10,942	9,141
Years driving	1.2 (0.88)	7.1 (2.97)	19.6 (5.90)	1.1 (0.75)	6.9 (3.22)	16.8 (7.15)

(When the dataset was statistically analysed, it was found that male drivers were doing significantly higher mileage than females. **While this indicates that the dataset reflects the current sex difference in mileage, it raises an important issue concerning a potential linkage between mileage and driver behaviour. Any sex differences derived from the above dataset could be linked to mileage differences. To address this issue a second dataset was derived from the first.**

3.4 The mileage-matched dataset (main study)

The highest mileage men and the lowest mileage women were excluded from the primary dataset to achieve a sample that had no gender difference with regards to mileage. The demographic and mileage details for this matched sample are shown below, in Table 3.2.

Table 3.2 Demographic and mileage information for the matched dataset (standard deviation in brackets)

(Appendix: demographics questionnaire (dem1, dem2))

	MALES			FEMALES		
Age group	**17–20**	**21–29**	**30–50**	**17–20**	**21–29**	**30–50**
N	71	72	61	72	75	62
Mean age	18.1 (0.96)	25.4 (2.39)	38.5 (5.96)	18.4 (0.95)	26.0 (2.49)	38.1 (6.52)
Mean mileage	3,977	11,010	10,901	3,964	11,085	10,885
Years driving	1.1 (0.87)	7.2 (2.83)	19.7 (6.27)	1.1 (0.78)	7.1 (3.07)	17.6 (7.43)

In subsequent chapters the statistical analyses were carried out on this second mileage-matched dataset.

3.5 Main study methodology

The experimental methodology employed in the running of this project is described here. All drivers were expected to complete two components of the study: a set of five video measures of driving behaviour and a questionnaire. The completion of all sections of the study took drivers, on average, about 45 minutes. The video measures were developed to assess individuals' driving behaviour with regard to the following areas: **speed choice, close following, gap acceptance, overtaking and hazard perception.** Each video measure consisted of digitised video footage, showing a "driver's eye" view of the road ahead, hence putting the participant in the driver's position.

3.5.1 Speed choice (see Appendix: speed choice section)

For the speed choice measure, each driver was asked to watch a series of video clips of a car being driven through a variety of traffic/road situations. For each clip, participants were asked to decide whether s/he would be driving more quickly/slowly or at about the same speed in that particular situation. S/he was asked to record how much faster or slower s/he would travel in each situation on a response sheet.

3.5.2 Close following

In order to measure close following behaviour, drivers were shown a video clip in which the "camera car" was driving along in lane 1 of a motorway, slowly approaching the rear of a "target vehicle" travelling in the same lane. Each driver was provided with a response button and asked to push it once when s/he was at the distance from the car in front that s/he would normally drive. The scenario would then continue, with drivers asked to push

the button once more when they began to feel uncomfortably close to the vehicle in front. During the whole clip, the "camera car" approached the one in front at a regular speed. Each time the button was pressed, a computer recorded the latency.

3.5.3 Gap acceptance (Appendix: gap acceptance section)

The gap acceptance behaviour of each individual was measured using a series of scenarios in which the "camera car" was at a junction, waiting to turn left onto a main road and join the traffic flow that was moving from right to left. Drivers were shown 24 scenarios in total that depicted gaps of varying size in the on-coming traffic. Each was asked to press the response button for any gap that s/he considered large enough to take. The experimenter recorded each response as either "yes" – driver would accept the gap or "no" – driver was not prepared to accept the gap.

3.5.4 Overtaking

In order to observe overtaking behaviour, drivers were shown a series of twelve scenarios in which the "camera car" was behind a relatively slow moving car. They were asked to imagine that they had been behind it for about half a mile and that it was driving at about 20 mph. For each situation shown, drivers were asked to press the response button as soon as they considered that the situation had become too dangerous to allow overtaking. Once again, latencies were recorded by the computer.

3.5.5 Hazard perception

Participants were shown a series of ten scenarios depicting various traffic situations. Each clip was again shown from the "driver's eye" point of view. The participants were asked to press the response button whenever they saw a situation which they felt was potentially hazardous. Each of the clips presented participants with a hazard, for example, a pedestrian stepping out onto the road. Latencies between the appearance of the hazard and driver's reaction to it were recorded on a computer.

3.5.6 Self-report questionnaire

A self-completion questionnaire was used to acquire information about drivers' perceptions of their own driving behaviours, their attitudes towards and concerning various aspects of driving and a selection of measures relating to their experiences as a driver. Participants were assured of the anonymity of their responses and instructed to raise any queries with the experimenter. A copy of the questionnaire can be found in the appendix.

3.6 Observational study

In addition to the main study outlined above, an observational study was undertaken to examine younger driver behaviours. **(The drivers and passengers involved were rated to be 25 years of age or less.)** The main aim of this study was to observe young drivers' on-the-road behaviour and to determine if there were any significant relationships with the presence or absence of peer passengers. **Three aspects of driving were measured in the observational study: speed choice, close following and gap acceptance.** The methodologies developed to measure these factors are described briefly below. The methodology of the observational study is discussed in greater detail in Chapter 5 along with the results.

3.6.1 Speed choice (observational study)

A hand-held radar speed gun was used to measure speed choice. The observation site was chosen to facilitate the experimenters' view of the road, without being seen themselves. Accurate measurements of the speed of passing vehicles were recorded, along with details relating to the occupants of the corresponding cars. A total of 456 observations were made.

3.6.2 Close following (observational study)

Measures of close following were obtained by erecting a video camera next to a main road leading into a town centre. The camera was sited perpendicular to the flow of traffic. Details of car occupancy were dictated onto the videotape using a microphone. The tapes were then viewed in the laboratory at a frame-by-frame speed, allowing time separation between the vehicles to be accurately calculated. A total of 602 observations were made.

3.6.3 Gap acceptance (observational study)

A video technique was also employed in the field observation of gap acceptance behaviour. A camera was set up at a junction and young drivers were filmed using the junction to join the flow of traffic on the main road. Again details of car occupants were recorded onto the videotape using a microphone. In the laboratory these films were again viewed at a frame-by-frame speed, allowing the size of the gap they had pulled into to be measured accurately. A total of 332 observations were made.

3.7 Summary

- 480 drivers were recruited for the main study. From the original dataset a mileage-matched dataset was then constructed.
- Digitised video techniques were used to assess drivers' behaviour with regards to speed choice, close following, gap acceptance, overtaking and hazard perception.
- Questionnaire methodology was used to gain insight into drivers' attitudes to driving and driver experiences.
- The observational study examined young drivers with particular attention to driving behaviour associated with the presence or absence of peer passengers.

Chapter 4 Results of the empirical investigation

4.1 Introduction

As noted in the previous chapter, the main project of this report used a range of different methodologies, including digitised video technology, a questionnaire and direct field observation of driving behaviours. (Self-report sheets can be found in the appendix.) **In the first part of Chapter 4 we explore those driver behaviours which might be directly implicated in accident involvement. These behaviours include speed choice, close following, gap acceptance, overtaking, hazard perception and violations. In the latter half of the chapter we look at those factors that might be more indirectly implicated in accident involvement. These factors include alcohol, drugs and fatigue. The chapter then closes by considering the experiences which men and women derive from driving.**

4.2 Speed

The decision to investigate driver speed choice was motivated by a number of concerns, particularly the relationship between driver speed choice and accident involvement. Speed has been found to be directly related to the severity of motor accidents (Joksch, 1993), but **there is also compelling evidence that suggests that speed choice is also implicated in the likelihood of *becoming* involved in an accident.** From a conceptual standpoint this seems likely, as at higher speeds, less time is available for the driver to react to unexpected traffic conditions or to correct any driver errors. As a result, it would be expected that more accidents would occur at higher speeds compared to lower, given the same driving situation. Rock (1995) reports an additional 300 road accidents per month in Illinois following a 10mph increase in interstate speed limits.

Given this relationship between speed choice and accident involvement, it was felt that inclusion of this measure within the test battery was of great importance. Speed choice was assessed by digitised video, self-report and field observation.

4.2.1 Video measure of speed choice

(Appendix : speed choice section)

Drivers were shown a series of video driving sequences with a "driver's eye" view of the road after which they were asked to record how much faster or slower they would have driven the same stretch of road. The average responses (in mph) are shown in Figure 4.1.

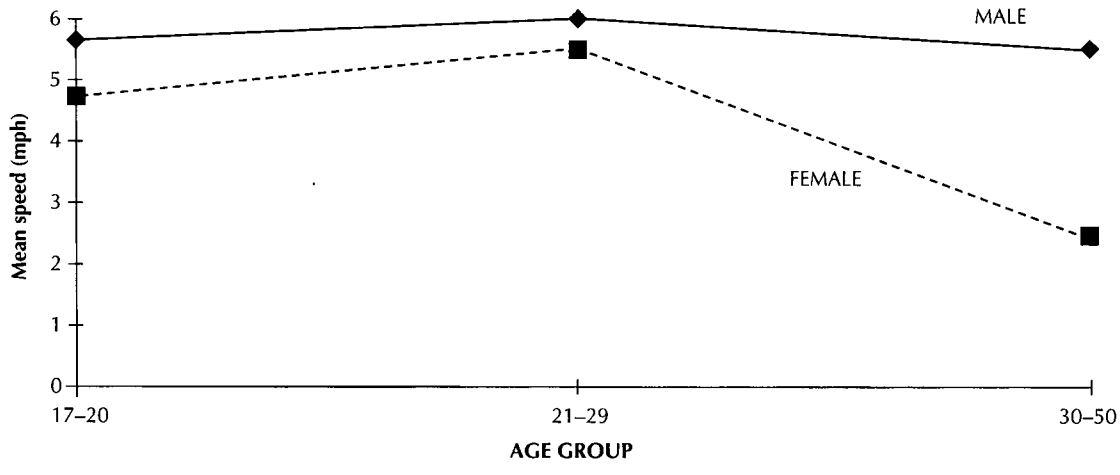


Figure 4.1
Mean video speed by age group and sex

Analysis of variance showed a significant main effect of sex on speed choice, with men choosing faster speeds than women. Age did not significantly moderate speed choice in male drivers, though 30–50 year old female drivers reported significantly lower speeds than the 20–29 year old females.

4.2.2 Self-report measures of speed choice

As well as taking the video measure of speed, the questionnaire employed in the study contained a number of questions on speed choice. Three questions designed by West were concerned with the frequency of fast driving (Appendix 2: West *et al*'s Questionnaire of Speeding, 1993). In addition, the speed limit violation question was concerned with the frequency with which drivers disregarded the speed limits when driving either late at night or very early in the morning (Appendix 4: Manchester Driver Behaviour Questionnaire (e)).

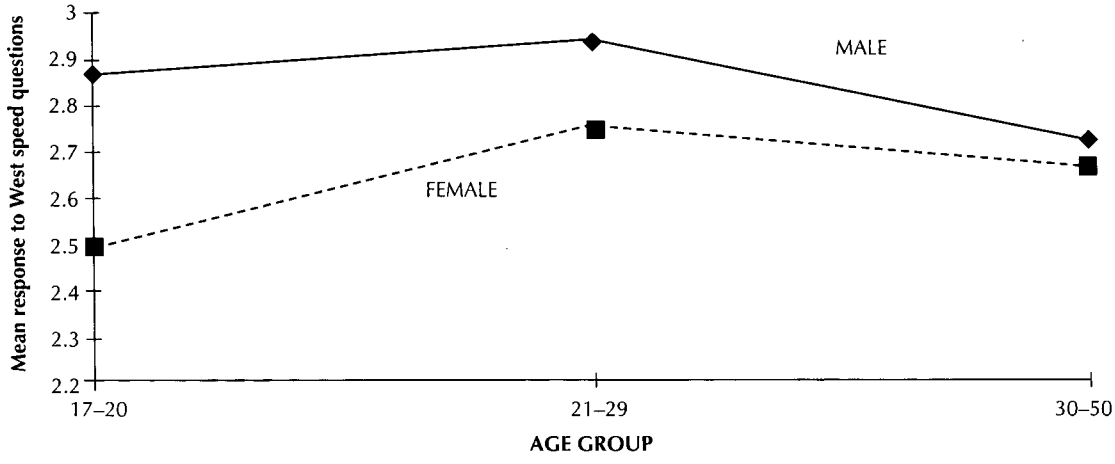
The pattern of responses to the West questions and the Manchester speed violation question were similar to the video speed measure (see Table 4.1).

Table 4.1
Self-report speed questions by age and sex
(Appendix: sections 2 and 4)

	17–20		21–29		30–50	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
West questions (0 = never drive fast, 5 = always drive fast)	2.87	2.50	2.94	2.75	2.70	2.65
Speed limit violation (0 = never, 5 = all the time)	2.52	1.88	2.36	2.15	1.85	1.73

Statistical analysis of the data indicated that, for both measures, there was a significant sex difference, with men scoring significantly higher than women, ie men were generally more inclined to speeding. There were no age group differences for the West questions, but the two youngest groups of male drivers were significantly more likely to commit the speeding violation than the oldest males. (See Figure 4.2 for an illustration of the pattern of results for the West questions.) These results (concerning the West questions specifically) are different from those obtained by West, Elander and French (1993): they found both significant age and sex differences.

Figure 4.2
Mean response to West questions by age group and sex
(0 = never drive fast, 5 = always drive fast)



Video speed choice correlated significantly with both the West questions (r= .44) and the Manchester speed violation question (r=.26). The correlation between the West questions and the Manchester speed violation question was .51.

4.2.3 Observational data

Using a radar speed gun an observational study was made of the speed choices of young drivers (estimated to be 25 years of age or less) driving alone. The site chosen to conduct the study was a 30 mph road which had sufficient foliage to allow the experimenters to have a clear view of the road whilst remaining relatively invisible to passing cars. All observations were done on dry, clear days; vehicles that were "in traffic" (those whose speed was dictated by the speed of others on the road) were ignored. The mean speeds recorded for young drivers are shown below in Table 4.2.

Table 4.2 Observed speed for young men and women

	Male	Female
No. of observations	124	79
Mean speed (mph)	32.4	28.5

Statistical analysis of the observational data showed that young male drivers were driving significantly faster than young female drivers, adding weight to the results of the analyses described above.

4.2.4 Potential factors involved in speed choice

A number of factors could be implicated in the sex difference in speed choice. The measures that will be considered in this section are **sensation seeking, the thrill derived from driving and worry about accident involvement.**

Sensation seeking refers to the need for novel and exciting experiences and was assessed using a modified version of Zuckerman's sensation seeking scale (Kraft and Rise, 1994). Thrill is a factor derived from the Driver Experiences questionnaire (Appendix 5: Driver Experiences Measure) – this was designed to assess the experiences people derive from driving. Accident worry is a single item from the Driver Experiences Questionnaire.

Table 4.3 Potential factors involved in speed choice by age and sex

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Sensation seeking (0 = not sensation seeking, 1 = sensation seeking)	0.63	0.57	0.65	0.50	0.52	0.45
Thrill (0 = does not drive for thrill, 8 = does drive for thrill)	4.2	3.6	3.1	2.9	2.8	2.6
Accident worry (0 = does not worry, 8 = does worry)	4.5	5.1	4.1	4.8	3.8	4.8

Main effects of both age and sex were found in the analysis of the sensation seeking data. Men scored consistently higher than women in all age groups (See Figure 4.3). With regard to age, 30–50 year old males scored significantly lower than younger males on this scale. The youngest female drivers scored significantly higher than those who were older.

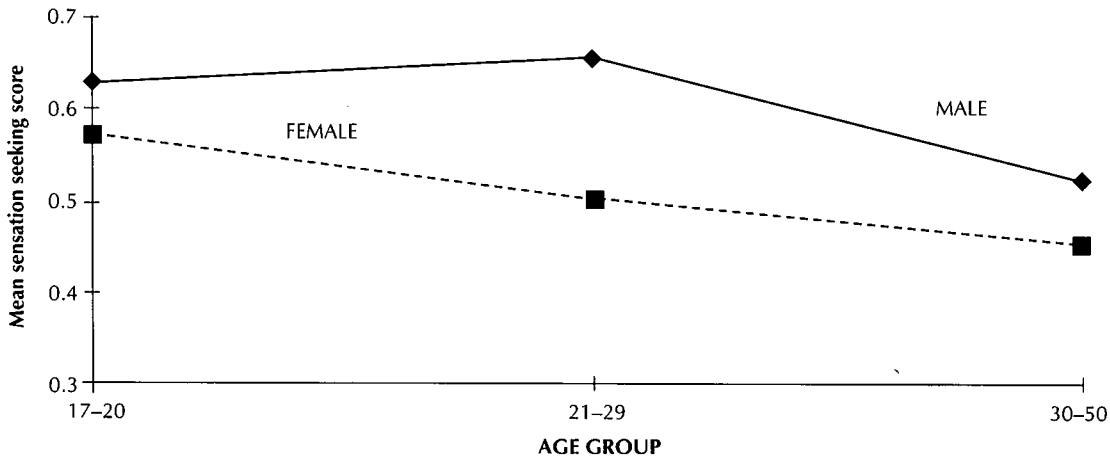


Figure 4.3 Mean sensation seeking score by age group and sex
(0 = not sensation seeking, 1 = sensation seeking)

One reason why men and women may differ in speed choice is the pleasure derived from the activity. The results from the Thrill factor indicate that men experience more excitement from driving than their female counterparts. There is also an age effect such that older drivers are less concerned with thrills while driving.

For accident worry there is an overall sex difference indicating that women are more concerned about accident involvement than men. Interestingly there is also an age-related trend indicating a tendency for accident worry to decrease with age.

4.3 Close following

Harvey, Jenkins and Sumner (1975) found close following to be the most frequent driver error, making it an important driving behaviour from the point of view of the current study. Following behaviour was assessed by digitised video, self-report and field observation.

4.3.1 Video measure of close following

The video measure used digitised footage of a car following situation on a motorway in which the camera car slowly approached the vehicle in front. Drivers responded by pressing a button at two points: when the camera car reached a following distance that they would normally travel at and again when they began to feel uncomfortably close to the target car. The computer recorded the time from the start of the scene so that longer times indicated closer following.

Table 4.4 Mean response times (seconds) for normal following distance and uncomfortable distance by age and sex

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Normal distance (s)	14.1	14.0	11.6	12.4	13.2	12.0
Uncomfortable distance (s)	21.6	21.3	19.1	19.7	19.7	18.9

Statistical analysis of the data relating to normal following distance revealed a main effect of age and no effect of sex. Females became progressively safer with age, responding earlier in the video clip and hence travelling less close to the target car. The pattern of data was different for males: 21–29 year old males were adopting much safer driving practices than younger drivers or older drivers.

For the uncomfortable distance there was once again no sex difference. However, the pattern of results was slightly different. Again, a significant main effect of age was observed, with females becoming safer with age. Young male drivers were closer to the vehicle in front than their older counterparts before reporting that they felt uncomfortably close.

4.3.2 Self-report

The questionnaire section relating to violations asked participants to rate how often they "drive especially close to the car in front as a signal to its driver to go faster or get out of the way" (Appendix 4: Manchester Driver Behaviour Questionnaire (a)). Higher scores reflected an increased frequency of engaging in this behaviour (see Table 4.5). **There was a significant effect of age with the youngest male drivers engaging in this behaviour significantly more frequently than those who were older. No age differences existed for female drivers.** There was also an interaction between sex and age such that, while 17–20 year old males engaged in deliberate close following behaviour more than 17–20 year old females, no other sex differences were significant.

Table 4.5 Deliberate close following by age and sex

(Appendix 4: Manchester Driver Behaviour Questionnaire (a).)

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Close following (0 = never, 5 = all the time)	1.62	1.04	1.03	1.31	0.97	0.89

4.3.3 Observational data

A field study of car following behaviour was carried out for young drivers. The time between consecutive vehicles was recorded and is presented in Table 4.6.

Table 4.6 Following behaviour for young men and women

	Male	Female
No. of observations	111	88
Mean headway (s)	1.50	1.78

Statistical analyses revealed that young males were driving significantly closer to the preceding vehicles than young females.

4.4 Gap acceptance

The fact that such a high percentage of accidents occur at junctions (61 percent, STATS 19) and that there is a sex difference (see Chapter 2) prompted the inclusion of this measure. Gap acceptance was assessed by digitised video and field observation.

4.4.1 Video measure of gap acceptance

The video measure employed to get an insight into drivers' gap acceptance behaviour again presented them with a driver's eye view. This time the camera car was at a T-junction waiting to turn left to join a flow of oncoming traffic. 24 gaps of varying size were shown to the drivers who were required to press the response button if they felt that the presented gap in the flow of the oncoming traffic was large enough to pull into. To target the higher risk gaps, a separate score was also calculated on the basis of subject responses to the seven smallest, and hence most dangerous gaps. Both the gap acceptance and the "risky gap" score are presented below in Table 4.7.

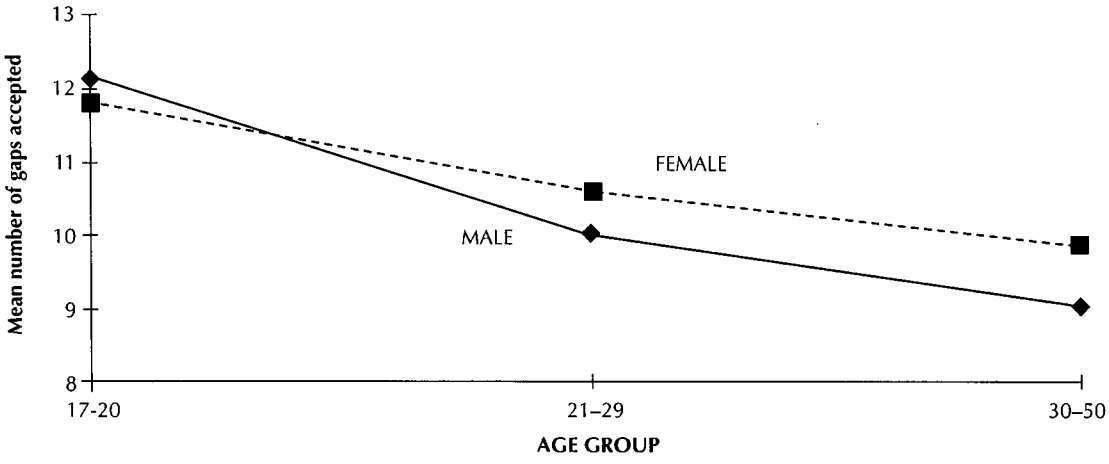
Table 4.7
Number of gaps accepted by age and sex
(Appendix: gap acceptance section)

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
No. gaps accepted	12.18	11.93	10.01	10.61	8.98	9.81
No. risky gaps accepted	0.09	0.09	0.03	0.05	0.04	0.07

In Table 4.7, the second measure represents the number of risky gaps that drivers would pull into (out of a total of seven). The numbers are small because these gaps were accepted by only a few drivers in each group.

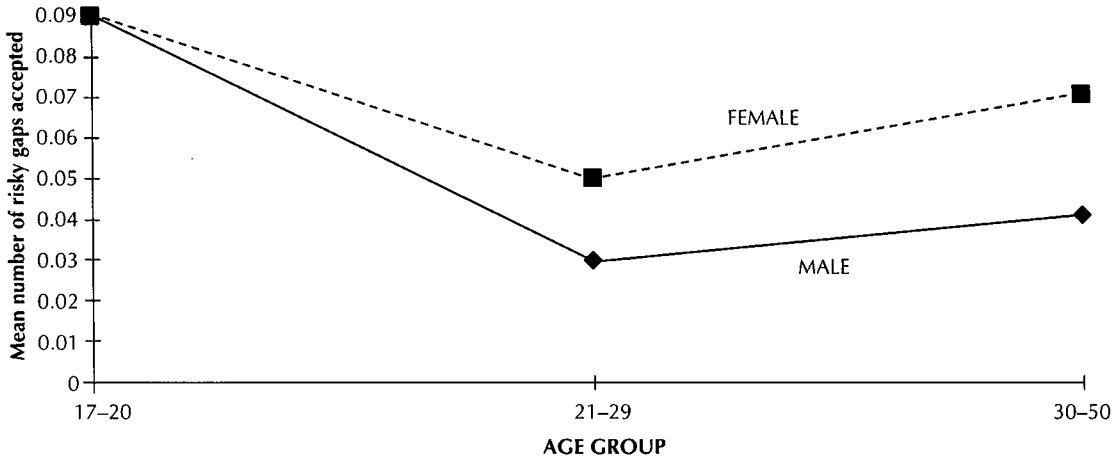
Analysis of the gap acceptance data revealed no sex differences although there was a significant main effect of age, such that older drivers took fewer gaps than younger drivers. This was significant for both male and female drivers.

Figure 4.4
Mean gap acceptance by age group and sex



As noted, a measure of the number of high risk gaps that each person accepted was taken to try to focus on dangerous driving situations. The findings for males was the same as for the normal gap acceptance measure: 17–20 year olds were taking more risk than older male drivers. There were no significant age differences across the three age groups for females and no significant sex differences for any of the age groups.

Figure 4.5
High risk gap acceptance by age group and sex



4.4.2 Observational data

To obtain a field measure of gap acceptance a video camera was set-up in foliage near a junction onto a main road. Young drivers were recorded pulling out of the junction and joining the main road, integrating themselves into the traffic flow. This provided a real-world equivalent of the gap acceptance video measure described earlier. The video was then viewed in the laboratory at a frame-by-frame speed and the gap calculated.

Table 4.8
Size of gap accepted for young men and women

	Male	Female
No. of observations	86	71
Mean gap size (s)	6.87	6.93

Statistical analysis of the observational data found no difference in the size of gap accepted by young male and female drivers. This finding mirrors that of the video measure of gap acceptance for the young drivers.

4.5 Overtaking

The potential dangers involved in overtaking and the presence of a sex difference in the accident statistic (see Chapter 2) raised the profile of overtaking. With this in mind, the overtaking video test was included in the test battery. In addition, we analysed a self-report measure of overtaking.

4.5.1 Video measure of overtaking

The drivers in this study were shown a series of scenarios from the driver's eye viewpoint. In each clip, the driver's "car" was following a relatively slow moving car (travelling at approximately 20 mph) on a single carriageway road, with the potential for overtaking. Drivers were asked to imagine that they had been following the car for about half a mile. A distant oncoming vehicle then approached. Using the response button, drivers were asked to indicate the point at which it became too dangerous to overtake, assuming that they were driving their usual vehicle. They were instructed to press the button immediately if they felt that they would not overtake at all in the presented situation. Clearly, the longer the driver delayed pressing the button, the more dangerous the manoeuvre became. Their mean response times were computed and are shown in Table 4.9.

Table 4.9
Mean overtaking scores by age and sex

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Mean overtaking (s)	6.3	6.6	4.7	4.8	4.4	5.0

Analysis of variance of the overtaking times revealed a main effect of age group and marginally significant effect of sex. Overtaking times dropped, ie became significantly less risky, with increasing age. In further analysis of the effect of sex, a significant difference was only found for the third age group (30–50 years) with women having higher scores, and hence taking more risk, than men. A note of caution is worth considering with reference to our overtaking measure. It is the measure which is least compatible with normal driving. In other words it is not usual for one to wait until the last possible moment before deciding to overtake. This measure required the most instruction before drivers were clear about what was required. There is, therefore, the chance that some drivers did not understand what was expected in the task. One possibility is that drivers misperceived the instructions and thought that they *had* to overtake. This would then leave open the prospect that men and women do not differ to a very great extent about when they chose to overtake but that men are more enthusiastic about overtaking.

4.5.2 Self-report

Although not designed specifically for this purpose, there was an item in the driver experiences questionnaire that asked drivers how much they enjoyed overtaking. Mean responses to this statement can be seen in Table 4.10.

Table 4.10
Ratings of enjoyment of overtaking by age and sex
(Appendix 5: driver experience measure)

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Enjoy overtaking (0 = do not enjoy, 8 = do enjoy)	4.93	3.68	4.79	3.59	4.38	3.52

Analysis of this response revealed a significant main effect of gender, such that males of all age groups enjoyed overtaking more than females.

4.6 Hazard perception

Simulation techniques have shown that drivers who are slow to identify potential road hazards are more likely to be involved in road accidents (Peltz and Krupat, 1974; Quimby, Maycock, Carter, Dixon and Wall, 1986).

4.6.1 Video measure of hazard perception

The digitised video test of hazard perception was based on the principles outlined in McKenna and Crick (1994). Drivers were shown a series of traffic video sequences and instructed to press the response button whenever they saw something that might turn into a potentially dangerous situation. Mean hazard response times were calculated and presented in Table 4.11.

Table 4.11
Mean hazard perception scores by age and sex

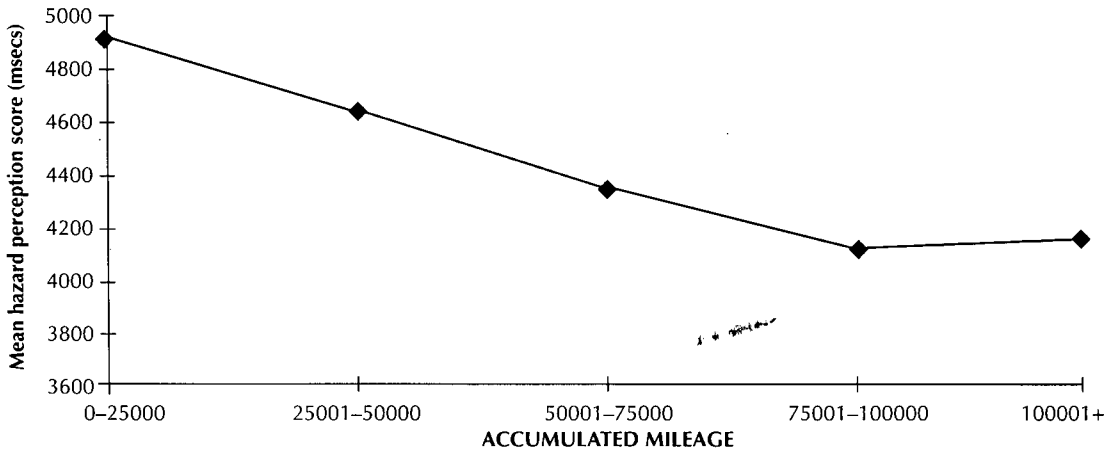
	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Hazard perception score (s)	4.9	4.9	4.3	4.8	4.1	4.1

Analysis of the hazard perception scores revealed that, while there was no difference between men and women, there was a main effect of age, such that hazard perception reaction time decreased as age increased.

4.6.2 Potential factor underlying age differences in hazard perception

It is likely that the age difference in hazard perception is more probably linked to training and experience than age. It was possible to explore the experience hypothesis by plotting hazard perception against an estimate of the total mileage of the driver (See Figure 4.6).

Figure 4.6
Hazard perception by total mileage



Results of the empirical investigation

Figure 4.6 indicates that there is a relatively linear decrease in hazard perception latencies with total mileage up to about 100,000 miles.

4.7 Violations

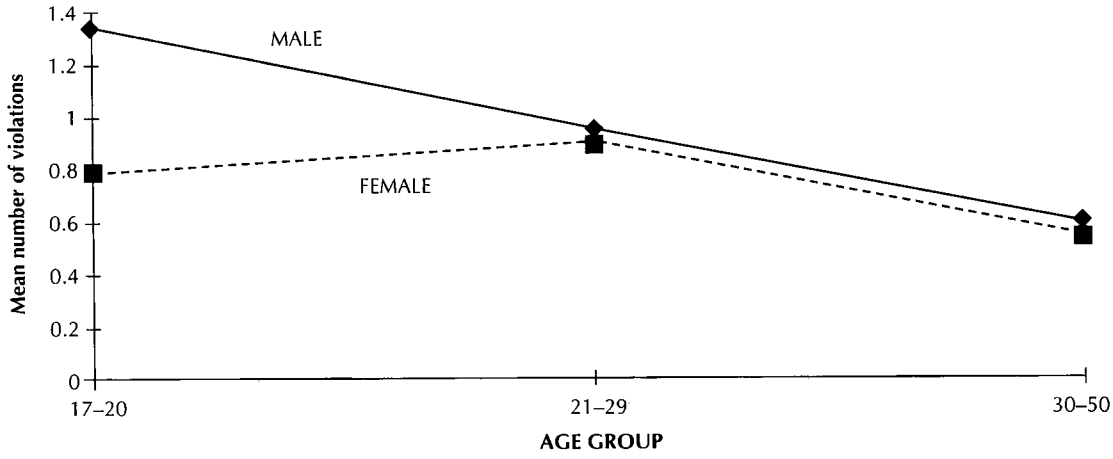
It has been known for many years that those with driving violations are more involved in accidents (see Little (1966) for an early discussion). In order to compare mileage matched men and women on the frequency of violations, we have assessed two measures. These were self-reported violations from the Manchester Driver Behaviour Questionnaire and the number of times that drivers had been stopped by the Police in the last three years.

4.7.1 Self-report violations

The frequency with which drivers reported engaging in violations is presented in Figure 4.7.

Figure 4.7
Violations scores
(0 = never, 5 = always)

(Appendix 5: Manchester Driver Behaviour Questionnaire)

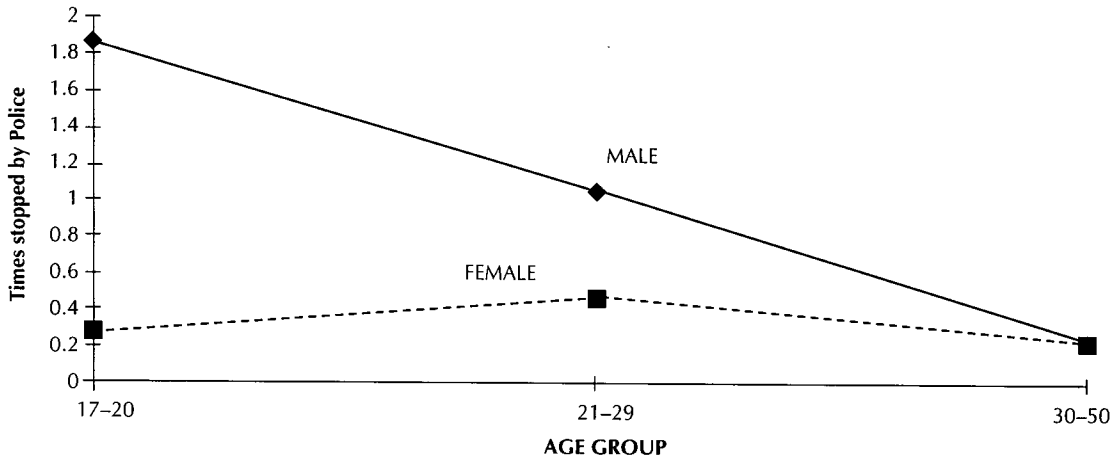


Overall, the analysis indicated that men reported more violations than women though this interacted with age such that the difference was significant for only the young group. It is not clear why, in this study, the difference was only significant for the youngest drivers since, in a previous unpublished study, we found the sex difference to be significant across the three age groups. The same result (ie overall sex difference) was also found in 1990 by Reason, Manstead, Stradling, Baxter and Campbell. **In this study, as far as male participants are concerned, older drivers are less likely to violate the rules of the road than those who are younger.**

4.7.2 Police stops

When asked how many times individuals had been stopped by the Police, the pattern was repeated: **males reported being stopped more than females, younger drivers were stopped more than those who were older.**

Figure 4.8
How many times have you been stopped by the Police in the last three years?



(It is important to remember that with an average age of 18 years and 3 months, many of the drivers in the youngest age group had been driving for less than 3 years and therefore that they are being stopped to an even greater extent than is illustrated by the graph).

4.8 Alcohol

The importance of alcohol within the driving domain has long been recognised. In the present study there were three areas of concern which were examined using the Alcohol, Drugs and Fatigue questionnaire (see appendix). This first considered how much alcohol the drivers had taken before driving. The second was concerned with the rules that drivers were applying to themselves, with reference to drinking and driving. Here we asked how much alcohol drivers were prepared to take and still drive. The third area considered whether drivers felt that the drink-drive laws should be changed. The data are summarised in Table 4.12 below.

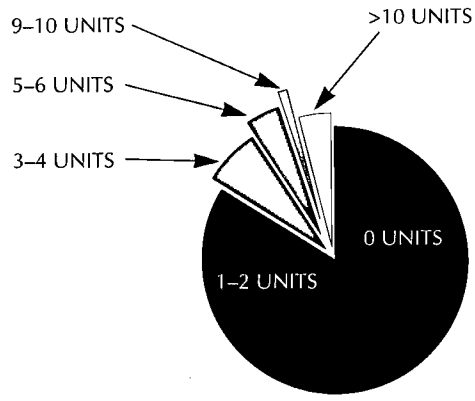
Table 4.12
Mean drink-driving scores
(Appendix 3: Alcohol, Drugs and Fatigue questionnaire)

	17–20		21–29		30–50	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Alcohol units actually drunk (max)	1.82	0.86	2.36	1.49	2.87	1.48
Alcohol units prepared to drink (max)	1.43	0.69	1.46	0.99	2.17	1.16
Drink-drive laws (1 = less strict, 3 = more strict)	2.45	2.57	2.60	2.65	2.46	2.70

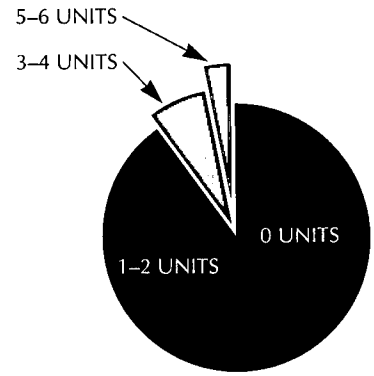
4.8.1 Reported drink-driving behaviour

It can be seen by looking at the relevant pie charts (Figures 4.9 and 4.10) that there are some males and females in all age groups who admit to drinking more than the amount allowed by the law. What is interesting about these charts though is the proportion of drivers who do not drink alcohol at all before driving. Figure 4.9 shows that this proportion is greatest for the youngest drivers and declines as age group increases for both male and female drivers. However, the maximum amount of alcohol taken before driving also decreases as age increases – most clearly for male drivers. In other words, there are a few drivers in the youngest age group who will drink considerably more before driving than drivers in any of the other groups; female drivers in this sample drink most before driving in the 21–29 age group.

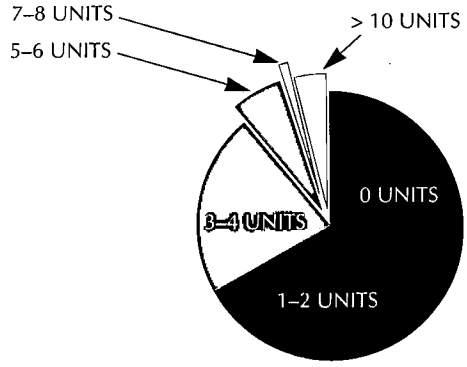
Figure 4.9
During the past two years, what is the maximum units of alcohol you have actually drunk before driving?



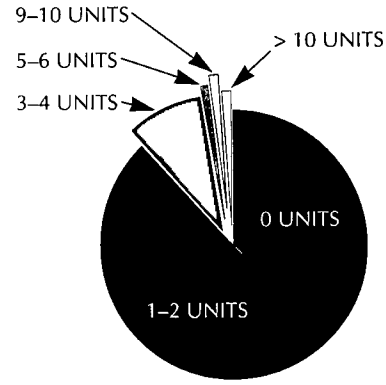
MALES: 17–20



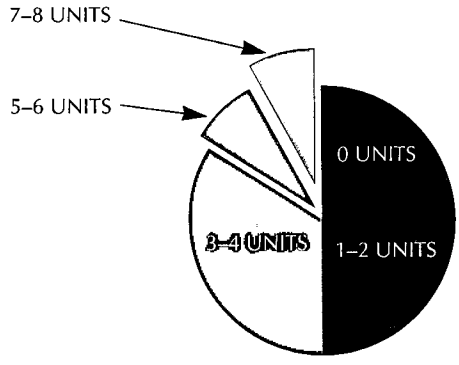
FEMALES: 17–20



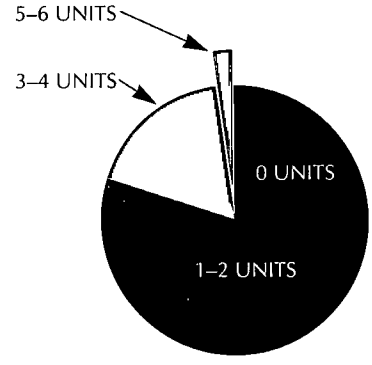
MALES: 21–29



FEMALES: 21–29

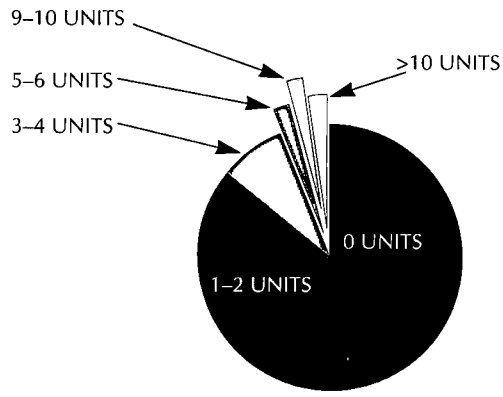


MALES: 30–50

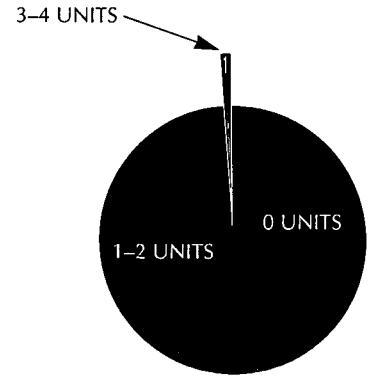


FEMALES: 30–50

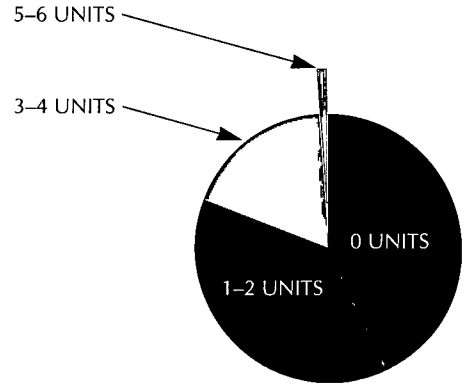
Figure 4.10
What is the greatest number of units you are prepared to drink before driving?



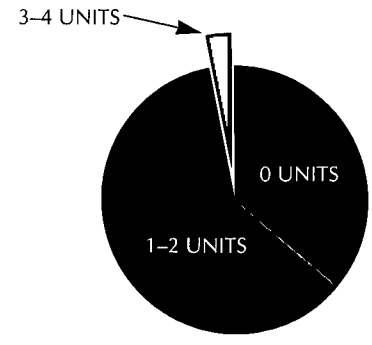
MALES: 17–20



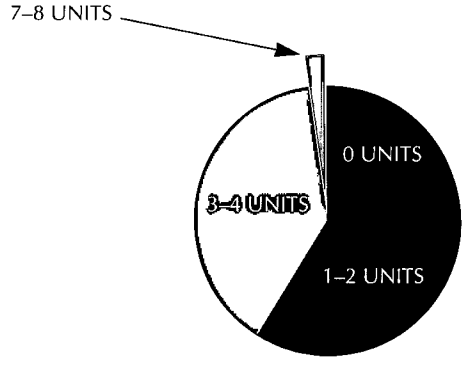
FEMALES: 17–20



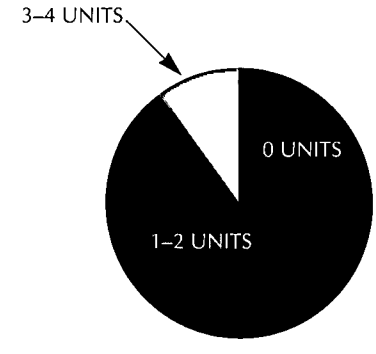
MALES: 21–29



FEMALES: 21–29



MALES: 30–50



FEMALES: 30–50

4.8.2 Preparedness to drink and drive

The amount of alcohol taken before driving is almost certainly affected by a number of factors, including a limit that people generally impose on themselves. In order to explore this self-imposed limit we asked drivers to inform us of the maximum amount of alcohol that they were *prepared* to take and still drive. This is also illustrated with the use of pie charts (Figure 4.10) and the results are very similar to those concerning how much alcohol has *actually* been drunk. What differs is the amount of alcohol: people appear to *intend* to drink less than they actually do although, interestingly, there is little if any difference between those who intend not to drink at all before driving and those who actually don't drink alcohol if they are then going to drive.

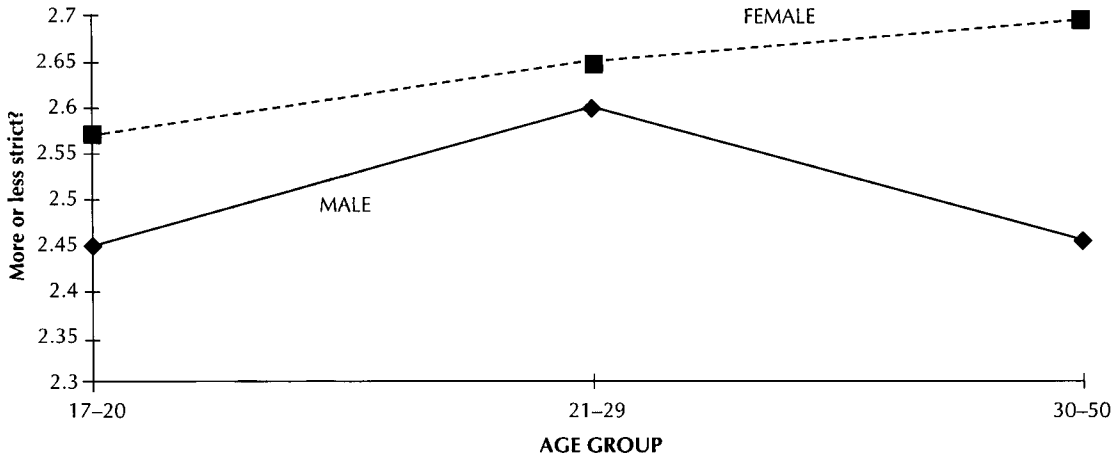
4.8.3 Attitudes to drink-driving legislation

In order to determine more general attitudes to drink-driving, drivers were asked whether they felt that drink-drive laws should be changed and if so whether they should be made more or less strict. Figure 4.11 indicates the results.

Figure 4.11 Should drink-drive laws be more or less strict, or stay the same?

(1 = less strict, 3 = more strict)

(Appendix 3: Alcohol, Drugs and Fatigue questionnaire(3))



On average, both men and women believed that drink-driving laws should become more strict but women are more certain about this than men (ie their average score is higher). For women, there is also a tendency for stricter attitudes to be associated with older drivers.

4.9 Drug use

Figures 4.12 and 4.13 indicate that more women than men have used at least one legal drug type (medicine) while driving. This pattern is consistent for drugs used over the past two years and for those used in the past 24 hours. The drug use reported here consists of those drug types found in the Alcohol, Drugs and Fatigue questionnaire (questions four and five) except painkillers. Although many painkillers are extremely strong and may have a powerful psychoactive effect, it was felt that these were difficult to disaggregate from less powerful everyday type painkillers such as aspirin.

Figure 4.12
Percentage of drivers who have used legal drugs over the past two years

(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (4))

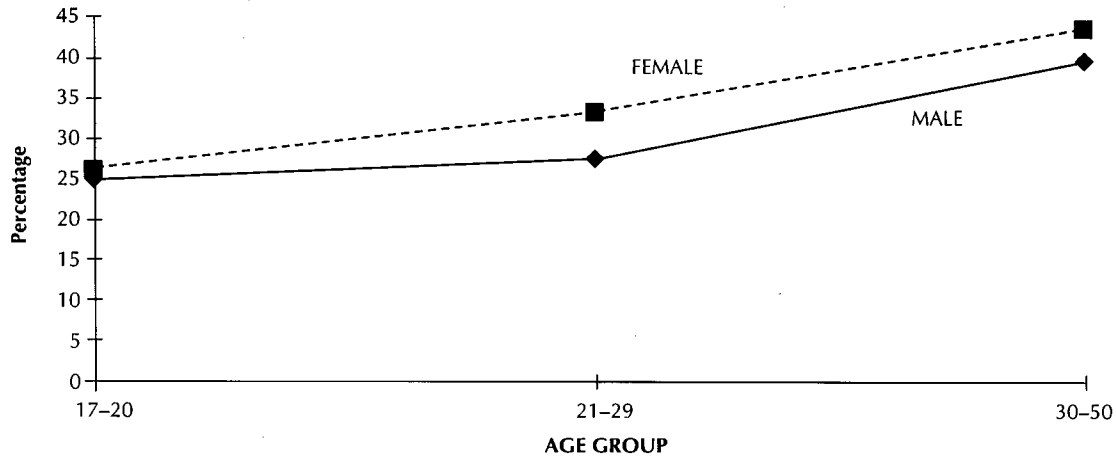
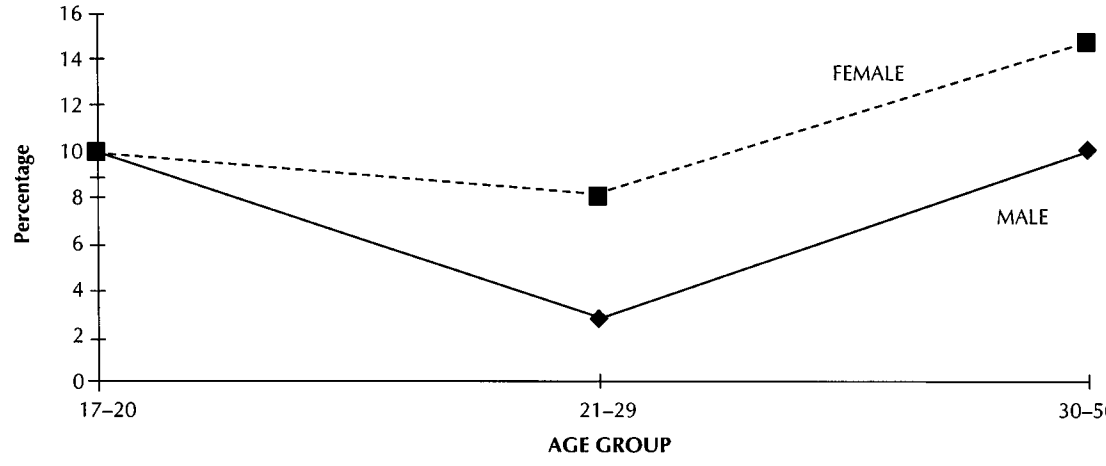


Figure 4.13
Percentage of drivers who have used legal drugs in the past 24 hours

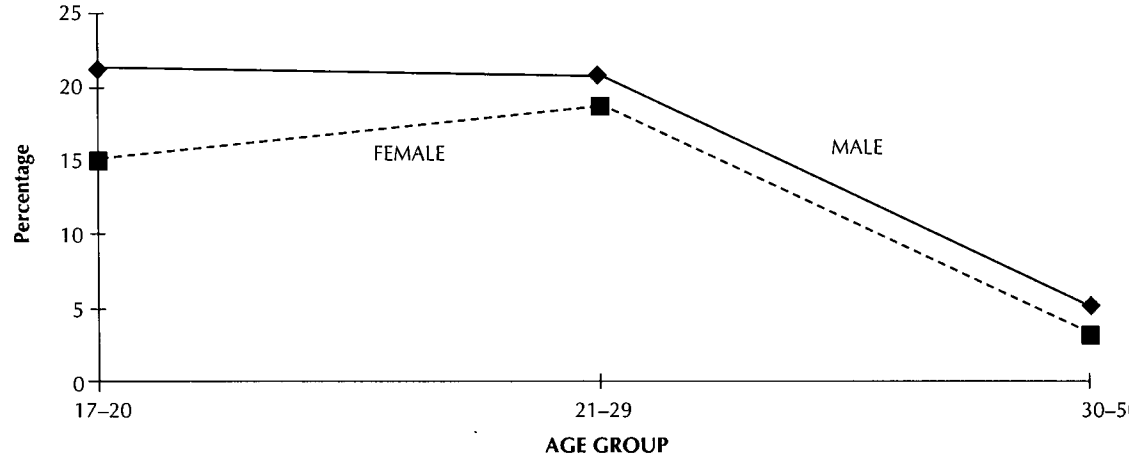
(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (5))



Interestingly, the opposite pattern exists for the use of illegal drugs while driving: in this instance, **more males than females have used illegal drugs while being in control of a vehicle:** Figure 4.14 below also shows that such illegal drug use is mainly the domain of the younger driver.

Figure 4.14
Percentage of individuals who admit to driving while using illegal drugs during the last two years

(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (6))



Results of the empirical investigation

Of those drivers who had used medicinal (legal) drugs of some type (excluding painkillers) which had been prescribed by a doctor, only 26 percent had received advice to take care while driving. 74 percent of patients reported receiving no advice. Only eight percent of drivers who had taken any or all of these legal drugs reported experiencing adverse effects during their use.

4.10 Fatigue

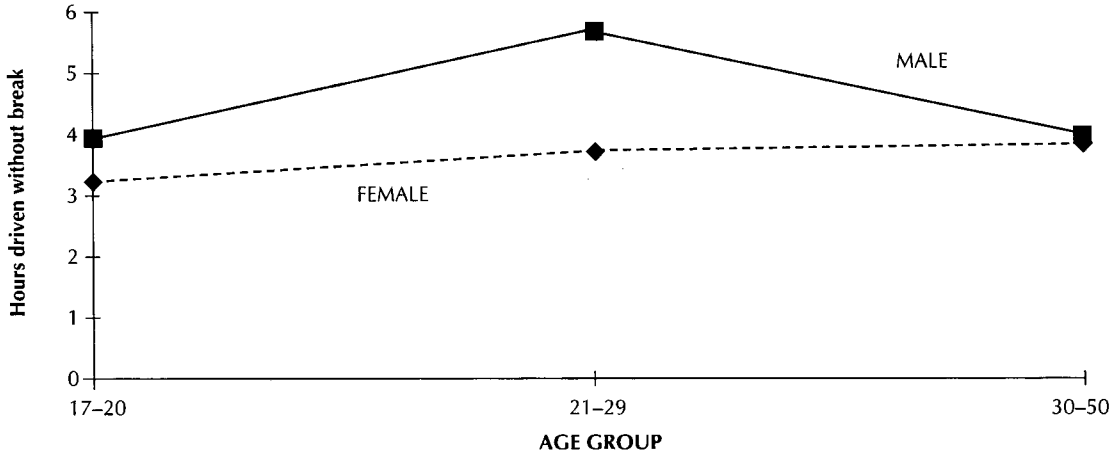
Issues surrounding the topic of driver fatigue are considered by addressing three issues (Appendix 3: Alcohol, Drugs and Fatigue questionnaire). First, we were concerned with the maximum number of hours that people have *actually* driven without taking a break. The second issue was the maximum number of hours that people state they are *prepared* to drive without a break and the third was whether they have fallen asleep at the wheel in the last two years.

4.10.1 Driving without a break

Drivers were asked a direct question concerning the maximum amount of continuous driving that they have engaged in during the last two years. The results are presented in Figure 4.15.

Figure 4.15 What is the longest period of time you have actually driven for, without taking a break?

(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (10))

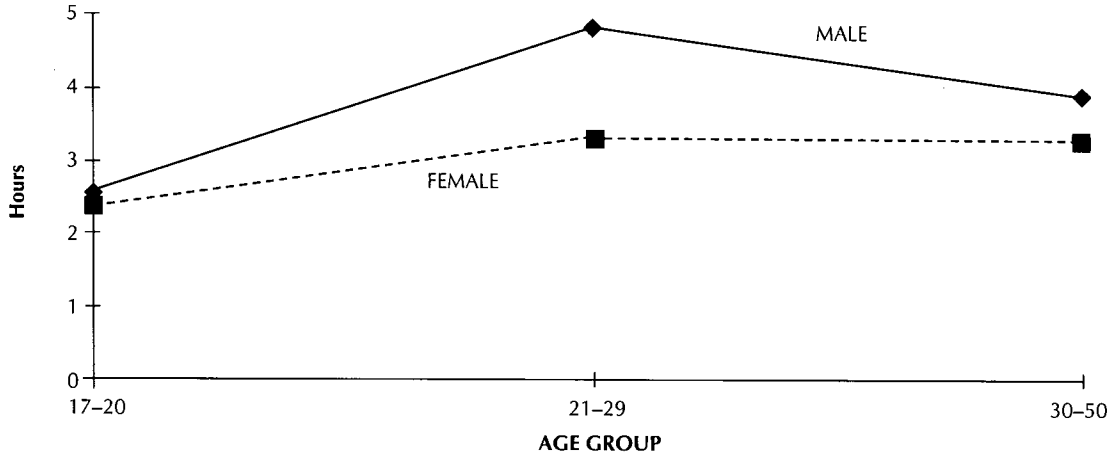


Men indicate that they have driven for significantly longer continuous periods than women though there was an interaction such that the sex difference was clearer for the two older groups. (It should be noted that while the question referred to the last two years many of the younger group have not held a driving licence for the whole of that period.)

4.10.2 Preparedness to drive without a break

In order to assess the personal rules that might constrain continuous driving we asked people how long they were prepared to drive without a break. Figure 4.16 illustrates the results.

Figure 4.16
What is the longest period of time that you would be prepared to drive for, without taking a break?
(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (11))

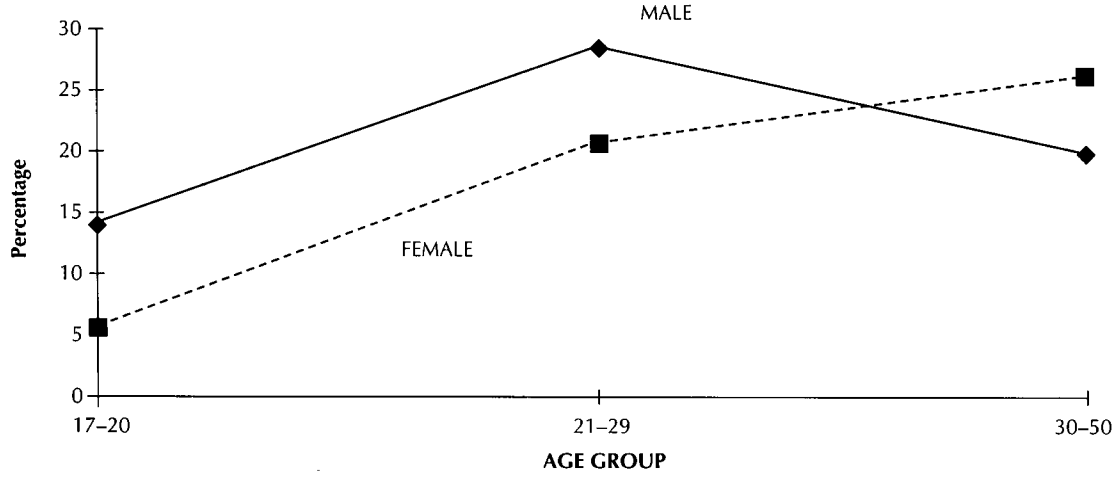


Statistical analysis shows that men indicate that they are prepared to drive for longer periods than women. Although it is not obvious from the graph, the analysis indicated that the sex difference was significant for the two younger groups but not for the oldest.

4.10.3 Falling asleep at the wheel

While extended continuous driving may provide an indirect indicator of potential fatigue, the most direct sign is actually falling asleep. Although this is a dramatic index, it does not necessarily imply that an accident occurred, since drivers may report falling asleep momentarily before regaining control. Nevertheless, falling asleep at the wheel at all must present a heightened risk of an accident.

Figure 4.17
Proportion of all drivers who have fallen asleep at the wheel in the past two years
(Appendix 3: Alcohol, Drugs and Fatigue questionnaire (10))



Apart from the discomfort of noting that a substantial percentage of drivers do report having fallen asleep at the wheel, it can be seen that, whereas an average of about 20 percent of men report having fallen asleep at the wheel, the corresponding figure for women was 17 percent.

4.10.4 Relationship between hours driving and falling asleep at the wheel

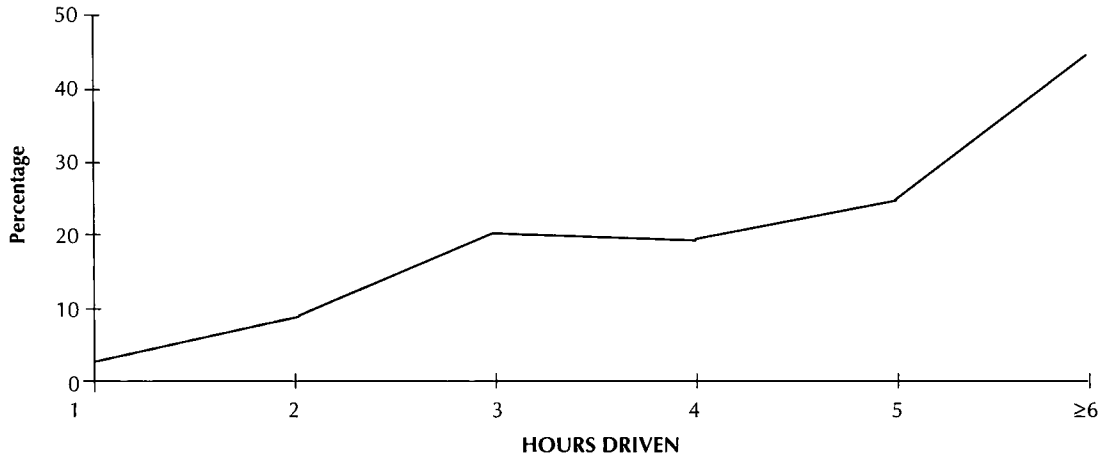
Although it is possible that the relationship between hours driving and falling asleep at the wheel may not be simple, it is worth examining the elementary proposal that those who do report falling asleep at the wheel drive continuously for longer hours than those who do not fall asleep at the wheel.

Table 4.13 Comparison of the maximum number of hours driven between those who have fallen asleep at the wheel and those who have not

	17–20		21–29		30–50	
	Male	Female	Male	Female	Male	Female
Have fallen asleep	4.1	3.3	5.7	3.8	4.0	3.9
Have not fallen asleep	2.4	2.3	4.4	3.2	3.7	3.1

Statistical analysis reveals that it is indeed the case that those who report falling asleep at the wheel have driven for significantly longer hours than those who have not. Figure 4.18 below shows the percentage of drivers who have fallen asleep at the wheel as a function of the maximum number of hours driven. It can be seen that between two and three hours there is a considerable increase in the number of drivers falling asleep at the wheel. Drivers at the wheel for more than five hours report still greater risk of falling asleep.

Figure 4.18 Percentage of all drivers who have fallen asleep at the wheel in the past two years according to hours driven without a break



4.11 Driver experiences questionnaire

In order to explore the possibility that the experiences derived from driving may be different for men and women the Driver Experiences Questionnaire was employed. The questionnaire contains 26 questions which investigate the feelings that people experience when driving. Five coherent factors were derived through factor analysis. (See Appendix 5: Driver Experiences Questionnaire for more details.)

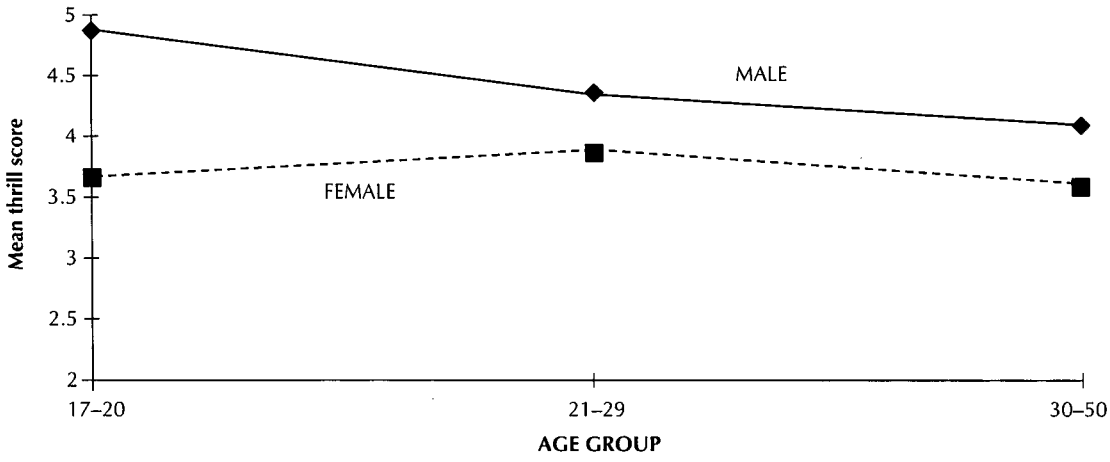
- Factor 1 was labelled **Enjoyment** – the highest loading items reflected whether people found driving to be pleasurable in general.
- Factor 2 was labelled **Thrill** – here, the highest loading items reflected feelings of excitement.
- Factor 3 was labelled **Competitiveness** since the highest loading items were explicitly concerned with competitive feelings.
- Factor 4 was labelled **Alertness** – the highest loading items were concerned with concentration and attention.
- Factor 5 was labelled **Independence** as the highest loading items were concerned with experiences of freedom and independence linked to the car.

For two of the factors (Factor 1: Enjoyment and Factor 4: Alertness) there were no differences across age group or sex so these factors are not discussed further.

4.11.1 Driver experiences: Factor 2: Thrill

Figure 4.19 presents the results for the Thrill factor. **Overall, there is a sex difference indicating that men have a greater experience of thrill while driving than women.**

Figure 4.19
Driving experiences: Thrill by sex and age
(0 = disagree very strongly that one drives for thrills, 8 = agree very strongly that one drives for thrills)
(Appendix 5: Driver Experiences Questionnaire)

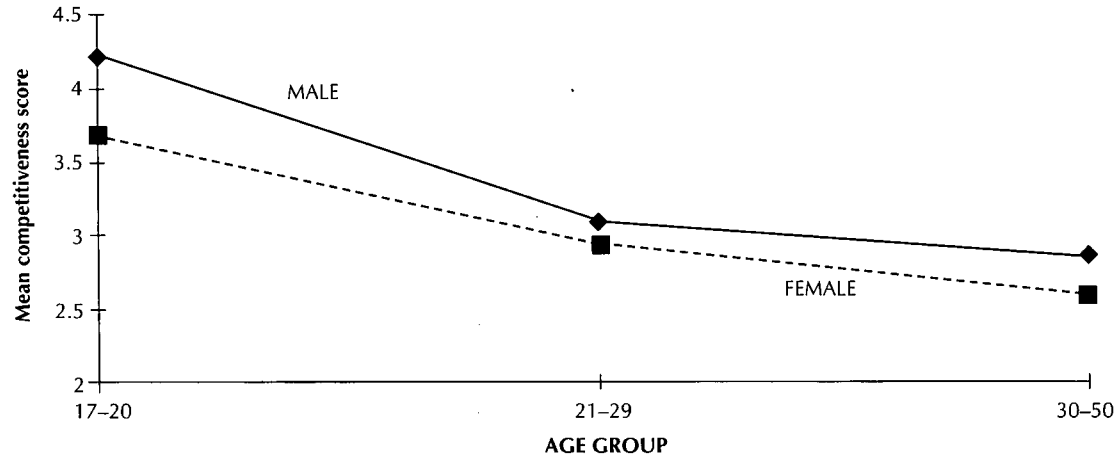


There is also a significant difference across age groups. When analysed separately **the difference across age group is significant for men and not for women.** For men the experience of Thrill decreases for the older groups. The Thrill factor is significantly correlated with speed choice as measured by the video speed test (r =.42) and the West self-report questionnaire (r =.62).

4.11.2 Driver experiences: Factor 3: Competitiveness

Figure 4.20 presents the results for the Competitiveness factor. Overall, there is a sex difference indicating that, while driving, men experience more feelings of competitiveness than women do.

Figure 4.20
Driver experiences: Competitiveness by age and sex
(0 = disagree very strongly that one is competitive, 8 = agree very strongly that one is competitive
(Appendix 5: Driver Experiences Questionnaire)



There was also a highly significant difference across age groups indicating that for both men and women the experience of competitiveness was less for older drivers. The Competitiveness factor is significantly correlated with speed choice as measured by the video speed test (r =.24) and the West self-report questionnaire (r =.39).

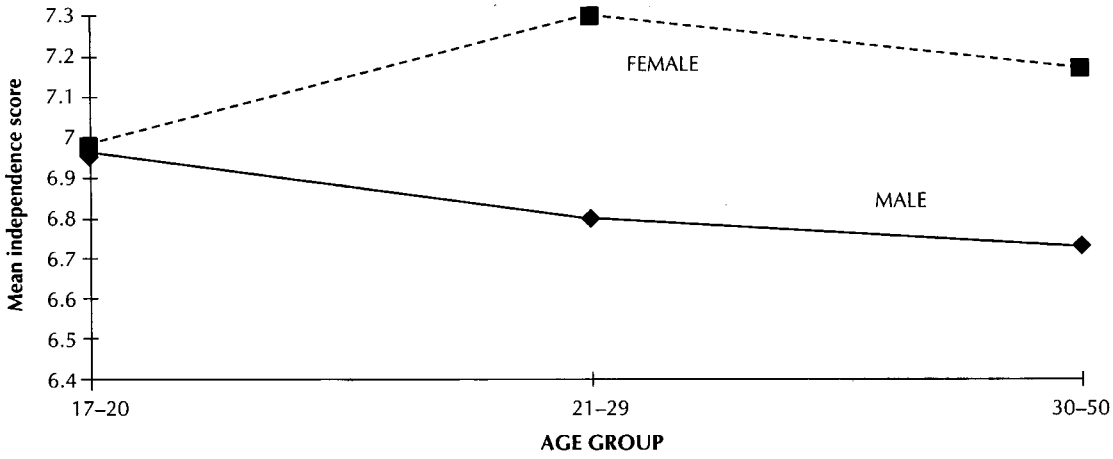
4.11.3 Driver experiences: Factor 5: Independence

Figure 4.21 presents the results for the Independence factor. Overall, there is a highly significant difference indicating that driving is more important as a source of independence for women than it is for men.

Figure 4.21
Driver experiences: Independence by age and sex

(0 = disagree very strongly, 8 = agree very strongly)

(Appendix 5: Driver Experiences Questionnaire)



The difference between men and women was not significant for the youngest group but was significant for the older groups.

4.12 Summary

- Speed
  Male drivers chose significantly higher speeds than female drivers in the video test and in their responses to the West and Manchester speed limit questions. In the observational study, young male drivers chose speeds which were significantly faster than those chosen by young females.
- Close following
  The video measure of close following produced significant age effects with females following less closely as age increased. 21–29 year old males followed less closely than the other two male groups. The self-report measure of close following as a violation produced significant sex effects for the younger drivers (there were no age effects); this was also true for the observational measure: both found that young males followed more closely than young females.
- Gap acceptance
  Significant age effects were also found for the video gap acceptance task: older drivers accepted fewer gaps than those who were younger. No difference was found in the observational study.
- Overtaking
  The overtaking video measure produced a significant effect of age only (older drivers took fewer overtaking risks than those who were younger) whereas the self-report measures found a significant sex difference in all age groups: males reported more enjoyment from overtaking than did their female counterparts.
- Hazard perception
  There was a significant age effect for hazard perception with older drivers perceiving hazards more quickly than those who were younger. There were no significant sex differences.
- Violations
  There was a significant effect of sex for the violations measure: young males reported committing violations more frequently while driving than young female drivers did. The same pattern of results was found for self-reports of times stopped by the Police.

- Alcohol and drugs
  The use of alcohol before driving and also the preparedness to use alcohol produced significant effects of sex, with males drinking more than females. More young drivers reported that they would not use alcohol at all if driving, compared to those who were older but if they did drink and drive, there were younger drivers who would drink considerably more than anyone else. **Drug use was also subject to sex differences:** females use more medicinal drugs than males but males use more illegal drugs.

- Fatigue
  There was a significant sex effect for the amount of time actually driven without a break and also the amount of time individuals were prepared to drive without a break: females drive for shorter periods of time than males. **Falling asleep at the wheel was linked to driving for longer periods for both sexes.**

- Driver experiences
  Two of the driver experience factors produced no sex or age differences and were therefore not reported. **Thrill and competitiveness factors showed both age and sex effects: they are more important for males and younger drivers. The independence factor showed sex effects** (ie was more important for females) in only the two oldest groups.

Chapter 5 Young driver behaviour and the presence of peer passengers

5.1 Introduction

The aim of Chapter 5 is to focus attention on the high risk young drivers. **In Chapter 2 it was shown that, in the UK, new drivers had a far higher accident risk than those who were older.** This problem goes well beyond national boundaries. For example, in the USA the accident risk for teenagers per mile driven is four times greater than that for more experienced drivers.

It is important to note that the fatalities are not just for drivers. In fact, in the USA approximately half (47 percent) of teenagers who died in motor vehicle accidents were passengers (Insurance Institute for Highway Safety, 1998). In addition, 63 percent of teenage passenger deaths in 1996 occurred in crashes *in which another teenager was driving*. This latter statistic raises the issue of the effect of the presence of teenagers in a car in which the driver is also a teenager. This is the issue that we consider here. In essence, are there peer group effects on driver behaviour and do these differ for men and women? In order to address this matter we set up a series of observational studies in which the behaviour of young drivers was observed both with and without the presence of peers. The ages of both driver and passenger(s) (where relevant) were judged to be 25 years or younger by each of the observers running the experiment. The specific behaviours investigated were **speed choice, close following and gap acceptance.** All observations were taken on roads in urban areas which had a speed limit of 30mph.

5.2 Speed

Two observers were responsible for data collection: one measured the vehicle speed, using a radar gun (Muni Quip K-GP model) and the other recorded the driver/passenger details on pre-formatted sheets. One of the criteria for the selection of the recording site was that the experimenters could observe without being observed, another that each road had a 30mph limit. All observations were done on dry, clear days. Vehicles whose speed was potentially constrained by the presence of another vehicle were excluded.

The mean recorded speeds in mph and number of observations for each cell (in brackets) are shown below in Table 5.1.

Table 5.1 Mean observed speed in mph by driver sex and passenger type (N)

	Passenger type		
	None	Male	Female
Male driver	32.4 (124)	33.8 (98)	28.2 (69)
Female driver	28.5 (79)	30.8 (38)	29 (44)

Figure 5.1
Mean observed speed by driver sex and passenger type (mph)

Statistical analysis of the data revealed a number of interesting findings:

1) In the absence of passengers, male drivers were observed to drive significantly faster than female drivers. This replicates the results obtained using the video speed choice test.

2) The presence of male passengers was associated with faster speeds for both men and women drivers.

3) The presence of women passengers was associated with a decrease in the speed of male drivers but there was no significant effect on the speed chosen by female drivers.

5.3 Close following

In a field observation of following behaviour, Rajalin, Hassel and Summala (1996) noted that younger drivers were more likely to close follow than those who were older, a finding particularly interesting in the context of the current study. They also observed that males seemed more prone to this behaviour, though this trend was not statistically significant. In our study an attempt was made to clarify the situation by targeting drivers aged 25 years or less.

A measure of following behaviour was taken with the aid of a video camera. The camera was erected at a main (30mph) road leading into a town centre. The observer, using a microphone, recorded the incidence of young drivers and any passenger details onto the video tape. A measure of following distance was taken by counting the number of video frames between each young driver's car and the preceding vehicle. This measure was then converted to time and is shown in Table 5.2. The number of observations is presented in brackets.

Table 5.2
Mean following distance in seconds by driver sex and passenger type (N)

	Passenger type		
	None	Male	Female
Male driver	1.50 (111)	1.60 (103)	1.99 (117)
Female driver	1.78 (88)	1.70 (77)	1.73 (106)

Figure 5.2
Mean following distance by driver sex and passenger type

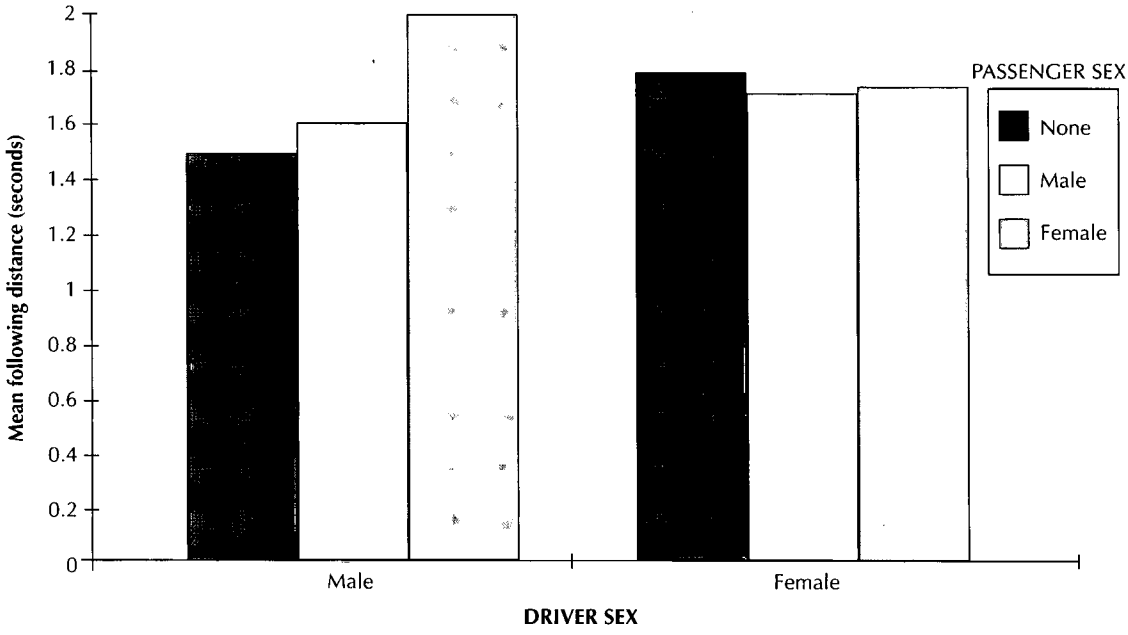


Figure 5.2 shows an interesting variation in the patterns of following behaviour for male and female drivers. Statistical analysis revealed the following:

1) In the absence of passengers young male drivers were observed to drive closer to the vehicle in front than young female drivers.

2) The presence of male passengers was not associated with any difference in following behaviour for men or women drivers.

3) The presence of a young woman passenger was associated with a greater headway for young male drivers but there was no significant effect for young women drivers.

5.4 Gap acceptance

To obtain a field measure of gap acceptance a video camera was set-up in the foliage near a junction which gave access to a 30mph urban road. Drivers (with and without passengers) that fell into the target age group were recorded pulling out of the junction and joining the main road, integrating themselves into the traffic flow. This provided a real-world equivalent of the gap acceptance video measure described earlier. The video was then viewed in the laboratory at a frame-by-frame speed. As the exiting car joined the main road it passed a road sign. A note was made of the video frame number when the car's rear bumper passed the sign. Using this approach the size of the gap accepted by each car could be obtained by counting the number of frames between the rear of the exiting car and the front of the following car reaching the same point. This measure was then converted to time (seconds).

The mean gap size, expressed in seconds, and number of observations for each cell (in brackets) is shown in Table 5.3 below:

Table 5.3
Mean gap size in seconds by driver sex and passenger type (N)

	Passenger type		
	None	Male	Female
Male driver	6.87 (86)	4.94 (58)	7.20 (47)
Female driver	6.93 (71)	5.55 (31)	7.18 (45)

Figure 5.3
Mean gap size by driver sex and passenger type

Statistical analysis revealed the following:

1) In the absence of passengers young men and women do not differ in the size of the gaps they accept. This replicates the findings reported in Chapter 4.

2) The presence of male passengers was associated with shorter gaps being taken by both men and women drivers.

3) The presence of a young women passenger was not associated with a significant difference in the size of the gap accepted by either men or women drivers.

5.5 Summary

The observational study of young drivers in the presence and absence of young passengers has revealed some findings that may have implications for their accident risk.

- **In the absence of passengers young male drivers were observed to drive more dangerously than young women.** In particular, young men drove faster and with a shorter headway than young women though there was no difference in the size of the gaps they accepted at junctions.
- **The presence of young male passengers was associated with more dangerous driving for both young male and young female drivers.** This was true for both speed choice and gap acceptance at junctions.
- **The presence of young women passengers was associated with safer driving for young men.** This was true for both speed choice and following distance. The presence of young women passengers was not associated with any difference in the behaviour of young women drivers.

Chapter 6 Implications and applications

6.1 Interpreting sex differences in general

The extent to which there may be general sex differences in cognitive performance and behaviour has been a long-standing issue. Likewise, the extent to which any such differences are best interpreted in psychological, biological or genetic terms has not only been a source for debate but also confusion. For example, one source of confusion is the view that biological differences are sufficiently distinct from psychological ones that the former cannot emerge from the latter. Casual observation of such activities as bodybuilding would suggest otherwise. In other words straightforward changes in behaviour, through extensive training, can produce significant changes in muscle tissue. Subsequent differences in biological measurement would then have *followed* from behavioural changes with no genetic influence. In essence, differences in biological measurement can follow from behavioural processes. Of course, at the other end of the debate it is a matter of fact that men and women do differ genetically and the extent to which this has behavioural consequences is unknown.

If the developmental experiences of males and females were the same then attributing any differences to genetics would be easier. However, this is not the case. The first label that is applied to a person is usually a sex identifier rather than an individual one, "It's a girl" or "It's a boy", and the subsequent way that the infant is treated, even to the point of how the infant is dressed, is then dependent on the identified sex (Beal, 1994). It is difficult to imagine, for example, that treating a boy as a girl or *vice versa* would not have an important effect.

In the psychological literature the differences that have been reported have been in the following areas: verbal skills, spatial ability and aggression. It has been found that, on average, women perform better on verbal tasks, men perform better on spatial tasks and that men are more aggressive. It is not immediately apparent that the differences in verbal skills have implications for a perceptual motor task such as driving. Differences in spatial ability and aggression are more likely to be of relevance to the present context. Spatial ability could be of importance for navigation in general and more specifically for parking and calculating whether to accept particular gaps. An interesting issue that emerges here is whether the changes in the social and cultural environment of women has had any impact on the magnitude of the sex difference. It has been argued that the way that men and women are now treated is less differentiated than in the past. Two studies (Feingold, 1988; Voyer,Voyer and Bryden, 1995) have reported that there is some evidence that sex differences in spatial ability have been declining in recent years.

It is also not difficult to see that differences in aggression could readily have implications for traffic behaviour, particularly if any credence is given to the proposal that "a man drives as he lives" (Tillman and Hobbs 1949). The relationship between driving violations and accident involvement would reinforce the potential importance of differences in aggression. By contrast with the work on spatial ability it has been reported that the differences in aggression are stable across time (Knight, Fabes and Higgins, 1996). This result, combined with the proposal that a significant part of aggression is genetic (Miles and Carey 1997) might be a source of some concern. However, the expression of aggression is highly socialised. The occurrence of indiscriminate aggression is relatively rare. In the realms of safety the critical issue is to ensure that educational and enforcement programmes are available that unambiguously indicate that aggression in the field of driving is neither appropriate nor acceptable.

6.2 The present study

Turning directly to the area of driving, we have observed that, although there is a higher proportion of men who obtain a driving licence, this sex difference is decreasing. We have also noted that men have a higher fatality risk per mile driven than women. In Chapter 2 we considered the pattern of accident involvement of men and women. It transpired that the pattern is different for men and women. Men have a higher proportion of their accident involvement on bends, while overtaking and during the hours of darkness. By contrast women have a higher proportion of their accidents at junctions. The sex difference in the pattern of accident involvement is most evident for the younger age groups and is less prominent for the older age groups. We have also found that, in the period in which there has been a very significant increase in the proportion of women obtaining a driving licence, there has been remarkable stability in the sex difference in the pattern of accident involvement. Given the popular conception that women are becoming more aggressive drivers and driving faster it is interesting that the pattern of accident involvement directly contradicts this view. For example, accidents on bends are often considered to involve a significant speed component. If women were driving faster then we would anticipate that, over time, there would be a higher proportion of their accidents involving bends; we might also have expected a decrease in the difference between men and women in more recent years. There is no evidence for either of these predictions.

A factor that must be considered in interpreting the sex difference in the pattern of accident involvement is the differential exposure of men and women. It is known that, on average, men do more mileage than women. This in turn has implications for the type of roads that men and women travel on since it has been found that as mileage increases the proportion of miles travelled on motorways increases and the proportion of miles on built up roads decreases. This in turn will mean that women will spend more of their time on built up roads. The question then is whether exposure can account for the difference between men and women. It is surely the case that exposure must make a significant contribution to the pattern of accident involvement but the crucial issue is whether exposure can account for all of the observed differences. There are reasons for doubting that it can. Let us consider once again accidents on bends. For the youngest age group the sex difference in the proportion of accidents is larger than for the two older age groups. However, the sex difference in mileage is not larger for the younger age group. A more likely explanation is the different pattern of accident involvement is due to a combination of exposure and behavioural differences.

In order to examine whether men and women differ in their driving behaviour and attitudes, the empirical part of our study **examined groups of men and women who were matched in terms of age and mileage.** Included among the wide range of measures were a number of key driving behaviours that have been shown to correlate with accident involvement. These behaviours were speed choice, close following, overtaking, hazard perception and violations. In addition, there were a number of measures of driver behaviour and attitudes which included assessment of gap acceptance, alcohol use, drug use, and fatigue. In order to explore the possibility that the experiences derived from driving may be different for men and women the Driver Experiences Questionnaire was employed. In the empirical part of the project (Chapter 4) interest is confined to an age range between 17 and 50 years of age. This means that the term older is being used in two different ways. In Chapter 2 it refers to drivers over the age of 55 whereas in Chapter 4 it refers to the oldest group in the sample, that is, those who are between 30 and 50 years of age.

In a separate study of the high-risk younger drivers, observations were taken to determine if passenger presence or absence was associated with differences in speed choice, close following and gap acceptance.

6.2.1 Speed choice

It has been known for some time that speed choice is linked to accident involvement and is one of the most important factors. It is also known that the public regard breaking speed

limits as a very minor offence (Brown and Copeman, 1975; Parker *et al*, 1992) and that the majority of drivers are observed to break the speed limit (Department of Transport, 1996). Under these circumstances modifying speed is not only a high safety priority but a particularly challenging one. The issue explored here was whether men and women differ in their speed choices. Whether the speed measure was through observation, self-report or video test it was found that **males adopt faster speeds.** Given this difference it becomes less surprising that men have a higher proportion of their accidents in circumstances where speed is likely to be a factor such as on bends. Factors such as sensation seeking and thrill seeking may be significant, since men tend to have greater sensation seeking tendencies in general. More particularly, men report that when driving, thrill seeking has a bigger part to play.

6.2.2 Close following

Observational analysis of following behaviour has revealed that those who follow more closely are more involved in accidents (Evans and Wasielewski, 1983). The magnitude of this problem is illustrated by the fact that Postans and Wilson (1983) found that 20 percent of drivers on a motorway were following with a gap of less than half a second. In an in-car observation of driver performance Harvey *et al* (1975) reported that following too close to the vehicle in front was the most frequent driving error. **In our research, although the video measure of close following revealed no differences between men and women in their response to a motorway scenario, there were differences across age group. Younger drivers were less inclined to appreciate the dangers of close following. The self-report measure of deliberative close following (as a signal to the driver in front to get out of the way) revealed a different pattern of results. Younger men reported that they more frequently adopted this aggressive style of driving than any other group.** The observational study which included only younger drivers indicated that in an urban setting younger men were driving closer to the vehicle in front than younger women. The majority of drivers were observed to adopt headways of less than two seconds. It remains the case that close following is probably one of the most neglected areas relative to the magnitude of the problem.

6.2.3 Overtaking

Although a relatively small proportion of accidents occur during overtaking (see Chapter 2) the fact that considerable absolute speeds and in some circumstances very considerable relative speeds (for example in head-on collisions) can be involved means that overtaking remains an important manoeuvre. Wilson and Greensmith (1983) have found that those who most frequently engaged in overtaking were more involved in accidents. **Although our video measure of overtaking indicated no difference between men and women, there was an age difference such that younger drivers took more risks than older drivers. In the self-report measure men report that they enjoy overtaking more than women do. Interestingly, in examining the pattern of accident involvement, while men have a higher proportion of overtaking accidents than women the trend over the years is that for both sexes the proportion of overtaking accidents is decreasing.** If it were known what factors were responsible for this decrease it might then be possible to accelerate the decline in what is likely to be a severe type of accident.

6.2.4 Hazard perception

Research into the anticipation skills of drivers is relatively recent. It has been shown that those drivers who are relatively slow to detect hazards on the road are more involved in accidents (Pelz and Krupat 1974; Quimby, Maycock, Carter, Dixon and Wall 1986). The interest in hazard perception is motivated not just by the relationship with accident involvement but also by the fact that training programmes have been shown to be effective (McKenna and Crick, 1994). **In our research we have found that, when matched for**

driving experience, there was no difference between men and women in their ability to detect hazards though there was an age effect such that the more experienced drivers were quicker to detect hazards. The absence of any sex difference may well be linked to the fact that we matched men and women for mileage. **We have shown that hazard perception performance is linked to total mileage, such that those with more driving experience were better at hazard perception.** Since it is known that men drive more than women it follows that studies that examine sex differences in hazard perception could incorrectly come to the conclusion that there is a sex difference when in fact what they are measuring is an experience difference.

6.2.5 Violations

The relationship between violations and accident involvement has been known for some time (Little, 1966) and in recent years it has been shown that self-report measures of violations provide a reliable relationship with accident involvement (Parker, Reason, Manstead, Stradling, 1995). **Our research, like previous work (Reason *et al* 1990), indicates that young men report more frequently engaging in violations than young women. We also found that young men reported being stopped by the Police more frequently than any other group.**

6.2.6 Gap acceptance

In Chapter 2 we presented the finding that women have a higher proportion of their accidents at junctions. To explore this result we examined the responses of men and women on the gap acceptance test to determine if women were accepting more dangerous gaps than men. **Overall, there was no significant difference between men and women in the number of gaps they accepted though, in the 30–50 year old group, women were accepting more dangerous gaps than men.** Since there were no differences in the performance of younger men and women then we have no complete behavioural explanation for the different pattern of accident involvement. In principle, the proposal that sex differences in spatial ability are declining over the years might account for the result that we only find a sex difference in gap acceptance for the older group. However, when we track the pattern of accident involvement over the years there is no evidence of a decline in the sex difference in junction accidents. This is inconsistent with the spatial ability argument. The likelihood that women spend more of their time driving in built-up areas is liable to make a contribution but whether it can entirely explain the difference is unknown.

6.2.7 Alcohol

In Great Britain the number of fatal accidents involving illegal levels of alcohol shifted from 850 in 1986 to 460 in 1995 (Road Accidents Great Britain, 1997). The fact that there was such a significant decrease is surely a move in the right direction but the fact that 13 percent of the people who die on the roads were killed in drink-drive accidents indicates that there is a great deal still to be done. **Our research indicated that men reported drinking more alcohol and driving than women.** In addition, men also indicate that they are prepared to drink more alcohol and drive which suggests that there is an element of premeditation. **There was also an age effect such that older drivers reported both that they had drank more alcohol and driven and that they were prepared to do so in the future.** In examining the distribution of drink-driving a more elaborate picture emerges. As a group, younger drivers are more likely to avoid drinking any alcohol if they are driving. However, there is also a small minority of younger drivers who are likely to drink excessive amounts of alcohol and drive. Given that this small group of young drivers will have relatively little experience of driving, little experience of drinking and little experience of drink-driving their accident likelihood is liable to be considerable.

Implications and applications

In examining attitudes to drink-drive legislation both men and women were in favour of more strict drink-drive laws. Women were significantly more in favour of stricter legislation than men.

6.2.8 Drug use

Providing an accurate assessment of the problem of drugs and driving is not without difficulty. Even when there is experimental evidence that particular drugs affect cognitive performance and driving the full implications are not entirely clear. If we consider legal drugs then one problem that occurs is that most of the experimental work is carried out with healthy volunteers who have no need for the drug. One particular problem that occurs is whether the patient who does need the drug is safer with or without the drug. If one considers the case of depression then the problem is that those who are depressed are likely to be at risk if they do not take medication and the issue is whether they are more or less at risk having taken the medication. For older drivers the issue is particularly difficult because they may be taking several different drugs each of which may interact with the others. If enforcement action is contemplated then additional problems occur in determining what level of the drug is acceptable and it becomes necessary to find cost effective means of measurement. People also adapt to the effects of some drugs so that the same level of intake may have differing effects across time.

While there are many problems associated with dealing with the issue of drugs and driving, the frequency with which both legal and illegal drugs are combined with driving means that this issue must be of concern. **In our sample about 32 percent report that in the last two years they have taken some form of legal drug and driven.** Of these 9 percent felt that they did have adverse effects from the drug. **About 15 percent report that they have taken an illegal drug and driven. In comparing the use of legal and illegal drugs while driving, a contrast occurs such that women are more inclined than men to take legal drugs and men are more inclined than women to take illegal drugs.** Another interesting contrast occurs in comparison with alcohol. While the evidence would appear to indicate that the younger age group are more inclined to appreciate the dangers of one particular drug, namely alcohol, they are less inclined to accept the dangers of illegal drugs.

6.2.9 Fatigue

Without doubt driver fatigue makes a significant contribution to accident involvement though quantifying the magnitude of the problem is difficult. Horne and Reyner (1995) estimate that between 16–20 percent of motorway accidents to which police were summoned were sleep-related. **In our sample 19 percent reported that they had fallen asleep while driving in the last two years.** A higher percentage of men reported that they had fallen asleep at the wheel. **Men reported not only that they had, in the past, driven for longer periods without a break but also that they were prepared to do so in the future.** It would appear that it is not just the behaviour of men and women that is different, their intentions are also different. **We found that those who had fallen asleep at the wheel reported driving for longer periods than those who had not.** It may be that the issue of falling asleep at the wheel may be simpler than is often thought. For example, while the Lex Report (1998) indicates that 87 percent of drivers would welcome a device which would sound if they started to fall asleep, these types of devices may not be necessary as drivers do not fall asleep without any warning. There are many cues such as feelings of tiredness and eyes shutting that provide the driver with important information. The crucial issue is that drivers should pay attention to these cues. The simplest solution would appear to be to avoid driving for such long periods without a break. **Our analyses would suggest that people should drive for no longer than two hours without a break.**

6.2.10 Driver experiences

We explored the possibility that people gain different experiences from driving. **For example, women report that driving produces more feelings of *independence* than men.** This difference only occurred for drivers over twenty years of age.

It was also found that the experience of thrill was more dominant for men than women and that this was particularly true for young men. There was a correlation between thrill and speed choice such that those who experienced more thrill chose faster speeds. With increases in congestion it may be that the opportunities for experiencing thrill will diminish over time.

It was found that men experience more feelings of *competitiveness* than women and that feelings of competitiveness were correlated with speed choice in the expected direction. It was also found that competitiveness was greatest in the youngest group and least in the most experienced group. It would appear that there is much to be done to persuade younger drivers that driving should not be a competitive exercise. This message might be given more weight in both driver education and driver instruction.

6.2.11 Passenger presence

The observational study of young drivers examined their behaviour in the presence and absence of young passengers. The behaviours observed were speed choice, close following and gap acceptance. **In the absence of passengers young male drivers were observed to drive more dangerously than young women. In particular, young men drove faster and with a shorter headway than young women.**

An important issue was whether the presence of young male passengers would be associated with more dangerous driving among young men drivers. This pattern was observed for both speed choice and gap acceptance at junctions. A potentially harder issue to predict is whether the presence of a young male passenger would be associated with any observable difference for young women drivers. The pattern that was observed for young women drivers was exactly the same as for young male drivers: in comparison to those women without passengers, those who had a young male passenger, were observed to drive faster and accept shorter gaps when merging with other traffic.

The presence of a young woman passenger also presents an interesting challenge for prediction, particularly in the case of the young male driver. If there are causal effects of passenger presence then two opposing hypotheses present themselves. The first is that in the presence of the young woman passenger young males will show off and present themselves as adventurous risk takers. Alternatively, young male drivers may see their role as more protective and hence drive in a safer manner than they would otherwise.
The results were consistent with the latter hypothesis in that **the presence of a young woman passenger was associated with slower speeds and greater following distances for male drivers.**

It is not clear what predictions to make for the case of women passengers with women drivers. **Our results indicated that the behaviour of those women driving on their own was indistinguishable from those driving with a woman passenger.**

One interesting feature to emerge is that, overall, men with passengers are exhibiting a greater range of behaviour than women. If the passengers are causing different behaviours then these results contradict the rugged, independent, self constructs that men have of themselves (Cross and Madson, 1997). Rather these results would be consistent with the view that there are circumstances where men are more vulnerable to the influences of the presence of others.

6.3 Conclusions

The report has examined a wide range of behaviours and attitudes that are relevant to the accident involvement of men and women between 17 and 50 years of age. As well as important age differences, there are significant sex differences which exist even when men and women are matched for driving experience. It is now apparent that driving is no longer dominated by men. **The proportion of the population of women who are obtaining driving licences is still increasing and the difference between men and women is decreasing.**

6.3.1 Men and women

The pattern of accident involvement for men and women is different. **Men have a higher proportion of their accidents on bends, overtaking, and during the hours of darkness. By contrast women have a higher proportion of their accidents at junctions. In addition, men have a higher fatality risk than women. From the evidence presented in this report, if one were to propose an explanation for the higher fatality risk of men it would rest on the facts that men adopt faster speeds, commit more driving violations, are more inclined to drink and drive, take illegal drugs and drive and are prepared to drive for longer periods.** It is likely that eliminating these differences would in large part eliminate the sex differences which occur.

Modifying speed choice represents one of the major challenges ahead, partly because the public do not regard this as a high priority. Success will almost certainly require the combined effects of changing attitudes, increased enforcement and engineering modifications. Driving violations are of particular importance for young drivers so moves to ensure that violations at this stage of their driving career are met with appropriate rehabilitation are of considerable importance. The fact that young men are more often stopped by the Police means that there is an opportunity for early intervention.

Our results indicated that, overall, people were in favour of more stringent legislation on drinking and driving. One question that arises is whether this opinion should most effectively be translated into lower overall limits, greater enforcement of the current limits or more severe penalties for extreme violations. The fact that the previously observed decreases in drink-drive fatalities have now stabilised means that this issue is of immediate concern. The importance of drugs and driving is not easy to evaluate. Public awareness of important symptoms such as drowsiness is a possible first step. The issue of illegal drugs is of more concern for younger drivers. Perhaps the message here is that younger drivers have, in large, taken on board the message that taking one drug, namely alcohol, and driving is not acceptable, and that awareness needs to be raised that the issue for many illegal drugs is just the same.

The fact that those who drive for longer are more likely to have fallen asleep at the wheel leads to the simple but consequential point that it is important to take breaks on long journeys.

6.3.2 Age differences

In almost all data samples involving driving age there are two general ingredients. These relate to chronological age and experience. These factors almost always go together such that younger drivers are generally less experienced than older drivers which means that it is difficult to disentangle the effects of age and experience. Younger drivers have a higher proportion of their accidents on bends and a particularly high proportion of their accidents during the hours of darkness. In the present report although some of the age differences involve the same factors as the sex differences there are important issues that emerge for young drivers. Younger drivers are more inclined to adopt closer following distances, accept more gaps when merging with other traffic and accept more dangerous overtaking manoeuvres. Previous work in this laboratory and in others (Parker *et al*, 1995) has indicated greater willingness to commit violations. Younger drivers report more feelings of competitiveness and have longer hazard perception times. This combination of characteristics is surely a lethal cocktail.

The question that arises is whether our young drivers are sufficiently well equipped to deal with the driving task they face. Their fatality risk suggests that they are not. While the measures outlined above would contribute to an improvement there are additional measures worthy of consideration. Younger drivers believe that their fast reaction times will keep them out of trouble. However, it is a matter of fact that they are slow to detect hazards. This problem can be remedied through training (McKenna and Crick, 1994). The government could implement a hazard perception test as part of the theory test. **The potential benefits are twofold: first, a standard for safe driving can be set so that those who have not met this standard can be identified and second, a hazard perception test would set an agenda for training and enable people to exceed the minimum standard.**

The high fatality rate of young drivers also prompts the issue of graduated licensing. The advantage of a graduated licensing system is that the aim is to increase exposure to risk gradually as the driver's skill level increases. A number of issues for consideration would arise here. For example, should new drivers be allowed to carry young passengers at the early stages of their career? The evidence we present is not completely clear cut. Those young men driving in the presence of a young woman are behaving more safely than those on their own. However, those young men and young women who are driving in the presence of a young man are driving more dangerously than those who are driving on their own. The other area that prompts active debate is whether new drivers should or should not be allowed to drive late at night. The argument against such a measure is the general restriction of freedom. The argument in favour stems from the fact that new drivers may be trying to learn many different aspects of the skill at the same time and presenting these issues sequentially may be beneficial. The fact that such a high proportion of their accidents occur at night means that this is not a trivial matter to dismiss.

6.4 Final comments

Although the issue of sex differences is politically sensitive and scientifically complex the dramatic shift in the demographics of the driving population compels enquiry. We have found that men and women differ in fatality risk and in the pattern of accident involvement and that the explanation for these differences lies not only in the different patterns of travel but also in the different behaviour and attitudes of men and women.

Chapter 7 Acknowledgments

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Appendix 1 Demographics Section (dem)

*Subject Number:*_____ *Date:* _____

DRIVING QUESTIONNAIRE

We need some general information about you and your driving. You are not required to give your name: the information you give will be treated with the strictest confidence, and in any case, it will be virtually impossible to trace the information back to you.

Please be as honest and accurate as possible. Where appropriate, please circle the correct answer. Otherwise write clearly in the space provided.

dem 1:

a) Do you hold a full UK driving licence? YES NO

b) Age:_____

c) Sex: MALE FEMALE

d) Are you married or living with someone as if you were married? YES NO

e) Do you have children? YES NO

f) What are the occupations of: yourself?_____

your partner? _____

your father? _____

dem 2:

a) Years since passed UK driving test:_____

b) What proportion of your driving experience has been obtained ***in the UK*** (ignoring holidays or brief visits abroad?)

None 25% 50% 75% 100%

c) How many years have you been ***actively*** driving (for example, more than once a week?) _____

d) Have you ever taken part in an advanced driving course? YES NO

If YES, please specify_____

dem 3:

a) We also need some details about your *usual* vehicle. If you are not sure, please tell the experimenter, who may be able to help you.

b) Make/model (eg Volvo 340 GL or Vauxhall Astra Merit (diesel)

c) Engine size (eg 1.1 litres or 1100cc):_____

d) Age of car (or registration letter):_____

dem 4:

a) Over *the last three years,* approximately how may miles per year on average have you driven? If you prefer, estimate the number of miles per week – (please ask the experimenter if you have difficulty estimating this).

_____ miles per year (or _____ miles per week)

b) Is your usual vehicle a company car? YES NO

dem 5:

a) Have you had any motoring convictions during the last three years?

If yes, please describe them:

_____

_____

b) Approximately how many times have you been stopped by the Police in the last three years? _____

dem 6:

Estimate the proportion of your driving that is done on the following types of road:

	up to one quarter	up to one half	up to three quarters	more than three quarters
built-up/urban/suburban	☐	☐	☐	☐
rural	☐	☐	☐	☐
motorways	☐	☐	☐	☐

Appendix 2 West's Questionnaire of Speeding (wqs) (West *et al* 1993)

How often do you:

(a) Exceed the 70mph speed limit during a motorway journey:

Never or very infrequently	Infrequently	Quite infrequently	Quite frequently	Frequently	Very frequently or always
0	1	2	3	4	5

(b) Drive fast:

Never or very infrequently	Infrequently	Quite infrequently	Quite frequently	Frequently	Very frequently or always
0	1	2	3	4	5

(c) Exceed the speed limit in built-up areas:

Never or very infrequently	Infrequently	Quite infrequently	Quite frequently	Frequently	Very frequently or always
0	1	2	3	4	5

Appendix 3 Drugs and Fatigue Questionnaire (ADFQ)

The following 3 questions are concerned with units of alcohol: 1 unit is equivalent to ½ a pint of beer or 1 glass of wine or 1 pub measure of spirits.

1) How many units would you be prepared to drink before getting in a car and driving?

_____

2) During the past two years, what is the greatest number of units of alcohol you have drunk before driving?

_____

3) Do you think that current laws on drink-driving should:

be less strict	stay the same	be more strict

4) During ***the past two years,*** have you ever driven while taking any of the following drugs or medicines? (Please tick and write down the brand name, if known):

anti-histamines *(for allergies, hayfever etc)* _____

anti-depressants *(for depression)* _____

anti-hypertensives *(for blood-pressure)* _____

anti-inflammatories
(for for arthritis, eczema, psoriasis etc) _____

anti-anxiety drug
(for anxiety, panic/obsessive compulsive disorders) _____

diuretics *(for water-retention)* _____

painkillers _____

other *(eg anti-convulsants for epilepsy please specify)* _____

5) During ***the past twenty-four hours,*** have you taken any of the following drugs or medicines? (Please tick and write down the brand name, if known):

anti-histamines *(for allergies, hayfever etc)* _____

anti-depressants *(for depression)* _____

anti-hypertensives *(for blood-pressure)* _____

anti-inflammatories
(for for arthritis, eczema, psoriasis etc) _____

anti-anxiety drug
(for anxiety, panic/obsessive compulsive disorders) _____

diuretics *(for water-retention)* _____

painkillers _____

other *(eg anti-convulsants for epilepsy please specify)* _____

6) Do you feel that any of the drugs you have used have had any adverse effects on your driving?

YES NO

7) If any of these drugs/medicines were prescribed by your doctor, were you given any specific instructions about taking care if driving or operating machinery?

YES NO

8) During the past two years, have you ever driven after having taking any of the following (please tick):

ecstasy	cocaine	opium
marijuana	LSD *(acid)*	psilocybin *(magic mushrooms)*
amphetamines *(speed)*	solvents	other *(please specify)*
heroin	methodone	

9) During the past two years, have you regularly driven home after ***working*** a night shift?

YES NO

10) During the past two years, have you ever fallen asleep at the wheel, even momentarily?

YES NO

11) During the past two years, what is the longest period of time that you have ever driven without a break?

_____

12) What is the maximum amount of time that you would be prepared to drive without taking a break?

_____

Appendix 4 Manchester Driver Behaviour Questionnaire (Reason *et al*, 1990)

How often do you do each of the following:

(a) Drive especially close to the car in front as a signal to its driver to go faster or get out of the way

Never					Nearly all the time
0	1	2	3	4	5

(b) Become impatient with a slow driver in the outer lane and overtake on the inside

Never					Nearly all the time
0	1	2	3	4	5

(c) Cross a junction knowing that the traffic lights have already turned against you

Never					Nearly all the time
0	1	2	3	4	5

(d) Angered by another driver's behaviour, you give chase with the intention of giving him/her a piece of your mind

Never					Nearly all the time
0	1	2	3	4	5

(e) Disregard the speed limits late at night or very early in the morning

Never					Nearly all the time
0	1	2	3	4	5

(f) Driven even though you realise you may over the legal blood-alcohol limit

Never					Nearly all the time
0	1	2	3	4	5

(g) Have an aversion to a particular class of road user, and indicate your hostility by whatever means you can

Never					Nearly all the time
0	1	2	3	4	5

(h) Get involved in unofficial "races" with other drivers

Never					Nearly all the time
0	1	2	3	4	5

Appendix 5 Driver Experiences Measure
(McKenna and Horswill)

Factor Breakdown:

Factor 1: (a1 + a4 + a9 + a11 + a12 + a16 + a22) / 7

Factor 2: (a7 + a10 + a17 + a18 + a20 + a23 + a25) / 7

Factor 3: (a2 + a3 + a6 + a8) / 4

Factor 4: (a5 + a14 + a21 + a26) / 4

Factor 5: (a15 + a24) / 2

Please indicate to what extent you agree or disagree with the statements below.

1. I enjoy being in control of the vehicle.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

2. I enjoy driving fast.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

3. I enjoy overtaking other vehicles when given the opportunity.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

4. I find driving relaxing.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

5. I sometimes have lapses of attention while I am driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

6. I enjoy the experience of acceleration when driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

7. I enjoy the sense of danger when driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

8. I get angry at vehicles in front that are not driven fast enough for the conditions.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

9. I find driving uninteresting.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

10. I enjoy the feeling of power that a car can give you.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

11. I enjoy driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

12. I find driving stressful.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

13. I often get annoyed at other drivers.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

14. I always maintain full concentration on the road while I am driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

15. I enjoy the freedom a car provides.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

16. I find driving boring.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

17. I often get a thrill from driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

18. I feel competitive when driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

19. I sometimes feel worried that I will be involved in an accident.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

20. I enjoy driving flat out.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

21. When driving, I sometimes find I can arrive somewhere remembering little of the journey.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

22. I regard driving as just a convenient means of transport.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

23. I dislike being overtaken.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

24. I enjoy the independence a car provides.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

25. I sometimes use the car to "let off steam".

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8

26. I often daydream while driving.

Disagree Very Strongly		Disagree		Neutral		Agree		Agree Very Strongly
0	1	2	3	4	5	6	7	8